Date of Issue: June 1996
Affected Publication: API Recommended Practice 14B, *Recommended Practice for Design, Installation, Repair and Operation of Subsurface Safety* Valve *Systems,* Fourth Edition, July 1, 1994.

ERRATA

This errata corrects editorial errors in API Recommended Practice 14B, Fourth Edition, July 1, 1994.

Make the following change to all SI units for "pressure," except in Appendix A. Change "Pa" to "bar" to correct the conversion errors for the following entries:

-Page 5—4.4.4.b, Step 6, Item 4, the pressure values should read "50 psig (3.45 bar)."
-Page 54.4.4, Item c.1, Step 6, Item c, the pressure values should read "50 psig (3.45 bar)."
-Page 6—4.4.4, Item c.1, Step 7, the pressure values should read "50 psig (3.45 bar)."
-Page 6-4.4.4, Item c.2, Steps 2 and 3, the pressure values should read "50 psig (3.45 bar)."

Page 1

In 1.2, add the following paragraph:

1.2.4 Class 4. Weight Loss Corrosion Service.

This class of SSSV equipment is intended for use in wells where corrosive agents could be expected to cause weight loss corrosion. Class 4 equipment must meet the requirements for Class 1 or Class 2 and be manufactured from materials which are resistant to weight loss corrosion.

Page 1

In Section 2. add the following sentence to the end of the first paragraph:

"Referenced standards may be the revision in effect at the time of manufacture of the original equipment or any later edition."

Page 2

In 3.13, add the following word to the end of the sentence:

Add "failure" to the end of the sentence.

Page 6

In 4.4.4. Item c, Subitem 2—Gas Lift Oil Wells-in the last sentence of Step I, make the following change:

Change "'Appendix A" to "Appendix B ."

Page 12

In 6.1, the first sentence, make the following change:

Change "conditions" to "condition."

Page 12

In 6.2. *I, make the following change in the second sentence:*

Delete "or any applicable edition including the current edition" and replace it with 'Or a later edition."

Page 12

In 6.2.2, Item 1, remove the following words:

"or remanufacture"

Pages 13 and 14

In 6.5.2, ***Item c, add the following to the last sentence:***

Add "(13.79 bar)" after "200 PSI" and add "(0.43 m³/min)" after "15 scfm."

Page 15

In Table A-l, make the following corrections:

-In the heading, change "IS0 3 1" to "IS0 31-3."
-In the column for SI units, change all commas (,) to periods (.) in all the SI Unit conversion factors.

Page 22

In G. 7, make the following changes to the definitions of terms under "Where ":

—**After** the definition of "*Q*," add "(m³/hr)."
-After the definition of "*V*," add "(m³)."
-Change the definition of "*T*' to the following:
T = is the absolute temperature at the SSSV, Deg F+460 (Deg C+273).

Page 22

In G.8, make the following change:

After "900 SCF gas per hour" delete "(15 SCF/min)" and insert "(25.5 m³/hr)."

Design, Installation, Repair and Operation of Subsurface Safety Valve Systems

API RECOMMENDED PRACTICE 14B (RP 14B)
FOURTH EDITION, JULY 1, 1994

Contains ISO 10417:1993
Petroleum end natural gas industries--Design, installation, repair and operation of subsurface safety valve systems

ANSI American National Standards Institute	ANSI/API RP 14B-1993

Strategies for Today's
Environmental Partnership

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

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Design, Installation, Repair and Operation of Subsurface Safety Valve Systems

Exploration and Production Department

API RECOMMENDED PRACTICE 14B (RP 14B)
FOURTH EDITION, JULY 1, 1994

American
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SPECIAL NOTES

Note: This section is not part of IS0 10417:1993.

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CONTENTS

[1]The term design wherever used throughout this standard shall be understood to mean *systems* design.

FOREWORD

Note: This section is not part of ISO 10417:1993.

API RP 14B serves as the basis for IS0 10417:1993. The complete text of both the API and IS0 standards is contained in this document. Some differences exist between the API version and the IS0 version of this standard; for example:

- The Special Notes and Foreword are not part of IS0 10417: 1993.

Language that is unique to the IS0 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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This document was developed as an API recommended practice under the jurisdiction of the API Production Department Committee on Standardization of Offshore Safety and Anti-Pollution Equipment (OSAPE), and was prepared with the guidance of the API, the Offshore Operators Committee (OOC) and the Western Oil and Gas Association (WOGA).

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, equipment testing and systems analysis methods.

Appendices are for information only except where cited as requirements in the text.

This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.

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

Design, Installation, Repair and Operation of Subsurface Safety Valve Systems

1 Scope

1.1 PURPOSE

The purpose of the Recommended Practice is to describe the components and the engineering principles for the design calculations, installation, and operation of subsurface safety valve systems. This document is intended for use by both engineering and operating personnel.

1.2 CLASS OF SERVICE

SSSV equipment installed in accordance with this RP shall conform to one or more of the following classes of service:

1.2.1 Class 1. Standard Service.

This class of SSSV equipment is intended for use in oil or gas wells which do not exhibit the detrimental effects caused by sand or stress corrosion cracking.

1.2.2 Class 2. Sandy Service.

This class of SSSV equipment is intended for use in oil or gas wells where a substance such as sand could be expected to cause SSSV equipment failure. Class 2 SSSV equipment must also meet the requirements for Class 1 service.

1.2.3 Class 3. Stress Corrosion Cracking Service.

This class of SSSV equipment is intended for use in oil or gas wells where corrosive agents could be expected to cause stress corrosion cracking. Class 3 equipment must meet the requirements for Class 1 or Class 2 and be manufactured from materials which are resistant to stress corrosion cracking. Within this service class there are two subclasses, 3S for sulfide stress cracking service and 3C for chloride stress cracking service.

1.3 COVERAGE

This RP covers considerations for system design, instructions for safe installation, repair, and guidelines for operating and testing to assure safe and efficient performance of the SSSV System. Also included are procedures for reporting failures. This recommended practice is directed toward wireline, tubing retrievable and pumpdown SSSV systems.

2 Referenced Standards

Below are RP's and standards which may prove useful in the design, installation, operation, repair and maintenance of SSSV systems.

API

Spec 14A	*Specifications for Subsurface Safety Valve Equipment,* [ISO 104321
API RP 14C	*Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms.*
API RP 14E	*Recommended Practice for Design and Installation Offshore Production Platform Piping Systems.*
API RP 14F	*Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms.*

3 Definitions

The definitions below are related specifically to subsurface safety valve systems and are presented to define the terminology used in this standard:

3.1 Bean: The orifice or designed restriction causing the pressure drop in velocity type SSCSVs.

3.2 Concentric Control System: A system utilizing a concentric tubular arrangement to transmit control signals to the SCSSV.

3.3 Control Line: An individual conduit utilized to transmit control signals to the SCSSV.

3.4 Equalizing Feature (EF): An SSSV mechanism which permits the well pressure to bypass the SSSV closing element to aid in opening the valve.

3.5 ESD: Emergency Shut-Down: A system of stations which, when activated, initiate platform shutdown.

3.6 Fail-Safe Device: A device, which upon loss of the control medium, automatically shifts to the safe position.

3.7 Failure: Any condition of the SSSV equipment that prevents it from performing the design function.

3.8 Flow Coupling: A heavy walled nipple. Its function is to resist erosion that can result from turbulence created by a restriction in the flow string.

3.9 Fusible Plug: A plug or portion of the SSSV surface control system which is designed to melt in case of a fire and actuate the fail safe features of the SSSV system.

3.10 Manufacturer: The principal agent in the design, fabrication and furnishing of SSSV equipment who chooses to comply with API Specification 14A.

3.11 Operating Manual: The publication issued by the manufacturer which contains detailed data and instructions related to the design, installation, operation and maintenance of SSSV equipment.

3.12 Operator: The user of SSSV equipment.

3.13 Preventative Maintenance: Service operations performed on sub-surface safety valve equipment not initiated as a result of SSSV equipment.

3.14 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.

3.15 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.

3.16 Repair: Any activity that involves either replacement of parts or disassembly/reassembly of the SSSV equipment in accordance with the operating manual. Repair may be conducted either on-site or off-site as defined below:

a. On-site Repair. The replacement of parts as defined in the operating manual.
b. Off-site Repair. An activity involving dis- assembly, reassembly, and functional testing of SSSV equipment in accordance with the operating manual.

3.17 Safety Valve Landing Nipple: A receptacle in the production string with internal sealing surfaces in which the SSSV can be installed. It can include recesses for locking devices to hold the SSSV in place and can be ported for communication to an outside source for SSSV operation.

3.18 Safety Valve Lock: A device attached to or a part of the SSSV that holds the SSSV in place.

3.19 Shall: Indicates the "recommended practice(s)" has universal applicability to that specificactivity.

3.20 Should: Denotes a "recommended practice(s)" 1) where a safe comparable alternative practice(s) is available; 2) that may be impractical under certain circumstances; or 3) that may be unnecessary under certain circumstances.

3.21 SCSSV: Surface controlled subsurface safety valve—an SSSV controlled from the surface by hydraulic, electrical, mechanical or other means.

3.22 SSCSV: Subsurface controlled subsurface safety valve-an SSSV actuated by the characteristics of the well. These devices are usually actuated by differential pressure through the SSCSV (Velocity Type) or by tubing pressure at the SSCSV (High or Low Tubing Pressure Types).

3.23 SSSV: Subsurface safety valve-a device installed in a well below the wellhead with the design function to prevent uncontrolled well flow when actuated. These devices can be installed and retrieved by wireline (Wireline Retrievable) and/or pump down methods (TFL-Thru Flow Line) or be an integral part of the tubing string (Tubing Retrievable.)

3.24 SSSV Assembly: A SSSV and safety valve lock. This term shall include only the SSSV when referring to tubing retrievable type SSSVs.

3.25 SSSV Equipment: The SSSV, safety valve lock and safety valve landing nipple.

3.26 SSSV System: The down-hole components, including the SSSV, safety valve lock, landing nipple, flow couplings and any required control components.

3.27 Surface Control System: The surface equipment including manifolding, sensors, and power source to control the SCSSV.

3.28 Surface Safety Valve (SSV): An automatic wellhead valve which will close upon loss of power supply. When used in this specification it includes SSV valve, SSV actuator, and heat sensitive lockopen device.

3.29 Well Test Rate: The stabilized rate at which the well is currently being produced on a routine basis.

3.30 Wellhead: The wellhead is a composite of equipment used at the surface to maintain control of the well. Included in wellhead equipment are casing heads-lowermost and intermediate-tubing heads, Christmas tree equipment with valves and fittings, casing & tubing hangers, and associated equipment.

4 Design[1]

4.1 INTRODUCTION

4.1.1 The SSSV system can be categorized as surface controlled (SCSSV) or subsurface controlled (SSCSV). Typical systems are depicted schematically in Figure 1. Selection of a SSSV system is governed by applicable regulations. In addition, the designer should consider tubular specifications, clearances, well effluents, inhibitors, setting depth and well producing characteristics to design the SSSV system. Attention should be given to the class of service as defined in Section 1 of this recommended practice.

[1]The term design wherever used throughout this standard shall be understood to mean systems design.

4.1.2 This section includes the factors that should be considered in designing, installing, operating and repairing the surface control system for SCSSV's operated from the surface or other remotely controlled points.

4.2 SURFACE CONTROLLED SUBSURFACE SAFETY VALVE (SCSSV)

4.2.1 Where surface controlled systems are utilized, tubular goods clearances are major design considerations. Casing and tubing sizes dictate selection of both SCSSV type and control conduit. Concentric control systems may require more space than the individual control line. Tubing retrievable type SCSSVs generally have larger outside diameters (OD) than the safety valve nipple of wireline retrievable types.

4.2.2 When using Concentric Control Systems, both outer and inner strings must be designed and tested for hydraulic control pressure or wellhead pressure whichever is greater. The completion design for this type of system should be evaluated to ensure that component design integrity is not exceeded by the test. Particular care must be taken to avoid connection leaks.

4.2.3 The following should be considered when making control line selection:

a. The temperature and annulus completion fluid to which the control line will be exposed.
b. Operating pressure.
c. Wellhead rated working pressure.
d. Potential for control line damage from abrasion during operation or installation.
e. Selection of banding materials.
f. Well effluents.
g. Control line ID and OD.
h. Continuous control line.
i. Control line connector design and material.
j. Control line materials.
k. Control line fluid.
1. Control line manufacturing technique.

4.2.4 The following should be considered when selecting control line fluids:

a. Flammability.
b. Flash point.
c. Solids content.
d. Corrosiveness.
e. Lubricity.
f. Compatibility with SCSSV metallic and sealing materials.
g. Compatibility with well effluents.
h. Temperature environment.
i. Viscosity.
j. Density.

4.2.5 SCSSV Setting Depth Determination

The following should be considered when determining the SCSSV setting depth:

a. A fail safe setting depth according to the operating manual.
b. Gradient of annulus and control/balance line(s) fluids.
c. SSSV first closed pressure from functional test data.
d. Calculated tubing pressure at SCSSV during open flow conditions.
e. Operating friction as related to type of SCSSV and sealing elements.
f. Safety factor.
g. Minimum depth allowable by regulatory requirements.

4.2.6 A recommended practice is to repressure the tubing to the shut-in tubing pressure before opening any SCSSV.

4.2.7 The wireline retrievable SSSV landing nipples and locks should be selected to be compatible with the conditions of the well bore environment.

4.2.8 Well bore conditions may be considered for the selection of the flow coupling as a means to mitigate erosion of the SSSV and/or tubular goods. The installation of flow couplings above and below each SSSV should be considered.

4.3 SURFACE CONTROL SYSTEM

4.3.1 The surface control system must include the necessary elements to sense abnormal conditions that may contribute to uncontrolled well flow and must transmit the necessary signal to the SCSSV for closure. (See Figure 2)

4.3.2 All elements in the system must be analyzed for potential hazards that may render the facility vulnerable to failure. For example, automatic resets must not be incorporated in the control system since this feature may cause the SCSSV to reopen when it should remain closed.

4.3.3 It may be desirable to integrate the SCSSV surface control system into the total surface safety system to avoid duplication. However, some features should be designed in the integrated systems whereby routine production upsets do not result in closure of all SCSSVs.

4.3.4 Where hydraulic or pneumatic control systems are utilized, the test pressure of the surface controls should be the rated working pressure of the components.

4.3.5 All components exposed to the SSSV operating pressure must be designed for the highest anticipated SSSV operating pressure.

4.3.6 Materials should be selected which are resistant to the elements in the environment; e.g. corrosion and temperature.

4.3.7 Sensors

a. Each installation must be analyzed to determine applicable sensors. The sensor types used to signal the SCSSV may include heat sensors, pressure sensors, and fluid level sensors.
b. High/low level sensor may be placed on the supply tank of hydraulic systems to warn of abnormal operating conditions, e.g., well flowing through control line or a leaking control line. A low pressure pilot can also be installed on pump discharge.

4.3.8 Power

a. The system should be designed with sufficient excess capacity to operate with the minimum energy input.
b. The design should include a back-up power source for convenience, which may be a simple manual pump on hydraulic systems or an independent prime mover on other systems. Provisions should be made to isolate and individually operate the SCSSVs for routine well maintenance.
c. In pneumatic and hydraulic systems, a relief valve should be incorporated to prevent overpressuring of the system.
d. For hydraulic systems, the capacity of the fluid reservoir should be sufficient to pressurize the control system to rated working pressure after the system is filled and maintain an efficient working level.
e. In hydraulic systems, the hydraulic fluid reservoir must be adequately vented to allow pressure relief for returned fluid upon closure of the SCSSV or in the event of back flow from the well through the control conduit.
f. Systems utilizing pneumatic controls require clean supply gas.

4.3.9 Manifolding

a. Figure 2 shows a simplified control system which includes manifolding, sensors, and power source. Included in the manifolding for the surface control system are ESD valves, valves for multiple well isolation, and wellhead connections for the safety systems.
b. For multiple well installations, the manifolding should include provisions for individual well isolation.
c. Caution should be taken in the design and location of the wellhead outlet for the control line. This connection may include a valve for closure and isolation of the individual well from the control system. However, this valve must be maintained in the open position during normal operations and readily identified as closed since closure will effectively render the SCSSV inoperative.
d. ESD valves should be installed in strategic locations in accordance with applicable regulations and sound engineering judgment. To avoid closure of the SCSSV under full well flow conditions, a delay should be incorporated between closure of the surface safety system and the downhole SCSSV. The opening sequence should be reversed on returning production facilities to normal operations. This delay mechanism must be carefully analyzed to assure that it does not create additional hazards that render the system more vulnerable to failure. Normally, this delay should be two to five minutes.

4.4 SUBSURFACE CONTROLLED SUBSURFACE SAFETY VALVE SYSTEM CONSIDERATIONS.

4.4.1 Where subsurface controlled SSSVs are selected, well effluents and producing characteristics become the governing factors in selection and design.

4.4.2 The extent of scale or paraffin deposition should be considered in determining the SSCSV setting depth.

4.4.3 Where no facilities exist for repressuring the tubing, equalizing subs are available for reopening the SSCSV by wireline.

4.4.4 Procedure for Sizing SSCSV

a. General. Two SSCSV type designs are generally available (either velocity type or low tubing pressure type). Velocity type SSCSV's are designed to close as a result of high well effluent velocity causing pressure differential across a bean in the valve in excess of a design differential chosen by the installer. Low tubing pressure type SSCSV's are designed to close when tubing pressure declines below a preset level referenced by a pneumatically charged container in the SSCSV. It is recommended that the valve manufacturer be consulted regarding the design of SSCSV's.
b. Velocity Type SSCSV. The following general procedure is recommended to size the velocity type SSCSV. Shown on Figure 3 is a flow diagram of the SSCSV sizing procedure.

Step 1-Obtain a representative well test rate. Such a test is needed for oil wells and for gas wells as outlined in Appendix B, section B.1 and B.2.

Step 2-Calculate or measure the flowing bottom hole pressure for the producing conditions of Step 1. A suitable vertical flow correlation should be used in making the calculation. If an SSCSV was installed during the test, the pressure drop across the bean (orifice) must be calculated to determine the correct flowing bottom hole pressure.

Step 3-Calculate the well inflow performance from data obtained in Step 1 and Step 2. For oil wells, a PI[1] or a Vogel[2] IPR should be calculated. The back pressure

[1]Productivity Index (PI) is defined as the barrels of fluid produced per day per psi drawdown in bottom hole pressure.
[2]Vogel, J. V.: "Inflow Performance Relationships for Solution Gas Drive Wells": Journal of Petroleum Technology (January 1968) Pages 83-92.

equation developed by the Bureau of Mines[3] for open flow potential can be used for gas wells. Two or more different rate tests may be useful in determining the well inflow performance more accurately. Once the well inflow performance has been determined, flowing bottom hole pressures for other producing rates can be calculated.

Step 4-Select a bean size or a desired pressure drop for a particular make, type, model and size velocity SSCSV The bean size must be small enough in diameter to create a sufficient pressure differential to close the SSCSV. In addition, the bean size should be sufficiently large in diameter to prevent excessive pressure drop to minimize erosion/corrosion of tubing. The manufacturer's recommended ranges of pressure differentials should be followed for each size and model velocity SSCSV. Caution must be taken if the bean diameter exceeds 80 percent of the flow tube diameter since the pressure drop calculations are less reliable. For gas wells, the calculated flow rate through the bean must not exceed the critical flow rate. To make reliable gas orifice calculations, the pressure drop through the bean should not normally exceed 15 percent of the value of the pressure immediately under the SSCSV. Appropriate orifice coefficient and pressure drop correlations for the SSCSV and bean should be obtained from the manufacturer.

Step 5-Select a closure rate condition. The closure rate should be no greater than 150 percent but no less than 110 percent of the well test rate. For oil wells producing less than 400 barrels of fluid per day (BFPD)(63.6 m^3/day), the SSCSV may be designed to close at a rate no greater than 200 BFPD (3 1.8 m^3/day) above the well test rate. To avoid frequent nuisance closures and valve throttling, the closure rate must be greater than the well test rate.

Step 6—Calculate the following for closure rate conditions:

1. The flowing bottom hole pressure. Use the well inflow performance obtained in Step 3 to calculate this value.
2. The pressure immediately under the SSCSV. Use a suitable vertical flow correlation.
3. The pressure drop or the bean size. Use the appropriate orifice correlation.
4. The flowing tubing well head pressure. Under closure-rate flow conditions, the surface tubing pressure should exceed 50 psig (3.45 Pa). If the calculated surface tubing pressure is less than 50 psig (3.45 Pa), select a reduced closure rate and recalculate.

Step 7-Calculate the required SSCSV Closing Force. The manufacturer will provide data, when applicable, to obtain the needed spring compression-normally by use of spacers. A spring with a particular spring-rate must be selected and compression must be applied which will keep the valve open under the well test rate but permit closure at the calculated closure rate. Ensure that all requirements of Steps 4, 5 and 6 are met. If not, return to Step 4 and select a different bean size or pressure drop.

c. Low Tubing Pressure Type SSCSV. The SSCSV that is actuated by a decrease in the tubing pressure can be used in flowing oil and gas wells and in continuous gas lift wells. Low pressure type SSCSVs are not suitable for intermittent gas lift wells. As with the velocity type SSCSV, the well test rate and closure-rate conditions must be known to properly size the low tubing pressure type SSCSV. Some wells may require the running of a pressure survey to determine more accurately the flowing pressure at the SSCSV. The low tubing pressure type SSCSV can be sized using the following recommended procedure. Shown on Figure 4 is a flow diagram of the SSCSV sizing procedure.

1. Flowing Oil and Gas Wells

Step l-Obtain the well test rate. Appendix B shows the required data for oil and gas wells.

Step 2-Calculate or measure the flowing pressure at the SSCSV depth and the flowing bottom hole pressure. Use an appropriate vertical flow correlation when making the calculations.

Step 3-Determine the well inflow performance. Use the same method listed in Step 3 for the velocity type SSCSV

Step 4-Determine the flowing temperature at the SSCSV. The temperature is required in order to properly size gas pressure charged type SSCSV. Normally a linear increase from the flowing surface temperature to the bottom hole static temperature is assumed.

Step 5—Select a closure-rate condition. The closure rate should be no greater than 150 percent but no less than 110 percent of the well test rate. For oil wells producing less than 400 barrels of fluid per day (BFPD) (63.6 m^3/day), the SSCSV may be designed to close at a rate no greater than 200 BFPD (31.8 m^3/day) above the well test rate. To avoid frequent nuisance closures and valve throttling, the closure rate must be greater than the well test rate.

Step 6-Calculate the following for closure-rate conditions:

a. The flowing bottomhole pressure. Use the well inflow performance obtained in Step 3 to calculate this value.
b. The pressure at the SSCSV. Use a suitable vertical flow correlation.
c. The flowing tubing wellhead pressure. The surface tubing pressure should exceed 50 psig (3.45 Pa) at closure-rate flow conditions. If the calculated flowing tubing wellhead pressure is less than 50 psig, select a reduced closure rate and recalculate.

[3]Rawlins, E. L. and M. A. Schellardt: "Back-Pressure Data on Natural Gas Wells and Their Application to Production Practices"; Bureau of Mines Monograph 7: (1935) Page 168.

Step 7-Set the low tubing pressure SSCSV to close at closure-rate condition. To avoid nuisance closures, the closure pressure should be at least 50 psi (3.45 Pa) less than the flowing pressure at valve depth.

2. Gas Lift Oil Wells

Step I-Obtain the well test rate under gas lifting producing conditions. Determine the injected gas volume and injection depths. Also, obtain a well test without gas injection. Appendix A shows the required data.

Step 2-Determine the pressure at the SSCSV for the two well test rates obtained in Step 1. Use a suitable vertical flow correlation when calculating the pressures. If the pressure at the SSCSV without gas injection is within 50 psi (3.45 Pa) or greater than the pressure for gas lifting conditions, the SSCSV is set too deep in the well or may not be suitable for **use.** Shallow settings (less than 1000 feet) (305 m) are frequently required. See Figure 5.

Step 3-Size the low pressure SSCSV to close at valve depth with a pressure (a) less than the well test rate pressure, and (b) greater than the producing rate pressure without gas injection (flowing). The closure pressure should be at least 50 psi (3.45 Pa) less than the normal operating pressure at the valve to prevent nuisance closures. A temperature adjustment as outlined in Step 4 for flowing oil and gas wells is required for gas-pressure-charged valves.

5 Installation

5.1 GENERAL

The following recommended installation practices are intended as guides and are not all inclusive, but cover the most common systems in use. They also provide information that may be utilized in other systems. Details in these procedures are in regard to the SSSV system only. Reference Figure 1 for schematic of equipment placement in each completion type. A recommended procedure for installation and removal of wireline devices is included in Appendix C and a recommended SCSSV test procedure is included in Appendix G. Inspection of new valves before installation is covered in Sections 6.3.1 and 6.5.1.

5.2 SURFACE CONTROLLED SUBSURFACE SAFETY VALVE (TYPE 1, FIGURE 1)

5.2.1 Control Line-Single Completion

Step l-Run production tubing until SCSSV position is reached. At this point, it is imperative that the well be fully under control since there may be difficulty in sealing around both tubing and control line with standard blowout preventers. As an added safety precaution, a planned procedure for cutting the control line and closing in the well should be provided. Special care should be taken to avoid excessive use of thread compound.

Step 2-Install safety valve landing nipple or tubing retrievable valve with flow couplings when used.

Step 3—Connect control line(s) to safety valve landing nipple or tubing retrievable SCSSV. A control line designed to withstand the maximum anticipated operating and environmental conditions is recommended. (Follow manufacturer's operating manual to purge the tubing retrievable SCSSV operating systems of air.)

Step 4—Test control line(s) and connections. Zero leakage should be attained. The control fluid is critical and should be selected as described in section 4.2.4.

(a) Wireline retrievable; install dummy or block off control ports, if control ports are exposed to well fluid, and test to the rated working pressure of the system.

(b) Tubing retrievable; test to maximum pressure differential as recommended by valve manufacturer.

Step 5-Run tubing and control line(s). Precaution should be taken: (a) to prevent entry of well bore contaminants into the control line(s), (b) to detect leaks while running and (c) to prevent damage to the control line(s). When continuous control line(s) are used, maintaining approximately 2000 psi (138 bar) on control lines while running will aid in achieving these objectives.

Step 6-Affix the control line(s) to the tubing with a minimum of two fasteners per joint placed immediately above and below the tubing string connections.

Step 7-Run tubing to bottom and space out.

Step 8—Install tubing hanger and connect control line(s) to wellhead outlet. At this point special care should be taken to follow the manufacturer's written instructions for installing the wellhead assembly and assuring pressure continuity of the control line system.

Step 9-Pressure test control line(s) as per Step 4a or Step 4b.

Step 10—(a) For wireline retrievable installations, where the control ports are exposed to the well bore fluid, pull dummy or open control ports and circulate a minimum of one (1) control line volume. Do not leave control line port open for prolonged periods; either install safety valve, reinstall dummy, close mandrel ports, or continuously pump small volumes of hydraulic fluid to keep foreign materials out of line.

(b) For tubing retrievable installations, test valve for proper operation as recommended by manufacturer.

5.2.2 Control Line-Multiple Completion

Step l-Run long string until subsurface safety valve location is reached and hangoff long string.

Step 2-Run short string(s) and latch into multiple packer.

Step 3-Install safety valve nipples and flow couplings, where used, in all strings. Strings are run simultaneously from this point. This procedure is recommended to avoid possible damage to the small control line(s).

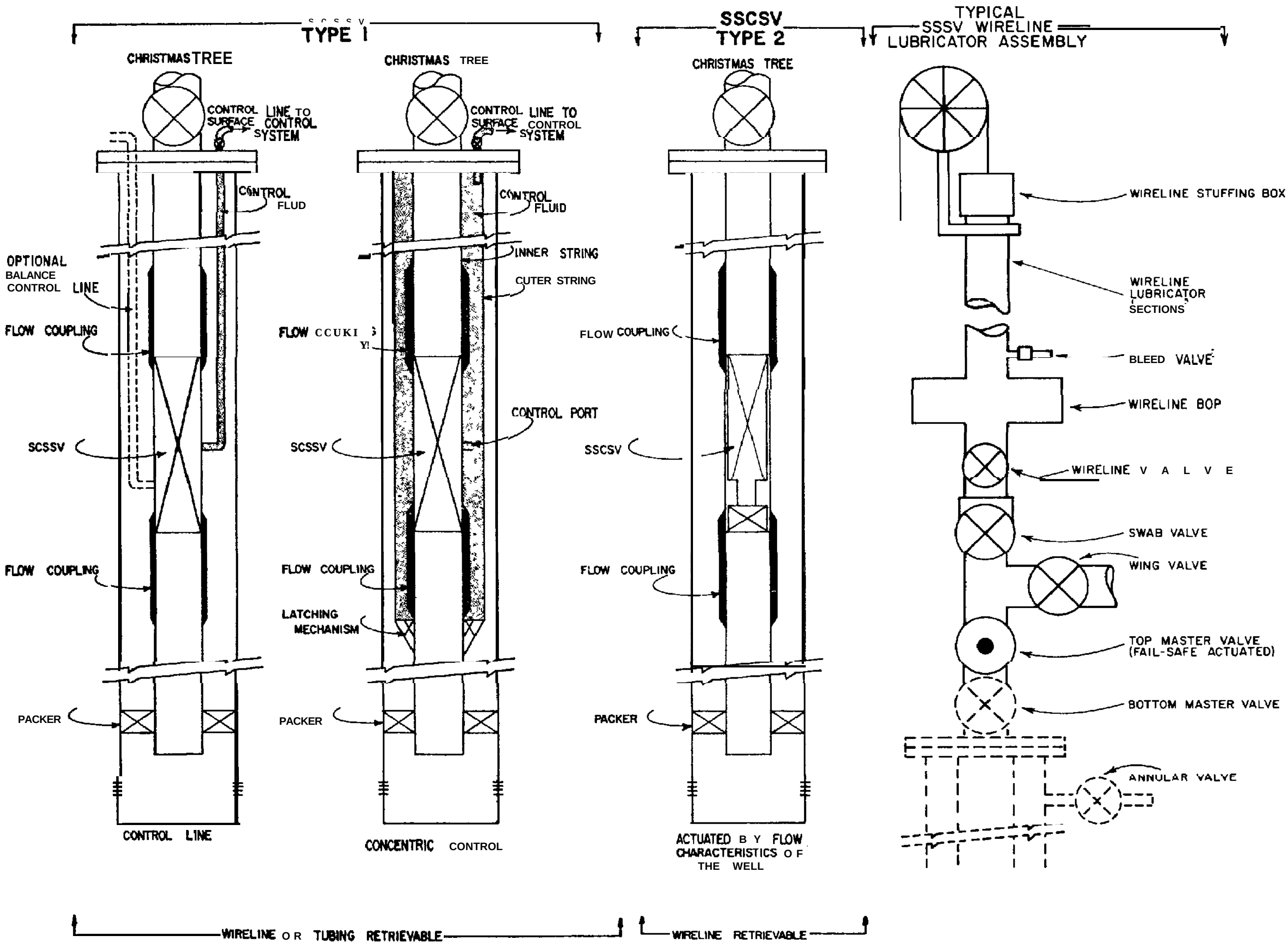

Figure 1-Examples of Subsurface Safety Valve Systems

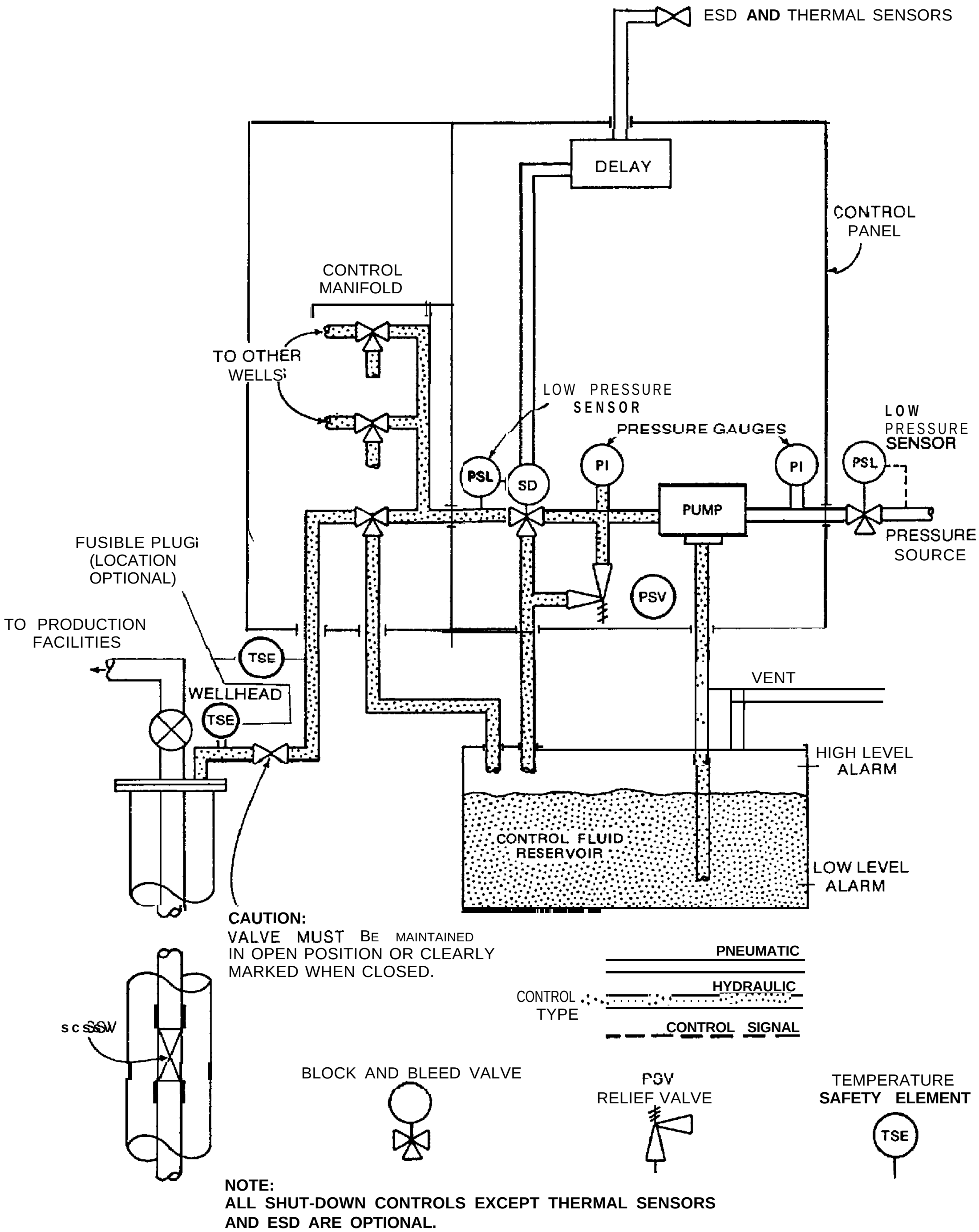

Figure 2-Example Schematic of a Control System for SCSSVs

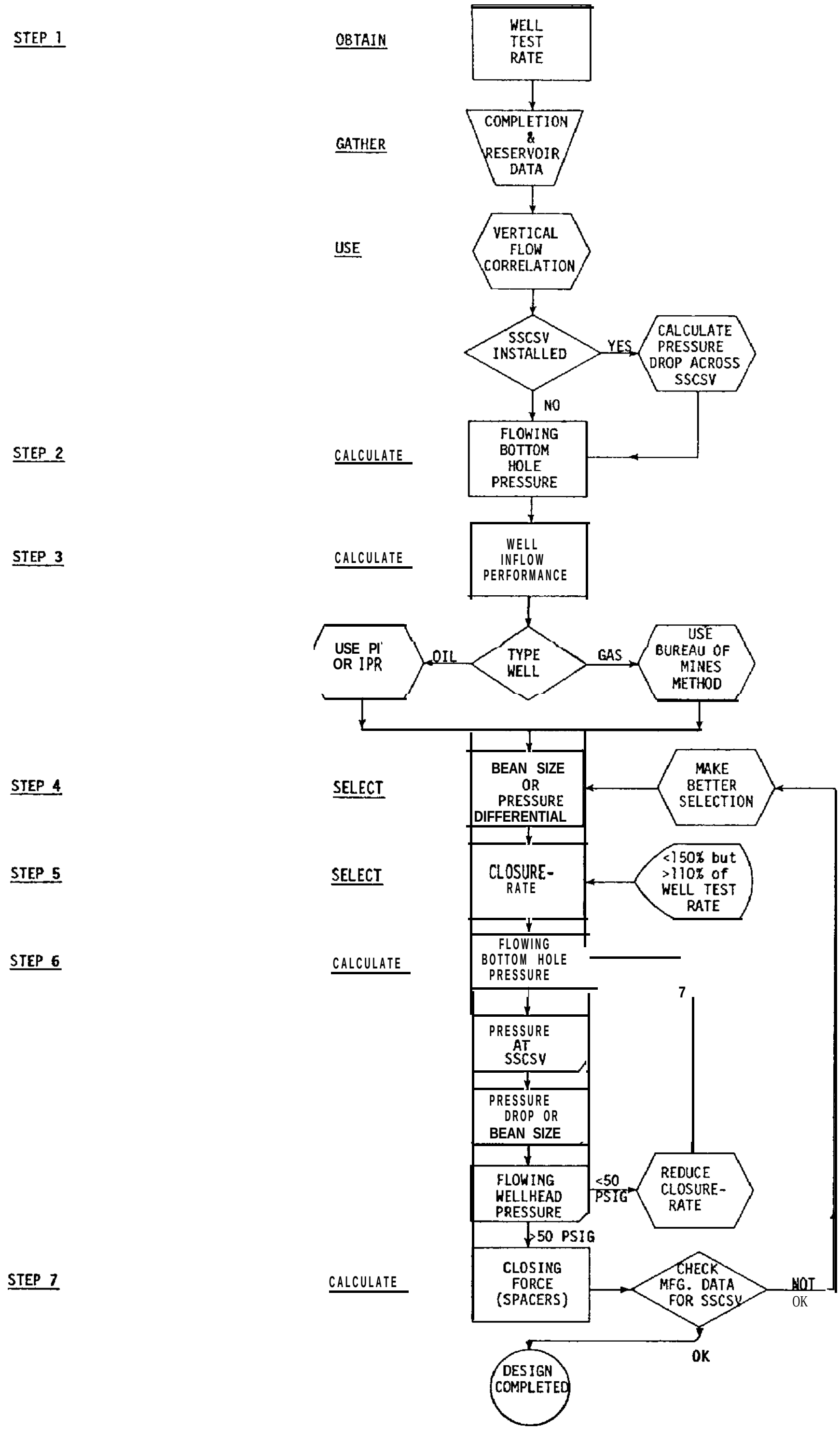

Figure 3-Flow Diagram for Sizing a Velocity Type SSCSV

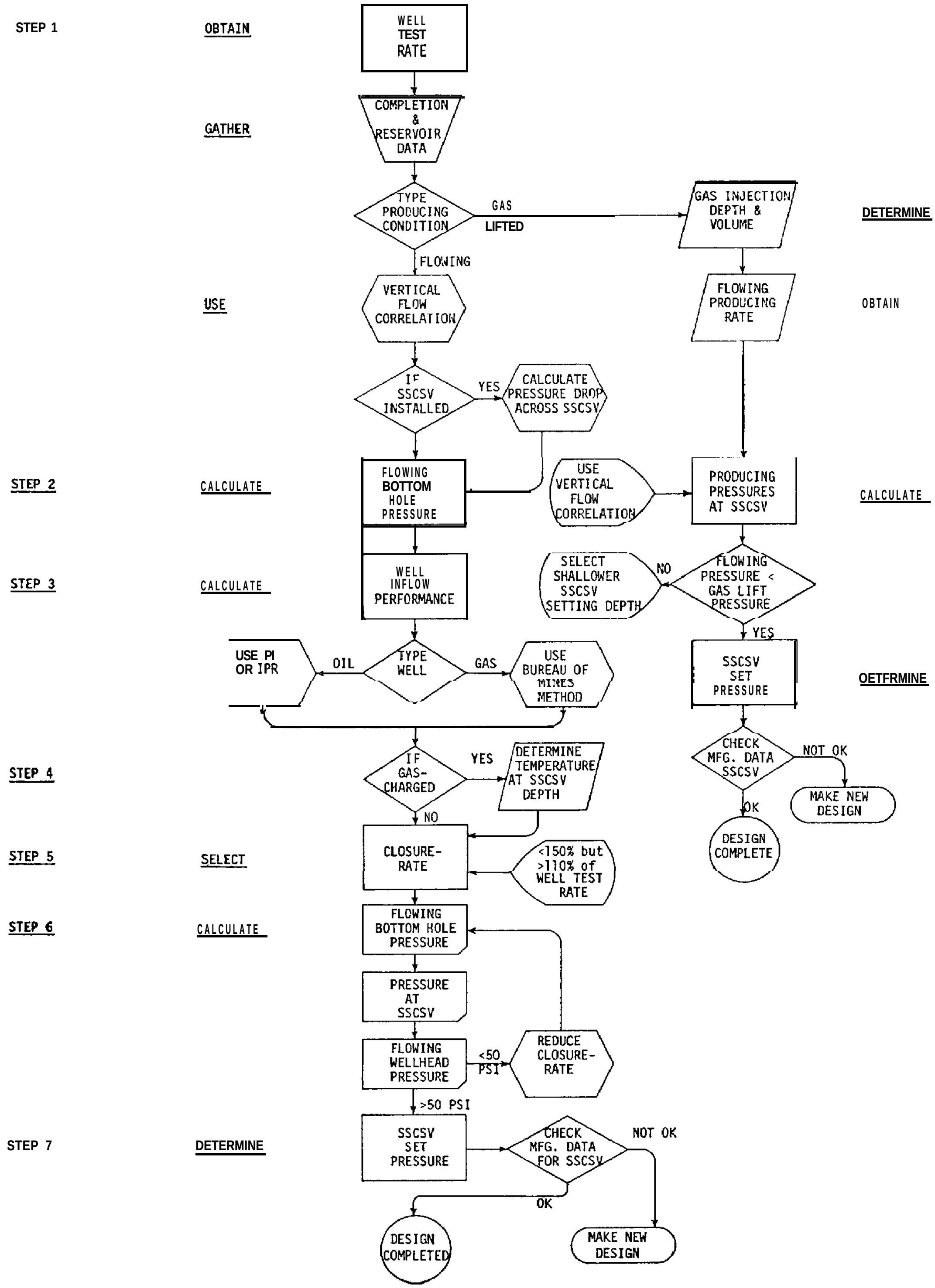

Figure 4-Flow Diagram for Sizing a Low Tubing Pressure Type SSCSV

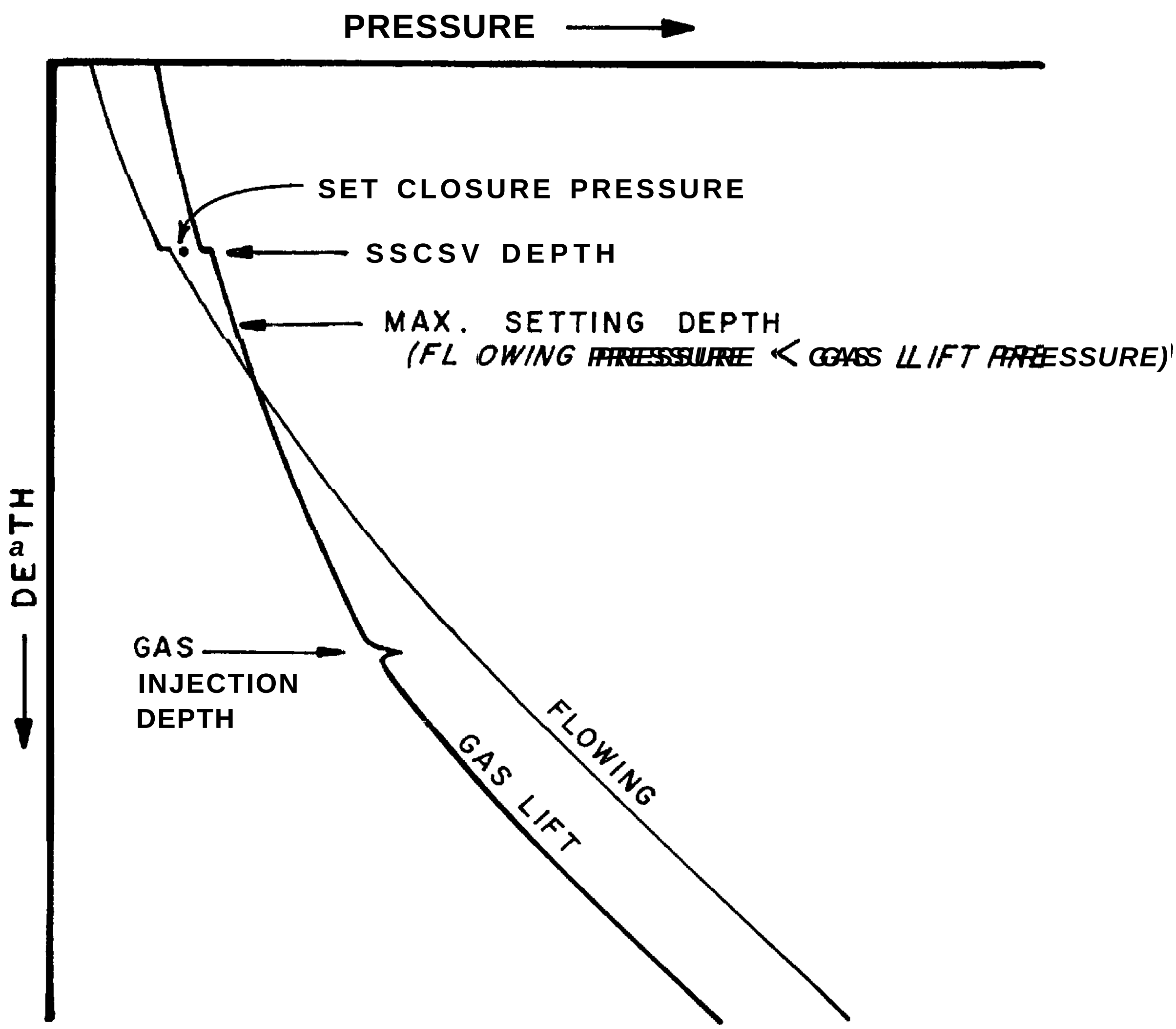

Figure 5—Design Envelope for Low Tubing Pressure Type SSCSV for Gas Lift Conditions

Remainder of procedure is a repetition of Section 5.2.1, Steps 3 through 10.

An alternate procedure may be used if it is desired to space out the short string from measurements of long string space out. This will minimize movement of tubing strings during final landing.

Step 1-Run long string including SCSSV landing nipple and flow couplings, where used, to packer and space out.

Step 2-Pull out the hole until SCSSV landing nipple is reached and hung-off. (Utilize long string measurement for space out of short string.)

Step 3-Run short strings and latch into multiple packer. Procedure from this point is the same as shown in Section 5.2.1, Steps 3 through 10.

5.2.3 Concentric Control — Applicable to Conventional and Tubingless, Multiple and Single Completions

Step 1-Clean outer string internally and inner string externally as necessary to remove all debris that could interfere with SCSSV operations.

Step 2-Run the outer string with inner string receptacle to the designed SCSSV depth. Special care must be taken to avoid use of excessive thread compound on both outer and inner strings to prevent plugging SCSSV.

Step 3-Space out and hang-off outer string.

Step 4-Run the inner string, latch assembly and SCSSV landing nipple with control dummy port closed if applicable.

Step 5—Circulate out control annulus to assure clean volume chamber for control fluid and then land tubing. (Consider filtering control fluid.) At this point, usual procedures for testing the installation should be performed.

Step 6—Pressure test control annulus to design working pressure of the system.

Step 7 For tubing retrievable installations, test the SCSSV for proper operation as recommended in Manufacturer's Operating Manual.

5.3 SURFACE CONTROL SYSTEM

5.3.1 Installation of the surface control system should be made in accordance with API RP14C for surface safety systems, API RP14E for piping systems and API RP14F for electrical systems.

5.3.2 The surface control system should be installed in such a fashion that it does not interfere with nor be subject to damage by the normal producing operations performed on the facility. The location of the control unit, while not critical to its operation, should be chosen for convenience and safety. The control unit enclosure should be weatherproof.

5.3.3 All functions, hydraulic, pneumatic, or electric, should be tested for proper operation prior to connection to the SCSSV. Hydraulic and pneumatic systems should be tested in accordance with manufacturer's recommended testing and operating procedures.

5.4 SUBSURFACE CONTROLLED SUBSURFACE SAFETY VALVE (TYPE 2, FIGURE 1)—APPLICABLE TO MULTIPLE AND SINGLE COMPLETIONS

5.4.1 Run tubing with safety valve landing nipple and flow couplings, where used, positioned at designed SSCSV installation depth.

5.4.2 Additional safety valve landing nipples with flow couplings, where used, may be desirable to allow alternate SSCSV placement.

5.4.3 Install the SSCSV as per wireline procedures outlined in Appendix C.

6 Operation, Inspection, Testing, Repair and Maintenance

6.1 GENERAL

The SSSV equipment supplied in conformance to the requirements of API Spec 14A should be inspected and tested on-site to ensure that the equipment is in the operable conditions. Repair both on-site and off-site should be performed by qualified personnel in accordance with the operating manual and this recommended practice. Replacement components or equipment subassemblies used in the repair of SSSV equipment should be qualified parts. A repair report (Appendix F) should be completed with each off-site repair.

The manufacturer must define the scope of repair such that these activities will not adversely affect the ability of the SSSV equipment to perform its design function.

6.2 REPAIRED SSSV EQUIPMENT

6.2.1 Repair

Repaired SSSV equipment should be of equivalent performance to the SSSV equipment in its original state. The repaired SSSV equipment should, at minimum, conform to the specification (API Spec 14A) in effect at the time of manufacture of the original equipment, or any applicable edition including the current edition. Repaired SSSV equipment consists of the use of qualified part(s) by qualified person(s) with proper testing and documentation.

6.2.2 Documentation

This section describes the documentation recommendations relative to repaired SSSV equipment.

1. Repair of SSSV equipment should be described in records which include the serial number, parts replaced, personnel or company performing the repair, date of repair or remanufacture and test results (reference Appendix F).
2. Repair records should be maintained for a minimum of five years.

6.3 SURFACE CONTROLLED SUBSURFACE SAFETY VALVE (SCSSV)

6.3.1 Inspection

a. On receipt of the SCSSV on location, documentation should be checked to verify that: (a) the serial number on the SCSSV corresponds to that recorded on the accompanying Shipping Report; (b) the SCSSV is sized in accordance with the design; (c) the safety valve lock for a wireline retrievable SCSSV is compatible with the landing nipple installed in the well.
b. Before running the SCSSV into the well, connections should be tightened or checked in accordance with the operating manual. Ascertain that all visible sealing elements are not damaged or deformed, and that all other visible features do not exhibit marring or distortion that may interfere with the SCSSV operation.
c. Disassembly of the SCSSV for inspection shall not be attempted by other than qualified personnel and should be in accordance with the operating manual.

6.3.2 Testing

a. On new and replaced SCSSVs, the opening and closing hydraulic pressures should be verified according to the operating manual. Ascertain that the SCSSV will function fail-safe at the setting depth before installation (see Section 4.2.5).
b. After installation of the SCSSV in the well, the SCSSV should be closed under minimum or no-flow conditions by operation of the surface control. Verification of closure may be accomplished by either wireline, pressure build-up or flow test. If the well is capable of flow, the SCSSV can be tested for leakage by opening the surface valves to check the flow. The SCSSV is then reopened following the operating manual. Verification of opening may be accomplished by the same methods as closure verification.
c. A recommended procedure for routine testing of the in-place SCSSV is provided in Appendix G, including a test for fail-safe operation.
d. Testing of repaired SCSSVs should be conducted by a qualified person in accord with Appendix G and the operating manual.
e. Mechanical function of the safety valve lock should be verified before installation.

6.3.3 Operation, Maintenance and Repair

a. The SCSSV should be operated at least every six months. More frequent operation of the SCSSV as dictated by field experience may serve to keep all moving parts free and functioning properly. This will aid in early detection of failures.
b. All maintenance and repairs should be performed in accordance with the operating manual and only by qualified persons. For verification of proper SCSSV operation within design limits, off-site repaired equipment should be functionally tested as described in Spec 14A.
c. A copy of the failure report as recommended in Appendix D should be forwarded to the manufacturer for all failures when the SCSSV is returned to the manufacturer.

6.4 SURFACE CONTROL SYSTEM

6.4.1 To assure performance of the surface control unit within the design limits, manufacturer's prescribed operating procedures should be followed.

6.4.2 Periodic operation of the surface control system will serve to keep all moving parts free and functioning properly and may lead to early detection of failures. It is recommended that the surface control system be tested at least every six months with considerations given to no-flow conditions:

To test the system, operate an ESD valve. The system tests successfully when all SCSSVs close after the prescribed delay. The pressure relief valves and pressure sensors should be tested in accordance with API RP 14C.

6.4.3 Routine checks should be made of all gages and other displayed controls. Ascertain that any valve or switch capable of rendering the system inoperative is in the proper position.

6.5 SUBSURFACE CONTROLLED SUBSURFACE SAFETY VALVES (SSCSV)

6.5.1 Inspection

a. On receipt of the SSCSV on location, documentation should be checked to verify that: (a) the serial number on the SSCSV corresponds to that recorded on the accompanying Shipping Report; (b) the SSCSV is sized in accordance with the design; (c) the safety valve lock is compatible with the landing nipple installed in the well.
b. Before running the SSCSV into the well, connections should be tightened or checked in accordance with the operating manual. Ascertain that all visible packing elements are not damaged or deformed, and that all other visible features do not exhibit marring or distortion that may interfere with the SSCSV operation.

6.5.2 Testing

a. Testing of an SSCSV in the well is not recommended.
b. Before installing, testing of repaired SSCSVs should be conducted by a qualified person in accordance with the operating manual.
c. Mechanical actuation and closure mechanism pressure integrity should be verified by testing of repaired SSCSVs. A mechanical device may be used to test the actuation mechanism. Pressure testing of the closure mechanism should be at 200 PSI minimum with a suitable fluid. Leakage exceeding

400cc/min of liquid or 15 scfm of test gas will be cause for rejection.

d. Mechanical function of the safety valve lock should be verified before installation.

6.5.3 Operation, Maintenance and Repair

a. The SSCSV should be inspected at least every year. More frequent inspection as dictated by field experience may be necessary for early detection of service wear or fouling.

b. All maintenance and repair should be performed in accordance with the operating manual and only by qualified personnel.

For verification of proper SSCSV operation within designed limits, off-site repaired equipment should be functionally tested as described in API 14A.

c. A copy of the Failure Report as shown in Appendix D should be forwarded to the manufacturer for all failures when the SSCSV is returned to the manufacturer.

APPENDIX A—SI UNITS

The conversion of English units shall be made in accordance with IS0 31.

Table A-1—SI Units

Quantity	U.S. Customary Unit	SI Unit
Length	1 inch (in)	25,4 mm (exactly)
Pressure	1 pound-force per square inch (lbf/in^2) NOTE: 1 bar = 10^5 Pa	6894,757 Pa
Strength or stress	1 pound-force per square inch (lbf/in^2)	6894.757 Pa
Impact engery	1 foot-pound force (ft-lbf)	1,355818 J
Torque	1 foot-pound force (ft-lbf)	1,355818 N•m
Temperature	The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (“C):	°C = 5/9 (“F-32)
Volume	1 cubic foot 1 gal (US) 1 barrel (US)	0,0283168 m^3 or 28,3168 dm^3 0,0037854 m^3 or 3,7854 dm^3 0,158987 m^3 or 158,987 dm^3
Mass	1 pound (lb)	0,45359237 kg (exactly)
Force	1 pound-force (lbf)	4,448222 N
Flow rate	1 barrel/day 1 cubic foot per minute (ft^3/min)	0,158987 m^3/day 0,02831685 m^3/min or 40,776 192 m^3/day

APPENDIX B-EXAMPLE SIZING DATA FORM FOR SUBSURFACE CONTROLLED SUBSURFACE SAFETY VALVE

COMPANY ____________________ DATE ____________________
LOCATION ____________________ LEASE AND WELL ____________________

B.1 Well Data-Oil Wells

Oil Production	(Gas Lift/Flowing)	________	BOPD
Water Production	"	________	BWPD
Gas Oil Ratio		________	GOR
Separator Pressure		________	psig
Flowing Tubing Head Pressure	"	________	psig
Crude Gravity		________	"API
Bubble Point Pressure		________	psig
Gas Injection Volume (gas lift only)		________	MCFPD
Depth of Gas Injection (gas lift only)		________	Feet

B.2 Well Data-Gas Wells

Gas Production	________	MMCF/D
Condensate Gas Ratio	________	B/MMCF
Water Gas Ratio	________	B/MMCF
Flowing Tubing Head Pressure	________	psig
Condensate Gravity	________	"API
"n" Back Pressure Equation Exponent		

B.3 Completion and Reservoir Data

Depth of Producing Zone (TVD)	________	Feet
Depth of SSSV (TVD)	________	Feet
Tubing I.D.	________	Inches
Static Bottom Hole Pressure	________	psig
Flowing BHP	________	psig
Static Bottom Hole Temperature	________	Deg. F
Flowing Wellhead Temperature	________	Deg. F

B.4 Standard Assumptions: (Oil/Gas)

Separator Gas Gravity (.7/.6 w/Air = 1.O)	________	S.G.
Water Specific Gravity (1.07/1.05)	________	S.G.
Absolute Pipe Roughness (.0018/.0006)	________	
Discharge Coefficient of Bean (.85/.90)	________	
Standard Pressure (15.025/15.025)	________	Psia
Standard Temperature (60/60)	________	Deg. F

B.5 Deviated Hole Data:

MD ________, ________, ________, ________ Ft.
TVD ________, ________, ________, ________ Ft.

B.6 Existing SSSV Data (Where Applicable)

Bean Size	________	Inches
Valve Code or Flow Tube I.D.	________	

B.7 Sizing Data

Valve Code or Valve Type: (Mfr. & Description) ____________________

Bean Size: (1) ________ in., (2) ________ psi, (3) ________ psi

OR

Pressure Differential: (1) ________ psi, (2) ________ psi, (3) ________ psi

Ratio of calculated closure rate to the tested production rate:

(1) ________, (2) ________, (3) ________, (4) ________, (5) ________

Refer to Appendix H of this RP for suggested data to be furnished the manufacturer on the purchase order.

APPENDIX C-RECOMMENDED PROCEDURES FOR INSTALLATION AND RETRIEVAL OF SUBSURFACE SAFETY VALVES BY WIRELINE

C.l General

This appendix contains practices that have been proven to provide optimum safety while efficiently performing the prescribed operations. The operating practices are applicable to all wireline operations; however, the detailed running and retrieving procedures are specifically related to SSSVs.

C.l.1 SAFETY CONSIDERATIONS

Safety of personnel, environment and equipment will be the prime consideration on every operation. Before beginning any wireline operation, the wireline operator must familiarize himself with all posted facility safety regulations. Work should be planned to allow completion during daylight hours unless sufficient lighting is available. All work must be performed in such a manner as to prevent pollution.

C.1.2 INFORMATION REQUIRED

Before any operation can be started, the wireline operator must be furnished with the following information:

a. Location (Well identification and directions).
b. All pertinent well data, including tubing I.D., O.D., and joint type; all landing nipple depths, and SSSV lock type; also previous wireline reports to include minimum diameters and known restrictions or obstructions.
c. Wellhead connections and maximum anticipated pressures.
d. Job to be performed including necessary special equipment-e.g., wireline material, lubricator material, stuffing box, tools, etc.-type wireline unit required and whether hole is straight or deviated.

C.1.3 OPERATING PRACTICES

a. Skid units must be securely anchored before beginning operations.
b. Equipment and tools must be checked to assure that the following items are included:

1. Necessary fishing tools to recover any work tools that may be run and lost in the hole.
2. Wireline Valve and Wireline Blowout Preventer (BOP).
3. Sufficient lubricator assembly to enclose all tools including fishing tools on a trip and of adequate pressure rating to contain maximum anticipated well pressure. (Special fishing jobs may require deviations from normal procedure.)
4. Stuffing box with BOP plug.
5. Weight indicator.
6. Jars.
7. Sufficient knuckle joints to insure flexibility of the work string in deviated holes.
8. Depthometer (depth counter).
9. Any SSSV lock-open tool and prong designed to manipulate SSSV without damage.

c. After installing wireline valve and lubricator, test to the maximum anticipated well pressure. *(Do not throttle thru master valve to fill lubricator with well fluid.) Count and record exact number of turns to open and close master valve.*
d. Wireline Valve, Blowout Preventer, lubricator, stuffing box, depthometer and weight indicator must be in good operating order at all times. Failure of any item that could adversely affect the operations should be corrected before proceeding with down hole work.
e. Wireline should not be left in the hole unattended.
f. The wireline or swab valve should be closed when tools are in the lubricator. When unattended or when lubricator is to be removed, the master valve should also be closed.
g. Wire should be cut and retied to the rope socket at least once each day. After prolonged fishing jobs or extensive jarring at one depth, wire should be slipped and cut to change the points of maximum wear. Also visually inspect line.
h. On every run into the well, check drag on tools at least every 1,000' (305 m). More frequent checks may be necessary on initial runs in tubing of unknown condition.
i. While coming out of the hole, the speed should be reduced to safe limits when approaching any restriction in the tubing string and when within 500 feet (153 m) of the surface. Once the tools are in the lubricator, the swab/wireline valve should be closed. All pressure trapped in the lubricator must be bled off before attempting to remove tools.
j. Pressure should be equalized before performing any operations that may result in blowing the wireline tools up the hole, e.g., sand bailing, pulling of valves and plugs.
k. On wells with pressures exceeding 10,000 psi (689.5 bar), it is recommended that the stuffing box be repacked before each trip in the hole. Also, a crown or swab valve should be included with the blowout preventer and wireline valve.
l. In special situations where unusual pressures or safety requirements exist, the following should be considered:

1. Dual wireline blowout preventer for an added degree of safety while performing wireline operations on or through the SSSV.
2. A wireline valve between the wireline BOPs and the wellhead swab valve can be used for added safety during wireline operations.
3. High pressure gas wells may require injection of methanol or glycol to prevent freezing at the stuffing box.

m. If a braided wireline is used, a grease injector packoff system is recommended for wireline packoff.

C.2 Running Procedure For SSSVs

C.2.1 Test lubricator and wireline valve to maximum anticipated pressure, following proper safety procedures.

C.2.2 Ascertain that all tools and connections are properly assembled and made up with new rope socket tie. On initial installation, and on subsequent operations where the tubing condition is questionable, run a full size gage thru the safety valve landing nipple before attempting to install the valve.

C.2.3 For SSCSVs, the operation of the equalizing sub should be checked on the surface with the proper prong. For SCSSVs, check to insure that any lock-open device will not damage the sealing surfaces.

C.2.4 Normally run SSSV into well in open position.

C.2.5 Follow the operating manual for the particular locking device in use to set the SSSV in the safety valve mandrel For hydraulically controlled SCSSVs, the control conduit must be completely filled with hydraulic fluid before the SCSSV is seated. While running the SCSSV, small volumes of fluid should be continuously pumped thru the control conduit to keep it clear of well effluents, unless some feature is provided to isolate the control conduit from the well bore, e.g., sliding sleeve and side pocket devices.

C.2.6 Check to assure that the SSSV is properly seated and the locking device is completely locked.

C.2.7 On SCSSVs, test valve for proper operation by operating the surface control system. Valve open and close positions may be checked by well flow or wireline. If wireline is used, care must be taken to avoid damage to the SSSV.

C.2.8 Retrieve running tools and close wireline valve and master valve. Bleed pressure off of lubricator and remove tools.

C.3 Retrieving Procedure For SSSVs

C.3.1 Test lubricator and wireline valve to maximum anticipated pressure.

C.3.2 Ascertain that all tools and connections are properly assembled and made up with new rope socket tie. On wells where scale or paraffin problems are known to exist or when conditions are unknown, a gauge ring run should be made before attempting to pull SSSV.

C.3.3 Equalize pressure across closed SSSV and open valve if possible.

C.3.4 For hydraulically operated SCSSVs, once the hold-open tool is in place, bleed off the control line pressure to the well shut in tubing pressure. This will relax the external packing and aid in ease of removal of the SCSSV from the mandrel. Once the SCSSV is unseated, small volumes of fluid should be continuously pumped thru the control conduit to keep it clear of well effluents, unless some feature is provided to isolate the control conduit from the well bore, e.g., sliding sleeve and side pocket devices.

C.3.5 Follow the operating manual procedure for unlocking and retrieving the SSSV.

C.3.6 Close wireline valve and master valve. Bleed pressure off lubricator and remove tools and SSSV.

C.4 Records

Upon completion of the wireline operation, a report signed by a qualified person must be submitted to the well operator. This report may be the service company wireline ticket or the operator's form, but should include:

C.4.1 Date

C.4.2 Well identification.

C.4.3 Time summary and operations performed including depth, pressures and equipment involved.

C.4.4 Subsurface equipment, removed and/or replaced.

C.4.5 All equipment lost or left in the hole and any restriction not previously reported.

C.4.6 Information required to complete failure analysis reports.

APPENDIX D-FAILURE REPORTING

User Recommendation

D.1

The operator of SSSV equipment manufactured to this specification should provide to the manufacturer a written report of equipment failure.

D.2

This report should include, as a minimum, the information included in Table D. 1.

TABLE D.1—Failure Report-Subsutface Safety Valve Equipment (Minimum Data)

OPERATOR DATA

I. Identification - Operator
- Operator
- Date
- Field and/or Area
- Lease Name and Well Number

II. - SSSV Equipment Identification
- SSSV____; SSV Landing Nipple ____, SSSV Lock
  - Make
  - Model
    Tubing retrievable ____
    Wireline retrievable ____
    SCSSV retrievable ____
    SSCSV retrievable ____
- Serial Number
- Working Pressure
- Nominal Size
- Service Class
  - Class 1 only
  - Class 1 and 2
  - Class 3

III. Well Data
- Well Test Rate
- Environmental Conditions
  Percent Sand
  - H_2S
  - CO_2
- Pressures and Temperatures
  - Surface
  -Bottom Hole
- SSSV Equipment Setting Depth
- SSSV Equipment Installation Date
- Time Equipment in Service
- Unusual Operating Conditions

IV. Description of Failure
- Nature of Failure
- Observed conditions which could have caused failure

V. Operator's Signature and Date

MANUFACTURER DATA (Completed on Receipt of Equipment)

I. Failed Equipment Condition
- Condition as received
- Failed components
- Damaged components

II. Test Results
- Furnished by Operator and/or Conducted by Manufacturer
- Failure Mode
- Leakage Rate
- Control Fluid
- Operational Data (Opening and Closing Pressures, etc .)

III. Cause of Failure
- Probable Cause
- Secondary Cause

IV. Repair and Maintenance
- Parts Replaced
- Other Maintenance or Repair

V. Corrective Action to Prevent Recurrence
- Operator Procedures
  - Design/Material Change
  - Proper Equipment Application

VI. Additional Information
- Facility location where failed valve was originally manufactured
- Date of manufacture

VII. Manufacturer's Signature and Date
- Completed Report to be transmitted to Operator with a copy retained

APPENDIX E-SUBSURFACE SAFETY VALVE SHIPPING REPORT (EXAMPLE) (MINIMUM DATA REQUIREMENT)

MANUFACTURER DATA ______

Manufacturer ______

Equipment Name ______

SSSV Catalog or Model No ______ Serial No Size ______

Rated Working Pressure ______ Temperature Rating: Min Max

Tubing Retrievable Only. Internal Yield Pressure ______ psig

Collapse Pressure ______ psig

Tensile Load Strength ______ lbs

Performance Test Agency ______ Test Report No. ______ Date of Report ______

Class of Service: ______

Customer: ______ Purchase Order No ______

Test Date: ______ Shipment Date: ______

Functional Test Summary

a. SCSSVs

1. Opening Pressures: Maximum ______ Minimum ______
2. Closing Pressures: Maximum ______ Minimum ______
3. Leakage Rate: 100% Working Pressure: ______ Low Pressure Gas: ______
4. Performed by: ______ Date ______

b. SSCSVs

1. Closing Flow Rates/Pressure Differentials/Tubing Pressures: ______
2. Orifice (bean) Size: ______
3. Number and Length of Spacers: ______ Spring Rate: ______ lbs/ in
4. Leakage Rate: 100% Working Pressure: ______ Low Pressure Gas: ______
5. Performed by: ______ Date ______

APPENDIX F-SUBSURFACE SAFETY VALVE REPAIR REPORT (EXAMPLE) (MINIMUM DATA REQUIREMENT)

MANUFACTURER DATA ____________________

Manufacturer ____________________

Equipment Name ____________________

SSSV Catalog or Model No ________ Serial No ________ Size ________

Replacement Parts*: ____________________

____

____

____

____

____

Customer: ____________________ Purchase Order No ________

Test Date: ____________________ Shipment Date: ____________________

Functional Test Summary

a. SCSSVs

1. Opening Pressures: Maximum ________ Minimum ________
2. Closing Pressures: Maximum ________ Minimum ________
3. Leakage Rate: 100% Working Pressure: ________ Low Pressure Gas: ________
4. Performed by: ____________________ Date ________

b. SSCSVs

1. Closing Flow Rates/Pressure Differentials/Tubing Pressures: ________
2. Orifice (bean) Size: ________
3. Number and Length of Spacers: ________ Spring Rate: ________ lbs/ in
4. Leakage Rate: 100% Working Pressure: ________ Low Pressure Gas: ________
5. Performed by : ____________________ Date ________

*Include, if appropriate, information on safety valve lock manufacturer, type, and serial number.

APPENDIX G-TEST PROCEDURE FOR INSTALLED SURFACE CONTROLLED SUBSURFACE SAFETY VALVES

G.l

Record the control pressure.

6.2

Isolate the control system from the well to be tested.

G.3

Shut the well in at the wellhead.

G.4

Wait a minimum of five minutes. Check the control line for lost of pressure which may indicate a leak in the system.

G.5

Bleed the control line pressure to zero to shut in the SC-SSV. Close the control line system and observe for pressure buildup which may indicate a faulty SCSSV system. If such pressure buildup occurs. Corrective action should be taken.

G.6

Bleed the pressure off the wellhead to the lowest practical pressure and then shut in the well at the wing or flowline valve. When possible, bleed flowline header pressure down to or below wellhead pressure and observe the flowline and wellhead for a change in pressure which would indicate a faulty surface valve. Any leaks through the wing or flowline valve must be repaired before proceeding with the test.

G.7

Conduct leakage test and document results. For gas wells, flow rates can be computed from pressure build-up by the formulas.

$$Q = 2122\left(\Delta\frac{P}{Z}\right)\left(\frac{1}{\Delta t}\right)\left(\frac{V}{T}\right)$$

$$Q = 17068\left(\Delta\frac{P}{Z}\right)\left(\frac{1}{\Delta t}\right)\left(\frac{V}{T}\right) \qquad \text{(SI Units)}$$

Where:

$\left(\Delta\frac{P}{Z}\right)$ = is the final P (pressure in psia) (Bar) divided by final Z (gas deviation factor) minus intial P divided by initial Z

Q = is the leakage rate, SCF/Hr.

At = is the build-up time in minutes to reach a stabilized pressure.

v = is the volume of the tubing string above the SSSV in cubic feet.

T = is the absolute temperature at the SSSV (Deg F+460).

For low pressure applications this formula may be simplified as follows:

$$Q = \frac{4(\Delta P)V}{\Delta t}$$

$$Q = \frac{58.1\,(\Delta P)\,V}{\Delta t} \qquad \text{(SI Units)}$$

For oil wells, the pressure build-up depends on the static fluid level and the amount of gas in the oil. If the fluid level is below the SCSSV, the formula for gas wells can be used. If the fluid level is above the SCSSV, the leakage rate should be measured.

G.8

If the SCSSV failed to close or if the leakage rate exceeds 900 SCF gas per hour (15 SCF/min.), or 6.3 gallons of liquid per hour (400cc/min.), corrective action should be taken.

G.9

After the SCSSV tests successfully, use the following recommended reopening procedure:

G.9.1 SCSSVs with Equalizing Features

a. With external pressure source.

Pressure the tubing above the valve until the pump thru feature of the SCSSV functions to indicate the pressures are equalized. When equalized, slowly increase control line pressure to the value recorded in Step 1 or to the pressure established for normal operations.

b. Without external pressure source.

With the well shut in, increase control pressure slowly until the tubing pressure begins to increase. Close the manifold control valve and record the opening pressure. When the tubing pressure stabilizes, pressure up the control system to open the SCSSV. Increase the hydraulic control line pressure to the value recorded in Step 1, or at least 500 psi greater than the opening pressure.

G.9.2 SCSSVs without Equalizing Features

An external pressure source should be used to equalize the pressure across the SCSSV before opening. When equalized, slowly increase control line pressure to the value recorded in Step 1 or to the pressure established for normal operations.

G.10

When the SCSSV has been determined to operate properly and is opened, the control line pressure must be tied back into the system control pressure and the well can be placed back on production. Check well test rate. A significant reduction in the well test rate may be the result of the SCSSV not reopening fully.

APPENDIX H-SUGGESTIONS FOR ORDERING SUBSURFACE SAFETY VALVE EQUIPMENT

In placing orders for subsurface safety valve equipment in accordance with API Spec 14A, operator should specify the following on the purchase order:

Specification and Edition (API Monogram required)	Yes ____	No ____
Tubing Size, Weight, Grade, Connection	Yes ____	No ____
SSSV Equipment		
Type System (See Section 4.1, 4.2 and 4.4)	Yes ____	No ____
Type and Model	Yes ____	No ____
Class of Service-API Spec 14A	Yes ____	No ____
Size-API Spec 14A	Yes ____	No ____
Rated Working Pressure-API Spec 14A	Yes ____	No ____
Temperature Range-API Spec 14A	Yes ____	No ____
Special Features	Yes ____	No ____
SCSSV		
Control System Pressure	Yes	No ____
Setting Depth-API Spec 14A	Yes ____	No ____
Type Control Fluid	Yes ____	No ____
Strength (tubing retrievable only) API Spec 14A	Yes ____	No ____
SSCSV		
Orifice Size, Spring, Spacers, Dome Charge, etc.	Yes ____	No -
OTHER EQUIPMENT		
Safety Valve Lock-API Spec 14A	Yes ____	No ____
Safety Valve Landing Nipple-API Spec 14A	Yes ____	No ____

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