



Analysis of Pressure Stability on Hydrostatic Test Pressure Control Equipment Using Barton Chart Recorder

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Article History:

Received: 04-04-2026

Revised: 10-04-2026

Accepted: 10-04-2026

Keywords: Barton Chart Recorder,
Hydrostatic Test, Pressure Control
Equipment, Pressure Stability,
Standard Test Procedure

Abstract: Pressure control equipment is essential for maintaining operational safety and well integrity in oil and gas well operations. This study analyzes pressure stability during hydrostatic testing of lubricator, stuffing box, and pumping tee components at PT. Nesitor workshop, Balikpapan, using a Barton Chart Recorder as the pressure-monitoring instrument. A qualitative descriptive approach combined with quantitative data analysis was applied based on direct field observation. The research population comprised all pressure control equipment handled by the workshop, while the sample was limited to lubricators, stuffing boxes, and pumping tees instrumented for hydrostatic testing. The Barton Chart Recorder was used as the main instrument, supported by pressure gauges and the Pressure Test System software. Data were analyzed by interpreting pressure-chart patterns and evaluating pressure stability, holding time, and leak detection. The tests followed API SPEC 6A in three stages: 200 psi for 5 minutes, 5,000 psi for 5 minutes, and 10,000 psi for 15 minutes. The results show that pressure remained stable without any drop in all stages, indicating no leakage and acceptable structural integrity. The conclusion is that standardized API-based procedures, systematic component identification, and the Barton Chart Recorder provide a reliable basis for evaluating pressure control equipment condition..

How to Cite: Muhammad Fathur Ruhma, Farid Daniel Abizard, Muhammad Yazid Rizky W, Fazal Achmad (2026). Analysis of Pressure Stability on Hydrostatic Test Pressure Control Equipment Using Barton Chart Recorder 4(1). Pp.92-102 <https://doi.org/10.61536/ambidextrous.v4i1.478>

 <https://doi.org/10.61536/ambidextrous.v4i1.478>

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Introduction

The advancement of science and technology in the era of global competition demands the availability of competent human resources, especially in the oil and gas energy sector as the most needed strategic commodity today. The optimal use of natural resource wealth can only be realized if it is balanced with an improvement in the quality of the workforce that is able to manage and operate industrial technology professionally. Engineering higher education institutions, especially petroleum engineering study programs, have an obligation to produce graduates who not only excel academically, but also have practical readiness to face the challenges of the industrial world. The gap between theoretical competence and applicability in the field is a problem that needs to be answered through real work experience-based learning programs (Fadilah, 2025).

Pressure control equipment is a critical component in the petroleum operating system that functions to maintain operational safety and well integrity during the production process. Regular maintenance and testing of this equipment is a technical imperative that cannot be ignored in order to prevent system failures that have the potential to cause serious hazards in the field (Anas, 2022). Hydrostatic test is one of the standard methods used to verify structural strength and sealability pressure control equipment to the pressure of the fluid under certain conditions. This testing process is carried out by filling the equipment using pressurized fluid, then monitoring the stability of the pressure that occurs during the specified period of time according to the applicable operating standards.

Barton Chart Recorder It is an analog mechanical-based pressure recording instrument that has long been used in the oil and gas industry to record pressure fluctuations continuously and accurately. The analysis of the graphs generated by this instrument allows field technicians to evaluate the stability of the pressure during the execution hydrostatic test comprehensively and measurably (Quariesta et al., 2024). Programs Practical work for petroleum engineering students in an industrial environment such as PT. Nesitor provides a hands-on opportunity to understand operational procedures, occupational safety standards, as well as high-pressure equipment maintenance methods applied in the field in real time. This experience strengthens students' capacity to integrate the theory gained in college with real professional work practices (Margaret, 2023).

Pressure stability analysis in the implementation of hydrostatic tests using Barton Chart Recorder recording data contributes significantly to increasing the effectiveness of the overall pressure control equipment maintenance program. This approach allows for early identification of potential leaks or pressure mismatches that can threaten operational safety in the petroleum industry field (Santoso, 2025). Based on the description of the background of the problem above, the formulation of the problem in this study is as follows: (1) How is the process of introduction and identification of Pressure Control Equipment used at PT. Nesitor?, (2) What are the stages of implementing light maintenance



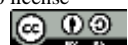
of Hydro Test on Pressure Control Equipment?

The limitation of the problem in this practical work is to study and understand the application of field practice in the introduction and maintenance of Pressure Control Equipment at PT. Nesitor, especially in the aspect of pressure stability analysis using the Barton Chart Recorder during the implementation of hydrostatic tests. The general purpose of the implementation of this practical work is to create a synergistic relationship between the world of higher education and the industrial world, as a means of socializing students to the professional work environment, as well as realizing the real contribution of the industrial world in supporting the development of a competency-oriented national education system.

The specific objectives of the implementation of this practical work include the introduction of operational tools and maintenance of Pressure Control Equipment, understanding the hydrostatic test method using the Barton Chart Recorder in the field, developing discipline and teamwork, and fulfilling the requirements for the Practical Work course at the S1 level of Petroleum Engineering at STT MIGAS Balikpapan. This practical work provides benefits in the form of expanding students' horizons on the application of petroleum engineering science in the real field, improving technical skills in pressure control equipment analysis, as well as growing professional work ethics and adaptability to industrial culture, especially in the operational context of high-pressure equipment in the environment of PT. Nesitor.

Research Methods

This research was conducted as part of a one-month Practical Work program from July 7, 2025 to August 7, 2025, at the workshop of PT. Nesitor located on Jl. AMD Projakal No. 67, Kariangau, North Balikpapan, East Kalimantan. The study employed a qualitative descriptive approach supported by quantitative data analysis derived from pressure recordings during the hydrostatic test process. The qualitative approach aimed to systematically describe technical phenomena occurring during equipment testing, while quantitative analysis evaluated test pressure values, holding time duration, and pressure stability recorded using the Barton Chart Recorder, with the integration of both approaches considered appropriate for generating a comprehensive understanding of pressure control equipment integrity (Suherman & Victorynie, 2025). Data were obtained from direct observation of pressure control equipment testing using hydrostatic tests, which involve filling components with fluid, typically water, and gradually increasing pressure until reaching predetermined working or test pressure standards (Riana, 2024). The tested equipment included lubricators, Blowout Preventers (BOP), stuffing boxes, pumping tees, and other pressure control components commonly used in high-pressure oil and gas operations. Data collection was conducted through direct observation of testing stages, interviews and discussions with field supervisors and operational personnel, and literature review of technical documents, SOPs, and scientific references, applying data triangulation



to enhance research validity and reliability (Yusuf et al., 2025). Data processing focused on test pressure values, holding time duration, and pressure stability during testing. The hydrostatic test utilized a hydrostatic pump to circulate fluid into components, with pressure gradually increased and monitored using the Barton Chart Recorder, which records pressure fluctuations in analog graphs, supported by Pressure Test System software for digital verification (Santoso, 2025). Components were declared acceptable if pressure remained stable and no leakage was detected, and recorded data were visually analyzed to identify pressure stability patterns, detect anomalies, and confirm compliance with established test pressure requirements.

Table 1. Specification of Lubricator, Stuffing Box, and Pumping Tee

Part Number	Collet Size	Working Pressure	Service	Lower Connection	Upper Connection
L-97 11 67	1 3/16"	10,000 psi	H2S	4 3/4"-4x2 (3.750") Elmar	2"-10TPI Acme Box
L-97 4439	1 3/16"	10,000 psi	STD	4 3/4"-4thd (3.750") Bowen	2"-6-60" Acme Box
L-97 4440	1 3/16"	10,000 psi	STD	4 3/4"-4thd (3.750") Bowen	2"-10TPI Acme Box
L-97 2218	1 3/16"	10,000 psi	H2S	6 1/8"-4x2 (4.750") Elmar	2"-10TPI Acme Box
L-97 4569	1 3/16"	15,000 psi	H2S	6 5/16"-4thd (3.750") Bowen	2"-6-60" Acme Box
L-97 4661	1 3/16"	10,000 psi	H2S	6 5/16"-4thd (4.375") Bowen	2"-6-60" Acme Box
L-97 4715	1 3/16"	10,000 psi	H2S	8 1/4"-4x2 (6.000") Bowen	2"-10TPI Acme Box
L-97 4816	1 3/8"	10,000 psi	H2S	5 3/4"-4thd (4.000") Otis	2"-10TPI Acme Box
L-97 4919	1 3/16"	5,000 psi	H2S	4 3/4"-4thd (3.750") Bowen	2"-10TPI Acme Box
L-97 4997	1 3/16"	5,000 psi	H2S	4 3/4"-4thd (3.750") Bowen	2"-6-60" Acme Box
L-97 5268	1 3/16"	10,000 psi	H2S	5 3/4"-4thd (4.000") Otis	2"-10TPI Acme Box
L-97 5279	1 3/16"	10,000 psi	H2S	6 5/16"-4thd (4.375") Bowen	2"-10TPI Acme Box
L-97 5719	1 3/16"	10,000 psi	H2S	8 1/4"-4x2 (6.000") Bowen	2"-6-60" Acme Box
L-97 8722	1 3/16"	5,000 psi	STD	5"-4thd (3.500") Otis	2"-10TPI Acme Box
L-97 6010	1 3/8"	10,000 psi	H2S	8 1/4"-4x2 (6.000") Bowen	2"-10TPI Acme Box
L-97 6157	1 3/16"	10,000 psi	H2S	6 5/16"-4thd (4.375") Bowen	6 5/16"-4thd (4.375") Bowen
L-97 6245	1 3/8"	10,000 psi	H2S	6 5/16"-4thd (4.375") Bowen	2"-10TPI Acme Box
L-97 8716	1 3/16"	5,000 psi	H2S	5 3/4"-4thd (4.000") Otis	2"-10TPI Acme Box



L-97 9471	1 3/16"	5,000 psi	H2S	5 1/2"-4x2thd (4.375") Bowen	2"-10TPI Acme Box
L-97 8707	1 3/16"	10,000 psi	H2S	6 1/2"-4thd (4.750") Otis	2"-10TPI Acme Box
L-98 0633	1 3/8"	10,000 psi	H2S	4 3/4"-4x2thd (3.750") Elmar	2"-10TPI Acme Box
L-98 0634	1 3/8"	10,000 psi	H2S	6 1/8"-4x2thd (4.750") Elmar	2"-10TPI Acme Box
L-97 8303	1 3/8"	5,000 psi	H2S	4 3/4"-4thd (3.750") Bowen	2"-10TPI Acme Box
L-97 6245	1 3/8"	10,000 psi	H2S	6 5/16"-4thd (4.375") Bowen	2"-10TPI Acme Box
L-98 1553	1 3/8"	5,000 psi	H2S	5 1/2"-4x2thd (4.375") Bowen	2"-10TPI Acme Box
L-97 01006 901	1 3/8"	5,000 psi	STD	5"-4thd (3.500") Otis	2"-10TPI Acme Box
L-97 01006 903	1 3/8"	10,000 psi	H2S	5 3/4"-4thd (4.000") Otis	2"-10TPI Acme Box
L-97 01006 904	1 3/8"	5,000 psi	H2S	6 1/2"-4thd (4.750") Otis	2"-10TPI Acme Box

PORTED 1/2" NPT (LOCATED IN UPPER BODY)

Part Number	Collet Size	Working Pressure	Service	Lower Connection	Upper Connection
L-980773	1 3/16"	10,000 psi	H2S	4 3/4"-4x2 (3.750") Elmar	2"-10TPI Acme Box
L-981592	1 3/16"	10,000 psi	H2S	6 1/8"-4x2 (4.750") Elmar	2"-10TPI Acme Box
L-9701010837	1 3/8"	10,000 psi	H2S	4 3/4"-4x2 (3.750") Elmar	2"-10TPI Acme Box
L-9701010838	1 3/8"	10,000 psi	H2S	6 1/8"-4x2 (4.750") Elmar	2"-10TPI Acme Box

(Source: Data from PT. Nesitor, 2025)



In order to ensure that the research systematics runs in a structured and directed manner, the research flow is arranged as follows.

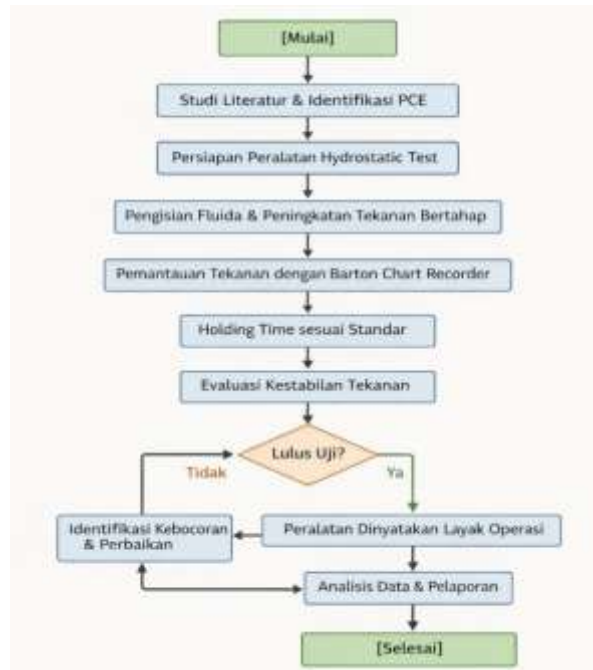


Figure 2. Hydrostatic Test Research Flow Diagram on Pressure Control Equipment (Source: Researcher Documentation, 2025)

Result and Discussion

Hydrostatic Test Results

Hydrostatic test is a test procedure that aims to determine the structural strength of the equipment being tested as well as identify whether or not there is a leak in the component. The test is carried out by running water into a pressure vessel or piping system until it reaches a predetermined pressure. If during the testing process no leaks are found and the water pressure in it remains stable, the tested equipment is declared to have passed the test and is suitable for operation.

Each equipment to be tested has a different working pressure (WP) value according to its technical specifications. Working pressure is the maximum limit of the strength of the equipment in resisting pressure according to the standard provisions that have been set. In the implementation of this test, the Barton Chart Recorder is used as a continuous reading instrument and pressure recorder, so that during the test the pressure value generated by the hydrostatic pump in pushing water fluid into the test equipment can be monitored directly and accurately.

Implementation Procedure

A. Work Instruction Procedure

Before the test is carried out, a series of technical preparations are carried out systematically as follows. First, prepare auxiliary equipment such as hydrostatic pumps and ensure that they are in good condition and ready for operation. Second, ensure that all joints including threads, grooves, and facings on the tested equipment are in clean condition and have been greased. Third, connecting the equipment to be tested with a test plug and test cap, and ensuring installation in a tight and safe condition. Fourth, fill the equipment with water to the fullest while opening one outlet to remove the air trapped in the system. Fifth, close the outlet and pre-test to ensure there are no leaks in the entire connection before the main test begins.

B. Prosedur Hydrostatic Test

The test was carried out in three staged stages according to the API SPEC 6A standard as follows.

Primary test period:

- Increase the pressure from 0 to 200 psi with a holding time of 5 minutes.
- Lower the pressure from 200 psi to 0 for 3 minutes.
- Increase the pressure from 0 to 5,000 psi with a holding time of 5 minutes.
- Lower the pressure from 5,000 psi to 0 for 3 minutes.
- Increase the pressure from 0 to 10,000 psi with a holding time of 15 minutes.
- Lower the pressure from 10,000 psi to 0 and the test is declared complete.

When the pressure is observed to be stable, slowly lower the pressure to 0 psi. If there is a pressure drop during holding time, perform a thorough inspection of the equipment to identify the location of the leak in accordance with the provisions of API SPEC 6A

Observation and Discussion Data

1. Pengujian Low Pressure 200 psi (Primary Test)



a. Pressure Gauge 200

b. Pressure Chart

Figure 2. Results of the First Hydrotest Test Graph: (a) Pressure Gauge 200 psi, (b) Pressure Chart

(Source: Documentation of PT. Nesitor, 2025)



In the first hydrotest (primary test), data was obtained that in the low pressure test of 200 psi with a holding time of 5 minutes there was no drop in the chart recorder, which means that there was no leakage in the equipment tested. The pressure stability at this stage indicates that all joints and components are in good condition and tight.

2. Pengujian Medium Pressure 5.000 psi (Secondary Test)



a. Pressure Gauge 5000 b. Pressure Chart

Figure 3. Results of the Second Hydrotest Test Graph: (a) Pressure Gauge 5,000 psi, (b) Pressure Chart

(Source: Documentation of PT. Nesitor, 2025)

In the second hydrotest (secondary test) data was obtained that in the medium pressure test of 5,000 psi with a holding time of 5 minutes there was no decrease in the chart recorder, which means that there was no leakage in the equipment tested. These results show that the equipment is able to withstand medium pressures according to the required technical specifications before proceeding to the high-pressure testing stage.

3. Pengujian High Pressure 10.000 psi



a. Pressure Gauge 10000 b. Pressure Chart

Figure 4. Third Hydrotest Test Chart Results: (a) Pressure Gauge 10,000 psi, (b) Pressure Chart

(Source: Documentation of PT. Nesitor, 2025)

In the third test, the results were obtained that at the initial holding time at 10,000



psi for 15 minutes, the pressure was observed to be stable without any decrease, then the pressure was lowered to 0 psi for 3 minutes. The equipment at this high pressure testing stage was declared to have passed the test. Overall, from the primary test to the high pressure test, there was no pressure reduction, which means that all components of the pressure control equipment tested did not leak and were declared to have passed the hydrostatic test according to applicable standards.

Table 2. Recapitulation of Hydrostatic Test Results

Yes	Testing Stage	Test Pressure (psi)	Holding Time	Results
1	Primary Test	200	5 minutes	Pass
2	Secondary Test	5.000	5 minutes	Pass
3	High Pressure Test	10.000	15 minutes	Lulus

(Source: Observation Data of PT. Nesitor, 2025)

Discussion

Identification and Introduction of Pressure Control Equipment

Pressure control equipment is a critical component that functions to maintain operational safety during the production and drilling process. Proper identification of each component such as lubricator, stuffing box, and pumping tee is a fundamental step before the implementation of the test is carried out. In a high-pressure drilling system, an in-depth understanding of the operational characteristics and limits of each component greatly determines the success of the entire test sequence. Failure to accurately identify component conditions has the potential to pose serious operational risks, especially in systems with working pressure high that are susceptible to sudden pressure fluctuations (Du et al., 2024; Wang et al., 2024).

Introduction process pressure control equipment also includes an understanding of the technical specifications of each component, including the value of the working pressure and test pressure that have been set by industry standards. Evaluation of the physical condition of the components before testing, including inspection Threads, groove, facings, and the conditions seal, is an integral part of the identification procedure that cannot be ignored. A systematic approach in equipment identification has been shown to correlate directly with the accuracy of the test results obtained, as shown by the results hydrostatic test in all components tested in the PT. Nesitor (Zhao et al., 2024).

Pressure Stability Analysis on Hydrostatic Test Using Barton Chart Recorder

Test results hydrostatic test which is implemented in three phased stages shows consistent pressure stability across all components pressure control equipment tested. At the stage primary test 200 psi with holding time 5 minutes, the pressure was observed to be stable without any indication of any decrease in the recording Barton Chart Recorder. Stability at this early stage confirms that all joints and components are in tight condition and there are no leaks at low pressures. Selecting the right test model with empirical data-based validation has been proven to result in more accurate and reliable performance



evaluations than conventional estimation approaches alone (X. Ma et al., 2025).

At the stage secondary test 5,000 psi with holding time 5 minutes, recording Barton Chart Recorder The back shows perfect pressure stability without dropping. The gradual increase in pressure applied in this procedure is in line with the principle of dynamic response-based pressure control, where the accuracy and consistency of the system's response greatly determine the overall reliability of the test results. In high-pressure systems, fluid viscosity factors and pressure response characteristics are critical variables that affect the overall performance of the system during testing (Meng et al., 2025).

Highest test level at 10,000 psi with holding time 15 minutes is the most critical stage in the entire series hydrostatic test. Rekaman Barton Chart Recorder Indicates that the pressure remains stable for a full 15 minutes without any decrease, before being slowly lowered to 0 psi for 3 minutes. The instrument's ability to record pressure fluctuations real-time It is crucial that even the slightest pressure deviation must be detected immediately to prevent potential system failure. The use of reliable pressure monitoring instruments is a fundamental component in maintaining operational safety, especially in systems operating in extreme pressure environments (Liu et al., 2025).

Duration holding time applied proportionally to the test pressure magnitude proved to be sufficient to comprehensively validate pressure stability. Setting the appropriate duration allows sufficient time for the system to distribute the internal pressure evenly across all parts of the component. Predictive consistency in pressure evaluation under various operational conditions is a key indicator of the reliability of a standardized test system (J. Ma et al., 2025).

Overall, the entire component pressure control equipment tested, i.e. lubricator, stuffing box, and pumping tee, declared to have passed the test hydrostatic test from the stage primary up to high pressure. This result proves that the structural integrity of all components is adequate and suitable for operation according to applicable pressure standards. The success of this test also confirms that the combination of standardized procedures, reliable monitoring instruments, and systematic component identification is a key determining factor in producing an evaluation pressure control equipment comprehensive and accurate in the oil and gas industry (Dong et al., 2025).

Conclusion and Recommendation

The implementation of hydrostatic testing on pressure control equipment at the workshop of PT. Nesitor produced highly satisfactory results, as all tested components—lubricators, stuffing boxes, and pumping tees—successfully passed all three testing stages: the primary test at 200 psi for 5 minutes, the secondary test at 5,000 psi for 5 minutes, and the high-pressure test at 10,000 psi for 15 minutes. The Barton Chart Recorder data confirmed that the pressure remained stable throughout the entire holding time without any



decline, indicating that there was no leakage in the joints or component bodies and demonstrating that the structural integrity of the equipment meets the operational standards required by the oil and gas industry. The main contribution of this research lies in the systematic application of API SPEC 6A-based testing procedures, structured component identification, and the use of the Barton Chart Recorder as a reliable pressure-monitoring instrument, which together enable a more comprehensive and accurate evaluation of pressure control equipment condition. Practically, this work implies that hydrostatic tests should be carried out regularly and consistently in accordance with API SPEC 6A, supported by routine maintenance of pressure-monitoring instruments, especially Barton Chart Recorders, to ensure data accuracy, as well as periodic training for field technicians in component identification and pressure-chart interpretation to enable early detection of potential anomalies, complemented by well-structured documentation of test results as a long-term reference for equipment condition assessment.

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