Consolidated®

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Consolidated® Safety Relief Valve Type 1900

Industrial Valves DRESSER

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

Design Options Include:

Bellows (-30),

O-Ring Seat (DA),

Liquid Trim (LA)

and

Thermodisc® (TD)

CON-2
Revised 7/97

Product Safety Sign and Label System

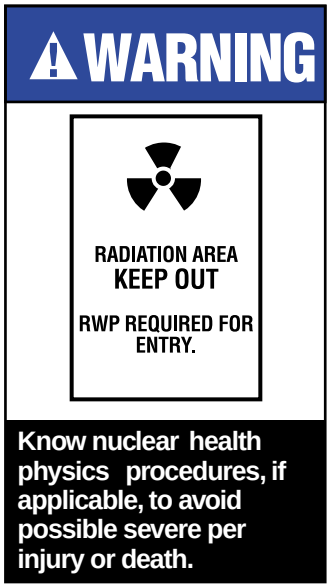
If and when required, appropriate safety labels have been included in the rectangular margin blocks throughout this manual. Safety labels are vertically oriented rectangles as shown in the ***representative examples*** (below), consisting of three panels encircled by a narrow border. The panels can contain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



SAFETY ALERTS!
READ – UNDERSTAND – PRACTICE

1. DANGER: High temperature/pressure can cause injury. Be sure all system pressure is absent before repairing or removing valves.

2. DANGER: Don't stand in front of valve outlet when discharging. STAND CLEAR OF VALVE to prevent exposure to trapped, corrosive media.

3. DANGER: When inspecting a pressure relief valve for leakage, BE VERY CAREFUL!

Contents

SAFETY ALERTS!
READ – UNDERSTAND – PRACTICE

1. WARNING: Allow the system to cool to room temperature before cleaning, servicing or repairing the system. Hot components or fluids can cause severe personal injury or death.
2. WARNING: Always read and comply with safety labels on all containers. Do not remove or deface the container labels. Improper handling or misuse could result in severe personal injury or death.
3. WARNING: Never use pressurized fluids/gas/air to clean clothing or body parts. Never use body parts to check for leaks or flow rates or areas. Pressurized fluids/gas/air injected into or near the body can cause severe personal injury or death.
4. WARNING: It is the responsibility of the owner to specify and provide guarding to protect persons from pressurized or heated parts. Contact with pressurized or heated parts can result in severe personal injury or death.
5. WARNING: Do not allow anyone under the influence of intoxicants or narcotics to work on or around pressurized systems. Workers under the influence of intoxicants or narcotics are a hazard both to themselves and other employees and can cause severe personal injury or death to themselves or others.
6. WARNING: Incorrect service and repair could result in product or property damage or severe personal injury or death.

7. WARNING: These WARNINGS are as complete as possible but not all-inclusive. Dresser cannot know all conceivable service methods nor evaluate all potential hazards.
8. WARNING: Use of improper tools or improper use of right tools could result in personal injury or product or property damage.
9. WARNING: Some valve 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 followed, if applicable.

1. CAUTION: Heed all service manual warnings. Read installation instructions before installing valve(s).

2. CAUTION: Wear hearing protection when testing or operating valves.

3. CAUTION: Wear appropriate eye and clothing protection.

4. CAUTION: Wear protective breathing apparatus to protect against toxic media.

NOTE:

Any service questions not covered in this manual should be referred to Dresser's Service Department, Phone (318) 640-6055.

II. 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:

  1. **Superimposed Back Pressure**
     Superimposed back pressure is the pressure in the discharge header before the safety relief valve opens.

     a) Constant - Specify single constant back pressure (e.g., 20 psig/1.38 bar).
     b) Variable - Specify variable back pressure range using min. and max. limits (e.g., 0 to 20 psig/1.38 bar).

  2. **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.

- **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.

- **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.

- **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 pressure 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 at least 10% under the maximum allowable working pressure or 5 psi (.34 bar), whichever is greater.

- **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, a relief valve is used primarily for liquid service.

- **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. A safety relief valve is used to protect personnel and equipment by preventing excessive overpressure.

II. (Continued)

- **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. It is used for steam, gas or vapor service.

- **Set Pressure**
  Set pressure is the gauge pressure at the valve inlet, for which the 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.

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

III. Introduction

A safety relief valve is an automatic pressure actuated relieving device suitable for use either as a safety valve or relief valve, depending on application.

Safety relief valves are used on hundreds of different applications, including liquids and hydrocarbons; therefore, the valve is designed to meet many requirements. The 1900 series valves included in this manual can ***only*** be used to meet Section VIII requirements. It cannot be used on ASME Code Section I steam boilers or superheaters, but may be used on process steam.

IV. Design Features and Nomenclature

- **Cap and Lever Interchangeability**
  Many times it is necessary to change the type of cap or lever in the field after a valve has been installed. All flanged Consolidated® Safety Relief Valves are designed so they can be converted to any type of lever or cap desired. It is not necessary to remove the valve from the installation, nor will the set pressure be affected when making such a change.

- **Design Simplicity**
  Consolidated Safety Relief Valves have a minimum number of component parts. This results in a savings by minimizing spare parts inventory and simplifies valve maintenance.

- **Nomenclature Related to Design Features**
  Applicable nomenclature of the components of Type 1900 valves, including those with design options for bellows O-Ring seat, and liquid trim and Thermodisc, is identified in Figures 1 thru 6 on pages 6 and 7.

- **Simple Blowdown Adjustment**
  The Consolidated single blowdown ring design makes it possible to set and test a valve that has been in service when it cannot be set on line and must be taken to the customer's shop. The ring can be positioned so that the set point can be observed although the volume of the testing media is very low. After the set pressure has been established, proper blowdown can be attained by merely positioning the ring in accordance with the adjusting ring position shown in Tables 12-14 (as appropriate), on page 34 of this manual.

- **Valve Interchangeability**
  A Standard Consolidated Safety Relief Valve may be converted to the bellows type, the O-Ring seat seal type, etc. and vice versa. This requires a minimum number of new parts, and results in lower costs should conversion be required.

CONSOLIDATED SAFETY RELIEF VALVE
TYPE 1900 - CONVENTIONAL

Part No.	Nomenclature
1	Base
2	Nozzle
3	Adjusting Ring
4	Adjusting Ring Pin
5	Adj. Ring Pin Gasket
6	Disc
7	Disc Retainer
8	Disc Holder
9	Guide
10	Guide Gasket
11	Bonnet
12	Bonnet Gasket
13	Base Stud
14	Stud Nut
15	Spindle
16	Spindle Retainer
17	Spring Washer
18	Spring
19	Adjusting Screw
20	Adjusting Screw Nut
21	Screwed Cap
*22	Bolted Cap
*23	Packed Cap
*24	Plain Cap
*25	Cap Bolt
*26	Cap Set Screw
27	Cap Gasket
*28	Release Nut
*29	Release Locknut
*30	Lever
*31	Lifting Fork
*32	Lever Shaft
*33	Packing
*34	Packing Nut
*35	Top Lever
*36	Drop Lever
40	Eductor Tube
41	Bonnet Vent Plug

* Shown in Figures 38-42 on page 39 of this manual.

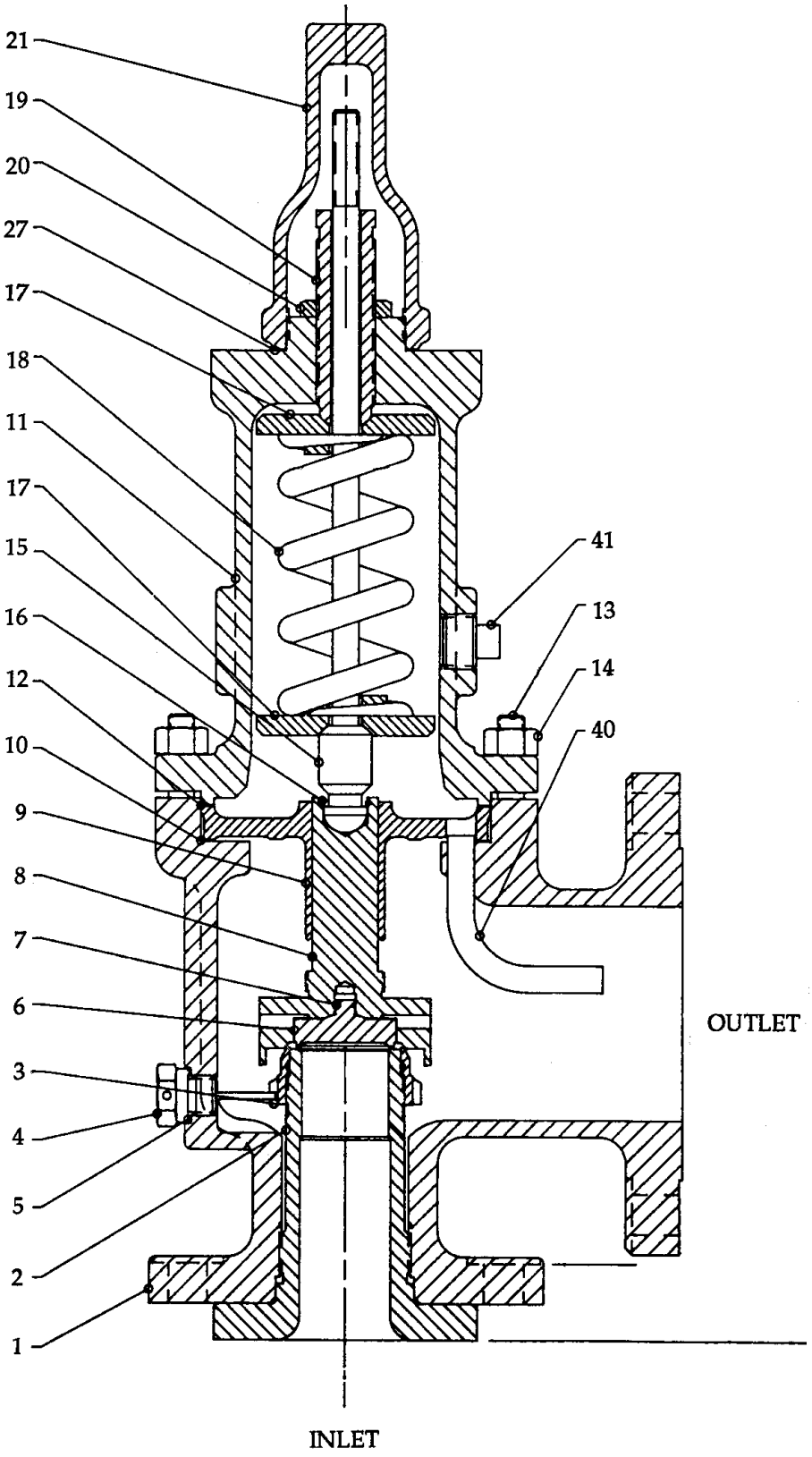
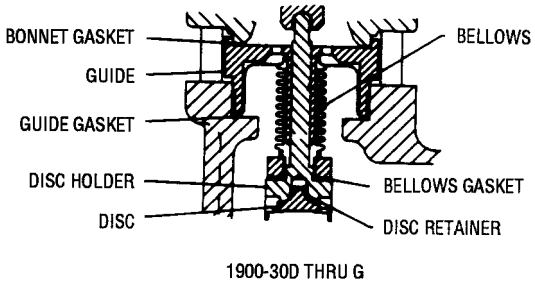


FIGURE 1

DESIGN OPTIONS



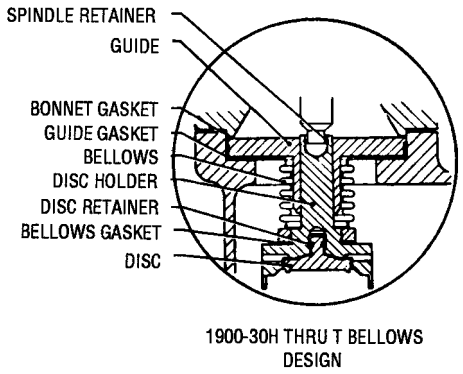


FIGURE 2

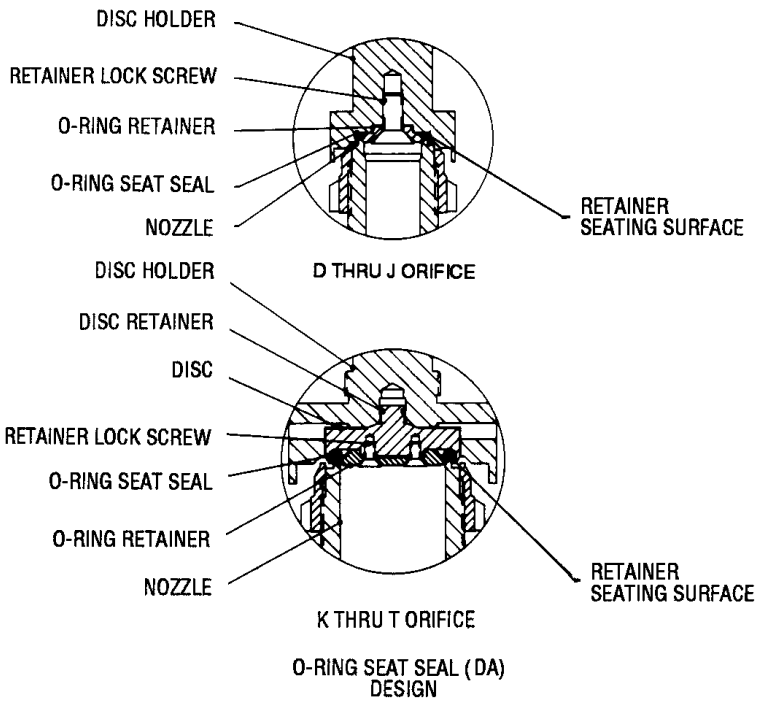
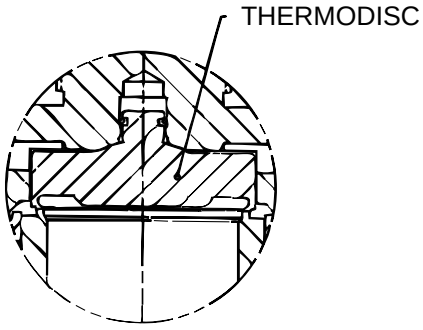


FIGURE 4



THERMODISC (TD) DESIGN

FIGURE 3

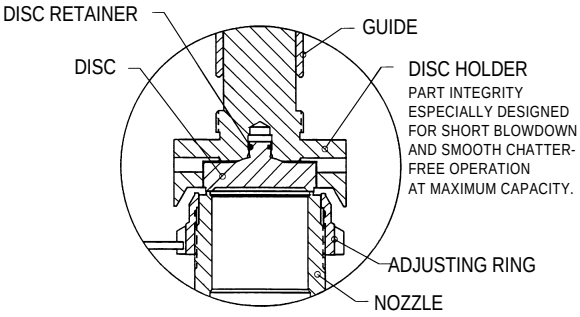


FIGURE 5
LA Liquid Trim Design
(See Fig. 20)

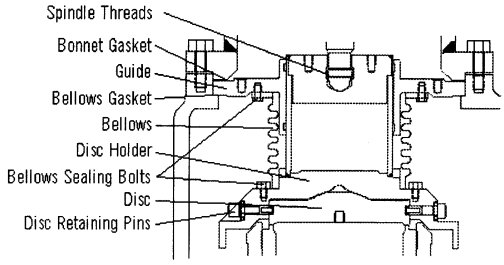


FIGURE 6
V & W Orifice Only

NOTE:

A combination of the O-Ring seat seal and liquid trim design options is designated as DA-LA.

V. Handling, Storage and Pre-Installation

- **Handling**
  A flanged valve, either crated or uncrated, should always be kept with the inlet flange down (i.e., in order to prevent possible misalignment and damage to internals).

  Uncrated valves should be moved or hoisted by wrapping a chain or sling around discharge neck, then around upper bonnet structure in such manner as will ensure the valve is in a vertical position during lift, i.e. not lifted in horizontal position.

  NOTE:

  Never lift the full weight of the valve by the lifting lever. Crated valves should always be lifted with the inlet flange down, i.e., same as installation position.

  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.

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

  Flange protectors and seating plugs should not be removed until the valve is ready to be bolted into the installation, i.e., both inlet and outlet.

- **Pre-installation**
  When safety relief valves are uncrated, and the flange protectors or sealing plugs removed immediately prior to installation, meticulous care should be exercised to prevent dirt and other foreign materials from entering the inlet and outlet ports while bolting in place.

VI. Recommended Installation Practices

A. Mounting Position

Safety relief valves should be mounted in 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 flanges and sealing faces of the valve and all connecting piping must be free from dirt, sediment and scale.

All flange bolts should be drawn evenly to prevent distortion of the valve body and the inlet nozzle.

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 7, below) 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 drop 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 flange, and in which the length does not exceed the face-to-face dimensions of a standard tee of the required pressure class.

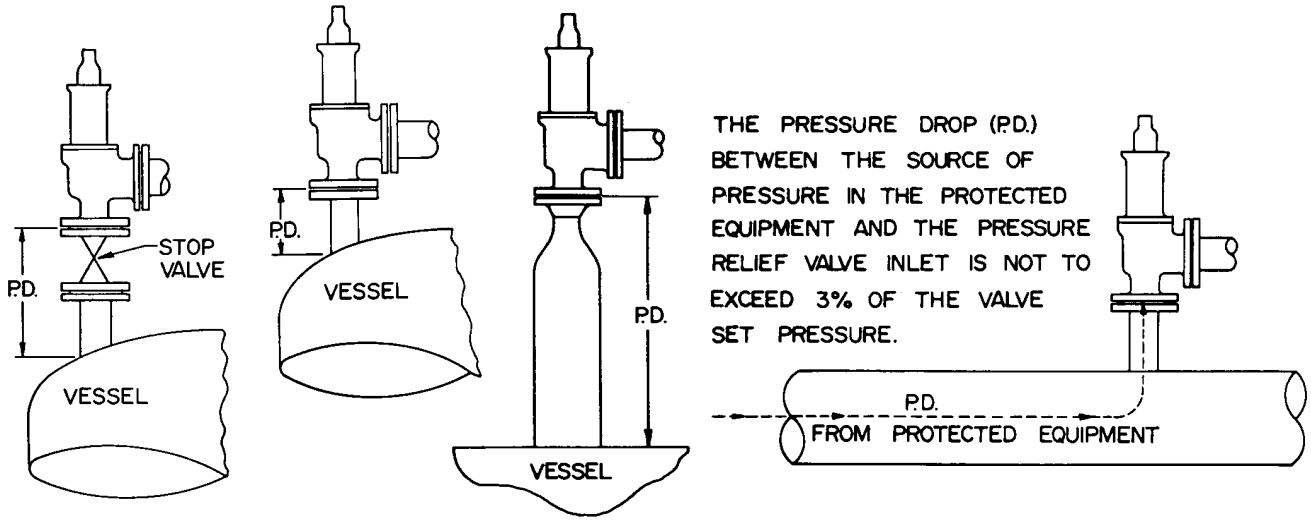
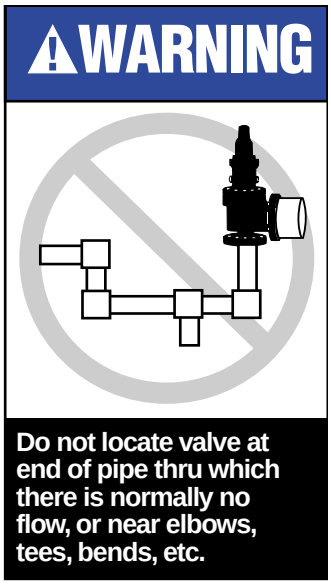


FIGURE 7

VI.B. (Continued)

Safety relief valve inlets should not be located at the end of a long, horizontal inlet 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.



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 induced by reaction forces during valve operation, by external loading, by vibration and by loads due to thermal expansion of discharge piping.

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.

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.**

VI. (Continued)

C. Outlet Piping

Alignment of the internal parts of a safety relief valve is important to ensure proper operation (see Figure 8, 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.

Consideration should be given to discharge pipe movement resulting from wind loads. 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.

Where possible, drains should be piped away to prevent the collection of water or corrosive liquid in the valve body. Attention should be given to the support of the drainage piping.

When two or more valves are piped to discharge into a common header, the built-up back pressure resulting from the opening of one (or more) valve(s) may cause a superimposed back pressure in the remaining valves, unless the bonnet is vented. Under these conditions, use of bellows valves is recommended. Bellows valves may also permit use of a smaller size manifold.

In every case, the nominal discharge pipe size should be as large as, or larger than, the nominal size of the pressure relief valve outlet flange. In the case of long discharge piping, it sometimes must be **much** larger.

NOTE:

Bonnet vent is to be plugged for all non-bellows valves. Bellows valves must have open bonnet vent.

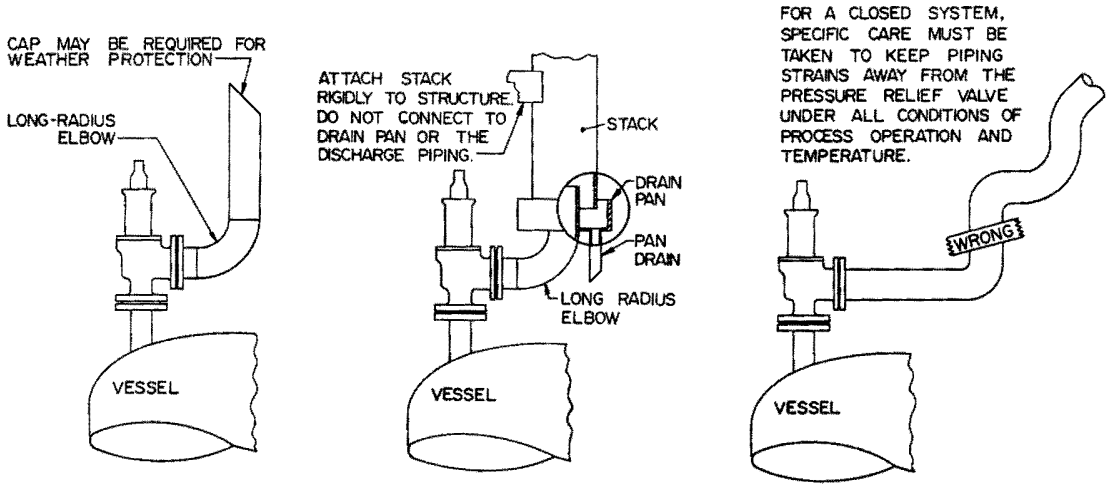


FIGURE 8

VII. Disassembly Instructions

NOTE:
Many pressure vessels that are protected by Consolidated® Safety Relief Valves contain dangerous materials. Decontaminate and clean the valve inlet and outlet and all external surfaces in accordance with the cleaning and decontaminating recommendations in the appropriate Material Safety Data Sheet.

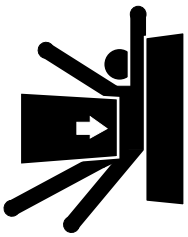
DANGER

Decontaminate or clean if necessary before pretesting or disassembly. Safety and environmental precautions must be taken for the decontamination or cleaning method used.

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 Figures 1-6, on pages 6 and 7, for parts nomenclature.)

DANGER



Do not remove bolts if pressure in line, as this will result in severe personal injury or death.

NOTES:

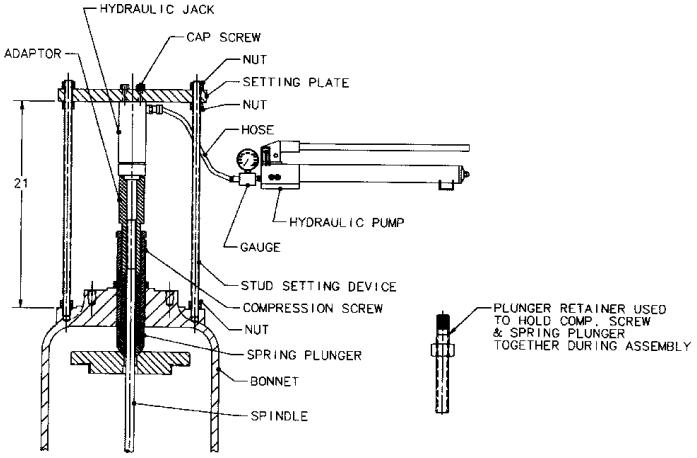
- **Before starting to disassemble the valve, be sure that there is no media pressure in the vessel.**
- **Parts from one valve should not be interchanged with parts from another valve.**

B. Specific Steps

CAUTION

Valve caps and bonnets can trap fluids. Use caution when removing to prevent injury or environmental damage.

1. Remove the cap (including lifting gear); then, remove the cap gasket, if applicable.
2. Remove the adjusting ring pin and gasket. If the existing blowdown is to be restored upon reassembly, the position of the adjusting ring, with respect to the disc holder, should be determined. To do this, turn the adjusting ring counterclockwise (i.e., move notches on the adjusting ring from left to right). Record the number of notches passing the ring pin hole, which are required for the ring to contact the disc holder. This information will be used in setting the ring upon reassembly of the valves.
3. a. For D-T Orifice Valves: Loosen the adjusting screw nut. Using a Depth Micrometer or a Dial Caliper, measure the distance from the top of the spindle to the top of the Adjusting Screw. This allows the adjusting screw to be re-adjusted close to the proper spring compression without excessive testing. Record the measurement for reference when re-assembling the valve. **Note: This procedure does not substitute for actual**



Ram In Use
FIGURE 9

VII.B. (Continued)

pressure testing. Remove the Compression Screw from the Bonnet. Use pliers to prevent the Spindle from turning when removing the Compression Screw.

b. For V and W Orifice Valves: Attach the setting device. Apply enough pressure to the plunger using the ram to free the compression screw. Unscrew the compression screw completely out of the bonnet. The valve should be set using the setting procedure after reassembly.

4. Remove the stud nuts and lift off the bonnet. Next, remove the bonnet gasket.

5. Remove the spring and spring washers. **The spring and spring washers should be kept together, as a unit, at all times.**

6. For D thru M orifice valves, remove the upper internal parts by carefully pulling "straight up" on the spindle. For bellows valves, care should be taken to avoid damaging the bellows or its flange. If parts are fouled, use a suitable solvent for loosening the components. For the P thru T orifice valves, special lifting tools are available for ease of upper, internal-parts removal. First, remove the spindle by using a screwdriver to compress the spindle retainer. Then insert the lifting tool (see Figure 10, below) into the disc holder spindle pocket and tighten the eyebolt. Remove the disc holder and disc by lifting up on the lifting tool. For V and W orifice valves, use the lifting lugs to lift the disc holder top and remove all internals.

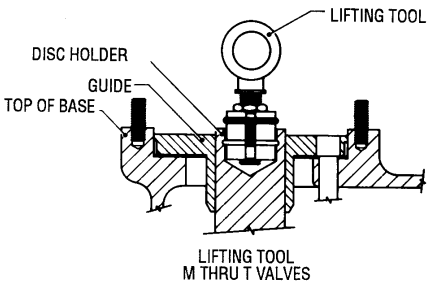


FIGURE 10

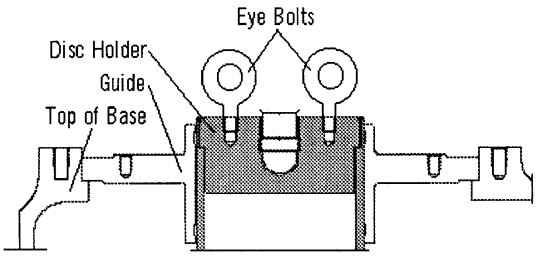


FIGURE 10 b

* Drift Pins, See Section XVII, page 43 for details.

7. To remove the spindle from the disc holder for D thru M orifice valves, clamp the skirt portion of the disc holder snugly between two wooden V-blocks in a suitable vise (see Figure 11, below). Then compress the spindle retainer with a screwdriver or similar tool through the slots provided, and remove the spindle.

8. Remove guide from the disc holder. (For restricted lift valves, refer to Paragraph X.L., on page 28 of this manual.) For V and W orifice, unbolt bellows from guide before guide removal.

9. For D-T orifice bellows valves, the bellows is attached to the disc holder by right-hand threads. Apply a special spanner wrench* to the bellows ring, and remove by turning counterclockwise (again, see Figure 11, below). The bellows convolutions are very thin, and fragile, and care should be taken to protect them from damage at all times. Next, remove the bellows gasket. For V and W orifice bellows valves, the bellows is bolted to the guide and disc holder. These bolts should be removed before removal of the guide.

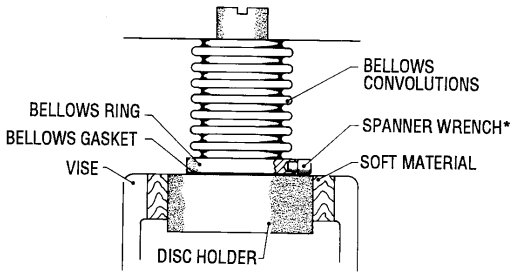


FIGURE 11

10. a. For D-T Orifice Valves: Remove the disc from the disc holder in the following manner. Clamp the stem portion of the disc holder, disc end up, firmly between two wooden V-blocks in a vise. Then start special drift pins* into the holes in the disc holder (see Figure 12) with the tapered portion of the pins working against the top of the disc as indicated. Tap each pin alternately, with a light machinist's hammer, until the disc snaps out of the recess in the disc holder.

b. For V and W Orifice Valves: Turn the disc holder on its side. Remove the retaining bolts. Attach the lifting lug to the disc and lift out.

VII.B. (Continued)

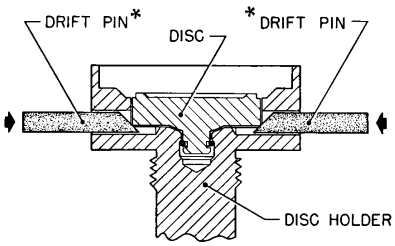


FIGURE 12

11. For O-Ring seat seal valves only, remove the retainer lock screw(s), retainer and O-Ring.

12. Remove the adjusting ring by turning it counterclockwise (left-handed).

13. The nozzle should be removed from the base. (Reference nozzle removal methods in paragraph 14.)

14. The nozzle is normally removed for routine maintenance and service. The nozzle is assembled to the base with threads and may be removed by turning it counterclockwise. To facilitate removal of the nozzle from the base, it may be found beneficial to first soak the threaded joint with a suitable penetrating liquid or solvent. In instances where the nozzle is frozen into the base, its removal may be helped by sufficiently heating the base from the outside with a blowtorch in the area of the nozzle threads, while dry ice or other cooling medium is applied to the inside of the nozzle.

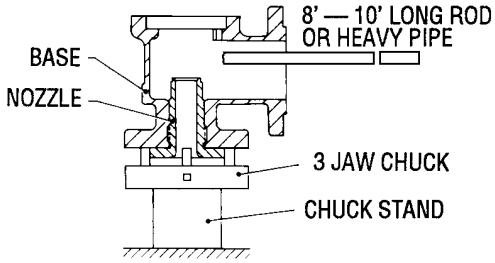


FIGURE 13

NOTE:

Should heat be applied, use care to prevent cracking of cast parts.

15. Utilize a 3 or 4 jaw chuck welded vertically to a stand bolted to a concrete floor. Chuck on nozzle flange and break the body loose from the nozzle with a heavy rod or pipe (see Figure 13).

NOTE:

Exercise care when inserting a rod or pipe in the outlet, in order to ensure that the valve nozzle is not damaged during this operation.

16. Use a large pipe wrench on nozzle flange to remove the nozzle from the base (see Figure 14).

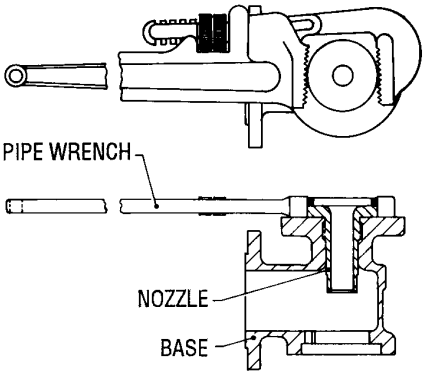


FIGURE 14

VIII. Cleaning

Follow recommendations for safe handling in the solvent's Material Safety Data Sheet and observe safe practices for any cleaning method.

1900 Series Safety Relief Valve internal parts may be cleaned with industrial solvents, cleaning solutions and wire brushes. If you are using cleaning solvents, take precautions to protect yourself from potential danger from breathing fumes, chemical burns, or explosion. See the solvent's Material Safety Data Sheet for safe handling recommendations and equipment.

It is not recommended to "sand blast" internal parts as it can reduce the dimensions of the parts. The base, bonnet and cap castings may be sand blasted with care not to erode internal surfaces, or damage machined surfaces.

IX. Parts Inspection

A. Nozzle Inspection Criteria

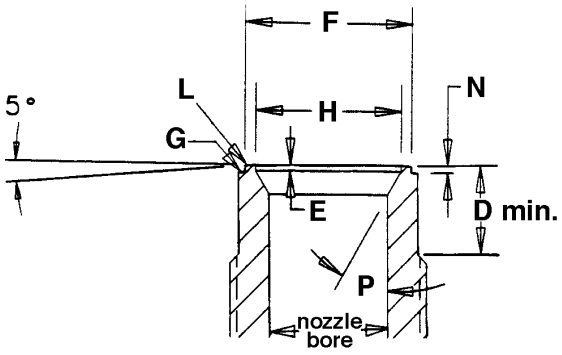
Nozzle should be replaced if:

1. Dim. from seat to first thread after remachining and lapping is less than D min. on Table 1.

2. Both thread sections are damaged from pitting and/or corrosion.

VIII. (Continued)

Metal Seated Nozzle



O-Ring Seal Nozzle

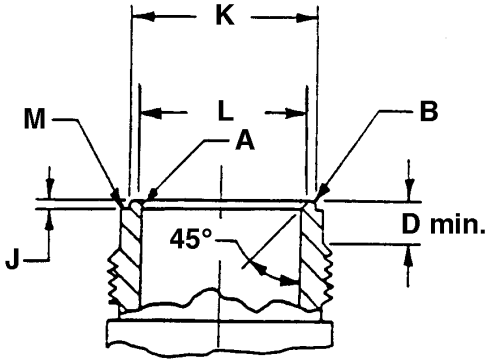


FIGURE 15

TABLE 1

ENGLISH UNITS, INCH										
Nozzle		**Metal-To-Metal**					**O-Ring Seat Seal**			
Orifice	D Min.	E± .005/.000	F± .000/.002	H± .002/.000	N± .005/.000	P ±1/2°	Radius B± .002/.000	J± .005	K	L Max.
D-1	13/32	.015	—	.518	—	30°	.015	.062	.573 +.000/−.002	.537
E-1	15/32	.020	.788	.686	.025	30°	.015	.060	.733 +.000/−.002	.688
D-2,E-2,F	5/16	.030	.955	.832	.035	30°	.015	.079	.868 +.000/−.003	.814
G	5/16	.035	1.094	.954	.035	30°	.021	.090	1.060 +.000/−.003	.999
H	1/4	.035	1.225	1.124	.035	45°	.021	.060	1.216 +.000/−.003	1.167
J	3/8	.035	1.546	1.436	.035	45°	.021	.074	1.534 +.000/−.003	1.481
K	7/16	.063	1.836	1.711	.063	45°	.021	.126	1.838 +.000/−.004	1.781
L	7/16	.063	2.257	2.132	.063	45°	.016	.126	2.208 +.000/−.004	2.158
M	7/16	.063	2.525	2.400	.063	45°	.021	.126	2.536 +.000/−.004	2.480
N	1/2	.063	2.777	2.627	.063	45°	.021	.101	2.708 +.000/−.004	2.652
P	5/8	.093	3.332	3.182	.093	45°	.021	.150	3.334 +.000/−.004	3.279
Q	7/8	.093	4.335	4.185	.093	45°	.021	.188	4.338 +.000/−.006	4.234
R	1	.093	5.110	4.960	.093	45°	.021	.215	5.095 +.000/−.006	5.036
T	3/4	—	6.234	6.040	.093	—	.021	.142	6.237 +.000/−.007	6.174
W	1 3/4"	.350	11.058	10.485	.348	30°	—	—	—	—

TABLE 1A

METRIC UNITS, MM										
Nozzle		**Metal-To-Metal**					**O-Ring Seat Seal**			
Orifice	D Min.	E± .13/.0	F± .0/.05	H± .05/.0	N± .13/.0	P ±1/2°	Radius B± .05/.0	J± .13	K	L Max.
D-1	10.3	.38	—	13.16	—	30°	.38	1.57	14.55 +.00/−.05	13.64
E-1	11.9	.51	20.01	17.43	.64	30°	.38	1.52	18.62 +.00/−.05	17.47
D-2,E-2,F	7.9	.76	24.26	21.13	.89	30°	.38	2.01	22.05 +.00/−.08	20.68
G	7.9	.89	27.79	24.24	.89	30°	.53	2.29	26.92 +.00/−.08	25.37
H	6.3	.89	31.12	28.55	.89	45°	.53	1.52	30.89 +.00/−.08	29.64
J	9.5	.89	39.27	36.47	.89	45°	.53	1.88	38.96 +.00/−.08	37.62
K	11.1	1.60	46.63	43.46	1.60	45°	.53	3.20	46.69 +.00/−.10	45.24
L	11.1	1.60	57.33	54.15	1.60	45°	.41	3.20	56.08 +.00/−.10	54.81
M	11.1	1.60	64.14	60.96	1.60	45°	.53	3.20	64.41 +.00/−.10	62.99
N	12.7	1.60	70.54	66.73	1.60	45°	.53	2.57	68.78 +.00/−.10	65.07
P	15.9	2.36	84.63	80.82	2.36	45°	.53	3.81	84.68 +.00/−.10	83.28
Q	22.2	2.36	110.11	106.30	2.36	45°	.53	4.78	110.19 +.00/−.15	107.54
R	25.4	2.36	129.79	125.98	2.36	45°	.53	5.46	129.41 +.00/−.15	127.92
T	19.0	—	158.34	153.42	2.36	—	.53	3.61	158.42 +.00/−.18	156.82
W	44.5	8.89	280.90	266.30	8.84	30°	—	—	—	—

IX.A. (Continued)

3. Top of flange and intersecting surface are damaged from galling and/or tearing.

4. Seat Width - see Table 7 on page 23 for proper seat width.

B. Nozzle Seat Width

Using a measuring magnifying glass, (See Maintenance Section "C" page 22), determine if the finish lapped seat surface must be machined prior to lapping. If the seat can be lapped flat without exceeding the required seat width, as indicated in table 7, it does not require machining. In order to reduce the seat width, the 5° angle surface must be machined. The Nozzle must be replaced, if the "D" dimension, is reduced below the minimum as indicated in table 1, or 1a.

NOTE: Flange thickness changes the center-to-face dimension. The minimum dimension for orifices D through P is 43/64 and orifices Q through T is 51/64**.**

C. Nozzle Bore Inspection Criteria

All Type 1900 Valve nozzles, **manufactured after August 1978**, have increased bore diameters. Physically, the nozzles (original versus new) are interchangeable, but their rated capacities are different. The following Table shows how each orifice was affected.

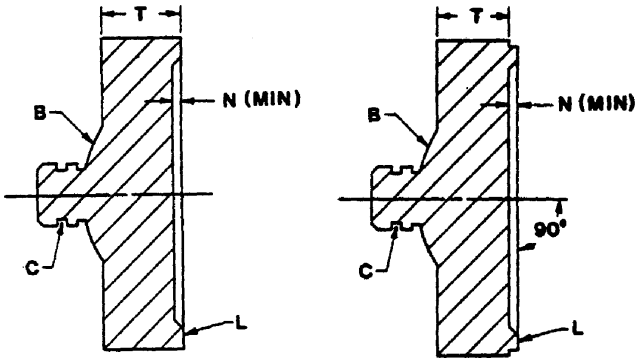
TABLE 2

Orifice	Pre-1978 Bore Diameter in Inches	Current Bore Diameter in Inches	Pre-1978 Bore Diameter in Millimeters	Current Bore Diameter in Millimeters
D-1	.393-.398	.404-.409	9.98-10.11	10.26-10.39
E-1	.524-.529	.539-.544	13.31-13.44	13.69-13.82
D-2	.650-.655	.674-.679	16.51-16.64	17.12-17.25
E-2	.650-.655	.674-.679	16.51-16.64	17.12-17.25
F	.650-.655	.674-.679	16.51-16.64	17.12-17.25
G	.835-.840	.863-.868	21.21-21.34	21.92-22.05
H	1.045-1.050	1.078-1.083	26.54-26.67	27.38-27.51
J	1.335-1.340	1.380-1.385	33.91-34.04	35.05-35.18
K	1.595-1.600	1.650-1.655	40.51-40.64	41.91-42.04
L	1.985-1.990	2.055-2.060	50.42-50.55	52.20-52.32
M	2.234-2.239	2.309-2.314	56.74-56.87	58.65-58.78
N	2.445-2.450	2.535-2.540	62.10-62.23	64.39-64.51
P	2.965-2.970	3.073-3.078	75.31-75.44	78.05-78.18
Q	3.900-3.905	4.045-4.050	99.06-99.19	102.74-102.87
R	4.623-4.628	4.867-4.872	117.42-117.55	123.62-123.75
T	6.000-6.006	6.037-6.043	152.40-152.55	153.34-153.49
W		10.029-10.034		254.74-254.86

D. 1900, 1900-30 Standard Disc

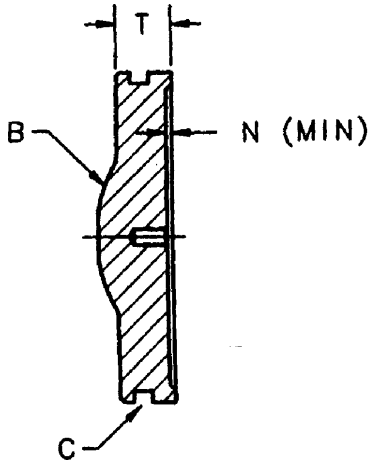
Inspection Areas

The standard 1900 disc as pictured in Figure 16 can be machined until the "N" dimension is reduced to the minimum, as listed in Table 3. The "T" dimension is provided to ensure the disc has not been machined beyond its limits. If the thickness of the disc ("T" min.), is reduced by remachining, the entire disc holder assembly would drop lower with respect to the seating plane of the nozzle. This would create a significant change in the huddle chamber configuration and result in significantly more "simmer" prior to opening.



Type 1
"D" through "H"
Orifice Discs

Type 2
"J" through "T"
Orifice Discs



(For 1900 V and W Only)
Type 3

Disc Inspection Areas
FIGURE 16

IX. (Continued)

TABLE 3

DISC TYPE	ORIFICE SIZE	INCHES		MILLIMETERS	
		"T" Minimum	"N" Minimum	"T" Minimum in millimeters	"N" Minimum in millimeters
TYPE 1	D-1	.155	.005	3.94	.127
	E-1	.158	.005	4.01	.127
	F, D-2, E-2,	.174	.010	4.42	.254
	G	.174	.010	4.42	.254
	H	.335	.010	9.02	.254
TYPE 2	J	.359	.010	9.12	.254
	K	.422	.015	10.72	.381
	L	.457	.015	11.61	.381
	M	.457	.015	11.61	.381
	N	.495	.015	12.57	.381
	P	.610	.015	15.49	.381
	Q	.610	.015	15.49	.381
	R	.610	.015	15.49	.381
	T	.822	.015	20.88	.381
TYPE 3	V	—	.015	—	.381
	W	1.692	.015	42.98	.381

Minimum Allowable Dimensions after
Machining of the Disc Seat

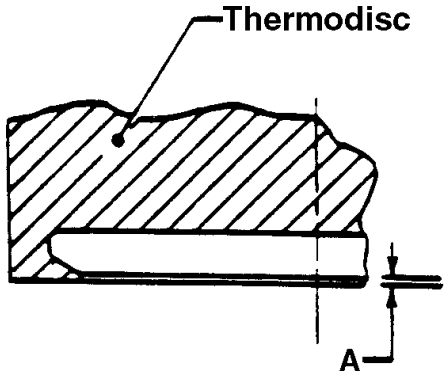
E. 1900 Series Thermodisc® Replacement Criteria

If seat defects and damage can not be lapped out without reducing the "A" dimension below that shown on Table 4, the Thermodisc must be replaced.

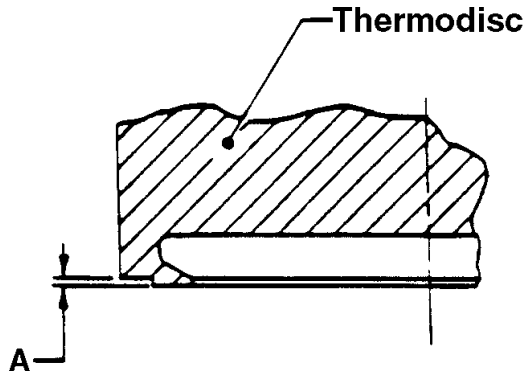
NOTE: "A" Dimension on through orifices is difficult to measure. If you cannot measure the .006 minimum thickness of the thermal lip, replace the Thermodisc.

TABLE 4

ORIFICE SIZE	"A" MIN. DIMENSION (IN)	"A" MIN. DIMENSION (MM)
D, E, F, G & H	.006	.153
J	.013	.331
K, L, M & N	.014	.356
P	.017	.432
Q & R	.015	.381
T	.025	.635
V & W	–	–



Thermodisc Design D-H Orifices



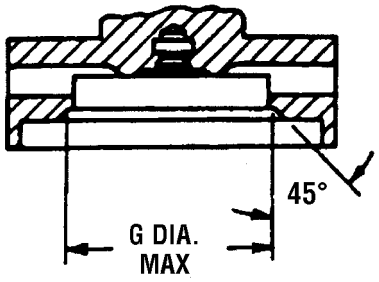
J-T Orifices

FIGURE 17

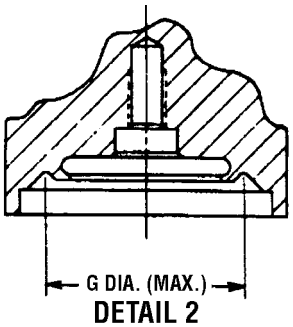
IX. (Continued)

F. Disc Holder Inspection Criteria

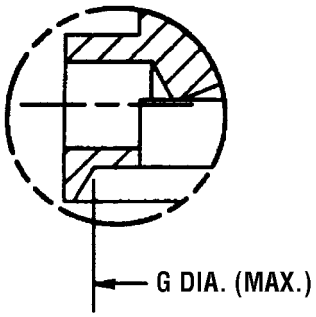
There are several designs of disc holders. Depending on the service and the type of valve. The particular type may be found in the details of Figure 16. for identification purposes the “G” dimension is provided. Please note that there are low pressure and high pressure disc holders.



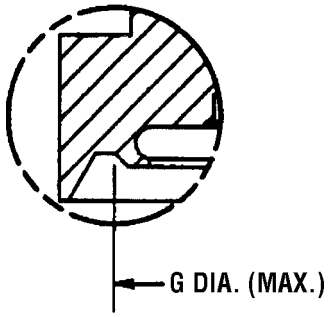
DETAIL 1
STANDARD DISC HOLDER



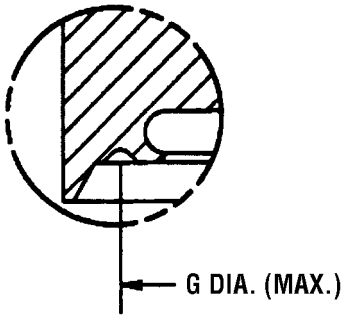
DETAIL 2
O-RING DISC HOLDER



DETAIL 3
LIQUID SERVICE DISC HOLDER
(LA DESIGN)



DETAIL 4
O-RING LIQUID SERVICE
(DALA) DESIGN
D-2, E-2 F & G ORIFICE



DETAIL 5
O-RING LIQUID SERVICE
(DALA) DESIGN
H & J ORIFICE

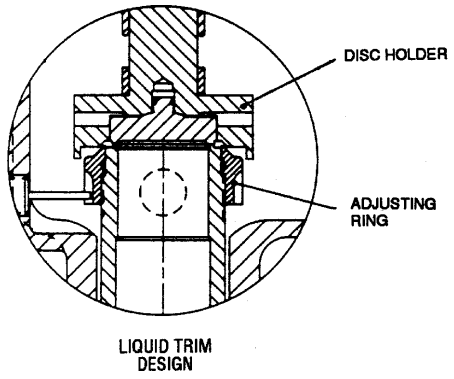
FIGURE 18

IX. (Continued)

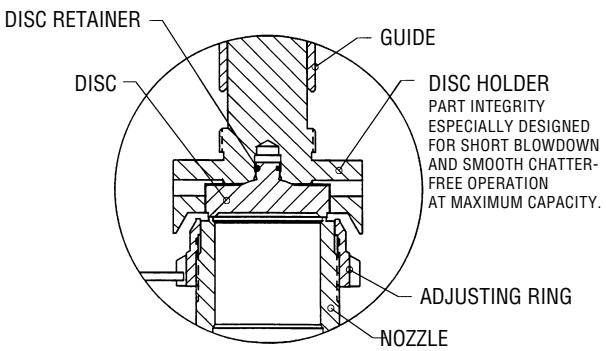
TABLE 5

G Diameter in inches for Disc Holder Identification. See Figure 18, for design details. (Detail 1, is standard unless noted).								
Orifice Size	Standard Disc Holder				O-Ring Disc Holder			
	Low Pressure	High Pressure	Liquid Trim		Liquid Trim		Low Pressure	High Pressure
			LS Design	LA Design	DL Design	DALA Design		
D-1	0.715	0.715	0.811	0.765 Detail 3	0.811	n/a	0.811	0.811
E-1	1.012	0.922	0.971	1.061 Detail 3	0.971	n/a	0.940 Detail 2	0.971
D-2	1.167	1.032	1.167	1.265 Detail 3	1.100 Detail 2	1.092 Detail 4	1.100 Detail 2	1.032
E-2	1.167	1.032	1.167	1.265 Detail 3	1.100 Detail 2	1.092 Detail 4	1.100 Detail 2	1.032
F	1.167	1.032	1.167	1.265 Detail 3	1.167 Detail 2	1.092 Detail 4	1.100 Detail 2	1.032
G	1.272	1.183	1.272	1.374 Detail 3	1.272	1.262 Detail 4	1.270 Detail 2	1.183
H	1.491	1.394	1.491	1.655 Detail 3	1.491	1.494 Detail 5	1.489 Detail 2	1.394
J	1.929	1.780	1.929	2.155 Detail 3	1.929	1.865 Detail 5	1.851 Detail 2	1.780
K	2.126	2.126	2.264	2.468 Detail 3	2.264	2.468 Detail 3	2.264	2.264
L	2.527	2.527	2.762	3.062 Detail 3	2.762	3.062 Detail 3	2.527	2.527
M	2.126	2.126	3.054	3.358 Detail 3	3.054	3.358 Detail 3	2.264	2.980
N	3.088	3.088	3.480	3.827 Detail 3	3.480	3.827 Detail 3	2.527	2.527
P	3.950	3.950	4.361	4.811 Detail 3	4.361	4.811 Detail 3	2.980	2.980
Q	5.197	5.197	5.546	6.108 Detail 3	5.546	6.108 Detail 3	5.197	5.197
R	6.115	6.115	6.563	7.218 Detail 3	6.563	7.218 Detail 3	6.155	6.155
T	7.494	7.494	7.840	8.624 Detail 3	7.840	8.624 Detail 3	7.494	7.494
W	12-21/32	12-21/32	n/a	n/a	n/a	n/a	n/a	n/a

*For valve manufactured prior to June 1987, use dimension 0.810 for D-1 orifice.



1900 LIQUID SERVICE (LS) INTERNALS
FIGURE 19



1900 LIQUID SERVICE (LA) INTERNALS
FIGURE 20

IX. (Continued)

TABLE 5A

G Diameter in millimeters for Disc Holder Identification. See Figure 18, for design details. (Detail 1, is standard unless noted).								
Orifice Size	Standard Disc Holder				O-Ring Disc Holder			
	Low Pressure	High Pressure	Liquid Trim		Liquid Trim		Low Pressure	High Pressure
			LS Design	LA Design	DL Design	DALA Design		
D-1	18.16	18.16	20.6	19.43 Detail 3	20.6	n/a	20.6	20.6
E-1	25.70	23.42	24.66	26.95 Detail 3	24.66	n/a	23.88 Detail 2	24.66
D-2	29.64	26.21	29.64	32.13 Detail 3	27.94 Detail 2	27.74 Detail 4	27.94 Detail 2	33.53
E-2	29.64	26.21	29.64	32.13 Detail 3	27.94 Detail 2	27.74 Detail 4	27.94 Detail 2	26.21
F	29.64	26.21	29.64	32.13 Detail 3	29.64 Detail 2	27.74 Detail 4	27.94 Detail 2	26.21
G	32.31	1.183	32.31	34.90 Detail 3	32.31	32.05 Detail 4	32.26 Detail 2	30.05
H	37.87	35.41	37.87	42.04 Detail 3	37.87	37.95 Detail 5	37.82 Detail 2	35.41
J	49.0	1.780	49.0	54.74 Detail 3	49.0	47.37 Detail 5	47.01 Detail 2	45.21
K	54.0	54.0	57.50	62.69 Detail 3	57.50	62.69 Detail 3	57.50	57.50
L	64.19	64.19	70.15	77.77 Detail 3	70.15	77.77 Detail 3	64.19	64.19
M	54.0	54.0	77.57	85.29 Detail 3	77.57	85.29 Detail 3	57.50	75.69
N	78.44	78.44	88.39	97.21 Detail 3	88.39	97.21 Detail 3	64.19	65.28
P	100.33	100.33	110.77	122.20 Detail 3	110.77	122.20 Detail 3	75.69	75.69
Q	132.00	132.00	140.87	155.14 Detail 3	140.87	155.14 Detail 3	132.00	132.00
R	155.32	155.32	166.70	183.34 Detail 3	166.70	183.34 Detail 3	156.34	156.34
T	190.35	190.35	199.14	219.05 Detail 3	199.14	219.05 Detail 3	190.35	190.35
W	321.47	321.47	n/a	n/a	n/a	n/a	n/a	n/a

*For valve manufactured prior to June 1987, use dimension 20.57 mm for D-1 orifice.

Set Pressure Change Note: If it is necessary to change the valve set pressure, it may be also be necessary to change the disc holder. See Table 8 to determine if the disc holder must be changed to (from) low pressure from (to) high pressure when changing the set pressure.

Media Change Note: If the protected media is changed in form from a compressable fluid (air, gas or steam), to a non compressable fluid (liquid), change from a standard to a liquid trim disc holder.

Bellows Conversion Note: If a conventional 1900 valve has a D, E, F, G, H, or J orifice disc holder, the disc holder must be exhanged for a bellows type holder.

O-Ring Conversion Note: If a standard metal seated 1900 valve is to be converted to an O-Ring valve, then the disc holder must be replaced with an O-Ring disc holder. If the valve has a “K” or larger orifice, the standard disc holder may be machined to receive the oversized O-Ring disc. Instructions for this procedure are provided with the kit. O-Ring disc holders may be obtained with the kit.

IX. (Continued)

G. Guide Inspection Criteria

Guide should be discarded if:

1. Visible galling is indicated in the inside guiding surface.
2. The gasket seating areas are pitted and cause the valve to leak between the bonnet and base.

Several different guides could be present in a particular valve depending if it is an O-Ring Valve or Bellows Valve or a Standard valve. On Table 6, find the line that contains the correct orifice size for the valve. Then measure the Barrel portion of the Disc Holder and compare the actual measurement to those indicated in Table 6, to determine the maximum allowable clearance between the disc holder and the guide.

Both the Guide and Disc Holder should be replaced if the clearance between the ID and the Guide and the OD of the Disc Holder is not within the clearance dimensions given in the table below.

H. Spindle Inspection Criteria

Spindle should be replaced if:

1. The bearing point is pitted, galled or distorted.
2. Threads torn so lift nuts won't thread on or off.
3. Concentricity – if spindle cannot be straightened less than .007 total indicator runout (see section X.J and Figure 31).

I. Spring Inspection Criteria

Spring should be discarded if:

1. Pitting and corrosion of the coils reduces coil diameter.
2. Inspect for end parallelism in the free height condition.
3. Check for any obvious unevenous in coil spacing or spring distortion.
4. Spring Washers are custom made for each end of a particular spring. The maximum clearance between the A and A_1 dimension, and B and B_1 dimension (see figure 21), should be 1/32 inch (.79mm) for springs with an inside diameter of less than four inches (100mm). The clearance for valves with a spring inside dimension that is four inches (101. plus) or larger should be 3/64 inch (1.19mm). If you find you must replace a spring, order a Spring Assembly as it will include custom fit Spring Washers not just a spring.

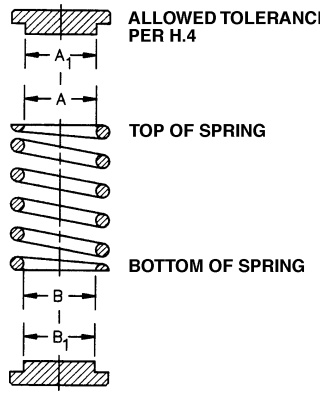


FIGURE 21

5. If constant back pressure is present in a conventional 1900 Series Safety Relief Valve (without balancing bellows), the correct spring should be chosen so that the **COLD DIFFERENTIAL SET PRESSURE** is within the spring range. Normally the spring is selected so that the Set Pressure of the valve is in the spring range. If only the relieving temperature causes the Cold Differential Set Pressure, then the spring is selected using the Set Pressure not the Cold Differential Set Pressure. See Section XII.E for further discussion of set pressure compensation.

TABLE 6

ALLOWABLE CLEARANCE FOR GUIDE AND DISC HOLDER

Orifice Size	Disc Holder Nominal Barrel Size in inches	Disc Holder Diametral Clearance in inches	Disc Holder Nominal Barrel Size in millimeters	Disc Holder Diametral Clearance in millimeters
D, E, F, G	.450, .496, .527 .995	.003-.007 .004-.008	11.43, 12.6, 13.38 25.27	.076-.177 .102-.203
H	.682 1.119	.004-.009 .005-.010	17.32 28.42	.102-.228 .127-.254
J, M	.994, 1.119, 1,744	.005-.010	25.24, 28.42, 44.3	.127-.254
K, L	1.242, 1.367	.007-.012	31.55, 34.72	.178-.305
N	1.870 2.242	.004-.009 .007-.012	47.50 56.95	.102-.228 .178-.305
P	2.304, 2.491	.008-.013	58.52, 63.27	.203-.330
Q,R	3.488, 3.988	.010-.017	88.6, 101.29	.254-.432
T	5.190	.012-.020	131.82	.304-.508
Q-2, R-2, T-3	2.304	.008-.014	58.52	.203-.355
W	8.425	.013-.026	214.0	.330-.660

X. Maintenance Instructions

A. General Information

After the valve has been disassembled, a close inspection should be made of the seating surfaces. In a majority of cases, a simple lapping of seats is all that is necessary to put the valve in first class working order. If an inspection of the parts shows the valve seating surfaces to be badly damaged, machining will be required before lapping. O-Ring seat seal valve nozzles can only be reconditioned by machining, not lapping. (For specific information concerning the machining of nozzle and disc seating surfaces, see Paragraphs X.H. and X.I. which follow.)

NOTE:

In order to determine if the valve contains *Glide-Aloy™ treated components (i.e., the disc holder and/or the guide), which will be identified for a particular valve by the coding found on the valve nameplate, please consult the Appendix to this manual for pertinent supplemental information.

The seating surfaces of the metal seated Consolidated® Safety Relief Valve are flat. The nozzle seat is relieved by a 5° angle on the outside of the flat seat. The disc seat is wider than the nozzle seat; thus, the control of seat width is the nozzle seat (see Figure 22).

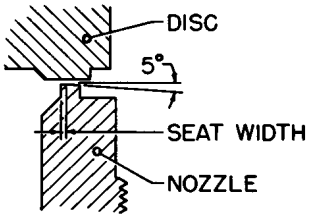


FIGURE 22

Reconditioning of the seating surfaces of the nozzle and disc is accomplished by lapping with a cast iron lap, coated with a lapping compound.

Anytime the V or W orifice valve is disassembled, be sure to inspect the guide rings for wear. If worn, replace before assembly.

NOTE:

In order to establish leak free valve seats, the nozzle seating surface and the disc seating surface must be lapped flat.

B. Lapping Nozzle Seats (Non O-Ring Styles)

NOTE:

Nozzle laps as illustrated below are available from DVCD (instructions and part numbers are located in the tooling section of this manual. It is not recommended to use these laps if the valve nozzle can be removed and machined to the seat dimensions described in Table 7 on page 23.

The 5° angle of the nozzle should be lapped first (see Figure 23, below). Then, invert the nozzle lap and use the flat side as a "starter" lap to insure squareness of the seat (see Figure 24, below). Finish lapping should be done with a ring lap (see Figure 25, below). The ring lap is to be used in an eccentric or figure-eight motion (see Paragraph X.G. for further information). Keep the lap squarely on the flat surface and avoid any tendency to rock the lap which will cause rounding of the seat.

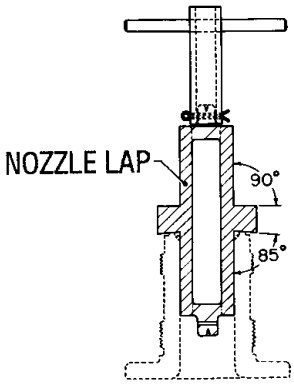


FIGURE 23

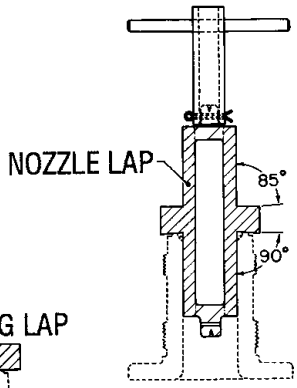


FIGURE 24

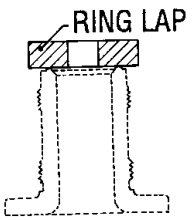


FIGURE 25

C. Nozzle Seat Widths-Lapped

A wide nozzle seat will induce simmer, especially in the smaller orifice lower pressure valves. For this reason, the seat of non-O-Ring valves should be as narrow as practical. Since the seat must be wide enough to carry the bearing load imposed upon it by the spring force, the higher pressure valves must have wider seats than the lower pressure valves. The nozzle seat width should conform with those listed in Table 7, on page 23.

X.C. (Continued)

TABLE 7

Orifice	Set Pressure psig (bar) for Metal Seated Valves except TD	Suggested Lapped Seat Width in Inches (mm)
D thru J	15-50 (1.03-3.45) 51-100 (3.52-6.90) 101-250 (6.96-17.24) 251-400 (17.31-27.58) 401-800 (27.65-55.16)	.012-.020 (.30-.51 mm) .018-.028 (.46-.71 mm) .025-.035 (.64-.89 mm) .032-.042 (.81-1.07 mm) .038-.048 (.96-1.22 mm)
D thru F	801-1500 (55.23-103.42) 1501-3000 (103.49-206.84) 3001-6000 (206.91-413.69)	.042-.052 (1.07-1.32 mm) .045-.055 (1.14-1.40 mm) .050-.060 (1.27-1.52 mm)
G thru J	801-1000 (55.23-68.95) 1001-2800 (69.02-193.05) 2801-6000 (193.12-413.79)	.040-.050 (1.02-1.27 mm) .042-.055 (1.07-1.40 mm) .045-.060 (1.14-1.52 mm)
K thru N	15-50 (1.03-3.45 51-100 (3.52-6.90 101-250 (6.96-17.24) 251-400 (17.31-27.58) 401-800 (27.65-55.16)	.025-.040 (.64-1.02 mm) .030-.045 (.76-1.14 mm) .035-.050 (.89-1.27 mm) .040-.055 (1.02-1.40 mm) .045-.060 (1.14-1.52 mm)
P thru R	15-50 (1.03-3.45) 51-100 (3.52-6.90) 101-250 (6.96-17.24) 251-400 (17.31-27.58) 401-800 (27.65-55.17) 801-1000 (55.23-68.95)	.030-.045 (.76-1.14 mm) .035-.050 (.899-1.27 mm) .045-.060 (1.14-1.52 mm) .050-.065 (1.27-1.65 mm) .060-.070 (1.52-1.78 mm) .062-.070 (1.57-1.78 mm)
T	15-50 (1.03-3.45) 51-100 (3.52-6.90) 101-200 (6.96-13.79) 201-300 (13.86-20.68)	.040-.060 (1.02-1.52 mm) .045-.065 (1.14-1.65 mm) .050-.070 (1.27-1.78 mm) .060-.080 (1.52-2.03 mm)
W	15-50 (1.03-3.45) 51-100 (3.52-6.90) 101-250 (6.96-17.24) 251-300 (17.31-20.68)	.095-.105 (2.41-2.67 mm) .115-.125 (2.92-3.17 mm) .135-.145 (3.43-3.68 mm) .155-.165 (3.94-4.19 mm)

Orifice	Set Pressure psig (bar) for TD Option only	Suggested Seat Width in Inches (mm) for TD Option only
D thru F	15-50 (1.03-3.45) 101-300 (6.96-20.68) 301-800 (20.75-55.17) 801 plus (55.24 plus)	.020-.030 (.50-.76 mm) .035-.045 (.89-1.14 mm) .045-.055 (1.14-1.40 mm) Add .005 (.13 mm) for each additional 100 psig
G thru J	15-100 (1.03-6.89) 101-300 (6.96-20.68) 301-800 (20.75-55.17) 801 plus (55.24 plus)	.025-.035 (.64-.89 mm) .035-.040 (.089-1.01 mm) .045-.055 (1.14-1.4 mm) Add .005 (.13 mm) for each additional 100 psig
K thru N	15-100 (1.03-6.89) 101-300 (6.96-20.68) 301-800 (20.75-55.17) 801 Plus (55.24 plus)	.035-.040 (.089-1.01 mm) .045-.055 (1.14-1.4 mm) .055-.065 (1.4-1.65 mm) Add .005 (.13 mm) for each additional 100 psig
P thru R	15-100 (1.03-6.89) 101-300 (6.96-20.68) 301-800 (20.75-55.17) 801-1000 (55.24-68.95)	.040-.050 (1.01-1.27 mm) .055-.065 (1.40-1.65 mm) .060-.070 (1.52-1.78 mm) .065-.075 (1.65-1.90 mm)
T	15-100 (1.03-6.89) 101-300 (6.96-20.68)	.050-.065 (1.27-1.65 mm) .060-.075 (1.52-1.90 mm)
W	- -	- -

The seat width can be measured by the use of a "Measuring Magnifier" (see Figure 26 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 nozzle seat width is shown in Figure 26 b (also below).

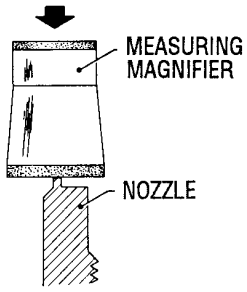


FIGURE 26

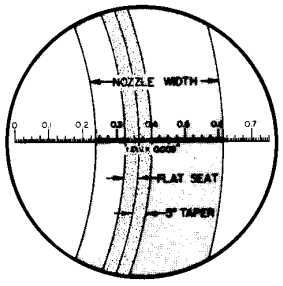


FIGURE 26 b

X.C. (Continued)

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).

D. Lapping Disc Seats

The disc seat may be lapped with a ring lap or a lapping plate. Lapping should be done in an eccentric or figure-eight motion in all directions, applying uniform pressure and rotating the disc or lap slowly. (See Paragraph X.G. for further information).

E. Precautions and Hints for Lapping Seats

The following precautions and hints will enable maintenance personnel to do a "professional" job of lapping sets:

1. Keep work materials clean.
2. Always use a fresh lap. If signs of wearing (out of flatness) are evident, recondition the lap.
3. Apply a very thin layer of compound to the lap. This will prevent rounding off the edges of the seat.
4. Keep the lap squarely on the flat surface, and avoid any tendency to rock the lap which causes rounding of the seat.
5. When lapping, keep a firm grip on the part to prevent the possibility of dropping it and damaging the seat.
6. Lap, using eccentric or figure-eight motion in all directions, at the same time applying uniform pressure and rotating the lap slowly. (See Paragraph X.G. for further information.)
7. Replace the compound frequently after wiping off the old compound, and apply more pressure to speed the cutting action of the compound.
8. 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.
9. 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.
10. The seat should now be thoroughly cleaned using a lint-free cloth and a cleansing fluid.

F. Lapping O-Ring Seating Surfaces

The contact surfaces of the nozzle and O-ring retainer are ground, prior to assembly, to provide metal to metal seat tightness in the event of O-ring failure.

Refer to Figure 4 (on page 7 of this manual) and assemble the retainer to the disc holder (D-J orifice), or disc (K-T orifice), using the retainer lock screw(s). Apply 3A compound to the retainer seating surface. Place the retainer on the nozzle seat and grind the retainer to the nozzle. Once uniform contact is established, clean the nozzle and retainer, and repeat the grinding procedure with 1000 grit compound.

Remove the retainer screw(s) and retainer, and thoroughly clean the retainer, retainer screws and disc holder or disc.

X. (Continued)

G. Reconditioning of Laps

1. Ring laps are reconditioned by lapping them on a flat lapping plate. The lapping should be done with a figure-eight motion as indicated in Figure 27, below. To assure the best results when lapping seats, the ring laps should be reconditioned after each usage and checked with an optical flat.

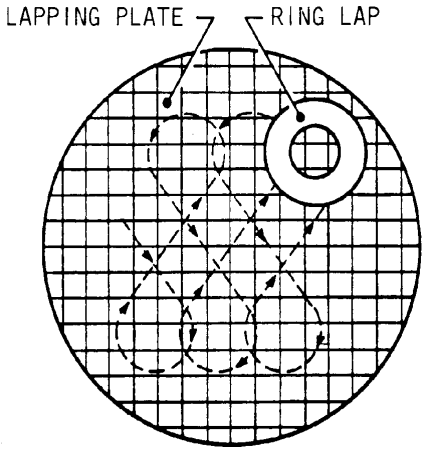


FIGURE 27

2. Nozzle laps must be remachined to recondition the lapping surfaces. Place the nozzle lap in a lathe between centers (see Figure 28, below). The surfaces marked A and B must be running concentric.

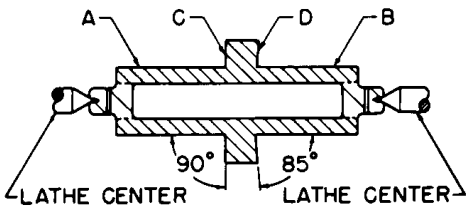


FIGURE 28

One lapping surface is 90° and the other is 85°. The angle of each surface is marked on the lap. Machine surfaces C and D, by taking light cuts at the proper angle, until the lapping surfaces are reconditioned.

H. Remachining Nozzle Seats and Bores

The nozzle should be removed from the valve to be machined (see Figure 29). See Nozzle Removal Instructions in paragraph VII.B.14. If it can not be removed from the base, it should be machined inside the base.

1. Lathe Set Up - Nozzle Removed

   a. Grip the nozzle in a four-jaw independent chuck, using a piece of soft material such as copper or fiber between the jaws and the nozzle as shown at A in Figure 29.

   b. True up the nozzle so that the surfaces marked B, C and D run true within .001" on indicator.

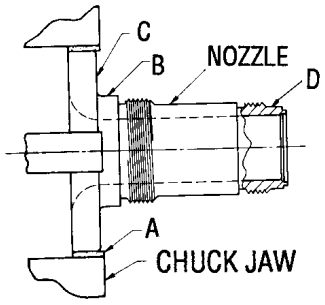


FIGURE 29

X.H. (Continued)

2. Machining Procedure: Metal to Metal Seat

   See Figure 15, page 15.

   a. Take light cuts across the surface L at 5°, until the damaged areas are removed. (See Figure 15) Turn to the smoothest possible finish.

   b. Cut back the outside surface at G, until dimension N is obtained. The surface at G is common to all nozzles **except the D-1. Omit this step on the D-1 orifice nozzles.**

   c. Machine bore diameter H, until dimension E is obtained. Re-establish angle P.

   d. The nozzle is now ready for lapping.

   e. When the minimum dimension D is reached, the nozzle should be discarded.

3. Machining Procedure: O-Ring Seat Seal

   See Figure 15, page 15.

   a. Take light cuts across surface A (45°), until the damaged areas are removed. Turn to the smoothest possible finish.

   b. Cut back the outside surface at M, until dimension J is obtained.

   c. Machine radius B.

   d. The nozzle is now ready for grinding.

   e. When the minimum dimension D is reached, the nozzle should be discarded.

I. Remachining the Disc Seat*

The standard disc seating surface (see Figure 30) can easily be machined as follows:

1. Grip the disc in a four-jaw independent chuck (or collet, if appropriate), using a piece of soft material such as copper or fiber between the jaws and the disc as shown at A.
2. True up the disc so that the surface marked B and C run true within .001" (0.025 mm), TIR.
3. Take light cuts across the seating surface L until damaged areas are removed. Turn to smoothest possible finish.
4. The disc is now ready for lapping.
5. When the minimum dimension N or T (see Table 3) is reached the disc should be discarded. Do not re-establish surface C.

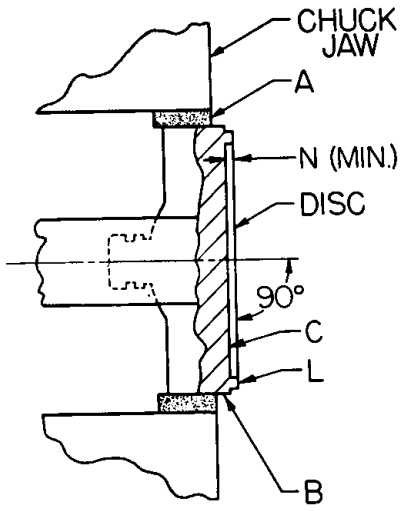


FIGURE 30

*Thermodisc® and O-Ring discs are not to be machined.

X. (Continued)

J. Checking Spindle Concentricity

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, either of the following methods is recommended:

1. 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. For hollow spindles, a ball pointed support is required. (See Figure 31).

   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 .007" (.17 mm). Straighten the spindle, if necessary.

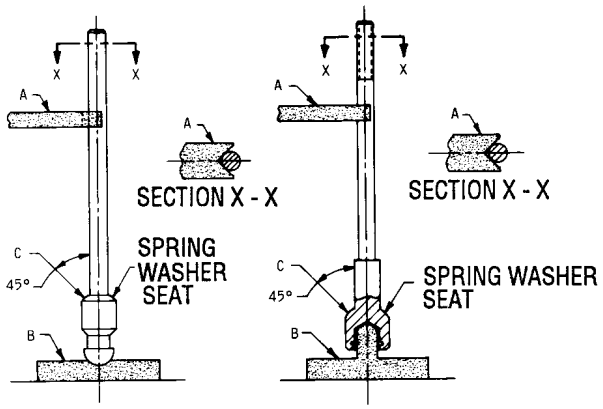


FIGURE 31

TABLE 8

Disc Holder Selection Criteria Pressures in psig, (kg/cm²) units.								
Orifice Size	Air / Gas Non Liquid Service				Liquid Service			
	Metal Seat		"O" Ring DA		LS Design		LA Design	
	Use low pressure discholder	Use high pressure discholder	Use low pressure "O"ring discholder	Use high pressure "O"ring discholder	Metal Seats	"O" Ring Seat	Metal Seat	"O"Ring Seat
D-1 -30D-1	Not available	Use for all pressures	Use for all pressures same as DL disc holder	Not applicable	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA for all Pressures	LA-DA discholder is not applicable
E-1 -30E-1	5 - 100 (71-1435)	101 and greater (1436) and greater	5 - 35 (71-499)	36 (500) and greater same as DL discholder	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	LA-DA discholder is not applicable
D-2 E-2 -30D-2 -30E-2 F-1 -30F-1	5 - 100 (71-1435)	101 and greater (1436) and greater	5 - 35 (71-499)	36 (500) and greater same as DL discholder	Use LS - Same as low pressure air / gas discholder	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	Use DA-LA disc-holders for all Pressures
G-1 -30G-1 H-1 -30H-1 J-2 30J-2	5 - 50 (71-711)	50 and greater (712) and greater	5 - 120 (71-1706)	121 (1720) and greater	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	Use DA-LA disc-holders for all Pressures
K - T -30K-T	Not applicable	use standard discholder for all pressures	Not applicable	All Pressures	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	Use DA-LA disc-holders for all Pressures

X. (Continued)

K. Set Pressure Change-Disc Holder*

The disc holder must be replaced if the set pressure must be changed and the change involves crossing the dividing line between high pressure and low pressure. See Table 8 to determine if the disc holder must be changed when changing the set pressure.

L. Checking Lift on Lift Restricted Valves

General

Restricted lift valves have a limit washer which prevents the disc and dischholder from lifting beyond the required lift and resulting capacity. The D-1 and E-1 valves do not require limit washers. The D-2 and E-2 valves have a special nozzle with the overall height and flange dimension of the D-1 or E-1, and the actual seat dimensions and bore diameter are identical to the F orifice nozzle.

Other 1900 series valves may be restricted in the same manner when necessary. These valves may be restricted to a minimum lift of 30% of the full rated capacity, or .080 inches or 2.03 mm. Please refer to National Board Code Case 1945-2.

It is important to check lift on all restricted lift valves after servicing or replacing parts. This procedure is necessary to insure the reliability of the nameplate capacity.

NOTE:

The required lift for a "restricted lift" valve is indicated on the restricted lift nameplate, (see figure 33).

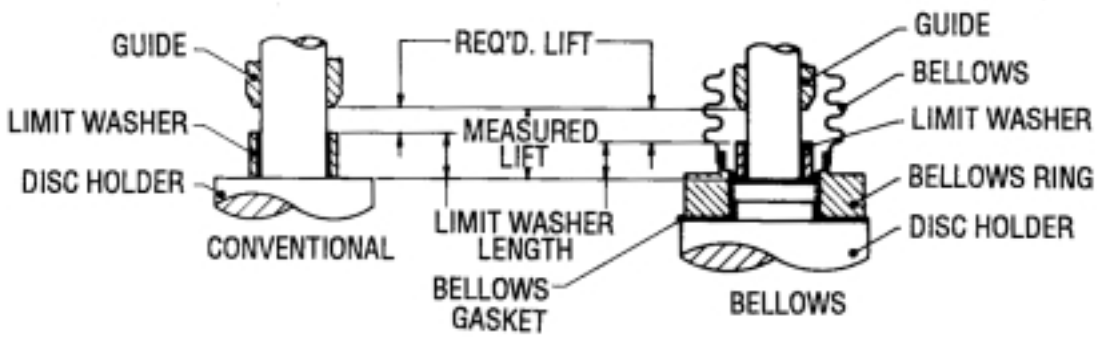


FIGURE 32

Restricted lift valves may be identified by the restricted lift nameplate (see Figure 33).

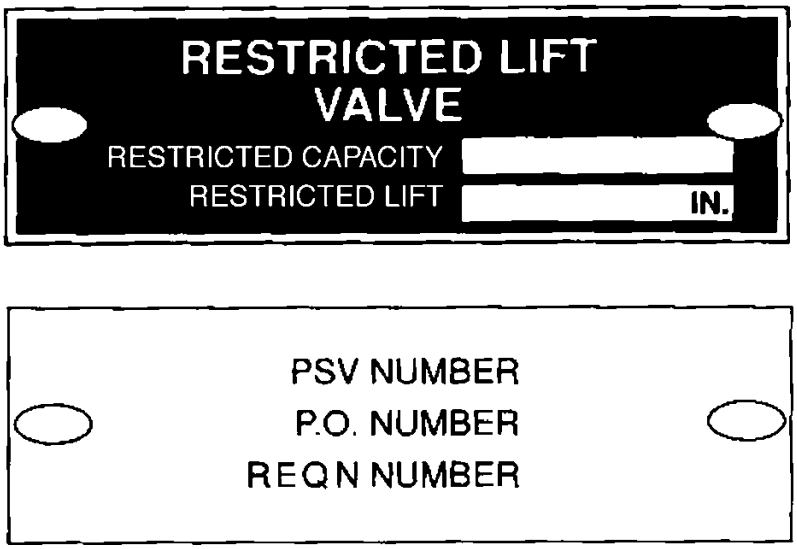


FIGURE 33

X. (Continued)

Specific Steps

Use the following procedure to determine the correct limit washer length.

1. Assemble the disc and holder (installing the bellows gasket and bellows, if applicable). Place the guide over the disc holder barrel; then connect the spindle to the disc holder. (Install the eductor tube in base, if applicable.) Then, install the adjusting ring below the seat.
2. Install the guide gasket and insert the assembly, from Step 1, above, into the base.
3. Install the bonnet gasket and bonnet (leaving out the spring assembly at this time).
4. Tighten the nuts to compress the gasket. **(Do not use an impact wrench on bellow valves.)**
5. Place a dial lift indicator on the bonnet and over the spindle, then zero the indicator.
6. Measure the total lift by pushing the disc upward.
7. Subtract the required lift of the valve from the measured lift, to find the required limit washer length.
8. Machine the limit washer to the required length. Next, machine the inside chamfer, then deburr and polish, as required.
9. Disassemble the valve, install the limit washer (with chamfer down), and prepare to reassemble the valve. Measure the actual lift of the valve, and compare it with the required lift for the valve, per the note above.
10. a. If the actual lift is less than required, machine the lift washer the additional amount necessary to obtain the required lift. (Machine, chamfer and deburr, before installation into the valve.)

    b. If the actual lift is greater than the required amount, obtain a new limit washer, and begin again with Step 7, above. (Again, machine, chamfer and deburr, before installation into valve.)
11. Remove the bonnet and install the spring assembly; then, reinstall the bonnet and tighten the stud nuts.
12. The valve is now ready for setting and testing.

NOTES:

- **The limit washer must be chamfered to fit over the radius on the disc holder. This chamfered end must be located down, next to the backface of disc holder, when assembled.**
- **For bellows Type "D" and "E" valves, the limit washer must be chamfered on the lower end, to remove the knife edge of the cut off. For bellow valves, the outside diameter must also be checked, and emery clothed down to .680" or 17.3 mm maximum diameter, in order to avoid any interference with the bellows threads.**
- **Be sure of all dimension requirements for each valve. Do not interchange internal parts, or use a different base, after a set of parts has been custom-fit.**

XI. Reassembly

A. General Information

The Type 1900 Safety Relief Valve can be easily re-assembled after the required maintenance of internal parts has been performed. (Again, refer to Figures 1-6, on pages 6 and 7, for parts nomenclature.) All parts should be clean prior to assembly. Special attention should be given to guiding surfaces, bearing surfaces, flange faces, retainer recesses and grooves. See Section XVII for Recommended Compounds and Tools.

NOTES:

- **Check all gaskets used during re-assembly. Undamaged solid metal gaskets (not pitted or creased) can be reused. All soft gaskets must be replaced. Before placing the (flat) gaskets, apply a light uniform coating of lubricant to the surface to be gasketed; then coat the top of the gasket with lubricant.**
- **If grinding in of bearing parts was necessary, be sure to remove all grinding compound; then, thoroughly clean both surfaces and rinse with alcohol or another suitable cleaner.**
- **With regard to restricted lift valves, be sure to measure the required lift before final assembly. (See Paragraph X.L. for instructions.)**
- **The last step before final assembly is lubrication. Apply lubricants sparingly, but be sure that each bearing surface is lightly (yet uniformly) covered.**

XI.A. (Continued)

- **If the involved valve has an O-Ring seat seal, refer to the tag plate mounted on the valve (see Figure 34) to determine O-Ring material and "as built" part number.**

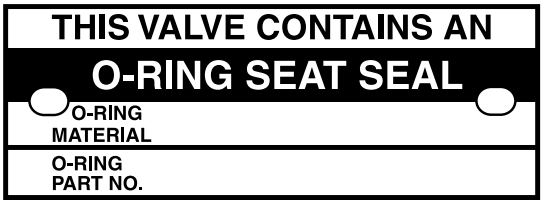


FIGURE 34

B. Lubrication

Use a nickel based anti-seize lubricant on all threads, and bearing surfaces. Typical brands are TWIST™, NEVER-SEEZE™, OR FEL-PRO NICKEL EASE™.

C. Specific Steps

1. If the valve nozzle was removed, apply thread lubricant to the nozzle threads before reinstalling in the valve base. Insert it in to the inlet flange of the base, and torque to the correct value listed in Table 9.

TABLE 9

Nozzle Torque Values +10% - 0%		
Orifice	**Required Torque ft.lbs.**	**Required Torque nm**
D-1	95	129
D-2 E-1 E-2 F-1	165	224
G	145	197
H	165	224
J	335	455
K	430	584
L	550	746
M	550	746
N	640	868
P	1020	1383
Q	1400	1898
R	1070	1451
T	1920	2604
V	2000	2712
W	2000	2712

2. Reinstall the adjusting ring on the nozzle, below seat level, so that the disc will seat on the nozzle and not on the ring.

3. a. For restricted lift valves, if the nozzle did not require any machining, the same limit washer (tagged during disassembly) may possibly be reused. However, lift should be checked and verified as described in Paragraph X.L.

   b. If a restricted lift valve nozzle was remachined, measure the required lift before final assembly. (Again, see Paragraph X.L. for instructions.)

4. Assemble the disc/disc holder as follows:

   a. Prior to assembly of the disc into the disc holder, remove the spring clip from the back of the disc. Use 1000 grit grinding compound on the bearing surface to grind the disc into the disc holder to properly establish the bearing surface.

   b. For all orifices, metal-to-metal discs, place the disc retainer into the groove in the disc. The retainer should “snap” into the disc holder pocket with moderate finger or hand force. **DO NOT USE EXCESSIVE FORCE TO ASSEMBLE THESE PARTS**. Be sure that the disc is free to “wobble” after it is in place.

      For V and W orifice discs, place disc into disc holder and secure disc retaining bolts.

   c. For O-Ring disc sizes K thru T, reassemble the disc using a new O-Ring, O-Ring retainer, and new screws. Assemble the disc into the disc holder as described in Paragraph 4.a., above.

   d. For O-Ring disc sizes D thru J, reassemble the disc holder using a new O-Ring, O-Ring retainer, and new screw(s). These disc holders are ready for the next step.

5. For bellows valves through T, (see Figure 11 on page 13), place a new bellows gasket on the disc holder. Thread the bellows, finger-tight, down to the gasket on the disc holder. Use a pin spanner wrench, or special cable type wrench to turn the bellows ring down until a pressure tight joint is obtained.

   For bellows valves V and W, place a new bellows gasket on the disc holder. Bolt down using proper torque as found in the assembly instructions.

6. On D and E restricted lift valves, install the limit washer with the chamfered side down.

XI.C. (Continued)

7. Place the guide over the disc holder. **(DO NOT DROP.)** If bellows is present, the weight of the guide will slightly compress the bellows.

8. Set the disc holder (disc side down), on the work surface. Place a small amount of 1000 grit grinding coumpound onto the ball end of the spindle and place it in the spindle socket of the disc holder. Turn the spindle clockwise, and then counter clockwise, to seat the spindle/disc holder bearing point.

9. Place the spindle retainer over the end of the spindle head or disc holder, as applicable. Apply lubricant sparingly to the ball tip of the spindle. Place the spindle in the disc holder, and align the spindle retainer so that the gap is midway between the two slots. Using a screwdriver, compress the spindle retainer and guide it into the retaining groove. Be sure that the spindle turns freely.

10. With a small amount of 320 grit grinding compound spread on the spring washer bearing surface. Place the spring washer over the spindle/spring washer bearing surface and turn it clockwise and then counter-counterwise to seat in the bearing surface. In the same manner grind the compression screw into the bearing surface of the upper spring washer to establish a smooth bearing surface.

TABLE 10

Bonnet Nut Torque in ft.lbs. +10% - 0%													
	1905 1906	1910	1912	1914	1916	1918	1920	1921	1922	1923	1924	1926	1928
D-1	55	55	55	60	60	120	55	**	55	**	75	60	115
D-2	55	55	60	60	60	120	55	**	55	**	60	60	115
E-1	55	55	55	60	60	120	55	**	55	**	60	60	115
E-2	55	55	60	60	60	120	55	**	55	**	60	60	115
F	55	55	60	70	70	115	55	**	55	**	70	70	115
G	55	55	60	70	70	75	55	**	60	**	70	70	75
H	90	60	75	65	65	**	60	**	60	**	75	85	**
J	60	75	100	100	100	**	75	**	75	**	100	100	**
K	65	60	60	135	145	**	60	**	60	**	60	140	**
L	75	90	90	140	140	**	90	**	90	**	140	140	**
M	95	110	95	95	**	**	90	**	95	**	95	**	**
N	105	130	85	85	**	**	130	**	85	**	85	**	**
P	120	145	125	125	**	**	145	**	**	125	125	**	**
Q	105	125	150	**	**	**	105	**	**	**	**	**	**
R	115	115	135	**	**	**	115	**	150	**	**	**	**
T	95	**	**	**	**	**	**	**	135	**	**	**	**
-2T	**	125	**	**	**	**	**	125	**	**	**	**	**
V	130	130	**	**	**	**	**	**	**	**	**	**	**
W	130	130	**	**	**	**	**	**	**	**	**	**	**

** Valves have not been built in this configuration.

XI.C. (Continued)

11. Place a new guide gasket in the base.

12. Install spindle/disc guide assembly. On M thru T sizes, use the same lifting tool (see Figure 10 on page 13) as was used during disassembly, then carefully lower it into the valve base. If conventional valve is involved, take care to align the hole(s) in the guide over the extended end of the eductor tube(s), to ensure proper fit. Then, install the spindle as described in Paragraph 8 above.

    On V and W sizes, use the same lifting lugs as were used during disassembly.

13. Apply a small quantity of lubricant to the spring washer bearing surface of the spindle. Place the spring assembly on the spindle.

14. Place a new bonnet gasket in the base prior to installing the bonnet. Uniformly tighten the bonnet stud bolts using the correct pattern as displayed in Figure 35. Use table 10 or 10A, to determine the required torque for the subject valve. Then use Table 11, to determine the torque values for each round of the pattern. The last round insures that all the stud nuts are at the required touque.

TABLE 10A

Bonnet Nut Torque in nm, +10% - 0%													
	1905 1906	1910	1912	1914	1916	1918	1920	1921	1922	1923	1924	1926	1928
D-1	75	75	75	82	82	163	75	**	75	**	102	82	156
D-2	75	75	82	82	82	163	75	**	75	**	82	82	156
E-1	75	75	75	82	82	163	75	**	75	**	82	82	156
E-2	75	75	82	82	82	163	75	**	75	**	82	82	156
F	75	75	82	95	95	156	75	**	75	**	95	95	156
G	75	75	82	95	95	102	75	**	82	**	95	95	102
H	123	82	102	89	89	**	82	**	82	**	102	116	**
J	82	102	136	136	136	**	102	**	102	**	136	136	**
K	89	82	82	184	197	**	82	**	82	**	82	189	**
L	102	123	123	189	189	**	123	**	123	**	189	189	**
M	129	150	129	129	**	**	123	**	129	**	129	**	**
N	143	177	116	116	**	**	177	**	116	**	116	**	**
P	163	197	170	170	**	**	197	**	**	125	170	**	**
Q	143	170	204	**	**	**	143	**	**	**	**	**	**
R	156	156	184	**	**	**	156	**	204	**	**	**	**
T	129	**	**	**	**	**	**	**	184	**	**	**	**
-2T	**	170	**	**	**	**	**	125	**	**	**	**	**
V	177	177	**	**	**	**	**	**	**	**	**	**	**
W	177	177	**	**	**	**	**	**	**	**	**	**	**

** Valves have not been built in this configuration.

XI.C. (Continued)

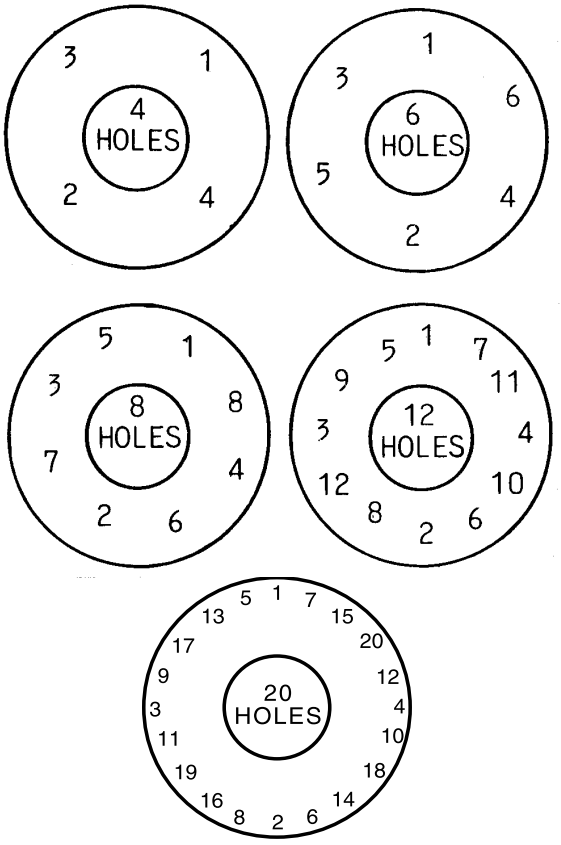


FIGURE 35

15. With the adjusting screw lock nut assembled near the top of the adjusting screw, apply a small quantity of lubricant to the spherical end of the adjusting screw, and also lubricate the threads. Thread the adjusting screw into the bonnet, until it contacts the spring washer.

    For V and W orifices, assemble the plunger and compression screw with the setting device. Set as if starting fresh.

16. When compressing the spring, hold the spindle with pliers to prevent the spindle from turning in the disc holder. Turn the adjusting screw clockwise, until the original distance between the end of the spindle and the top of the adjusting screw is obtained. This method of compressing the spring will "approximately" re-establish the original set pressure. **The valve must still be reset for the required pressure**.

17. Restore the adjusting ring to its original position, with reference to the disc holder, as recorded, and replace the adjusting ring pin using a new gasket. If the original position of the ring is not known, verify the number of notches on the adjusting ring, then refer to one of the three tables (i.e., Tables 12, 13 & 14), depending upon the number of notches on the ring, and set the ring position according to the applicable set pressure and orifice size.

18. The valve is now ready for Setting and Testing.

TABLE 11

Torque required for each round of pattern	
Round	Percentage of required tourque
1	Wrench tight
2	25
3	60
4	100
5	100

XI.C. (Continued)

TABLE 12

RING SETTINGS FOR VALVES WITH SERIAL NUMBERS BEFORE TK-68738*			
ORIFICE	NO. OF NOTCHES ON ADJ. RING	SET PRESSURE 100 PSIG (6.90 BAR) & BELOW	SET PRESSURE ABOVE 100 PSIG (6.90 BAR)
D-1	16	1 Notch	4 Notches
D-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
E-1	16	1 Notch	4 Notches
E-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
F	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
G	18	1 Notch	4 Notches
	30	2 Notches	6 Notches
H	24	1 Notch	5 Notches
	30	2 Notches	6 Notches
J	24	1 Notch	5 Notches
	30	2 Notches	8 Notches
K	24	6 Notches	14 Notches
	32	8 Notches	19 Notches
L	24	6 Notches	18 Notches
	40	10 Notches	31 Notches
M	24	7 Notches	20 Notches
	40	10 Notches	30 Notches
N	24	7 Notches	20 Notches
	40	10 Notches	30 Notches
P	24	8 Notches	24 Notches
	40	14 Notches	42 Notches
Q	28	10 Notches	28 Notches
	48	17 Notches	47 Notches
R	32	28 Notches	36 Notches
	48	42 Notches	64 Notches
T	24	30 Notches	38 Notches
W	–	–	–

*** Valve Serial Numbers are alphabetically and numerically chronological.**

TABLE 13

RING SETTINGS FOR VALVES WITH SERIAL NUMBERS AFTER TK-68738*			
ORIFICE	NO. OF NOTCHES ON ADJ. RING	SET PRESSURE 100 PSIG (6.90 BAR) & BELOW	SET PRESSURE ABOVE 100 PSIG (6.90 BAR)
D-1	16	1 Notch	4 Notches
D-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
E-1	16	1 Notch	4 Notches
E-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
F	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
G	18	1 Notch	4 Notches
	30	2 Notches	6 Notches
H	24	1 Notch	5 Notches
	30	2 Notches	6 Notches
J	24	1 Notch	5 Notches
	30	2 Notches	8 Notches
K	24	2 Notches	5 Notches
	32	2 Notches	7 Notches
L	24	2 Notches	6 Notches
	40	4 Notches	11 Notches
M	24	2 Notches	7 Notches
	40	4 Notches	12 Notches
N	24	3 Notches	8 Notches
	40	4 Notches	13 Notches
P	24	3 Notches	9 Notches
	40	5 Notches	16 Notches
Q	28	5 Notches	15 Notches
	48	8 Notches	25 Notches
R	32	7 Notches	20 Notches
	48	10 Notches	30 Notches
T	24	6 Notches	19 Notches
W	24	10 Notches	30 Notches

TABLE 14

LIQUID TRIM			
OLD - LS		NEW - LA	
ORIFICE	RING POSITION	ORIFICE	RING POSITION
D	10	D	5
E	10	E	5
F	10	F	5
G	14	G	5
H	20	H	5
J	20	J	5
K	24	K	5
L	24	L	5
M	24	M	5
N	24	N	5
P	36	P	5
Q	42	Q	5
R	48	R	5
T	36	T	5

NOTES:

- **Be careful to choose the correct table.**
- **If the Valve has an "O" Ring Seat Seal, tighten and lock the adjusting screw prior to the final setting of the adjusting ring.**
- **Be sure the ring pin enters the notch in the ring, but does not bind the ring. The ring should move freely from side to side within the notch. If necessary, cut the pin to the needed length, or replace the pin.**

XII. Setting and Testing

A. General Information

Before putting the reconditioned valve in 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

For best results, 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.

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 15, 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 15

Set Pressure Multipliers for Cold Differential Set Pressure at Ambient Temperature

OPERATING TEMP. F	OPERATING TEMP. C	MULTIPLIER	OPERATING TEMP. F	OPERATING TEMP. C	MULTIPLIER
250	120	1.003	900	498	1.044
300	149	1.006	950	510	1.047
350	177	1.009	1000	538	1.050
400	204	1.013	1050	565	1.053
450	248	1.016	1100	593	1.056
500	260	1.019	1150	621	1.059
550	288	1.022	1200	649	1.063
600	316	1.025	1250	676	1.066
650	343	1.028	1300	704	1.069
700	371	1.031	1350	732	1.072
750	415	1.034	1400	760	1.075
800	427	1.038	1450	788	1.078
850	454	1.041	1500	815	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.

Table 16, below, shows the multiplier that should be used based on temperature above the saturated temperature (degrees of superheat).

TABLE 16

Set Pressure Multipliers for Cold Differential Set Pressure (Superheat Temperature)

Degrees of Superheat, Temp. above Sat.		Multiplier
Fahrenheit	Celsius	
100	38	1.006
200	93	1.013
300	149	1.019
400	187	1.025
500	260	1.031
600	315	1.038
700	371	1.044
800	427	1.050

XII.E. (Continued)

2. **Cold Differential Set Pressure For Back Pressure Compensation**

NOTE:

For valves with variable superimposed back pressure, install a bellows to allow the set pressure to remain constant.

When a conventional Type 1900 valve is to operate with a constant back pressure, the cold differential set pressure is the set pressure minus the constant back pressure.

When a Type 1900-30 D-1, or 1900-30 E-1, non-balanced bellows valve is used with constant back pressure, the set pressure must be compensated. This valve design cannot be used for variable back pressure. If the valve's set pressure, or back pressure, changes, contact DVCD Field Service at 318-640-6055 for the CDS of the valve.

When Consolidated® Type 1900-30 D-2, 1900-30 E-2 and 1900-30 F thru T balanced bellows valves are used with constant or variable back pressure, no compensation to the valve's set pressure is required due to back pressure.

3. **Sample Calculations For Type 1900 Consolidated Safety Relief Valve (Refer to preceding pages, Tables 15 & 16).**

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

a.	Set Pressure	2500	psig
	Multiplier from **Table X .....**	X1.019	
	Cold Differential Set Pressure	2547.5	psig
b.	Set pressure 2500 psig, temperature 500 F, constant back pressure 150 psig		
	Set Pressure	2500	psig
	Minus Constant Back Pressure	-150	psig
	Differential Pressure	2350	psig
	Multiplier from **Table X .....**	X1.019	
	Cold Differential Set Pressure	2395	psig
c.	Set pressure 2500 psig, temperature 100 F, constant back pressure 150 psig		
	Set Pressure	2500	psig
	Minus Constant Back Pressure	-150	psig
	Cold Differential Set Pressure	2350	psig
d.	Set pressure 400 psig on superheated steam, 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

4. **Setting Procedure**

NOTE:

Valves for steam service should be set using saturated steam. Valves for gaseous service should be set using air or nitrogen. Valves for liquid service should be set using water.

NOTE:

The ASME Boiler and Pressure Vessel Code Section VIII set pressure tolerance is ±2 psi (.14 bar) for set pressures less than 70 psig (4.8 bar) and ± 3% for pressures equal to or greater than 70 psig (4.8 bar).

Before mounting the valve on the test stand, remove all dirt, sediment or scale from the test tank nozzle and the inlet port of the valve. Be sure that the test gauge is accurate and has recently been calibrated on a dead weight gauge tester.

Mount the valve on the test stand. If the adjusting screw of the reconditioned valve has been turned down to its original position, slowly bring the pressure up in the test tank to the cold differential set pressure. If the valve opens before the desired pressure is reached, additional compression is required on the spring. Hold the spindle to prevent rotation and turn the adjusting screw down (clockwise or right-handed). If the valve does not open at the desired pressure, maintain the required pressure in the test tank and slowly release the compression on the spring by turning the adjusting screw counterclockwise, until the valve opens. Continue adjustment until the valve opens at the desired pressure. Be sure to hold the spindle when turning the adjusting screw. The spindle should be centrally located within the adjusting screw. Hard rubbing of the spindle against the side of the adjusting screw can cause poor valve action.

NOTE:

On compressible fluids, set pressure is defined as the pressure where the valve pops open, NOT where it begins to simmer.

NOTE:

On liquid vlaves, set pressure is indicated by the first continious flow of water out of the outlet of the valve.

After the required set pressure is obtained, tighten the adjusting screw nut and repeat test. At least two repeat openings at the same pressure should be obtained to be sure that the valve is set accurately.

XII. (Continued)

F. Seat Tightness Testing

1. **General Information**

A typical test arrangement for determining seat tightness for safety relief valves on air or gas service (in accordance with ANSI B147.1/API RP 527) is shown in Figure 36.

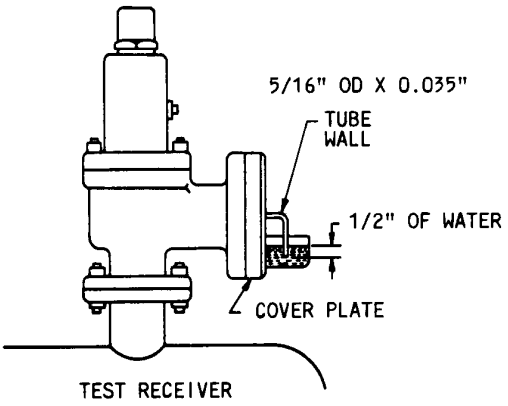


FIGURE 36

Leakage measurement shall be made with the use of a piece of 5/16 in. OD tubing with 0.035 in. wall. The tube end shall be cut square and smooth. It shall also be perpendicular to, and 1/2 in. below, the surface of the water.

2. **Seat Tightness Testing: Metal to Metal Seats**

With the valve mounted vertically (as shown in Figure 39 above), the leakage rate, in bubbles per minute, shall be determined with pressure at the safety relief valve inlet, which must be held at 90 percent of the set pressure immediately after popping. For valves set at 50 psig or below, the pressure shall be held at 5 psi below set point. The test pressure shall be applied for a minimum of 1 min. for valves on inlet sizes through 2 inches; 2 min. for sizes 2-1/2, 3 and 4 inches; and 5 min. for sizes 6 and 8 inches.

For metal to metal valves, designated for gaseous service, the leakage rate (in bubbles per minute) shall not exceed that shown in Table 17.

TABLE 17

Type of Valve	Manufacturer's Orifice Size	Maximum (Bubbles per Minute)	Approximate Leakage Rate (Standard Cubic Feet per 24 hour) Maximum
Conventional	F and smaller	40	0.60
	G and larger	20	0.30
Balanced Bellows	F and smaller	50	0.60
	G and larger	30	0.45

There shall be **no** visible leakage for valves designated for steam service (and tested on steam) or for liquid service (and tested on water).

3. **Seat Tightness Testing for O-Ring Seat Seal Valve**

The "Tightness Standard', for O-Ring seat seal valves shall be no leakage at, or below, the test pressures shown in Table 18, below.

TABLE 18

Seat Tightness Testing for "O" Ring Seat Seals®		
Set Pressure (psig)	Set Pressure (bar)	Test Pressure (% of Set Pressure)
5 to 30	.35 to 2.07	90
31 to 50	2.14 to 3.45	92
51 to 100	3.52 to 6.9	94
100 and above	6.9 and above	95

4. **Recommended Back Pressure Testing for Joint Leakage**

After a given valve has been set for the correct opening pressure, and if the valve is to be used in a closed discharge system, it should be back pressure tested. Testing can be conducted by installing the cap, with gasket, and applying air, or nitrogen, to the base drain connection, or to the valve outlet. All other openings must be sealed.

Test pressure should be the greater of 30 psi (2 bar), or the actual valve back pressure. Air, or nitrogen, pressure should be held for 3 minutes, before applying leak detector solution to all connections (joints).

XII.F. (Continued)

On bellows valves, also install a clean pipe plug in the bonnet vent connection, until it is finger tight. The purpose of this is to obtain the smallest possible leak path. **Remove this plug upon completion of test**.

Examine the following valve components for leakage during back pressure testing:

a. The nozzle/base joint.
b. The adjusting ring pin seal.
c. The base/bonnet joint.
d. The bonnet/cap joint.
e. If conventional valve, the "tight" bonnet vent plug.
f. The "loose" bonnet vent plug, if bellows valve.

Leakage is best detected by application of a liquid leak detector.

NOTE:

The use of soap, or household detergent, as a leak detector is not recommended, as it may bridge small leaks.

Repair of leaking valve joints may be attempted by tightening the leaking joint while the valve is still on the stand. If this does not stop the leak, tear down and inspect the leaking joint(s); both the metal surface(s) and gasket(s).

If the valve internals have been disturbed, it is necessary to retest in accordance with the instructions contained in this manual. Otherwise, repeat the back pressure tests, as outlined above.

5. **Blowdown Adjustment**

Blowdown adjustments are made by means of the adjusting ring on Type 1900 valves.

If longer or shorter blowdown is required, it can be obtained as follows:

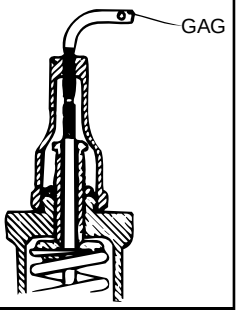
a. To increase the blowdown (lower reseating pressure), the adjusting ring must be raised by moving the notches, from left to right, past the ring pin hole.

b. To decrease the blowdown (raise reseating pressure), the adjusting ring must be lowered by moving the notches, from right to left, past the ring pin hole.

NOTES:

- **Unless the test stand capacity is equal to, or greater than, that of the valve, do not attempt to set blowdown. Simply return the adjusting ring to the recommended position. (Tables 12-14).**
- **The valve will not achieve rated relieving capacity if the adjusting ring is positioned too low.**

⚠WARNING



Gag safety valve during ring adjustments to avoid possible severe personal injury or death.

XIII. Hydrostatic Testing and Gagging

When hydrostatic tests are required after installation of a safety relief valve, the safety relief valve should be removed and replaced with a blind flange, if the hydrostatic test pressure will not be greater than the operating pressure of the equipment, a test gag may be used. 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.)

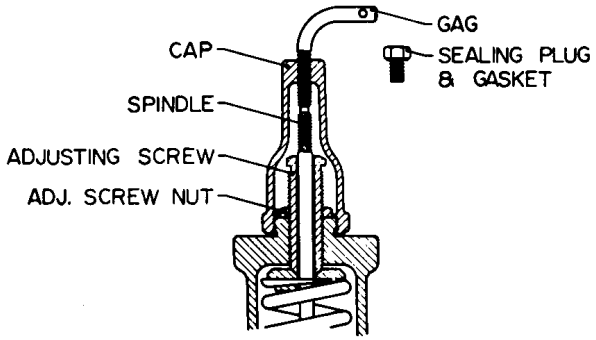


FIGURE 37

XIV. Manual Popping of the Valve

Consolidated Safety Relief Valves are furnished, when so ordered, with packed or plain lifting levers for hand popping, or with an air operated lifting device for remote control. (See Figures 38-42, following.)

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.

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.

The air operated lifting device is designed to fully open the valve with 75% of set pressure under the valve disc in compliance with ASME Section VIII. For certain applications, the air operater may be designed to fully open the valve with no pressure at the valve inlet. An air operated device can be operated from a remote point and can be used as a "drop out" valve. (A typical design is shown in Figure 42, and can be purchased from DVCD.)

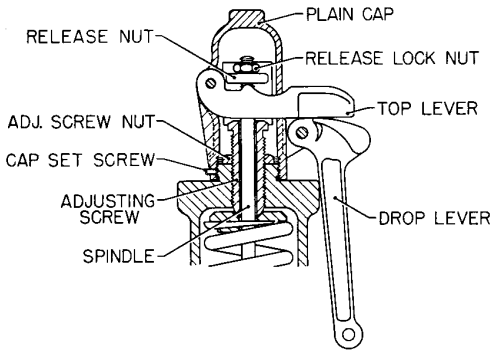


FIGURE 38
PLAIN LEVER

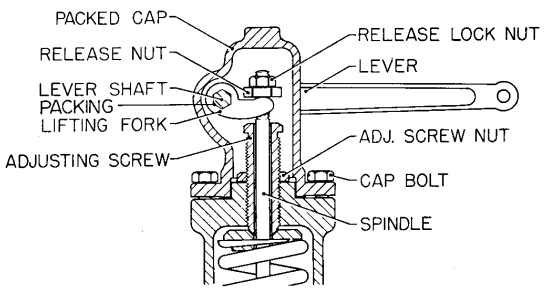


FIGURE 39
PACKED LEVER

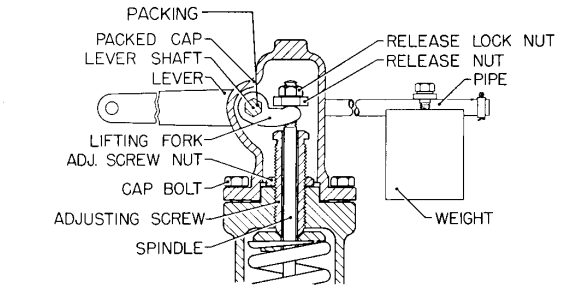


FIGURE 40
"L" TYPE PACKED LEVER

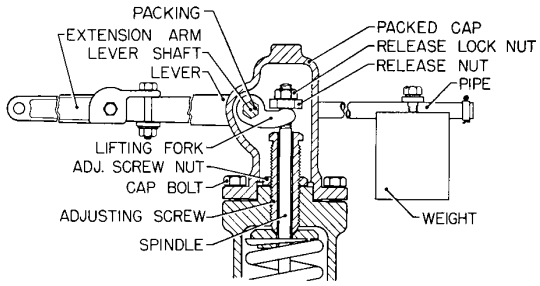


FIGURE 41
"R" TYPE PACKED LEVER

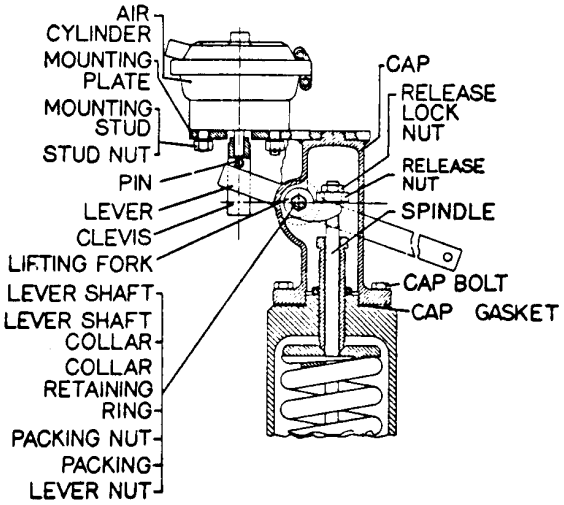


FIGURE 42
AIR OPERATED PACKED LEVER

XV. Conversion of Type 1900 Flanged Safety Relief Valves From Conventional to Bellows Type, and Vice Versa

A. General Information

Consolidated® Type 1900 Flanged Safety Relief Valves can be readily converted from conventional to bellows style, or vice versa, in the customer's repair shops. However, the Type 1901 and 1902 valves were constructed in the conventional type only. Table 16, below, shows the parts necessary for the typical conversion.

NOTE:

With regard to all bellows valves, the bonnet vent plug must be removed and the bonnet vented to a safe area.

TABLE 19

VALVE ORIFICE SIZE	NEW PARTS TO CONVERT FROM	
	CONVENTIONAL TO BELLOWS VALVE	BELLOWS TO CONVENTIONAL VALVE
D, E, F, G, H	1. Bellows Assembly - Standard Material, AISI 316L Stainless Steel 2. Set of gaskets for bellows valve. 3. Guide for bellows valve. 4. Disc holder for bellows valve. 5. Spindle for bellows valve (F, G & H only). 6. Spindle retainer for bellows valve. 7. Base studs for bellows valve (D, E, F & G only). 8. Machine existing lower spring washer. (See Paragraph XV.B. and Figure 43 for F, G & H orifices only.) Upper spring washer, no change. 9. Drill 23/32 dia. on bonnet boss and tap 1/2 N.P.T. (as required).*	1. Eductor tube for conventional valve. 2. Set of gaskets for conventional valve. 3. Guide for conventional valve. 4. Disc holder for conventional valve. 5. Spindle for conventional valve (F, G & H only). 6. Spindle retainer for conventional valve. 7. Base studs for conventional valve (D, E, F & G only). 8. New lower spring washer for conventional valve. (See Paragraph XV.C. and Figure 44 for F, G & H orifices only.) Upper spring washer, no change. 9. Bonnet vent plugged (if desired).
K, L, M, Q R, T **Also J, N, P manufactured after 1981	1. Bellows Assembly - Standard Material, AISI 316L Stainless Steel. 2. Set of gaskets for bellows valve. 3. Drill 23/32 dia. on bonnet boss and tap 1/2 N.P.T. (as required).* 4. Studs (1905-30 K & L, 1906-30 K & L only).	1. Eductor tube for conventional valve. 2. Set of gaskets for conventional valve. 3. Bonnet vent plugged (if desired). 4. Studs (1905 K & L, 1906 K & L only).
J, N, P **Manufactured prior to 1982	1. Bellows Assembly - Standard Material AISI 316L Stainless Steel 2. Set of gaskets for bellows valve. 3. Guide for bellows valve. 4. Disc holder for bellows valve. 5. Drill 23/32 dia. on bonnet boss and tap 1/2 N.P.T. (as required).* 6. Studs (1905-30 N & P, 1906-30 N & P only).	1. Eductor tube for conventional valve. 2. Set of gaskets for conventional valve. 3. Bonnet vent plugged (if desired). 4. Drill 7/16 dia. thru guide flange 1-13/16 from guide bore centerline (J orifice only). 5. Studs (1905 N & P, 1906 N & P only).
W	1. Bellows Assembly 2. Set of gaskets for bellows valve 3. Guide for bellows valve 4. Lift restricting ring 5. Studs	1. Set of gaskets for conventional valve 2. bonnet vent plug (if desired)

* Valves manufactured after 1980 are furnished with bonnet vent machined.

** J, N, P orifice valves manufactured after 1981 are furnished with threaded disc holder and reduced guide bore for balanced bellows conversion.

XV. (Continued)

B. Conversion From Conventional to Bellows Type

The eductor tube is not needed in bellows valves, and it should be entirely removed to provide a flat surface for proper bellows flange seating. To remove the eductor tube from the base, first drill into the bore of the tube (where it is attached to the base) with a drill approximately 1/64" smaller in diameter than the outside diameter of the tube. This will reduce the tube wall thickness to the extent that it can easily be collapsed for removal. The hole in the guide surface, which will remain after the eductor tube is removed, will be covered by the bellows flange. Next, machine the existing lower spring washer in accordance with Figure 43 and Table 20, below.

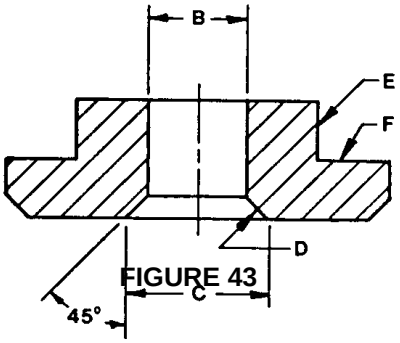


FIGURE 43

TABLE 20

VALVE TYPE		B	C
1905F 1910F 1920F 1905G 1910G 1920G	1906F 1912F 1922F 1906G 1912G 1922G	11/16" 17.5 mm	1" 25.4 mm
1914F 1924F 1914G 1918G 1926G	1916G 1926F 1916G 1924G 1928G	7/8" 22.2 mm	1-1/4" 31.8 mm
1918F	1928F	1" 25.4 mm	1-7/16" 36.5 mm
1905H 1910H 1920H	1906H 1911H 1922H	11/16" 17.5 mm	1-1/8" 28.6 mm
1912H	1924H	7/8" 22.2 mm	1-5/16" 33.3 mm
1914H 1926	1916H	1" 25.4 mm	1-1/2" 38.1 mm

When indicated at surfaces D and E, run out at surface F is not to exceed .005 full indicator reading.

C. Conversion from Bellows to Conventional Type

In converting from a bellows to a conventional valve, the eductor tube may be secured in the base by expanding, or swaging, into the hole provided. The upper end of the tube should project above the guide surface of the base approximately 1/8-inch, and the lower end should point directly and squarely toward the valve outlet. When the valve is assembled, the hole at the outer edge of the guide flange must fit loosely around the projection of the eductor tube.

The new lower spring washer must be machined as follows for the F, G, & H valves only. (See Figure 44 and Table 21, below.)

NOTE:

For all Type 1900 valves, Dimension A may not be less than specified in Table 18, below.

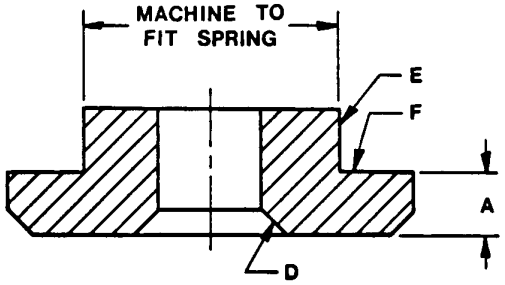


FIGURE 44

TABLE 21

VALVE TYPE			A
1905-30F 1920-30F 1906-30G 1905-30H	1906-30F 1922-30F 1910-30G 1906-30H	1910-30F 1905-30G 1920-30G	1/4" 6.35 mm
1912-30F 1910-30H 1922-30H	1911-30H	1922-30G 1920-30H	5/16" 7.94 mm
1914-30F 1926-30F 1918-30G 1928-30G	1916-30F 1914-30G 1924-30G 1912-30H	1924-30F 1916-30G 1926-30G 1924-30H	3/8" 9.52 mm
1918-30F	1928-30F		7/16" 11.11 mm
1914-30H	1916-30H	1926-30H	1/2" 12.7 mm

When indicated at surfaces D and E, run out at surface F is not to exceed .005 full indicator reading.

XVI. Trouble Shooting Type 1900 Valves

TABLE 22

MALFUNCTION	CAUSE	SOLUTION
Seat Leakage	Damaged seats	Rework seats or replace part.
	Improper installation	Inspect installation, i.e. piping.
	Operating pressure too close to set pressure Excessive system vibration	Increase differential. Recheck application.
	Misalignment of valve components	Ensure valve is installed vertically. Ensure valve has been properly assembled.
	Trash trapped on seats	Pop valve to clean seats. Rework seats.
Simmer	Damaged seats	Rework seats or replace part.
	Wide nozzle seat	Rework seat.
	Improper adjusting ring setting	Check ring setting.
	Misalignment/binding	Inspect valve and installation.
Chatter	Improper installation or valve sizing	Check for piping restrictions. Check required capacity.
	Built-up back pressure	Check outlet piping.
	Improper ring setting	Check ring setting.

XVII. Maintenance Tools and Supplies

TABLE 23

ORIFICE	*ORIGINAL NOZZLE		*NEW NOZZLE		**NOZZLE LAP HANDLE	***RING LAP
	NOZZLE BORE DIAMETER	NOZZLE LAP PART NO.	NOZZLE BORE DIAMETER	NOZZLE LAP PART NO.		
D	.393-.398	0543001	.404-.409(*4)	4451501	0544603	1672805
E	.524-.529	0543002	.539-.544(*5)	4451502	0544601	1672805
F	.650-655	0543003	.679-.674(*6)	4451503	0544601	1672805
G	.835-.840	0543004	.863-.868	4451504	0544601	1672805
H	1.045-1.050	0543005	1.078-1.083	4451505	0544601	1672805
J	1.335-1.340	0543006	1.380-1.385	4451506	0544601	1672805
K	1.595-1.600	0543007	1.650-1.655	4451507	0544601	1672807
M	2.234-2.239	0543102	2.309-2.314	4451602	0544601	1672809
N	2.445-2.450	0543103	2.535-2.540	4451603	0544601	1672809
P	2.965-2.970	0543104	3.073-3.078	4451604	0544602	1672810
Q	3.900-3.905	0543105	4.045-4.050	4451605	0544602	1672812
R	4.623-4.628	0543106	4.867-4.872	4451606	0544602	1672812
T	6.000-6.006	0543107	6.037-6.043	4451607	0544602	1672813
W	10.029	None	10.029-10.034	None	None	4875401

* Ring Lap on W orifice is an assembly which includes lap handles, the Ring Lap should be used for all lapping operations.

* After August 1978, all 1900 SRV Nozzles manufactured have increased bore diameter. The above chart shows how each orifice was affected. Nozzles-original vs. new - are interchangeable, but nozzle laps are not. On the O.D. of the new Nozzles, the letter "C" is stamped. If this stamp becomes obliterated, the nozzle bore diameter must be measured to select the correct nozzle lap from above chart.

** Nozzle lap handles are interchangeable between original and new nozzle laps.

*** Ring laps - One set of three (3) ring laps is recommended for each orifice to assure ample flat laps are available at all times.

(*4) Use for all D-1 designs.

(*5) Use for all E-1 designs.

(*6) Also used for all D-2 & E-2 designs.

XVII. (Continued)

LAPPING TOOLS

The following tools are required for proper maintenance of Consolidated® Safety Relief Valve seats, and may be purchased from DVCD upon request.

Nozzle Lap - The nozzle lap is used for lapping the nozzle seat and has one flat side and one side with a 5° angle. This lap guides in the bore of the nozzle; therefore, a different size lap is required for each valve orifice.

Ring Lap - The ring lap is used for lapping the disc seat and finish lapping of the nozzle seat.

Lapping Plate - The lapping plate is used for reconditioning the ring lap. It may also be used for lapping the disc. One 11" diameter plate is required for the entire line of valves (Part No. 0439004).

Lapping Compound - Used as a cutting medium when lapping the valve seats (as specified below).

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

Drift Pins - Two pins are required for the removal of the disc from the disc holder. (See Figure 45, below.)

Orifice	A (in.)	A (mm)	B (in.)	B (mm)	Part No.
D, E, F G, H, J, K	1-3/4	44.5	7/32	55.5	0430401
L, M, N, P	2-1/2	63.5	3/8	95.3	0430402
Q, R	3	76.2	5/8	158.7	0430403
T	3-1/2	88.9	7/8	222.2	0430404

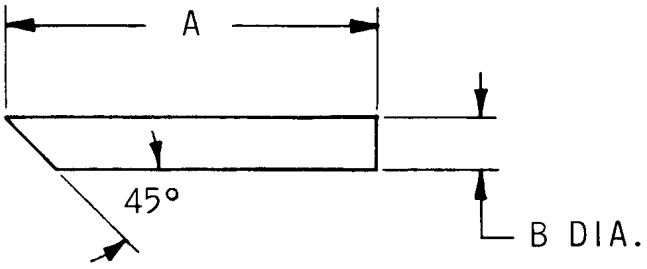


FIGURE 45

Lifting Tools - For removal of upper internal parts of larger valves (as specified below).

Orifice	Part No.
M, N	4464602
P, Q, R, T	4464604

Wrenches - For removal of bellows from disc holder (as specified below).

Valve Orifice	Description of Wrench	Pin Spanner Wrench No.
F	3/4" Radius - 7/32" Pin	4451801
G	3/4" Radius - 7/32" Pin	4451801
H	7/8" Radius - 15/64" Pin	4451802
J	1-1/8" Radius - 17/64" Pin	4451803
K	1-1/4" Radius - 9/32" Pin	4451804
L	1-3/8" Radius - 19/64" Pin	4451805
M	1-5/8" Radius - 21/64" Pin	4451806
N	1-7/8" Radius - 23/64" Pin	4451807
P	1-7/8" Radius - 23/64" Pin	4451807
Q	2-1/2" Radius - 7/16" Pin	4451808
R	3" Radius - 1/2" Pin	4451809
T	3-3/4" Radius - 1/2" Pin	4451810

XVIII. Replacement Parts Planning

A. Basic Guidelines

The following guidelines should be of assistance in developing a meaningful replacement parts plan.

1. The total number of valves in service should be classified by size, type, and temperature class.
2. the parts inventory should by classified by the tendency to require replacement.
   Class I - Most frequently replaced
   Class II - Less frequently replaced but critical in an emergency
3. Parts for the valve types covered by this manual are classified on page 46. “Qty. Parts” is the number of parts or sets which is recommended to achieve a desired need-probability, as it relates to the total number of valves in service by size and type. For example, a “Qty. Parts” of 1 for “Valves in Service” of 5 means that 1 part should be stocked for each 5 valves of the same type and size in service.
4. When ordering replacement parts, please specify in accordance with applicable nomenclature (see Figures 1 through 6). Be sure to state the size, type and serial number of the valve for which parts are required.

* Predicted 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).

C. Replacement Parts List

Consult the Recommended Spare Parts list (see Section XX of this manual) to define 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.

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
   d. Serial Number
   Example 1: 1-1/2" 1910Fc*
   S/N TD-94578

2. Specify parts required by:
   a. Part Name (See Figures 1-6 on pages 6 and 7)
   b. Part Number (if known)
   c. Quantity
   Contact Parts Marketing: 1-318-640-6044
   In addition, the serial number is stamped on the top edge of the outlet flange. Be sure to include the one or two letters preceding the figures in the serial number. Typical valve nameplates are shown in Figures 46-49, below.

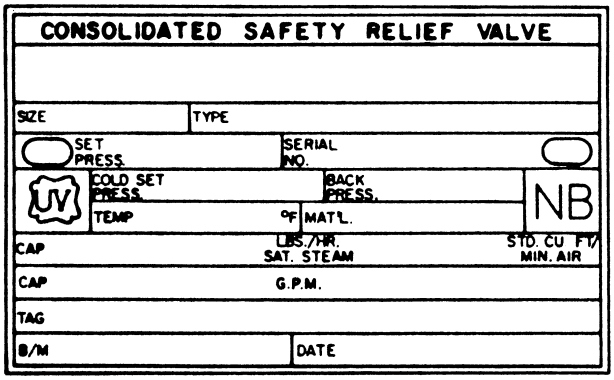
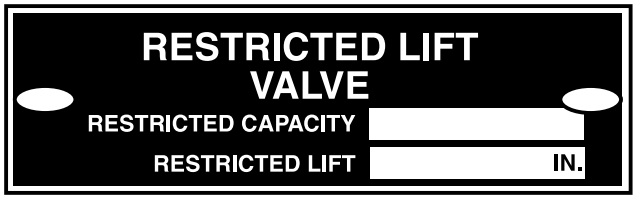


FIGURE 46



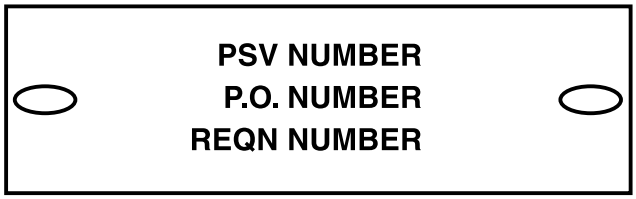


FIGURE 47

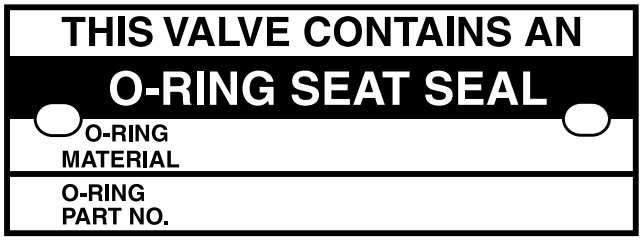


FIGURE 48

XVIII. Replacement Parts Planning (Continued)

* In order to determine if the valve contains Glide-Alloy® components (i.e., the disc holder and/or the guide), which will be identified for a particular valve by the coding found on the valve nameplate, please consult the Appendix to this manual for pertinent supplemental information.

When a pressure relief valve is repaired, a metal repair nameplate (see Figure 49, below), stamped with the DVCD insignia, the National Board "VR" symbol and stamp number, and the date of repair is permanently attached to the valve near the original nameplate. This repair nameplate may also contain information regarding altered set pressures, capacities or blowdown, as applicable.

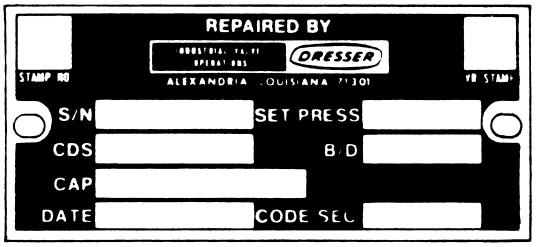


FIGURE 49

XIX. Geniune 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 1879.
- DVCD has worldwide service.
- DVCD has fast response availability for parts.

XX. Recommended Spare Parts For 1900 Safety Relief Valves

1900 CONVENTIONAL & 1900-30 BELLOWS
1900 CONVENTIONAL & 1900-30 BELLOWS WITH LIQUID TRIM (LS)
1900 CONVENTIONAL & 1900-30 BELLOWS WITH THERMODISC® (TD)

CLASS	PART NAME	C-CONVENTIONAL B-BELLOWS	QTY PARTS/ SAME VALVES IN SERVICE	NEED PROBABILITY COVERAGE
I. Class I Parts should be stocked at the rate described in the column "Qty. Parts". Stocking this class of parts will provide sufficient replacement parts on hand for 70% of all possible maintenance requirements.	Disc (TD)	C & B	1/1	
	Disc (Standard)	C & B	1/3	
	Nozzle	C & B	1/10	
	*Limit Washer	C & B	1/1	
	Bellows	B	1/3	
	Adj. Ring Pin	C & B	1/3	
	Disc & Spindle Retainers	C & B	1 Set/1	70%
	Gasket (Set)			
	(1) Cap Gasket	C & B	1/1	
	(1) Bonnet Gasket	C & B	1/1	
	(1) Guide Gasket	C & B	1/1	
	(1) Adj. Ring Pin Gasket	C & B	1/1	
	(1) Bellows Gasket	B	1/1	
II. Class II parts should be stocked at the rate described in the column "Qty. Parts". Stocking Class II parts, in addtion to Class I parts, will provide sufficient replacement parts on hand for 85% of all possible maintenance requirements.	Disc Holder	C & B	1/6	
	Spindle	C & B	1/6	
	Guide	C & B	1/6	85%
	Studs, Base	C & B	1 Set/6	
	Nuts, Base Stud	C & B	1 Set/6	

*Used only in 1905, 1906/1910 & 1918 D & E Orifices, (-2) Design

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 INDUSTRIAL VALVE & CONTROLS DIVISION"

XX. (Continued)

1900 CONVENTIONAL & 1900-30 BELLOWS WITH O-RING SEAT SEAL DESIGN (DA)
1900 CONVENTIONAL & 1900-30 BELLOWS WITH O-RING SEAT SEAL DESIGN AND LIQUID TRIM (DL)

CLASS	PART NAME	C-CONVENTIONAL B-BELLOWS	QTY PARTS/ SAME VALVES IN SERVICE	NEED PROBABILITY COVERAGE
I. Class I Parts should be stocked at the rate described in the column "Qty. Parts". Stocking this class of parts will provide sufficient replacement parts on hand for 70% of all possible maintenance requirements.	O-Ring Disc (K-T only) O-Ring Retainer Retainer Lock Screw *Limit Washer Nozzle Adj. Ring Pin Gasket (Set) (1) Cap Gasket (1) Bonnet Gasket (1) Guide Gasket (1) Adj. Ring Pin Gasket (1) Bellows Gasket Bellows Disc Retainer (K-T only) Spindle Retainer	C & B C & B C & B C & B C & B C & B C & B C & B C & B C & B C & B C & B B B C & B C & B	1/1 1/10 1/5 1 Set/1 1/1 1/5 1/1 1 Set/1 1/1 1/1 1/1 1/1 1/1 1/3 1/1 1/1	70%
II. Class II parts should be stocked at the rate described in the column "Qty. Parts". Stocking Class II parts, in addtion to Class I parts, will provide sufficient replacement parts on hand for 85% of all possible maintenance requirements.	Disc Holder Spindle Guide Studs, Base Nuts, Base Stud	C & B C & B C & B C & B C & B	1/6 1/6 1/6 1 Set/6 1 Set/6	85%

*Used only in 1905, 1906/1910 & 1918 D & E Orifices, (-2) Design

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 INDUSTRIAL VALVE & CONTROLS DIVISION."

XXI. Manufacturer's Warranty Field Service, Training & Repair Program

A. Warranty Information

*WARRANTY STATEMENT - Dresser warrants that its products and work will meet all applicable specifications and other specific product and work requirements (including those of performance), if any, and will be free from defects in material and workmanship.

Defective and nonconforming items must be held for Dresser's inspection and returned to the original F.O.B. point upon request.

INCORRECT SELECTION OR MISAPPLICATION OF PRODUCTS - DVCD cannot be responsible for customer's incorrect selection or misapplication of our products.

UNAUTHORIZED REPAIR WORK - DVCD has not authorized any non-Dresser affiliated repair companies, contractors or individuals to perform warranty repair service on new products or field repaired products of its manufacture. therefore, customers, contracting such repair services from unauthorized sources must do so at their own risk.

**Refer to Dresser's Standard Terms of Sale for complete details on warranty and limitation of remedy and liability.*

B. Field Service

Utilities and Process Industries expect and demand service on a moment's notice. CONSOLIDATED® Field Service can be depended upon for prompt response, even in extreme off-hour emergency situations.

DVCD maintains the largest and most competent field service staff in the industry. Service Engineers are located at strategic points throughout the United States to respond to customer's requirements for service. Each Service Engineer is factory trained and long experienced in servicing Safety Relief Valves. DVCD Service Engineers restore disc and nozzle critical dimensions which effect valve performance, and are capable of modernizing valves in the field.

It is highly recommended that the professional talents of a DVCD Field Service Engineer be employed to make final field adjustments during the initial setting of all CONSOLIDATED® valves.

All Field Service Engineers' activities are coordinated from the Alexandria, Louisiana, Field Service Office. Upon receipt of a purchase order number authorizing the trip, the engineer is dispatched.

Contact: Field Service Dept., Field Service Supv., (318) 640-6055.

C. Factory Repair Facilities

The factory at Alexandria, Louisiana, maintains a complete CONSOLIDATED repair center. The Repair Department, in conjunction with the manufacturing facilities is equipped to perform specialized repairs and product modifications, e.g. but-weld, bushing replacements, code welding, pilot replacement, etc.

Contact: Customer Service - Valve Repair, (318) 640-6047.

D. Safety Relief Valve Maintenance Training

Rising costs of maintenance and repair in the Utility Process Industries indicate the need for trained maintenance personnel. Dresser Industrial Valve Operation conducts service seminars that can help your maintenance and engineering personnel to reduce these costs.

Seminars, conducted either at your site, or at our Alexandria, Louisiana manufacturing plant, provide participants with an introduction to the basics of preventative maintenance necessary to minimize downtime, reduce unplanned repairs and increase valve safety. While these seminars do not make "instant" experts, they do provide the participants with "hands on" experience with CONSOLIDATED® valves. The seminar also includes valve terminology and nomenclature, component inspection, trouble shooting, setting and testing, with emphasis on the ASME Boiler and Pressure Vessel Code.

For further information, please contact the Product Training Manager by fax at (318) 640-6041, or telephone (318) 640-6054.

The Self Study Edition of the 1900 and 1900-30 Safety Relief Valve Maintenance Training Program is available for valve shop personnel.

The Self Study program consists of a Video Tape that is integrated with a participant work book. A participant begins with an introduction to the product and progresses through the various stages of disassembly, cleaning, maintenance repair, reassembly, setting, testing, installation and conversions. The Program can also be used as an instructor led course. The training package includes:

- five Participant Training Manuals.
- five Consolidated® 1900 and 1900-30 Safety Relief Valve Installation, Operation and Maintenance Manuals.
- an integral 1900 SRV video tape.
- a Coaches' Guide to facilitate learning.

Program Kits, as well as additional Training and Maintenance manuals are available through:

Training Department Manager
Global Aftermarket Group
Dresser Valve and Controls Division
PO Box 1430
Alexandria, LA 71309-1430

Telephone: (318) 640-6054
Telefax: (318) 640-6041

Appendix Re:

Optional Glide-Aloy™ Parts and the Repair Processing of Such Components

Glide-Alloy is a proprietary process of DVCD which is utilized to provide a combination of low coefficient of friction between sliding components and to protect the surfaces of the components to which the process has been applied. A Glide-Aloy™ surface hardened valve component may be readily recognized by its flat, dull gray color and slick surface. The parent metal should not be visible on a new and unused component.

NOTE:

Do not attempt to remove the coating of a Glide-Aloy™ treated component.

The Glide-Aloy™ reaction bonding process is commonly applied to Consolidated® Type 1900 Safety Relief Valve disc holders and/or guides, when specified. Although the entire surface area of the component is treated, ***only*** the guiding surface is critical. When Consolidated® Type 1900 valves contain Glide-Aloy™ parts, they may be identified by the coding found on the valve nameplate.

Example: 1905Jc-2-G1
where the “G” designation indicates Glide-Aloy™
“G1” - Glide-Aloy™ Holder
“G2” - Glide-Aloy™ Guide
“G3” - Glide-Aloy™ Holder and Guide

Glide-Aloy™ treated components may be cleaned by low pressure compressed air, microbead blasting, or by brushing. Also, a non-chlorinated hydrocarbon shop solvent may be used. The latter is for personnel safety reasons and ***not*** because of any imcompatibility between chlorides and Glide-Aloy™.

With regard to personnel safety, all personnel should be familiar with the appropriate processes as well as the material safety data sheets supplied by the vendor of any cleaning compounds. Protective gloves, goggles, etc. should be worn so as to avoid contact with materials that may be splashed during the cleaning process.

For a component which has been in service, after the cleaning process has been completed, parts may be visually inspected to ensure that all debris has been removed, and that the components have the required finish. DVCD's experience indicates that if the components have been properly cleaned, adequate coating will remain to ensure proper operation. The coating may appear to be lighter, or even missing, in some areas, but the desired results will be achieved as a result of the coating characteristics which were imparted to the parent metal during the original coating process.

NOTE:

Do not machine guiding surfaces which have been Glide-Aloy™ treated.

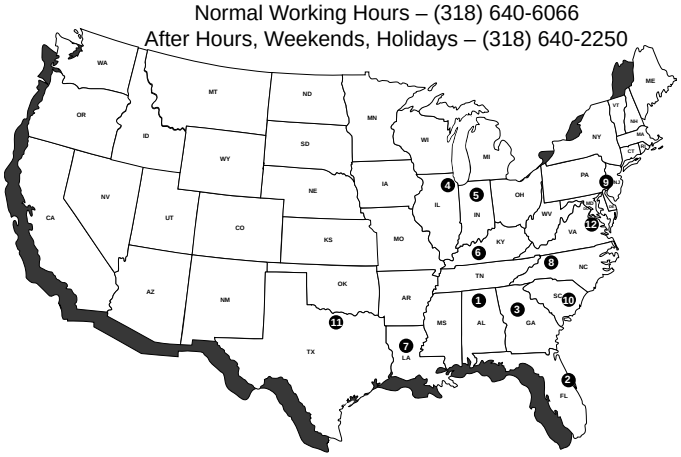
Components which are deeply gouged or galled, and which do not meet dimensional requirements, cannot be cleaned and returned to service. Machining will remove the coating and render the parts unacceptable. The surface hardness approximates that for diamonds, and is only approximately 0.002” thick.

For more detailed instructions, consult the appropriate Dresser manual.

Location of Service Engineers

THE DRESSER FIELD SERVICE ORGANIZATION IS UNEQUALED

For prompt field service, please call
Dresser Industrial Valve Operations Service Department, Alexandria, Louisiana.
Normal Working Hours – (318) 640-6066
After Hours, Weekends, Holidays – (318) 640-2250



Sales Office Locations

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(*) The appropriate International Access Code will need to precede the telephone/fax number if you are placing a call to a location outside of your country.

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