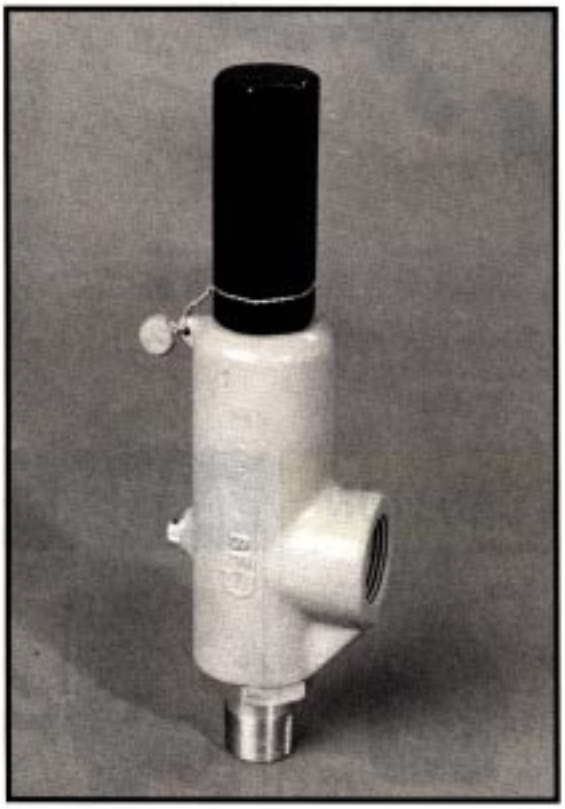
Consolidated®

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Consolidated® Safety Relief Valve Series 1990 and Series 3990



Industrial Valves | DRESSER

Industrial Valve Operation
Dresser Valve and Controls Division
Alexandria, Louisiana 71309-1430 (USA)

Series Types Include The Following Design Options:

O-Ring Seat Seal (XDA), Except for Type 3999; Liquid Trim (XLS)
and
Combination O-Ring Seat Seal
and
Liquid Trim (XDL), Except for Type 3999

CON-4
Revised 4/91

Product Safety Sign and Label System

If and when required, appropriate safety labels have been included in the rectangular margin blocks throughout this manual. Safety labels are vertically oriented rectangles as shown in the ***representative examples*** (below), consisting of three panels encircled by a narrow border. The panels can contain four messages which communicate:

- The level of hazard seriousness.
- The nature of the hazard.
- The consequence of human, or product, interaction with the hazard.
- The instructions, if necessary, on how to avoid the hazard.

The top panel of the format contains a signal word (DANGER, WARNING, CAUTION or ATTENTION) which communicates the level of hazard seriousness.

The center panel contains a pictorial which communicates the nature of the hazard, and the possible consequence of human or product interaction with the hazard. In some instances of human hazards the pictorial may, instead, depict what preventive measures to take, such as wearing protective equipment.

The bottom panel may contain an instruction message on how to avoid the hazard. In the case of human hazard, this message may also contain a more precise definition of the hazard, and the consequences of human interaction with the hazard, than can be communicated solely by the pictorial.

① **DANGER — Immediate hazards which WILL result in severe personal injury or death.**

② **WARNING — Hazards or unsafe practices which COULD result in severe personal injury or death.**

③ **CAUTION — Hazards or unsafe practices which COULD result in minor personal injury.**

④ **ATTENTION — Hazards or unsafe practices which COULD result in product or property damage.**

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Contents

I. Safety Notice

Proper installation, operation and maintenance is essential to the safe and reliable operation of all valve products. The relevant procedures recommended by Dresser Valve and Controls Division (DVCD), and described in this manual, are effective methods of performing the required tasks. Some of these procedures require the use of tools specifically designed for an intended purpose. These special tools should be used when, and as, recommended.

It is important to note that this manual contains various "safety messages" which should be carefully read in order to minimize the risk of personal injury, or the possibility that improper procedures will be followed which may damage the involved DVCD product, or render it unsafe. It is also important to understand that these "safety messages" *are not* exhaustive. DVCD can not possibly know, evaluate, and advise any customer of all of the conceivable ways in which tasks might be performed, or of the possible hazardous consequences of each way. Consequently, DVCD has not undertaken any such broad evaluation and, thus, anyone who uses a procedure and/or tool, which is not recommended by DVCD, or deviates from DVCD recommendations, must be thoroughly satisfied that neither personal safety, nor valve safety, will be jeopardized by the method and/or tools selected. If not so satisfied, contact DVCD (at 318/640-2250) if there are any questions relative to tools/methods. Some of the products manufactured by DVCD may be used in radioactive environments. Consequently, prior to starting any operation in a radioactive environment, the proper "health physics" procedures should be consulted and followed, if applicable.

⚠WARNING

Know nuclear "health physics" procedures, if applicable, to avoid possible severe personal injury or death.

⚠CAUTION

Wear necessary protective equipment to avoid possible personal injury.

The installation, operation and maintenance of valves and/or valve products may involve proximity to fluids at extremely high pressure and/or temperature. Consequently, every precaution should be taken to prevent injury to personnel during the performance of any procedure. These precautions should consist of, but are not limited to, ear drum protection, eye protection, and the use of protective clothing. (i.e., gloves, etc.) when personnel are in or around a valve work area. Due to the various circumstances and conditions in which these operations may be performed on DVCD products, and the possible hazardous consequences of each way, DVCD can not possibly evaluate all conditions that might injure personnel or equipment. Nevertheless, DVCD does offer the safety precautions listed on page 3 for customer information only.

It is the responsibility of the purchaser or user of DVCD valves/equipment to adequately train all personnel who will be working with the involved valves/equipment. Further, *prior* to working with the involved valves/equipment, personnel who are to perform such work should become thoroughly familiar with the contents of this manual. Accordingly, should additional copies of this manual be required, they can be purchased, at a minimal cost, by contacting DVCD (in writing) at P.O. Box 1430, Alexandria, LA 71309-1430, or (telephonically) at 318/640-2250.

II. Safety Precautions

Follow all plant safety regulations, but be sure to observe the following:

- Do not stand in front of the discharge side of a safety relief valve when testing or operating.
- Hearing protection should be used when testing or operating a valve.
- Exercise care when examining a safety relief valve for visible leakage.
- Never install a safety relief valve in a horizontal position. Safety relief valve internals are designed to move vertically. When installed horizontally, misalignment and galling, or hang-up, may prevent the valve from opening or closing properly.
- Safety relief valves should be mounted to provide adequate access, 360° around the valve plus overhead, to permit removal for testing and maintenance.
- When removing a safety relief valve for disassembly, stand clear and/or wear protective clothing to prevent exposure to splatter of any corrosive process medium which may have been trapped inside the valve. Ensure the valve is isolated from system pressure before the valve is removed.
- When a valve is equipped with a lifting lever, the lever should be positioned to avoid unintentional contact with other equipment, or with personnel, which might cause the valve to lift accidentally.
- All valves require periodic inspection and tests by qualified persons to insure that the valves are in proper working condition, and will function as designed by DVCD.
- The owner/operator of the valves must be aware of usage conditions, and must bear the responsibility for determining the appropriate frequency of examination of the valves.

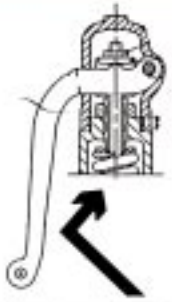
⚠ DANGER

Stand clear of discharge side of valve, when testing or operating, to avoid severe personal injury or death.

⚠ WARNING

Ensure the valve is isolated from system pressure before the valve is removed to avoid possible severe personal injury or death.

⚠ WARNING



If valve is equipped with a lifting lever, position lever to prevent accidental contact with other objects, to avoid possible severe personal injury or death.

III. Introduction

The Consolidated® Series 1990 and Series 3990 portable pressure relief valves are designed to meet ASME Section VIII requirements for fixed blowdown pressure relief valves and liquid relief valves. They may be used for various media such as air, liquids, process steam and hydrocarbons, and may serve as either a safety valve or a relief valve, depending upon the application.

IV. Terminology for Safety Relief Valves

- **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 percentage of that pressure, or actual pressure units.

- **Back Pressure**
  Back pressure is the pressure on the discharge side of a safety relief valve. (Also see "Built-Up Back Pressure" and "Superimposed Back Pressure", below.)

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

- **Built-up Back Pressure**
  Built-up back pressure is pressure which develops at the valve outlet as a result of flow, after the safety relief valve has been opened.

- **Chatter**
  Chatter is the abnormal, rapid reciprocating motion of the movable parts of a valve in which the disc contacts the seat.

- **Closing Pressure**
  Closing pressure is the point at which the valve recloses.

- **Cold Differential Set Pressure**
  Cold differential set pressure is the pressure at which the valve is adjusted to open on the test stand. This pressure includes the corrections for back pressure and/or temperature service conditions.

- **Differential Between Operating and Set Pressures**
  Valves in process service will generally give best results if the operating pressure does not exceed 90% of the set pressure. However, on pump and compressor discharge lines, the differential required between the operating and set pressures may be greater because of pressure pulsations coming from a reciprocating piston. It is recommended that the valve be set as high above the operating pressure as possible.

IV. (Continued)

- **Flutter**
  Flutter is the abnormal, rapid reciprocating motion of the movable parts of a valve in which the disc does not contact the seat.

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

- **Maximum Allowable Working Pressure**
  Maximum allowable working pressure is the maximum gauge pressure permissible in a vessel at a designated temperature. A vessel may not be operated above this pressure, or its equivalent, at any metal temperature other than that used in its design. Consequently, for that metal temperature, it is the highest pressure at which the primary safety relief valve is set to open.

- **Operating Pressure**
  The operating pressure is the gauge pressure to which the vessel is normally subjected in service. A suitable margin is provided between operating pressure and maximum allowable working pressure. For assured safe operation, the operating pressure should be as follows:

Boiler Design Pressure, psig	Minimum Differential as a Percentage of Boiler Design Pressure
Over 15 to 300	10% but not less than 7 psi
Over 300 to 1000	7% but not less than 30 psi
Over 1000 to 2000	5% but not less than 70 psi
Over 2000	Per designer's judgment

NOTE:
Above 2000 psig, the pressure differential between operating pressure and the maximum allowable working pressure is a matter for the designer's judgment, taking into consideration such factors as satisfactory operating experience and the intended service conditions. (Consult DVCD for specific recommendations.)

- **Overpressure**
  Overpressure is a pressure increase over the set pressure of the primary relieving device. Overpressure is similar to accumulation when the relieving device is set at the maximum allowable working pressure of the vessel. Normally, overpressure is expressed as a percentage of set pressure.

- **Rated Capacity**
  Rated capacity is the percentage of measured flow at an authorized percent overpressure permitted by the applicable code. Rated capacity is generally expressed in pounds per hour (lb/hr) for vapors; standard cubic feet per minute (SCFM) or m^3/min for gases; and in gallons per minute (GPM) for liquids.

- **Relief Valve**
  A relief valve is an automatic pressure-relieving device, actuated by static pressure upstream from the valve. This type of valve is used primarily for liquid service.

IV. (Continued)

- **Safety Relief Valve**
  A safety relief valve is an automatic pressure-relieving device which may be used as either a safety or relief valve, depending upon application. This type of valve is used to protect personnel and equipment by preventing excessive overpressure.

- **Safety Valve**
  A safety valve is an automatic pressure-relieving device actuated by the static pressure upstream of the valve, and characterized by rapid opening or pop action. This type of valve is used for steam, gas or vapor service.

- **Seat Tightness Pressure**
  Seat tightness pressure is the specified inlet static pressure at which a quantitative seat leakage test is performed in accordance with a standard procedure.

- **Set Pressure**
  Set pressure is the gauge pressure at the valve inlet, for which the safety relief valve has been adjusted to open under service conditions. In liquid service, set pressure is determined by the inlet pressure at which the valve starts to discharge. In gas or vapor service, the set pressure is determined by the inlet pressure at which the valve pops.

- **Simmer**
  Simmer is characterized by the audible passage of a gas or vapor across the seating surfaces just prior to "pop". The difference between this "start to open pressure" and the set pressure is simmer, and is generally expressed as a percentage of set pressure.

- **Superimposed Back Pressure**
  Superimposed back pressure is the pressure in the discharge header before the safety relief valve opens. This can be further defined as follows:

  Constant Superimposed - This type of back pressure remains essentially at a fixed value (constant) and exists (superimposed) continuously prior to and during opening of the valve. (e.g., 20 psig/1.38 bar).

  Variable Superimposed - This type of back pressure varies or changes over a range from a minimum to a maximum, or vice versa. (e.g., 0 to 20 psig/1.38 bar). The actual back pressure at any specific time depends on conditions in the piping system to which the outlet of the valve is connected.

- **Valve Trim**
  Valve trim includes the nozzle and disc.

V. Design Features and Nomenclature

A. Design Features

1. General Information

The Series 1990 portable safety relief valve has 316 stainless steel trim as standard material. Reliable performance and easy maintenance procedures are characteristics of this valve, when properly installed in suitable applications for its design.

V.A. (Continued)

The Series 3990 portable safety relief valve is of the same dimensional design as the Series 1990 portable safety relief valve. However, in the Series 3990, the component material is entirely 316 stainless steel. Thus, this valve is suitable for low temperature (-425°F) service, in properly designed installations.

All Series 1990 and Series 3990 safety relief valves have fixed blowdown. This means that the guide is prepositioned during assembly so that no further blowdown adjustment is required when setting or testing the valve.

2. Design Options

a. O-ring seat seal valves and liquid trim valves

All Series 1990 and Series 3990 Valves (with the exception of Type 3999) are available with an O-ring seat seal, as a design option. This optional design provides a bubble tightness up to 95% of the valve set pressure, in order to meet application requirements beyond the normal capabilities of metal to metal seat valves. Consolidated® Series 1990 and Series 3990 Valves with the O-ring seat seal option are identified by the suffix XDA (e.g., 1-1990-XDA).

Further, all Series 1990 and Series 3990 Valves are available with a liquid trim design option. This optional trim design provides the combination of a high coefficient of discharge with a full lift at 10% overpressure. Consolidated Series 1990 and Series 3990 Valves with the liquid trim option are identified by the suffix XLS (e.g., 3/4-1990-XLS). In addition, the liquid trim option can be combined with the O-ring seat seal option for all Series 1990 and Series 3990 Valves (with the exception of Type 3999), and this combination of options is identified by the suffix XDL (e.g., 3/4-1990-XDL).

b. Lifting Levers, Caps and Gags

All Series 1990 and Series 3990 Valves are designed so that field conversion from the standard screwed cap to a plain lifting lever cap (with the exception of Type 3999), or to a packed lifting lever cap (or vice versa) does not require valve disassembly or resetting. The lifting lever option is designed to open the valve at 75% of the valve set pressure, in compliance with ASME Code Section VIII. Further, all available series 1990 and Series 3990 Valve caps may be equipped with a gag, upon customer request.

V.A. (Continued)

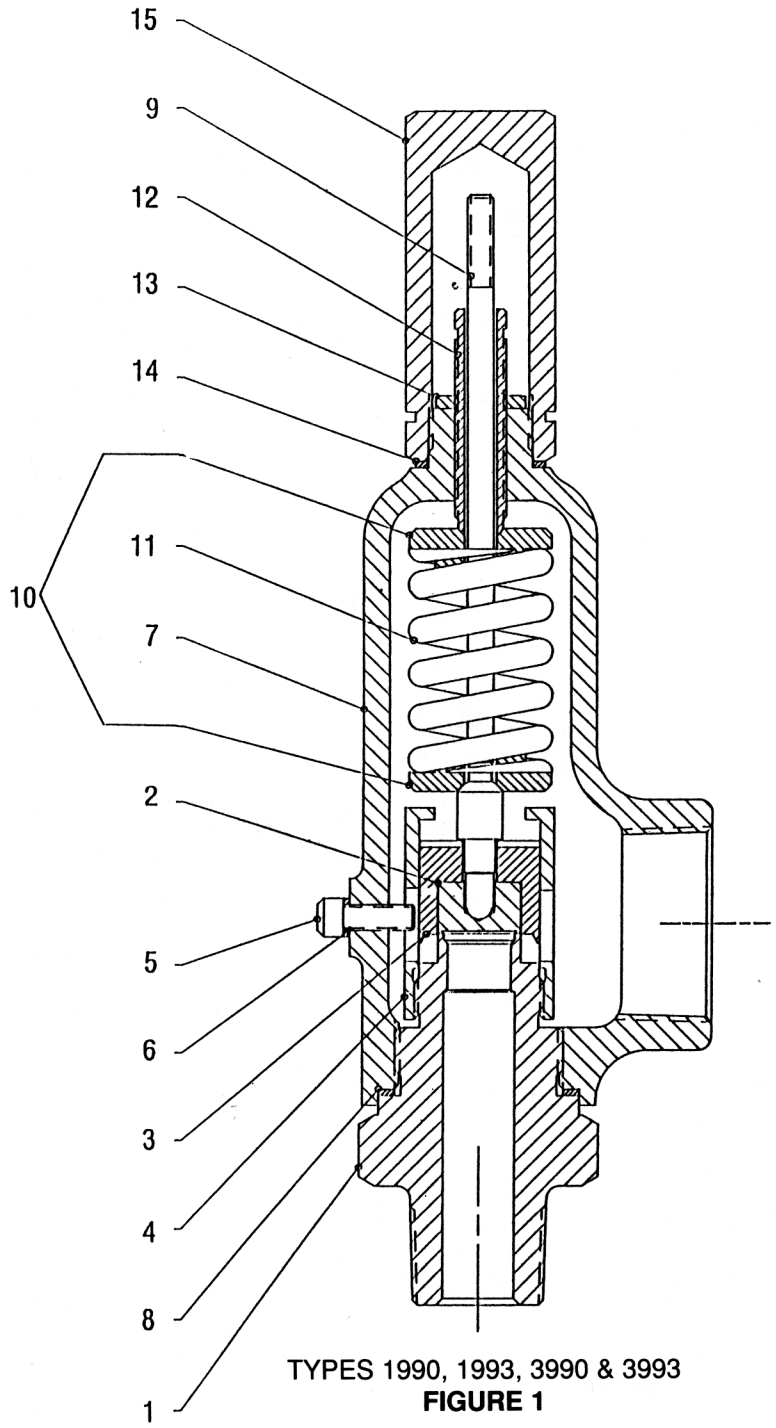
c. Inlet/Outlet Connections

All Series 1990 and Series 3990 Valves can be provided by DVCD with flanged, as opposed to socket weld, inlet and outlet connections, upon customer request.

B. Nomenclature

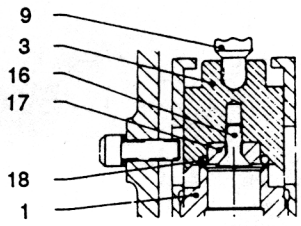
Applicable valve nomenclature for Types 1990, 1993, 3990 and 3993 (see Figure 1), Types 1994 H/HP, 1996 H, 1996 H/HP, and 3996 H (see Figure 2), Types 1995/HP, 1996 and 3996 (see Figure 3), Types 1997, 1998, 3997 and 3998 (see Figure 4) and Type 3999 (see Figure 5) is provided on pages 9, 10, 11, 12 and 13, respectively. Further, relevant parts nomenclature for such design options as the O-ring seat seal (XDA), liquid trim (XLS) and the combination (XDL) are provided for each of the above specified valve types, where applicable, as Figures 1A, 1B, 1C, etc. Relevant parts nomenclature for the optional lifting levers, caps and the gag, as applicable, is shown in Figures 6 thru 9 on page 14.

V.B. (Continued)

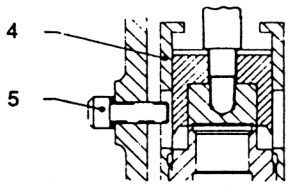


Part No.	Nomenclature
1	Base
2	Disc
3	Disc Holder
4	Guide
5	Guide Pin
6	Guide Pin Gasket
7	Bonnet
8	Bonnet Gasket
9	Spindle
10	Spring Washers
11	Spring
12	Adjusting Screw
13	Adjusting Screw Lock-nut
14	Cap Gasket
15	Screwed Cap
16	Retainer Lock Screw
17	O-ring Retainer
18	O-ring Seat Seal

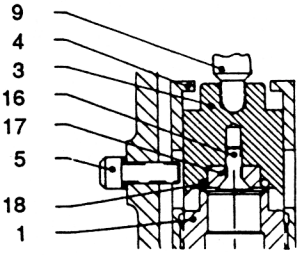
TYPES 1990, 1993, 3990 & 3993
FIGURE 1



XDA
FIGURE 1A



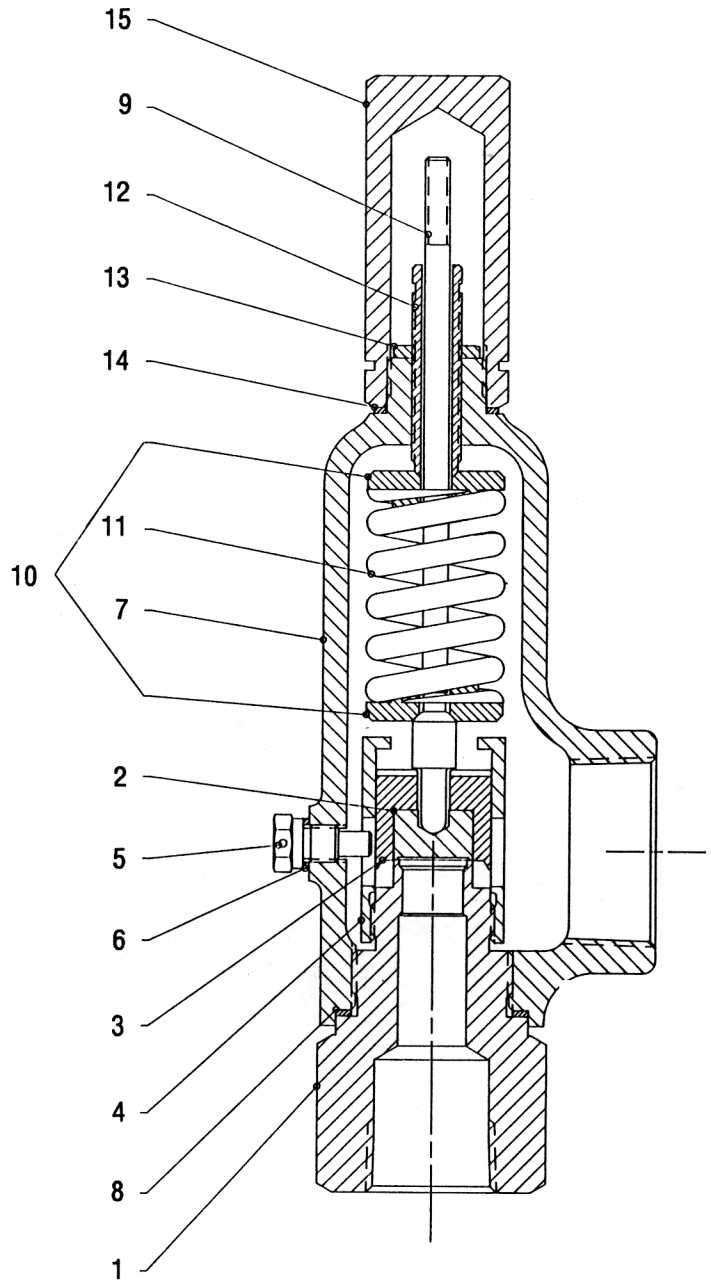
XLS
FIGURE 1B



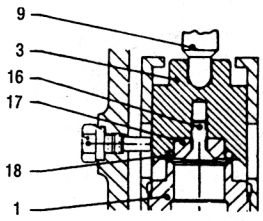
XDL
FIGURE 1C

V.B. (Continued)

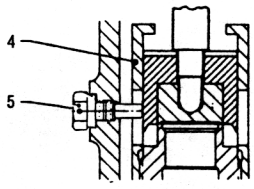
Part No.	Nomenclature
1	Base
2	Disc
3	Disc Holder
4	Guide
5	Guide Pin
6	Guide Pin Gasket
7	Bonnet
8	Bonnet Gasket
9	Spindle
10	Spring Washers
11	Spring
12	Adjusting Screw
13	Adjusting Screw Lock-nut
14	Cap Gasket
15	Screwed Cap
16	Retainer Lock Screw
17	O-ring Retainer
18	O-ring Seat Seal



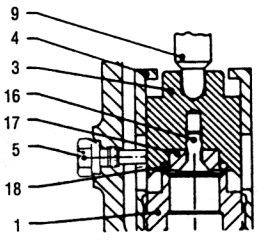
TYPES 1994 H/HP, 1996 H, 1996 H/HP & 3996 H
FIGURE 2



XDA
FIGURE 2A

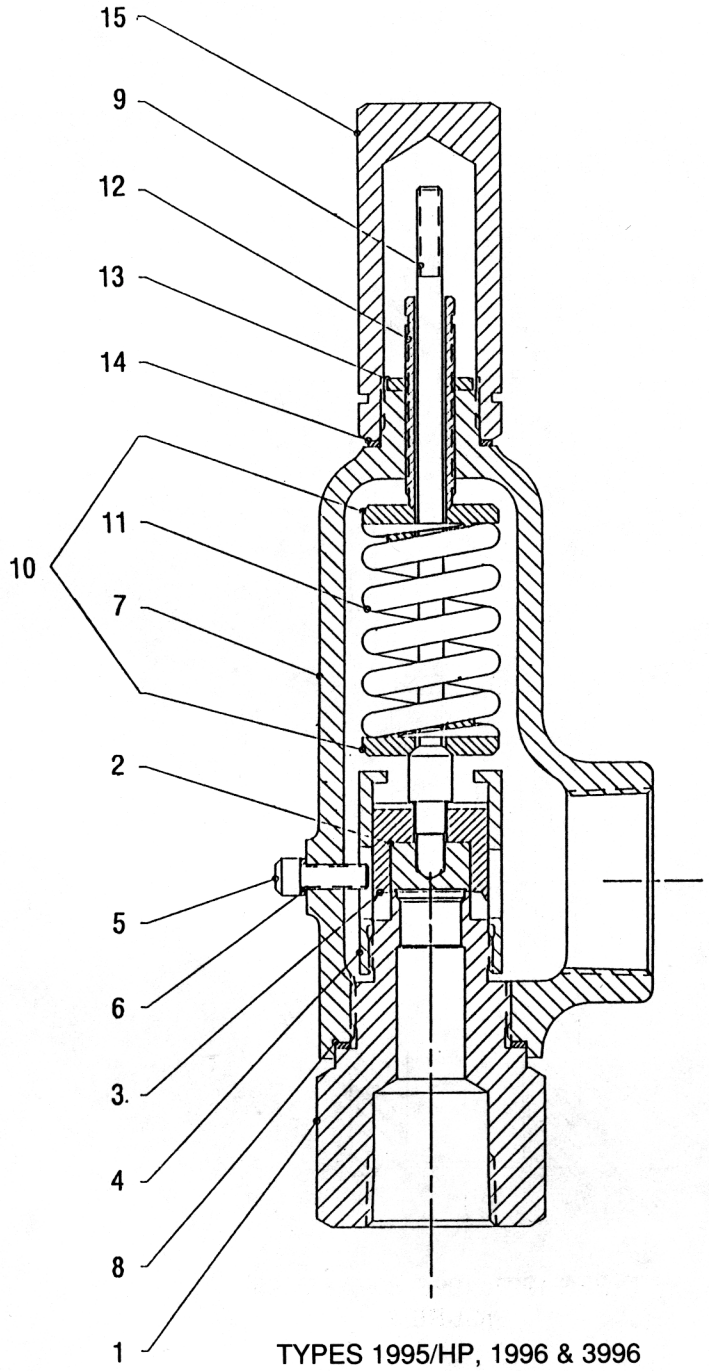


XLS
FIGURE 2B



XDL
FIGURE 2C

V.B. (Continued)



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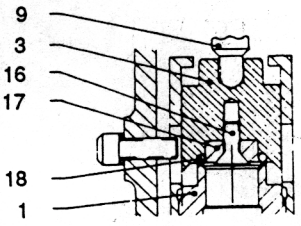
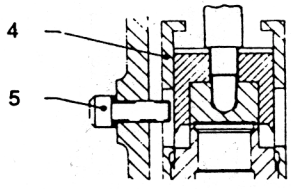
9	Spindle
10	Spring Washers
11	Spring
12	Adjusting Screw
13	Adjusting Screw Lock-nut
14	Cap Gasket
15	Screwed Cap
16	Retainer Lock Screw
17	O-ring Retainer
18	O-ring Seat Seal

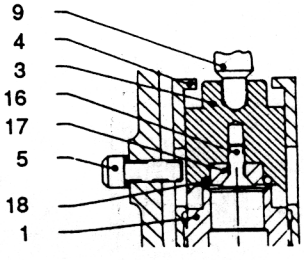
TYPES 1995/HP, 1996 & 3996
FIGURE 3



XDA
FIGURE 3A



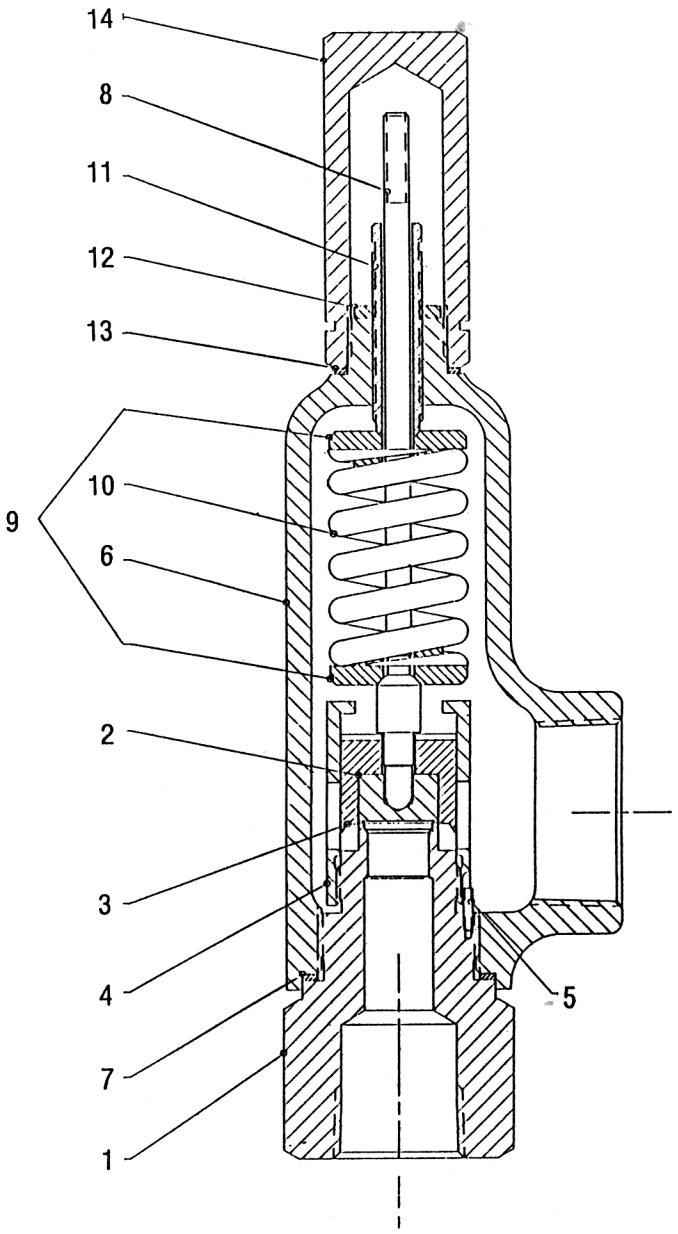
XLS
FIGURE 3B



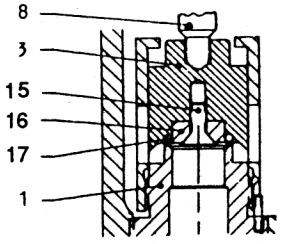
XDL
FIGURE 3C

V.B. (Continued)

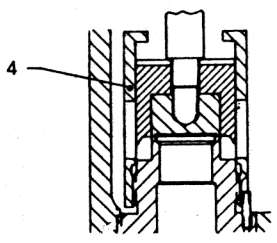
Part No.	Nomenclature
1	Base
2	Disc
3	Disc Holder
4	Guide
5	Guide Pin
6	Bonnet
7	Bonnet Gasket
8	Spindle
9	Spring Washers
10	Spring
11	Adjusting Screw
12	Adjusting Screw Locknut
13	Cap Gasket
14	Screwed Cap
15	Retainer Lock Screw
16	O-ring Retainer
17	O-ring Seat Seal



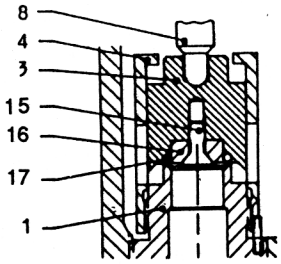
TYPES 1997, 1998, 3997 & 3998
FIGURE 4



XDA
FIGURE 4A

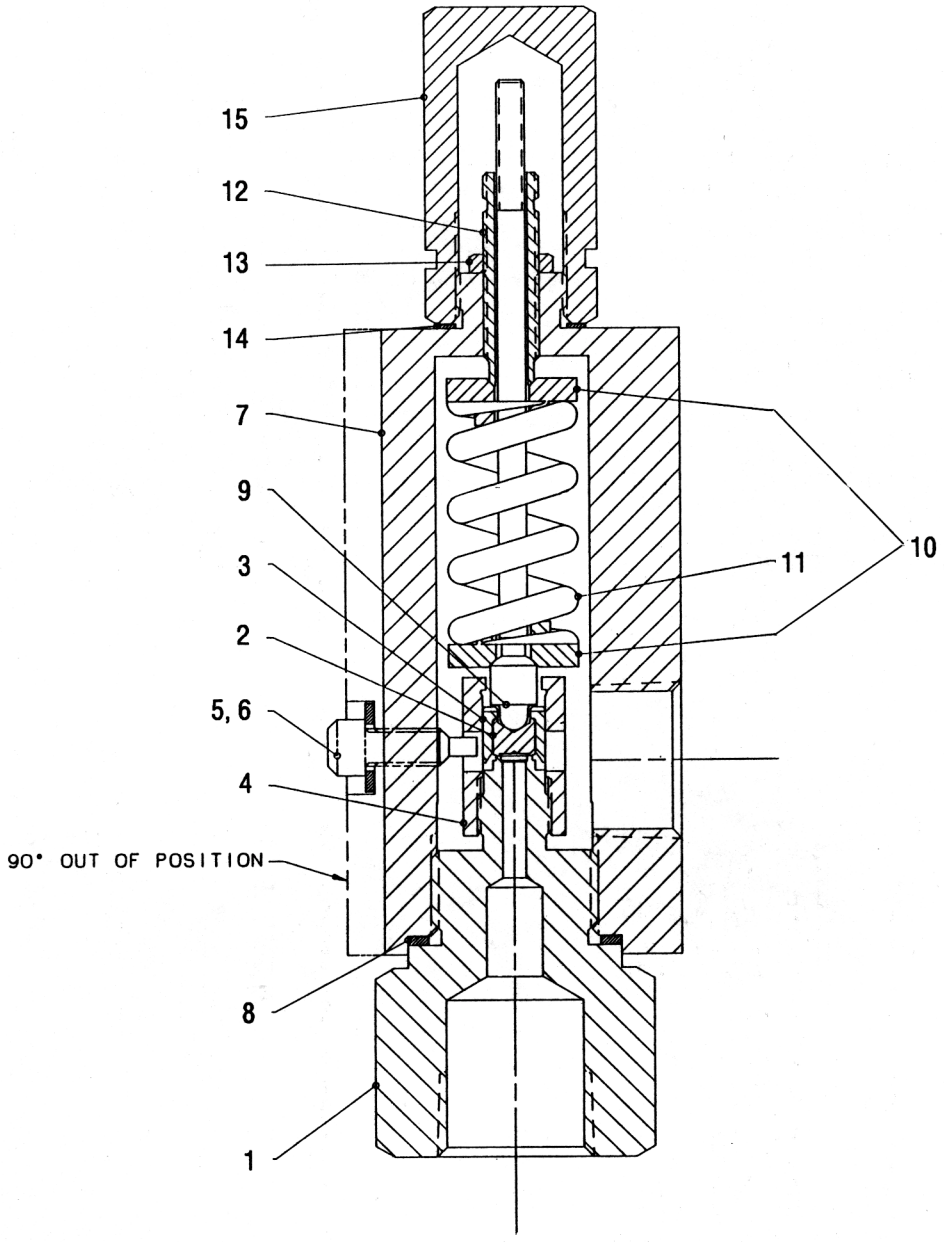


XLS
FIGURE 4B



XDL
FIGURE 4C

V.B. (Continued)



Part No.	Nomenclature
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5	Guide Pin
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7	Bonnet
8	Bonnet Gasket
9	Spindle
10	Spring Washers
11	Spring
12	Adjusting Screw
13	Adjusting Screw Lock-nut
14	Cap Gasket
15	Screwed Cap

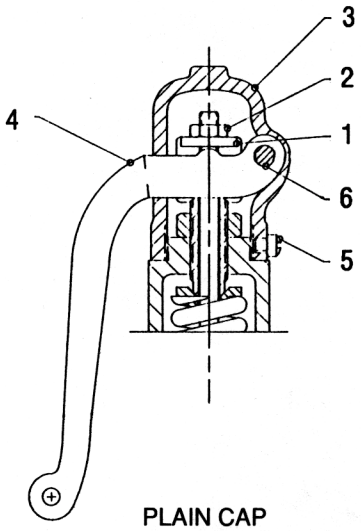
TYPE 3999
FIGURE 5

NOTES:

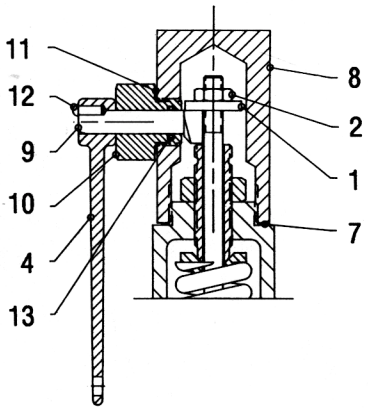
- **The Type 3999 Valve is not available with an O-ring seat seal (XDA).**
- **The liquid trim (XLS) design option is available simply by substituting the liquid trim guide for the standard guide.**

V.B. (Continued)

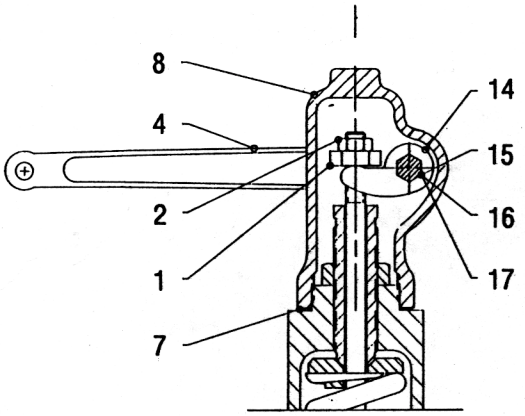
Part No.	Nomenclature
1	Release Nut
2	Release Locknut
3	Plain Cap
4	Lifting Lever
5	Cap Screw
6	Lever pin
7	Cap Gasket
8	Packed Cap
9	Cam Shaft
10	Bushing
11	Bushing Gasket
12	Drive Screw
13	O-ring
14	Lifting Fork
15	Lifting Shaft
16	Packing
17	Packing Nut
18	Gag Bolt
19	Sealing Plug
20	Sealing Plug Gasket



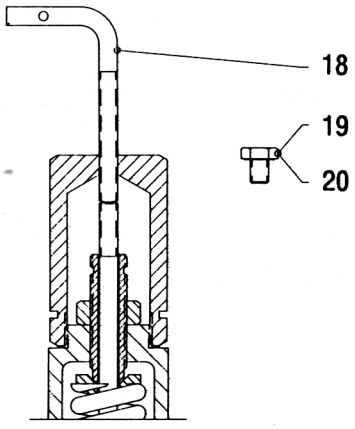
PLAIN CAP
WITH LIFTING LEVER FOR
ALL SERIES 1990 AND
SERIES 3990* VALVES
FIGURE 6



PACKED CAP
WITH LIFTING LEVER FOR TYPES
1990, 1993, 1995/HP, 1996, 3990,
3993, 3996 AND 3999
FIGURE 7



PACKED CAP WITH LIFTING
LEVER FOR TYPES 1994 H/HP,
1996 H, 1996 H/HP, 1997, 1998,
3996 H, 3997 AND 3998
FIGURE 8



TYPICAL**
CAP WITH GAG
FIGURE 9

* Plain cap with lifting lever not available for valve Type 3999.

** Both the standard screwed cap and the optional caps can be provided with a gag, if required.

VI. Handling, Storage and Pre-Installation

A. Handling

Safety relief valves, either crated or uncrated, should never be subjected to sharp impact. This would be most likely to occur by bumping or dropping during loading or unloading from a truck. While hoisting to the installation, care should be taken to prevent bumping the valve against steel structures and other objects.

NOTE:

Never lift the full weight of the valve by the lifting lever (if the valve is so equipped).

B. Storage

Safety relief valves should be stored in a dry environment to protect them from the weather. They should not be removed from the crates until immediately prior to installation.

Protectors and sealing plugs (both inlet and outlet) should not be removed until the valve is ready to be installed.

C. Pre-installation

When safety relief valves are uncrated, and the protectors or sealing plugs have been removed (immediately prior to installation), meticulous care should be exercised to prevent dirt and other foreign materials from entering the inlet and outlet ports.

VII. Recommended Installation Practices

A. Mounting Position

Safety relief valves should be mounted in only a vertical upright position (per API RP520). Installing a safety relief valve in other than a vertical position (±1 degree) will adversely affect its operation in varying degrees, as a result of induced misalignment of moving parts.

A stop valve may be placed between the pressure vessel and its relief valve only as permitted by code regulations. If a stop valve is located between the pressure vessel and safety relief valve, the stop valve port area should equal or exceed the nominal internal area associated with the pipe size of the safety relief valve inlet. The pressure drop from the vessel to the safety relief valve shall not exceed 3% of the valve's set pressure, when flowing at full capacity.

The inlet and outlet ports, and sealing faces, of the valve and all connecting piping must be free from dirt, sediment and scale.

Safety relief valves should be located for easy access and/or removal so that servicing can be properly performed. Sufficient working space should be provided around, and above, the valve.

B. Inlet Piping

The inlet piping (see Figure 10, on the opposite page) to the valve should be short and direct from the vessel, or equipment, being protected. The connection to the vessel should be provided with a radius to permit smooth flow to the valve. Sharp corners should be avoided. If this is not practical, then the inlet should be bored at least one additional pipe diameter. In any event, the pressure drop from the vessel to the valve should not exceed 3% of valve set pressure when the valve is flowing full capacity. In no event should the inlet piping be smaller in diameter than the inlet connection of the valve. Excessive pressure loss at the inlet of a pressure relief valve in gas, vapor, or flashing-liquid service will cause extremely rapid opening and closing of the valve, which is known as "chattering". Chattering will result in lowered capacity and damage to the seating surfaces. The most desirable installation is that in which the nominal size of the inlet piping is the same as, or greater than, the nominal size of the valve inlet, and in which the length does not exceed the face-to-face dimensions of a standard tee of the required pressure class.

Safety relief valve inlets should not be located at the end of a long horizontal pipe through which there is normally no flow. Foreign matter may accumulate, or liquid may be trapped, and may interfere with the operation of the valve, or be the cause of more frequent valve maintenance.

VII.B. (Continued)

Safety relief valve inlets should not be located where excessive turbulence is present such as near elbows, tees, bends, orifice plates, or throttling valves.

Section VIII of the ASME Boiler and Pressure Vessel Code requires that the design of the inlet connection consider stress conditions incuded by reaction forces during valve operation, by external loading, by vibration and by loads due to thermal expansion of discharge piping.

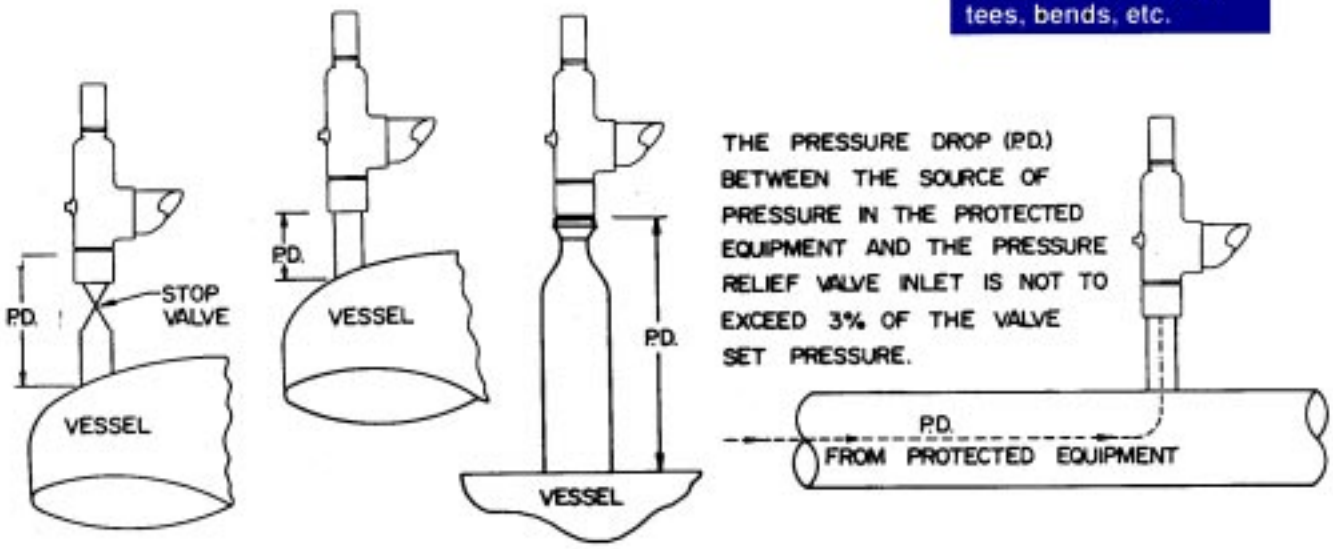


FIGURE 10

1. The determination of reaction forces during valve discharge is the responsibility of the vessel and/or piping designer. DVCD publishes certain technical information about reaction forces under various fluid flow conditions, but assumes no liability for the calculations and design of the inlet piping.

2. External loading by poorly designed discharge piping and support systems can be the cause of excessive stresses and distortions in the valve as well as the inlet piping. The stresses set up in the valve may cause malfunctioning or leakage of the valve. Forced alignment of the discharge piping will also induce such stresses. Discharge piping should be independently supported and carefully aligned.

VII.B. (Continued)

3. Vibrations in the inlet piping systems may cause valve seat leakage and/or fatigue failure of the piping. These vibrations may cause the disc seat to slide back and forth across the nozzle seat and result in damage to the seating surfaces. Vibration may also cause separation of the seating surfaces and premature wear to certain valve parts. High-frequency vibrations are more detrimental to pressure relief valve tightness than low-frequency movements. This effect can be minimized by providing a larger difference between the operating pressure of the system and the set pressure of the valve, particularly under high-frequency conditions.

4. Temperature changes in the discharge piping may be caused by fluid flowing from the discharge of the valve, prolonged exposure to the sun, or heat radiated from nearby equipment. Any change in temperature of the discharge piping will cause a change in the length of the piping. The resulting change in length may cause stresses which will be transmitted to the pressure relief valve and its inlet piping. Stresses caused by thermal changes in the discharge piping can be avoided by proper support, anchoring, or provision for flexibility of the discharge piping. **Fixed supports should not be used.**

C. Outlet Piping

Alignment of the internal parts of a safety relief valve is important to ensure proper operation (see Figure 11, below). Although the valve body will withstand a considerable mechanical load, unsupported discharge piping consisting of more than a companion flange, long radius elbow and a short vertical pipe is not recommended. Care should be taken to ensure thermal expansion of piping and support system does not produce strains in a valve. Spring supports are recommended where this may be the case. The discharge piping should be designed to allow for vessel expansion as well as expansion of the discharge pipe itself. This is particularly important on long distance lines.

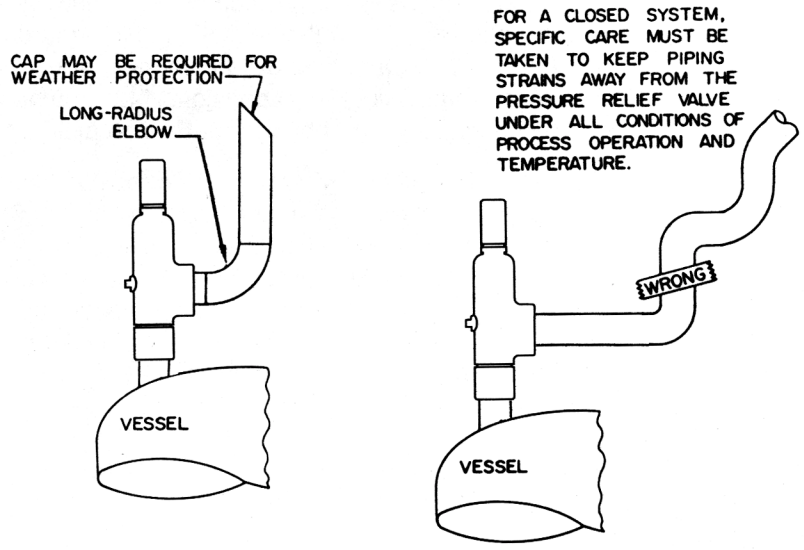


FIGURE 11

VII.C. (Continued)

Consideration should be given to discharge pipe movement resulting from wind loads, since a continual oscillation of the discharge piping introduces stress distortion in the valve body, and the resultant movement of the internal parts may cause leakage.

As a final point, the discharge piping size is never less than the size of the valve outlet, it shall not be heavier than schedule 40 pipe size, and the discharge piping must be designed to limit the total backpressure to a maximum of 10% of the valve set pressure, or 400 psi, whichever is smaller.

VIII. Disassembly Instructions

A. General Information

Consolidated® Safety Relief Valves can be easily disassembled for inspection, reconditioning seats, or replacing internal parts. Appropriate set pressure can be established after reassembly. (Again, refer to Figure 1, 1A, 1B & 1C thru Figure 5, for parts nomenclature.)

NOTES:

- **Before starting to disassemble the valve, be sure that there is no media pressure in the vessel.**
- **Parts from one valve should not be interchanged with parts from another valve.**

B. Metal to Metal Seat Valves, Including Liquid Trim Option (XLS)

1. Remove the cap (including lifting gear, if any); then, remove the cap gasket.
2. Remove the guide pin and the guide pin gasket from the bonnet, where applicable (i.e., on Valve Types 1990, 1993, 1994 H/HP, 1995/HP, 1996, 1996 H, 1996 H/HP, 3990, 3993, 3996, 3996 H and 3999).
3. Loosen the adjusting screw locknut.
4. Remove the adjusting screw. Count, and record, the number of turns necessary to barely remove all spring compression. (Removal of the spring compression is indicated when the spindle stops rotating.)
5. Unscrew the bonnet from the base.

VIII.B. (Continued)

6. Remove the spring and spring washers.
7. Remove the internal guide pin, where applicable (i.e., on Valve Types 1997, 1998, 3997 and 3998).
8. Remove the guide, disc holder and spindle from the base.
9. Remove the spindle from the disc.
10. Remove the disc from the disc holder.

C. O-Ring Seat Seal Valves (XDA), Including Combination O-Ring Seat Seal and Liquid Trim Option (XDL)

1. Remove the cap (including lifting gear, if any); then, remove the cap gasket.
2. Remove the guide pin and the guide pin gasket from the bonnet (i.e., on Types 1990 XDA and XDL, 1993 XDA and XDL, 1994 H/HP XDA and XDL, 1995/H XDA and XDL, 1996 XDA and XDL, 1996H XDA and XDL, 1996 H/HP XDA and XDL, 3990 XDA and XDL, 3993 XDA and XDL, 3996 XDA and XDL, and 3996 H XDA and XDL).
3. Loosen adjusting screw locknut.
4. Remove the adjusting screw. Count, and record, the number of turns necessary to barely remove all spring compression. (Removal of the spring compression is indicated when the spindle stops rotating.)
5. Unscrew the bonnet from the base.
6. Remove the spring and spring washers.
7. Remove the internal guide pin (i.e., on Types 1997 XDA and XDL, 1998 XDA and XDL, 3997 XDA and XDL, and 3998 XDA and XDL).
8. Remove the guide, O-ring disc holder assembly and spindle from the base.
9. Remove the spindle from the disc holder.
10. Remove the lock screw and the O-ring retainer.
11. Carefully remove the O-ring. Be sure not to damage the O-ring groove in the disc holder.

IX. Maintenance Instructions

A. Metal to Metal Seat Valves, Including Liquid Trim Option (XLS)

1. Precautions and Hints for Lapping Seats

Reconditioning of the seat surface may be accomplished by lapping with a flat cast iron ring lap coated with Grade No. 1000 Kwik-Ak-Shun Silicone Carbide compound or its equivalent. The following precautions and hints will enable maintenance personnel to do a "professional" job of lapping seats:

a. Keep work materials clean.

b. Always use a fresh lap. If signs of wearing (out of flatness) are evident, recondition the lap. Reconditioning of laps is accomplished by lapping them on a flat lapping plate. The lapping should be done with a figure-eight motion as indicated in Figure 12, below. To assure the best results when lapping seats, the laps should be reconditioned after each usage and checked with an optical flat.

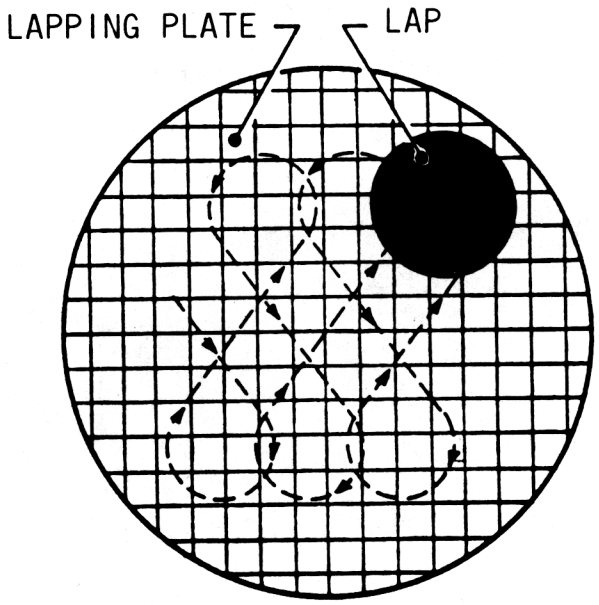


FIGURE 12

c. Apply a very thin layer of compound to the lap. This will prevent rounding off the edges of the seat.

d. Keep the lap squarely on the flat surface, and avoid any tendency to rock the lap which causes rounding of the seat.

e. When lapping, keep a firm grip on the part to prevent the possibility of dropping it and damaging the seat.

f. Lap, using an eccentric, or figure-eight motion, in all directions, while at the same time, applying uniform pressure and rotating the lap slowly. (Again, see Figure 12, above.)

IX.A. (Continued)

g. Replace the compound frequently after wiping off the old compound, and apply more pressure to speed the cutting action of the compound.

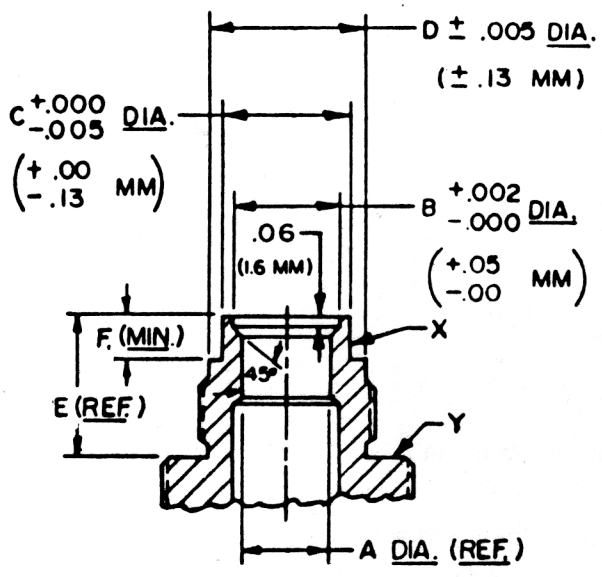
h. To check the seating surfaces, remove all compound from both the seat and the lap. Then, shine the seat with the same lap using the lapping motion described above. Low sections on the seating surface will show up as a shadow in contrast to the shiny portion. If shadows are present, further lapping is necessary and only laps known to be flat should now be used. Only a few minutes will be required to remove the shadows.

i. When the lapping is completed, any lines appearing as cross scratches can be removed by rotating the lap (which has been wiped clean of compound) on the seat about its own axis.

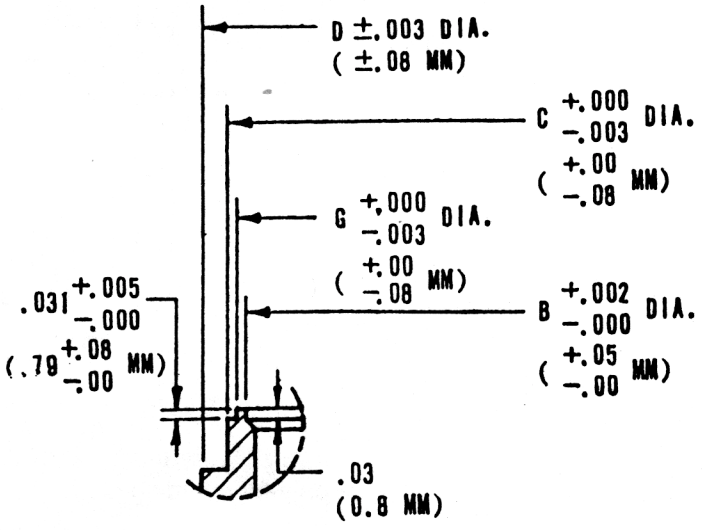
j. The seat should now be thoroughly cleaned using a lint-free cloth and a cleansing fluid.

2. Machining the Base Seat

a. When the base seat cannot be repaired by lapping, it can be machined as shown in Figure 13, below, using the dimensions provided in Table I, on the following page.



All series 1990 valves (except 1997 and 1998) and all series 3990 valves (except 3997 and 3998)



Type 1997, 1998, 3997 & 3998 valves only

FIGURE 13

IX.A. (Continued)

TABLE I
REWORKING DIMENSIONS OF THE METAL TO METAL SEAT BASE

VALVE TYPE	ORIFICE TYPE SQ. IN. SQ. CM.	A (REF.) IN. MM.	B IN. MM.	C IN. MM.	D IN. MM.	E (REF.) IN. MM.	F (MIN.)* IN. MM.	G IN. MM.
1990 & 3990	.110 .710	.375 9.5	.392 10.0	.506 12.9	.650 16.5	3/4 19.1	.178 4.5	
1995/HP	.110 .710	.375 9.5	.392 10.0	.506 12.9	.650 16.5	3/4 19.1	.178 4.5	
1993, 3993, 1996 & 3996	.292 1.884	.610 15.5	.684 17.4	.798 20.3	1.158 29.4	29/32 23.0	.265 6.7	
1997 & 3997	.442 2.852	.750 19.1	.854 21.7	1.115 28.3	1.425 36.2	1-17/32 38.9	.360 9.1	
1998 & 3998	.754 4.865	.980 24.9	1.000 25.4	1.215 30.9	1.521 38.6	1-15/32 37.3	.360 9.1	
3999	.019 .123	.156 3.96	.178 4.52	.283 7.19	.413 10.49	5/8 15.9	.088 2.24	.243 6.17
1994 H/HP	.126 .813	.401 10.19	.430 10.92	.638 16.21	.944 23.98	27/32 21.4	.203 5.16	
1996H, 1996 H/ HP& 3996H	.226 1.458	.531 13.64	.556 14.12	.798 20.3	1.158 29.4	27/32 21.4	.203 5.16	

b. DVCD recommends that the following procedure be adhered to when machining the base seat:

(1) Using a four-jaw chuck, align the base so that surfaces marked X and Y run true within .001" on an indicator.

(2) Take light cuts on the seat surface until all damage is removed. Re-establish seat dimensions except F (min.). When F (min.) is obtained, the base should be replaced.

(3) After all machining has been accomplished, lap the seat.

3. Lapping the Disc Seat

The disc seat may be reconditioned using essentially the same procedures described for the base seat; however, the dimensions provided in Table II, below, should be used to determine the seat width.

TABLE II

VALVE	SET PRESSURE		NOMINAL LAPPED SEAT WIDTH	
Series 1990	(psi)	(bar)	(in)	(mm)
and	21-100	1.448-6.896	.010	.254
Series 3990	101-300	6.965-20.689	.015	.381
	301-800	20.758-55.172	.020	.510
	801-Up	55.241-Up	*	*

* Add .005 in. (.127mm) per 100 psi (6.896 bar) not to exceed a total width of .070 in (1.778mm).

IX.A. (Continued)

The seat width can be measured by the use of a "Measuring Magnifier" (see Figure 14.A below). DVCD recommends the use of Model S1-34-35-37 (which is manufactured by Bausch and Lomb Optical Co., Rochester, N.Y.). This is a seven power glass, with a three quarter inch scale showing graduations of 0.005 inch. The use of this scale in measuring the seat width is shown in Figure 14.B. (also below).

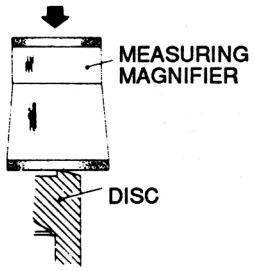


FIGURE 14.A

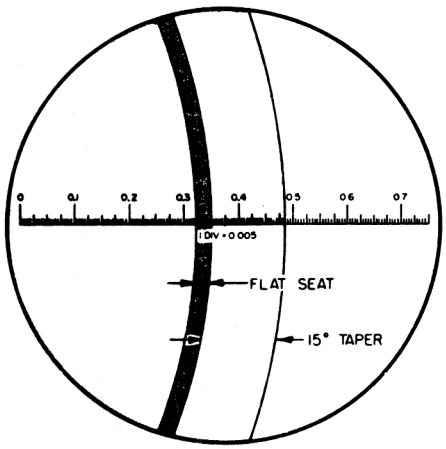


FIGURE 14.B

If additional lighting is required for measuring the seat, DVCD suggests a goose-neck flashlight similar to the Type A Lamp Assembly Flashlight (which is manufactured by Standard Molding Corporation, Dayton, Ohio).

4. Machining the Disc Seat

a. When the disc seat cannot be repaired by lapping, it can be machined as shown in Figure 15, below, using the dimensions provided in Table III, on the opposite page.

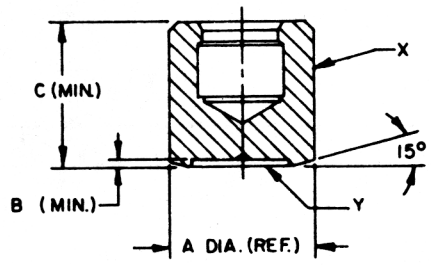


FIGURE 15

IX.A. (Continued)

TABLE III
REWORKING DIMENSIONS OF THE DISC SEAT

VALVE TYPE	ORIFICE TYPE SQ. IN. SQ. CM.	A (DIA.) (REF.) IN. MM.	B (MIN.) IN. MM.	C (MIN.) IN. MM.
1990 & 3990	.110 .710	.507 12.9	.010 .3	.490 12.4
1995/HP	.110 .710	.507 12.9	.010 .3	.490 12.4
1993, 3993, 1996, 3996	.292 1.884	.799 20.3	.010 .3	.490 12.4
1997 & 3997	.442 2.852	1.118 28.4	.010 .3	.615 15.6
1998 & 3998	.754 4.865	1.249 31.7	.010 .3	.615 15.6
3999	.019 .123	.284 7.21	.010 .25	.240 6.10
1994 H/HP	.126 .813	.639 16.23	.010 .25	.687 17.45
1996H, 1996 H/ HP& 3996H	.226 1.458	.799 20.29	.010 .25	.687 17.45

b. DVCD recommends that the following procedure be adhered to when machining the DISC seat:

(1) Grip the disc in a collet.

(2) True up the disc so that surfaces marked X and Y run true.

(3) Take light cuts across the seating surface at 15° until the damage is removed.

(4) The disc is now ready for lapping.

(5) When the minimum dimensions B and/or C are reached, the disc should be replaced.

B. O-Ring Seat Seal Valves (XDA), Including Combination O-Ring Seat Seal and Liquid Trim Option (XDL)

1. Replacing the Disc

The disc cannot be refurbished by either lapping or machining; therefore, if the disc is damaged, it must be replaced.

IX.B. (Continued)

2. Polishing the Base Seat

Normally the base seating area on this type of valve is not damaged, since the "O" ring absorbs the impact when foreign material is trapped between the "O" ring and the base seating area. The "O" ring will therefore hold a bubble tight seal with slight indications on the base seating surface. Nevertheless, slight indications on the base seat surface may be removed by placing the base in a lathe and polishing the damaged area.

NOTE:

Remember that the O-ring should be replaced during "Reassembly."

C. Checking Spindle Concentricity

1. General Information

It is important that the spindle of a safety relief valve be straight, in order to transmit the spring load to the disc without lateral binding. Over-gagging is one of the common causes of bent spindles. To check the essential working surfaces of the spindle, the method stated in paragraph IX.C.2 (on the following page) is recommended.

IX.C. (Continued)

2. V-Block Support Set Up

a. The ball pointed spindles should be placed in a piece of material, B, that has been recessed to permit free rotation of the spindle. (See Figure 16, below.)

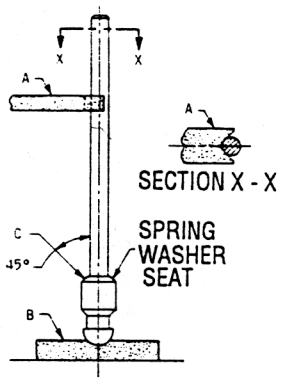


FIGURE 16

b. Support the spindle with a V-block A, placed near the upper end of the spindle, but below the threads.

c. Apply a machinist's indicator at approximately 45° to the outer edge of the spring washer seat at C. Rotate the spindle. The total indicator reading should not exceed .005". Straighten the spindle, if necessary.

X. Reassembly

A. Metal to Metal Seat Seals, Including Liquid Trim Option (XLS)

NOTE:

- **Insure that the guide is properly positioned. Failure to properly position the guide may result in decreased valve capacity.**

X.A. (Continued)

1. Bearing surfaces should be ground together using Clover 3A compound. These surfaces are: (a) the disc spindle pocket and spindle spherical nose radius, (b) the lower spring washer and spindle spring washer radius and (c) the upper spring washer and adjusting screw spherical radius. Remember that, before assembly, all parts should be cleaned.

2. Apply small amount of "Kopr-Kote" to the base bonnet gasket surface and the bonnet threads. Place the bonnet gasket on the base, and apply a small amount of "Kopr-Kote" to the gasket surface. When a stainless steel bonnet and base are used, or a standard bonnet for service above 500°F temperature, apply "Molykote" to the bonnet threads on the base in place of the above mentioned "Kopr-Kote".

3. Use a clean, properly lapped disc for valve set pressure (again, see Table II on page 23) that is free of nicks and burrs. Place the disc in the disc holder, with the disc seat facing outward. Check the spindle and disc holder assembly for wobble by firmly pressing the disc against the disc holder, and pushing the spindle in the disc spindle pocket. A slight amount of wobble should be present and is required to obtain valve seat tightness. Remove the spindle from the assembly.

4. Place the disc assembly in the guide and, while holding the disc assembly off the base seat, screw the guide onto the base until the guide bottoms out on the base shoulder.

5. For metal to metal seat seal valves which ***do not*** have the liquid trim (XLS) option:

   a. Align the guide hole on Types 1990, 1993, 1994 H/HP, 1995/HP, 1996, 1996H, 1996 H/HP, 3990, 3993, 3996, 3996H and 3999 with the outlet centerline, and back the guide off 5 notches (holes) from the base shoulder.

X.A. (Continued)

b. Align the guide case notch on Types 1997, 1998, 3997 and 3998 with the threaded guide pin hole in the base by backing the guide off the base face 1/4 turn or less. Then, back the guide off 5 notches. Install the guide pin using a 3/32" hex allen wrench. Apply sufficient torque to keep the guide pin from backing out.

6. For metal to metal seat seal valves which ***have*** the liquid trim (XLS) option:

   a. Back the guide off on Types 1990-XLS, 1993-XLS, 1994 H/HP-XLS, 1995/HP-XLS, 1996-XLS, 1996 H-XLS, 1996 H/HP-XLS, 3990-XLS, 3993-XLS, 3996-XLS, 3996 H-XLS and 3999-XLS until the bottom of the guide holes are even with the bottom of the disc holder; then, back the guide off until a guide hole aligns with the outlet centerline of the valve.

   b. Back the guide off on Types 1997-XLS, 1998-XLS, 3997-XLS and 3998-XLS until the bottom of the guide holes align with the bottom of the disc holder; then, align the guide cast notch with the threaded guide pin hole in the base by backing the guide off the base an additional 1/4 turn or less. Install the guide pin using a 3/32" hex allen wrench. Apply sufficient torque to keep the guide pin from backing out.

7. Lubricate the spindle nose with a small amount of "Molykote", and insert the spindle into the disc spindle pocket.

8. Apply a small amount of "Molykote" on the bearing surface of the lower spring washer, and slip it over the spindle. Install the spring and upper spring washer.

X.A. (Continued)

9. Install a new bonnet gasket on the base. Apply a small amount of "Kopr-Kote" to the bonnet base threads and gasket surface. When a stainless steel bonnet and base are used, and/or a standard bonnet for service above 500° temperature, apply "Molykote" to the bonnet base threads and gasket surface. Install the bonnet on the base using sufficient torque to obtain a proper gasket seal. Place the guide pin gasket onto guide pin and lightly coat both sides of the gasket with Molykote. Install the guide pin and guide pin gasket into the bonnet using a 3/16" hex allen wrench to tighten the guide pin in order to obtain a leak tight seal. Check the guide and disc holder for binding, since slight movement is required.

10. Thread the adjusting screw locknut on the adjusting screw. Apply a light coat of "Molykote" to the adjusting screw threads and spherical radius. Install the adjusting screw in the bonnet, rotating the number of times required to compress the spring slightly. When the spindle begins to turn, use pliers to hold it in position and rotate the adjusting screw the number of turns recorded at disassembly (Again, see Paragraph VIII.B.4 on page 19).

11. The valve is now ready for setting. After the set pressure has been adjusted, tighten the adjusting screw locknut. Install the cap and cap gasket, or lifting gear, on the valve after applying a small amount of "Molykite" to the gasket seal surfaces, as well as to the cap and bonnet threads. On those valves with a lifting gear, wire the lifting lever securely to the valve.

B. O-Ring Seat Seal Valves (XDA), Including O-Ring Seal Seal and Liquid Trim Option (XDL)

NOTE:

Insure the guide is properly positioned. Failure to properly position guide may result in decreased valve capacity.

1. All bases shall have seats free of nicks and burrs and with a 63 rms finish (maximum).

X.B. (Continued)

2. Bearing surfaces should be ground together using Clover 3A compound. These surfaces are: (a) the disc spindle and spindle spherical nose radius, (b) the lower spring washer and spindle spring washer radius and (c) the upper spring washer and adjusting screw spherical radius. Remember that, before assembly, all parts should be cleaned.
3. Carefully insert a new O-ring seal into the disc holder. Make sure the O-ring is the right size, material and hardness for the application. Refer to the valve nameplate for information required when ordering an O-ring.
4. Install the O-ring retainer and a new retainer lock screw.
5. Place the disc holder assembly in the guide, and screw the guide onto base until the guide bottoms out on the base shoulder.
6. For O-ring seat seal valves (XDA) which ***do not*** have the combination liquid trim option (XDL):
    a. Align the guide hole on Types 1990-XDA, 1993-XDA, 1994 H/HP-XDA, 1995/HP-XDA, 1996-XDA, 1996 H-XDA, 1996 H/HP-XDA, 3990-XDA, 3993-XDA, 3996-XDA and 3996 H-XDA with the outlet centerline by backing the guide off the base face 1/4 turn or less. Then, back the guide off 5 notches (holes) from the base shoulder.
    b. Align the guide cast notch on Types 1997-XDA, 1998-XDA, 3997-XDA and 3998-XDA with the threaded guide pin hole in the base by backing the guide off the base face 1/4 turn or less. Then, back the guide off 5 notches.

X.B. (Continued)

7. For O-ring seat seal valves (XDA) which ***have*** the combination liquid trim option (XDL).

   a. Back the guide pin off on Types 1900-XDL, 1993-XDL, 1994 H/HP-XDL, 1995/HP-XDL, 1996-XDL, 1996H-XDL, 1996 H/HP-XDL, 3990-XDL, 3993-XDL, 3996-XDL and 3996 H-XDL until the bottom of the guide holes are even with the bottom of the disc holder; then, back the guide off until a guide hole aligns with the outlet centerline of the valve.

   b. Back the guide off on Types 1997-XDL, 1998-XDL, 3997-XDL and 3998-XDL until the bottom of the guide holes align with the bottom of the disc holder, then align the guide cast notch with the threaded guide pin hole in the base by backing the guide off the base an additional 1/4 turn or less.

8. Lubricate the spindle nose with a small amount of "Molykote", and insert the spindle into the disc spindle pocket.

9. Apply a small amount of "Molykote" on the bearing surface of the lower spring washer, and slip it over the spindle. Install the spring and upper spring washer.

10. Install a new bonnet gasket on the base. Apply "Kopr-Kote" to the bonnet threads on the base and install the bonnet on the base. When a stainless steel bonnet and base are used, apply "Molykote", in place of "Kopr-Kote", to the bonnet threads on the base and, then, install the bonnet on the base, using sufficient torque to obtain a proper gasket seal. Place the guide pin gasket onto guide pin and lightly coat both sides of the gasket with Molykote. Install the guide pin and guide pin gasket into the bonnet using a 3/16" hex allen wrench to tighten the guide pin in order to obtain a leak tight seal. Check the guide and disc holder for binding, since slight movement is required.

X.B. (Continued)

11. Thread the adjusting screw locknut onto the adjusting screw. Apply a small amount of "Molykote" to the tip of the adjusting screw. Install the adjusting screw in the bonnet, rotating the number of times required to compress the spring slightly. When the spindle begins to turn, use pliers to hold it in position and rotate the adjusting screw the number of turns recorded during disassembly. (Again, see Paragraph VIII.C.4 on page 20).

12. The valve is now ready for setting. After the valve set pressure has been adjusted, tighten the adjusting screw locknut. Install the cap gasket and cap, or lifting gear, on the valve after applying a small amount of "Molykote" to the gasket seal surfaces, as well as to the cap and bonnet threads. On those

XI. Setting and Testing After Reconditioning

A. General Information

Before putting the reconditioned valve into service, it must be set to open at the required set pressure. Although the valve can be set on the service installation, it is more convenient to set the valve, and check seat tightness, on a test stand. Any spring replacement shall be in accordance with current DVCD guidelines.

B. Test Equipment

Test stands for testing DVCD Safety Relief Valves normally consist of a pressure source, a supply line with a throttle valve, and a receiver having the following features:

1. Outlet for attaching valve to be tested.
2. Pressure gauge with a shut-off valve.
3. Drain line with a shut-off valve.
4. A volume in receiver adequate for the valve to be tested to achieve proper operation.

C. Test Media

Steam valves shall be tested on saturated steam; air or gas valves on air or gas, at ambient temperature; and liquid valves on water, at ambient temperature.

XI. (Continued)

D. Setting the Valve

The valve should be set to open at the set pressure as shown on the nameplate. If a cold differential set pressure is indicated on the nameplate, the valve should be set to open at that pressure. The cold differential set pressure is the set pressure corrected to compensate for back pressure and/or operating temperature.

If changes are to be made to the set pressure or back pressure or the service temperature changes, a new cold differential set pressure may need to be determined.

E. Set Pressure Compensation

1. Cold Differential Set Pressure For Temperature Compensation

During production testing of safety and safety relief valves, the valves are often tested at temperatures that are different from the temperature the valve will be exposed to in service. Increasing the temperature from ambient causes the set pressure to decrease. This decrease in set pressure is due to thermal expansion of the seating area and spring relaxation.

Therefore, it is important to compensate for the difference between production test temperature and service temperature. The service temperature is the normal operating temperature of the valve. If the operating temperature is unavailable, no correction due to temperature will be made to valve set pressure.

Table IV, below, gives the set pressure multipliers that should be used when computing the cold differential set pressure for valves being set on an air or water test stand at ambient temperatures.

TABLE IV

Set Pressure Multipliers for CDS			
Operating Temp (F)	Multiplier	Operating Temp (F)	Multiplier
250	1.003	900	1.044
300	1.006	950	1.047
350	1.009	1000	1.050
400	1.013	1050	1.053
450	1.016	1100	1.056
500	1.019	1150	1.059
550	1.022	1200	1.063
600	1.025	1250	1.066
650	1.028	1300	1.069
700	1.031	1350	1.072
750	1.034	1400	1.075
800	1.038	1450	1.078
850	1.041	1500	1.081

Valves to be used in saturated steam service are tested on saturated steam and, therefore, no CDS is required. However, valves in superheated steam service are tested on saturated steam and, therefore, require a CDS.

XI.E. (Continued)

Table V, below, shows the multiplier that should be used based on temperature above the saturated temperature (degrees of superheat).

TABLE V

Set Pressure Multipliers for CDS (Superheat Temperature)

Degrees of Superheat (F)	Multiplier
100	1.006
200	1.013
300	1.019
400	1.025
500	1.031
600	1.038
700	1.044
800	1.050

2. Cold Differential Set Pressure For Back Pressure Compensation

When a conventional Series 1990 or 3990, valve is to operate with a constant back pressure, the cold differential set pressure is the set pressure minus the constant back pressure.

3. Sample Calculations For Series 1990 and 3990 Consolidated Safety Relief Valves (refer to preceding Tables IV and V)

a. Set pressure 2500 psig, temperature 500 F, back pressure atmospheric.

Set Pressure	2500	psig
Multiplier from Table X	X1.019	
Cold Differential Set Pressure	2598	psig

b. Set pressure 2550 psig, temperature 500 F, constant back pressure 150 psig

Set Pressure	2500	psig
Minus Constant Back Pressure	-150	psig
Differential Pressure	2400	psig
Multiplier from Table X	X1.019	
Cold Differential Set Pressure	2598	psig

c. Set pressure 2550 psig, temperature 100 F, constant back pressure 150 psig

Set Pressure	2500	psig
Minus Constant Back Pressure	150	psig
Cold Differential Set Pressure	2400	psig

d Set pressure 400 psig, temperature 650 F, back pressure atmospheric

Operating Temperature	650	F
Minus Temperature of Sat. Steam at 400 psig	-448	F
Degrees of Superheat	202	F
Set Pressure	400	psig
Multiplier from Table Xa	x1.013	
Cold Differential Set Pressure	405	psig

XI. (Continued)

F. Blowdown

The blowdown for all series 1990 and Series 3990 valves is fixed. ***Do not attempt to adjust the blowdown on these valves.***

G. Simmer

If simmer causes erratic valve opening, refer to the Trouble Shooting Guide on page 38.

H. Seat Leakage

1. Air

The air-leakage test shall be performed with all connections and openings in the body and bonnet pressure-tight. The cap, with the gasket which covers the adjusting screw, must be installed. Test the valve for leakage using an API test fixture. The API leakage test procedure is described below:

a. Per API Standard 527, (ANSI B147.1-72), a standard test fixture consists of a piece of tubing 5/16" (7.94mm) x .035" (0.89mm) wall, one end of which is joined to an adaptor on the valve outlet, and the other end of which is immersed 1/2" (12.70mm) below the surface of a reservoir of water.

b. The leakage rate for a valve with metal to metal seats shall be determined with the valve mounted vertically and using a standard test fixture, as described above. "The leakage rate, in bubbles per minutes, shall be determined with the pressure at the safety relief valve inlet held at 90 percent of the set pressure, immediately after popping, for valves set 51 psig (3.517 bar) and above. On valves set at 50 psig (3.448 bar) and below, test for lekage at 5 psig (0.345 bar) below the set pressure, immediately after popping. The test pressure shall be applied for a maximum of 1 minute."

c. The "Tightness Standard" is the leakage rate in bubbles per minute, and shall not exceed that shown in Table VI, below.

TABLE VI

Max. Leakage Rate (Bubbles Per Minute)	Approx. Leakage Rate (Std. Cu. Ft. Per 24 Hr.)
40	0.60 (16.99 liters)

A valve with a seat of resilient material (i.e., an O-ring valve) shall show no leakage at pressures less than those indicated in Table VII, below, when the test medium is either air or water.

TABLE VII

Set Pressure PSIG	Min. Leak Point (% of Set Pressure)
15/(1.034 bar) or 30 psig (2.069)	90%
31/(2.138 bar) to 50 psig (3.448 bar)	92%
51/(3.517 bar) to 100 psig (6.897)	94%
101/(6.966 bar) psig or greater	95%

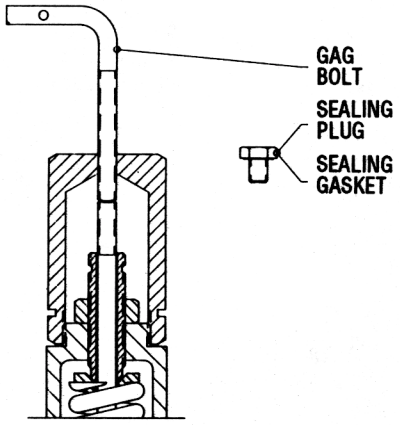
XI.G. (Continued)

2. **Water**
   When a metal-to-metal seat valve is tested using water as the test medium, there shall be no leakage, as determined by sight or feel, when the pressure is held at 90% of set pressure.

3. **Steam**
   When a valve is checked for tightness using steam as the test medium (at 90% of the set pressure), there shall be no visual or audible leakage after the interior of the valve is allowed to dry after popping. If there is no visual or audible leakage, the valve is acceptable.

XII. Hydrostatic Testing and Gagging

When hydrostatic tests are required after installation of a safety relief valve, a test gag must be used (see Figure 17 below). Very little force (i.e., fingertight pressure) on the test gag is sufficient to hold hydrostatic pressures. **Too much force applied to the gag may bend the spindle and damage the seat.** After a hydrostatic test, the gag must be removed and replaced by the sealing plug furnished for this purpose. (Test gags for Consolidated® Safety Relief Valves can be furnished for all types of caps and lifting gears.)



TYPICAL
CAP WITH GAG
FIGURE 17

XIII. Manual Popping of the Valve

Consolidated Safety Relief Valves are furnished, when so ordered, with packed or plain lifting levers for hand popping.

When the valve is to be opened by hand, the pressure at the valve inlet should be at least 75% of the valve's set pressure. Under flowing conditions, the valve must be fully lifted from its seat, so that dirt, sediment and scale will not become trapped on the seating surfaces. When allowing the valve to close under flowing conditions, completely release the lever from maximum lift to snap the valve back on its seat.

XIII. (Continued)

Since, in some cases, the dead weight of the lever will have a tendency to lift the valve, the lever should be hung, supported, or counter weighted, so the lifting fork does not contact the release nut.

XIV. Trouble Shooting Guide

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Valve leaking	A. Damaged seat or O-ring.	A. Disassemble valve, lap seating surfaces, replace disc or O-ring, if required, as outlined in this manual.
	B. Part misalignment	B. Disassemble, valve, inspect contact area of disc and nozzle, lower spring washer or spindle, compression screw, spindle straightness, etc., as outlined in the manual.
	C. Discharge stack binding on outlet.	C. Correct as required.
Simmer	A. Steam line vibrations. B. Lapped seat too wide.	A. Investigate and correct cause. B. Rework seat as specified in this manual.
Chatter	A. Improper installation or valve sizing.	A. Check for piping restrictions; check required capacity.
	B. Built-up back pressure.	B. Check outlet piping for flow restriction.
No action; valve does not go into full lift; Valve does not close from full lift.	A. Foreign material trapped between disc holder and guide.	A. Disassemble valve and correct any abnormality as outlined in this manual. Inspect system for cleanliness.

XV. Maintenance Tools and Supplies

- The laps* identification in Table VIII, below, are required for proper maintenance of Consolidated® Series 1990 and Series 3990 seats.

TABLE VIII

LAPS	
VALVE	PART NUMBER
1990, 1995/HP 3990, 3999	1672802
1993, 3993, 1996 H/HP, 1996, 1996H, 3996H, 3996	1672803
1997, 1998 3997, 3998	1672805

NOTE:

One set of three (3) laps is recommended for each size to assure ample flat laps are available at all times.

- The Lap Resurfacing Plate* is P/N 0439003
- Lapping compounds are identified in Table IX, below.

TABLE IX

Brand	Grade	Grit	Lapping Function	Size Container	Part No.
Clover	1A	320	General	4 oz.1	199-3
Clover	3A	500	Finishing	4 oz.	199-4
Kwik-Ak-Shun	—	1000	Polishing	1 lb.	199-11
				2 oz.	199-12

* Laps and the lapping plate may be purchased from DVCD.

XVI. Inventory Philosophy

A. General Information

The importance of maintenance planning is the key to good plant operations. Part of that planning involves making sure that replacement parts needed to repair valves are available at the jobsite when required. Developing and implementing a standard valve maintenance plan will quickly pay for itself by eliminating costly downtime, unscheduled outages, etc.

B. Inventory Planning

The basic objectives in formulating a replacement parts plan are:

PROMPT AVAILABILITY
MINIMUM DOWNTIME
SENSIBLE COST
SOURCE CONTROL

Having parts immediately available from plant storeroom inventory is obviously the best way to accomplish those objectives. Since it is impractical to have every part that might be needed to accomplish a given repair in stock at all times, guidelines for establishing meaningful inventory levels are summarized in the table below:

PART CLASSIFICATION	REPLACEMENT FREQUENCY	PREDICTED AVAILABILITY*
CLASS I	MOST FREQUENT	70%
CLASS II	LESS FREQUENT BUT CRITICAL	85%
CLASS III	SELDOM REPLACED	95%
CLASS IV	HARDWARE	99%
CLASS V	PRACTICALLY NEVER REPLACED	100%

C. Replacement Parts List

Consult the Recommended Spare Parts list (see Section XVIII of this manual) to determining the parts to be included in the inventory plan.

Select the desired parts and determine those required for proper maintenance of the valve population in the plant.

* Prediced availability means that percentage of time the user plant will have the right parts to make the proper repair on the product, (i.e. if Class I parts are stocked at the owners facility, the parts needed to repair valve in question will be immediately available in 70% of all instances).

XVI. (Continued)

D. Identification and Ordering Essentials

When ordering service parts, please furnish the following information to insure receiving the correct replacement parts:

1. Identify valve by the following nameplate data:
   a. Size
   b. Type
   c. Temperature Class (Spring Selection)
   d. Serial Number
      Example:
      3/4"-1990C-1
      S/N TC75834

2. Specify parts required by:
   a. Part Name
   b. Part Number (if known)
   c. Quantity

XVII. Genuine Dresser Parts

The next time replacement parts are needed, keep these points in mind:

- DVCD designed the parts.
- DVCD guarantees the parts.
- CONSOLIDATED® valve products have been in service since 1877.
- DVCD has worldwide service.
- DVCD has fast response availability for parts.

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Dresser IVO
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Telephone: 44-895-58161

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Trevithick Works
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Skelmersdale, Lancashire
WN8 9TU England
Telephone: 44-695-24234

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Zona Franca
Sector M., Calle Y
08004 Barcelona, Spain
Telephone: 345-3-335-4200

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I.V.O.
Room 405, Maersk Building
Yokohama 231
Japan
Telephone: 81-45-651-5601

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Telex: 455211 (BHTP IN)

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Dresser Limited Valve
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P.O. Box 2234
16 Edendale Road
Eastleigh, Edenvale 1610
Telephone: 27-11-452-1550 thru 1557

XVIII. Recommended Spare Parts For Series 1990 and Series 3990 Safety Relief Valves

METAL TO METAL SEAT VALVES

CLASS	PART NAME	Qty. Parts/Size, Type & Material Valves in Service	Need Probability Coverage
I	Disc Guide Pin Gaskets A. Cap B. Guide Pin C. Bonnet	1/1 1/1 1 Set/1	70%
II	Disc Holder Spindle Guide	1/5 1/5 1/5	85%
III	Spring Assembly Compression Screw	1/5* 1/5	95%
IV	Compression Screw Locknut Cap (Specify Screwed, Packed, Plain) Release Nut (Used on Packed or Plain Lever Only) Release Locknut (Used on Packed or Plain Lever Only)	1/5 1/5 1/5 1/5	99%

* Consult Spring Selection Chart before ordering Springs to determine actual quantities required in view of pressure setting potential in each spring range.

YOUR SAFETY IS OUR BUSINESS!!!
DVCD has not authorized any company or any individual to manufacture replacement parts for its valve products.

When ordering replacement valve parts, please specify in your purchase order: "ALL PARTS MUST BE DOCUMENTED AS NEW AND SOURCED FROM DRESSER VALVE & CONTROLS DIVISION."

BE SURE! BE SURE!

XVIII. (Continued)

O-RING SEAT SEAL VALVES

CLASS	PART NAME	Qty. Parts/Size, Type & Material Valves in Service	Need Probability Coverage
I	O-Ring Retainer O-Ring Lock Screw Guide Pin Gaskets A. Cap B. Guide Pin C. Bonnet	1/1 1/1 1 Set/1 1/1 1 Set/1	70%
II	CLASS II Disc Holder Spindle Guide	 1/5 1/5 1/5	85%
III	CLASS III Spring Assembly Compression Screw	 1/5*	95%
IV	CLASS IV Compression Screw Locknut Cap (Specify Screwed, Packed, Plain) Release Nut (Used on Packed or Plain Lever Only) Release Locknut (Used on Packed or Plain Lever Only)	 1/5 1/5 1/5	99%

* Consult Spring Selection Chart before ordering Springs to determine actual quantities required in view of pressure setting potential in each spring range.

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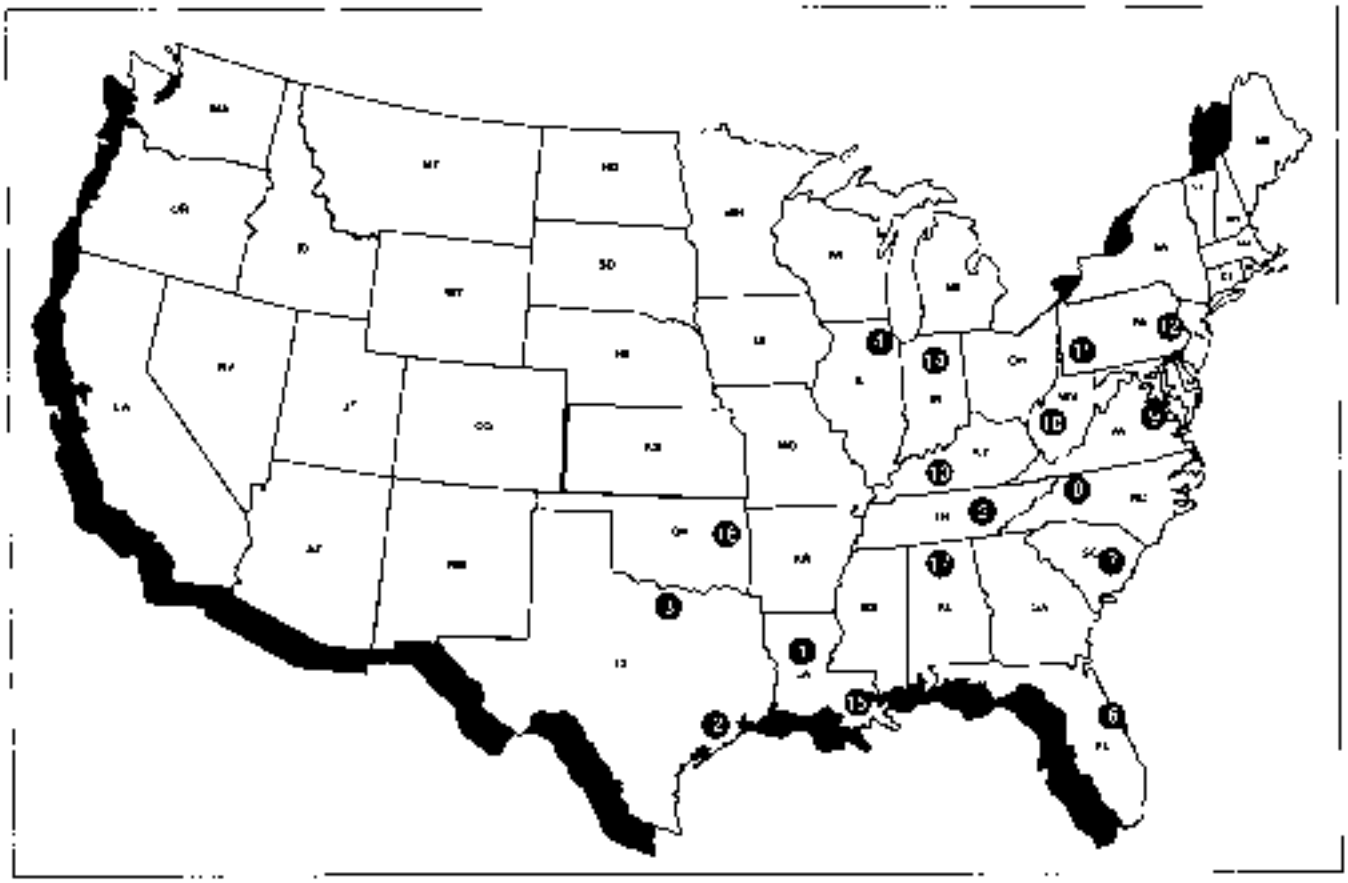

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For prompt field service, please call Dresser Valve and Controls Division Service Department, Alexandria, Louisiana.
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After Hours, Weekends, Holidays - (318) 640-2250

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