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

API RECOMMENDED PRACTICE 14H
FIFTH EDITION, AUGUST 2007

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Upstream Segment

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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 wellstrean shutoff 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 (RP) is to provide guidance for inspecting, installing, operating, maintaining, and onsite repairing SSVs/USVs manufactured according to API Spec 6A (17th Edition or later), Clause 10.20 or API Spec 14D (withdrawn). Included are procedures for testing SSVs/USVs.

1.3 This RP covers guidelines for inspecting, installing, maintaining, onsite repairing, and operating SSVs/USVs. Nothing in this RP 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 a 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 a 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 a 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 remanufacture: Activity involving disassembly, reassembly, and testing of the SSV/USV, with or without the replacement of parts, where machining, welding, heat treating or other manufacturing operations are employed.

Note: Remanufacture does not include the replacement of bodies.

2.9 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 below.

2.9.1 offsite repair: Activity performed at a location other than the equipment installation site which restores the equipment to its original performance meeting the requirements of the edition of API Spec 6A in effect at the time of original manufacture, as a minimum.

2.9.2 onsite repair: Activity performed in accordance with this RP at the equipment installation site.

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

2.11 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.

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

2.13 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.

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

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

2.16 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 the 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 of service (14D valves) or material class (6A, 10.20 valves) to which it may be subjected as outlined in API Spec 6A.

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 Spec 6A. Installation of bolting should be done in accordance with API Spec 6A. Where applicable, installation of USV bolting and ring gaskets should be in accordance with API Spec 6A.

4.7 After installation, but prior to application of any wellstrean 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 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 REPAIR OF SSVS/USVS

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

5.1.2 Onsite repair does not include the replacement of the SSV/USV valve body.

5.1.3 Replacement parts should be qualified parts and should be documented on the SSV/USV Repair Record Sheet (Exhibit 2). Qualified parts shall meet or exceed design requirements for the original parts.

5.1.4 Testing should be performed in accordance with 6.3.

5.1.5 Documentation: completed copies of the SSV/USV Repair Record Sheet (Exhibit 2) and the SSV/USV Functional Test Data Sheet for Onsite Repairs (Exhibit 3).

5.2 OFFSITE REPAIR/REMANUFACTURE OF SSVS/USVS

5.2.1 Offsite repair/remanufacture is not addressed in this RP. These operations should be performed at a facility where the procedures, specifications and quality control allow restoration of the equipment to its original performance meeting the requirements of the edition of API Specs 6A or 14D in effect at the time of original manufacture, as a minimum. Exhibit 2 and Exhibit 4 may be used for documentation.

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 bleed 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 decimeters 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 Pressure Holding Test

Each operator should use a method appropriate to his system to demonstrate the pressure integrity of the USV and quantify build-up 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 minute) 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, a SSV/USV should be subjected to the appropriate test(s) listed in 6.3.2 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 3.

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. No leakage is allowed.

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 the assembly 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.

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 Exhibit 1 and a copy of the SSV/USV Repair Record Sheet (Exhibit 2).

8 Documentation Requirements

An operator complying with this standard should retain the following documentation on SSVs/USVs purchased in accordance with API Spec 6A:

a. Operating manual.
b. SSV/USV Repair Record Sheet (Exhibit 2), SSV/USV Functional Test Data Sheet (Exhibit 3 or 4, as applicable), repair records, and personnel.
c. Failure Report for Surface Safety Valves (SSV) and Underwater Safety Valves (USV) (Exhibit 1).
d. Equipment location, routine tests and maintenance records.

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 RP 14C, Appendix C, C.2, for associated power supply and control systems for SSVs.

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

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:
   - 2.2 Well test rate. Include percent sand, H_2S, CO_2
   - 2.3 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. Submitted by:
   - 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.

   ____

   ____

EXHIBIT 2—SSV/USV REPAIR RECORD SHEET (EXAMPLE)

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 actuator 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 3—SSV/USV FUNCTIONAL TEST DATA SHEET FOR ONSITE REPAIRS (EXAMPLE)

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 actuator 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 SIT ____________________ 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 ____

Performed by: ____________________

Company: ____________________

Date: ____________________

EXHIBIT 4
SSV/USV FUNCTIONAL TEST DATA SHEET FOR OFFSITE REPAIRS
(EXAMPLE)

Location

Company (operator) ____________________

Lease no. ____________________ Field ____________________

Platform ____________________ Well no. ____________________

SSV/USV Valve Data

Manufacturer ____________________

SSV/USV actuator 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 actuator 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: ____________________

Pneumatic ____________ Hydraulic ____________

At 20% of working pressure rating

Beginning time ____________ Test gauge pressure reading ____________

Ending time ____________ Test gauge pressure reading ____________

At 80% 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 ____________

Secondary 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

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.

Note: The following examples are merely examples for illustration purposes only. [Each company should develop its own approach.] They are not to be considered exclusive or exhaustive in nature. API makes no warranties, express or implied for reliance on or any omissions from the information contained in this document.

A.1 Example

TFL flowline, 2.375 in. OD, 1.996 in. ID, 2583 ft long.
Capacity = 56.13 cu ft.
Temperature = 80°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:

261.1 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:

$$P_1 V_1 = Z n_1 {}^\circ R T_1$$

where

P_1 = 2117 psfa

V_1 = 55.91 cu ft

Z = 1

n_1 = initial number of moles

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

T_1 = °F + 460 = 540 °R

$$n_1 = \frac{P_1 V_1}{Z°RT}$$

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

n_1 = *0.142 moles*

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

$$P_2 V_2 = Z n_2 °R T_2$$

where

P_2 = 2117 psfa

V_2 = 900 cu ft

Z = 1

n_2 = initial number of moles influx

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

T_2 = 60°F + 460 = 520°R

$$n_2 = \frac{P_2 V_2}{Z°RT_2}$$

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

n_2 = 2.372 moles

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

$$n_t = n_1 + n_2$$

$$n_t = 0.142 + 2.372 = 2.514 \text{ moles}$$

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

$$P_f V_1 = Z n_t °R T_f$$

where:

P_f = Final pressure

V_1 = 55.91 cu ft

Z = 1

n_t = 2.514 moles

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

$T_f = 540°R$

$$P_f = \frac{ZN_t°RT_f}{V_1}$$

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

P_1 = 37,514 psfa or 260.5 psia

P_1 = 260.5 – 14.7 = 245.8 psig

The 246 lbs per square in. gauge increase represents the maximum allowable gas influx into the 2583 ft – $2^3/8$ in. OD flowline during the 1 hour test.

APPENDIX B—SI UNITS

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) 1 cubic foot per minute (ft^3/min)	0.158987 cubic meters per day (m^3/d) 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-lb)	1.355818 Joules (J)
Length	1 inch (in.) 1 foot (ft)	25.4 millimeters (mm) (exactly) 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 Farenheit (°F) to degrees Celsius (°C)	°C = $^5/_9$ (°F – 32)
Torque	1 inch pound-force (in-lbf) 1 foot pound-force (ft-lbf)	0.112985 newton meters (N-m) 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}) 1 cubic foot (ft^3) 1gallon (U.S.) 1 barrel (U.S.)	16.387064 × 10^{-3}cubic decimeters (dm^3)(exactly) 0.0283168 cubic meters (m^3) or 28.3168 cubic decimeters (dm^3) 0.0037854 cubic meters (m^3) or 3.7854 cubic decimeters (dm^3) 0.158987 cubic meters (m^3) or 158.987 cubic decimeters (dm^3)

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