Pressure Testing Validation

BALLOT # **7076**

API STANDARD 16M
FIRST EDITION, XXXX 202X

Pressure Testing Validation

1 Scope

This document presents standardized pressure testing acceptance criteria used in the validation of Well Control Equipment and supporting systems for drilling and intervention operations. It covers both analog and digital pressure-testing methodologies considering the effects of environmental, system, and operational variables on interpreting test results. The guidance is intended for equipment within the scope of API SC16 but may be used for other types of pressure-testing activities.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Standard 53, Well Control Equipment Systems for Drilling Wells

ASME B40.100, Pressure Gauges and Gauge Attachments

3 Terms, Definitions, Acronyms, and Abbreviations

3.1 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
accuracy
Maximum difference between the value (e.g., pressure, temperature) measured by the transducer and the actual, true value, expressed as a percentage of the full-scale output.

3.1.2
blowout preventer stack
BOP stack
Complete assembly of well control equipment, including preventers, spools, valves, and nipples, connected to the top of the wellhead or wellhead assemblies

3.1.3
calibration
Comparison to a standard of known accuracy and making any needed adjustment(s).

3.1.6
data acquisition system
System for capturing and storing data.

NOTE Examples include strip chart recorders, circular chart recorders, or computer systems.

3.1.8
high-pressure test
A controlled pressure test conducted at a specified pressure level—typically up to the rated working pressure of the equipment or MAWHP—intended to verify the structural integrity, pressure containment, and sealing performance of pressure-containing components under maximum operating load conditions.

3.1.9
low-pressure test
A controlled pressure test that verifies seal integrity and containment at a pressure below design limits, minimizing mechanical loading. Pressures are defined in the applicable codes.

3.1.10
precision
The ability of the device to consistently output the same electrical signal when exposed to the same value (e.g., pressure, temperature), while maintaining a very small difference between measured and true value.

3.1.11
pressure
Ratio of force to the area over which that force is distributed (i.e. pound force to an area (in2), measured in “psi”, etc.)

3.1.12
pre-deployment test pressure (PDTP)
One API pressure designation above well program MAWHP for a subsea BOP system, not to exceed the rated working pressure (RWP) of the equipment being tested.

3.1.13
pressure-containing
Part whose failure to function as intended results in a release of wellbore fluid to the environment.

3.1.14
pressure-controlling
Part intended to control or regulate the movement of wellbore fluids.

3.1.15
pressure test
Periodic application of pressure to a piece of equipment or a system to verify the pressure containment capability for the equipment or system.

3.1.16
rate of change
The ratio of the change in one variable to the corresponding change in another. The rate of change can also be referred to as slope.

3.1.17
rated working pressure
Maximum internal pressure that the equipment is designed to contain and/or control on surface

3.1.18
record (noun)
Retrievable document or dataset created that provides objective evidence of activities performed, results achieved, or statements made

3.1.19
reportable
Test performed and the results documented

3.1.20
resolution
The smallest, detectible change in input value (e.g., pressure, temperature) that causes a measurable, step-like change in the output signal.

3.1.22
stabilized (pressure testing)
State in which the initial pressure-change rate has decreased to within the specified rate of respective test.

NOTE Pressure change can be caused by such things as changes in temperature, setting of elastomer seals, or compression of air trapped in the equipment being tested.

3.1.23
stabilized (temperature testing)
State in which the initial temperature-change rate has decreased to within the specified range

NOTE Temperature change can be caused by such things as mixing different-temperature fluids, convection, conduction, or pressure.

3.1.24
test series
Group of tests at the same load condition (i.e. rated, extreme, survival) that are related to each other in some manner, such as capacity or type of test

EXAMPLE A Rated Capacity Test Series comprises all the tests that are conducted to a load level that corresponds to a rated capacity rating.

3.2 Acronyms and Abbreviations

For the purposes of this document, the following acronyms and abbreviations apply.

BOP blowout preventer

psi pounds per square inch

RWP rated working pressure

4 Introduction

In the oil and gas industry, chart recorders have served as the primary method for documenting pressure tests for many years. A dual-pen, circular chart recorder typical of those used for testing is shown in Figure 1. In recent years, the use of digital pressure transducers has become more widespread. Digital tools improve the objectivity of pressure-test evaluation, yet the granularity of digital data (e.g., Figure 2) can complicate decisions about acceptable pressure-change rates, which are often easier to interpret as a flat line on a traditional chart recorder, with their broader scale and heavier line weights.

Individual companies have developed proprietary algorithms to evaluate if the results from a digital measurement device meet the test acceptance criteria to remove the subjective interpretation of a flat line. The acceptable pressure change rate varies for each algorithm, and the method of how these tools were qualified varies for each company. A common criterion or standard system qualification protocol is desired to verify if a proprietary system can detect a leak.

Annex A provides additional background information.

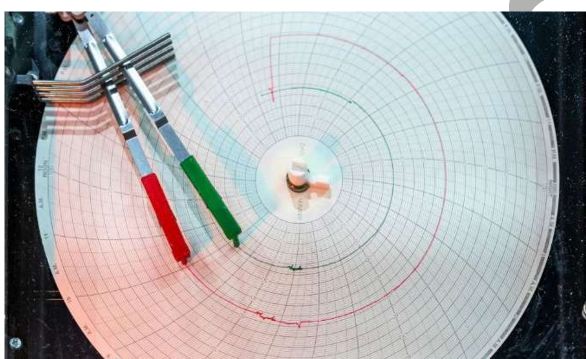


Figure 1: CHART RECORDER

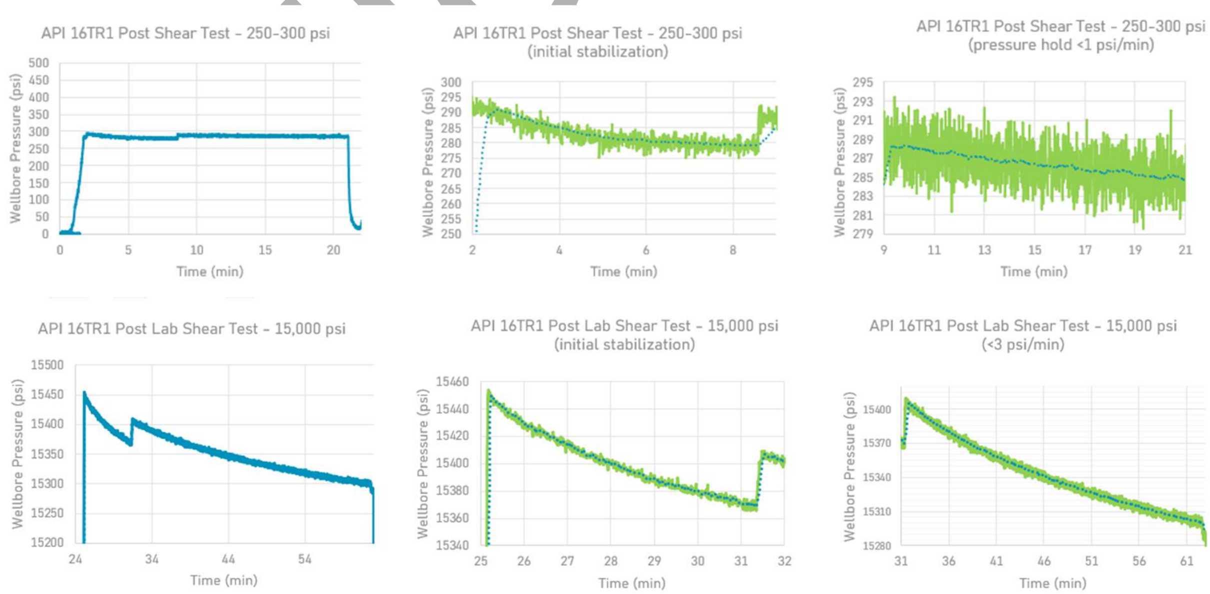


Figure 1: Digital double ram BOP low-pressure (top) and high pressure (bottom) test charts.

5 Measurement Devices

5.1 Mechanical Analog Pressure Measurement

Mechanical analog pressure measurement devices shall conform to the requirements of API 53. In addition, full scale is displayed over a minimum span of 120° of the dial; and the devices meet the requirements of ASME B40.100 Grade C or better.

Chart recorders shall use a colored pen that contrasts with the lines of the chart paper and use a fine pen. The range of the chart paper shall be a small as practical to improve the readability of the test plot.

5.2 Electronic Pressure Measurement

Electronic pressure measurement shall include the following:

a) accuracy within .25 % of the circuit(s) operational range;

b) resolution within .25 % of full-scale output (FSO);

c) precision within .1 % of full-scale output

5.3 Mechanical Analog Temperature Measurement

Mechanical analog temperature measurement devices shall be selected in accordance with the following:

a) maximum operating temperature is less than or equal to 75 % of full scale;

b) minimum operating temperature (when used as a test gauge) is greater than or equal to 25 % of full scale;

c) normal operating temperature (when used as a control system gauge) is between 25 % and 75 % of full scale (it is acceptable for a control system gauge to measure below 25 % of full scale when the normal operating temperature range exceeds 50 % of full scale);

d) full scale is displayed over a minimum span of 120°;

e) meets the requirements of ASME B40.100 Grade C or better.

f) accuracy within .25% of span including pen

5.4 Electronic Temperature Measurement

Electronic temperature measurement shall include the following:

a) accuracy within .2 % of full scale;

b) sensor drift <.1% full scale per year.

5.5 Units

Pressure readings may be displayed in psi, bar, or pascals; additional units of measure are optional.

Temperature readings may be displayed in °F or °C; additional units of measure are optional.

Volume readings may be displayed in gallons or liters; additional units of measure are optional.

Time readings may be displayed by date and time using a 24-hr clock system with hour, minutes, and seconds; additional units of measure are optional.

Displayed units of measurement shall be consistent throughout the system.

5.6 General Requirements

Test results shall be recorded using pressure transducers, chart recorders, or data acquisition systems that are calibrated within 12 months of previous calibration according to the equipment manufacturer's procedures and requirements.

> NOTE A secondary device may be used (either analog or digital) for reference but shall not be used as the primary test pressure measurement device unless it meets the same requirements of the primary.

Pressure transducers, chart recorders, and data acquisition systems shall be used within the device manufacturer's specified range.

Calibrations shall be traceable to a recognized national calibration standard and signed and dated by the calibration technician.

6 Test System (Equipment and Process) Validation

6.1 General

Digital data acquisition systems and acceptance criteria that utilize algorithms or other means to perform trend line analysis shall be validated against environmental effects. The systems should provide reliable assessment of the integrity of the pressure boundaries irrespective of system volume, test pressures, thermal effects, fluid properties, and any other properties that may affect the accuracy of the results. If correction factors are used, they shall be documented. Acquisition systems shall be qualified to verify correct identification of pass/fail results according to established criteria (e.g., no visible leaks, stability) for various fixed volumes for low, medium, and high-pressure testing for the equipment's qualified range.

Field trials shall be conducted to verify the system's capability to correctly identify pass/fail results over specified test ranges. Known leaks should be used to verify the equipment's sensitivity to pressure change rates if qualification testing cannot test large volume test setups like those used in field applications. Systems should be vetted against existing data with acceptable test results and known leaks to verify if the data acquisition system can detect leaks that would affect test evaluations.

If pressure change acceptance rates vary depending on the applicable test conditions they shall be documented during qualification testing.

If averaging is used over time, it shall be documented during qualification testing.

6.2 System Performance Feedback Process

The Company that develops the test processes and software shall have a continuous improvement process that considers past learning events with the system and incorporates, as appropriate, changes to better evaluate the condition of the tested system(s). This process should have input from associated companies (i.e., operators, contractors and third parties) that were involved in conducting pressure tests with the test system and include observations and concerns.

6.3 Test Criteria

A system integration test shall be performed with the qualification test unit. The components shall be documented (e.g., pressure transducers, temperature transducers, software version, hardware). A baseline test shall be established if any component of the qualification unit is changed to verify the system meets the original qualification. If the baseline test is not within the acceptance criteria of the original unit, then the system shall be requalified to establish the new limits of the system and documented. Test setups shall include but not limited to the following:

a) Various volumes
b) Various pressures
c) Various temperatures
d) Exposure to the environment (e.g., sunlight, submerged)
e) Simulated leaks
f) For Process Validation of Pressure test criteria including processes, procedures, and algorithms.

6.4 Qualification Documentation

Validation testing shall be documented formally including all validation/qualification testing and field trials supporting the protocols and procedures.

A technical datasheet shall be available and should include, but not limited to the following:

a) Type of pressure measurement (e.g., analog, digital)
b) Pressure ranges (e.g., 0-500 psi, 0-1,000 psi, 0-2,500 psi, 0-10,000 psi, 0-15,000 psi, 0-20,000 psi)
c) Volume ranges
d) Test fluid type with density and compressibility
e) Temperature ranges
f) Pressure change rate sensitivity
g) Pressure sensitivity
h) Pressure averaging basis
i) Pressure forecasting method

6.5 Digital Data

Data shall be synchronous with a common time stamp with a minimum sampling rate of 1 Hz to avoid aliasing. Time stamps shall be local time, data shall be stored in UTC time, and metadata shall include local time zone when data is captured but visually the system would read local time for the operator.

Data resolution shall have a minimum of 4 significant figures.

Signal conditioning shall not be used for Metadata. Post-processing data may be conditioned (filtered) to evaluate trend line analysis. If conditioning (filtering) is used for the analysis, it must be identified by the Company that developed the software and include the version utilized. (e.g: filtered by XYZ company, version 2605).

Metadata shall be segregated by time, date, well, customer, estimated volume, test pressure, temperature, fluid type, water depth, and any other essential variables.

Data shall be transmitted to a shore-based backup system via OPC-UA or other compatible transmission.

A universal data protocol format shall be used.

7 Testing

7.1 General Test Criteria

Pressure testing shall comply with the applicable standards for the system being verified.

Test Pressure(s) cannot exceed the safe operating pressure of the equipment.

Allowable Test Pressure tolerance shall be within the applicable standards for the system to be verified.

The timing of all pressure tests shall not start until the test pressure has stabilized.

Test Fluids shall comply with the applicable standards for the system being verified.

Pre-test calibration shall be performed to verify the digital test equipment is within the testing companies' acceptance parameters.

7.2 Acceptance Criteria

Acceptance Criteria shall be no visible leakage during the test and the pressure shall not drop below the minimum required test pressure during the hold period. During the hold period, the pressure change and pressure change rate shall be within acceptance limits shown below:

a) Digital low-pressure test – pressure change shall not exceed 3 psi/min during pressure hold and the pressure change rate shall be improving (i.e., flattening).
b) Digital high-pressure test - pressure change shall not exceed 5 psi/min during pressure hold and pressure change rate shall be improving (i.e., flattening).
c) Circular chart low/high-pressure test – pressure shall be a flat line during pressure hold.

7.3 Pressure Test Barries

Personnel should be alerted when pressure test operations are to be conducted, when testing operations are underway, and when pressure testing has concluded.

Only designated personnel shall enter the test area to inspect for leaks when the equipment involved is under pressure.

Tightening, repair, or any other work shall be done only after verification that the pressure has been released.

Pressure shall be released only through pressure release lines.

When pressure testing, a procedural method shall be used to confirm pressure has been bled off.

Lines and connections that are used in the test procedures shall be secured.

Fittings, connections, and piping used in pressure-testing operations shall have an RWP equal to or greater than the maximum test pressure.

The drill pipe test joint should be capable of withstanding the tensile, collapse, and internal pressures that will be placed on it during the test operation.

A procedure shall be developed to identify test plug leaks.

8 Test Documentation

Pressure and function tests shall be documented.

NOTE 1 Example worksheets are provided in Annex B.

Pressure tests shall be documented with a pressure chart or an equivalent data acquisition system.

Test documentation shall be signed by the lead test operator, contractor's representative, and operator's representative.

NOTE 2 This does not include maintenance testing such as hydraulic chamber tests.

Unsuccessful pressure tests and actions to remedy the problem(s) shall be documented per the equipment owner's procedures.

Testing after major modifications or welding of equipment shall be performed according to the manufacturer's written procedures.

Rig-specific procedures for installation, removal, operation, and testing of equipment installed shall be available and followed.

Pressure and function test reports shall be recorded and retained including pre-installation and all subsequent tests for each well.

Pressure and function test reports shall be readily available on the rig site for the duration of the well program.

A test certificate of performance with a test report shall be included in the documentation packets upon completion of the testing.

For surface offshore installations, pressure and function test reports shall be preserved at an offsite location for a minimum of two years.

Test documentation, raw, and filtered data shall be stored for a minimum of 2 years on the rig and 10 years onshore and be made available upon request.

9 Test Technician Qualifications

Technicians must be certified to perform pressure testing and to use the applicable test software.

Technicians must be able to understand test plans and how test plans translate into work at a facility.

Technicians must have a basic understanding of the system being tested.

Technicians should have knowledge of relevant standards and regulations related to testing.

Technicians shall verify equipment is calibrated and test records are signed off and stored.

10 Test Plan

A test plan consists of one or more tests. A representation of a test plan shall include one diagram for each test. Each test shall depict the general layout of the components in the test and essential data (e.g., tubular size, water depth, location, test fluid).

Each test of the test plan shall include test pressures.

The test plan shall include a legend that describes the various symbols used in the test plan.

The test plan shall include a date of creation.

The test plan should include signature lines.

The test plan may use symbols described in IEC 60617 and ISO 1219.

11 Test Reporting

A test report shall be created with all test results.

A Test Report shall include metadata regarding the report including:

a) the date and time of the start of the test series and the date and time of the end of the test series.
b) The standard and/or regulation used in the assessment of tests (e.g., API Standard 53, 30 CFR 250.737, NORSOK D-010, operator-specific standard, etc.).
c) the location of the test series (e.g., rig name, well name, wellbore, stack-up)
d) The test type of each test of the test series (e.g., BOP test, casing test, choke/kill line test, formation integrity test)
e) Required pressure(s) for the test (e.g., a range of 250-350 psi, or a minimum of 7,500 psi)
f) Test stage (initial, intermediate, final, retest)
g) Test medium (e.g., fluid type such as water, OBM, etc.) and density of the test medium.

The test report should include an explanation of failed tests and any corrective actions prior to repeating the test.

The details reported for each test shall include information about the components (e.g., annular, upper pipe ram, blind shear ram) being tested and the configuration of the components (e.g., open or closed). These details may be provided by inclusion of images from the test plan.

Each test shall include a description of the test direction (surface to subsea, reverse, etc.).

Each test shall report the initial test pressure applied, the duration of the test and the final slope of the pressure curve.

Results of each test (as Passed, Failed or some other status) shall be reported.

A chart that shows the Pressure vs. time graph (showing buildup, stabilization, hold, and bleed-off) of all tests shall be included in the test report.

The average data sampling interval (e.g., 1Hz) may be reported on the test report.

Each test report should include documentation of the test pressure measuring device (i.e. transducer, chart recorder, pressure gauge, etc.) and calibration certificate. Measurement devices shall be within calibration.

The test report may indicate information from an independent gauge or secondary source that was used for validation of pressures.

A test report should include comments on any unusual behavior (e.g., noisy valve, bounce-back, thermal effect) along with any corrective actions (if retest was needed) or tools used (e.g., Pressure Logger, DAQ system) to address unusual behavior.

The test plan shall include signature lines. Examples of expected signature lines are:

a) Technician/operator who performed test
b) Witnesses (company man, third-party, QA/QC rep)
c) Reviewer/approver (Superintendent, RTM engineer, etc.)

It shall be acceptable for a test report to include digital signatures / authentication.

Each test in the test report shall include a unique test number (e.g., 1, 2, 3, 3a, 3b, 4, etc.) or some other reference ID.

The test report may include references or links to procedures (job pack, BOP schematic, test plan).

A test report may contain a concise test summary including what was tested, whether the items tested passed or not, any operational impact or follow-up required and links to documents or digital references.

Annex A (informative) Background of Pressure Testing

A.1 Overview

A chart recorder (Figure 1) is an electromechanical device that records an electrical or mechanical input trend onto a piece of paper (the chart). Chart recorders may record several inputs using different color pens and may record onto strip charts or circular charts. Chart recorders may be entirely mechanical with clockwork mechanisms, electro-mechanical with an electrical clockwork mechanism for driving the chart (with mechanical or pressure inputs), or entirely electronic with no mechanical components at all (a virtual chart recorder).

Chart recorders are built in three primary formats. Strip chart recorders have a long strip of paper that is ejected out of the recorder. Circular chart recorders have a rotating disc of paper that must be replaced more often but are more compact and amenable to being enclosed behind glass. Roll chart recorders are like strip chart recorders except that the recorded data is stored on a round roll, and the unit is usually fully enclosed.

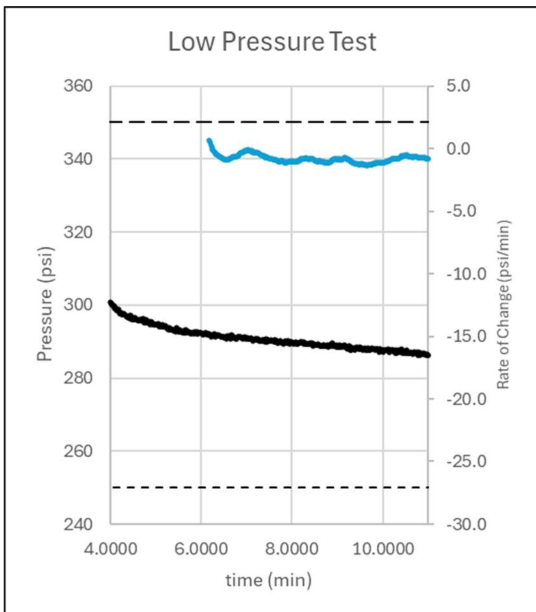
A pressure transducer is a device that measures the pressure of liquids or gases and converts it into a proportional electrical signal (like voltage or current) for monitoring, control, or display. It works using a sensing element (like a diaphragm) that deforms under pressure, changing electrical property (resistance, capacitance, etc.) that's then measured and translated into usable readings at high resolutions. Pressure transducers offer many advantages including the ability to record data at high scan rates, to record anomalies, to allow for post processing of data trends, to allow comparison of test results over time and to automate acceptance criteria. Pressure change rate can be trended and scaled more accurately with digitally recorded data than with a circle chart recorder (Figure A.1 and Figure A.2).

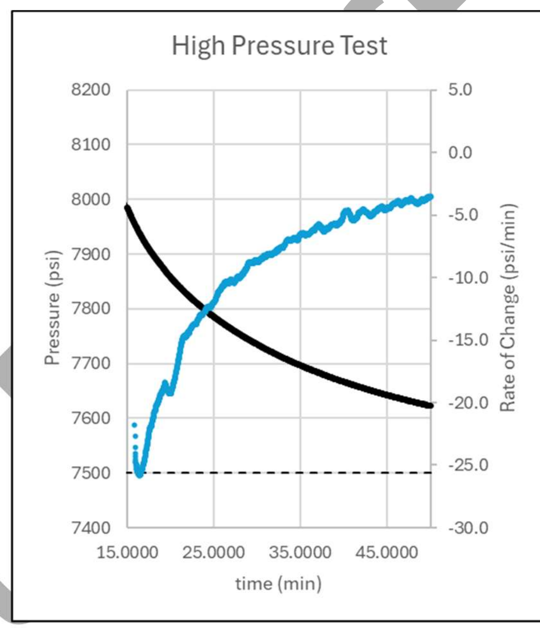
Several published studies (Table A.1) comparing subjective analog flat line charts against digital pressure test data have attempted to correlate a chart recorder test with a measured pressure change rate using a digital tool but many of the studies reference one or two studies so additional testing may be needed to validate pressure change rates with randomized controlled trails.

Table. A.1 Published Studies

Reference	Notes
[1]	Primary Source – promotes -4 psi/min decline rate as stable. 15,000 psi chart / ~11,000 psi test
[2]	Primary source – promotes -3 psi/min (from observation of -2 psi/min to -5 psi/min) as stable. Used same chart as SPE 87155
[3]	Primary source - observation of -4 psi/min to -20 psi/min (no comparisons to charts) -~10,000 psi test (transducer)

[4]	Related source – tests 3 psi/min for 5 minutes (no comparisons to charts)
[5]	Related source - utilized 3 psi/min pressure decline rate





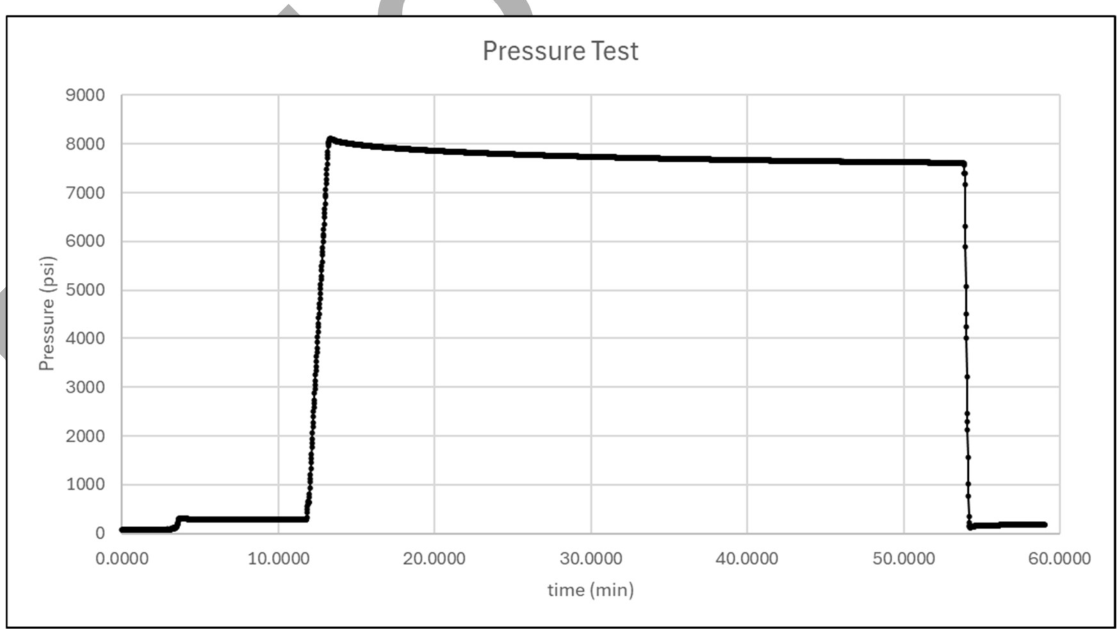


Figure A.1: Low Pressure (LP) and High Pressure (HP) Tests collected on a deepwater rig according to API 53. The blue curves in the two upper images are the rate-of-change calculated based on a fitted curve. No filtering has been applied.

The following test chart is from a field pressure test on land. It is an example of useful comments added to the chart for clarity.

NOTE the stabilized test period is clearly indicated.

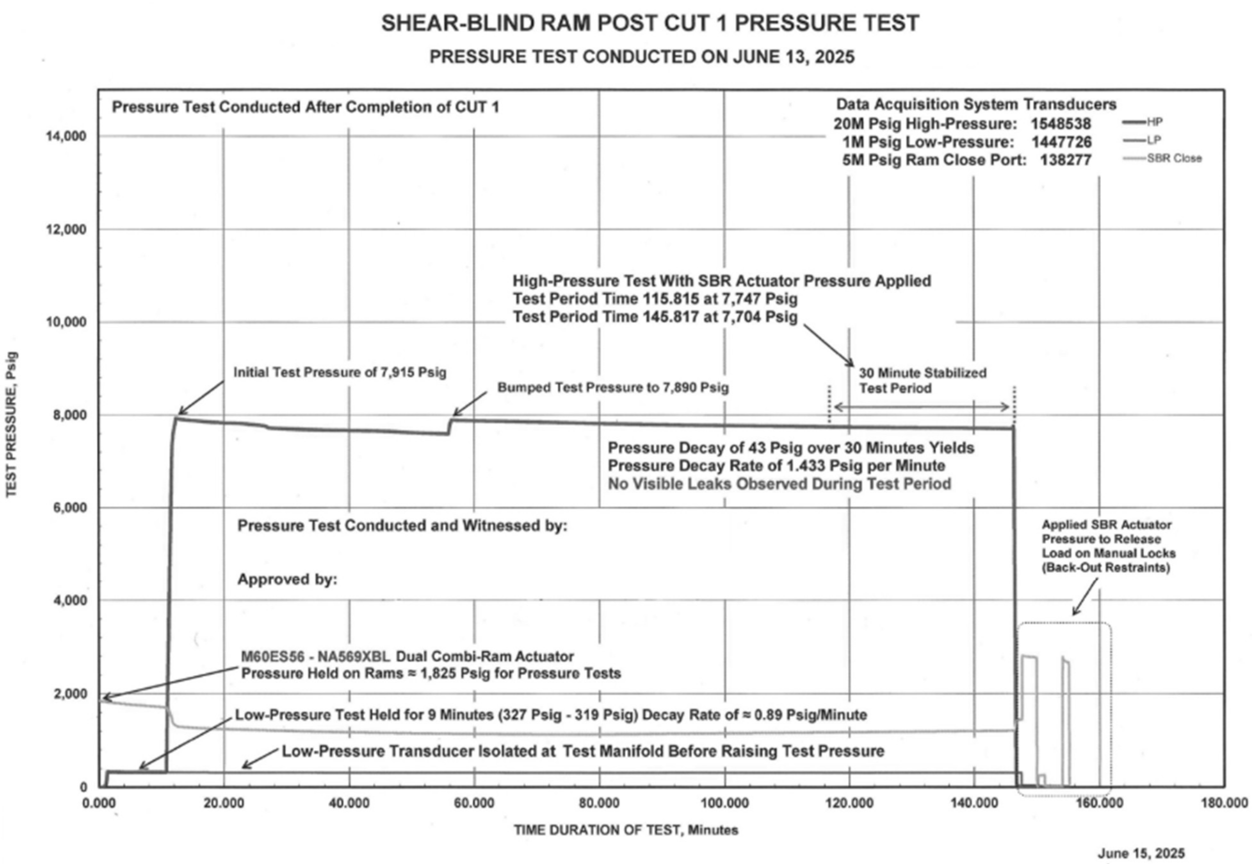


FIGURE A.2. An example of a low-pressure test and a high-pressure test on a shear ram.

A. 2 Considerations for Pressure Testing

Volume, temperature, fluid properties, equipment, and water depth can affect the amount of time required for pressure to stabilize. Larger volumes may require long hold times whereas smaller volumes may require shorter hold times. The test volume for a deepwater subsea system may require several barrels of fluid to reach test pressure, resulting in a temperature increase due to both the heat generated during pumping and the significant temperature gradient between the surface and the BOP stack on the seafloor. These conditions typically necessitate extended hold times to allow for thermal stabilization and to achieve the sensitivity required for leak detection, as pressure fluctuations resulting from temperature changes can become significant enough to mask actual system leakage.

Test sequence order can be used to reduce pressure change rates caused by thermal effects by transitioning from alternating low/high pressure testing to grouping all low-pressure tests followed by all high-pressure tests, where permitted by the applicable procedure. During sequential low/high pressure testing, low-pressure results may exhibit increasing pressure trends over time rather than the expected decrease. This behavior is likely driven by thermal effects; however, if not properly accounted for, it may mask a system anomaly. Grouping all low-pressure tests followed by high-pressure tests can mitigate these effects, although it may result in an increased number of required test line-ups.

Testing companies shall perform sufficient testing to demonstrate that the test system is capable of detecting leaks across various configurations and is fit for purpose. Procedures should be established to verify suspected leaks, which may include the use of dye injection with ROV confirmation, extended hold periods, and retesting at the surface during field operations. During surface testing in controlled environments, the absence of visual leakage can typically be confirmed through direct observation and/or camera surveillance as well as pressure decay rates. In such cases where visual verification is available, strict pressure change rate criteria may not be necessary.

No visible leakage is the primary acceptance criterion in API 16A and API 16D equipment. API 6A includes requirements for stabilization required before starting a pressure test hold period.

A.3 Environmental effects on pressure testing

Historically pressure testing has been conducted with an analog chart recorder and documented on a circle chart. A five-minute straight line on the circle chart is typically the accepted passing criteria. To achieve this criteria, additional time is required to allow the pressure to stabilize.

This primary pressure stabilization driver is the process of temperature equalizing to ambient within the closed test. The drop in pressure due to this temperature effect slows the time to achieve straight line criteria.

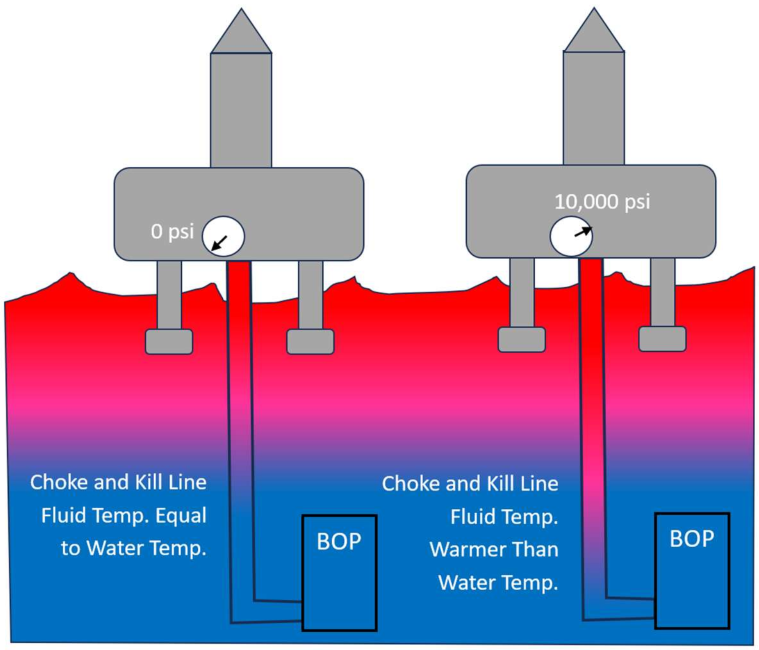


Figure A.3. A figure illustrating the qualitative temperature differential (red to blue) of seawater between the rig and a subsea BOP as well as the displacement of relative warmer water to lower depths when pressure is applied during a positive pressure test.

The varied temperature ranges with subsea testing (Figure A.3) provides insight into how this variable affects the test and is discussed below.

Before the test is started temperature of the kill line fluid and seawater temperature are equal. Pumping the closed system up to test pressure moves kill line fluid down the water column to where it is warmer than the seawater column.

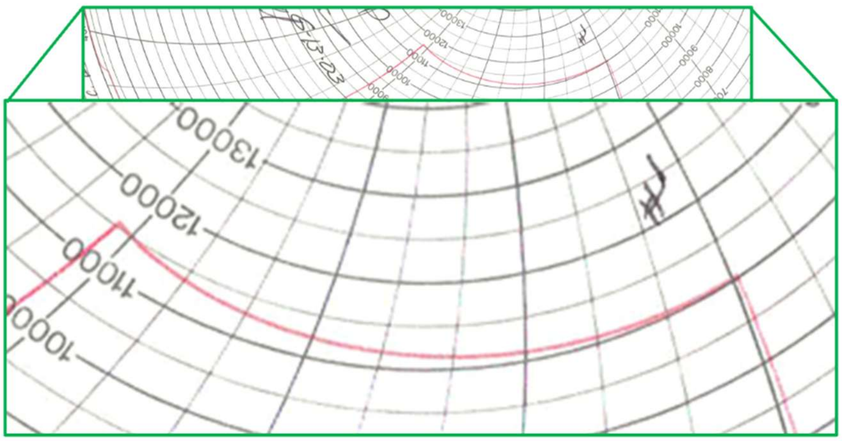


Figure A.4. An example of a pressure test recorded on a circle chart.

When the system is closed in for the high-pressure test, the warmer kill line fluid slowly cools to match seawater ambient temperatures. As the kill line fluid cools the closed in pressure drops, quickly at first and slows as the temperature reaches ambient.

Historical pressure testing practice of using a chart recorder with straight line criteria showed us that it takes considerable time for this fluid cooling to complete and draw a straight line on the chart recorder (Figure A.4). The circular chart depicted right shows three 15 minute time periods (bold lines) with varying pressure loss in each period and the pressure decline rate improving due to temperature equalization to ambient. The pressure loss in the first 15 minute period is ~250 psi (17 psi/min). The pressure loss in the second period is ~160 psi (11 psi/min). The pressure loss in the third period is ~ 90 psi (6 psi/min). The last 5 minute pressure loss is ~5 psi/min which was at the high end of test acceptance performed in SPE 105198.

This improving pressure decline rate due to the temperature effect mimics an improving trend over time, pressure loss improves as the fluid temperature gets closer to ambient. The improving trend temperature equalization is greatest at the beginning of the test (~8-12 minutes depending on system configuration and environmental conditions).

This same temperature effect can periodically be seen on low pressure tests (Figure A.5 and Figure A.6) when they are conducted too quickly after a high-pressure test bleed off. The pressure rises in this scenario as the cooler kill line fluid is moved into warmer seawater ambient temperatures. This improving pressure effect could hide a low-pressure test leak. The test results shown below help illustrate this issue.

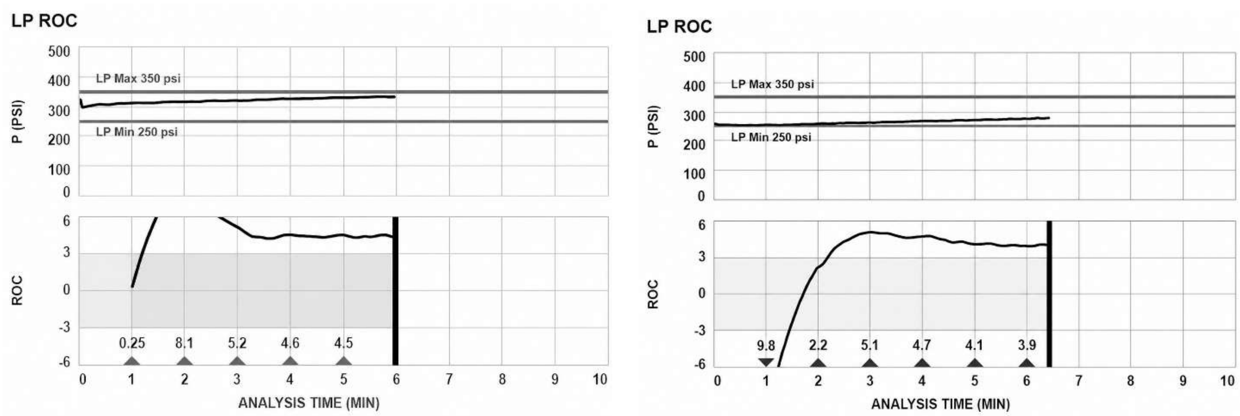


Figure A.5. The two tests above show an increase in pressure while the system is closed in for these tests.

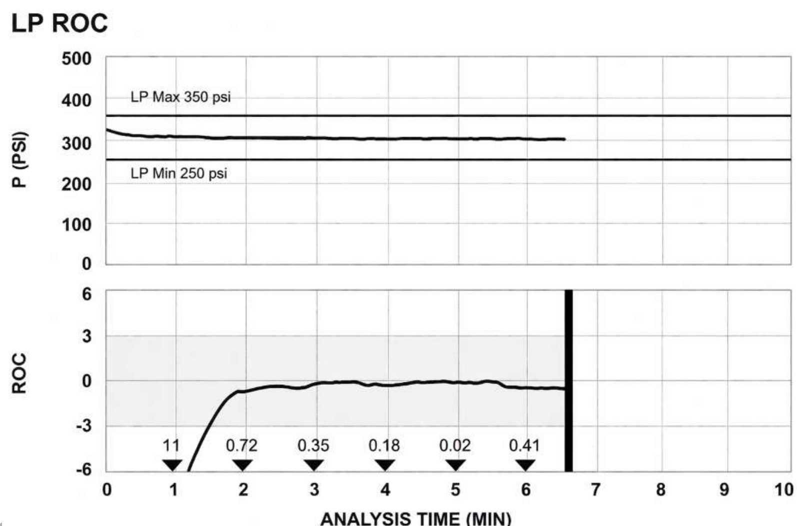


Figure A.6. The single test above occurred within the same test protocol as the other two tests. It does not show a pressure increase.

The three atypical test results depicated in figures A.5 and A.6 could be caused by a variety of conditions such as a leaking barrier that allows fluid being added to the system, or faulty pressure transducers, or unusual test medium properties, or temperature effects of the test fluid and associated system, etc. The test system (equipment, software, protocols, etc) should provide insight regarding atypical results. If the reason is not explained, further investigation may be necessary to insure that the test results meet the pressure test criteria before indicating that the test has passed.

Annex B (informative) Examples of Test Records

Figure A.7 shows an example pressure test schematic with areas under pressure (black) and not under pressure (white) indicated. Table 2 provides an example of the documentation for a pressure test.

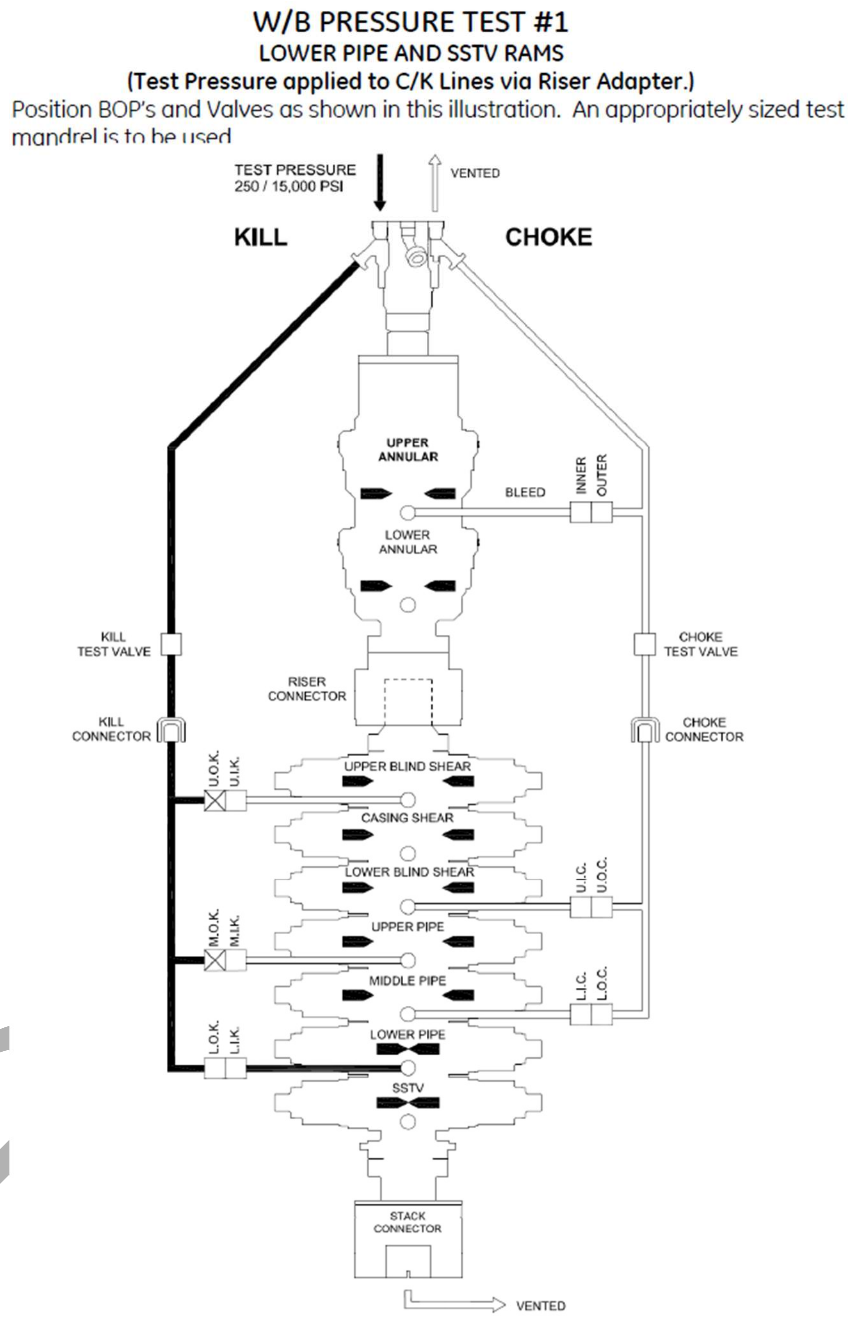


Figure A.7: Example Test Configuration

Wellbore Pressure Test #1
Lower Pipe and Test Rams
(Test pressure applied to Kill Line via Riser Adapter)

Test Procedure				When Completed
Apply 250-350 psi. Allow pressure to stabilize and record value below.				
Hold Test pressure for 5 minutes (Low Pressure Test). Acceptance criteria during hold is ±3 psi/min.				
Increase pressure to max test pressure (+5%/-0% or +500psi/0psi - whichever is less). Allow pressure to stabilize and record value below.				
Hold test pressure for 10 minutes (High Pressure Test). Acceptance criteria during hold is ±5 psi/min.				
Reduce pressure to zero (0) psi.				
Pressure and Hold Time	Hold Time Start Pressure	Hold Time End Pressure	Actual Hold Time	Pressure Change
Low Pressure test - 250-350 psi (5 minutes)				
High Pressure test - +5%/0% or +500 psi/0 psi (whichever is less)				
Acceptance Criteria: No visible leakage and defined pressure change rate. Pressure shall not fall below the minimum test pressure. Pressure stabilization shall not be exceeded during hold.				Pass / Fail
Notes:				

*Attach charts from the data acquisition device

Print	Signature	Company	Date
Lead Test Operator:			
Contractor's representative:			
Operator's representative:			
Optional:			
Optional:			

Table A.2: Example Test Documentation

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[8] API Specification 16D, Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment

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