



# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

Before installation, these instructions must be read carefully and understood.



### WARNING

*Suitability of the material and product for the use contemplated by the buyer is the sole responsibility of the buyer. Also storage, installation and proper use and application are the sole responsibility of the purchaser. Emerson disclaims any and all liability arising out of the same.*

*Any installation, maintenance, adjustment, repair and testing performed on safety relief valves should be done in accordance with the requirements of all applicable codes and standards under which those performing such work should maintain proper authorization through appropriate governing authorities. No repair, assembly and test work done by other than Emerson shall be covered by the warranty extended by Emerson to its customers. You assume full responsibility for your work.*

*In maintaining and repairing Crosby products, you should use only parts manufactured by Emerson. Call your nearest Emerson sales office or our factory for a Crosby valve service engineer should you wish assistance with your field needs.*

### NOTE

An operating procedure or condition which is highlighted, underlined or printed in bold type for emphasis.

These precautionary statements are not exhaustive. Emerson cannot possibly know, evaluate and advise customers of all conceivable ways in which tasks might be performed, or of the possible hazardous consequences of each way. Consequently, Emerson has not included such comprehensive evaluation and disclaims liability for work performed by other than Emerson personnel. All personnel working with Crosby products should be trained adequately and be thoroughly familiar with the contents of this manual.

Emerson cannot evaluate all conditions that might injure personnel or damage equipment. However, Emerson does offer the following general safety precautions:

- Hearing and eye protection should be used when working on a valve which is under pressure.
- Never strike a valve which is under pressure. Premature actuation can result.
- Never stand in front of the discharge outlet of a pressure relief valve which is under pressure.

Always approach and use any pressure relief valve with great care.

### SAFETY PRECAUTIONS

Proper installation, maintenance and operation is essential to the safe and reliable operation of all pressure relief products.

Precautionary statements in the form of warnings, cautions and notes are used in this manual to emphasize important and critical instructions where applicable.

### Examples:

#### WARNING

*An operating procedure or practice which, if not observed strictly, may result in injury to personnel or loss of life.*

#### CAUTION

*An operating procedure or practice which, if not observed strictly, may result in damage to or destruction of equipment.*

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### SAFETY

The safety of lives and property often depends on the proper operation of the safety valves. Consequently, the valves should be kept clean and should be tested periodically and reconditioned to make sure they function properly.

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### PARTS LIST

Part ref. no.	Part name	Spare parts designation (See notes 1, 2, 3)
1A	Body	
1B	Nozzle	
3	Nozzle ring	2
4	Nozzle ring set screw	2
5	Disk insert	1
6	Disk holder	2
7	Disk holder retaining nut	
9	Eductor	2
10	Guide ring	2
11	Guide ring set screw	2
12	Spindle assembly	3
13	Piston	
14	Piston retaining ring	2
15	Spindle nut	
17	Bonnet	
18	Bonnet studs	
19	Bonnet stud nuts	
20	Spring	3
21	Bottom spring washer	3
22	Top spring washer	3
24	Bearing adapter	
25	Thrust bearing	
26	Adjusting bolt	
27	Adjusting bolt nut	
28	Cap	
30	Lever	
31	Lever pin	
33	Forked lever	
34	Forked lever pin	

### NOTES

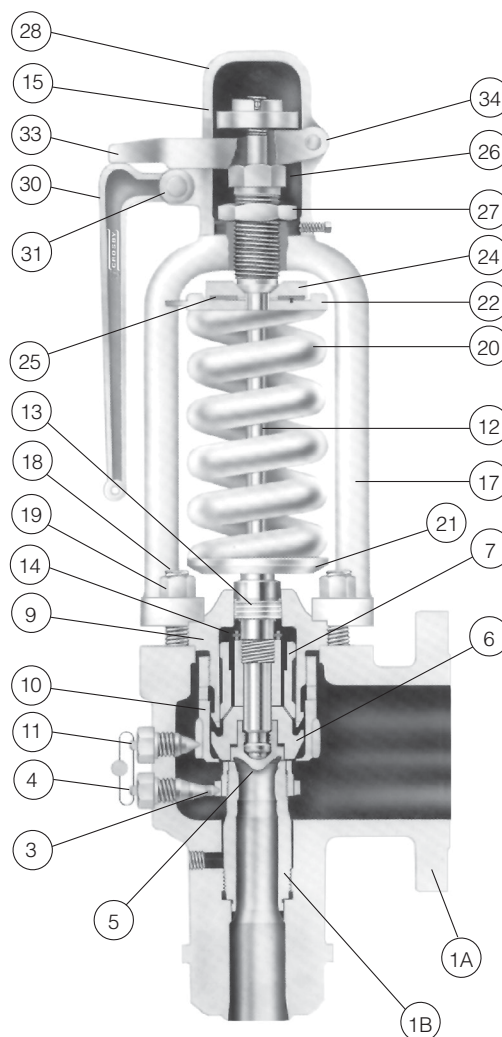
1. Consumable spare parts: valve parts which should be replaced as part of any disassembly. (Disk inserts must be replaced if seats are damaged severely).
2. Repair spare parts: valve parts exposed to wear and/or corrosion during normal operation. They are in fluid flow paths and may require replacement as part of any repair.
3. Insurance spare parts: valve parts exposed to process or environmental wear and/or corrosion and may require replacement as part of a major repair.

Emerson recommends that sufficient inventory of spare parts be maintained to support process requirements. Always be sure to use genuine Emerson parts to ensure continued product performance and warranty.

### NOTES

A complete set of spare cotter pins (not listed above) is also recommended for proper maintenance of the valve.

Figure 1  
SERIES HE ISOFLEX SAFETY VALVE



# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

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### 1 INTRODUCTION

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The design of the Crosby Series HE safety valve with a balanced piston is shown in Figure 1. This drawing shows the safety valve assembly in cross section and covers the essential elements of the valve.

#### NOTE

When specific information is required on the valves supplied, approved drawings supplied with the valve should be used.

Figure 1 shows the body (1A), the nozzle (1B), the nozzle ring (3), guide ring (10), eductor (9), the disk insert (5) which is designed to thread onto the spindle point of the spindle assembly (12) in a manner which allows the insert enough freedom to properly position itself on the nozzle (1B) and the disk holder (6), which is retained between the disk insert (5) and the disk holder retaining nut (7). The eductor (9) is retained between the body (1A) and bonnet (17) by the bonnet studs (18) and bonnet stud nuts (19). The bonnet (17) contains the spring washers (21 and 22) with load carrying bearing adapter and thrust bearing (24 and 25), and the spindle assembly (12), the lower end of which passes through the disk holder and is positioned on the bearing surface of the disk insert. The adjusting bolt (26) is locked in place by the adjusting bolt lock nut (27) on the top of the bonnet within the cap. Manual lifting means is provided by the lever (30), lever pin (31), forked lever (33), forked lever pin (34) and spindle nut (15).

### 2 FACTORY PREPARATION OF WELDED INLET VALVES FOR SHIPMENT

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All Crosby Series HE welded inlet safety valves are equipped with hydrostatic test plugs and shipped in two parts - valve body and valve superstructure. This makes handling easier for installation welding. Each portion ready for shipment is illustrated in Figure 2.

The welded inlet Series HE safety valves are prepared specially for shipment from the factory.

After the safety valve is tested as a complete assembly for set pressure and tightness, the spring set compression is held by spacer blocks under the bottom spring washer (21). The safety valve superstructure is then removed from the valve body. The two portions are boxed and shipped separately.

The safety valve body as shipped to the site, is tagged as follows:

**Install and/or weld in place as required.**  
**Prepare for hydrostatic test - see instruction.**  
**Hydrostatic plug in place. Install O-ring and backup ring prior to hydrostatic test.**

The safety valve superstructure as shipped to the installation site is boxed separately from the valve body and is tagged as follows:

**Hold for assembly after hydrostatic test.**

### 3 PREPARATION OF VALVE FOR SERVICE (initial installation)

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#### Storage

Often, safety valves are on the job site months before they are installed. Unless they are stored properly and protected, their performance may be affected seriously. Rough handling may damage flanges or cause misalignment of the valve parts. It is best to leave valves in their shipment cases and store them in a dry place under cover until they are to be used.

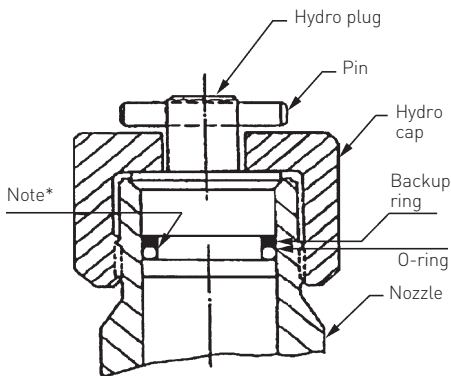


# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

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Figure 3

### HYDROSTATIC TEST PLUG ASSEMBLIES



View showing hydro plug assembled in valve nozzle

#### NOTE\*

O-ring and backup ring to be installed after welding of body to installation

#### Hydrostatic testing

##### • Flanged and welded inlet safety valves

All welded inlet HE safety valves are prepared for shipment from the factory with hydrostatic test plugs and caps installed. When safety valves are equipped with flanged inlets, it is recommended that blank flanges be used for hydrostatic test. However, if blank flanges are not used and the valves are to be installed for the hydrostatic test, Emerson recommends the use of hydrostatic test plugs shown in Figure 2 and Figure 3 on all flanged and welded inlet safety valves.

##### • Hydrostatic test procedure

Before imposing the hydrostatic test pressure on the vessel, it is necessary to install the O-ring and backup ring on the plug as illustrated in Figure 3. The O-ring, backup ring and the plug pin are shipped in a bag attached within the body.

##### • Hydrostatic testing using hydrostatic test plugs

Referring to Figure 3, inspect the hydrostatic plug O-ring groove. Install O-ring and backup ring in the groove. Install the plug in the valve nozzle (1B). Place the cap over the plug and screw down hand tight. Install the test plug pin. The valve is now ready for hydrostatic test. Observations should be made at the start of the test that there is no leakage when pressure is applied. If leakage is evident, tightening of the cap will not reduce leakage but generally is an indication that the O-ring or backup ring is damaged and should be replaced.

The O-ring and backup ring materials are suitable for a temperature of 450°F (232°C) (and to 500°F (260°C) for a short period of time), hence the boiling out operation can be performed to a saturated steam pressure corresponding to the temperature.

After completion of the hydrostatic test, remove the hydrostatic test plug assembly from the nozzle. To facilitate removal, place the hydrostatic test plug pin in the plug extension. Unscrew the cap, which will engage the plug pin and exert an upward force as the cap is turned, thus lifting the plug and rings from the valve nozzle (1B).

Clean the nozzle bore and seat and inspect the seating surface (if surface is damaged, lap per instructions on pages 11 and 12).

##### • Hydrostatic testing using gag (see Figure 6)

Hydrostatic testing at pressure above the valve set pressure using a gag is not recommended.

### 4 INITIAL VALVE ASSEMBLY

#### • Cleaning and lubrication

All parts have been cleaned thoroughly prior to initial assembly and the following areas have been lubricated at the factory before and during assembly.

They should be cleaned and relubricated as required.

Recommended lubricants are Never-Seez® and Molykote 321™ Dry Film Lubricant or equivalent.

#### • Lubrication points (reference Figure 4 and Figure 5)

- Nozzle to nozzle ring threads and guide ring to eductor threads
- Adjusting bolt and bonnet threads
- Spindle point threads
- Spindle point tip
- Spindle rod threads
- Spring washer to adjusting bolt and spindle point bearing surfaces
- Set screw threads
- All studs and nuts

### TABULATION OF HYDROSTATIC TEST PLUG O-RINGS AND BACKUP RINGS

Orifice	Crosby O-ring part no.	Manufacturers O-ring no. (size)	Crosby backup ring part no.	Manufacturers backup ring no. (size)
K	85280	2-218	91175	8-218
K <sub>2</sub>	85141	2-222	81563	8-222
M	77583	2-225	81565	8-225
M <sub>2</sub>	85282	2-226	81576	8-226
P <sub>2</sub>	85283	2-232	81571	8-232

1. Never-Seez® is a mark owned by Bostik.

2. Molykote 321™ is a mark owned by E.I. du Pont de Nemours and Co.

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- Initial field assembly procedures

**NOTE**

It is recommended that upon completion of all hydrostatic tests on new installations, a Crosby service technician be present for assembly of the safety valves (see page 14).

The following instructions should be followed:

**CAUTION**

Check the valve identification numbers and match the proper superstructure to each valve body. Figure 4 shows the location of valve identification numbers.

- The valve superstructure assembly is illustrated in Figure 2 and consists of the bonnet, adjusting bolt, spring subassembly, spindle, eductor, disk holder, guide ring and disk insert, all of which are shipped as an assembly. The nozzle ring and set screws are packaged together in a box and delivered with the superstructure. The contents of the box are marked for identification.

**CAUTION**

Each valve superstructure nozzle ring and set screw is identified and matched to a specific valve body by a tag number and should be assembled accordingly.

- Although all parts have been inspected thoroughly, cleaned, lubricated and protected for shipment, the parts should be inspected for evidence of foreign matter or damage prior to installation. Special attention should be given to the seating surface, disk insert (5) and nozzle (1B). These seats should be free from surface damage. If cleaning and/or repair is necessary, refer to section 'Repair procedures'.

- Assembly of valve (spring compression retained)

Lubricate and install nozzle ring (3) onto nozzle (1B). Leave the top of the nozzle ring level with the nozzle seat.

Install the nozzle ring set screw into the base and verify the fit and notch engagement. The tip of the nozzle ring set screw should not touch the nozzle ring. The nozzle ring should be free to move side to side with approximately 1/32 in. (.794 mm) clearance with set screw.

After the correct nozzle ring to set screw fit is obtained, remove the set screw and raise the nozzle ring 1/16 in. (1.59 mm) above the nozzle seating surface.

**CAUTION**

(Prior to installing superstructure) It is possible to thread the adjusting ring too high onto the eductor (9). If this happens when the valve is assembled, the disk holder (6) will load on the guide ring (10) lip before the disk insert (5) can come into contact with the nozzle seat. To avoid this, the adjusting ring should be positioned on the eductor so that the holes in the adjusting rings are just below the threads of the eductor - see Figure 5. No threads should be visible through these adjusting ring holes.

Remove the forked lever pin (34), forked lever (33) and cap (28).

With the superstructure lifted and the spindle in the vertical position, inspect the eductor to bonnet fit. Position the superstructure so that the valve identification number stamped on the bonnet is opposite the valve outlet (see Figure 4).

Lower the superstructure slowly, carefully align the eductor with the body bowl.

**IMPORTANT**

Do not permit any rocking motion of the spindle or any part while lowering the superstructure into the body. Any rocking motion could damage seats.

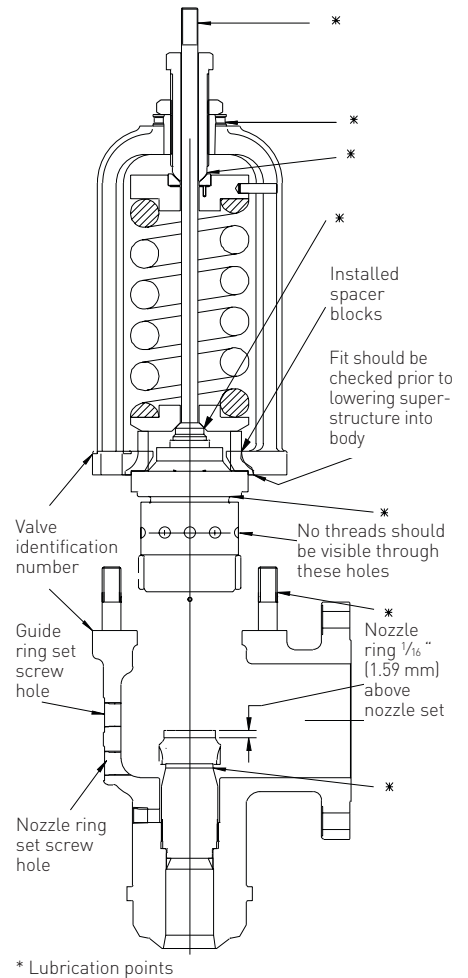
Install the bonnet stud nuts (19) on the bonnet studs (18) and tighten uniformly.

After the bonnet nuts have been tightened, lift up the spindle approximately 1/4 in. (6.35 mm). With the spindle in the lifted position, place a screwdriver in the nozzle ring set screw hole and turn the nozzle ring to the left (clockwise) until the top edge of the nozzle ring is below the nozzle seating surface. The location can be checked by looking in through the adjusting ring set screw hole while shining a light through the nozzle ring set screw hole. Lower the spindle assembly slowly until it bottoms.

**IMPORTANT**

Lift the spindle up and down gently to make sure that the spindle and insert threads are not engaged.

Figure 4  
**LUBRICATION AND ASSEMBLY**





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It is now necessary to remove the three spacer blocks under the lower spring washer, thereby transferring the spring load to the valve seats. This is accomplished by unjacking the valve using the hydraulic jacking device. Referring to Figure 7, install the bonnet spacer (5) on the bonnet (17). Position the jacking device assembly by lifting it over the spindle (12) and lowering it onto the bonnet spacer (5).

### CAUTION

The piston (2) should be seated within the housing (1) before continuing. This seated position is reached when the first notch on the piston (2) is level with or below the top of the housing (1) as indicated in Figure 7.

Lubricate the spindle threads with Never-Seez®, Molykote-G™ or equivalent. Thread the spindle adapter onto the spindle, turning until it comes into contact with the jacking device assembly. Attach the hand operated hydraulic pump (7) and hose (8). To raise the valve spindle, pressure is applied to the jacking device assembly with the hand operated hydraulic pump. This activates the piston (2) which raises the lower spring washer, compressing the spring.

### CAUTION

This device has a limited piston stroke that should not be exceeded.

If the piston stroke is exceeded, the second notch on the piston (2) will be above the top of the housing (1) and hydraulic fluid will flow from the bleed hole, located in the housing. If hydraulic fluid is flowing from the bleed hole, but the piston stroke has not been exceeded, the O-rings (3 and 3A) and the backup rings (4 and 4A) should be inspected for wear or damage and replaced if necessary.

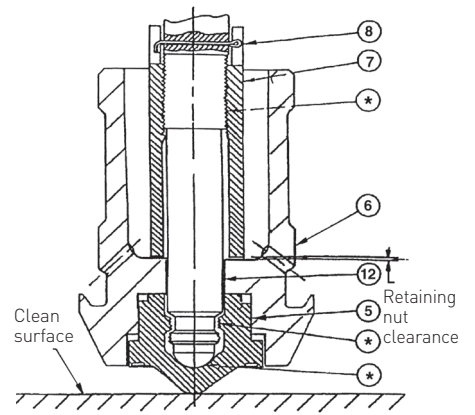
The spacer blocks may now be removed and the spring load transferred to the valve seats by releasing the pressure in the hydraulic pump slowly. Remove the spindle adapter, jacking device assembly and bonnet spacer. Referring to Figure 1, set the nozzle ring (3) and guide ring (10). The nozzle ring location and guide ring location are determined at the factory and their locations are stamped on the valve bonnet where the cap is seated. Place a screwdriver in the nozzle ring set screw hole and turn the nozzle ring to the right (counterclockwise - positive direction [+]) until it makes contact with the disk holder. Then turn the nozzle ring to the left (clockwise - minus direction [-]) to the factory setting. Repeat the same procedure described above to set the guide ring.

Lock the set screws (4 and 11) in place making sure that the proper set screws are installed and engaged in a notch and lock wire in place. Install the spindle nut (15), spindle nut cotter, cap (28) and lifting gear assembly before tightening the cap set screws. Be sure that the forked lever (33) is free to move from 1/16 in. (1.59 mm) to 1/8 in. (3.18 mm) before coming into contact with the spindle nut. If travel is excessive, thread the spindle nut down. If there is not enough travel, back off on the spindle nut.

### 5 DESCRIPTION OF OPERATION

The operation of the Crosby Series HE safety valve is as follows:  
 When the pressure in the valve inlet reaches the set point, the valve will open with a sharp pop with very little simmer or warn. Full relieving capacity is reached within the rated accumulation above set pressure. After the valve has popped, it will remain open until the pressure under the valve has decreased to the closing pressure, at which point it will then close sharply.

Figure 5  
**CLEARANCE BETWEEN DISK HOLDER AND RETAINING NUT**



\* Lubrication points

Stand assembly on clean surface making certain that the end of the spindle rotates freely on the disk insert bearing surface (not loading on the insert threads). Thread disk holder retaining nut (7) down until it makes contact with the disk holder (6). Locate the hole in the spindle (12) relative to a notch on the retaining nut. Back off the retaining nut by turning counterclockwise to establish proper clearance. (Clearance for particular orifice sizes are listed in the table below). Install cotter pin through retaining ring notch and spindle hole.

### RETAINER NUT CLEARANCE VALUES

Orifice size	Retaining nut notches	Clearance, in. (mm)
K	4 - 6	.008 - .012 (.203 -.305)
K <sub>2</sub>	5 - 6	.010 - .012 (.254 -.305)
M	5 - 6	.010 - .012 (.254 -.305)
M <sub>2</sub>	5 - 6	.010 - .012 (.254 -.305)
P <sub>2</sub>	5 - 6	.010 - .012 (.254 -.305)

### CAUTION

The cotter pin head should be turned so that it fits between and into the retaining nut notch and makes contact with the spindle. The split ends of the cotter pin should both be bent down.

1. Never-Seez® is a mark owned by Bostik.  
 2. Molykote-G™ is a mark owned by E.I. du Pont de Nemours and Co.

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### 6 SET PRESSURE TESTING AND ADJUSTMENT

The set pressure of a safety valve may be checked by the following two methods with the valve on the system:

#### Set pressure on system

##### • Air and hydraulic pressure devices

The first method is through the use of a set pressure device which allows set pressure setting of the safety valves on the system at pressures below normal system operating pressures. The air set pressure device method is described in Test Procedure No. T-1652. The hydraulic set pressure device method is described in Instruction No. I-11288. Copies of these manuals can be obtained on request (see page 15).

##### • System pressure

The second method of set pressure testing is by raising the system pressure and popping the valve. Set pressure testing using this method will establish the valve set and closing pressure (blowdown). Setting the valve with the air set pressure device is recommended prior to pressure testing. This allows the set point to be established without raising and lowering system pressure several times.

Prior to pressure testing, the following items should be checked:

- A pressure gauge with known accuracy should be located on the system being tested.
- Outlet piping should be anchored sufficiently to prevent any vibrations while valve is discharging; it should be directed and there should be no obstructions to prevent discharging.
- Set screws should be locked into the body and lock wired.
- The tapped holes for drains in body should be connected to a drain.
- Lifting gear should be fastened securely to the valve.
- Communications should be set up between control room and the system being tested.

#### CAUTION

*All safety valves on the system except the valve which is to be popped should be gagged (refer to Figure 6). System pressure should be 70% of valve set pressure before gagging. This is to prevent added loads from being applied to the spindle due to thermal expansion.*

*Gagging must be done with care not to overload the spindle since considerable damage may occur to the valve spindle, seat and other internals. However, a minimum force should be applied to ensure that the valve will not open.*

Raise system pressure until the valve pops. Record the popping and reseating pressure (pressure at which the valve closes sharply). If the valve pops before set pressure is reached or it does not pop at set pressure, the following steps for set pressure adjustment should be taken:

#### CAUTION

*The adjusting bolt (26) should never be turned when the vessel pressure is near the set pressure of the valve. Adjustments should not be made until the pressure is 10% to 20% below the actual popping pressure of the valve. This precaution should be taken to avoid possible damage of internal parts.*

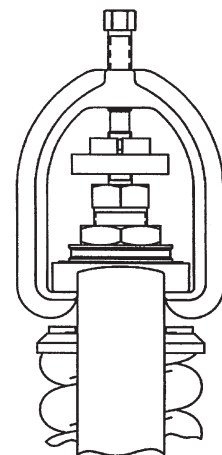
Remove the forked lever and cap assembly. The popping pressure may now be adjusted as follows:

- Loosen the adjusting bolt locknut (27).
- If the valve has popped before the set pressure stamped on the valve nameplate, an increased set pressure is necessary. This is obtained by turning the adjusting bolt to the right (down).
- If the valve did not pop at set pressure, decrease set pressure by turning the adjusting bolt to the left (up).
- After each adjustment, the locknut should be tightened securely to prevent loosening of the bolt and the lifting gear reinstalled.

#### CAUTION

*Never make any ring adjustments with the vessel under pressure without gagging the valve properly. Care should be taken to use only sufficient torque on the gag to hold the valve closed. Overgagging may damage the valve internals. (The gag is not recommended for hydrostatic testing at pressures above valve set pressure.)*

Figure 6  
VALVE GAG



### RECOMMENDED TORQUE VALUES\*

Orifice size	Torque (ft-lb)	Torque (N•m)
K	5	6.8
K <sub>2</sub>	7	9.5
M	11	14.9
M <sub>2</sub>	12	16.3
P <sub>2</sub>	22	29.8

\* For gagging to be applied when system pressure is 70% of valve set pressure



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### Nozzle ring and guide ring adjustment

The nozzle ring location and guide ring location are determined at the factory and their locations are stamped on the valve bonnet where the cap is seated. However, if the desired blowdown is not obtained, it will be necessary to adjust the rings. The following steps should be taken:

### CAUTION

*Never make any ring adjustments with the vessel under pressure without gagging the valve properly. Care should be taken to use only sufficient torque on the gag to hold the valve closed. Overgagging may damage the valve internals.*

#### • Guide ring adjustment

The guide ring (10) is the principal blowdown control ring in the valve. To change the guide ring position, remove the guide ring set screw (11) from the body (1A). Insert a screwdriver or similar tool and engage one of the notches (these can be seen through the set screw hole). The guide ring can then be turned to the right or left as desired.

### NOTE

Turning the guide ring to the right (counterclockwise) decreases the blowdown. The guide ring should never be turned more than five notches either way without retesting the valve. After each adjustment always replace, tighten and lock wire the set screw being careful that its point engages a notch.

#### • Nozzle ring adjustment

The nozzle ring (3) is necessary in obtaining the pop action of the valve. This ring setting is determined carefully by factory test and rarely needs any further adjustment. However, in case the guide ring (10) adjustment does not give the described operating characteristics under all conditions of operation, the nozzle ring may be adjusted to control the valve operation for very fine adjustment.

The nozzle ring is adjusted by removing the nozzle ring set screw (4) from the valve body (1A). Moving the ring to the right (counterclockwise) results in a strong 'pop' action and will increase blowdown. Moving the ring to the left (clockwise) lowers the ring and decreases the blowdown. Warn or simmer may result if lowered too far.

The range of adjustment of this ring is limited and it should not be moved more than one notch at a time from its set position. The valve performance should be checked after each adjustment.

After each adjustment, always replace, tighten and lock wire the set screw, being careful that its point engages a notch.

Whenever ring adjustments are changed, a record should be kept of the number of notches and the direction in which the ring was moved. This will make it possible to return to the original setting in case of error.

After the valve has been adjusted to open and close at the desired pressures, make sure the adjusting bolt locknut and the set screws are installed properly and tightened. If different ring locations are obtained from testing, restamp the valve bonnet with the new ring settings. Install the cap, forked lever and lever making sure there is a 1/16 in. (1.59 mm) clearance between the spindle nut and forked lever.

### 7 VALVE MAINTENANCE

The functioning and life of a safety valve depends primarily on methods used in its maintenance. For this reason, the following recommended steps for maintenance should be followed:

#### General information

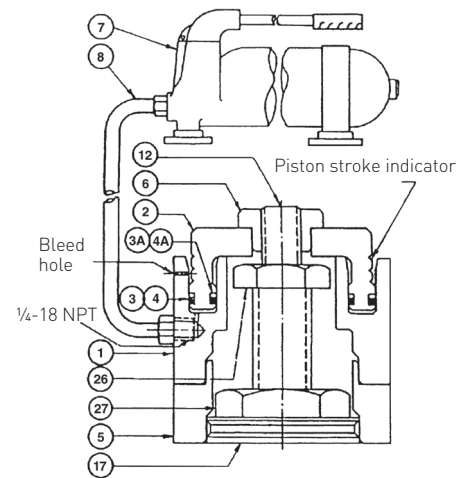
When possible remove flanged inlet valves from the system before dismantling. In any case, there should be no system pressure when a valve is either dismantled in place or removed for shop repair.

Nozzle and guide ring set screws are custom fitted to each valve and are not to be interchanged. The spring washers are fitted to each end of the spring. The spring and washer are to be kept intact as a unit.

The piston (12) is retained on the spindle assembly (12) by means of a piston ring (14). The piston (13) has labyrinth grooves which should be oriented downward toward the nozzle when assembled on the spindle.

Before disassembly, spare parts and service equipment (such as lapping compound, lapping blocks and jacking gear) should be available.

Figure 7  
CROSBY HYDRAULIC JACKING DEVICE



#### Parts list

1	Housing
2	Piston
3	O-Ring
3A	O-Ring
4	Backup ring
4A	Backup ring
5	Bonnet spacer
6	Spindle adapter
7	Hydraulic pump
8	1/4" Hose
12	Valve spindle
17	Bonnet
26	Adjusting bolt
27	Adjusting bolt nut

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### Valve disassembly

#### • Removal of the lifting gear

Remove the forked lever pin (34), forked lever (33), cap (28), spindle nut cotter and spindle nut (15).

#### • Recording of ring settings

Remove the nozzle ring set screw. Check the setting of the nozzle ring by turning it to the right (counterclockwise) counting the number of notches turned until it makes contact with the disk holder. Record the number of notches. This location is given a minimum (-) (down) notches from this contact position.

The guide ring should be turned to the right (counterclockwise) until it makes contact with the disk holder and raises the disk holder into contact against the retaining nut. The guide ring position is recorded as (-) (down) notches from this contact position.

### Disassembly (retaining spring compression)

If the valve is to be reconditioned without retesting, the original set pressure can be retained by use of a jacking device as shown in Figure 7. This device is a service tool that can be obtained from Emerson (see page 15).

1. Measure from the bottom face of the bottom spring washer to the bonnet flange top face and record the dimension. Cut three pieces of bar stock (1 in. [25.40 mm] diameter minimum), 1/8 in. (3.18 mm) longer than the recorded dimension.
2. Install the bonnet spacer (5) on the bonnet (17). Position the jacking device assembly by lifting it over the spindle (12) and lowering down onto the bonnet spacer (5).

### CAUTION

*The piston (2) should be seated within the housing (1) before continuing. This seated piston is reached when the first notch on the piston (2) is level with or below the top of the housing (1) as indicated in Figure 3.*

3. Lubricate the spindle threads with Never-Seez®, Molykote 321™ Dry Film Lubricant, or equivalent. Thread the spindle adapter onto the spindle turning it until it comes into contact with the jacking device assembly.
4. Attach the hand operated hydraulic pump (7) and hose (8).
5. To raise the valve spindle, pressure is applied to the jacking device assembly with the hand operated hydraulic pump. This activates the piston (2) which raises the lower spring washer, compressing the spring.

### CAUTION

*This device has a limited piston stroke that should not be exceeded. If the piston stroke is exceeded, the second notch on the piston (2) will be above the top of the housing (1) and the hydraulic fluid will flow from the bleed hole, located in the housing. If hydraulic fluid is flowing from the bleed hole, but the piston stroke has not been exceeded, the O-rings (3 and 3A) and the backup rings (4 and 4A) should be inspected for wear or damage and replaced if necessary.*

6. After the spring load has been taken up and the valve has been jacked up approximately 1/8 in. (3.18 mm), place the three spacer blocks provided in step 1 of this section, under the lower spring washer (see Figure 2B).
7. The jacking device can now be removed by releasing the pressure in the hydraulic pump. Remove the spindle adapter, jacking device and bonnet spacer.
8. Referring to Figure 1, loosen and remove the bonnet stud nuts (19).
9. Using an eyebolt threaded onto the spindle and a suitable lifting device, lift the superstructure carefully straight up and out of the body.

### CAUTION

*Do not permit any rocking motion of the spindle or of any parts while lifting the superstructure out of the body. Any rocking motion could damage the seats.*

10. Lay the superstructure down so that the spindle is in the horizontal position. Care must be exercised to prevent the parts from being damaged while laying the superstructure down.
11. Remove the eyebolt from the spindle and slide the internals (disk holder, insert, eductor, guide ring and spindle) carefully out of the spring and bonnet assembly.

1. Never-Seez® is a mark owned by Bostik.

2. Molykote 321™ is a mark owned by E.I. du Pont de Nemours and Co.

# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

### Disassembly (without retaining spring compression)

If it is desired to disassemble the valve completely and not retain the spring compression, the following procedures should be used:

1. Measure the distance from the top of the adjusting bolt to the machine bonnet surface. This measurement will be necessary when the valve is reassembled.
2. Release spring tension by loosening the adjusting bolt locknut (27) and then the adjusting bolt (26).

### CAUTION

Never loosen the bonnet stud nuts (19) before releasing spring tension with the adjusting bolt (26).

3. Remove the guide ring set screw (11) and the nozzle ring set screw (4).
4. Loosen and remove the bonnet stud nuts (19).
5. Using an eyebolt threaded onto the spindle, lift the assembled superstructure straight up and out of the body.

### CAUTION

Do not permit any rocking motion of the spindle or of any parts while lifting the superstructure out of the body. Any rocking motion could damage the seats.

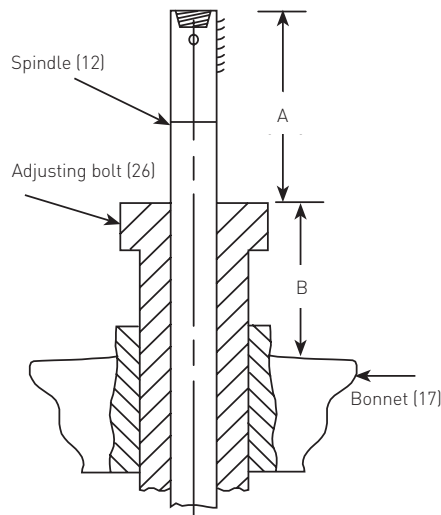
6. Lay the superstructure down so that the spindle is in the horizontal position. Care must be exercised to prevent the parts from being damaged while laying the superstructure down.
7. Remove the eyebolt from the spindle and slide the internals (disk holder, insert, eductor, guide ring and spindle) carefully out of the spring and bonnet assembly.

## 8 REPAIR PROCEDURE

When the valve is dismantled completely, examine all parts for signs of wear, damage or corrosion to determine if any replacement parts are required. Particular care should be used to examine the following parts:

- **Insert (5)**
  - Seat (see Figure 8 for minimum dimension)
  - Spindle bear surface on the inside of the insert
  - Land outside diameter which interfaces with the disk holder

### 1.a Check ring settings



- **Spindle (12)**
  - At bottom spring washer (21) bearing surface
  - Where the spindle point bears on disk insert (5)
  - The surfaces that pass through the adjusting bolt (26) upper and over spring washers (21 and 22) and disk holder (6).

If replacement parts are required, refer to the paragraph 'Spare parts'.

### Lapping of the valve seats

Good seating surfaces on the nozzle (1B) and disk insert (5) are of the greatest importance when reconditioning safety valves. The seats should always be flat and free from surface scratches.

- **Lapping block (see Figure 9)**

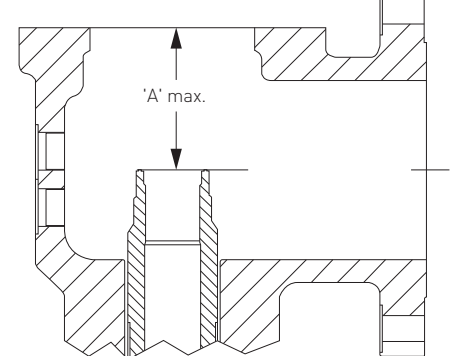
This is made of a special grade of annealed cast iron, perfectly flat on both sides. It is essential that it remain flat to produce a truly flat seating surface. In checking the lapping block and for restoring flatness after its use, a lapping block reconditioner should be used.

- **Lapping block reconditioner (see Figure 9)**

This is also made of a special grade of annealed cast iron, machined and lapped on the side which has small squares. This is the surface on which the lapping blocks are reconditioned.

Figure 8

### NOZZLE HEIGHT



Model	Orifice size	
	Service A Max, in. (mm)	Manufacturing A', in. (mm)
HE - K	4.701 (119)	4.625 (117)
HE - K2	5.326 (135)	5.250 (133)
HE - M	5.826 (148)	5.750 (146)
HE - M2	5.826 (148)	5.750 (146)
HE - P2	7.737 (197)	7.660 (195)

1. Tolerance of  $\pm 0.013$  in. (0.330 mm)

# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

### • Lapping compounds

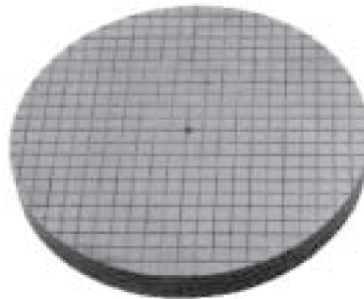
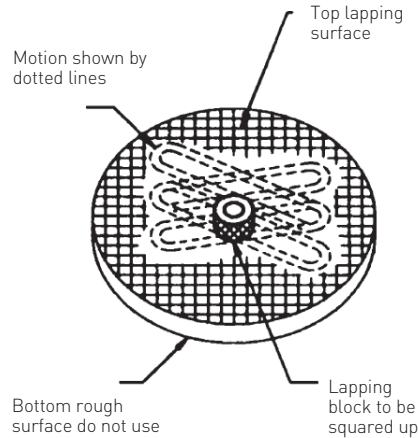
Experience has proven that three grades of compound – medium, fine and polish - will condition almost any damaged valve seat properly, unless, of course, remachining to establish the seat contour is necessary. A medium coarse compound may be used for fast cutting as a first operation after machining, if desired. The lapping compounds shown overleaf, or their commercial equivalents, are suggested.

### • Lapping procedures

Different individuals have different methods of lapping valve seats, but certain essential steps must be taken to get satisfactory results. The following procedure is suggested for lapping of valve seats:

- Never lap the disk insert against the nozzle. Lap each part separately against a cast iron lapping block of the proper size. These blocks hold the lapping compound in their surface pores, but must be recharged and reconditioned frequently.
- Check the lapping block frequently on a good lapping block conditioner to make certain that it is perfectly flat on both sides. If considerable lapping is required, spread a thin coat of medium lapping compound on the block. After lapping with this compound, lap again with a fine compound using a new lapping block surface. The first step can be omitted unless much lapping is called for. Next, lap again using a polish compound.
- Lap the block against the seat. Never rotate the block continuously, but use an oscillating movement.
- When all nicks and marks have disappeared, remove all the compound from the block and seat. Apply polish compound to another block and lap the seat with this. As the lapping nears completion, only the compound left in the pores of the block should be present. This should give a very smooth finish. If scratches appear, the cause is probably dirty lapping compound. These scratches should be removed by using compound free of foreign material.
- Extreme care should be taken throughout to make certain that the seats are kept flat.

Figure 9



Lapping block resurfacing plate



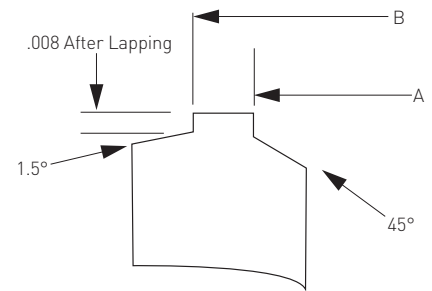
Lapping block

### Micro-finishing of valve seats

Valve seats should be lapped to a micro-inch finish using special compounds and the lapping procedure herein outlined. Prior to micro-finishing, the valve seats should be lapped flat and to a fine surface finish in accordance with lapping procedures discussed above.

Figure 10

### NOZZLE



### NOZZLE DIMENSIONS

Model	Seat ID A <sup>1</sup> , in. (mm)	Seat OD B <sup>1</sup> , in. (mm)
HE II - K	1.757 (45)	1.963 (50)
HE II - K2	2.006 (51)	2.308 (59)
HE II - M	2.449 (62)	2.735 (69)
HE II - M2	2.583 (66)	2.884 (73)
HE III - K	1.747 (44)	1.958 (50)
HE III - K2	2.055 (52)	2.300 (58)
HE III - M	2.440 (62)	2.726 (69)
HE III - M2	2.575 (65)	2.875 (73)
HE III - P2	3.439 (87)	3.831 (97)

1. Tolerance of ± 0.001 in. (0.025 mm)

### LAPPING COMPOUNDS

Abrasive	Grit size	Average micron size	Description	Manufacturer's trade name or equivalent
Silicon carbide	320	31	Medium coarse	U.S. products no.2F Crystolen
Silicon carbide	400	22	Medium	U.S. products no.3F Crystolen
Silicon carbide	600	16	Fine	U.S. products no.A-600 Crystolen
Hard alumina or aluminum oxide	900	9	Polish	U.S. products no.38-900-A

# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

Hyprez® Diamond Lapping Compound 3(L) or 6(L) is used in conjunction with a lapping and cleaning thinner, Hyprez® Hyprelube no. 236, and should be used as described in the following procedure:

1. Clean lapping block using acetone or apply cleaning thinner, Hyprelube no. 236. Wipe with a clean, dry, soft cloth or Kimwipes® (or equivalent) prior to applying lapping compound.
2. Apply dots of Hyprez® Diamond Lapping Compound 3(L) or 6(L) on the lapping block approximately one-half to one inch apart (not less than four per block) circumferentially on the face of the lapping block. Apply a drop of lapping thinner Hyprelube no. 236 to each dot of compound.
3. Lap the valve seat, keeping the lapping block against the seat and applying slight downward pressure. During the operation the lapping compound may begin to get stiff and movement of the lapping block more difficult. Remove lap from lapped surface and add a few drops of the Hyprelube lapping thinner to the lapping block. Replace on surface being lapped and continue to rotate exerting no downward pressure.

### CAUTION

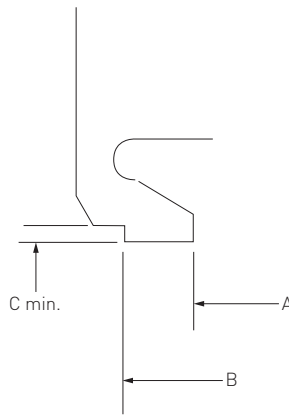
The lapping compound cuts very quickly. Therefore the lapping block must be checked periodically to be sure that the block is flat and that a groove is not worn in the lapping block due to the lapping operation.

4. While lapping, the lapping block should slide smoothly over the surface being lapped. Indications of roughness in lapping are indicative of contaminated compound. The lapping block and seating surface should be cleaned thoroughly with thinner and the lapping operation repeated.
5. Continue this for approximately one minute then remove the lapping block and clean lapped surface and the block with thinner and wipe with a clean, dry, soft cloth or Kimwipes®.
6. If the surface is still in an unsatisfactory condition, change the lapping block and repeat the above process until a satisfactory surface is obtained.
7. After final lapping, clean the seating area with the lapping thinner and then with acetone (or equivalent) and wipe clean with cotton.

1. Hyprez® is a mark owned by Engis Corporation.
2. Kimwipes™ is a mark owned by Kimberly Clark Corporation.

Figure 11

### DISK INSERT



### DISK INSERT DIMENSIONS

Model	Seat ID A, in. (mm)	Seat OD B, in. (mm)	C Min., in. (mm)
HE II - K	1.752 [45] <sup>1</sup>	1.908 [48] <sup>2</sup>	0.005 [0.13]
HE II - K2	2.093 [53] <sup>1</sup>	2.242 [57] <sup>2</sup>	0.005 [0.13]
HE II - M	2.481 [63] <sup>1</sup>	2.804 [71] <sup>2</sup>	0.005 [0.13]
HE II - M2	2.617 [66] <sup>1</sup>	2.666 [68] <sup>2</sup>	0.005 [0.13]
HE III - K	1.782 [45] <sup>1</sup>	1.958 [50] <sup>1</sup>	0.007 [0.18]
HE III - K2	2.093 [53] <sup>1</sup>	2.300 [58] <sup>1</sup>	0.008 [0.20]
HE III - M	2.481 [63] <sup>1</sup>	2.726 [69] <sup>1</sup>	0.008 [0.20]
HE III - M2	2.617 [66] <sup>1</sup>	2.875 [73] <sup>1</sup>	0.009 [0.23]
HE III - P2	3.487 [89] <sup>1</sup>	3.831 [97] <sup>1</sup>	0.010 [0.25]

1. Tolerance of ± 0.001 in. (0.03 mm)
2. Tolerance of ± 0.002 in. (0.05 mm)

### DISK HOLDER OD AND EDUCTOR ID

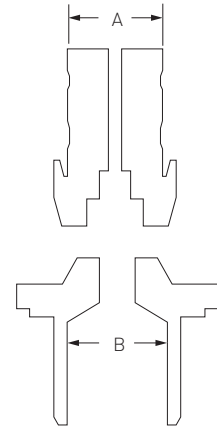
Model	Disk Holder OD A, in. (mm)	Eductor ID B, in. (mm)
HE II - K	2.831 to 2.832 [71.91 to 71.93]	2.845 to 2.846 [72.26 to 72.29]
HE II - K2	3.329 to 3.330 [84.56 to 84.58]	3.343 to 3.344 [84.91 to 84.94]
HE II - M	3.958 to 3.959 [100.53 to 100.56]	3.973 to 3.974 [100.91 to 100.94]
HE II - M2	4.162 to 4.163 [105.71 to 105.74]	4.178 to 4.179 [106.12 to 106.15]
HE III - K	2.842 to 2.843 [72.19 to 72.21]	2.849 to 2.850 [72.36 to 72.39]
HE III - K2	3.348 to 3.349 [85.04 to 85.06]	3.354 to 3.355 [85.19 to 85.22]
HE III - M	3.980 to 3.981 [101.09 to 101.12]	3.986 to 3.987 [101.24 to 101.27]
HE III - M2	4.185 to 4.186 [106.30 to 106.32]	4.191 to 4.192 [106.45 to 106.48]
HE III - P2	5.577 to 5.578 [141.66 to 141.68]	5.583 to 5.584 [141.81 to 141.83]

### Refurbishment of nozzle seats

If machining of the nozzle (1B or 2), seat or other major repairs are necessary, it is recommended that the valve be returned to a Crosby authorized facility for repair. All parts must be accurately machined per Crosby specifications. No safety valve will be tight nor will it operate properly unless all parts are correctly machined. If unable to return to a Crosby authorized repair facility for remachining, use of a Crosby reseating machine is recommended (see page 16).

Figure 12

### DISK HOLDER AND EDUCTOR



Machining dimensions for Crosby Series HCl safety valves are shown in Figure 10. Remove only enough metal to restore the surface to its original condition. Turning to the smoothest possible finish will facilitate lapping. The nozzle must be replaced when the minimum face-to-seat dimension is reached. This critical dimension is shown in Figure 10.

### NOTE

Whenever the nozzle (1B or 2) seat has been remachined, the lift stop [8] should be reset according to paragraph, "Setting of the lift stop".

# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

### 9 VALVE ASSEMBLY

#### Assembly of valve (retaining spring compression)

See section 'Assembly of valve (retaining spring compression)'.

#### Assembly of valve (without retaining spring compression)

#### NOTE

All lubrication points discussed in this section are shown in Figures 3, 4 and 5.

Lubricate and thread the disk holder retaining nut (7) onto spindle (12). With the retaining nut in its highest position, install the disk holder (6) over lower end of the spindle. Lubricate the insert bearing surface and insert threads and thread the disk insert (5) onto the end of the spindle until it drops off the bottom thread and rotates freely on the insert bearing surface.

#### CAUTION

Care should be used in the assembly operation to insure against disk insert and nozzle seat damage.

To establish clearance between the disk holder and retaining nut refer to Figure 5. Install eductor (9) by lifting the eductor over the spindle assembly (12) and lowering it into position on the disk holder (6). The guide ring (10) may be now screwed onto the eductor.

#### CAUTION

The guide ring can be threaded too high onto the eductor. If this happens, when the valve is assembled the disk holder will load on the guide ring lip before the insert can come into contact with the seat.

To avoid this, the guide ring should be positioned so that the holes in the guide ring are just below the threads on the eductor. No threads should be visible through these holes. Stand the assembly on the guide ring face, with spindle vertical, on a clean work surface.

Lubricate and install the thrust bearing (25) and bearing adapter (24) for the top spring washer and lubricate the bottom spring washer (21). Place the spring and washer assembly in position within the bonnet.

Install the adjusting bolt lock nut (27) onto adjusting bolt (26) by screwing it all the way to the top. Lubricate the entire threaded portion of the adjusting bolt and the bonnet threads carefully and screw the adjusting bolt part way into the bonnet.

Using a suitable lifting device, (hoist, chain fall, etc.) lift the spring/ washer and bonnet assembly up over the spindle assembly and lower carefully into place.

Lubricate and install nozzle ring (3) onto nozzle (1B) making sure the nozzle ring is above the nozzle seating surface (approximately 1/8 in. [1.59 mm]). (If new nozzle ring or set screw is used, refer to section 'Assembly of valve (retaining spring compression)' for set screw fit).

Using an eyebolt threaded onto the spindle and a suitable lifting device, lift the assembled superstructure.

#### CAUTION

With the superstructure lifted and the spindle in the vertical position, inspect the eductor to bonnet fit. Be sure eductor is fully seated in the bonnet.

Lower the superstructure slowly, align the eductor carefully with the body bowl.

#### IMPORTANT

Do not permit any rocking motion of the spindle or of any parts while lowering the superstructure into the body. Any rocking motion could damage seats.

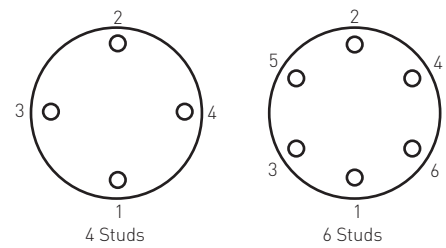
Lubricate and install bonnet nuts (19) on bonnet studs (18) and tighten uniformly in the sequence and the torque values shown in Figure 13. After bonnet nuts have been tightened, lift the spindle approximately 1/4 in. [6.35 mm] to free nozzle ring. With the spindle in the lifted position, place a screwdriver in the nozzle ring set screw hole and turn the nozzle ring to the left (clockwise) until the top edge of the nozzle ring is below the nozzle seating surface.

The location can be checked by looking through the adjusting ring set screw hole while shining a light through the nozzle ring set screw hole. Lower the spindle assembly slowly until it bottoms. The nozzle and disk insert seating surfaces are now in intimate contact.

#### IMPORTANT

Lift the spindle up and down gently to make sure that the spindle and insert threads are not engaged.

Figure 13  
TIGHTENING OF BONNET STUD NUTS



Thread	Torque, Ft.-lbs (N•m)	
	Minimum	Maximum
5/8 - 11	70 (95)	90 (122)
3/4 - 10	115 (156)	150 (203)
7/8 - 9	185 (251)	240 (325)
1 - 8	240 (325)	370 (502)
1 1/8 - 8	405 (549)	525 (712)
1 1/4 - 8	580 (786)	750 (1017)

#### NOTES

- Maximum tolerance zone for surface TIR  
For orifice K through M<sub>2</sub> .009  
For orifice P<sub>2</sub> .011
- Maximum tolerance zone for parallelism  
All orifices .0015



# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS

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Tighten the adjusting bolt a few flats and check the guide and nozzle rings to be sure they are free. The adjusting bolt may now be tightened to achieve desired set pressure.

Tighten the adjusting bolt until the distance is the same as that recorded in step 1, 'Disassembly (without retaining spring compression)' before the valve was dismantled.

Unless considerable lapping or machining has been done, the set pressure should be almost the same as before reconditioning.

Regardless, the set pressure of the valve should be re-established using the methods described in section 'Set pressure testing and adjustment'.

Having recorded the ring positions at disassembly, return rings to recorded location.

Touch nozzle/guide ring with disk holder and turn down (left)(minus) to recorded position at disassembly. Lock set screws in place making sure that set rings are engaged in a notch.

Replace the spindle nut (15), spindle nut cotter cap (28) and lifting gear assembly.

### 10 SPARE PARTS

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Emerson recommends spare parts as shown on the outline drawing, Figure 1.

When ordering spare parts the valve assembly number should be given together with part number, valve size and style. On the valve nameplate (location of name shown in Figures 1 and 2), the valve assembly number is shown as a 'Shop number'. Any Emerson sales office or representative can expedite your spare parts requirements.

### 11 FIELD SERVICE RECOMMENDATIONS

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Emerson operates an extensive field service organization capable of adjusting, setting, and maintaining Crosby valves worldwide. Service technicians are located throughout the world for fast response to our customers' needs. Service technicians are factory-trained and are experienced in servicing safety valves. It is strongly recommended that on new installations, a Emerson service technician be present for assembly and testing of safety valves.

#### Service equipment available

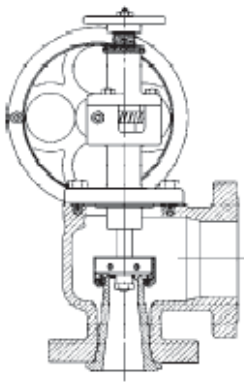
All service equipment mentioned in this instruction is available for purchase or rental. Any Emerson sales office, representative or service manager can expedite your service equipment requirements.

#### NOTES

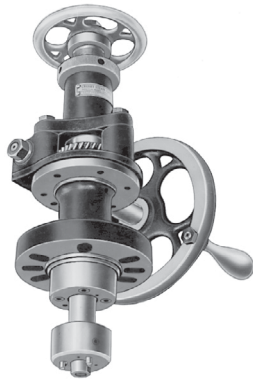
1. Manufactured by Bostik Corporation
2. Manufactured by Dow Corning Corporation
3. Manufactured by the Hyprez Division, Engis Corporation
4. Manufactured by Kimberly Clark Corporation

# CROSBY SERIES HE ISOFLEX® SELF-ACTUATED SAFETY VALVES

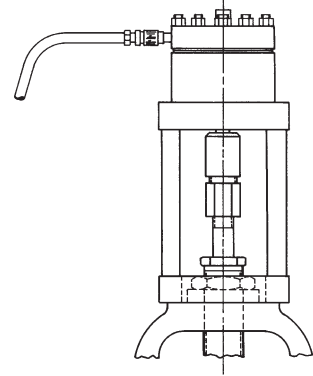
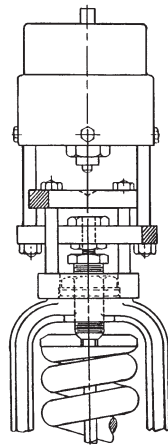
## INSTALLATION, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS



**Reseating machines**



**Air set pressure device**



**Hydraulic set pressure device**

### 12 MAINTENANCE EQUIPMENT

#### Reseating machines

Crosby valve reseating machines will remachine the nozzle seats in place without removing the safety valve from the installation. Form cutters are used to cut a new seat to exact dimensions. Reseating machines, cutters and auxiliary equipment may be rented or purchased. Contact the factory.

#### Jacking devices

When a safety valve is to be disassembled and it is desired to retain spring compression, i.e., the set pressure, a mechanical or hydraulic jacking device may be used. Jacking devices are used to lift the bottom spring washer sufficiently to allow the disk or disk insert to lift clear of the nozzle (permitting the entire bonnet assembly to be removed). Jacking devices may be rented or purchased. Contact the factory.

#### Air (ASPD) and Hydraulic (HSPD) - set pressure devices

The set pressure of safety valves may be determined without raising system pressure to the popping pressure of the valves by using a Crosby valve set pressure device which may be rented or purchased.

The apparatus consists of a lifting device mounted on the bonnet and connected to the spindle of the safety valve. The differential force required to open the safety valve when the system (steam) pressure is less than the valve set pressure is applied by the operator. The differential force at which the valve opens is determined and the safety valve set pressure is calculated from this measurement. Contact the factory.

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