SIGNATURE CONTROL		
DEVELOPED	**REVISED**	**AUTHORIZED**
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Quality Control Inspector	Quality Control Manager	Managing Director

CHANGE CONTROL		
DESCRIPTION OF THE CHANGE	**REVISION**	**DATE**
The information about the duration and performance of the airtightness test is complemented.	04	04.SEP.23
The translation of this PCC-12 procedure is included in the IMS, and the English version is integrated with the same control data as the Spanish document. Modification of associated formats for handling the English-Spanish version.	03	08.MAR.23
Section Integration: Reference Documents, Definitions, and Responsibilities	02	13.AUG.22
Security Section Integration	01	13.JUN.22
Creation and issuance of the procedure.	00	07.FEB.22

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PURPOSE OF THE PROCEDURE

Establish the necessary technical guidelines to carry out the examination and evaluation of piping systems and Pressure Vessels (RSP) using the Pressure Change Measurement (MCP) technique to guarantee reliability during normal operation.

SCOPE OF THE PROCEDURE

This procedure covers the execution methods of filling, pressure testing, dislodging of test fluid, and final inspection of piping systems and RSPs, whether stainless steel or carbon steel.

REFERENCE DOCUMENTS

- International Quality Management Systems ISO 9001:2015 Standard
- International Standard Environmental Management Systems ISO 14001:2015
- ASME BPVC – V. Section V, Nondestructive examination.
- ASME BPVC – VIII Section VIII, Pressure Vessels
- ASME B31.3 Process Piping.
- ASME B31.4 Pipeline Transportation Systems for Liquids and Slurries
- ASME B31.8 Gas Transmission and Distribution Piping Systems
- ASME B16.5 Pipe Flanges and Flanged Fittings
- ASME PCC-2 Repair of Pressure Equipment and Piping

- NOM-020-STPS-2011 Pressure vessels, cryogenic vessels, and steam generators or boilers – Operation – Safety conditions.
- API STD 1104 Welding of pipelines and related facilities
- API RP 1110 Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide.
- ASNT SNT-TC-1A Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing.

DEFINITIONS

Pneumatic Test (PN): It is an alternative pressure test that replaces the hydrostatic test, a pneumatic test implies that the fluid being used is a gas, usually air or an inert gas.

Watertightness test (PH). Airtightness testing seeks to check the ability of a vessel, such as a tank, pipe, or piping system, to withstand internal pressure without leaking liquid or gas.

MCP. Measurement of Pressure Changes.

Test Fluid. It is the fluid used to raise the internal pressure during the test.

Pressure indicator. An instrument for pressure measurement, where data will be obtained for acceptance or rejection of the test.

Pressure and Temperature Recorder (Thermomanographer). Instrument to measure and record continuously on a graph with a scale according to the magnitude of the internal pressure of pipes, equipment, or process sections under test.

Pneumatic Test Pressure (PPN). It is the internal pressure designated to perform the pneumatic test.

Test temperature. It is the internal temperature of the equipment during the development of the test.

Design pressure (PD). It is the value of the pressure at the design conditions, which should never be less than the most severe conditions of pressure and temperature simultaneously expected during the operation of the piping system.

Design temperature (TD). It is the temperature used to design pipes and equipment to the most severe conditions expected during the operation of the service.

Pipe component. A mechanical element for assembling or joining pipe to form a piping system and/or service or process equipment to hermetically contain the pressure and fluid within. It can be pipe, tubing, fittings, flanges, gaskets, studs, valves, expansion joints, flexible joints, traps, filters, in-line instruments, and separators.

Spool. It is the union of pipe with fittings, which are joined by welding, yes, to determine the configuration according to isometric according to the APC drawings of the project.

Test circuit. Spool and/or equipment assembly joined by flanged and/or threaded joints that constitute the object of the test.

Brittle fracture. It is the sudden and very rapid cracking of a material or equipment under stress where the material shows little or no signs of ductility or plastic degradation before the fracture occurs.

RSP. Vessel subject to pressure.

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PIP. Inspection and Testing Plan.

DTI. Piping and Instrumentation Diagram.

PS. Design Pressure

RESPONSIBILITIES

Customer:

- Attest to the test and assess together with the Test Inspector that the result of the Airtightness/Pneumatics Test is within acceptable evaluation criteria

Quality Control Inspector (ASNT Level II):

- Implement this procedure in conjunction with the Construction Supervisor.
- Monitor strict compliance with the established parameters.
- Evaluate together with the Client that the results obtained are within the acceptable evaluation criteria.
- Prepare the reports established in this procedure.
- Make the announcements when applicable.
- It must be certified as Level II, according to the applicable method by ASNT, ISO 9712, or ISO11484.

Site Supervisor:

- Inform the QA inspector of the start of the process.
- Set the limits of the test circuit.
- Assemble the circuit and operate it under the instructions of the Quality Control Inspector.
- Provide input information.
- Perform correction actions when required.
- Promote the proper use of tools and equipment.
- Properly carry out activities for the proper management of waste.

Safety, Health, and Environment Supervisor:

- Verify the requirements of Industrial Safety at work to prevent risks to workers and the environment,
- Deliver the Occupational Safety Analysis and have it at the place of execution of the work.
- Train staff in safety and environmental standards.
- Monitor that the activities are carried out following safety regulations.

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DESCRIPTION OF THE PROCEDURE		
Responsible	**Activity**	**Records**
Quality Control Inspector	**1. GENERAL** **A. TEAM** The following equipment and instruments are required by each test circuit. • Pressure and Temperature Recorder (pressure range of 1.5 to 4 times the PPH). • Pressure gauges (instrument range of 1.5 to 4 times PPN value, accuracy within +/- 1% of span). • Air compressor and/or tanks with the determined test medium. • Pressure relief device, with a set point equivalent to the test pressure plus the lesser value between 50 psig and 10% of the PPN. • Arrangement of test medium injection valves. • Graphs for pressure and temperature recorder (can be quadratic or percentage). • Different colored nibs for the recorder. • 100 lumens lamp (minimum). • Bubble emitting solution **B. ENTRY INFORMATION** The following input information must be provided before starting the PN. • Piping and Instrumentation Diagram with the delimited test circuit. • General Mechanical Arrangement with the delimited test circuit. • Isometric pipes with the test circuit delimited. • Records of NDT tests carried out on the components of the pipe circuit (Visual inspection, X-rays, Penetrating liquids, Scintigraphies, etc.). • Calibration certificates, valid for no more than one year, of the equipment and instruments to be used during the test. **C. DELIMITATION OF THE TEST CIRCUIT** Pneumatic testing involves the danger of releasing energy stored in a compressed gaseous medium. Therefore, precautions should be taken to minimize the presence of a brittle fracture during the test. Taking special care in the test temperature is essential to avoid this phenomenon.	Engineering and/or Design Information
Construction Supervisor Engineering	For the delimitation of the test circuits, the following information must be available from the engineer/builder. • **Stored energy**. The test circuit/equipment must contain a stored energy of less than 200,000,000 ft-lbs (271,000,000 J). • **Equivalence of energy stored in TNT.** The stored energy equivalence of the delimited piping circuit must be less than 127 lb TNT.	Engineering and/or Design Information

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	• **Shock wave safety distance.** It is the space that must be considered between the personnel and the test circuit/equipment to be tested. If engineering/builder does not provide this data, it can be calculated as follows: **1) Stored Energy (E):** When air or nitrogen is used as a test medium.	
Construction / Engineering Supervisor	**$E = 360 \times Pat \times V [\ 1 - (Pa/Pat)^{0.286}\ ]$** Where: E = Stored Energy (ft-lb) Pa = Absolute Atmospheric Pressure (psi) Pat = Absolute Test Pressure (psi) V = Total Test Circuit Volume (ft3)	
	2) TNT equivalence:	
Construction / Engineering Supervisor	**$TNT = E / 1\ 488\ 617$** Where: E = Stored energy The result of these equations must be endorsed by the engineering area.	
Construction / Engineering Supervisor	**Shock Wave Safety Distance:**	Engineering and/or Design Information

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Construction / Engineering Supervisor

Table 501-III-2-1 Minimum Distances for Fragment Throw Considerations

TNT Equivalent (kg)	Minimum Distance (m)	TNT Equivalent (lb)	Minimum Distance (ft)
0 to 3	50	0 to 5	140
3 to 5	60	5 to 10	180
5 to 10	70	10 to 20	220
10 to 15	80	20 to 30	250
15 to 20	90	30 to 40	280
20 to 25	95	40 to 50	300
25 to 35	105	50 to 75	340
35 to 50	120	75 to 100	380
50 to 65	130	100 to 125	400
65 to 80	140	125 to 150	430
80 to 100	150	150 to 200	470
100 to 120	160	200 to 250	510
120 to 150	170	250 to 300	540
150 to 200	190	300 to 400	590
200 to 250	205	400 to 500	640
250 to 300	215	500 to 600	680
300 to 350	225	600 to 700	710
350 to 400	240	700 to 800	750
400 to 450	245	800 to 900	780
450 to 500	255	900 to 1,000	800
500 to 600	270	1,000 to 1,200	850
600 to 700	285	1,200 to 1,400	940
700 to 800	300	1,400 to 1,800	980
800 to 900	310	1,800 to 2,000	1,010
900 to 1 100	330	2,000 to 2,500	1,090
1 100 to 1 300	350	2,500 to 3,000	1,160
1 300 to 1 500	365	3,000 to 4,000	1,270
1 500 to 1 900	395	4,000 to 5,000	1,370
1 900 to 2 300	420	5,000 to 6,000	1,460
2 300 to 2 800	450	6,000 to 7,000	1,540
2 800 to 3 300	475	7,000 to 8,000	1,600
3 300 to 3 800	500	8,000 to 9,000	1,670
3 800 to 4 400	525	9,000 to 10,000	1,730
4 400 to 5 000	530	10,000 to 12,000	1,750
5 000 to 5 500	535	12,000 to 14,000	1,770
5 500 to 6 500	545	14,000 to 16,000	1,800
6 500 to 7 500	570	16,000 to 18,000	1,880
7 500 to 8 500	590	18,000 to 20,000	1,950
8 500 to 10 000	605	20,000 to 25,000	2,000

GENERAL NOTE: Based on American Table of Distances published by the Institute of Makers of Explosives. Lengths are for inhabited buildings, unbarricaded.

Table 1. Minimum safety distances for blast waves

Engineering and/or Design Information

Engineering and/or Design Information

Engineering and/or Design Information

D. PNEUMATIC TEST PRESSURE (PPN)

If the input information does not provide the PPN, it can be determined according to the recommendations of the applicable building code.

1) ASME B31.3

The test pressure must not be less than 1.1 times the PD and must not exceed the value less than:

- 1.33 times the PD.
- Hoop Stress pressure (less than 90% of the material yield value).

2) ASME B31.4

The test pressure shall be at least 1.25 times the internal design pressure.

3) ASME B31.8

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	The pneumatic test pressure must not exceed less than 1.25 times the PD or as indicated in table 841.3.3-1 of the building code.	Engineering and/or Design Information

Table 841.3.3-1 Maximum Hoop Stress Permissible During an Air or Gas Test

Test Medium	Location Class, Percent of Specified Minimum Yield Strength		
	2	3	4
Air or nonflammable nontoxic gas	75	50	40
Flammable gas	30	30	30

GENERAL NOTE: Refer to para. 841.3.2(c).

4) ASME BPVC – VIII

RSP New

PPN = 1.1 [PD (STP/STD)]

Where:
PPN = Pneumatic Test Pressure
PD = Design Pressure
STP = Permissible Stress at Test Temperature
STD= Permissible Stress at Design Temperature

RSP With Use

PPH = 1.1 [PO (STP/STO)]

Where:
PPN = Pneumatic Test Pressure
PO = Operating Pressure
STP = Permissible Stress at Test Temperature
STD= Permissible Stress at Operating Temperature

Engineering and/or Design Information

Construction Supervisor / Engineering

E. TRIAL DURATION

The duration of the test must be as stated in the applicable building code or the customer's specification; it must be indicated in the Inspection and Testing Plan. In case it is not indicated, before the performance of the PN, all the conditions that influence the duration of the PN must be determined together with the client.

Engineering and/or Design Information

1) Pneumatic Test.

The duration of the pneumatic test should not be less than 10 minutes for each increase in pressure.

2) Watertightness Test

The test should be maintained for at least 10 minutes or when all joints and connections have been examined for leaks.

F. TEST TEMPERATURE

To avoid brittle fractures, the test pressure should not be applied until the metal and the test medium are at the same temperature, with a difference of approximately +/- 3°C.

Engineering and/or Design Information

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	The test medium must be kept at least 16°C above the minimum design temperature of the metal. **G. TEST FLUID** The test medium to be used should normally be compressed air. If a means other than compressed air is used, it must comply with the following indications: • It must not be combustible • It must not be corrosive • It must not be toxic • He must obey the universal law of gases In case nitrogen is the test medium to be used, the PPN should not be greater than 2500 psig. **Note:** Using hydrogen and/or oxygen as a means of proof is prohibited. **2. PNEUMATIC AND AIRTIGHTNESS TEST INSPECTION** **A. PNEUMATIC TEST (PN)** **1.** The personnel to execute the PN must have basic personal protective equipment. **2.** Verify that the tools, equipment, and consumables necessary for the execution of the PN are in optimal condition. **3.** Cordon off the work area with prohibition tape (red) will not allow access to personnel other than the one being carried out by the PN. **4.** Assemble and connect the system to be pneumatically tested (mechanical shaft, pressure gauges, pressure, and temperature recorder, selected air compressor or test fluid, and test circuit). Verify that the vent of the pressure relief device is directed to a safe location. **5.** One or more pressure gauges must be connected to the system. If more than one indicator is used, one should be a Pressure and Temperature Recorder. Pressure gauges and the Pressure and Temperature Recorder must be easily visible to personnel running the PN throughout the pressurization and test cycle. **6.** Filling the circuit with the test medium, pressurize up to 25 psig above atmospheric pressure. Make a visual inspection of the test circuit in search of gross leaks, for the verification of each connection, a lamp of minimum 100 lumens of intensity can be used as a support. **7.** In case of detecting joints with gross leaks, the system must be pressed and the detected joint adjusted. Once inspected, without the presence of gross leaks, the graph must be placed on the pressure and temperature recorder.	
Quality Control Inspector		

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Quality Control Inspector	NOTE: Make sure the time on the pressure and temperature logger matches the start time of the PN. **8.** The pneumatic test begins by increasing the pressure in a controlled manner until the first third of the PPN is reached. **9.** Performs visual inspection of the system to detect possible leaks, the pressure is maintained until the test pressure is stabilized in a period not less than 5 min. **10.** Increase the pressure in a controlled manner to a second-third of the NPP. **11.** Perform the visual inspection of the system again to detect possible leaks, the pressure is maintained until the test pressure is stabilized in a period not less than 5 min. **12.** Increase the pressure in a controlled manner to the last third of the PPN and wait 10 minutes until the pressure in the system or object is stabilized, during this time, the visual inspection of the system is performed. Disconnect the pressure pump. **13.** The duration of the test will be established in section E of this procedure. **14.** At the end of the pneumatic test duration, the pressure is gradually released in three phases (1/3 of the PPN each) with an interval of 5 min between them until atmospheric pressure is reached. **15.** Remove the graph from the pressure logger. **16.** The area must be free of any dirt or residue generated during the test (order and cleanliness of the area). **B. WATERTIGHTNESS TEST** **1.** Assembly of the test circuit. The circuit must be assembled, and torque must be applied 100% with the final materials, instruments, and equipment established for delivery to the customer. **2.** Connect the test circuit with the mechanical arrangement of test fluid injection. A pressure gauge should be placed in the system. **3.** Filling the circuit with the test medium. Pressurize up to 100 psig above atmospheric pressure. Do a visual inspection of the test circuit for leaks; there are two methods of leak testing. a) Bubble test: Perhaps one of the most basic ways to detect a leak. It consists of putting a little solution of water mixed with soapy liquid on the flanged connection. If air bubbles form, it means that the gas escapes and, therefore, there is a leak, for the verification of each connection, a lamp of a minimum of 100 lumens of intensity can be used as a support. In case of detecting a leak, the gasket must be	

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adjusted. If the leak persists, the sealing element of the gasket must be replaced (gasket). Apply torque again and repeat the process.

b) Pressure change test: This allows you to detect a leak in an entire network of pipes and fittings. It consists of introducing an inert gas under pressure throughout the circuit. On the one hand, air is introduced, and on the other, it is measured with the pressure gauge. After a while, it is necessary to check that the pipe contains it since, in a closed environment, the pressure accumulates and is not released. If the pressure decreases, it means that there is a leak at some point. Therefore, the leak must be located

4. Inspected the circuit to 100% of the joints, and no leaks were detected. The system is slowly depressurized.

5. The area must be free of any dirt or residue generated during the test (order and cleanliness of the area).

3. EVALUATION AND ACCEPTANCE CRITERIA

A. PNEUMATIC TEST.

The evaluation method is by MCP (Measurement of Pressure Changes).

Site Supervisor

The test is accepted if it presents pressure decreases, attributable and proportional to temperature variations, not greater than 1% of the PPN value.

The increase in pressure above the PPN value during the duration of the test, attributable and proportional to temperature variations, is acceptable if it meets the following conditions:

Quality Control Inspector

a) It is not greater than 1.5 times the pressure at 38°C of the ASME class of flanged joints that make up the circuit.

b) The Hoop Stress value of the pipe is not more than 90% of the yield of the pipe material.

The following conditions are not allowed and are grounds for rejection:

- Leaks
- Visible permanent deformations.
- Ruptures

In the event of one of these phenomena, the Quality Control inspector must notify the Site Supervisor to carry out the pertinent actions; the inspector will determine if the finding is greater to make a communication and initiate the Control *of Non-Conforming Outputs (PSGI-03) process.*

Non-Conforming Output Control (PSGI-03)

B. WATERTIGHTNESS TEST

1. The evaluation criterion will be by visual inspection.

2. The test is accepted if there are no leaks in the visual inspection of 100% of the joints that make up the circuit.

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Quality Control Inspector	**3.** The presence of leaks that cannot be sealed will be cause for rejection of the test. In the event of one of these phenomena, the Quality Control inspector must notify the Site Supervisor to carry out the pertinent actions; the inspector will determine if the finding is greater to make a communication and initiate the Control *of Non-Conforming Outputs (PSGI-03) process.* **4. DOCUMENTARY RECORD** The Pneumatic and Airtightness Test is considered completed when the results, records, and information obtained during the test have been reviewed, accepted, and signed by the customer representative, the Test Inspector, and the Quality Inspector.	Non-Conforming Output Control (PSGI-03)
Quality Control Inspector	All data obtained from the test must be recorded in the *Pneumatic Test Report (PCC-12/F-01), Hermeticity Test Report (PCC-12/F-02),* and in the graph obtained. This data must be at least: ● Name of the line or spool to be tested ● Test Medium Used ● Hydrostatic Test Pressure ● Date and time of start and end of the test ● Description of the equipment and instruments used and their calibration date ● Name, signature, and position of the person validating or attesting to the test The Quality Inspector must deliver the signed reports to the Quality Department for their integration into the Quality Dossier of each project.	*Pneumatic Test Report (PCC-12/F-01)* *Water tightness Test Report (PCC-12/F-02* Graph of results
Safety, Health, and Environment Supervisor	**5. SAFETY, HEALTH AND ENVIRONMENTAL REQUIREMENTS** The Safety, Health, and Environment Supervisor (HSE) will be in charge of verifying the performance of the test in a multidisciplinary manner with the Quality Control area based on the applicable Industrial Safety, Health, and Environmental Protection regulations. **A. SECURITY MEASURES** The work will be carried out once: a) A visual inspection of the workplace or work site has been carried out. b) The place of the tests has been cordoned off with red tape to prevent the passage of personnel outside the activity. c) Have complete PPE for the activity. d) Inspection of work equipment and tools is carried out. e) Have the current AST generated by the Safety, Health, and Environment area and disseminate it with the personnel who will be carrying out the activities (Consult the AST format). f) Check the weather conditions to proceed with the scheduled activities if they are carried out outdoors.	Waste Management (PSE-02)

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	a) There is a container where the water resulting from the Test will be discharged. The Safety, Health, and Environment Supervisors will monitor and support the proper use of resources (water). g) Waste management will be carried out by procedure *PSE-02 Waste management*.	

FORMATS ASSOCIATED WITH THE PROCEDURE

CODE	REGISTRATION	REVIEW LEVEL	RETENTION TIME
PCC-12/F-01	*Pneumatic Test Record*	01	1 year at the end of the contract / Digital without expiration
PCC-12/F-02	*Airtightness Test Record*	01	1 year at the end of the contract / Digital without expiration

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