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ERRATA

Preface

This errata corrects editorial errors in API RP 14H, Fourth Edition, July 1, 1994

Page 4, Par. 6.4.1. Change the first sentence to read as follows:
After an offsite repair, SSV/USV should be functionally tested in accordance with API Specification 14D

Page 6, Exhibit 1. *Under SSV/USV Actuator Data, change "SSV/USV valve catalog or model no." to "SSV/USV actuator catalog or model no."*

Page 7, Exhibit 2. *Under SSV/USV Actuator Data, change "SSV/USV valve catalog or model no." to "SSV/USV actuator catalog or model no."*

Page 8, Exhibit 3. Make the following changes:

Under SSV/USV Actuator Data:

Change "SSV/USV valve catalog or model no." to "SSV/USV actuator catalog or model no."

Delete line 4, "SSV/USV valve bore" and "Class of service".

Under SSV/USV Actuator Seal Test. Add the following:

At 80% of working pressure rating

*Beginning time*_______________ *Test Gage Pressure Reading*_______________

*Ending time*_______________ *Test Gage Pressure Reading*_______________

Under SSV/USV Valve Body and Bonnet Hydrostatic Test. Add the following:

Secondary pressure holding period

*Beginning time*_______________ *Test Gage Pressure Reading*_______________

*Ending time*_______________ *Test Gage Pressure Reading*_______________

Page 9, Par. A.1. *Change "Temperature" line to: "Temperature = 80°F or 540° Rankine."*

Recommended Practice for Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore

API RECOMMENDED PRACTICE 14H
FOURTH EDITION, JULY 1, 1994

Contains ISO 10419:1993

Petroleum and natural gas industries—Drilling and production equipment—Installation, maintenance, and repair of surface safety valves and underwater safety valves offshore

ANSI American National Standards Institute	ANSI/API RP14H–1993

Strategies for Today's Environmental Partnership

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005

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Recommended Practice for Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore

Exploration and Production Department

API RECOMMENDED PRACTICE 14H
FOURTH EDITION, JULY 1, 1994

American Petroleum Institute

SPECIAL NOTES

Note: This section is not part of ISO 10419:1993.

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FOREWORD

Note: This section is not part of ISO 10419:1993.

API Recommended Practice 14H serves as the basis for ISO 10419:1993. The complete text of both the API and ISO standards is contained in this document. Some differences exist between the API version and the ISO version of this standard; for example:

- The Special Notes and Foreword are not part of ISO 10419:1993.
- Appendix A is not part of ISO 10419:1993.
- Appendix B is not part of API Recommended Practice 14H.

Language that is unique to the ISO version is shown in ***bold oblique type*** in the text or, where extensive, is identified by a note under the title of the section. Language that is unique to the API version is identified by a note under the title of the section or is shaded. The bar notations identify parts of this publication that have been changed from the previous API edition.

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Users of this publication should become familiar with its scope and content. This document is intended to supplement rather than replace individual engineering judgment.

Recommended Practice for Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore

1 Scope

1.1 One of the means of assuring positive wellstream shut-off is the use of the wellhead surface safety valve (SSV) or underwater safety valve (USV). It is imperative that the SSV/USV be mechanically reliable. It should therefore be operated, tested, and maintained in a manner to assure continuously reliable performance.

1.2 The purpose of this recommended practice is to provide guidance for inspecting, installing, operating, maintaining, and repairing SSVs/USVs manufactured according to API Specification 14D. Included are procedures for testing SSVs/USVs.

1.3 This standard was developed as an API recommended practice under the jurisdiction of the API Committee on Standardization of Offshore Safety and Anti-Pollution Equipment (API OSAPE Committee) and was prepared with the guidance of API, the Offshore Operators Committee (OOC), and the Western States Petroleum Association (WSPA).

1.4 The API OSAPE Committee has the following scope: API specifications and recommended practices for safety and anti-pollution equipment and systems used in offshore oil and gas production, giving emphasis when appropriate in such standards to manufacturing, quality assurance, equipment performance, testing, and systems analysis methods.

1.5 For many years, the petroleum industry has devised plans and procedures to provide a safe operating environment and to prevent waste and pollution. These recommended practices for operating SSVs/USVs are based on the accumulation of experiences and plans.

1.6 This recommended practice covers guidelines for inspecting, installing, maintaining, repairing, and operating SSVs/USVs. Nothing in this recommended practice is to be construed as a fixed rule without regard to sound engineering judgment nor is it intended to override applicable federal, state, or local laws.

2 Definitions

The following definitions are related specifically to surface safety valves and underwater safety valves and are presented to define the terminology used in this standard.

2.1 failure: Improper performance of a device or equipment item that prevents completion of its design function.

2.2 heat sensitive lock open device: A device installed on an SSV actuator to maintain the SSV valve in a full open position until exposed to sufficient heat to cause the device to release and allow the SSV valve to close.

2.3 manufacturer: The principal agent in the design, fabrication, and furnishing of an SSV/USV actuator and/or SSV/USV valve. The SSV/USV valve and SSV/USV actuator define functional entities and do not necessarily represent the units as supplied.

2.4 operating manual: The publication issued by the manufacturer containing detailed data and instructions related to the design, installation, operation, and maintenance of SSV/USV equipment.

2.5 operator: The user of an SSV/USV who chooses to comply with this standard.

2.6 qualified part: A part manufactured under an authorized quality assurance program and, in the case of replacement, produced to meet or exceed the performance of the original part.

2.7 qualified person: An individual with characteristics or abilities gained through training or experience or both as measured against established requirements such as standards or tests that enable the individual to perform a required function.

2.8 repair: Any activity that involves either replacement with qualified parts or disassembly/reassembly of the SSV/USV. Repair may be offsite or onsite as described in this document.

2.9 surface safety valve (SSV): An automatic wellhead valve assembly that will close upon loss of power supply. When used in this standard it includes SSV valve, SSV actuator, and heat sensitive lock-open device.

2.10 SSV/USV actuator: The device that causes the SSV/USV valve to open when power is supplied and to automatically close when power is lost or released.

2.11 SSV/USV valve: The portion of the SSV/USV that contains the wellstream and shuts off flow when closed.

2.12 tree, christmas: An assembly of valves and fittings used for production control that includes, as applicable, the tubing head top flange, the bottom most master valve, the crown valve (swabbing valve), the wellhead choke, and all valves and fittings in between.

2.13 valve, master: A valve located in the vertical run of a christmas tree whose primary purpose is to shut off well flow.

2.14 valve, wing: A valve located on the christmas tree, but not in the vertical run, which can be used to shut off well flow.

2.15 underwater safety valve (USV): An automatic valve assembly (installed at an underwater wellhead location) that will close upon loss of power supply. When used in this standard, it includes USV valve and USV actuator.

3 Receiving Inspection

3.1 Upon receipt of the SSV/USV at the wellsite, check the SSV/USV documentation to verify the following:

a. The serial numbers on the SSV/USV correspond to those recorded on the accompanying receiving report.
b. The SSV/USV valve and SSV/USV actuator are the proper size and pressure rating for the service intended.
c. The SSV/USV valve is marked for the class service to which it will be subjected as outlined in API Specification 14D.

3.2 Check the SSV/USV for visible damage that might impair its proper operation.

Note: Disassembly of the SSV/USV for inspection must not be attempted by other than qualified personnel and should be in accordance with the manufacturer's operating manual.

4 Installation and Maintenance

4.1 The SSV should be the second valve in the wellhead flowstream (e.g., if two master valves are used, the SSV should be the top master valve; if a single master valve is used, the SSV should be the wing valve). The USV should be in a practical location in the wellhead flowstream and within reasonable proximity of the well bore.

4.2 Installation and maintenance of SSVs/USVs should be performed by a qualified person(s).

4.3 Installation procedures outlined in the operating manual should be followed.

4.4 All supply lines should be cleared of foreign matter prior to hookup.

4.5 The SSV actuator supply medium (gas or liquid) should be clean and noncorrosive. If pneumatic, it should be free from solids, liquid hydrocarbons, and water or vapor. Hydraulic fluid should be free from gases and solids. Hydraulic fluid is normally used as the USV actuator supply medium.

4.6 End connection bolting and ring gaskets for SSVs should meet the requirements of API Specification 6A. Installation of bolting should be done in accordance with API Specification 6A. Where applicable, installation of USV bolting and ring gaskets should be in accordance with API Specification 6A.

4.7 After installation, but prior to application of any wellstream fluid or pressure, the SSV/USV valve should be operated several times to ensure smooth operation. Continuity should be checked between the shutdown controls and SSV/USV to assure proper operation of the complete system.

4.8 After installation on the well, the SSV should be tested in accordance with 6.1. The USV should be tested in accordance with 6.2.

4.9 Periodic inspection and maintenance of SSVs/USVs are necessary. Each SSV/USV should therefore be tested at specified regular intervals as dictated by field experience, operator's policy, and governmental regulations. The test should consist of an operating and pressure holding test as referenced in 6.1. For USVs, the test is described in 6.2.

4.10 Maintenance should be performed in accordance with the manufacturer's operating manual. The SSV should be properly lubricated as recommended in the manufacturer's operating manual, or more often if dictated by field experience. Lubricants and sealants used should be as prescribed in the manufacturer's operating manual or an acceptable alternate. The interior of an uncoated or unprotected actuator should be greased as often as necessary to prevent rusting.

4.11 The following should be considered when determining the USV installation depth:

a. Installation depth should be determined according to the manufacturer's instructions.
b. Pressure gradient of seawater/control line fluid.
c. Calculated tubing pressure at USV during the open flow conditions.
d. Operating friction as related to type of USV and sealing elements.
e. Safety factor.

5 Repair

5.1 ONSITE REPAIRS OF SSVs/USVs

5.1.1 Onsite repairs should be accomplished by a qualified person(s).

5.1.2 Replacement parts should be qualified parts and should be documented on the SSV/USV Repair Record Sheet (Exhibit 1).

5.1.3 Testing should be performed in accordance with 6.3.

5.1.4 Documentation: completed copies of the SSV/USV Repair Record Sheet (Exhibit 1) and the SSV/USV Functional Test Data Sheet for Onsite Repairs (Exhibit 2).

5.2 OFFSITE REPAIR OF SSVs/USVs

5.2.1 For continued assurance of quality, an offsite repair should be performed at a facility where the procedures, specifications, and quality control as described in API Specification 14D should be used.

5.2.2 Replacement parts should be qualified parts and should be documented on the SSV/USV Repair Record Sheet (Exhibit 1).

5.2.3 Testing should be performed in accordance with 6.4.

5.2.4 Documentation: completed copies of the SSV/USV Repair Record Sheet (Exhibit 1) and the SSV/USV Functional Test Data Sheet for Offsite Repairs (Exhibit 3).

6 Testing Procedures

6.1 PERIODIC SSV OPERATING AND PRESSURE HOLDING TEST

6.1.1 SSV Operating Test

a. Shut-in well.
b. Close SSV.
c. Open SSV.
d. Return well to production.

6.1.2 SSV Pressure Holding Test

a. Shut-in well and SSV as for operation test.
b. Position wing and flowline valves to permit pressure to be bled off downstream of SSV.
c. With pressure on upstream side of SSV, open bleed valve downstream of SSV and check for continuous flow. If sustained liquid flow exceeds 400 cubic centimeters per minute (0.4 cubic decimeter per minute) or gas flow exceeds 15 standard cubic feet per minute (611.6 cubic meters per day) during the pressure holding test, the SSV should be repaired or replaced. Test duration should be a minimum of 5 minutes.
d. Close bleeder valve.
e. Return well to production.

6.2 PERIODIC USV OPERATING AND PRESSURE HOLDING TEST

6.2.1 USV Operating Test

a. Shut-in well.
b. Close USV.
c. Open USV.
d. Return well to production.

6.2.2 USV Seat Leakage Test

Each operator should use a method appropriate to his system to demonstrate the pressure integrity of the USV and quantify leak rates. The following are two options offered for general guidance only:

a. Option 1: Perform test as in 6.1.2.
b. Option 2:
   1. Shut-in well and USV as for operation test (see 6.1.2a and 6.1.2b) and close downstream header or flowline valve.
   2. With pressure on upstream side of the USV, measure pressure buildup in the flowline versus time. If the absolute pressure buildup in the confined line segment downstream of the USV is in excess of that which represents a flow rate of 400 cubic centimeters per minute (0.4 cubic decimeter per day) of liquid or 15 standard cubic feet per minute (611.6 cubic meters per day) of gas, the USV should be repaired or replaced. An example with calculations is given in Appendix A. Test duration should be a minimum of 5 minutes.
   3. Return well to production.

6.3 TESTING AFTER ONSITE REPAIRS

6.3.1 General

After onsite repair, an SSV/USV should be subjected to a series of tests to demonstrate proper assembly and operation. When repair on the SSV/USV actuator does not affect the SSV/USV valve, testing may be limited to that required in 6.1.1 or 6.2.1.

The test results should be documented on an SSV/USV Functional Test Data Sheet for Onsite Repairs similar to the example shown in Exhibit 2.

6.3.2 Testing

Recommendations for testing SSVs/USVs following onsite repairs are stated below. Testing may be limited according to onsite repairs performed.

6.3.2.1 Onsite repairs where the SSV/USV actuator pressure containing seals are broken or disturbed. The SSV/USV actuator should be tested for leakage using the SSV/USV actuator media. Test pressure should be normal field operating supply pressure. The SSV/USV actuator should not leak.

6.3.2.2 Onsite repairs that might affect the alignment of the gate (plug) and seats. The SSV/USV valve should be opened and checked visually or, if possible, with a drift mandrel for proper alignment.

6.3.2.3 Onsite repairs that might affect operation of the SSV/USV. The complete assembly should be tested for operational integrity: Cycle fully open and fully closed three times with the SSV/USV valve body at ambient pressure or at wellhead shut-in tubing pressure (SITP) with no flow. (If equipment through the first downstream block valve will not withstand full wellhead SITP, conduct this test at the working pressure of the downstream equipment.)

6.3.2.4 Onsite repairs that require breaking or disturbing a pressure containing seal in the SSV/USV valve. The SSV/USV valve seals should be tested for leakage with the SSV/USV in a fully or partially open position and with the SSV/USV valve body exposed to maximum wellhead SITP. Test duration should be a minimum of 5 minutes with no leakage. (If equipment through the downstream block valve will not withstand full wellhead SITP, conduct this test at the working pressure of the downstream equipment.)

6.3.2.5 Onsite repairs that might affect the SSV/USV valve seat seal. The SSV/USV valve seat should be tested according to 6.1 or 6.2 following the test prescribed in 6.3.2.4 above.

6.4 TESTING AFTER OFFSITE REPAIR

6.4.1 General

After an offsite repair, SSV/USV should be tested as required by 4.8 of API Specification 14D. The test results should be documented on an SSV/USV Functional Test Data Sheet for Offsite Repairs similar to the example shown in Exhibit 3.

6.4.2 Exceptions

6.4.2.1 The valve body hydrostatic test should be performed at the valve rated working pressure of the SSV/USV.

6.4.2.2 The actuator hydrostatic test will not be required.

7 Failure Reporting

User Recommendation: The operator of SSV/USV equipment repaired to this standard should provide a written report of equipment failure to the manufacturer. This report should include, as a minimum, the information in Table 1 and a copy of the SSV/USV Repair Record Sheet (Exhibit 1).

8 Documentation Requirements

An operator complying with this standard should retain the following documentation on SSVs/USVs purchased in accordance with API Specification 14D:

Table 1—Failure Report for Surface Safety Valves (SSVs) and Underwater Safety Valves (USVs) (Minimum Data)

Failure ________________ of SSV/USV actuator __________

SSV/USV valve ________________

Heat sensitive lock-open device ________________________
(not required for USVs)

To be completed by operator:

1. Identification:
   - 1.1 Operator.
   - 1.2 Date.
   - 1.3 Field and/or area.
   - 1.4 Lease name and well number.
   - 1.5 Type device: makes, models, sizes, serial numbers (include data on both SSV/USV valve and SSV/USV actuator).
2. Well data:
   - 2.1 Well test rate. Include percent sand, H_2S, CO_2.
   - 2.2 Well pressures and temperatures: (surface).
3. Description of failure:
   - 3.1 Suspected cause.
   - 3.2 Field conclusions.

To be completed by manufacturer:

4. Failed components. Include provision to list failed components.
5. Miscellaneous failure. Include provision to list associated equipment failure.
6. Cause of failure. Include provision to list probable and secondary causes.
7. Corrective action. Include provision to list all corrective action taken.
8. Other:
   - 8.1 Include provision to list any other information the operator deems important.
   - 8.2 Mode of failure.
   - 8.3 Leakage rate.
   - 8.4 SSV/USV actuator control fluid.
   - 8.5 Copy sent to the originator.
9. Submitted by:

Signatures of qualified person (inspector) and operator's representative.

____

____

a. Operating manual.
b. SSV/USV Functional Test Data Sheet.
c. Failure Report for Surface Safety Valves (SSV) and Underwater Safety Valves (USV).
d. Equipment location, routine tests, and maintenance records.
e. Repair records, including serial number, personnel, parts replaced, date of repair, and test data sheet (Exhibits 1 and either 2 or 3).

9 Miscellaneous

9.1 On an SSV, if a lock-open device is necessary, it should be a heat sensitive type.

9.2 Reference should be made to API Recommended Practice 14C, Appendix C, C.2, for associated power supply and control systems for SSVs.

EXHIBIT 1
SSV/USV REPAIR RECORD SHEET
(Formerly Exhibit 1.1, API RP 14H)

Location

Company (operator) ______________________________
Lease no. ______________________ Field ______________________
Platform ______________________ Well no. ______________________

SSV/USV Valve Data

Manufacturer ______________________________
SSV/USV valve catalog or model no. ____________ Serial no. ____________ Size ________
Rated working pressure ____________ Temp. rating max. ____________ Min. ________
SSV/USV valve bore ____________ Class of service ____________

SSV/USV Actuator Data

Manufacturer ______________________________
SSV/USV valve catalog or model no. ____________ Serial no. ____________ Size ________
Rated working pressure ____________ Temp. rating max. ____________ Min. ________

Part No. of Replaced Part(s)	Qty.	Description	Traceability/Reference No.
Prepared by		Company	Date

EXHIBIT 2
SSV/USV FUNCTIONAL TEST DATA SHEET FOR ONSITE REPAIRS (EXAMPLE)

(Formerly Exhibit 1.2, API RP 14H)

Location

Company (operator) ____________________

Lease no. ____________________ Field ____________________

Platform ____________________ Well no. ____________________

SSV/USV Valve Data

Manufacturer ____________________

SSV/USV valve catalog or model no. ____________________ Serial no. __________ Size __________

Rated working pressure ____________________ Temp. rating max. __________ Min. __________

SSV/USV valve bore ____________________ Class of service ____________________

SSV/USV Actuator Data

Manufacturer ____________________

SSV/USV valve catalog or model no. ____________________ Serial no. __________ Size __________

Rated working pressure ____________________ Temp. rating max. __________ Min. __________

Functional Test Date ____________________

I. SSV/USV Actuator Seal Test Performed by ____________________

Normal operating pressure ____________________

Actual test pressure ____________________ Test media ____________________

II. Drift Test Performed by ____________________

Drift mandrel inspection: Yes ________ No ________ OD ____________________

Visual inspection: Yes ________ No ________

III. SSV/USV Operation Test Performed by ____________________

Number of cycles completed with SSV/USV valve body at atmospheric pressure ____________________

Number of cycles completed with SSV/USV valve body exposed to SITP ____________________

IV. SSV/USV Valve Leakage Test Performed by ____________________

Well SITP ____________________ Test pressure ____________________

Test time ____________________

Leakage observed: Yes ________ No ________

V. SSV/USV Valve Seat Leakage Test Performed by ____________________

Well SITP ____________________ Test pressure ____________________

Test time ____________________

Leakage observed: Yes ________ No ________

Prepared by: ____________________

Company: ____________________

Date: ____________________

EXHIBIT 3
SSV/USV FUNCTIONAL TEST DATA SHEET FOR OFFSITE REPAIRS (EXAMPLE)

(Formerly Exhibit 1.3, API RP 14H)

Location

Company (operator) ____________________

Lease no. ____________________ Field ____________________

Platform ____________________ Well no. ____________________

SSV/USV Valve Data

Manufacturer ____________________

SSV/USV valve catalog or model no. ____________________ Serial no. __________ Size __________

Rated working pressure ____________________ Temp. rating max. __________ Min. __________

SSV/USV valve bore ____________________ Class of service ____________________

SSV/USV Actuator Data

Manufacturer ____________________

SSV/USV valve catalog or model no. ____________________ Serial no. __________ Size __________

Rated working pressure ____________________ Temp. rating max. __________ Min. __________

SSV/USV valve bore ____________________ Class of service ____________________

Functional Test Date ____________________

I. SSV/USV Actuator Seal Test Performed by ____________________

Pneumatic ____________________ Hydraulic ____________________

At 20 percent of working pressure rating

Beginning time ____________________ Test gauge pressure reading ____________________

Ending time ____________________ Test gauge pressure reading ____________________

II. Drift Test Performed by ____________________

Drift mandrel ____________________

Visual inspection ____________________

III. SSV/USV Operation Test Performed by ____________________

Number of cycles completed ____________________

IV. SSV/USV Valve Body and Bonnet Hydrostatic Test Performed by ____________________

Required test pressure ____________________

Primary pressure holding period

Beginning time ____________________ Test gauge pressure reading ____________________

Ending time ____________________ Test gauge pressure reading ____________________

V. SSV/USV Valve Seat Test Performed by ____________________

SSV/USV valve type: uni-directional ____________________ bi-directional ____________________

Required test pressure ____________________

Beginning time ____________________ Test gauge pressure reading ____________________

Ending time ____________________ Test gauge pressure reading ____________________

Secondary seal test (pressure applied from downstream end)

Beginning time ____________________ Test gauge pressure reading ____________________

Ending time ____________________ Test gauge pressure reading ____________________

Certified by: ____________________

Title: ____________________

Company: ____________________

Date: ____________________

APPENDIX A—SAMPLE PRESSURE BUILDUP CALCULATION

Note: This section is not part of ISO 10419:1993

For installations inaccessible to leakage flow monitoring or for installations piped into large volume flowlines or vessels (10 barrels or more), leakage may be monitored as a function of pressure increase per unit of time. For example, in the case of a long flowline, the flow may be monitored by closing the USV, bleeding the pressure to ambient in the flowline segment and closing the first convenient isolation valve. Pressure increase in that isolated volume can then be monitored per unit of time; if the resulting increase is higher than specified in 6.2.2, Option 2, the valve should be repaired or replaced.

A.1 Example

TFL flowline, 2.375 inches OD, 1.996 inches ID, 2583 feet long.
Capacity = 56.13 cu ft.
Temperature = 86°F or 540° Rankine.
Standard temperature = 60°F or 520° Rankine.
Initial pressure (P_1) = 0 psig = 14.7 psia or 2117 psfa.
Produced gas liquid ratio = 1500 SCF/bbl or 267.1 SCF/cu ft.
Z = 1.0, dimensionless compressibility factor (change negligible).

A.2 Solution

Theoretical liquid capacity of line:

267.1 cu ft of gas at 80°F occupies 257.2 cu ft under standard conditions

$$(267.1 \times \frac{520}{540} = 257.2 \text{ cu ft})$$

$$56.13 \text{ cu ft} \times \frac{1 \text{ cu ft liquid}}{257.2 \text{ cu ft gas}} = 0.22 \text{ cu ft liquid}$$

Gas capacity of line:

56.13 cu ft – 0.22 cu ft = 55.91 cu ft

Limiting volume increase (due to leakage) is 15 SCF/min or 900 SCF/hr. This calculation assumes a 1 hour pressure buildup test.

a. Determine the initial moles of gas in the flowline:

$$P_1 V_1 = Z n_1 °R T_1$$

Where:

P_1 = 2117 psfa
V_1 = 55.91 cu ft
Z = 1
n_1 = initial number of moles

$$°R = 1545 \frac{\text{ft-lb}}{°R \text{ mole}}$$

$$T_1 = °F + 460 = 540°R$$

$$n_1 = \frac{P_1 V_1}{Z °R T_1}$$

$$n_1 = \frac{(2117)(55.91)}{(1)(1545)(540)}$$

$$n_1 = .142 \text{ moles}$$

b. Additional moles of gas entering the line (assuming negligible liquid enters the line):

$$P_2V_2 = Zn_2{}^{\circ}RT_2$$

Where:

P_2 = 2177 psfa
V_2 = 900 cu ft
Z = 1
n_2 = initial number of moles influx

$$^{\circ}R = 1545 \frac{\text{ft-lb}}{^{\circ}R \text{ mole}}$$

$$T_2 = 60^{\circ}\text{ F} + 460 = 520^{\circ}R$$

$$n_2 = \frac{P_2V_2}{Z^{\circ}RT_2}$$

$$n_2 = \frac{(2117)(900)}{(1)(1545)(520)}$$

$$n_2 = 2.372 \text{ moles}$$

c. Total moles of gas at end of 1 hour test:

$$n_t = n_1 + n_2$$
$$n_t = .142 + 2.372 = 2.514 \text{ moles}$$

d. Final pressure at 540°R, assuming all gas is at 80°F:

$$P_fV_1 = Zn_t{}^{\circ}RT_f$$

Where:

P_f = Final pressure
V_1 = 55.91 cu ft
Z = 1
n_t = 2.514 moles

$$^{\circ}R = 1545 \frac{\text{ft-lb}}{^{\circ}R \text{ mole}}$$

$$T_f = 540^{\circ}R$$

$$P_f = \frac{ZN_t{}^{\circ}RT_f}{V_1}$$

$$P_f = \frac{(1)(2.514)(1545)(540)}{(55.91)}$$

P_1 = 37,514 psfa or 260.5 psia
P_1 = 260.5 – 14.7 = 245.8 psig

The 246 pounds per square inch gauge increase represents the maximum allowable gas influx into the 2583 feet – 2 $^3/_8$ inches OD flowline during the 1 hour test.

APPENDIX B—SI UNITS

Note: This appendix is not part of API Recommended Practice 14H.

The conversion of English units shall be made in accordance with ISO 31-3.

Table B-1—SI Units

Quantity	U.S. Customary Unit	SI Unit
Area	1 square inch (in.^{2})	645.16 square millimeters (mm^2) (exactly)
Flow rate	1 barrel per day (bbl/d)	0.158987 cubic meters per day (m^3/d)
	1 cubic foot per minute (ft^3/min)	0.02831685 cubic meters per minute (m^3/min) or 40.776192 cubic meters per day (m^3/d)
Force	1 pound-force (lbf)	4.448222 newtons (N)
Impact energy	1 foot pound-force (ft•lbf)	1.355818 Joules (J)
Length	1 inch (in.)	25.4 millimeters (mm) (exactly)
	1 foot (ft)	304.8 millimeters (mm) (exactly)
Mass	1 pound (lb)	0.45359237 kilograms (kg) (exactly)
Pressure	1 pound-force per square inch (lbf/in.^{2}) or 1 pound per square inch (psi) (Note: 1 bar = 10^5 Pa)	6894.757 pascals (Pa)
Strength or stress	1 pound-force per square inch (lbf/in.^{2})	6894.757 pascals (Pa)
Temperature	The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (°C):	°C = 5/9 (°F – 32)
Torque	1 inch pound-force (in•lbf)	0.112985 newton meters (N•m)
	1 foot pound-force (ft•lbf)	1.355818 newton meters (N•m)
Velocity	1 foot per second (ft/s)	0.3048 meters per second (m/s) (exactly)
Volume	1 cubic inch (in.^{3})	$16.387064 \cdot 10^{-3}$ cubic decimeters (dm^3) (exactly)
	1 cubic foot (ft^3)	0.0283168 cubic meters (m^3) or 28.3168 cubic decimeters (dm^3)
	1 gallon (U.S.)	0.0037854 cubic meters (m^3) or 3.7854 cubic decimeters (dm^3)
	1 barrel (U.S.)	0.158987 cubic meters (m^3) or 158.987 cubic decimeters (dm^3)

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