



CROSBY EM SERIES SPRING LOADED PRESSURE SAFETY VALVES

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

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



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⚠ WARNING

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 and reconditioned periodically to make sure they function properly.

⚠ CAUTION

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 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 Emerson products you should use only parts manufactured by Emerson. Call your nearest Emerson regional sales office or representative for a service engineer should you wish assistance with your field needs.

ORDERING SPARE PARTS

When ordering spare parts, you must include:

- Model Number
- Serial number
- Set pressure and CDTP
- Part reference from page 18

The valve model, serial number, set pressure and CDTP are shown on the valve nameplate. Spare parts may be ordered from any Emerson regional sales office or representative.

SAFETY PRECAUTIONS

Proper handling, storage, installation, maintenance and operation are essential to the safe and reliable functioning of any safety valve. Precautionary statements in the form of warnings, cautions and notes are used throughout this instruction to emphasize important and critical factors 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.

These precautionary statements are by no means exhaustive.

SAFETY

Emerson cannot be expected to know, evaluate and advise customers of all the possible applications and operating conditions for its products or of the possible hazardous consequences which may result from the misapplication or misuse of such products.

Consequently, the improper handling, storage, installation, use or maintenance of any Emerson product by a non Emerson employee may void any Emerson guarantees or warranties with respect to such product.

All personnel working with Emerson products should be trained adequately and thoroughly familiar with the contents of the appropriate instruction manual(s).

Emerson cannot evaluate all conditions in which the products may be used.

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However, Emerson offers the following general safety suggestions:

- Never subject valves to sharp impact loads. Rough handling (striking, bumping, dropping, etc.) may alter the pressure setting, deform valve parts and affect seat tightness and valve performance adversely. Striking a valve which is under pressure can cause premature actuation.
- When moving a valve, never use the lifting lever to lift the valve.
- Always lower the system pressure to the pressure level specified in the instruction before making any adjustment to the valve.
- Ear and eye protection should be used when working on a valve which is under pressure.
- Never stand in front of the discharge outlet of a pressure relief valve which is under pressure.
- Always stand to the side of and at a safe distance from the valve discharge and use extreme care when observing a valve for leakage.

The above precautions and suggestions are by no means exhaustive and the user should always approach and use any safety valve with great care.

Operation, Installation and Safety Instructions are available at Emerson.com/FinalControl or from your local Emerson regional sales office or representative.

1 INTRODUCTION

Crosby EM-Series are spring loaded safety valves manufactured and certified in compliance with:

- European Pressure Equipment Directive 2014/68/EU
- EN ISO 4126-1
- ASME Pressure Vessel Code Sections VIII and XIII

and other codes and standards as applicable. All the Crosby EM-Series valves are designed and certified to operate on gas, steam or liquids. Material configurations are available from -196 to +427°C (-321 to +801°F), making them ideally suited for a very broad range of applications in any industrial environment. They are selected because of their performance features, reliability and ease of maintenance. Adherence to the installation and maintenance instructions herein will provide the utmost in safety, a minimum of maintenance and a long service life.

1.1 Style Variations

The EM-Series valves are available in 3 styles:

- Style EMC is a conventional closed bonnet valve.
- Style EMH is also a conventional valve, but with an open bonnet, typically for air or steam applications.
- Style EMB has a metallic balanced bellows for minimizing the effect of back pressure and protecting the guiding surfaces. The bonnet of the Style EMB is vented to atmosphere.

1.2 Interchangeability and Flexibility

The Crosby EM-Series Safety Valve was designed with flexibility and interchangeability in mind. Retrofitting from conventional to balanced bellows is accomplished with a minimum number of new parts.

- Balanced Bellows

A Style EMC conventional non-bellows safety valve may be converted to a Style EMB balanced bellows valve by adding the disc-bellows assembly, the lift-stop and the bonnet extension with its bolting and gasket and changing the spindle.

- Restricted lift

The lift and therefore the maximum flowing capacity of each Crosby EM-Series valve can be adjusted to match the needs of the protected equipment. This reduces instability risks, but also greatly reduces emissions and process fluid losses. A lift restriction can be easily retrofitted on any existing Crosby EM-Series valve.

2 STORAGE AND HANDLING

Valves are often on hand at the job site months before they are installed. Unless stored properly and protected, valve performance may be affected adversely. One can also refer to API Standard 520, part II.

CAUTION

Rough handling and dirt may damage or cause misalignment of the valve parts.

2.1 Storage

It is recommended that the valves be left in their original shipping container, unopened. The container should only be opened just before the installation of the safety valves.

In case of necessity to store the valves apart without closed packing, ensure that during all the time of storage before installation each safety valve is kept away from moisture, dust and any foreign particles or aggressive atmosphere. In any case, keep the safety valves with their flange covers on until installation on site to prevent foreign particles to enter the valve which could cause valve malfunctions. Whenever possible the safety valves should be kept inside their original container, properly closed and stored in a dry and dust-free warehouse.

2.2 Care in Handling

Safety valves must be handled carefully and never subjected to sharp impact loads. They should not be struck, bumped or dropped. Rough handling may alter the pressure setting, deform valve parts and affect seat tightness and valve performance adversely. When a safety valve is out of its container, it shall always be kept away from the ground on a clean and soft surface (plywood, rubber...) free from dust, grit and humidity.

When it is necessary to use a hoist, the chain or sling should be placed around the valve body and bonnet in a manner that will ensure that the valve is in a vertical position to facilitate installation.

Inlet and outlet protectors should remain in place until the valve is ready to be installed on the system.

CAUTION

A safety valve should never be lifted or handled using the lifting lever.

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3 INSTALLATION

3.1 Inspection

- Visual inspection - Safety valves should be inspected visually before they are installed to ensure that no damage has occurred during shipment or while in storage.
- Check nameplate - The valve nameplate and other identifying tags should be checked to ensure that the valve is being installed at the correct location for which it was intended.
- Check seals - The valve seal protecting the spring setting should be intact. If the seal is broken, the valve should not be installed: it should be inspected, tested and a new seal installed properly before use. A broken seal voids the manufacturer warranty.
- Remove all protective material - All protective material, sealing plugs and any extraneous material inside the valve body or nozzle must be removed.

3.2 Inlet Piping

Safety valves should be mounted vertically in an upright position either directly on a nozzle from the pressure vessel or on a short connecting fitting that provides direct and unobstructed flow between the vessel and the valve.

Installing a safety valve differently might affect its operation adversely.

Piping connections upstream of the valve should be rounded or bevelled. Otherwise, a nozzle or fitting at least one size larger should be used.

Inlet piping (nozzles) must be designed to withstand the total forces due to the valve discharging at the maximum accumulated pressure and the expected piping loads. The magnitude of the bending moment exerted on the inlet piping will depend on the configuration and method of supporting the outlet piping. Many valves are damaged when first placed in service because of failure to clean the connections properly when installed. Both the valve inlet and the vessel and/or line on which the valve is mounted must be cleaned thoroughly of all foreign material. The inlet connection bolts or studs should be tightened evenly to avoid straining the valve body with possible distortion of the nozzle flange or base.

CAUTION

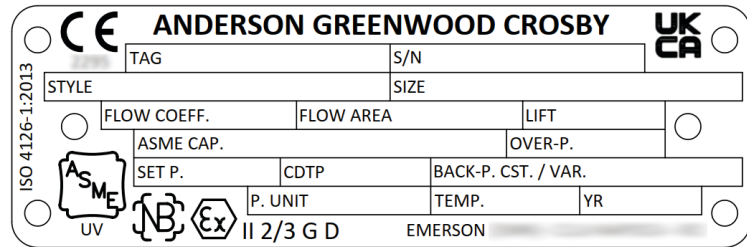
Inlet piping nominal diameter should always be equal to or larger than the inlet nominal diameter of the safety valve, never smaller.

$$\text{Inlet Piping DN} \geq \text{PSV Inlet DN}$$

FIGURE 1

Sample Nameplate

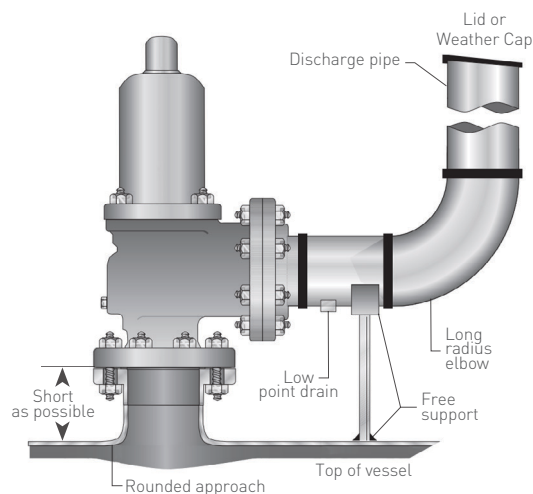
(stamps and data may vary depending on certifications required)



TAG	Customer's tag number
S/N	Emerson's serial number
STYLE	Model number
SIZE	Inlet x Outlet Connections
FLOW COEFF.	Certified coefficient of discharge
FLOW AREA	Certified flow area with unit
ASME CAP.	ASME certified flow capacity of air, water or steam [depending on process fluid]
OVER-P.	Overpressure in % of set pressure
SET P.	Set pressure
CDTP	Cold differential test pressure
BACK-P. CST/VAR	Backpressure constant / variable
P.UNIT	Unit of the pressures given
TEMP.	Temperature, with unit
YR	Year of manufacture

FIGURE 2

Recommended installation discharging to atmosphere



3.3 Outlet Piping

Outlet piping should be simple and direct. Where possible, for non-hazardous fluids, a short discharge pipe or vertical riser connected through a long radius elbow venting directly to atmosphere is recommended. All discharge piping should be run as direct as is practicable to the point of disposal. And the point of disposal should be in a safe area. Where discharge piping is long, it is recommended to use long radius elbows and to reduce excessive line strains using expansion joints and proper means of support to minimize line sway and vibrations under operating conditions. In installations where the safety valve discharges into a closed system, it is very important that built-up and superimposed backpressures have been calculated properly, specified and accounted for when sizing and selecting the valve. The Style EMH (open bonnet configuration) cannot be used for discharging into a closed system: these Style EMH valves must discharge to atmosphere. Where built-up backpressure is expected to exceed 15% of set pressure or if superimposed back pressure is variable, a balanced bellows valve Style EMB is recommended: conventional valves like the Styles EMC or EMH are not suitable for these operating conditions. Adequate drainage is required to prevent corrosive media from collecting in the discharge side of the pressure safety valve. When required, low point drains shall be provided in the discharge pipe. Crosby EM-Series valves can be fitted with a body drain (optional). This drain is plugged when the valve is delivered and should be properly connected on site to a piping drain. The drains must be directed or piped to a safe disposal area.

CAUTION

Discharge piping nominal diameter should always be equal to or larger than the outlet nominal diameter of the safety valve, never smaller

$$\text{Discharge Piping DN} \geq \text{PSV Outlet DN}$$

The discharge piping must be fully and independently supported so that no loads are carried by the safety valve body.

3.4 Flange Gaskets

Flange gaskets must be fitted between the valve and the piping inlet and outlet flanges. They should be properly located so that they do not impede the flow to the valve. Flange bolting should be tightened down evenly in a criss-cross pattern to prevent unnecessary strain and possible misalignment and leakages.

3.5 Body Drain

If the valve is fitted with a body drain, this drain will be plugged when the valve is originally delivered from our factory. The drain should be properly piped to a safe location.

WARNING

When the valve opens, it is possible that process fluid under pressure will escape through the drain.

3.6 Style EMB: Bonnet Vent

In case of bellows failure on a Style EMB balanced bellows valve, process fluid will flow through the bonnet vent to the atmosphere. A 'bug screen' is available on option to protect the inside of the bonnet. If the fluid released is toxic, dangerous or hazardous in anyway, the bonnet vent should be piped away to a location where it is safe to vent the fluid.

WARNING

It is extremely important for the proper operation of the valve that atmospheric pressure is maintained at all times in the bonnet. Never plug the bonnet vent.

3.7 Style EMH

The Style EMH is a conventional valve with an open bonnet. This enables the spring to be partially cooled by the surrounding air. It should always be installed discharging to the atmosphere and never on applications with closed discharge piping with superimposed backpressure.

WARNING

When the Style EMH valve opens, process fluid will escape through the bonnet, around the valve. Make sure that the valve is installed safely and that the escaping process fluid will never cause any hazardous situation either for people or the equipment.

4 HYDROSTATIC PRESSURE TEST

4.1 Hydrostatic Test of Vessel or System

When a pressure vessel or system is to be hydrostatically tested, it is recommended to remove the safety valve and to install a blank flange in its place. This practice precludes the possibility of any damage to the safety valve. Bent spindles and damaged valve seats can be caused by improper hydrostatic test procedures. Remove the blank flanges and reinstall the safety valve before the vessel is placed into service again. When the hydrostatic test must absolutely be performed with the valve in place, a test gag may be used. Crosby EM-Series valves can be fitted with test gags for use with each type of cap (optional). When test gags are used, do not overtighten them as that could damage the valve spindle and seats. Hand tightening the test gag should provide sufficient force to hold the valve closed.

WARNING

After the hydrostatic test, remove the test gag and replace the cap plug.

4.2 Hydrostatic Test of Outlet System

When a hydrostatic test must be conducted on the outlet piping system, with the valve in place, special consideration must be given not to exceed the design pressure limits of the downstream side of the safety valve. The outlet side of a safety valve is known as the secondary pressure zone. This zone is normally designed to a lower pressure rating than the inlet and frequently is designed to a lower pressure rating than the outlet flange. This is true particularly in the case of balanced bellows designs and in larger size valves. Consult relevant product specifications for the back pressure design limits of Crosby EM-Series valves. In case of doubt, contact your local Emerson regional sales office or representative for advice.

5 SETTING, TESTING AND ADJUSTMENT

CAUTION

Improper testing may cause valve damage and seat leakage.

5.1 New Valves

Every new Crosby EM-Series safety valve is fully tested and sealed prior to shipment.

5.1.1 Valve Seals and Nameplate

The external adjustment points of each valve are sealed to ensure that no change has been made to the valve after shipment and that the valve has not been disassembled or tampered with. The seals and nameplates are your assurance that the valve has been built and tested to the applicable Codes and Standards and are the physical evidences of our product warranty.

All new Crosby EM-Series valves are tested fully prior to shipment on the appropriate testing medium, so there is no need to pre-test the valve prior to installation. If pretesting is required, a Crosby valves authorized service organization should be contacted to perform the testing. Contact your local sales representative or visit our website to locate the authorized service organization closest to your location. By choosing an authorized service organization to perform testing you can be assured that the correct testing procedure is followed which will save time and costs by avoiding possible valve damage caused by improper testing methods.

5.1.2 Pre-Testing

In any event, if pre-testing is to be performed, several important cautions should be observed:

- Use the appropriate test fluid. See Section 5.4.1 below. This will ensure accuracy of the test results as well as avoid possible damage to the valve.

- All Crosby EM-Series valves are tested for seat tightness after the final set pressure test and prior to shipment from the factory. If further seat tightness testing is required before installation, this test should be performed prior to any set pressure verification testing. Repeated pressure testing of a metal seated valve can cause damage to the sealing surfaces leading to seat leakage.
- Testing on a low volume test stand requires specific testing techniques to ensure accurate test results and to avoid damage to the sealing surfaces of the valve.

Note: It is not required to 'pop' open the Crosby EM-Series valves for testing (refer to paragraph 5.5.1 below for set pressure definitions).

5.1.3 Inspection

The valve shall be inspected prior to installation (see also Section 3.1). This inspection determines any damage which may have occurred due to rough handling in transit or storage and initiates appropriate service records.

5.2 Repaired Valves

Valves which have not been in service for extended periods due to plant shutdown or long-term storage or valves which have been repaired or reconditioned, should be tested before being put back into service.

5.3 Valves Removed from Service

Valves being removed from service should be tested on a shop test bench before being disassembled ('pre-test') to determine the set pressure and seat tightness. This is an important phase of the maintenance routine and the test results should be recorded for review and determination of necessary corrective action. The 'as received from service' condition of a safety valve is a most useful tool in establishing the proper time interval between inspections.

5.4 Test Bench

The quality and condition of the shop test bench is paramount to obtaining proper test results. The test bench must be free of leaks and the test fluid must be clean. Solids or other foreign material in the test medium will damage the seating surfaces of the safety valve being tested.

The test pressure gauges must be calibrated and have a range such that:

- The valve set pressure is within the middle third of the dial of the test gauge.

The test bench provides an accurate and convenient facility for determining valve set pressure and seat tightness. However, it does not replicate all the field conditions to which a safety valve will be exposed while in service:

- It is not possible to measure relieving capacity or blowdown using a test bench.

5.4.1 Test Fluid

- Valves used on gas and vapour service: use **air or nitrogen**
- Valves used on liquid service: use **water**
- Valves for steam service: use **saturated steam**

However, if steam testing is not possible, it may be acceptable to use air instead, but a correction may be required (see paragraph 5.5.3.2 below).

It may be necessary to make a correction to the adjusted set pressure to compensate for the difference in temperature of the test fluid: see instructions on CDTP in paragraph 5.5.3 below.

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5.5 Set Pressure

5.5.1 Crosby EM Definitions of Set Pressure

Crosby EM-Series on **gas, vapour or steam** service (tested with air or steam) reach their set point at the **first audible leakage**. Valves for **liquid service** (tested with water) reach their set point when there is a continuous, unbroken stream of liquid flowing from the valve: the **first steady stream**.

5.5.2 Set Pressure Changes

Set pressure changes beyond the specified spring range will necessitate a change in the valve spring assembly. The new spring must be obtained from Emerson and the valve must be reset and the nameplate restamped by an authorized valve repair facility.

5.5.3 Cold Differential Test Pressure (CDTP)

When a safety valve is installed on a system operating under high temperature and/or a high back pressure, a compensating adjustment is necessary when testing this valve on a test bench at ambient temperature and under atmospheric back pressure. The test pressure required for the valve to open at the desired set pressure under actual service conditions is known as the Cold Differential Test Pressure or CDTP.

5.5.3.1 Back Pressure Correction (Style EMC Valves Only)

Conventional valves without balancing bellows set with atmospheric pressure at the outlet and intended for use under elevated constant back pressure conditions shall be adjusted so that the test pressure is equal to the set pressure minus the expected back pressure. See example below:

Set pressure	10 bar (145 psi)
Constant back pressure	3 bar (44 psi)
Cold differential test pressure	7 bar (101 psi)

NOTE

This back pressure correction is not applicable to Style EMB valves which are balanced against back pressure.

5.5.3.2 Temperature Correction

When a Crosby EM-Series Valve is set on air or water at room temperature and then used at a higher service temperature, as the spring of the valve will relax slightly due to this high temperature, the test pressure shall be corrected to exceed the set pressure using the temperature correction shown in Table 1.

- Valve on steam service
Crosby EM-Series safety valves that operate on saturated steam service do not require a temperature correction when they are set on steam. However, if they are set on air at ambient temperature, the correction factors from Table 1 must be applied.

NOTE

This temperature correction applies to any style and configuration of Crosby EM-Series.

5.5.3.3 Temperature and Back Pressure

The back pressure correction is applied first, for conventional Style EMC valves. Then the temperature correction is applied on this corrected pressure to obtain cold differential pressure, CDTP:

$$CDTP = (\text{Set} - \text{Constant BP}) \times \text{Temperature correction}$$

Example 1: Valve Style EMC on a process gas service

Set pressure	10 bar (145 psi)
Temperature	200°C (392°F)
Cold back pressure	3 bar (44 psi)

$$CDTP = (10-3) \times 1.01 = 7.07 \text{ bar (102 psi)}$$

Example 2: Valve Style EMB on a process gas service

Set pressure	10 bar (145 psi)
Temperature	200°C (392°F)
Cold back pressure	3 bar (44 psi)

$$CDTP = (10) \times 1.01 = 10.1 \text{ bar (146 psi)}$$

NOTE

No correction for back pressure needed because the Style EMB is balanced against back pressure. Only the temperature correction is needed.

5.5.3.4 Spring Selection

In all instances, the spring is selected based on the set pressure corrected by the constant back pressure only (if any), without taking any temperature correction into account. In the examples above, the spring will be selected for:

Example 1: 7.0 barg (not 7.07)
Example 2: 10.0 barg (not 10.1)

See sample nameplate on page 3 which shows how temperature and back pressure are indicated.

TABLE 1 - TEMPERATURE CORRECTION FACTOR

Operating temperature	Correction to set at ambient temperature
Up to 121°C (250°F)	None
121 to 316°C (250 to 600°F)	1%
316 to 427°C (600 to 800°F)	2%

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5.5.4 Set Pressure (CDTP) Adjustment

⚠ WARNING

Before making any adjustments, reduce the pressure under the valve seat to at least 10% below the stamped set pressure. This will prevent seat damage due to turning of the disc on the nozzle seat and minimize the chance of an inadvertent valve opening.

- 5.5.4.1 Remove the cap or lifting lever following the instruction for valve disassembly (see paragraph 6.2 below).
- 5.5.4.2 Loosen the adjusting bolt nut and turn the adjusting bolt clockwise to increase set pressure or counter-clockwise to reduce set pressure.
- 5.5.4.3 Retighten fully the adjusting bolt nut following each adjustment.
- 5.5.4.4 Two consecutive valve openings at the same pressure are necessary to verify the opening pressure accurately.
- 5.5.4.5 Set pressure tolerance shall comply with the applicable code and standards (see Table 2).
- 5.5.4.6 Once the set pressure has been established, re-assemble the cap and the lift lever (if any) on the valve. One last test should be done then to confirm that the cap or the lift lever does not impede the opening and that the set pressure is consistent. Then, seal wire the cap with identifying seals.

5.6 Seat Leakage Test

Immediately after the CDTP has been adjusted, all openings shall be closed and the valve shall be tested for leakage.

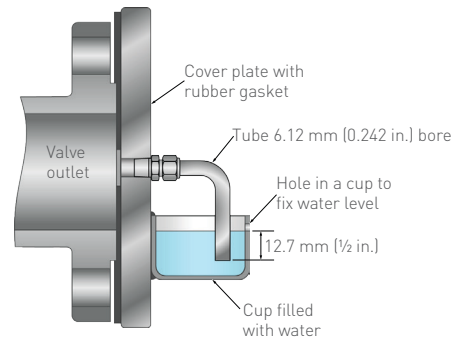
The procedure recommended herein is from the API Standard 527. It provides a standard for 'commercial' tightness and has been adopted by industry and users in order to clarify testing methods and tightness criteria. It is also referenced in the EN ISO 4126 standards.

5.6.1 Tightness Standard for Gas Service

5.6.1.1 Test Apparatus

A typical test arrangement for determining seat tightness for pressure relief valves per API standard 527 is shown in Figure 3. Leakage is measured using a 6.12 mm ID or 7.9 mm OD with 0.89 mm wall (0.24 in. ID or 5/16 in. OD with 0.035 in. wall). The tube end is cut square and smooth, is parallel to and 12.7 mm (1/2 in.) below the surface of the water.

FIGURE 3
Typical test arrangement



NOTE

The cover plate should be fitted with a suitable device to relieve body pressure in case of accidental popping of the valve.

TABLE 2 - SET PRESSURE TOLERANCES

Set	Tolerance
Tolerance per ASME Section VIII	
≤ 5 barg (70 psig)	± 0.15 bar (2 psi)
> 5 barg (70 psig)	± 3%
Tolerance per EN ISO 4126	
≤ 3.3 barg (48 psig)	± 0.10 bar (1.45 psi)
> 3.3 barg (48 psig)	± 3%

NOTE

1. Values in bar are from ASME Section VIII.
2. Values in psig are directly converted.

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5.6.1.2 Procedure

Use air or nitrogen at ambient temperature as the test fluid. With the valve mounted vertically, raise the pressure at the valve inlet up to 90% of the CDTP and keep it at this value during the test. For the valves set at 3.45 barg (50 psig) or below, the pressure shall be 0.345 barg (5 psig) below the CDTP.

- Testing Style EMC or EMB Valves (Closed Bonnet)
 - a. Before the actual seat leakage test starts, the test pressure shall be applied for a minimum waiting time which depends on the size of the valve, as given in Table 3.
 - b. First, check the tightness of all gaskets and joints on the valve by using a soapy solution: there must be no external leakage at all.
 - c. Then, proceed with the seat leakage test as follows.
 - Metal-to-Metal Seated Valves
The leakage rate in bubbles per minute shall be observed for at least one minute and shall not exceed the values indicated in Table 4.

- Testing Style EMH Valves with Open Bonnet
 - a. Before the actual seat leakage test starts, the test pressure shall be applied for a minimum waiting time which depends on the size of the valve, as given in Table 3. On a Style EMH valve, there is no gasket or joints under pressure: no need to test for external leakage.
 - b. Then, proceed with the seat leakage test as follows.
 - i. Block the base of the outlet flange (for example using strong sticky tape) and fill the outlet body bowl with water up to 12.7 mm (½ in.) above the seat level.
 - ii. Using a mirror to look safely inside the valve outlet, count any bubbles during one minute as per above and Table 4.

5.6.2 Tightness Standard for Steam Service

- Valve on steam service can also be tested on air as above. If testing on steam is required, the procedure is as follows.
- a. Prior to the seat leakage test, safety valves intended for steam service shall also be tested on air or nitrogen for external leakage as described above for the valves on gas service.
 - b. Then the valve shall be mounted vertically on a steam test stand and the valve outlet body bowl should be dried if needed, using shop air for example.

- c. The pressure at the safety valve inlet shall be raised up to and held at 90% of the set pressure or cold differential test pressure (CDTP). For valves set at 3.45 barg (50 psig) or below, the pressure shall be 0.345 barg (5 psig) below the set pressure or CDTP.
 - Steam leakage from the valve outlet shall be observed against a black background.
 - No audible or visible leakage is allowed for one minute.

5.6.3 Tightness Standard for Liquid Service

- a. Prior to the seat leakage test, safety valves intended for liquid service shall also be tested on air or nitrogen for external leakage as described above for the valves on gas service.
- b. Check for seat tightness by a quantitative seat leakage test, using water at ambient temperature. All the test fluid passing through the tested valve is collected and measured per the following procedure:
 - a. Fill the outlet body bowl of the valve with water.
 - b. Raise inlet pressure up to and held at 90% of the set pressure or cold differential test pressure (CDTP). For valves set at 3.45 barg (50 psig) or below, the pressure shall be held at 0.345 barg (5 psig) below the set pressure or CDTP.
- c. The test pressure is maintained for not less than ten minutes.
 - Metal-to-Metal Seated Valves
The maximum allowable leakage rate should not exceed 0.4 cm³/hr / mm of DN (10 cm³/hr / in.) of inlet size. For inlet sizes of DN 25 (1 in.) or less, the leakage rate shall not exceed 10 cm³/hr.

TABLE 3 - LEAKAGE TEST PRESSURE

CDTP	≤ 3.45 barg (50 psig)	> 3.45 barg (50 psig)
Leakage Test Pressure	CDTP - 0.345 barg (CDTP - 5 psig)	90% of CDTP

TABLE 4 - MAXIMUM ALLOWED LEAKAGE RATES FOR ONE MINUTE

Inlet Size	≤ DN 25 (1 in.)	≤ DN 50 (2 in.)	≤ DN 65 - 100 (2½ - 4 in.)	> DN 100 (4 in.)
Waiting time	1 min	1 min	2 min	5 min
Metal-to-Metal seat				
Air or nitrogen	10 bubbles per min (177 cm ³ /hr)			
Water	10 cm ³ /hr	0.4 cm ³ /hr per Inlet DN		
Steam	No audible or visible leakage (tested on steam) 10 bubbles per min (177 cm ³ /hr) (tested on air)			

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6 VALVE MAINTENANCE

WARNING

Valves in hazardous fluid service and any other materials classified as dangerous must be neutralized immediately after removal from service.

6.1 Visual Inspection and Neutralizing

A visual inspection shall be made when valves are first removed from service. The presence of deposits or corrosive products in the valve and in the piping should be recorded and valves should be cleaned to the extent possible prior to disassembly. Check the condition of external surfaces for any indication of corrosive atmospheric attack or evidence of mechanical damage.

NOTE

Pre-Test: It is always good practice to test the valve on the test bench before every service and prior to disassembly. All pressures and leakage shall be recorded and will provide valuable information for establishing service frequency and for any troubleshooting.

6.2 Disassembly - All Valves

Crosby EM-Series Valves should be disassembled as described below. Parts identification may be found in Figure 11 on page 17.

The parts from each valve should be marked properly and segregated to keep them separate from parts used in other valves.

6.2.1 Unscrew the cap (35) and remove the cap gasket (40). If the valve has a lifting lever device, follow the instructions in Section 6.4 or Section 6.5 below as applicable.

- 6.2.2 Slacken the locknut (32). Before releasing the spring load, make note of the depth of the adjusting bolt in the bonnet and count the number of turns required to remove the spring load. This information will help when reassembling the valve to its approximate original setting.
- 6.2.3 Release all the spring (20) load by turning the adjusting bolt (30) anti-clockwise.
- 6.2.4 Remove the bonnet stud nuts (27). The studs (26) should stay in the body.
- 6.2.5 Lift the bonnet (25) straight up to clear the spindle (15) and spring (20).

CAUTION

Exercise care when lifting the bonnet as the spring and spindle could then fall aside. On large valves the bonnet (25) can be very heavy: do not attempt to lift it without assistance.

- 6.2.6 The spring (20) and its top spring washer (21) can now be lifted off the spindle (15), the lower spring washer staying on the spindle. The spring and spring washers must be kept together as a subassembly.
- 6.2.7 Remove the spindle (15) from the guide (10), complete with the lower spring washer (21). It is recommended to hold the disc (5) down on the nozzle (2) while lifting the spindle to avoid the disc to move. The lower spring washer (21) may then be lifted off its split collar (16) and removed from the spindle (15). The spring and spring washers must be kept together as a subassembly. **Take care not to lose the split collar (16). The collar is made of two halves.**

- 6.2.8 If the valve is DN 80 (3 in.) inlet or larger with high pressure configuration, it will be fitted with a bonnet extension. The stud nuts (87) holding the bonnet extension (85) to the body (1) should be removed and the extension (85) lifted away from the guide (10).
- 6.2.9 The guide (10) may now be removed from the body (1). Do not release the guide by inserting a tool through the nozzle (2) as this will damage the disc (5) and nozzle. Be careful when removing the guide (10) not to damage the bellows unit (55) on balanced bellows valves.
- 6.2.10 For Style EMC and EMH valves lift the disc assembly (5) carefully out of the body, being careful not to lose the lift spacer (only on valves with restricted lift) and the ball (17).
- 6.2.11 For Style EMB valves lift the bellows (55) complete with disc assembly from the nozzle (2), being careful not to lose the lift stop (61) and ball (17). If the bellows needs replacing, note that the bellows is supplied welded to the disc. Only use factory supplied bellows units.

NOTE

Restricted Lift Valves: Take care about the lift spacer (one or more, depending on the configuration) that is located on the top of the disc. Refer to 6.11 below.

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6.3 Disassembly - Disc

6.3.1 Metal Seated Valves

- a. Remove the disc circlip (7) using a blunt tool, like a small screwdriver and slip the deflector (6) down, being careful not to damage the disc seat faces. If the deflector does not go off easily, using a small soft mallet, tap gently on the top edge of the deflector. The disc can be held between fingers or place the disc on the flat end of a rod in plastic or wood, taking care that the rod is small enough so that it does not touch the disc seat faces.
- b. Examine the disc (5), re-lap as necessary [see Section 6.8 below].

6.4 Disassembly - Open Lift Lever, Cap C

- 6.4.1 Remove the pin (66) from the lever (65) using a pin punch. For valves with DN 50 (2 in.) inlet or smaller, you can use a 5 mm (3/16 in.) punch and an 8 mm (5/16 in.) punch from DN 65 (2 1/2 in.) and above. The Lever (55) may now be withdrawn from the cap (35).
- 6.4.2 Loosen the grub screw (69) and unscrew the cap (35) using a wrench on the base of the cap.
- 6.4.3 It is recommended that the two spindle nuts (73) be marked prior to removal so that the correct position can be attained upon reassembly. Remove the two spindle nuts and the spindle washer (68). Further dismantling of the valve is achieved by following the procedure outlined in Section 6.2 above.

6.5 Disassembly - Packed Lift Lever, Cap D and E

- 6.5.1 Unscrew the gland (70). It may be necessary to ease the eccentric (72) outwards during this operation to ensure that the gland (70) can be withdrawn from the cap (35). The lever assembly may now be withdrawn from the cap, complete with the gland packing (71).
- 6.5.2 The tension pin (75) should be released from the lever (65) using a punch of 3 mm (1/8 in.) for valves with DN 50 (2 in.) inlet or smaller and 5 mm (3/16 in.) from DN 65 (2 1/2 in.) and above. The lever (65), gland (70) and packing (71) may now be removed from the eccentric shaft (72).

NOTE

It will be necessary to fit a new gland packing (71) on reassembly.

- 6.5.3 The cap (35) may now be unscrewed from the bonnet (25) using a flat wrench at the base of the cap.
- 6.5.4 It is recommended that the lock nut (74) be marked prior to removal so that the correct position can be attained upon reassembly. Unscrew the locknut and the spindle nut (73). Further dismantling of the valve is achieved by following the procedure outlined in 6.2 above.

6.6 Cleaning

If the valve is being serviced following some fault or incident, a thorough visual examination of every part should be done prior to any cleaning to note any unusual deposit, marks, corrosion, etc. which will be very useful information for determining the causes of the incident.

External parts such as the valve body, bonnet and cap should be cleaned by immersion in a bath such as hot Oakite solution or equivalent. These external parts may be cleaned by wire brushing, provided the brushes used do not damage nor contaminate the base metals. Only clean stainless-steel brushes should be used on stainless steel components. The internal parts such as the guide, disc and spindle should be cleaned by immersion in a commercial high alkaline detergent. Guiding surfaces on the spindle and guide may be polished using a fine emery cloth. The bellows and other metal parts may be cleaned using acetone or alcohol, then rinsed with clean tap water and dried thoroughly.

FIGURE 4
Open lift lever, Cap C

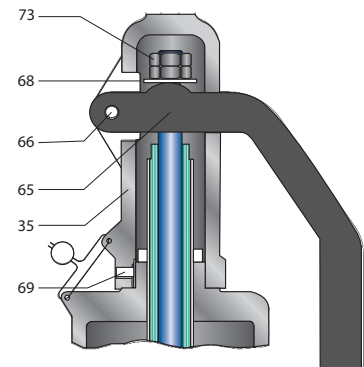
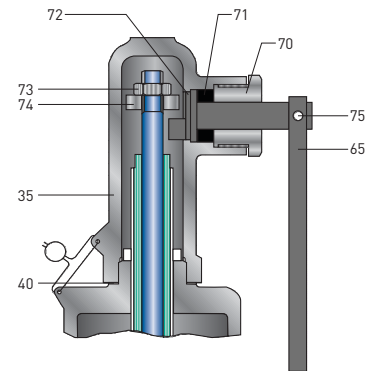


FIGURE 5
Packed lift lever, Cap D



6.7 Inspection

Inspection of valve components is important to ensure proper valve performance. Damaged valve parts must be repaired or replaced. Check all valve parts for wear and corrosion. If the valve is being serviced following some fault or incident, a thorough inspection of every part should be done to note any unusual wear, discoloration or damage which will be very useful information for determining the causes of the incident.

6.7.1 Seats

The valve seats on both the nozzle and disc must be examined to determine if they have been damaged. Most often, lapping the valve seats is all that is necessary to restore them to their original condition.

If the inspection shows that the valve seats are damaged badly, it may be advisable to replace these parts. When the time element is a factor, it may be advantageous to replace damaged parts from spare parts stock, thereby permitting the replaced part to be checked and reworked at leisure. [See Figure 6 and Table 5 for critical dimensions].

6.7.2 Spring

The valve spring (20) should be inspected for evidence of cracking, pitting or deformation.

6.7.3 Bellows

Only for style EMB valves: the bellows (55) should be inspected for evidence of cracking, pitting or deformation that might develop into a leak.

CAUTION

The bellows is an essential component that is critical for the correct operation of the safety valve. A damaged bellows cannot be repaired and needs replacing.

6.7.4 Guide and Spindle

The bearing surfaces on the guide (10) and spindle (15) should be checked for residual product build up and any evidence of scoring. Spindles should be checked for straightness. Any spindle out of tolerance should be replaced. For all sizes, the straightness of the spindle should be within 0.13 mm (0.005 in.).

6.7.5 Thrust Point Bearing

Examine the ball (17) location points in the disc (5) and spindle (15) and ensure that they are of a clean smooth finish. Examine the ball for surface imperfections and replace if damaged. **Note:** The ball is included in standard repair kits.

6.7.6 Adjusting Bolt

Check and inspect the bush (31) inside the top of the bolt (30). The inner diameter of the bush must be smaller than the inner diameter of the bolt so that the spindle (15) does not rub against the bolt. Replace if it is worn out or damaged.

6.7.7 Gaskets

Check and inspect all gaskets for evidence of damage (creases, gouges, cuts) or corrosion that may highlight some issues.

All fibre or soft gaskets should be replaced at every service of the valve. Most of these are included in the standard repair kits.

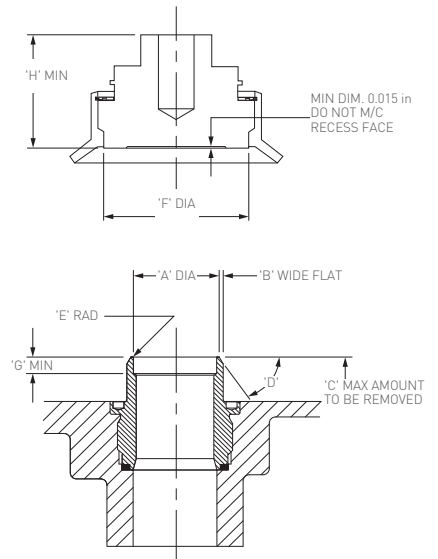
6.8 Reconditioning of Valve Seats

The tightness of a valve and its proper operation depend directly on the condition of the seats. Many safety valve problems are due to eroded or damaged seats.

The standard Crosby EM-Series Valve is constructed with a flat metal-to-metal seat. It is important that seating surfaces be refurbished properly by lapping with a flat cast iron lap coated with the correct lapping compound.

FIGURE 6

Nozzle and disc seat critical dimensions



6.8.1 Lapping Procedures

Unless the seats have been damaged badly by dirt or scale, lapping the seating surfaces should restore them to their original condition.

Proper lapping will:

- Restore dimensional accuracy, maintaining valve performances.
- Produce a high quality finish of the seating faces to reduce potential for seat leakage and increase service life.

Lapping is a surface finishing process that involves the cutting and shearing action of the loose abrasive particles in the lapping compound and the fine grinding of the abrasive particles embedded in the lapping plate or block. Lapping compound and lapping plate must therefore be compatible (see Tables 6 and 7).

NOTE

Never lap the disc against the nozzle. Do not lap any part with deep marks or scratches: these will damage the lapping plate.

TABLE 5 - NOZZLE AND DISC SEAT CRITICAL DIMENSIONS (SEE FIGURE 6)

Inlet Size	A (diameter)		B		C (maximum)		D	E (radius)		F (diameter)		G (minimum)		H (minimum)	
	mm	in.	mm	in.	mm	in.		degrees	mm	in.	mm	in.	mm	in.	mm
DN 25 (1 in.)	24.70	0.973	0.65-0.80	0.025-0.032	1.00	0.040	60	0.35	0.014	27.95	1.101	5.00	0.196	29.35	1.156
DN 32 (1 ¼ in.)	31.75	1.250	0.85-1.00	0.033-0.040	1.00	0.040	60	0.35	0.014	37.00	1.456	6.00	0.236	27.50	1.082
DN 40 (1 ½ in.)	39.75	1.565	1.00-1.20	0.040-0.047	1.00	0.040	60	0.35	0.014	51.00	2.007	7.00	0.275	39.55	1.558
DN 50 (2 in.)	49.75	1.958	1.25-1.45	0.050-0.057	1.00	0.040	60	0.35	0.014	57.50	2.263	9.00	0.354	42.15	1.660
DN 65 (2 ½ in.)	64.75	2.550	1.45-1.70	0.057-0.067	1.50	0.060	60	0.35	0.014	74.50	2.933	10.45	0.412	44.35	1.747
DN 80 (3 in.)	79.75	3.140	1.65-1.90	0.065-0.075	1.50	0.060	60	0.35	0.014	92.00	3.622	11.50	0.452	47.70	1.877
DN 100 (4 in.)	99.75	3.927	2.35-2.55	0.093-0.100	2.05	0.080	60	0.35	0.014	110	4.331	10.95	0.432	59.35	2.337

6.8.1.1 Assessment of Seat Condition

Before lapping, any material damage, pitting, etc. should be removed using medium to fine (320 to 600 grit) silicon carbide abrasive paper. Otherwise, the surface of the lap (block or plate) could be damaged, scratched.

Scratches and nicks will require a first lapping with medium compound, followed with fine compound to prepare for the final polishing.

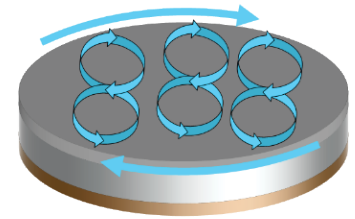
Light marks or blemishes may only need polishing.

6.8.1.2 Compounds and Equipment

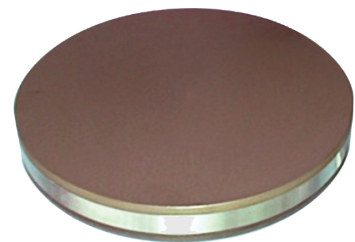
There are two types: conventional cast iron plates and blocks with associated compounds; and composite types to use with diamond compounds. The laps hold the lapping compound in their surface pores and must be recharged frequently. The iron ones are typically used with silicon carbide or aluminium oxide lapping paste. The composite ones must be used with diamond lapping compound. Diamond lapping compounds are recommended to produce the final mirror finish.

- **Lapping plates and blocks**
 There is a block for each orifice size. Each block has two perfectly flat working sides and it is essential that they retain this high degree of flatness to produce a truly flat seating surface. Before a lapping block is used, it should be checked for flatness and reconditioned after use on a lapping plate. The block should be lapped in a 8 figures motion, applying uniform pressure while rotating the lapping block against the plate as shown in Figure 7.
- **Lapping Compounds**
 Experience has proven that medium coarse, fine and polish lapping compounds will condition any damaged safety valve seat properly except where the damage requires remachining. See Tables 6 and 7 for the suggested lapping compounds or their commercial equivalents.

FIGURE 7



Lapping with '8' figures, using all the surface of the plate



Composite lapping plate with 2 sides (medium and polish)

TABLE 6
 Conventional (Cast iron plates)

Grit compound no.	Particle Size	Description
320	30 µm	Coarse
400	17 µm	Medium
600	9 µm	Fine
1000	5 µm	Polish
1200	3 µm ⁽¹⁾	Polish

TABLE 7
 Diamond (composite plates)

Diamond Grade	Description
14 µm	Medium / Fine
3 µm	Polish

NOTE

1. This polishing grade is recommended to be a diamond compound

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6.8.1.3 Methodology

- a. If considerable lapping is required, it is recommended to eliminate the damages with some abrasive paper before lapping. The abrasive paper should be attached to a flat plate (double sided tape, glue etc.) otherwise excessive rounding of the edges can occur.
 - b. The lap should be cleaned with an appropriate degreasing solvent and lint free cloth and checked for flatness prior to use. By lapping, the piece surface will replicate the flatness of the lap. Therefore, the flatness of the lap is critically important.
 - c. The disc seat can be lapped on a plate or with a block, whilst the nozzle seat will require lapping blocks. Before lapping the disc (5), pull out the circlip (7) to remove the deflector (6). Refer to the disassembly instructions 6.3.1 above.
 - d. Never rotate the disc continuously but use an oscillating motion or '8' figures, using the whole surface of the plate (see Figure 7). Every now and then, rotate the position of the disc by 90°. Take great care to keep the seat perfectly flat against the plate.
 - e. Spread a thin coat of medium lapping compound on the plate. After lapping with the medium compound, carefully clean the plate and seat and lap again with a fine grade compound. Unless much lapping is needed, the first step with the medium compound can be omitted. When all nicks and marks have disappeared, clean all the compound off the plate and seat. Apply polish compound to another plate and lap the seat to a shine mirror finish.
 - f. If scratches appear during lapping, the cause is probably dirty compound or plate. Cleanliness is obviously extremely important at all stages during lapping.
 - g. Before the deflector is put back on the disc, both parts must be thoroughly cleaned. If the disc is damaged too badly to be reconditioned by lapping, it should be replaced. Re-machining the disc will change critical dimensions, affect the action of the valve and is not recommended.
- Note:** The nozzle (2) must be lapped in situ in the body (1) using lapping blocks.

6.8.2 Machining of Nozzle Seats

If machining of the nozzle seat or other major repairs are necessary, it is recommended that the valve be returned to an authorized Emerson Service Center for repair. Note that, although the nozzle is screwed into the body, it is not recommended to remove it. Removal of the nozzle should only be done by an authorized Emerson Service Center. All parts must be machined accurately per Emerson specifications.

⚠ CAUTION

No safety valve will be tight, nor will it operate properly unless all parts are machined correctly.

6.9 Assembly

Prior to assembly, all parts should be clean, undamaged and free of grease. Before assembling the following parts, lubricate with 'Pure Nickel Never-Seez' or an equivalent anti-seize compound:

- All studs and nut threads.
- Cap (35) threads.
- Spring washers (21) bevels.
- Spindle (15) point thrust bearing, disc (5) bearing and ball (17).
- Adjusting bolt (30) and bonnet threads (25).
- Body drain and bonnet 'bug-screen' threads if installed.
- Packed lever gland (70) threads if installed.

⚠ CAUTION

Use lubricant sparingly, paying special attention to keep disc and nozzle seat surfaces and guiding surfaces perfectly clean and free of grease.

6.9.1 If they were removed or changed, screw the studs into the body.

- For Style EMB valves fitted with a metallic bellows, there is a spacer (60) between body and bonnet. Position the spacer with the spigot going into the recess of the body on top of the gasket (41). Place another gasket (41) in the recess of the spacer (60). If the disc circlip has to be changed on a Style EMB valve, slide the new circlip over the disc as shown on Figure 9, taken care not to scratch the seat faces.

6.9.2 Slide the deflector (6) on the disc and secure it with its circlip ring (7). Insert the ball (17) inside the disc and position carefully the disc on top of the nozzle (2).

⚠ CAUTION

Check that the circlip ring (7) is well and fully engaged into the groove of the deflector (6). This can be done by pushing the ring fully with a blunt instrument like a screwdriver in 4 or more locations. See Figure 10. If the circlip ring is properly engaged, it should be possible to rotate freely the deflector around the disc.

- Style EMB valves fitted with a metallic bellows have a lift stop (61). Carefully place the lift stop on top of the disc (5), inside the bellows (55). Make sure that the bellows flange fits properly within the recess of the spacer (60) on top of the gasket. There is no gasket needed on top of the bellows flange.

FIGURE 8

Recommended lubrication points

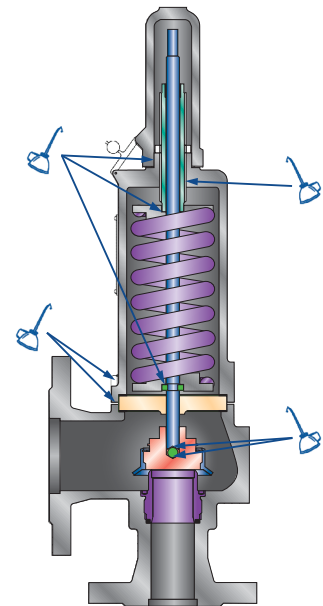
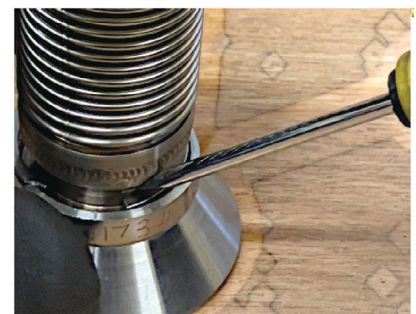


FIGURE 9



FIGURE 10



- For valves with restricted lift, position carefully the limit spacer on top of the disc (5) or on top of the lift stop (61) if fitted.

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- 6.9.3 Slide the guide (10) on the spindle (15), making sure that the shoulder (if any) of the guide faces downwards, towards the point bearing of the spindle. Install the spindle into the disc on to the ball, through the limit spacer (60) and/or the lift stop (61) if these are fitted. Position the guide in the recess of the body on top of the gasket (41) or on top of the bellows flange in the recess of the spacer (60) for Style EMB valves. Ensure that the spindle is free to move. Put the upper gasket (41) on top of the guide.
- For high pressure valves with DN 80 (3 in.) inlet and above, there is a bonnet extension (85) between the guide (10) and the bonnet (15). Position this bonnet extension on top of the gasket (41) on the guide so that the guide fits within the recess of the bonnet extension. Place the extension gasket (88) on top of the bonnet extension.
- 6.9.4 Place the two halves of the split collar (14) into the groove of the spindle and slide the lower spring washer (21) over the spindle down on the split collar. Then slide the spring (20) on top, followed by the upper spring washer.
- 6.9.5 Lower the bonnet (25) over the spindle and spring assembly onto the bonnet studs (26) in the body. Position the bonnet recess on the O.D. of the guide and lower the bonnet onto the guide.

NOTE

For Style EMB valves, it is usual to position the bonnet so that the bonnet vent points toward the outlet flange. Of course, if the vent is piped away this does not apply.

- 6.9.6 Screw the bonnet nuts (27) onto the bonnet studs and tighten down evenly in a criss-cross pattern to prevent unnecessary strain and possible misalignment. The nuts should be tightened to the torque values given in Table 8.

- 6.9.7 Slide the adjusting bolt (30) over the spindle (15) and screw it into the bonnet to apply force on the spring. The original set pressure can be approximated by screwing the adjusting bolt down to the measurement taken during disassembly, as explained in 6.2.2. Secure the bolt with the lock-nut (32).

CAUTION

Make sure that the threads of the bonnet nuts (27), adjusting bolt (30) and its lock-nut (32) are properly lubricated before assembly.

- 6.9.8 If fitted (optional accessory only for Style EMB valves), screw the bug-screen into the bonnet vent, with the screen pointing downwards.
- The valve is now ready for testing. After testing, the following measures should be taken:
- Be sure that adjusting bolt nut (32) is locked.
 - Install the cap or lifting device, following instructions in Section 6.12 below as needed.
 - Seal the cap with wire and seal to prevent tampering.

FIGURE 11
Style EMB Valves

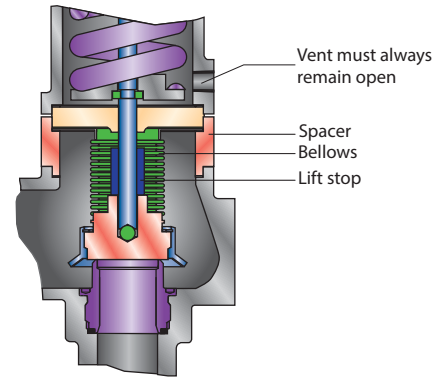


FIGURE 12
High-pressure Valves

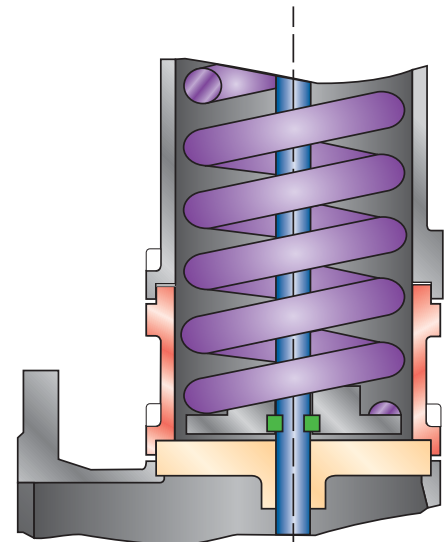


TABLE 8

Torque Values

Inlet Size	DN 25 (1 in.)	DN 32 and 40 (1 ¼ and 1 ½ in.)	DN 50 and 65 (2 and 2 ½ in.)	DN 80 and 100 (3 and 4 in.)
Bonnet Nut Torque	40 N•m (30 ft-lb)	68 N•m (50 ft-lb)	166 N•m (122 ft-lb)	295 N•m (218 ft-lb)

6.11 Restricted Lift Valves

Crosby EM safety valves are available in a restricted lift version. The purpose of a restricted lift valve is to match the required capacity of the protected equipment more closely with the rated capacity of the safety valve.

Restricted lift valves are identified by 'RL' in the model number.

Existing non-restricted lift versions of the EM-Series may be converted to the restricted lift version. In addition, existing restricted lift valves may have their lift modified using the same procedure.

Restricted lift valves have a limit spacer on top of the disc that limits the lift of the disc to restrict the maximum capacity of the valve as required.

WARNING

The lift restriction influences the capacity of the valve. It is imperative that adding or changing lift restriction is being done only by a certified Emerson facility.

CAUTION

The limit spacer (one or more, depending on the configuration) is specifically designed for the restricted capacity of this particular valve. It is particularly important to keep the spacer with the valve and not to mix it with other valves.

6.12 Assembly of Cap and Lifting Lever Devices

The Crosby EM-Series safety valves can be supplied with several different caps and lifting lever devices.

6.12.1 Types J and K

- a. Install the cap gasket (40) on the bonnet and screw the cap. Tighten with a flat spanner on the base of the cap.
- b. For the Type K, continue by installing the cap plug gasket (82) and screw the cap plug (81) into the cap. The gag screw (80) is installed only during system hydrostatic testing. Never install the gag screw unless performing system hydrostatic testing.

6.12.2 Type C

- a. Put the washer (68) on the spindle and screw both nuts (73) just on the top of the spindle. Screw the cap on the bonnet so that its opening faces towards the back of the valve. Install the lever (65) underneath the washer (68) and fix the lever to the cap with the pin (66).
- b. Screw the spindle nuts down until there is a 1.5 mm (1/16 in.) minimum of play between the lever and the spindle washer. It may be necessary to remove the lever and the cap to adjust the nuts. When the lower spindle nut is properly adjusted, secure it with the top nut. Re-install the cap, the lever and its pin.
- c. Position the lever opposite the valve outlet. Install the grub screw (69) and tighten it to secure the cap.

6.12.3 Types D and E

- a. Install the cap gasket (40) on the bonnet. Screw the spindle nut (73) up to the mark that was put during the disassembly (see Section 6.5.4) on the spindle, followed by the lock nut (74). Screw the cap (35) on the bonnet. Insert the eccentric shaft (72) in the cap with its pin at the bottom, all the way in. With the pin of the eccentric in the lowest position, scribe a horizontal line on the end of the eccentric shaft. Rotate the eccentric until it touches the spindle nut. If there is too much play to reach the spindle nut, pull out the eccentric, unscrew the cap and screw the spindle nut a bit more. Screw the cap on the bonnet again and repeat the sequence above until the eccentric touches the spindle nut when the mark made on the shaft is still horizontal. Take the assembly off again and unscrew the spindle nut up to about 1.5 mm (1/16 in.) (final minimum play between the spindle nut and the eccentric pin when it is in the lower position) higher up. Secure the spindle nut into position with the lock nut (74). Screw the cap back on the bonnet. Push the eccentric into the cap, making sure that the pin is in the lower position (mark is horizontal). Push the packing (71) inside the cap around the shaft and screw in and tighten the gland (70). Slide the handle (65) over the eccentric shaft so that it is vertical when the mark on the eccentric is horizontal and secure with the pin (75).

- b. For the Type E, continue by installing the cap plug gasket (82) and screw the cap plug (81) into the cap. The gag screw (80) is installed only during system hydrostatic testing. Never install the gag screw unless performing system hydrostatic testing.

7 SERVICE RECORDS

Service records should be completed before a valve is returned to service. These records are important and will provide guidance on establishing time intervals between repairs as well as providing the historical record of repairs and service conditions. Well kept records will be useful in predicting when to retire a valve and which spare parts should be maintained in inventory to ensure uninterrupted plant operation.

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8 TROUBLE SHOOTING

Troubles encountered with safety valves can affect the life and performance of the valve vitally and must be corrected at the first possible opportunity.

Failure of a safety valve to function properly could result in the rupture of a line or vessel jeopardizing the safety of personnel and causing damage to property and equipment. Some of the most common troubles and the recommended correction measures are discussed in the following paragraphs.

8.1 Seat Leakage

A leaking valve allows fluids to circulate into the secondary pressure zone of the valve where it can cause corrosion of the guide and valve spring.

When a leaking valve problem is not addressed immediately, the leakage itself will further contribute to seat damage through erosion (wire-drawing).

8.2 Seat Damaged by Foreign Matter

Seating surfaces may be damaged when hard foreign particles such as mill scale, welding spatter, coke and dirt are trapped between the seats. While this type of damage usually occurs while the valve is in service, it may also happen in the maintenance shop. Every precaution should be taken to clean the process system before installing a pressure relief valve and to test the valve using only clean fluids.

Generally, damaged seating surfaces are reconditioned by lapping. Most often small pits and scratches may be removed by lapping alone. More extensive damage will also require remachining prior to lapping.

If the corrosive media is present in the exhaust system, conversion to a Style EMB bellows seated valve will isolate and protect the guides and valve spring from any corrosive fluids.

8.3 Distortion from Piping Strains

Valve bodies can be distorted by excessive piping loads causing seat leakage. Both inlet and discharge piping must be supported properly and anchored so that high bending loads are not transmitted to the valve body.

8.4 Operating Pressure too Close to Set Pressure

A carefully lapped metal-to-metal seated valve will be commercially tight at a pressure approximately ten percent under the set pressure or 0.345 barg (5 psig), whichever is greater. Consequently, this minimum pressure differential should be maintained between set and operating pressure to avoid seat leakage problems.

8.5 Chatter

Oversized valves, excessive pressure drop in the inlet lines, restrictions in the inlet line, too great a build up of back pressure or pulsating inlet pressure will cause instability to the pressure relief valve. In such installations, the pressure under the valve disc may be great enough to cause the valve to open but, as soon as flow is established, the pressure drops allowing the valve to close immediately. This cycle of opening and closing sometimes occurs at very high frequency causing severe seat damage, sometimes beyond repair. Proper valve selection and installation techniques are paramount to reliable valve performance.

8.6 Incorrectly Adjusted Lifting Gear

A space of 1.5 mm ($\frac{1}{16}$ in.) minimum should always be provided between the lifting device and the spindle lift nut. Failure to provide sufficient clearance may result in inadvertent contact causing a slight shift in the opening pressure.

8.7 Other Causes of Seat Leakage

Improper alignment of the spindle, too much clearance between the valve spring and the spring washers or improper bearing contact between the adjusting bolt and the spring washers, spindle and disc holder or spindle and lower spring washer may cause seat leakage problems. Spindles should be checked for straightness and springs and spring washers should be fitted properly and kept together as a spring assembly.

8.8 Corrosion

Corrosion may result in pitting of valve parts, failure of various valve parts, build up of corrosive products and general deterioration of the valve materials.

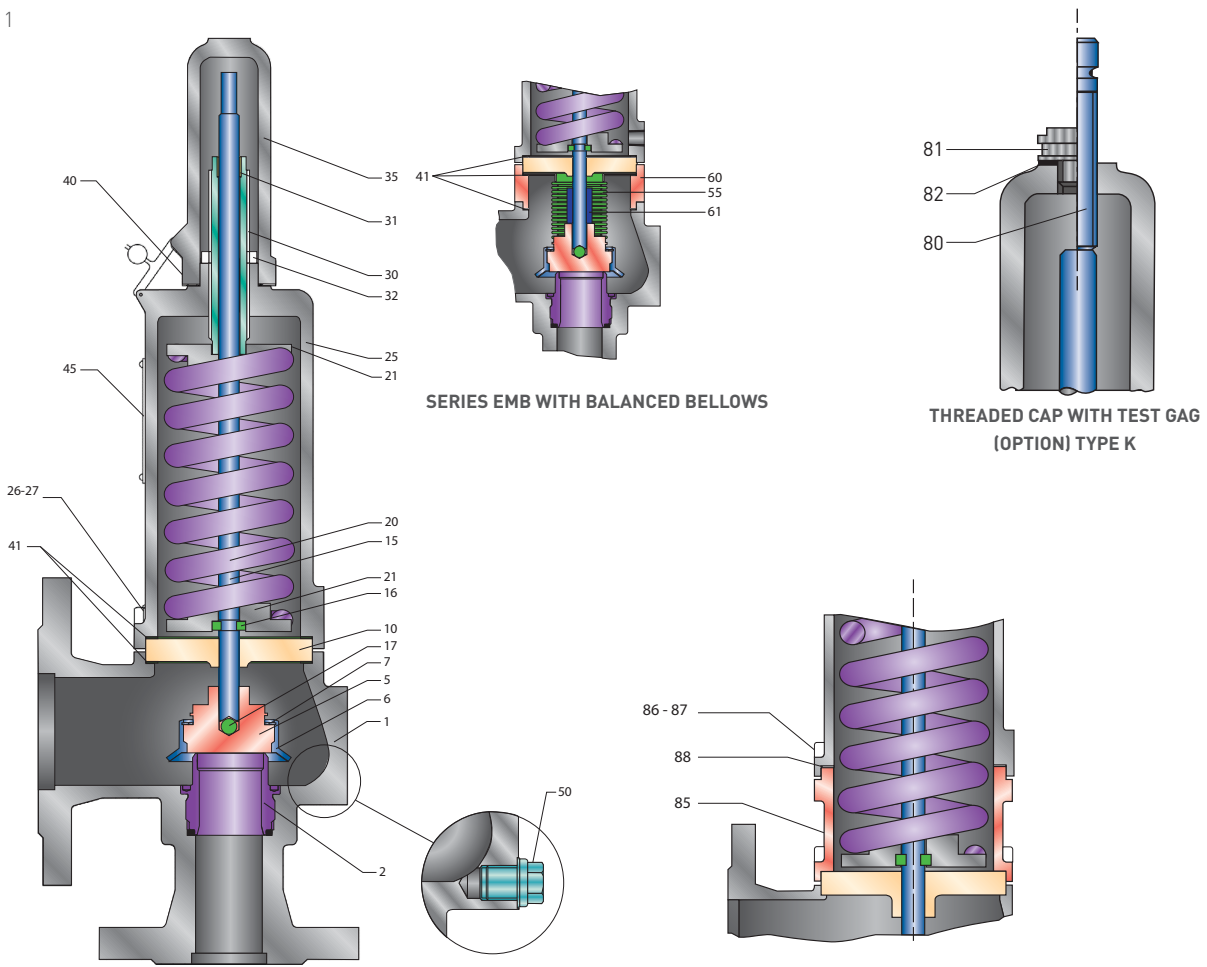
Generally, corrosive attack is controlled through selection of suitable materials or by employing a bellows or diaphragm to isolate the valve spring, adjusting bolt, spindle and guiding surfaces from the corrosive attack of the process fluid.

Environmental corrosion attacks all exposed surfaces, including studs and nuts. In general, the materials required for a particular service are dictated by the temperature, pressure and the degree of corrosion resistance required.

CROSBY EM SERIES SPRING LOADED PRESSURE SAFETY VALVES

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

FIGURE 11



PARTS LIST

No.	Part name	Notes
1	Body	
2	Nozzle	
5	Disc	1
6	Disc deflector	2
7	Disc circlip	2
10	Guide	3
15	Spindle	3
16	Split collar	3
17	Ball	1, 4
20	Spring	3
21	Spring washer (2 required)	3
25	Bonnet	
26	Bonnet studs	
27	Bonnet stud nuts	
30	Adjusting bolt	
31	Adjusting bolt bush	3
32	Adjusting bolt nut	
35	Threaded cap	

No.	Part name	Notes
40	Cap gasket	1, 4
41	Guide gaskets (2 required)	1, 4
45	Nameplate	
50	Drain plug	
55	Bellows assembly	2
60	Spacer	
61	Lift Stop	
80	Gag screw	
81	Gag plug	
82	Gag plug gasket	1, 4
85	Bonnet extension	
86	Extension studs	
87	Extension nuts	
88	Extension gasket	1, 4

NOTES

- Consumable spare parts: valve parts which should be replaced as part of any disassembly plus the disc which must be replaced if seats are damaged.
- 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.
- 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.
- These parts are all included in the basic spare kit. See page 18.

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SPARE PARTS

Part	Part Number	Material	Valve Style	Part Variation	Inlet Size						
					DN 25 (1 in.)	DN 32 (1½ in.)	DN 40 (1½ in.)	DN 50 (2 in.)	DN 65 (2½ in.)	DN 80 (3 in.)	DN 100 (4 in.)
Gasket Kit ⁽¹⁾	17, 40, 41 (or 88) and 82	Graphite Fiber	All styles	All variations ⁽⁴⁾	11537336	11537337	11537338	11537339	11537341	11537342	11537343
Disc ⁽²⁾	5	316L / 1.4404	EMC, EMH	Metal seat	11525728	11525729	11525730	11525731	11525732	11525733	11525734
		Stellited	EMC, EMH	Hardened Seat	11529470	11529471	11529472	11529473	11529474	11529475	11529476
Disc Deflector	6	316L	All styles	All variations	11525721	11525722	11525723	11525724	11525725	11525726	11525727
Disc Circlip	7	Stainless steel	All styles	All variations	11525735	11525736	11525737	11525738	11525739	11525740	11525741
Ball	17	440C	All styles	C1, L1 and S1	11522340	11522340	11522341	11522342	11522343	11522344	11522345
		316L	EMC	S2 Materials	11537330	11537330	11537331	11537332	11537333	11537334	11537335
Bellows Assembly (disc + bellows)	55	316L / 1.4404	EMB	Welded with disc	11525749	11525750	11525751	11525752	11525753	11525754	11525755
				Welded with Stellited disc	11546712	11546713	11546714	11546715	11546716	11546717	11546718
Spindle	15	431	EMC, EMH	C1, L1 and S1	11522239	11522221	11522179	11522201	11522257	N/A	N/A
		431	EMC, EMH	C1, L1 and S1 LP ⁽³⁾	N/A	N/A	N/A	N/A	N/A	11522287	11522316
		431	EMC, EMH	C1, L1 and S1 HP ⁽³⁾	N/A	N/A	N/A	N/A	N/A	11522289	11522318
		431	EMB	C1, L1 and S1	11522240	11522222	11522180	11522202	11522258	N/A	N/A
		431	EMB	C1, L1 and S1 LP ⁽³⁾	N/A	N/A	N/A	N/A	N/A	11522288	11522317
		431	EMB	C1, L1 and S1 HP ⁽³⁾	N/A	N/A	N/A	N/A	N/A	11522290	11522319
		316L / 1.4404	EMC	S2 Materials	11525793	11525792	11525790	11525791	11525794	N/A	N/A
		316L / 1.4404	EMC	S2 LP ⁽³⁾	N/A	N/A	N/A	N/A	N/A	11525796	11525798
Split Collar	16	17-4 PH	All styles	C1, L1 and S1	11522225	11522225	11522183	11522205	11522262	11522293	11522322
		Inconel 625	All styles	S2 Materials	11537325	11537325	11537323	11537324	11537326	11537328	11537329
Guide	10	416 / 1.4005	All styles	C1, L1 and S1	11522238	11522220	11522178	11522200	11522256	11522286	11522315
		316L / 1.4404	EMC	S2 Materials	11537319	11537318	11537314	11537317	11537320	11537321	11537322
Adjusting Bolt Bush	31	PTFE	All styles	All variations	11522224	11522224	11522182	11522204	11522261	11522292	11522321

1. Includes the following: cap gasket (40), three guide gaskets (41), gag plug gasket (82) and ball (17) for C1, L1 and S1 variations. Note that this kit is not suitable for the cryogenic S2 variation.

2. The disc of the Style EMB is welded to the bellows. See below for complete spare assembly bellows and disc

3. Low/High Pressures Set Pressure ranges are as follows:

	Inlet Size	Low Pressure	High Pressure	Low Pressure	High Pressure
		in bar		in psi	
EMC,	DN 80 (3 in.)	< 16.5	>= 16.5	< 240	>= 240
EMH	DN 100 (4 in.)	< 9	>= 9	< 130	>= 130
EMB	DN 80 (3 in.)	< 15.5	>= 15.5	< 225	>= 225
	DN 100 (4 in.)	< 9	>= 9	< 130	>= 130

4. Standard ball in 440C is included in the Gasket Kit. Ball for cryogenic variation S2 is not included and must be procured separately.

9 SPARE PARTS

When ordering spare parts, the valve shop number, assembly number or serial number should be given together with set pressure, part name and item number, valve size and style. Spare parts may be ordered from any Emerson regional sales office or representative.

10 EMERSON FIELD SERVICE AND REPAIR PROGRAMS

Emerson field service provides on-site, in line testing and repair capability for all types of safety devices.

10.1 Parts

Emerson will help you establish the right mix of on-site spares with Emerson’s own distribution and manufacturing support.

10.2 Training

Emerson offers intensive factory or on-site seminars to improve maintenance and application skills.

10.3 Testing

Emerson has the capability to evaluate pressure relief valve operability either in the field or at various Emerson facilities. Special qualifications programs may also be conducted in our laboratories.

10.4 Contract management

Emerson will combine a group of services to satisfy your special maintenance needs.

⚠ WARNING

The product is a safety related component intended for use in critical applications. The improper application, installation or maintenance of the product or the use of parts or components not manufactured by Emerson may result in failure of the product. The advice of a qualified engineer should be sought prior to any use of the product.

Any installation, maintenance, adjustment, repair or test performed on the product must be done in accordance with the requirements of all applicable codes and standards.

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