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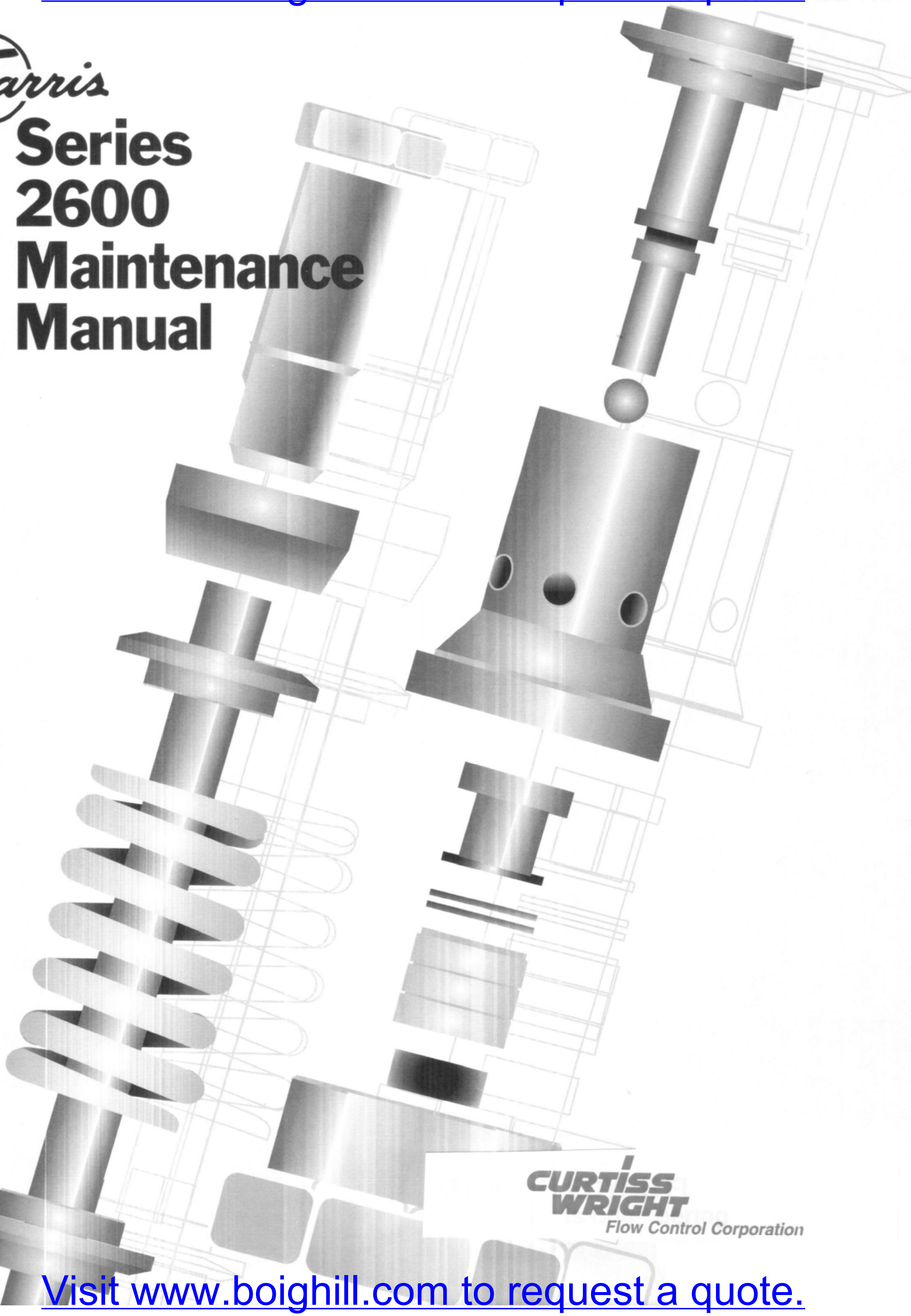
Farris

Series 2600 Maintenance Manual



Curtiss Wright
Flow Control Corporation

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This Maintenance Manual is provided because you have Farris Pressure Relief Valves protecting equipment and personnel in your plant. We trust that you will find this manual useful, as it is intended to clearly present all the essential information you will need in order to keep your Farris Valves in perfect operating condition.

Generally, maintenance becomes necessary as a result of dirt or scale in the lines, exposure to service conditions, incorrect servicing, improper testing procedure, or improper installation. If you follow the instructions in this Manual, the maintenance of your valves should be reduced in effort and expense.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Farris Engineering.

On the following pages you will find definitions of commonly used pressure relief valve terminology, cross-sectional illustrations of both conventional (A10) and Balanseal bellows (A11) 2600 Series valve designs along with a page explaining the numbering system used on this valve series. In order to get the most out of this maintenance manual you should familiarize yourself with the information on these pages and the design of the Farris 2600 Series valve line.

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PRESSURE RELIEF
VALVES
AND TESTING EQUIPMENT

UV

TUV Rheinland
of North America, Inc.
ISO 9001 Registered Facility

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Series 2600
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(Manual Revision 3, May 1998)

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TYPE AND SERIAL NUMBERING SYSTEMS

Familiarity with Farris valve type and serial numbering systems will greatly benefit anyone using this manual or any other Teledyne Farris literature. The ability to recognize certain valve type and construction features along with identifying serial numbers will assist correct maintenance procedures and spare part selection/ordering. All Farris valve nameplates contain a specific valve type number and serial number unique to the particular valve that the nameplate is attached upon. See Figure 1.2 for an example of a typical 2600 Series Nameplate.

Serial Numbering System

Each Farris pressure relief valve is assigned a unique serial number. This serial number is assigned by the factory and remains part of the factory records. Providing this serial number to the factory will assist in the identification of the construction and metallurgy of the valve in question. The following outline will give general guidelines on the serial numbering system used on 2600 Series valves.

Serial Number Suffix	Valve Type	Description	Production Dates
-A	Full nozzle valves, conventional and bellows types	This serial number suffix covered all types of constructions, i.e. *Conventional, FarriSeal, BalanSeal,* Enclosed and Exposed Spring.	1943- 1955
-A2,A4 &A6	Conventional Design	Includes both 2605 and 2675 Series	1955 - 1967
-A3, A5 & A7	BalanSeal Bellows Design		
-A8	Conventional Design	Full nozzle valves conforming to API RP-526	1959 - 1976
-A9	BalanSeal Bellows Design		
-A10	2600 Conventional Design (air, steam & vapor)	Full nozzle valves conforming to API RP-526 with nozzles revised to incorporate ASME 0.9 capacity reduction factor.	1976 - present
-A11	2600 BalanSeal Design (air, steam & vapor)		
-A14	2600L Conventional Design (liquid service)	Full nozzle valves conforming to API RP-526 ASME Section VIII certified for liquid service.	1985 - present
-A15	2600L BalanSeal Design (liquid service)		
-A10/M	2600 Conventional - "O" Ring (air, steam & vapor)	Modified "D" through "K" orifice "O" ring seat design that replaced the original A10 & A11 "O" ring seat design. *Starts at serial #'s above 300000.*	July 1993 - July 1996
-A11/M	2600 BalanSeal - "O" Ring (air, steam & vapor)		
-A14/M	2600L Conventional - "O" Ring (liquid service)	Modified "D" through "K" orifice "O" ring seat design that replaced the original A14 & A15 "O" ring seat design. Starts at serial #'s above 300000 & above.	July 1993 - present
-A15/M	2600L BalanSeal - "O" Ring (liquid service)		
-A10/R	2600 Conventional - "O" Ring (air, steam & vapor)	"D" through "K" orifice "O" ring seat design that replaced the modified A10/M & A11 /M"O" ring seat design. Starts at serial #'s above 312123.	August 1996 - present
-A11/R	2600 BalanSeal - "O" Ring (air, steam & vapor)		

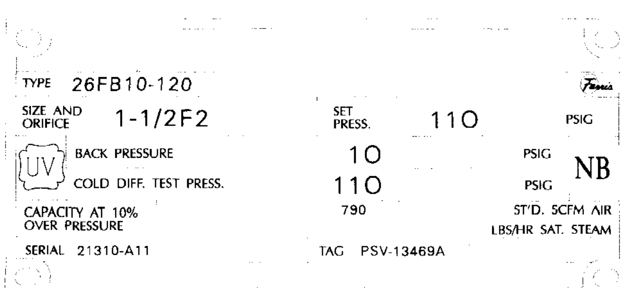

Figure 1.2

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Type Numbering System

The diagram below illustrates the Farris 2600 Series valve type numbering system. You will find this type of number on the nameplate of every Farris 2600 Series valve. The number found on each valve nameplate describes the valve with its construction and metallurgy. Valve types with numbers ending in "SP" are special valves. Example; (26DA10-120/S4/SP).

It may be necessary to contact the factory for assistance when replacement parts or maintenance is required on such valves.

Complete standard metallurgy details for individual parts in the 2600 Series valve line can be obtained by consulting a current sales catalog.

Example: **Valve Type H26QA10L–120/S4**

H	26	Q	A	1	0	L	–	1	2	0/	S4
PREFIX	SERIES	ORIFICE	DESIGN	TEMP CLASS	FLANGE RATING	SPECIAL CONSTRUCTION		INLET	CAP CONSTRUCTION	TEST GAG OPTION	MATERIAL CLASS

BASIC SERIES

BASIC SERIES
2600

API ORIFICE DESIGNATION

LETTER	EFFECTIVE AREA SQ. IN.	LETTER	EFFECTIVE AREA SQ. IN.
D	0.110	L	2.853
E	0.196	M	3.60
F	0.307	N	4.34
G	0.503	P	6.38
H	0.785	Q	11.05
J	1.287	R	16.00
K	1.838	T	26.00

PREFIX (IF APPLICABLE)

H	SET PRESSURE ABOVE API 526*
SJ	STEAM JACKET
HTF	HEAT TRANSFER FLUID

** Available Only on Q, R, T Orifices*

DESIGN TYPE

A	CONVENTIONAL SERIAL SUFFIX (A10/A14)
B	BALANSEAL SERIAL SUFFIX (A11/A15)
C	CONVENTIONAL "O"-RING (A10/A/14)
D	BALANSEAL® "O"-RING (A11/A15)
E	BALANSEAL® W/BALANCED PISTON (A12)

INLET TEMPERATURE RANGE

	INLET TEMPERATURE RANGE °F	MATERIAL	
		BODY & BONNET	*SPRING*
1	-20°F TO 450°F	CARBON STEEL	CHROME ALLOY
2	451°F TO 800°F	CARBON STEEL	CHROME ALLOY
3	801°F TO 1000°F	CHROME MOLY ST.	HIGH TEMP ALLOY
4	1001°F TO 1200°F	CHROME MOLY ST.	HIGH TEMP ALLOY
5	1201°F TO 1500°F	AUSTENITIC ST. ST.	HIGH TEMP ALLOY
6	-21°F TO -75°F	31/2% NICKEL STEEL	CHROME ALLOY
7	-76°F TO -150°F	31/2% NICKEL STEEL	AUSTENITIC ST. ST.
8	-151°F TO -451°F	AUSTENITIC ST. ST.	AUSTENITIC ST. ST.

SPECIAL CONSTRUCTION*

A	Expanded API Sizes: Air, Steam & Gas Service.
B	Expanded API Sizes: ASME Liquid Valve.
C	Expanded API Sizes: ASME Code Section VIII exposed spring design.
D	Valve suitable for heat transfer fluid service – Vapor.
E	Valve suitable for heat transfer fluid service – Liquid.
F	Expanded API size valves suitable for heat transfer service – Vapor.
G	Expanded API size valves suitable for heat transfer service – Liquid.
H	Integral steam jacket expanded API. Sizes – Vapor Service.
J	Integral steam jacket – Vapor Service.
K	Integral steam jacket – Liquid Service.
L	ASME Code certified for liquid service only.
S	ASME Code Section VIII exposed spring design.
X	Integral steam jacket expanded API sizes – Liquid Service.

FLANGE RATINGS

0	150
1	300 LIGHT WEIGHT
2	300
3	600
4	900
5	1500
6	2500

TEST GAG OPTION

0	NO TEST GAG
1	TEST GAG

CAP CONSTRUCTION

2	PLAIN
3	BOLTED
4	PACKED
5	L TYPE PACKED LEVER
6	R TYPE PACKED LEVER
7	OPEN LEVER
8	REMOTOR (W/PACKED CAP)

CORROSIVE SERVICE MATERIALS*

H ( )	HASTELLOY H1 THRU H4
M ( )	MONEL M1 THRU M4
S ( )	316 STAINLESS STEEL S1 THRU S7

** If Applicable*

INLET/OUTLET FACING

0	SPECIAL CONSULT FACTORY
1	RAISED FACE
2	LARGE FEMALE
3	SMALL MALE
4	SMALL FEMALE
5	LARGE TONGUE
6	LARGE GROOVE
7	SMALL TONGUE
8	SMALL GROOVE
9	RING JOINT
A	125 AARH SMOOTH FINISH
H	63 AARH SMOOTH FINISH
B	125 AARH (OUTLET ONLY)
C	125 AARH (INLET & OUTLET)
J	63 AARH (OUTLET ONLY)
K	63 AARH (INLET & OUTLET)

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VALVE TERMINOLOGY

SAFETY VALVE - An automatic pressure relieving device actuated by the static pressure upstream of the valve, and characterized by rapid full opening or pop action. It is used for steam, gas, or vapor service.

RELIEF VALVE - An automatic pressure relieving device actuated by the static pressure upstream of the valve which opens in proportion to the increase in pressure over the opening pressure. It is used primarily for liquid service.

SAFETY RELIEF VALVE - An automatic pressure actuated relieving device suitable for use as either a safety or relief valve, depending on application.

PRESSURE RELIEF VALVE - A pressure relief valve is a pressure relief device which is designed to reclose and prevent the further flow of fluid after normal conditions have been restored.

SET PRESSURE - Set pressure, in pounds per square inch gage, is the inlet pressure at which the pressure relief valve is adjusted to open under service conditions. In a safety or safety relief valve in gas, vapor, or steam service, the set pressure is the inlet pressure at which the valve starts to discharge under service conditions.

DIFFERENTIAL SET PRESSURE - The pressure differential in pounds per square inch between the set pressure and the constant superimposed back pressure. It is applicable only when a conventional type safety relief valve is being used in service against constant superimposed back pressure.

COLD DIFFERENTIAL TEST PRESSURE - Cold differential test pressure, in pounds per square inch gage, is the inlet static pressure at which the pressure relief valve is adjusted to open on the test stand. This pressure includes the corrections for service conditions of back pressure or temperature, or both.

OPERATING PRESSURE - The operating pressure of a vessel is the pressure, in pounds per square inch gage, to which the vessel is usually subjected in service. A vessel is usually designed for a maximum allowable working pressure, in pounds per square inch gage, which will provide a suitable margin above the operating pressure in order to prevent any undesirable operation of the relief device. (It is suggested that this margin be as great as possible consistent with economical vessel and other equipment design, system operation and the performance characteristics of the pressure relieving device.)

MAXIMUM ALLOWABLE WORKING PRESSURE
Maximum allowable working pressure is the maximum gage pressure permissible at the top of a completed vessel in its operating position for a designated temperature. This pressure is based on calculations for each element in a vessel using nominal thicknesses, exclusive of allowances for corrosion and thickness required for loadings other than pressure. It is the basis for the pressure setting of the pressure-relieving devices protecting the vessel. The design pressure may be used in place of the maximum allowable working pressure in cases where calculations are not made to determine the value of the latter.

OVERPRESSURE - Overpressure is a pressure increase over the set pressure of a pressure relief valve, usually expressed as a percentage of set pressure.

ACCUMULATION - Accumulation is the pressure increase over the maximum allowable working pressure of the vessel during discharge through the pressure relief valve, expressed as a percent of that pressure or in pounds per square inch.

BLOWDOWN - Blowdown is the difference between actual popping pressure of a pressure relief valve and actual reseating pressure expressed as a percentage of set pressure or in pressure units.

LIFT - Lift is the actual travel of the disk away from closed position when a valve is relieving.

BACK PRESSURE - Back pressure is the static pressure existing at the outlet of a pressure relief device due to pressure in the discharge system.

CONSTANT BACK PRESSURE - Back pressure which does not change appreciably under any condition of operation whether the pressure relief valve is closed or open.

VARIABLE BACK PRESSURE - The pressure existing at the outlet of a pressure relief device, which does not remain constant when the pressure relief valve is closed.

BUILT-UP PRESSURE - Built-up back pressure is pressure existing at the outlet of a pressure relief device occasioned by the flow through that particular device into a discharging system.

SUPERIMPOSED BACK PRESSURE - Superimposed back pressure is the static pressure existing at the outlet of a pressure relief device at the time the device is required to operate. It is the result of pressure in the discharge system from other sources.

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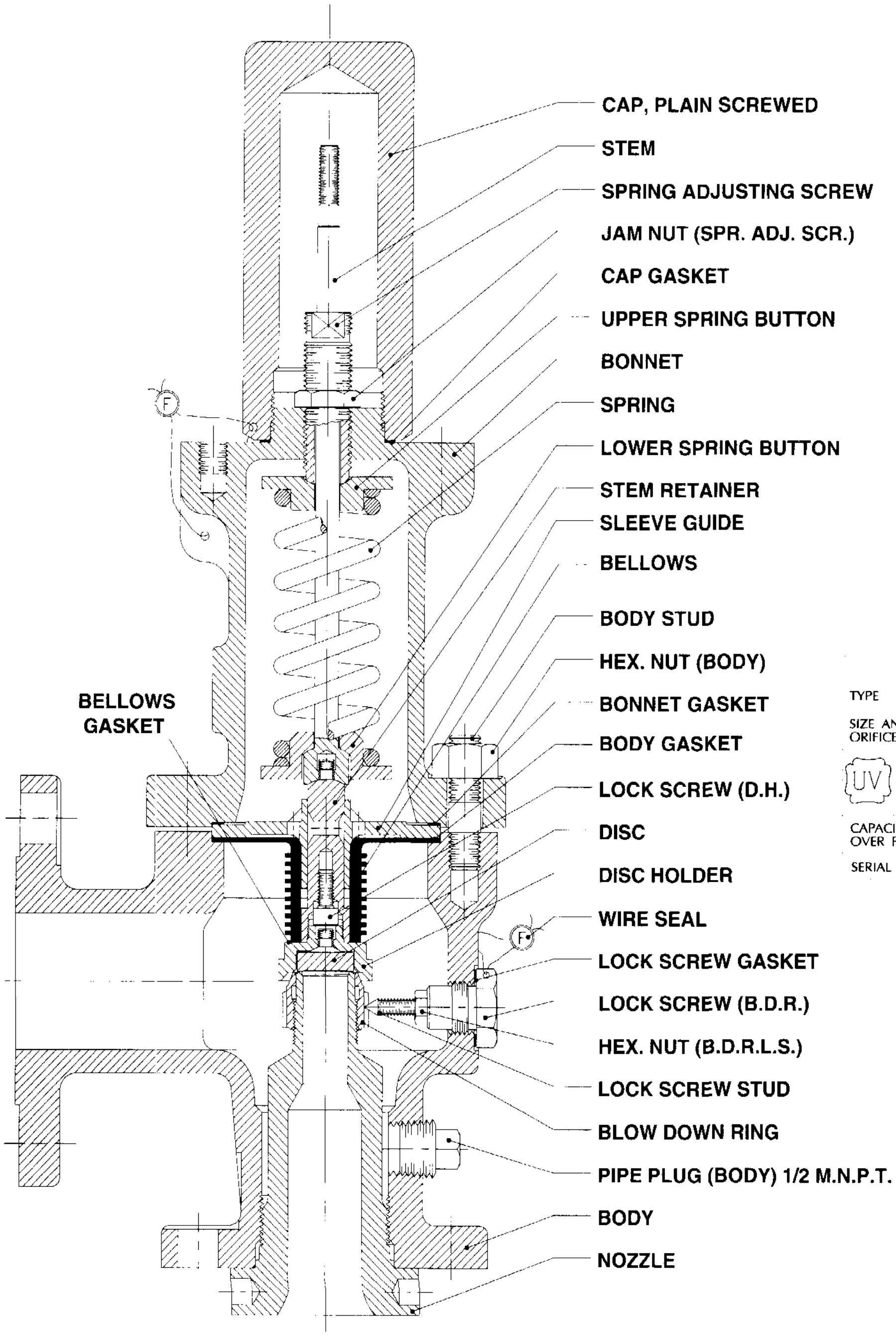

Figure 1.3

Figure 1.1

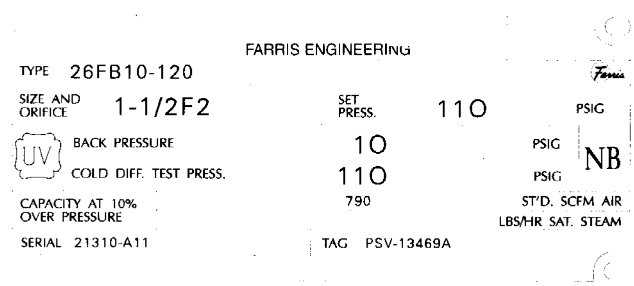

Figure 1.2

Notes: Figure 1.1 Only BalanSeal® bellows equipped valves are supplied with this identifying plate. The maximum backpressure figure indicated thereon is a design rating and in actual usage the backpressure should not exceed 80% of the valve set pressure as applicable for the particular model.

Figure 1.2 The nameplate illustrated is typical and may contain more or less information depending on the actual valve model supplied.

Figure 1.3 The BalanSeal® safety valve cross-section illustrated is typical and actual construction details will vary depending on valve size and pressure rating. Consult the other illustrations contained elsewhere in this manual for greater detail or consult the factory for a cross-section drawing for the actual valve size and pressure rating.

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INTERNALS FOR A10/A11 & A14/A15 SERIES

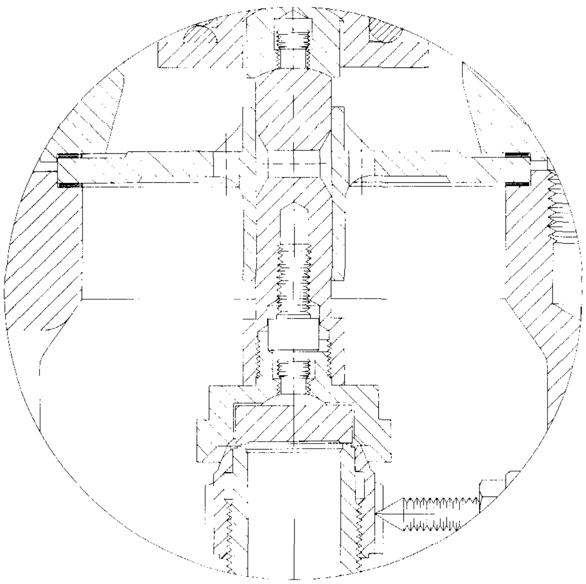

Figure 1.4

Internals for Orifice D–J

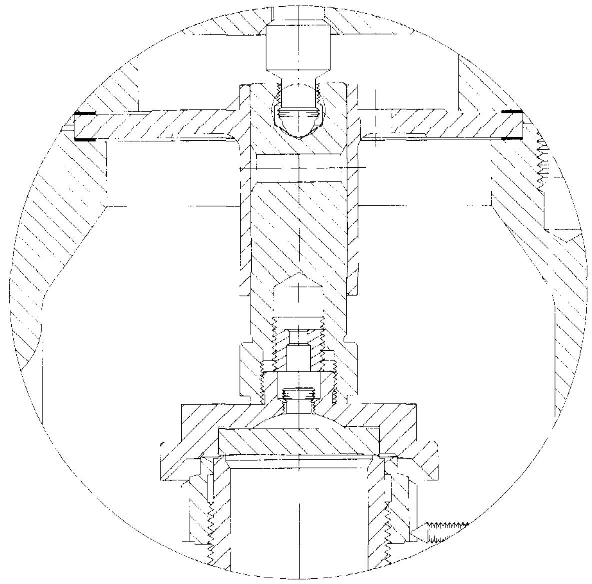

Figure 1.5

Internals for Orifice K–P

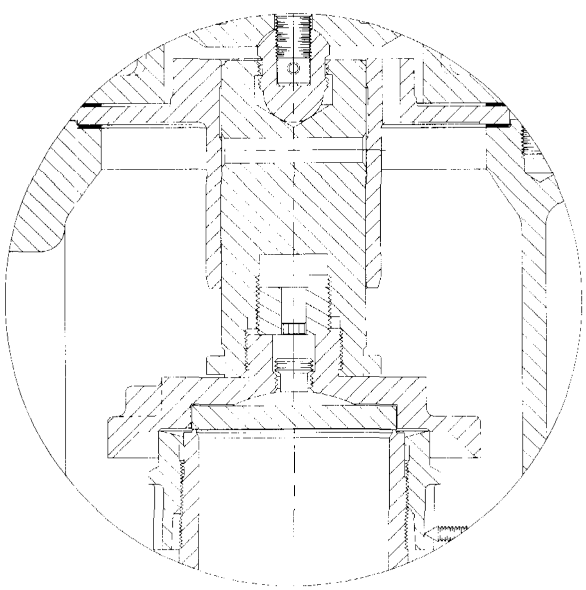

Figure 1.6

Internals for Orifice Q–T

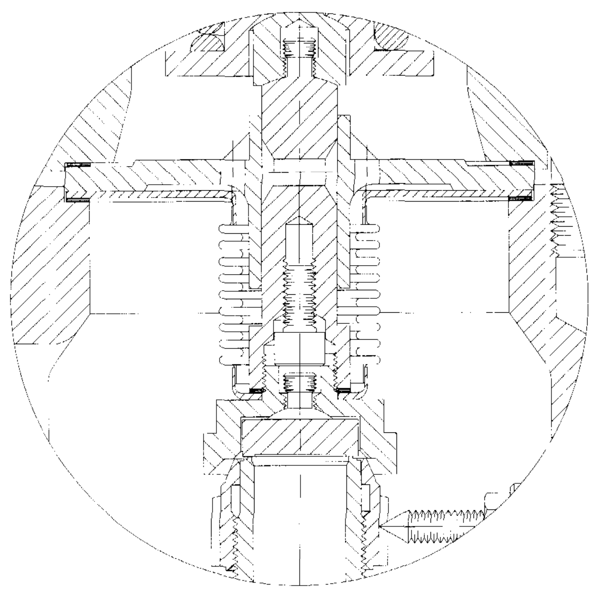

Figure 1.7

BalanSeal® Bellows Safety Valve

GENERAL DISASSEMBLY OF VALVES

After the valve is received and checked it is ready for shop inspection and repair. The valve should be carefully dismantled. If you are unfamiliar with this line of Farris valves carefully study the cross-sectional drawings in Figures 1.3 through 1.7 to familiarize yourself with part terminology and location. Proper facilities should be available for segregating parts as the valve is dismantled. At each stage in the dismantling process all parts of the valve should be visually inspected for evidence of wear and corrosion. If parts are worn, replace them. See Appendix A for necessary tools.

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BILL OF MATERIALS

Conventional (A10)			BalanSeal® (A11)	
PART NAME		MATERIAL	VALVE TYPE	MATERIAL
Body	26( )A10 thru 26( )A26	SA-216 GR.WCB. Carbon Steel	26( )B10 thru 26( )B26	SA-216 GR.WCB. Carbon Steel
	26( )A32 thru 26( )A36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2Moly)	26( )B32 thru 26( )B36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2Moly)
Bonnet	26( )A10 thru 26( )A26	SA-216 GR.WCB. Carbon Steel	26( )B10 thru 26( )B26	SA-216 GR.WCB. Carbon Steel
	26( )A32 thru 26( )A36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2 Moly)	26( )B32 thru 26( )B36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2Moly)
Cap. Plain Screwed		Carbon Steel		Carbon Steel
Disc		Stainless Steel		Stainless Steel
Nozzle		316 Stainless Steel		316 Stainless Steel
Disc Holder		316 Stainless Steel		316 Stainless Steel
Blow Down Ring		300 Series Stainless Steel		300 Series Stainless Steel
Sleeve Guide		300 Series Stainless Steel		300 Series Stainless Steel
Stem		Stainless Steel		Stainless Steel
Spring Adjusting Screw		Stainless Steel		Stainless Steel
Jam Nut (Spr. Adj, Scr.)		Stainless Steel		Stainless Steel
Lock Screw (B.D.R.)		Stainless Steel		Stainless Steel
Lock Screw Stud		Stainless Steel		Stainless Steel
Stem Retainer		Stainless Steel		Stainless Steel
Bellows		N/A		Inconel Composite
Bellows Gasket		N/A		Flexible Graphite
Spring Button		Carbon Steel, Rust Proofed		Carbon Steel, Rust Proofed
Body Stud		ASTM A193 Gr. B7, Alloy Steel		ASTM A193 Gr. B7, Alloy Steel
Hex Nut (Body)		ASTM A194 Gr. 2H, Alloy Steel		ASTM A194 Gr. 2H, Alloy Steel
Spring	26( )A10 thru 26( )A26	Chrome Alloy, Rust Proofed	26( )B10 thru 26( )B26	Chrome Alloy, Rust Proofed
	26( )A32 thru 26( )A36	High Temp. Alloy Rust Proofed	26( )B32 thru 26( )B36	High Temp. Alloy Rust Proofed
Gasket, Cap		316 St. St.		316 St. St.
Gasket, Body		316 St. St.		316 St. St.
Gasket, Bonnet		316 St. St.		316 St. St.
Gasket, Lock Screw		316 St. St.		316 St. St.
Hex Nut (B.D.R.L.S.)		Stainless Steel		Stainless Steel
Lock Screw (D.H.)		Stainless Steel		Stainless Steel
Pipe Plug (Bonnet)		Steel		N/A
Pipe Plug (Body)		Steel		Steel

Table 1.1

General Notes:

1. Parenthesis in type number indicates orifice designation, as 26FA10, for conventional and 26FB10 for BalanSeal® bellows design.
2. Materials listed are for general purpose valves. For materials used in specific applications such as high or low temperatures, for open and packed lever valve materials, please refer to a current sales catalog.

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2. INSTALLATION, STORAGE, & HANDLING

Installation guidelines are provided in Technical Bulletin 286T available free on request from your Farris Engineering Representative or the factory. A more thorough discussion of installation can be found in this bulletin.

Installation is the keynote of any successful valve operation. Maintain cleanliness in all installation work. Pipelines, connecting flanges and connecting spools should be carefully cleaned. At all cost, avoid foreign material which might lodge between the disc and seat, such as loose pieces of gasketing material, pipe turnings, dirt, rust, etc.. Pipelines should be blown out to clean the lines on both the inlet and outlet sides of the valve. Failure to do so may cause seat leakage. Tighten all bolts evenly. Prevent strain on the valve body and outlet flanges by supporting the discharge piping. Mount the valve in a vertical position with the inlet down and keep inlet and discharge piping as short as possible. Never use inlet or outlet piping of sizes less than the size of the valve connection. Where direct connection of the pressure relief valve to its pressure source or point of discharge is not possible then pipe sizes larger than the nominal connections on the pressure relief valve may be necessary to minimize the inlet pressure drop or the back pressure build-up. A 1/2" NPT drain connection is provided on all 2600 Series A10/A11 valve bodies and is fitted with a pipe plug as shipped from the factory. The pipe plug should be removed and a drain pipe fitted, otherwise discharge piping should be self draining.

Because cleanliness is essential for the satisfactory operation and tightness of a pressure relief valve, all necessary precautions should be taken to keep out all foreign materials. Valves which are not installed soon after receipt should be closed off properly at both inlet and outlet flanges. Particular care should be taken to keep the valve inlet and internals absolutely clean. Preferably, valves should be stored indoors or in location where dirt and other forms of contamination are at a minimum. Valves should be handled carefully and not subjected to heavy shocks. If due consideration is not given to this point, some internal damage or misalignment can result and seat tightness may be adversely affected. Store, transport and install valves with the stem in the vertical position.

After the pressure relief valve is removed from the installation it should be transported to the shop for inspection, testing, maintenance, and resetting. Careful handling in transit is important, as rough handling can change the pressure setting or deform the pressure relief valve parts so they cannot be set or function properly. Flanges on the piping and flange faces on the valve should be protected so that gasket faces are not damaged. Large valves should be handled with suitable rigging equipment to avoid dropping or rough handling. Pressure relief devices should not be stocked in a careless manner and, where practical, they should be segregated and not stored with heavy pipe fittings or other types of valves. Pressure relief valves should be treated as delicate instruments because their accurate functioning is very important to safe plant operation.

MAINTENANCE AND INSPECTION

After a manufacturer or one of their authorized assemblers has delivered a valve that meets all the requirements of ASME Section VIII or other construction code, a continuity of this level of integrity and safety should be maintained. In practice, a repaired pressure relief valve (including one that has been only cleaned or readjusted) is called upon to provide the same degree of protection

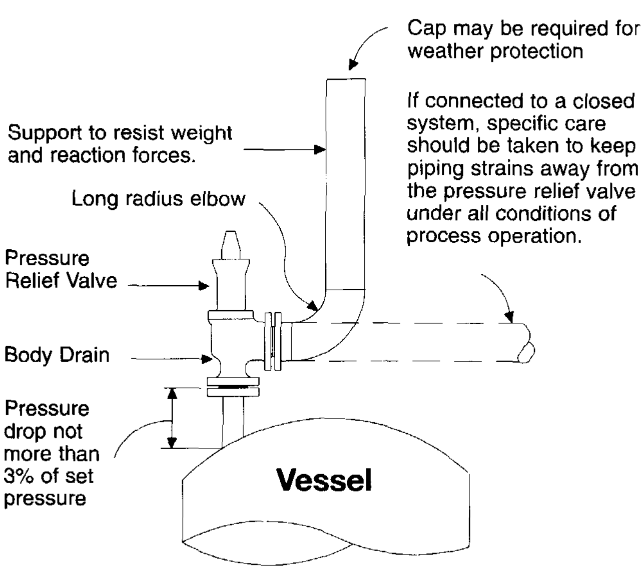

Figure 2.1

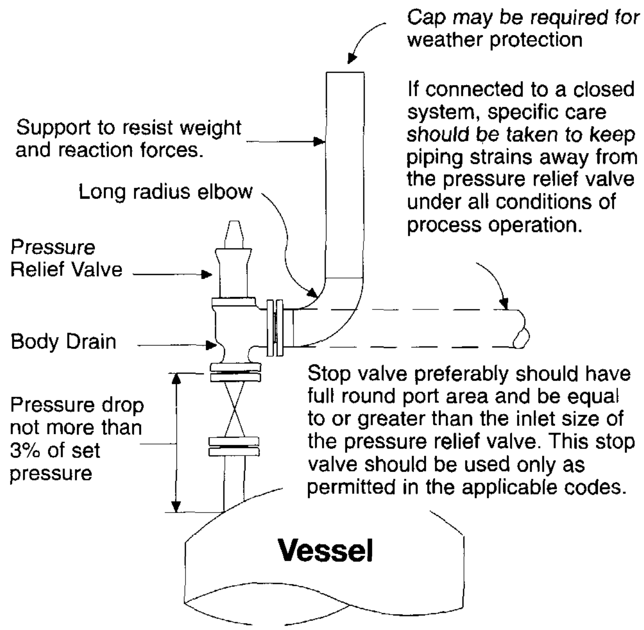

Figure 2.2

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as a new valve. It follows that maintenance personnel must be trained to a level of proficiency that enables them to restore a valve to original condition and function. Complete individual hands-on training by Farris Engineering is recommended to maintain warranties and becomes most effective when monitored and coordinated by the owner/user and conducted at the users repair facility or at a Farris factory. The company also supports the prerequisite training activities promoted by jurisdictions, and the National Board of Boiler and Pressure Vessel Inspectors. It is recommended that historical records be established and maintained including brief test reports. This will provide data to determine the frequency of inspection and repair for various services. One excellent publication for reference on pressure relieving devices is the American Petroleum Institute's Guide for Inspection of Refinery Equipment, Chapter XVI. The use of original manufacturer's replacement parts is necessary to maintain new valve performance, capacity flow and warranty. Teledyne Fluid Systems expressly voids its warranty and will not be responsible for faulty valve operation if non-factory replacement parts or methods are utilized in product repair.

FIELD REMOVAL

A visual inspection of pressure relief valves should be made when the valves are first removed from the system. Many types of deposits or corrosive debris may be loose and drop out from the pressure relief valve while it is being transported to the shop. When fouling is a frequent problem, it may be desirable to collect samples for further testing and to make notes regarding deposit location and appearance. Any obstructions in the valve should be noted and corrected.

Inspection of Inlet and Outlet Piping

When a pressure relief valve is removed from service, the upstream and downstream piping is often open and available for inspection. However, where it is the practice to remove pressure relief devices from equipment during operation by closing block valves, it is usually not possible to make a complete inspection of piping. Such inspection should be made when the operation equipment is out of service. Inspection of the piping at the pressure relief valve will often indicate the condition of other process piping which is not readily available for inspection. Piping should be checked for corrosion, indications of thinning and deposits which may interfere with valve operation. The character of the deposits may supply clues regarding leakage from the pressure relief valve in a closed system.

In-Situ Testing

In-situ or in place testing is frequently performed as a substitute for valve removal and in-shop testing. This should not be considered as equivalent to shop maintenance, however, it may be employed under controlled situations to extend the shop service frequency of particular valves. The most common method of in-situ testing employs an external power source applied to the valve to determine the valve set pressure at some lower system pressure. While this method can accurately determine the valve set pressure, valve reseat pressure cannot be determined using the method. Care must be exercised with this method to avoid possible valve damage that may go undetected during the in-situ test.

In-Shop Inspection

When a valve is first received in the shop it should be given a visual inspection to note its condition when removed from service. The results of this inspection should be noted on appropriate forms. It is generally considered <u>important</u> to determine the set pressure of the valve when removed from service and prior to the valve being disassembled. If the valve opens at the set pressure, the valve need not be tested further to determine the as-received relieving pressure. If the initial pop is higher than the set pressure, it is advisable to test a second time. If the valve then pops at approximately the set pressure, this indicates that the valve was probably stuck because of deposits. If the valve does not pop near the set pressure, this indicates that the valve setting was either in error originally or may have been changed during operation.

Valves which are found acceptable upon shop pre-test cannot be returned to service with a National Board "VR" stamp being applied unless they are completely disassembled and complete repairs are undertaken. Some maintenance programs may however authorize valves found acceptable on shop pretest to be returned to service based on historical records, tear-down cycles and all seals and valve identifications remaining intact.

Preparation For Maintenance

Before valve teardown is performed a review of previous maintenance records will assist in an understanding of past valve performance, settings and maintenance requirements. A complete maintenance records management system will allow proper stocking of common replacement items such as gaskets and seals and adequate stocking of major replacement parts such as nozzles, discs, and springs. Maintenance records, when properly updated, can serve to identify the need for ordering spare parts when valve servicing shows that the useful life of a particular part has been reached. Rematching details and installation of new parts should be recorded to aid future service activities.

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3. DISASSEMBLY OF VALVES

GENERAL DISASSEMBLY OF VALVES

After the valve is received and checked it is ready for shop inspection and repair. The valve should be carefully dismantled. If you are unfamiliar with this line of Farris valves carefully study the cross-sectional drawings in Figures 1.3 through 1.7 of Chapter 1, to familiarize yourself with part terminology and location. Proper facilities should be available for segregating parts as the valve is dismantled. At each stage in the dismantling process all parts of the valve should be visually inspected for evidence of wear and corrosion. If parts are worn, replace them. See Appendix A for necessary tools.

CLEANING AND CHECKING OF PARTS

All parts should be properly marked and segregated by individual valve. At this point, the valve parts should be thoroughly cleaned and inspected. Cleaning methods should be carefully selected to avoid part damage. Abrasive blasting of ground surfaces can alter the factory supplied finish. Threads can also be damaged by excessive blasting or shot cleaning. These surfaces should be protected during such cleaning processes.

The following discussion on parts inspection will precede the detailed valve disassembly. However, detailed inspection should be given separate attention to assure that only serviceable parts are used. This inspection should be completed after the proper parts cleaning.

The following general points will provide a brief checklist to follow during assembly. Detailed discussion will follow for specific critical parts.

- Presence of Wire Seal at all points of adjustment.
- Complete and properly identified nameplates and tags.
- Condition of flanges; for evidence of pitting, roughening, deterioration of gasket surface, distortion, etc.
- Springs, for evidence of corrosion or cracking, and correct selection.
- Bellows (if the valve is of bellows type).
- O-Ring condition (if applicable).
- Inlet and outlet openings, for evidence of deposits of foreign material and for corrosion.
- Condition of the external surfaces; for any indication of corrosion or evidence of mechanical damage.
- Body, nozzle, and bonnet wall thickness, thread and stud condition.
- Valve components and material; to check against identification tag and specification card.

NOZZLE AND DISC

The nozzle and disc require the greatest inspection of all the critical parts. Inspect for the following:

1. Nozzle length and disc thickness. It is important to replace the nozzle and/or disc when they are below the minimum length or thickness. Failure to do so may cause part failure or faulty valve operation due to the change in the critical parts respective relationship.
2. Seating surfaces should conform to the manufacturer's dimensions and profile. Normal lapping will alter these dimensions and profiles. Machining or refacing of the seat surfaces should be in accordance with the original manufacturer's specifications. Any refacing should be followed by a confirmation that the minimum nozzle length and disc thickness are within specification.

Since the nozzle and disc contain the primary or inlet pressure of the protected system these parts should be checked for any cracks or other detrimental material conditions. Corrosion and service stresses induce cracking which must be found during valve repair. Applicable NDE procedures should be employed to detect these conditions. When the set pressure is changed substantially, consideration should be given to hydrostatically test these components at the new pressure conditions.

SLEEVE GUIDE AND STEM RETAINER

The sleeve guide and stem retainer make up an important part of the guiding for the valve. Their mating surfaces are machined to close tolerances. The outside of the stem retainer and the inside barrel of the sleeve guide should be closely examined for any sign of galling or scoring. The stem retainer should move freely within the barrel of the sleeve guide. The drainage holes in the sleeve guide flange should be clear and open.

SPRING

Springs are always stressed once the valve is set. Large orifice or high set pressure valves will have higher stressed springs. Surface corrosion or surface defects can quickly cause stress concentration points.

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These conditions can lead to corrosion failure or load loss capacity. Springs should be adequately examined for such defects and even minor defects should be cause for considering spring replacement. NDE processes should be employed for spring examination as visual examination alone may not be sufficient to adequately accept springs for further service.

It is common for springs to be blasted clean however the remaining surface will readily allow corrosion to take hold. Spring surfaces should be painted or coated after cleaning and inspection to retard any further deterioration.

Spring identification during repair is important. Small springs may not contain any permanent marking thus making record keeping vital to retain spring integrity.

BELLOWS

Bellows require very thin materials to provide the required flexibility. This results in a delicate assembly which should be carefully handled. Do not attempt to repair a bellows assembly and cleaning should be limited to solvent methods. Any pitting or surface corrosion are sure signs of limited service life even though the bellows may be pressure tight. All bellows assemblies should be pressure tested in accordance with Figure 3.0. Any leakage should be cause for bellows replacement.

BELLOWS ASSEMBLY LEAK TESTING

1. Place bellows/stem retainer/disc holder assembly into bellows leak test fixture with the bellows flange at the base.
2. Seal the flange of the bellows to the base of the bellows test fixture as illustrated in Figure 3.0 below.
3. Compress the bellows approximately 1/8 inch with a securing bar so that the bellows does not elongate when pressure is applied as in Figure 3.0.
4. Fill the disc holder with water. Omit this step for D & E Balanseal® designs as these designs have a one piece disc holder/stem retainer.
5. Apply 30 psig pressure to the bellows.
6. Apply soapy water to bellows exterior to check for bellows integrity.
7. If bubbles appear on bellows exterior there are pin holes or a tear. Replace bellows and repeat the procedure.
8. Check to be sure the bellows/disc holder connection is leak tight. If water in disc holder bubbles or the connection bubbles, tighten the connection or replace gasket.
9. Vent pressure.
10. Release bellows assembly.
11. Air dry bellows assembly to remove soapy water.

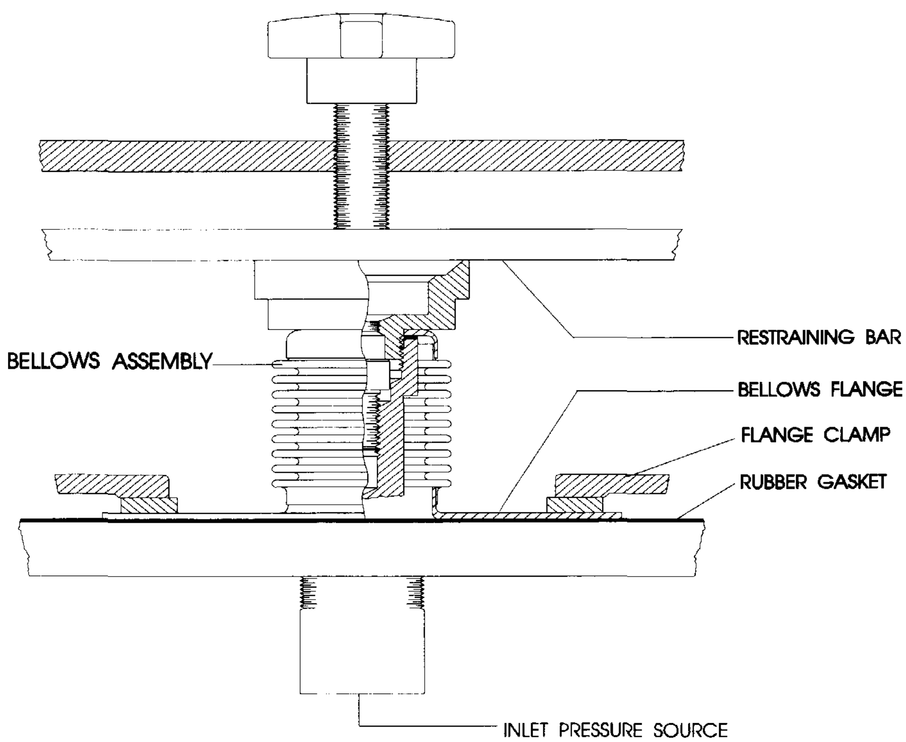

Figure 3.0

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STEM

The stem transmits the spring load to the stem retainer. This load must be transmitted axially otherwise a side load will exist which will cause binding. Over-gagging is a common cause for bent stems. The stem is also integral to any lifting gear. Abuse of the lifting gear may result in stem damage. Check the bearing point on the stem tip for a smooth surface. Lap if necessary against the mating part to improve the surface. However excessive lapping will destroy the spherical contact. At this point replace the stem.

To check the critical stem areas for eccentricity use the following procedures; Take Vee Blocks of bench rollers and check the stem at the mid point and also at the lower spring button radius for any eccentricity. By applying a machinist's dial indicator and rotating the stem the total indicator reading should not exceed .007". Straighten if necessary. (Figure 3.1)

The top area of the stem (A) just below the thread serves as the valve internals upper guide surface in conjunction with the spring adjusting screw. This area should be free from any signs of galling or pitting. This area is supplied from the factory with a 63 AARH finish.

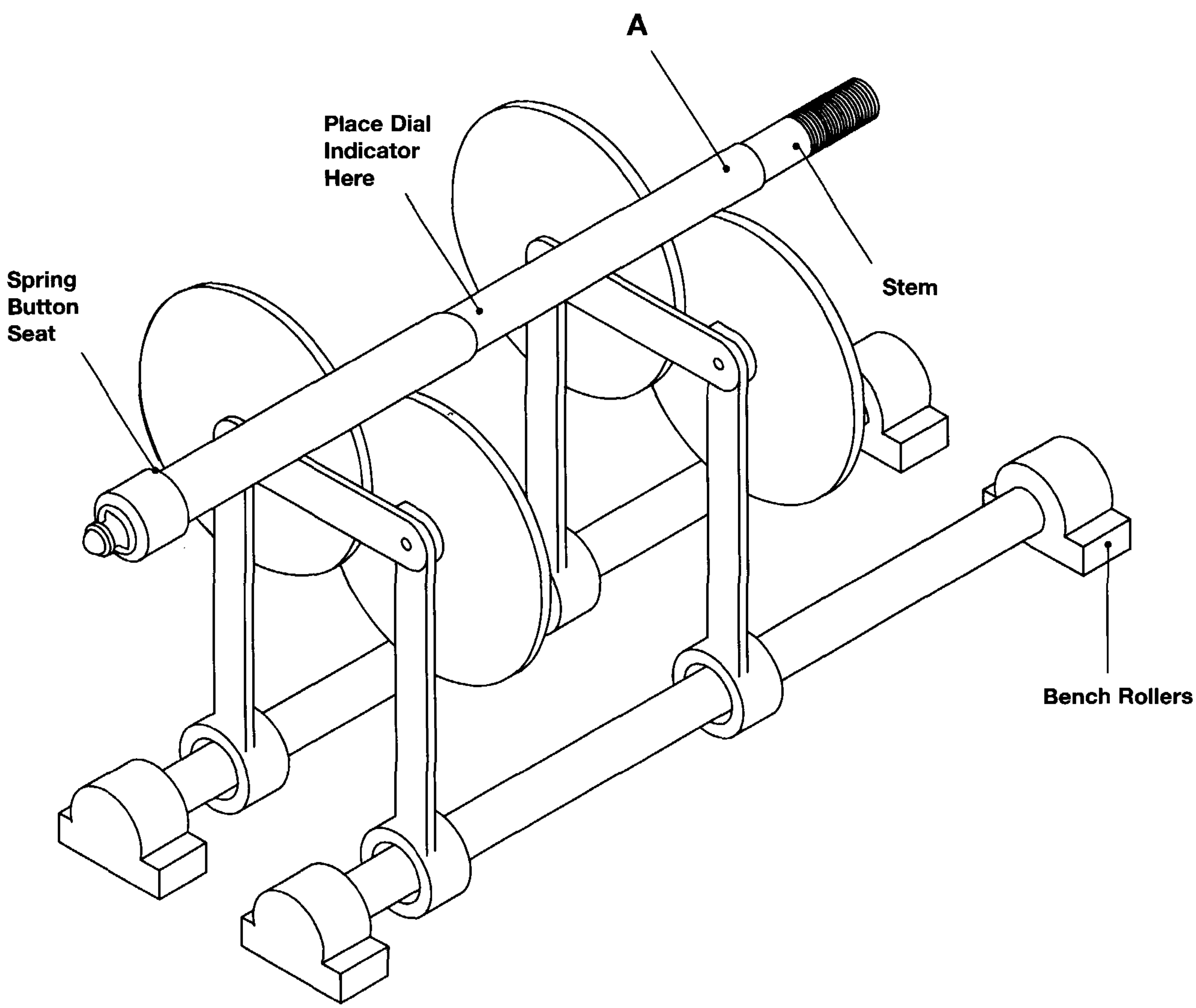

Figure 3.1

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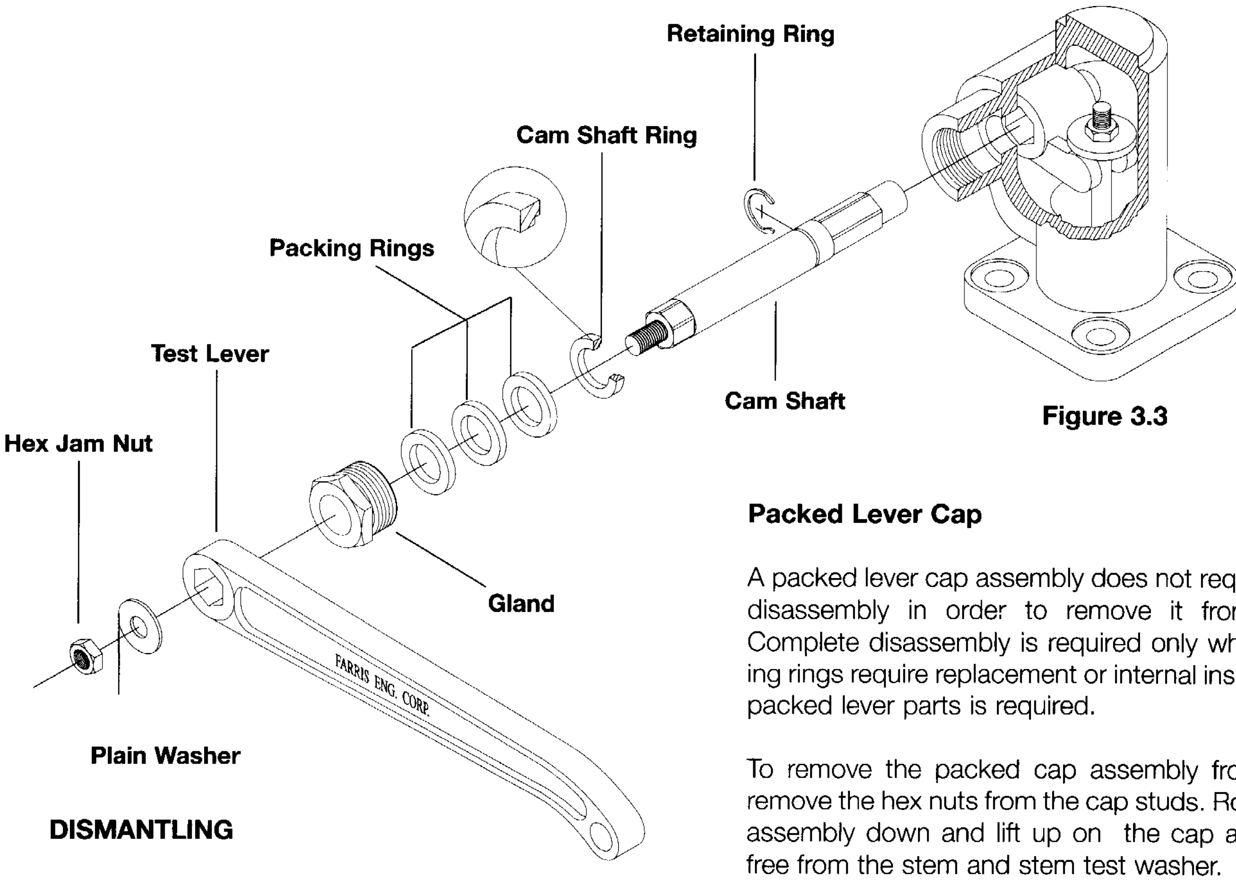


Figure 3.3

DISMANTLING

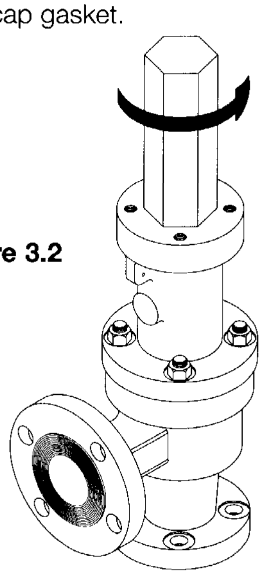
Place the internal assembly at a suitable work height. The work surface should be clean and strong enough the handle the weight of the parts and the forces required during disassembly and assembly.

When dismantling valves with lifting gear, record the position of the lever relative to the outlet as some installation positions may require a nonstandard lever position

Plain Cap

Unscrew the cap from the valve (see Figure 3.2). Remove the cap gasket.

Figure 3.2



Packed Lever Cap

A packed lever cap assembly does not require complete disassembly in order to remove it from the valve. Complete disassembly is required only when the packing rings require replacement or internal inspection of the packed lever parts is required.

To remove the packed cap assembly from the valve, remove the hex nuts from the cap studs. Rotate the lever assembly down and lift up on the cap assembly until free from the stem and stem test washer.

To disassemble the packed cap lever assembly, (Figure 3.3), remove the hex jam nut, plain washer and test lever from the camshaft. Remove the gland nut. Considerable force is required to remove the camshaft and packing rings from the cam as the packing rings will have been compressed into place. Place a short 1/2" drive socket over the end of the camshaft and using a standard hex nut and plain washer tighten the hex nut to exert a pulling force on the camshaft and packing ring assembly. Continue until the camshaft and packing rings have been freed from the cap housing.

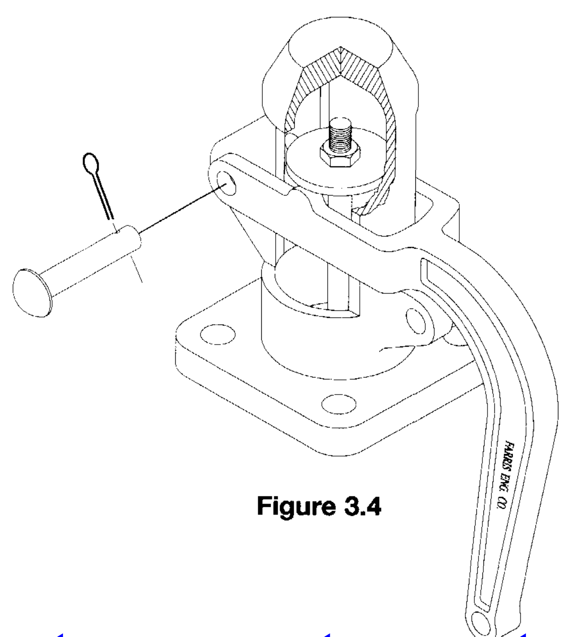


Figure 3.4

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OPEN LEVER CAP ASSEMBLIES

Open lever caps may be classified as single or double acting. Double acting levers use a fork and two fulcrum points for increased lifting advantage. This type of open lever is found on larger orifice valves as well as high pressure models.

Open Lever-Single Acting

Remove the cotter pin from the rivet holding the test lever. Remove the rivet and lever. Remove the cap bolts and lift off the cap. Remove the stem jam nut and stem test nut from the end of the stem (Figure 3.4).

Open Lever-Double Acting

Remove the cotter pins from the test lever and test lever fork. Remove both rivets, test lever and test lever fork. Remove cap studs and lift off the cap. Remove the stem jam nut and stem test nut from the stem (Figure 3.5).

VALVE DISASSEMBLY

Remove the lock screw assembly (Figure 3.6). Count the number of notches the blowdown ring is from contacting the disk holder. Measure location of spring adjusting screw by marking spring adjusting screw above jam nut before loosening the jam nut (Figure 3.7), or by counting the number of counter clockwise revolutions of the spring adjusting screw until the spring is no longer compressed. This will allow the approximate set pressure to be re-established when reassembling the valve. Once the data are recorded, remove the jam nut and spring adjusting screw. Recording the spring adjusting screw position and blowdown ring position will save time in the reassembly of the valve.

Remove the body hex nuts **(first ensure that the spring is not compressed)** and remove the bonnet. On larger valves the combination of bonnet weight and the height that it must be lifted to clear the stem requires that a hoist be used to remove the bonnet. During this

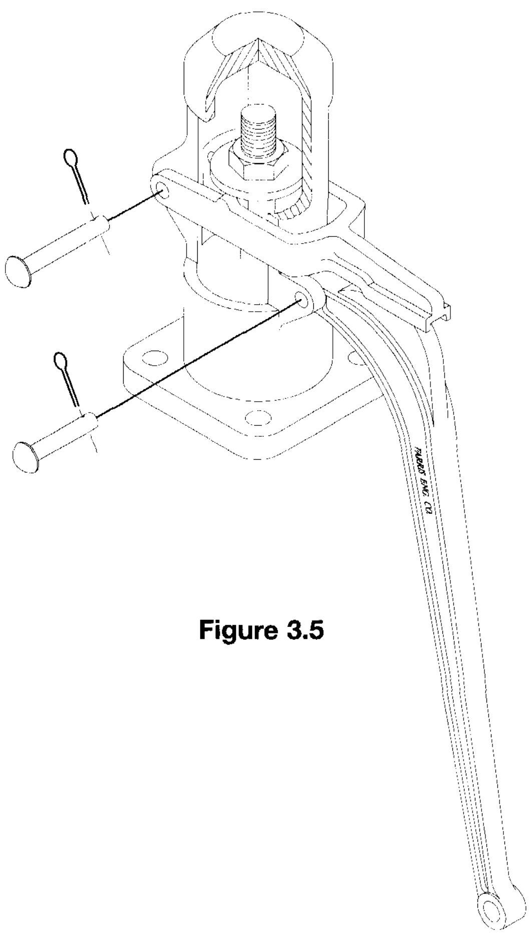

Figure 3.5

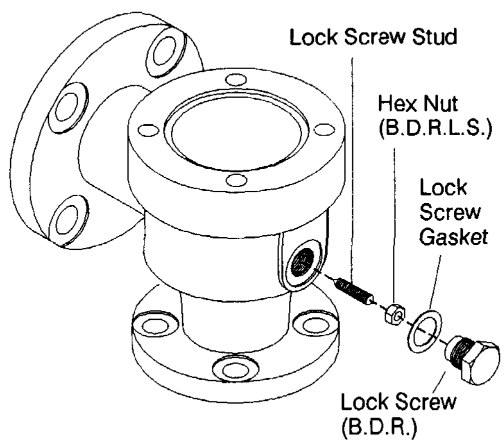

Figure 3.6

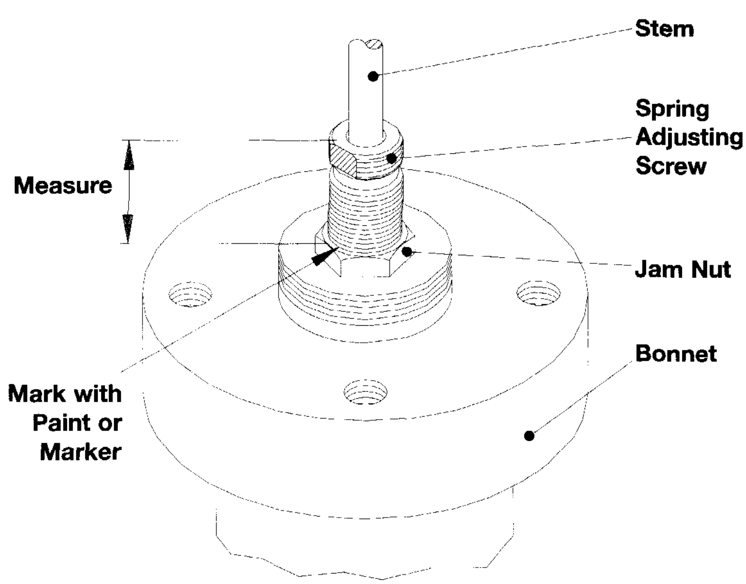

Figure 3.7

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operation the valve body should be secure to prevent it from tipping over once the bonnet is removed. The weight of the spring assembly at an angle to the rest of the valve will be sufficient to cause the valve to tip over. Record the position of the bonnet drain relative to the valve outlet. Remove spring assembly from the stem (spring and spring buttons) and bonnet gasket (Figure 3.8)

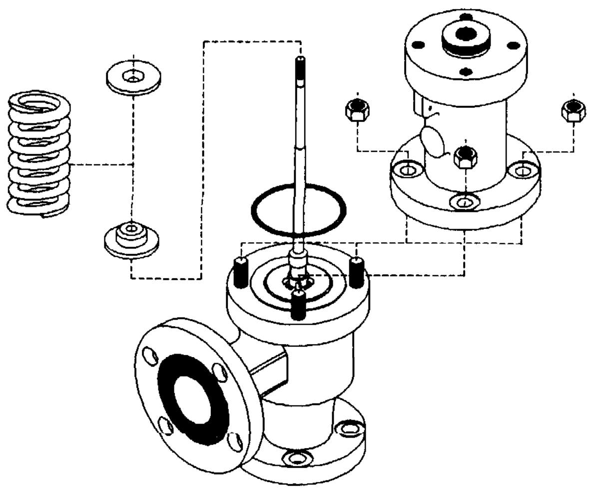

Figure 3.8

Using stem as a handle lift the complete internal assembly from the body. On larger valves a hoist is advisable due to the weight of the internal assembly. An eye bolt may be attached to the stem test washer thread at the end of the stem to assist in lifting. Remove body gasket (Figure 3.9).

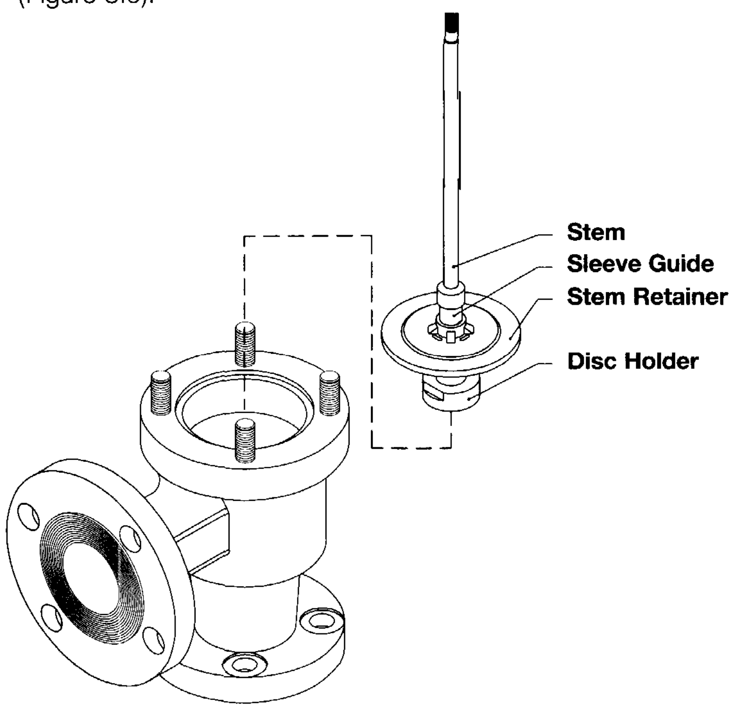

Figure 3.9

To remove the stem from the stem retainer, lift up on the stem and rotate counter-clockwise at the same time. This will engage the thread. Continue rotating until the stem is removed (Figure 3.10).

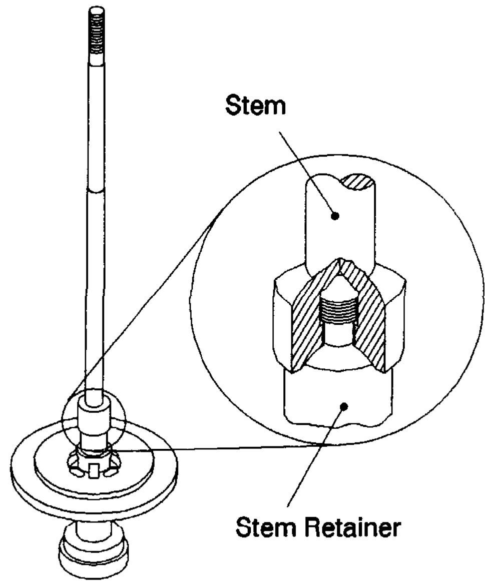

Figure 3.10

Lift off the sleeve guide (Figure 3.11) and place it such that it cannot fall or roll.

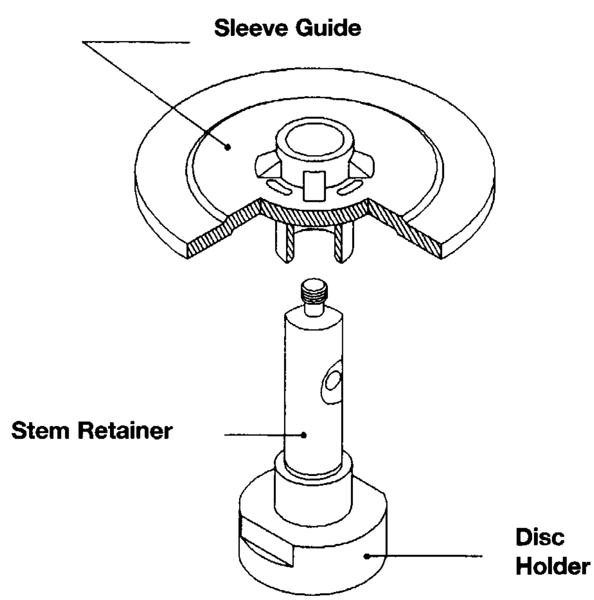

Figure 3.11

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Remove the disc from the disc holder (Figure 3.12). Hold assembly and rotate disc with tip of finger. For O-Ring seat type valves, refer to Figure 3.15 and 3.16 (page 16).

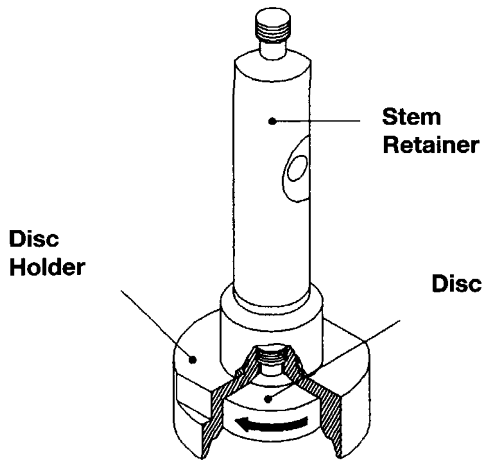

Figure 3.12

Except for the D& E orifice bellows (A11) designs (which have a one piece stem retainer/disc holder) the stem retainer and disc holder are held together with a "disc holder lock screw". The disc holder lock screw has a hex socket requiring use of an allen key (Figure 3.14). Locking tension is relieved by threading the lock screw UP INTO the stem retainer. To separate the two parts first thread the lock screw up into the stem retainer using the fixture shown in Figure 3.13 to hold the assembly. Allen key wrench sizes are shown in Table 3.1. **DO NOT USE A VISE OR ANY METHOD THAT MIGHT MAR THE GUIDING SURFACE OF THE STEM RETAINER.**

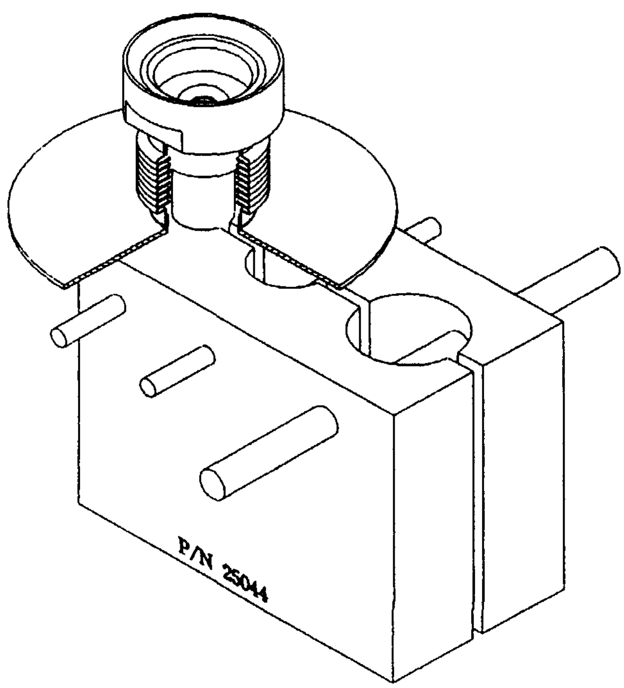

Figure 3.13

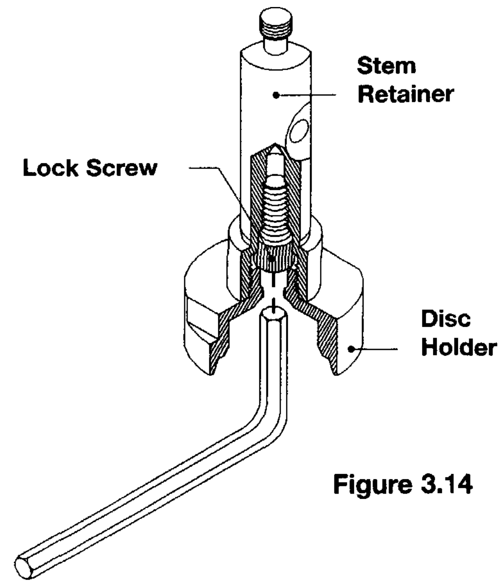

Figure 3.14

ALLEN KEY SIZES	
DISC HOLDER LOCK SCREW	
ORIFICES	ALLEN KEY SIZE
D THRU J	3/16"
K THRU P	7/32"
Q THRU T	3/8"

Table 3.1

For Balanseal bellows equipped valves use the same fixture shown in Figure 3.13. Exercise care in handling the internal assembly when equipped with a bellows as any damage to the bellows in the form of a nick or dent will render the bellows unfit for service. Bellows are not repairable.

To finish the disassembly of the entire valve take the blowdown ring lock screw assembly and remove the hex nut from the lock screw stud. Remove the lock screw stud from the lock screw thus separating all parts in the assembly. (See Figure 3.15).

Next remove the blowdown ring from the nozzle and remove the nozzle by unscrewing it from the body. Be careful not to damage the seat while removing the nozzle.

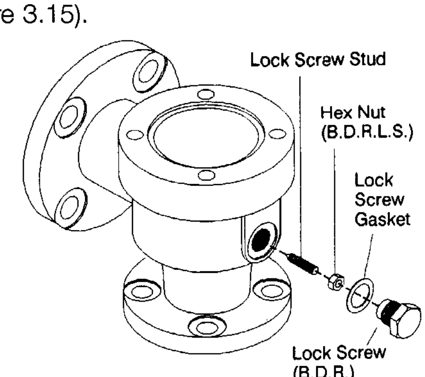

Figure 3.15

Finally, if the body studs are damaged or corroded and need to be replaced they can be removed by unscrewing them from the valve body. This will complete the disassembly of the valve.

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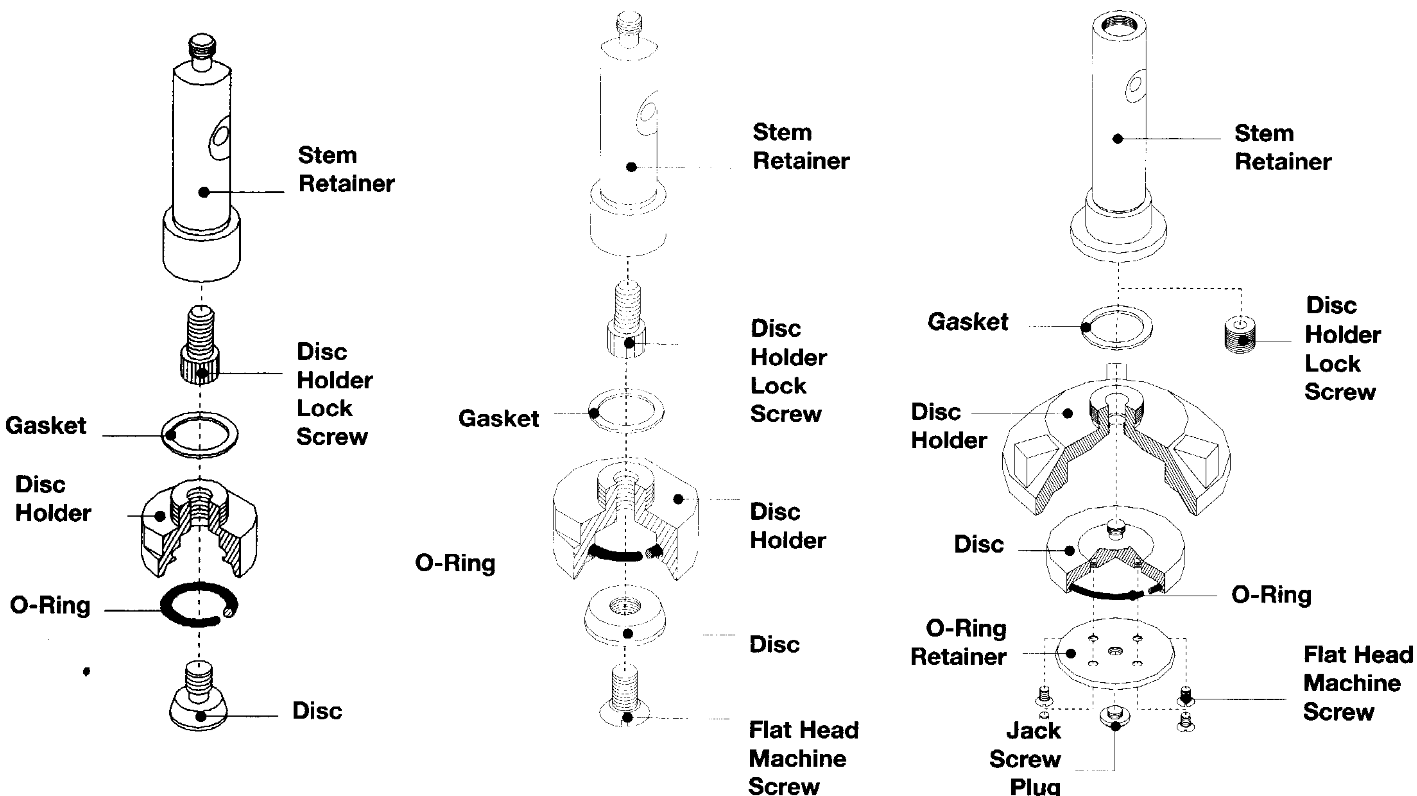
O-RING CONSTRUCTION

Follow the standard disassembly instructions except for the removal of the disc. The following diagrams (Figure 3.16) illustrate 2600 Series Soft Seat design. These illustrations are typical for conventional (A10) construction.

For Balanseal® bellows construction a bellows and gasket(s) are added in all orifices except D and E. For D and E orifice O-ring bellows construction refer to Figure 3.17.

Figure 3.16

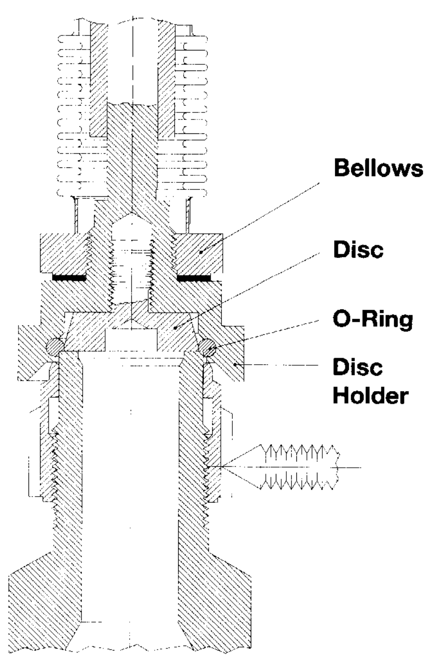


D&E ORIFICES
CONVENTIONAL DESIGN ONLY

F THRU K ORIFICES

L THRU T ORIFICES

Figure 3.17



D&E O-RING SEAT WITH BALANSEAL® BELLOWS

Note that disc holder/stem retainer is a one piece design, for the D & E orifice Balanseal® valves.

To Remove the "O"-ring on D thru K orifice valves first remove the discs and use an "O-ring extractor" to reach into the disc holder and pull the "O"-ring out.

On orifice sizes L and above, first remove the "O"-ring retainer from the disc by removing the outer flat head machine screws. Next remove the Jack screw plug and thread a long screw into the retainer in its place such that it bottoms out on the disc and forces the retainers to separate from the disc. The "O"-ring can then be removed with the aid of an "O"-ring extractor if necessary.

Figure 3.16 is a typical example of this one design found on both the soft & metal seat bellows designs for these orifices.

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4. NOZZLE AND DISC REFACING

Nozzle Refacing

1. Prior to refacing the nozzle seating area, grip the nozzle flange in a universal three-jaw lathe chuck fitted with soft jaws (preferably with removable top jaws), and bored on each set-up to fit the nozzle flange outside diameter.

2. True up the nozzle by means of an indicator, ensuring that the nozzle bore and flange outside diameter are concentric with each other within 0.002" full indicator reading.

3. Machine a light cut across the seat until the damaged areas are removed. The seat should be machined to the smoothest possible finish. Rigidity of the cutting tool is critical.

4. Relap to the required finish.

5. Discard and replace the nozzle when the length from the seat to the flange becomes less than the minimum specified by the manufacturer. Do not reduce the nozzle flange thickness in an attempt to maintain the "L" dimension. The valve center to face dimension will be altered as a result and nozzle strength may be impaired.

Disc Refacing

1. Prior to refacing the disc seating area, grip the disc outside diameter in a universal three-jaw lathe chuck fitted with soft jaws (preferably with removable jaws), and bored on each set-up to the disc outside diameter. Avoid excessive chucking force.

2. True up the disc by means of an indicator, ensuring that the disc outside diameter and seat face are true with each other within 0.002" full indicator reading.

3. Machine light cuts across the seat at 90 deg. to the axis until the damaged areas are removed, facing to the smoothest possible finish. Rigidity of the cutting tool is critical.

4. Relap flat across the full width of the raised seating surface.

5. Discard and replace the disc when the raised seating surface has been depleted.

LAPPING COMPOUNDS

The three grades of Farris Lapping Compounds are prepared especially for the requirements of pressure relief valves. These are the only compounds recommended for achieving extreme valve tightness. These compounds are available in 2 ounce tubes. Use sparingly.

FARRIS LAPPING COMPOUNDS			
PART NO.	**GRADE**	**FINISH**	**SIZE**
18635 (055)	3F	ROUGHING	2 OZ. TUBE
18636 (075)	38-500	MEDIUM	2 OZ. TUBE
18637 (105)	38-1200	FINAL	2 OZ. TUBE

LAPPING PROCEDURES (Manual)

1. Use a cast iron lapping block or Pyrex lapping glass which is known to have a perfectly flat face.

2. Select the appropriate lapping compound. When lapping the disc, operate with a light figure eight motion over entire block surface. In this way complete contact will be made (Figure 4.1).

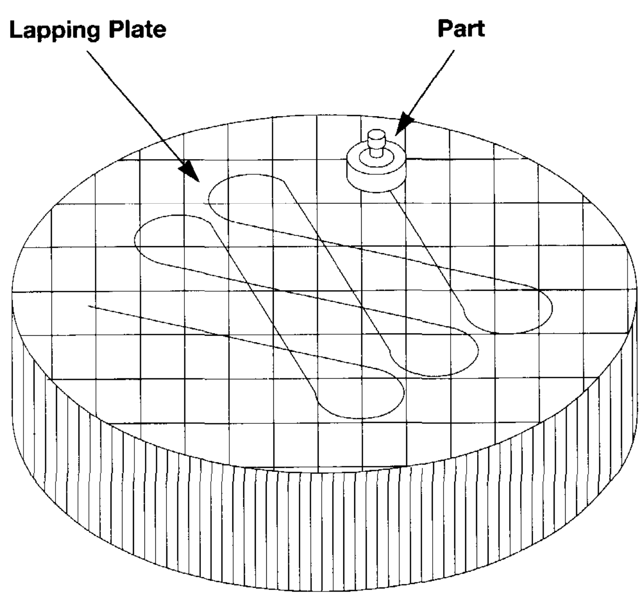

Figure 4.1

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3. Lap the disc until all blemishes and score marks have been removed. As the figure eight motion is executed, frequently lift the disc away from the block to get a fresh bite on the compound. Most important, do not contaminate compounds with with dirt. Store lapping blocks and lapping glass in a clean, dust-free area.

4. Follow the same procedure for lapping the nozzle. When lapping nozzles the nozzle can be placed on a table and a lapping block placed on the nozzle. Be sure that the lapping block does not tip over the side of the nozzle (which would cause rounding of the edges). Use a light, rapid figure eight stroke, lifting the block from the nozzle occasionally.

5. When finished, be sure that all parts are carefully cleaned of all lapping compound using a suitable solvent. Residual compound may damage the seating surfaces during valve operation. When reassembling the parts in the valve be careful not to scratch or score the seating surfaces.

6. If the nozzle or disc is badly scored or pitted a fine machine cut should be made to reface the surfaces following instructions in the refacing section of this manual.

LAPPING PROCEDURES (Machine)

Machine Lapping Instructions

Lapping machines come in a variety of styles. There are limitations to the parts that can be lapped, which may be due to constraints of the lapping machine or the nature of the part to be lapped.

Limitations:

1. The size of the lapping machine.

   Obviously, you will be limited by the size of the lapping plate on the machine. A part that is larger than the lapping plate capacity will have to be hand lapped.

2. The weight of the part to be lapped.

   Some parts will be too heavy to lap on the machine, relative to the area to be lapped. These parts will have to be hand lapped.

3. How well the part can be balanced on the lapping machine.

   Due to geometry and weight distribution of the part, the part may tend to wobble or fall over in the lapping machine. For these types of parts a holding fixture should be designed or the part should be lapped by hand.

General Operation

This is a general procedure for the use of lapping machines. ALWAYS FOLLOW THE MANUFACTURERS OPERATING INSTRUCTIONS.

Thoroughly clean all contaminates from the seat area of the nozzle or disc to be lapped. Place the nozzle or disc seating area on the lapping plate. Turn on the machine and adjust the flow of lapping fluid which should be enough to keep the lapping plate covered with a thin film. The lapping plate should be neither dry nor overly lubricated.

The duration of time that the nozzle or disc should be lapped is dependent on the weight of the part, the hardness of the material, and the area to be lapped. A combination of a heavy part with a small area to be lapped made from a soft material will take the shortest time to lap. A combination of a light part with a large area to be lapped *made from a hard material will take the longest time to lap.*

Once the lapping is complete, remove the nozzle or disc from the lapping plate and remove the lapping fluid with soft tissue and suitable solvent. Protect the seating areas with soft tissue covered by a plastic cap.

LAPPING MACHINE MAINTENANCE AND SEAT INSPECTION

Seat flatness is critical to achieving leak tight seats. As the width of most pressure relief valve seats is quite narrow it is difficult to check seat flatness directly with a monochromatic light. Instead, a standard test block should be kept on the lapping machine that can be periodically checked to determine the condition of the lapping plate. If the test block "reads" flat then all parts lapped on the machine will also be flat. Since the lapped surface needs to be reflective in order to "read" the surface flatness using a monochromatic light source and optical flat, a polishing stand is a needed accessory, Remove the test block from the lapping machine and clean off all lapping fluid. Rub the test block on the polishing stand as if you were hand lapping the test block. Only a few strokes will be necessary to make the surface reflective enough to allow reading the lines produced by the monochromatic light. For full details on how to read these lines and the subsequent adjustments of the machine consult the lapping machine manufacturer.

The quality of the lapped surface produced by the lapping machine can only be as good as the level of maintenance of the machine itself.

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5. 2600 ASSEMBLY PROCEDURE

Lubrication and Sealant:

All threaded parts should be lubricated to prevent galling, especially parts made of similar materials. In addition, guides and pivot points should contain lubricant which is compatible with the service conditions. Sealant should also be applied to prevent fluid from escaping valve boundaries, especially if back pressure is present. The adjacent table lists the suggested lubricant and sealant for air, steam, and liquid service. Service conditions may dictate that other lubricant or sealant be used.

- Only a light film lubricant should be applied to the guiding surfaces. Too much lubricant will hinder valve performance.

- Always use new gaskets and packing when reassembling valves.

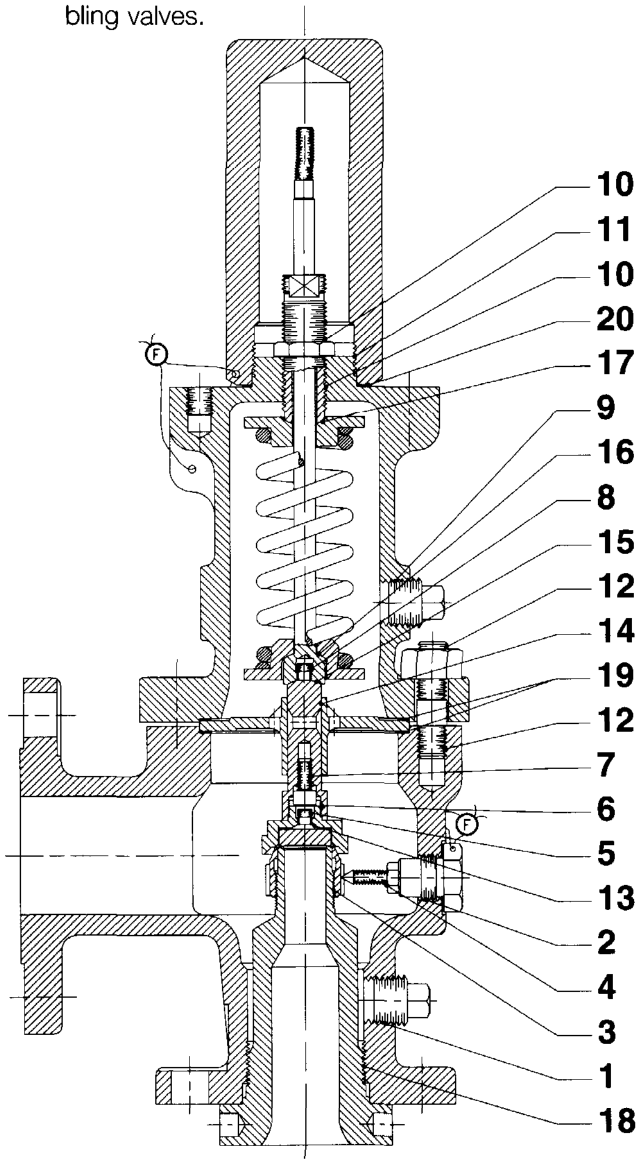

Figure 5.1

ITEM	THREAD LUBRICATION	AIR	STEAM	LIQUID
1	PIPE PLUG/BODY	A	A	A
2	LOCK SCREW (BDR) BODY	A	A	A
3	BLOWDOWN RING/NOZZLE	A	A	A
4	LOCK SCREW STUD/JAM NUT (BDRLS)	A	A	A
5	DISC/DISC HOLDER	A	A	A
6	STEM RETAINER/ DISC HOLDER (IF APPLICABLE)	A	A	A
7	LOCK SCREW (DH)/STEM RETAINER	A	A	A
8	STEM RETAINER/STEM	A	A	A
9	PIPE PLUG/BONNET (IF APPLICABLE)	A	A	A
10	SPRING ADJUSTING SCREW/BONNET/ JAM NUT	A	A	A
11	PLAIN CAP/BONNET (IF APPLICABLE)	A	A	A
12	BODY STUD/BODY/HEX NUT	A	A	A
	GUIDING AND PIVOT LUBRICATION:			
13	DISC/DISC HOLDER	A	A	B
14	SLEEVE GUIDE/STEM RETAINER	D	D	D
15	STEM RETAINER/STEM	A	A	A
16	SPRING BUTTON/STEM	A	A	B
17	SPRING BUTTON/SPRING ADJUSTING SCREW	A	A	B
	SEALANT:			
18	BODY/NOZZLE	A	A	A
19	BODY/BONNET/SLEEVE GUIDE/GASKETS	C	A	C
20	BONNET/GASKET/CAP (IF APPLICABLE)	C	A	C

CODE FOR ABOVE RECOMMENDED LUBRICATION AND SEALANT

A = BOSTIC NEVER SEEZ

B = MOLYKOTE 3452

C = PERMATEX FORM-A-GASKET OR RECTOSEAL #5

D = NO LUBRICATION

* SERVICE CONDITIONS MAY REQUIRE AN ALTERNATE LUBRICANT OR SEALANT

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I. Conventional Construction

1. Thread Nozzle into Body.

2. Thread Pipe Plug (Body) into Body.

3. Thread Blow Down Ring onto Nozzle.

4. Thread Hex Nut (BDRLS) onto Lock Screw Stud. Thread Lock Screw Stud into Lock Screw (BDR).

5. Thread Lock Screw assembly into Body including Lock Screw Gasket. Adjust position of LOCK Screw Stud so that it prevents rotation of the Blow Down Ring yet does not bind the Blow Down Ring. Tighten hex nut to lock screw stud in correct position.

6. Thread Body Studs into Body.

7. Place Body Gasket in Body counterbore.

8. Thread Disc Holder Lock Screw into Stem Retainer.

9. Thread Disc Holder onto Stem Retainer using special assembly block (see Figure 5.2). Do not attempt to hold Stem Retainer on the guiding surface. Thread Disc Holder Lock Screw counter clockwise until contact is made with Disc Holder. Tighten to lock the assembly together.

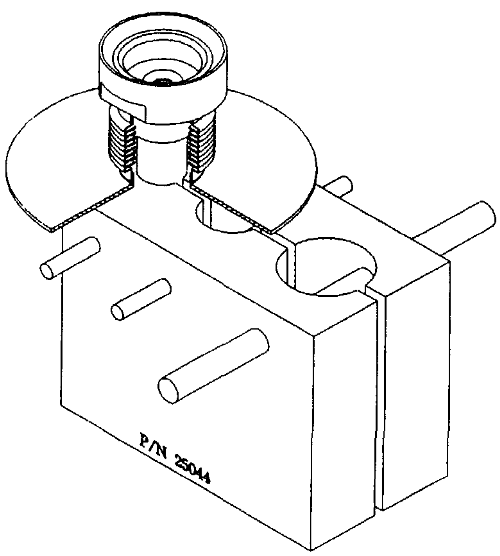

Figure 5.2

10. Thread Disc into Disc Holder. Be sure Disc is free floating.

11. Place Guide over Stem Retainer with long Lift Stop down. Be sure that the guiding motion is smooth with the least resistance possible.

12. Thread Stem and Stem Retainer together. Be sure connection is free floating.

13. Lower Stem, Sleeve Guide, and Disc Holder assembly into Body counterbore.

14. Place Bonnet Gasket on Sleeve Guide, or secure with sealant in Bonnet counterbore.

15. Place Lower Spring Button on Stem (Caution–in some valve sizes the upper and lower buttons are different).

16. Place Spring on Lower Spring Button.

17. Place Upper Spring Button on Spring.

18. Thread Pipe Plug (Bonnet) into Bonnet.

19. Place Bonnet on Body aligning Pipe Plug to the position indicated in disassembly notes. Normal convention is to position Pipe Plug opposite the valve outlet.

20. Thread Hex Nut (Body) onto Body Studs. Be sure that Body and Bonnet Gaskets are properly positioned in the respective counterbores.

21. Thread Jam Nut onto Spring Adjusting Screw.

22. Thread Spring Adjusting Screw into Bonnet to the position indicated in disassembly notes.

23. Valve should now be ready for testing, final assembly and sealing.

II. BalanSeal® Bellows Construction

Follow the same procedure as for Conventional type valves except as follows:

For D and E orifice valves only:

Place Bellows Gasket on Disc Holder. Thread Bellows onto Disc Holder and securely tighten. See Figure 5.3 for bellows leak test.

Do not thread Pipe Plug (Bonnet) into Bonnet (omit step 18). Bonnet must be vented.

For J and K orifice valves only:

Place Gasket on Stem Retainer. Place Bellows on Stem Retainer. Thread Disc Holder to Stem Retainer using special assembly block. Thread Disc Holder Lock Screw counter clockwise until contact is made with the Disc Holder. See Figure 5.3 for bellows leak test.

Do not thread Pipe Plug (Bonnet) into Bonnet (omit step 18). Bonnet must be vented.

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For all other orifices:

Place Bellows on Stem Retainer. Place Gasket on Stem Retainer. Thread Disc Holder to Stem Retainer using special assembly block. Thread Lock Screw counter clockwise until contact is made with the Disc Holder.

Do not thread Pipe Plug (Bonnet) into Bonnet (omit step 18). Bonnet must be vented.

See Figure 5.3 for Bellows Leak Test.

III. O-Ring Seat Construction (Figure 5.4)

Follow the same procedure as for Conventional type valves except for as follows:

For D and E orifices only:

Place O-Ring in Disc Holder groove. Thread Disc into Disc Holder.

For orifices F through K only:

Place O-Ring in Disc Holder groove. Place Disc into Disc Holder. Thread Flat Head Machine Screw through Disc into Disc Holder.

For orifices L through T only:

Thread Disc into Disc Holder. Be sure Disc is free Floating. PLace O-Ring into Disc groove. Place O-Ring Retainer on Disc. Thread Flat Head Machine Screws through Stem O-Ring Retainer into Disc. Thread Jack Screw Plug into O-Ring Retainer.

IV. Plain Cap Construction

23. Place Cap Gasket on Bonnet.

24. Thread Cap onto Bonnet.

V. Open Lever Cap Construction

For single acting lever only: (Figure 3.4, page 12)

23. Thread Stem Test Washer onto Stem.

1. Place bellows/stem retainer/disc holder assembly into bellows leak test fixture with the bellows flange at the base.
2. Seal the flange of the bellows to the base of the bellows test fixture as illustrated in Figure 5.3.
3. Compress the bellows approximately 1/8 inch with a securing bar so that the bellows does not elongate when pressure is applied as in Figure 5.3.
4. Fill the disc holder with water. Omit this step for D & E Balanseal® designs as these designs have a one piece disc holder/stem retainer.
5. Apply 30 psig pressure to the bellows.
6. Apply soapy water to bellows exterior to check for bellows integrity.
7. If bubbles appear on bellows exterior there are pin holes or a tear. Replace bellows and repeat the procedure.
8. Check to be sure the bellows/disc holder connection is leak tight. If water in disc holder bubbles or the connection bubbles, tighten the connection or replace gasket.
9. Vent pressure.
10. Release bellows assembly.
11. Air dry bellows assembly to remove soapy water.

BELLOWS ASSEMBLY LEAK TEST

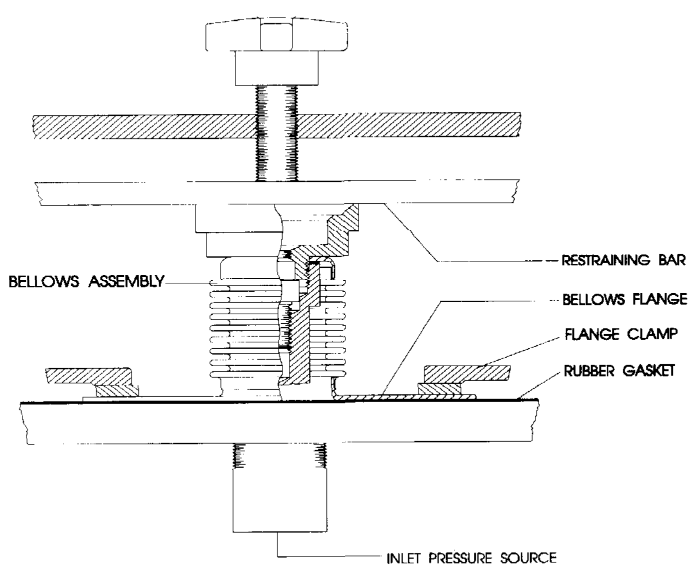

Figure 5.3

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24. Thread Jam Nut (Stem) onto Stem.

25. Place Cap onto Bonnet so that Test Lever is in the same position as in disassembly notes. The standard position is opposite the valve outlet.

26. Thread Cap Studs through Cap into Bonnet.

27. Place Rivet through Test Lever and Cap hole and secure with Cotter Pin. Adjust Stem Test Washer so there is 1/8" clearance between Test Lever fulcrum and Stem Test Washer.

For double acting lever only: (Figure 3.5, page 13)

23. Thread Stem Test Washer onto Stem.

24. Thread Jam Nut (Stem) onto Stem.

25. Place Cap onto Bonnet so that Test Lever is in the same position as in disassembly notes. The standard position is opposite the valve outlet.

26. Thread Cap Studs through Cap into Bonnet.

27. Place Rivet through Test Lever Fork and Cap hole. Secure Rivet with Cotter Pin.

28. Place Rivet through Test Lever and Cap hole and secure with Cotter Pin. Adjust Stem Test Washer so there is 1/8" clearance between Test Lever Fork fulcrum and Stem Test Washer.

VI. Packed Lever Construction (Figure 3.3, page 12)

23. Thread Stem Test Washer onto Stem.

24. Thread Jam Nut (stem) onto Stem.

25. Place Cap Gasket on Bonnet.

26. Place Cam Shaft Ring on Cam Shaft.

27. Place counter-bored side of Retaining Ring on cam shaft against cam shaft ring.

28. Place Packing Rings over Cam Shaft and into Retaining Ring cavity.

29. Slide Cam Shaft through hole in cap and through Cam while holding Cam in place inside Cap.

30. Place Cap onto Bonnet so that Test Lever is in the same position as in disassembly notes. The standard position is opposite the valve outlet.

31. Thread Cap Studs through Cap into Bonnet.

32. Adjust Stem Test Washer so there is 1/8" clearance between Stem Test Washer and Cam.

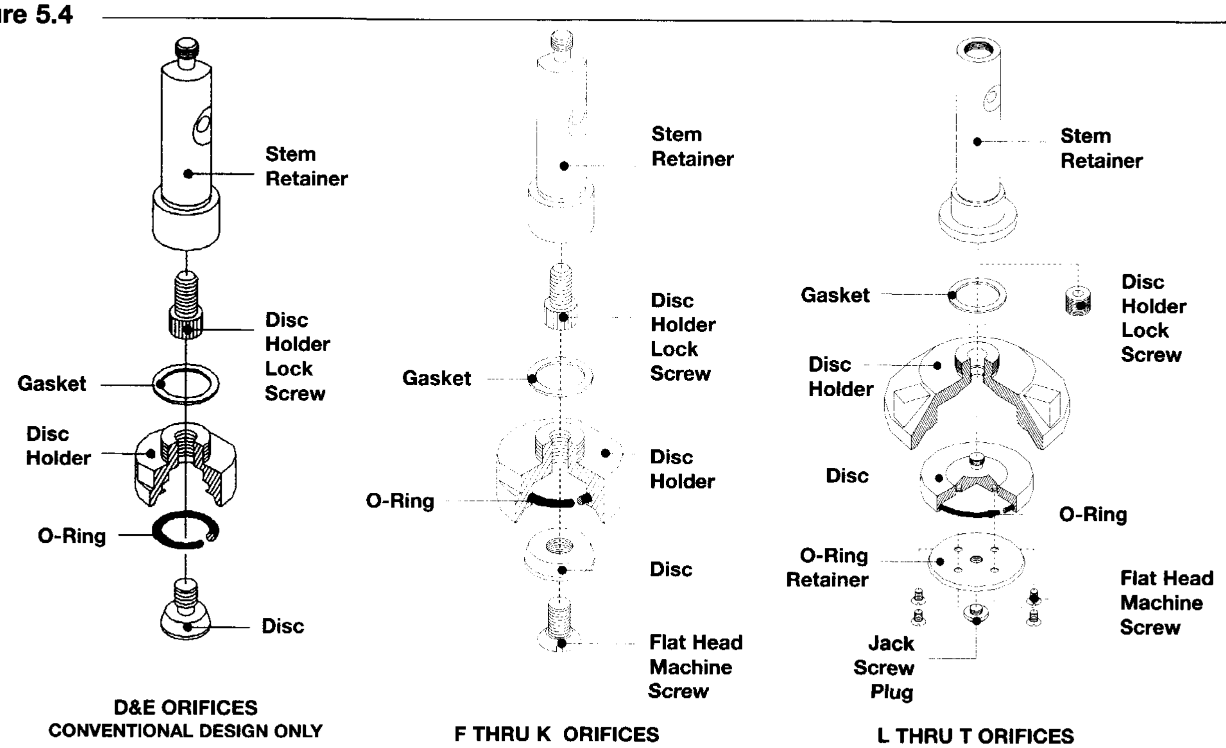
33. Thread Gland into Cap.

34. Place Test Lever on Cam Shaft.

35. Place Plain Washer over Cam Shaft.

36. Thread Hex Jam Nut (Lever) onto Cam Shaft.

Figure 5.4



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6. SETTING & TESTING

TRAINING COURSES

Farris Engineering provides programs which coordinate classroom and hands-on training. It is recommended that individuals performing pressure relief valve maintenance receive training specific to those valve series they expect to repair and set. Only this type of training will ensure the proper application of these instructions. The National Board of Boiler and Pressure Vessel Inspectors conducts training programs on valve repair in conjunction with their VR program. This is a broad-based program and is recommended to supplement training received from specific manufacturers.

Equipment

Air testing is the usual method of testing and setting pressure relief valves. A pressure source supplies air to a test drum usually having 1-1/2 cubic feet internal volume. The air pressure to the test drum is controlled by a quick opening valve (approximately 1 inch). The valve being tested is mounted directly on the test drum without restrictions. If considerable numbers of valves are tested, it is advisable to provide an air receiver between the compressor and the quick opening valve. This arrangement allows a small-volume high-pressure compressor to store air during off-hours. Farris Engineering offers a complete line of valve test stands designed to facilitate the proper layout of a test center. They can be augmented by existing or new air receivers to suit the plant or repairer's particular requirements. A worthwhile advantage to these is the accompanying adaptors and clamping arrangements which enable quick test set-ups.

Adjustments & Performance

The use of the correct spring is a matter of critical importance. Attempting to employ a spring below its rated pressure range may result in a loss of lift with resulting loss of capacity and a generally sluggish valve action. Using a spring above or below its rated temperature range may cause a change in spring characteristics and possibly failure of the spring itself. Before changing the set pressure of any valve verify that the new pressure is within the range of the spring and valve construction. When raising the set pressure, check the applicable design code and the design pressure of the protected equipment to ensure compliance with equipment design and local requirements. Before reducing the set pressure, make certain that the capacity at the reduced pressure is sufficient for the protection of your equipment. Valves which are properly installed on steam, gas, or vapor services will relieve with a pronounced pop when opening. After the excess pressure has been relieved, the valve will generally reseat at approximately 5% to 7% below the set pressure.Actual blowdown will vary with each valve and installation. There is generally no distinct pop with liquid service relief valves as the opening will generally be proportional to the rise in pressure. It is usual for a sudden increase in lift to occur at some overpressure. Where such data are not available, blowdown rings should be set carefully and accurately in accordance with the table values.

Procedure

To properly test a valve, the test drum pressure is brought up to about 90% of the set pressure of the valve. The quick opening valve is now opened sufficiently to cause the test drum pressure to continue to increase 2 psi/sec until the valve pops. A test gage connected to the test drum in a static pressure zone will indicate the pressure the valve pops. Further spring setting adjustments may be necessary to achieve the desired set pressure of the valve. The tightness of a pressure relief valve on gas or vapor service is closely connected with the operation of the valve, i.e. unless a valve opens and closes sharply, it may leak. The action of such a valve depends upon the expansive and reactive forces of the flowing medium (gas or vapor only) which in turn depends upon the location of the blowdown ring. Since the capacity of the test stand is considerably less than the actual valve capacity, it is essential that the blowdown ring be adjusted for good test stand operation. The lowest ring position that can be tolerated for a given size test drum depends upon the valve size and its set pressure relative to the test drum size. Raising the nozzle ring to within two notches from touching the disc holder will obtain the maximum reaction from the smallest amount of the test fluid. However, this position may produce excessive impact and seat damage to small valves set at high pressures. This ring setting is necessary for checking the valve on the test stand and adjusting conditions.

Adjusting Valve to Required Set Pressure

After the valve has been reconditioned and reassembled minus the cap and/or lever assembly, it is ready for a final spring adjustment to the required set pressure. If a new set pressure is required, the limits for adjustment of the spring must be observed. It may be necessary to provide a different spring. After the final adjustment is made, the valve should be popped at least once to prove the accuracy of the setting.

Air Test Stand Settings

For spring Adjustment or checking set point on air test stands with a capacity under 1-1/2 cu. ft., raise ring to a position 2 notches down from contact with disc holder. On air test strands with capacity over 1-1/2 cu. ft., raise ring to a position of approximately 1/2 of tabulated number of notches down from contact with disc holder. Return ring to tabulated field setting or setting established through in-place testing before installation... Be sure to include temperature compensation of set pressure where applicable.

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Liquid Service

Liquid relief valves must be set on water at the first continuous flow as the inlet pressure is raised. Intermittent opening and closing indicates leakage. The reduction in inlet pressure required to reseat the valve depends on the rate of flow and operator manipulation.
Set the blow down ring to the position indicated in Table 6.3. Do not attempt to adjust the blow down ring without gagging the valve first (or reducing inlet pressure to zero). Remove the gag. When the valve is first mounted there will be some air under the disc of the valve. This may cause the valve to pop open suddenly. To remove the air lift up on the stem to let the air slowly seep out, if possible. Pressure may need to be added under the valve to assist in lifting the stem. Next, raise the pressure to the desired set point. When the pressure is within 90% of the set pressure, raise the pressure at a rate of 1 psig per 2 seconds. Adjust the spring adjusting screw until the desired set pressure is reached. We define set pressure for a liquid valve as the first continuous flow which is flowing 90 degrees from the outlet. Be patient with liquid valves. They will sometimes exhibit a "false" set point. By holding the pressure at the point which appears to be the set pressure the system operator can prevent the valve from thinking that this is the correct set pressure. If the valve is exhibiting a "false" set point and the operator holds the pressure constant, the flow from the valve will taper off and may even completely stop flowing. The operator should then continue to raise the pressure until the valve is correctly set.

Securing The Blowdown Ring

The adjusted position of the ring is maintained by a Blow Down Ring Lock Screw which threads into the valve body from the outside and engages notches (like gear teeth) on the outside diameter of the blowdown ring. To make an adjustment, loosen and remove the blowdown ring lock screw assembly. Insert a screw driver and rotate the nearest notch toward the left to lower the ring or toward the right to raise it, counting the notches as they are moved. Reinstall the lock screw assembly, ensuring that is intercepts a notch without exerting side-pressure on the ring. CAUTION! When making the adjustments under pressure, be sure the valve is lightly gagged to avoid accidental popping. The gag screw must be removed immediately after use. Failure to do so will render the valve inoperable.

SEAT TIGHTNESS TESTING

After the valve is satisfactorily checked for set pressure it is necessary to check the valve for leakage. It is important to minimize leakage from pressure relief valves. Excessive leakage could lead to fouled and inoperable valves and serious product loss and could also be hazardous to personnel and equipment. The valve can be tested for tightness on the test stand by increasing the pressure on the valve to 90 percent or more of the set pressure and observing the discharge side of the valve for evidence of leakage. Methods of determining leakage are covered by applicable standards and specific user requirements.

API Standard 527 is a widely accepted standard for the procedure and acceptance criteria for assessing the seat tightness of pressure relief valves. The user should be familiar with this standard, in addition to any information presented therein. The following seat tightness methods and requirements are in general compliance with API Standard 527.

Air Testing Blow Down Ring Position

All openings from the secondary pressure zone shall be closed before counting the bubble rate. This includes such items as caps, drain holes, vents and outlets. A soap solution or equivalent test shall be applied to secondary joints to detect escape of air other than that being measured. Seat tightness tests are normally conducted with pressure at the pressure relief valve inlet held at 90 percent of the set pressure immediately after popping. For valves set at 50 PSIG or below, the pressure shall be held a 5 PSIG below the set pressure immediately after popping. Before starting the bubble count, the test pressure shall be applied for a minimum of: 1 minute for valves of inlet sizes 2 inches and smaller; 2 minutes for sizes 2-1/2, 3, and 4 inches; 5 minutes for sizes 6 inches and larger.

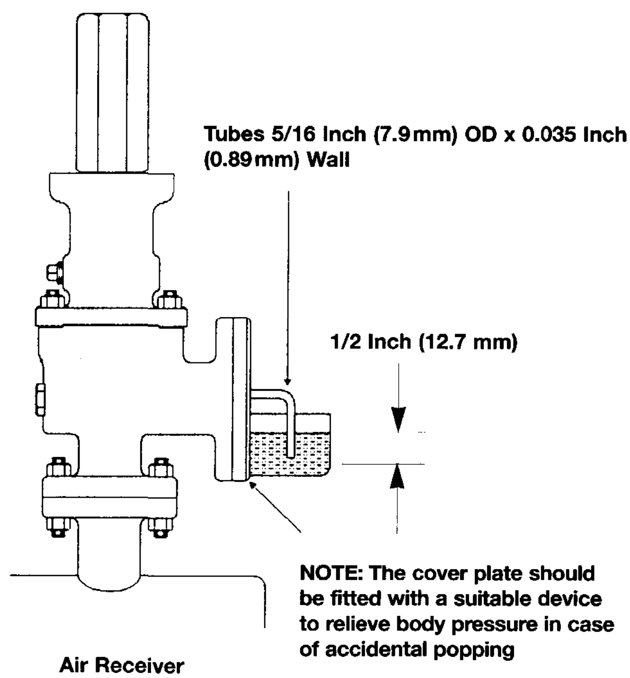

Figure 6.1

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Air at ambient temperature shall be used as the pressure medium. The valve shall be observed for leakage for at least 1 minute. The leakage rate in bubbles per minutes shall not exceed the numbers listed in Table 6.1. For an O-Ring seated valve, there shall be no leakage for 1 minute (0 bubbles per minute @ 95% of set pressure). (Figure 6.1)

Maximum Seat Leakage Rates for Metal-Seated Pressure Relief Valves		
SET PRESSURE psig	LEAKAGE RATE (BUBBLES PER MINUTE)	
	F ORIFICE AND SMALLER	G ORIFICE AND LARGER
15-1000	40	20
1500	60	30
2000	80	40
2500	100	50
3000	100	60
4000	100	80
5000	100	100
6000	100	100

Table 6.1

Steam Testing

Steam service pressure relief valves which are set and adjusted on steam shall be leak-tested on steam visually using a black background. There shall be no visible or audible leakage from the valve outlet when the inlet pressure is held at 90% of the set pressure after popping and reseating. For set pressure below 50 psig this test shall be conducted at 5 psig below set pressure. The valve shall be observed for leakage for at least 1 minute. This criteria applies to both metal and O-Ring seated valves.

Liquid Testing

Liquid service pressure relief valves which are set and adjusted on water shall be leak-tested on water at near ambient conditions. Before starting the seat tightness test, the set pressure shall be verified, and the outlet body bowl shall be filled with water, which shall be allowed to stabilize with no visible flow from the valve

BLOW DOWN RING SETTINGS

AIR, GAS, AND VAPOR APPLICATIONS									
	SET PRESSURE RANGE, PSIG								
ORIFICE	15-100	101-200	201-300	301-400	401-500	501-600	601-800	801-1000	1000 & UP
D (note 1)	37 2	37 2	38 3	39 4	39 4	40 5	40 5	41 6	42 7
E (note 1)	37 2	37 2	38 3	39 4	39 4	40 5	40 5	41 6	42 7
F	2	3	4	5	6	7	8	9	10
G	3	4	5	6	7	8	9	10	11
H	3	4	5	6	7	8	9	10	11
J	3	5	5	6	7	8	9	10	11
K	4	5	6	7	8	9	10	11	12
L	4	6	9	9	10	10	10	11	12
M	4	6	12	12	12	12	12	12	12
N	5	10	15	15	15	15	15	15	15
P	6	16	20	20	20	20	20	20	20
Q	6	16	20	20	20	20	20	20	—
R	4	16	20	20	—	—	—	—	—
T	4	16	20	—	—	—	—	—	—
STEAM APPLICATIONS									
	SET PRESSURE RANGE, PSIG								
ORIFICE	15-100	101-200	201-300	301-400	401-500	501-600	601-800	801-1000	1000 & UP
D (note 1)	37 2	38 3	39 4	40 5	41 6	42 7	43 8	44 9	45 10
E (note 1)	37 2	38 3	39 4	40 5	41 6	42 7	43 8	44 9	45 10
F	2	4	5	6	7	8	9	10	12
G	3	5	6	7	8	9	10	11	13
H	3	5	6	7	8	9	10	11	13
J	3	6	6	7	8	9	10	11	13
K	4	6	7	8	9	10	11	12	14
L	4	7	7	8	9	10	11	12	14
M	4	7	7	8	9	10	11	12	14
N	4	7	7	8	9	10	11	12	14
P	4	7	7	8	11	10	11	12	14
Q	4	8	9	10	11	12	13	15	—
R	4	8	9	10	—	—	—	—	—
T	4	8	9	—	—	—	—	—	—

Note 1: Use this row only for "D" & "E" orifice valves purchased before July 1, 1993

Table 6.2

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outlet. The inlet pressure shall be increased to the test pressure. The valve shall be observed for 1 minute at the test pressure. For valves set at 50 PSIG or below, the pressure shall be held at 5 PSIG below the set pressure. Above 50 PSIG set pressure hold the pressure at 90% of the set pressure.

For O-Ring seated valves there shall be no visible leakage when held at the test pressure for 1 minute regardless of valve size. For metal seated valves less than 1 inch inlet size the allowable leakage rate shall not exceed 10 cubic centimeters per hour. For metal seated valves one inch inlet size or larger the allowable leakage rate shall not exceed 10 cubic centimeters per hour per inch of inlet size. Example: The maximum allowable leakage rate from a 4 inch inlet metal seated pressure relief valve shall not exceed 40 cubic centimeters per hour. This is a difficult test to conduct and it is easier to aim for zero leakage during this test by proper repair procedures. Should seat leakage be encountered a more quantitative test can be conducted to determine valve acceptability.

BLOWDOWN RING SETTING

Tables 6.2 and 6.3 give blow down ring settings in the number of notches down from disc holder contact. The higher the ring the sharper the pop and longer the blowdown. The lower the ring, the poorer the pop, the shorter the blowdown.

LIQUID SERVICE APPLICATIONS			
ORIFICE			NUMBER OF NOTCHES
D	E		2
F			3
G	H	J	4
K	L		8
M	N	P	12
Q	R	T	20

Table 6.3

FIELD SETTINGS

The above settings are final average field settings for good performance under actual operating conditions on the installation. Use recommended number of notches, or maximum adjustment possible if less than table. Finer adjustments may be desirable or necessary because of individual piping and service differences. On applications where the valve will operate at substantially reduced flow, fewer notches may help eliminate chatter and ensure seat tightness.

COMPENSATION FOR TEMPERATURE

Any increase in temperature causes a reduction in set pressure of a safety-relief valve. The primary factors are the linear expansion of the body and top works, which reduces the spring loading, and the direct effect of temperature on the spring itself.

It is customary to compensate for this effect by increasing the setting when a valve is set at ambient conditions on a test stand and the valve is intended for a higher operating temperature in service. Although the adjustment is approximate and may be outweighed by other differences caused by variations in media and blowdown ring adjustments, compensation for temperature as an independent variable improves the accuracy of the setting. It is not recommended to reduce a spring setting for valves intended for sub-zero service. (Table 6.4)

Normal Operating Temperature	% Increase in Set Pressure At Atmospheric Temp.
minus 400°F to +300°F	none
+300°F to +600°F	1%
+601°F to +900°F	2%
+901°F to +1200°F	3%

Table 6.4

COLD DIFFERENTIAL TEST PRESSURE (CDTP) is the inlet pressure at which the valve is adjusted to open on a test stand at ambient temperature conditions, discharging to atmosphere. Computation includes compensation for constant back pressure (if required) and inlet operation temperature. Cold Differential Test Pressure is the sum of the Spring Selection and the Increase in Setting to compensate for temperature. The abbreviation is Cold Set. (Table 6.4)

COMPENSATION FOR BACKPRESSURE

BACK PRESSURE is the pressure existing at the valve outlet and in the valve outlet and in the downstream portion of the valve body. It may be superimposed, built-up, constant, or variable. The spring setting should be compensated for constant and superimposed back pressure, except for BalanSeal® valves. For these type valves variable back pressure is not compensated for, but the maximum pressure limit of the bellows is stamped on the nameplate.

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OPERATING DIFFERENTIALS

The variety of service conditions for section VIII applications precludes a rigid set of rules. Operating difficulties can be minimized by providing as much differential as possible for known conditions on a particular application. Table 6.6 lists the suggested minimum differentials.

SET PRESSURE TOLERANCE AND OPERATING DIFFERENTIALS

GASES, VAPORS, AND LIQUIDS

	SET PRESSURE psig	SET PRESSURE TOLERANCE (+) OR (-)	MINIMUM DIFFERENTIAL SUGGESTED (Gases & Vapors)	MINIMUM DIFFERENTIAL SUGGESTED (Liquids)
METAL SEAT SOFT SEAT	15 To 70	2 PSI	5PSI	5PSI
METAL SEAT SOFT SEAT	71 To 1000	3%	10%	10%
METAL SEAT SOFT SEAT	1001 To 6000	3%	10%	10%

Table 6.6

FINAL NOTES

Once your valve has been assembled and tested make sure that you have completed all necessary records before placing it back in service. These records are important for the effective future use of the valve. They will provide some guidance as to when to retire valves and replace components as well as providing the historical record of the conditions and services under which the valve operated. A sample history card appears in Appendix C which can be photocopied and used for this purpose.

The valve should be properly installed in service or prepared for storage. If the valve is to be stored the inlet and outlet of the valve should be covered to protect against any foreign matter entering the valve.

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TROUBLE SHOOTING

TYPICAL PROBLEMS WITH PRESSURE RELIEF VALVES

CHATTER

The valve is oversized for installation.

If the inlet capacity is less than 25% of the valve capacity there will be a tendency for the valve to chatter.

The inlet piping is of excessive length or the inlet pipe diameter is less than the inlet size of the valve.

Design inlet piping systems so that the pressure drop to the valve is less than 3%. The inlet pipe diameter should be at least the inlet size of the valve.

The outlet piping is of excessive length or the diameter is less than the valve flange size.

Design outlet piping so that the diameter is at least the outlet size of the valve and that pressure on the outlet does not build up causing the valve to shut.

INCORRECT SET PRESSURE

Misreading the nameplate

Always compensate for backpressure and temperature when bench testing the safety-relief valve by following the Cold Differential Test Pressure.

The blowdown ring position changed

Check that the lock screw stud has engaged between the teeth on the blowdown ring to prevent rotation. This could also cause erratic blowdown characteristics as well as leakage.

Internals are misaligned.

See section on leakage.

Jam nut is loose.

Tighten jam nut.

Rough handling.

A safety-relief valve is a precision instrument and should be handled with care. It is also recommended that the valve be popped once or twice to realign the parts after rough handling.

Pressure surge at inlet.

Sudden impact of a fluid may cause the valve to open prematurely. Pressure build-up should be gradual.

The valve contains a bellows and the bonnet is not vented.

Remove bonnet pipe plug so that the bonnet is exposed to atmospheric pressure.

LEAKAGE

The seats are damaged.

Lap the seats to remove the damage. If the scratches are deep, machining may be required. Remove any foreign particles from the system to prevent scoring the seats.

The system operating pressure is too close to the valve set pressure.

Always have at least 10% (or 5 psig, whichever is greater) differential between operating pressure vs. set pressure for metal seated valves, and 7% (or 5 psig, whichever is greater) for soft seated valves. See table 6.6, page 27

Misaligned lifting gear.

Adjust the stem test washer so that there is 1/8 inch clearance between either the cam or lever and the stem test washer.

Excessive external loads to the outlet piping.

Support outlet piping so that the maximum recommended weight on the outlet is not exceeded. See Appendix E, Table 7.1

Horizontal mounting.

Safety-relief valves must be mounted with the stem in the vertical plane. If mounted horizontally the valve will experience excessive friction on the guides and will not align properly.

Lock screw stud not adjusted properly.

Adjust the length of the lock screw stud so that it does not press into the blowdown ring causing misalignment.

Misaligned internals.

Disassemble valve and check all universal ball joints, flatness of disc and nozzle seat and repair or replace.

Other.

Check for bent stem, springs with uneven ends or out of alignment. A common cause of bent stems is overgagging. Test gags are designed to be finger tightened only.

BLOWDOWN

Blowdown is excessive/the valve is hanging up

Lower the blowdown ring until the desired blowdown is achieved. Also check for dirt or other foreign material in the seating area or on the guiding surfaces.

Blowdown is too short.

Raise the blowdown ring to lengthen the desired blowdown.

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APPENDIX A

REQUIRED TOOLS	ORIFICE													
	D	E	F	G	H	J	K	L	M	N	P	Q	R	T
OPEN END WRENCHES														
7/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
9/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
3/4"	•	•	•	•	•	•	•	•	•	•	•			
13/16"	•	•	•	•	•	•	•	•	•	•	•			
7/8"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
1"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
1-1/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	
1-1/8"								•	•	•	•	•	•	•
1-1/4"			•	•	•	•	•	•	•	•	•	•	•	•
1-3/8"	•	•	•	•	•									
1-1/2"				•										
1-5/8"					•									
1-3/4"						•	•	•	•	•	•			
2"								•	•	•	•	•	•	•
2-1/4"	•	•	•	•	•	•	•	•	•	•	•			
2-3/4"							•							
3-1/4"						•	•	•	•	•	•	•	•	•
3-1/2"								•	•					
3-11/16"				•	•									
3-3/4"										•				
5"							•				•			
5-1/4"						•								
5-3/4"												•		
6"													•	
6-3/16"							•	•	•	•	•	•	•	
ALLEN WRENCHES														
3/16"	•	•	•	•	•	•								
7/32"							•	•	•	•	•			
3/8"												•	•	•
ADJUSTABLE PIN SPANNERS														
1-1/4" TO 3"	•	•	•		•									
2" TO 4-3/4"				•	•	•								
4-1/2" TO 6-1/4"							•	•	•	•	•	•	•	
8-1/2"												•	•	
10 5/8"														•
ADJUSTABLE HOOK SPANNERS														
2" TO 4-3/4"								•	•	•				
4-1/2" TO 6-1/4"											•			
6-1/8" TO 8-3/4"												•	•	
9-1/4"														•
ADJUSTABLE WRENCHES	•	•	•	•	•	•	•	•	•	•	•	•	•	•
FLAT HEAD SCREW DRIVERS	•	•	•	•	•	•	•	•	•	•	•	•	•	•
WIRE CUTTERS	•	•	•	•	•	•	•	•	•	•	•	•	•	•
SUPER JOINT PLIERS	•	•	•	•	•	•	•	•	•	•	•	•	•	•
PIPE WRENCH	•	•												
O-RING PICK	•	•	•	•	•	•	•	•	•	•	•	•	•	•
FLASHLIGHT	•	•	•	•	•	•	•	•	•	•	•	•	•	•

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APPENDIX B
EXTERNAL LOADS

Mechanical forces may be applied to the valve by discharge piping as a result of thermal expansion, movement away from anchors and weight of any unsupported piping. The resultant bending movements on a closed pressure relief valve may cause valve seat leakage and excessive stress in inlet piping. The design of the installation should consider these factors.

The determination of bending movements, stresses and supports is the responsibility of the designer of the pressure relief system in accordance with the appropriate codes, recommended practices and site conditions. However, since a closed pressure relief valve cannot tolerate as much load applied to the outlet as a fitting or line valve, the manufacturer if often requested to provide guidelines to avoid seat leakage.

For this purpose, we are considering small deflections at moderate stress levels principally in a vertical plane through the horizontal and vertical axes of the valve. Let us examine a maximum allowable dead weight applied vertically at the outlet flange, being a function of the moment of inertia of the inlet neck, the horizontal moment arm, a constant and an empirical factor determined by tests. The result would be a great number of computations compared with a fitting whose bending moment is simply 1500 times the section modulus.

Similarly, the bending moments in X,Y and Z axes could be calculated by dimensional analyses of the great number of valve bodies in the catalog. However, lacking industry standardization in presenting such data in a uniformly acceptable manner, the use of weight units provide a quantitative reference for improving installation designs. It is preferable to the general instruction of supporting all discharge piping independently.

The following approximate method tabulates only the most significant factor, which is the maximum dead weight load F_Z in pounds which we recommend as a limit to avoid seat leakage.

MAXIMUM RECOMMENDED WEIGHT ON OUTLET Fz POUNDS					
ORIFICE	TYPE	Fz	ORIFICE	TYPE	Fz
	26DA10	85		26KA10	630
	11	85		11	940
	12	85		12	940
D	13	85	K	13	400
	14	158		14	400
	15	158		15	470
	16	230		—	—
	—	—		26LA10	600
	26EA10	85		11	900
	11	85	L	12	2000
	12	85		13	1070
E	13	85		14	820
	14	158		—	—
	15	158		26MA10	1220
	16	230		11	1900
	—	—	M	12	1900
	26FA10	205		13	1240
	11	275		14	820
	12	140		—	—
F	13	140		26NA10	830
	14	155		11	900
	15	155	N	12	900
	16	230		13	815
	—	—		14	815
	26GA10	350		—	—
	11	400		26PA10	600
	12	145		11	700
G	13	155	P	12	730
	14	155		13	730
	15	330		14	730
	16	330		—	—
	—	—		26QA10	1350
	26HA10	330		11	1350
	11	370	Q	12	2700
	12	590		13	2700
H	13	300		H26QA13	—
	14	430		26RA10	1500
	15	430		11	2700
	—	—	R	12	1800
	26JA10	490		13	2200
	11	620		H26RA13	—
J	12	770		26TA10	2400
	13	445	T	11	2400
	14	870		12	2400
	15	870	T	H26TA12	2400

Table 7.1

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APPENDIX C
MAINTENANCE & INSPECTION SPECIFICATION RECORD

Valve Type: S/N:

Manufacturer:

Body and Bonnet Material:

Nozzle and Disc Material:

Trim Material:

Spring Material **Spring No.**

Carbon Steel:

Alloy:

Inlet:

Orifice:

Back Pressure:

Spring Set Pressure

Relieving Pressure:

Remarks:

Maintenance Engineers Phone:

No	Unit	Location

HISTORICAL RECORD

Date Tested	Popped	Reseat	Disposition	Condition	Repairs	Remarks

The information in the above form is typical of the data that should be recorded for all valves. This information should be compiled for new valves as well as valves removed from service for maintenance. This form should be photocopied and used as part of any repair shops' proper record keeping system on maintenance of valves.

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GENERAL REFERENCE SOURCES

These reference materials are available and should be helpful in the installation and testing of Pressure Relief Valves. Since it is impossible to include all industry practices that are used in the installation of a Pressure Relief Valve, this manual has been prepared to describe routine field handling and installation procedures to make a safe and acceptable installation.

American National Standards Institute
New York, NY
ANSI B16.5 - Pipe Flanges and Flanged Fittings

ANSI B16.34 - Valves - Flanged, Threaded and Welding End.

ASME PTC 25 - Performance Test Code.

ANSI/ASHRAE 15-78 - Safety Code for Mechanical Refrigeration, {B9.1}.

American Petroleum Institute
Washington, D.C.

API RP 520, Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries, Part-1 Sizing and Selection.

API RP 520, Part II - Installation

API RP 521, Guide for Pressure-Relieving and Depressuring Systems.

API Standard 526, Flanges Steel Safety Relief Valves.

API Standard 527, Seat Tightness of Pressure Relief Valves.

API Standard 2510, Design and Construction of LP-Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refiner- and Tank Farms.

API RP 576, Inspection of Pressure-Relieving Devices.

API PAPER 62-73, Computerized Safety Valve Maintenance Records by JH Forrester, Jr., May 17, 1973

American Society of Mechanical Engineers
New York, NY
ASME Boiler and PRessure Vessel Code Section VIII, Rules for Construction of Pressure Vessels, Division I.

ASME Boiler and Pressure Vessel Code Section I, Rules for Construction of Power Boilers

Compressed Gas Association, Inc.
Arlington, VA

Safety Relief Device Standards:

Part 1 - Cylinders for Compressed Gases, Pamphlet S-1.1.

Part 2 - Cargo and Portable Tanks for Compressed Gases, Pamphlet S-1.2.

Part 3 - Compressed Gas Storage Containers, Pamphlet S-1.3.

National Board of Boiler and Pressure Vessel Inspectors
Columbus, Ohio

National Board Inspection Code, NB-23.

National Fire Protection Association
Quincy, Massachusetts

NFPA No. 30, Flammable and Combustible Liquids Code.

NFPA No. 58, Standard for the Storage and Handling of Liquified Petroleum Gases.

NFPA No. 59, Standard for the Storage & Handling of Liquified Petroleum Gases at Utility Gas Plants.

Farris Engineering

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Plant
Farris Engineering, Brecksville, Ohio USA

Plants in Canada
Farris Engineering, Brantford, Ontario;

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