Exloc Instruments, Inc.

Installation, Operation and Maintenance Manual for Exloc Instruments Leakage Compensation (Model LC) "X" Purge and Manifold logic Pressurizing Systems for Class I conforming to NFPA 496, 2003 edition

IMPORTANT NOTE

It is essential, to ensure conformity with the standard, that the user of the Exloc Instruments system observe the following instructions:
Please refer to the standard for detailed requirements and definitions.
References to clauses in the standard are in italics

(N.B. These instructions apply only to the Pressurizing system. It is the responsibility of the manufacture of the Pressurized Enclosure to provide equivalent instructions for the Enclosure.)

Contents:

Section 0 Description and principle of operation

All Exloc Instruments pressurization systems provide

a) a method of pressurizing a Pressurized Enclosure (PE) while at the same time compensating for any leakage, together with
b) a method of Purging the enclosure before power is turned on to remove any flammable gas that may have entered the enclosure while it was unpressurized.

All systems have the following two major items:

A **Control Unit (CU)** Type “X” Pressurization containing as a minimum, a dust/water filter, Flow Control Valve (FCV), Minimum Pressure and Purge Flow sensing devices, a “Pressurized”/”Alarm” indicator and an output signal showing whether the PE pressure is satisfactory or not. A fully automatic Purging controller with a Purge timer and electrical power switch interlock.

A **Relief Valve (RLV)** fitted to the Pressurized Enclosure (PE) to provide a means of limiting the maximum pressure experienced by the PE during operation. The RLV model number has a suffix giving the diameter of the valve aperture (in millimetres) e.g. RLV - - /cs (Carbon Steel) or /ss (Stainless Steel). All RLV’s incorporate a metal foam Spark Arrestor to prevent sparks being ejected from the PE through the RLV aperture. The Relief Valve design is patented. Model LC purge systems are covered by this manual. They are described on the following paragraphs.

0.1 “Leakage Compensation” systems, Model LC

The Leakage Compensation system, Model LC, is intended to have minimal airflow after the initial purge has taken place. The Pressurized Enclosure (PE) is built as leak tight as possible and the LC system merely tops up for any enclosure leakage. The system provides an initial high flow of purging air which leaves the PE through the Relief Valve. After the initial purging has been completed the Control Unit changes over to Leakage Compensation mode and the Relief Valve closes. The only flow thereafter is the flow through the “Leakage Compensation Valve” (LCV) which is adjusted so that the flow is just enough to compensate for any leakage from the Pressurized Enclosure (PE). Hence the term “Leakage Compensation”. In consequence the system is much more economical to operate than a “Continuous Flow” system.

The Purging Flow rate is monitored by a separate “Purge Flow Sensor” located in the Control Unit which detects the back pressure caused by the purge flow rate through the RLV Spark Arrestor. The Spark Arrestor is calibrated during manufacture so that the back pressure at the desired Purge Flow rate is known. The Purge Flow Sensor is set to operate when that back pressure is exceeded. The output from the Flow Sensor is indicated on the Control Unit and initiates the automatic purge timer. Both Enclosure Pressure and Purge Flow have to be correct before the Purge Timer can start.

Section 1 Installation of the system

1.1 Installation of the Exloc Instruments LC Systems

.1 The Purge Control Unit should be installed either directly on or close to the Pressurized Enclosure (PE). If not installed on the PE it should be as close as possible. It should be installed so that the system indicators may be readily observed

.2 All parts of any system carry a common serial number. If installing more than one system, ensure that this commonality is maintained on each installation.

.3 Any tubing, conduit and fittings used to connect to the PE should be metallic, or, if non-metallic, conform to the local codes for flammability ratings. No valve may be fitted in any tube connecting the X-Purge system to the PE.

.4 If the purge exhaust is required to be discharged into a non-classified area the ducting shall conform to:

4.2.2 Discharge of the protective gas

.5 The user or manufacturer of the PE shall determine the volume of the PE, the necessary purging volume, and the time allowed for purging using the XLC system purge flow rate chosen. It is the user's responsibility to verify or enter this data on the PE and/or Exloc system name plate. Ask Exloc Instruments if in doubt.

Example calculations:

a) If the PE external dimensions give a volume of 20 cubic feet, and the PE is NOT a motor, multiply the volume by four to get the Purging Volume i.e. 80 cubic feet. Divide the Purging Volume by the purge rate e.g. 32 cubic feet per minute, and round up to the next even minute above, i.e. 4 minutes.

b) If the PE is a motor, multiply the Internal Free Volume by ten to get the Purging Volume. In this case the Purging time would be 8 minutes.

.6 If the PE contains an internal source of release of flammable gas or vapour, the procedures for assessment of the release as given in Chapter 8 of NFPA496 shall be observed. The user must verify that the specification of the Purge system e.g. pressures and type of protective gas are correct for the specific application. If an inert protective gas is required the Control Unit can be specified to have Compressed Air for the control logic and Inert Gas for the protective gas to minimise Inert Gas consumption.

.7 More than one PE can be protected by a single system. If PEs are connected and purged in "series" e.g. "Daisy Chained", the Outlet Orifice must be fitted on the last enclosure with the Purge Inlet to the first enclosure. The bore and length of the tube or conduit used to interconnect the enclosures is critical and will determine the maximum pressure experienced by the first enclosure in the series. Advice on sizing can be obtained from your Exloc Instruments Sales office. The test pressure for all the enclosures should be 3 times the pressure inside the first enclosure when purging is taking place.

1.2 Quality and installation of the Pressurizing air or inert gas supply

.1 The source of the compressed air must be in a non-classified area. Inert gas may be used as an alternative to compressed air.

.2 Unless a supply shut-off valve has been specially fitted within the Purge system, a valve with the same, or larger, thread size as the Control Unit inlet fitting shall be fitted externally.
.3 The tubing and fittings used must conform to 1.1.3 above.

.4 The following clauses from NFPA 496:2003 shall be observed:

4.4.1 The quality and contamination of the protective gas
4.4.1.2 Type of protective gas
4.4.2 Piping for the protective gas
4.4.3 Air compressor intake in a non-classified location
4.4.4 Compressor intake line requirements
4.4.5 Compressor power supply requirements

1.3 Provision and installation of Alarm devices

.1 Type XLC systems have a Minimum Pressure Sensor set to a pressure of at least 0.1" w.c. (0.25mb). When the PE pressure is above this set point the Sensor produces a positive "Pressurized" signal. This is displayed on a Red/Green indicator fitted on the Control Unit and can also be used to operate an electrical contact for a remote "Alarm". The pneumatic signal may be supplied, as an option

a) to an electrical pressure operated switch (Option Code /IS) suitable for an Intrinsically Safe circuit in accordance with Exloc Instruments drawing EXI-001-A
or
b) to a bulkhead fitting where it is available to the user (Option Code /PO). It can then be used to operate an external electrical switch either local e.g. explosionproof), or remote in a non-classified area.

When the enclosure pressure falls below the set point of the Sensor the "Pressurized" signal is removed, i.e. the absence of the signal indicates an "Alarm" ("Pressure Failure") condition. The user must make use of this external alarm facility in accordance with NFPA496: 2003 requirements IF the system "Alarm" indicator is not located in a place where it can be readily observed.

Example: The "Pressurized" signal can be used to produce an "Alarm" action by means of a conventional "pressure switch" set to operate at around 15psi (1 bar). The "Pressurized" signal from the Control Unit at 30psi (2 bar) or more will hold the switch in the operated position until the CU detects a low pressure in the Pressurized Enclosure and removes the "Pressurized" signal. The Alarm switch will reset and its contacts can be used to operate a remote electrical alarm.
If the switch is located in the hazardous area it must either be part of an Intrinsically Safe circuit, or be suitably protected e.g. explosionproof. The pressure switch should be IS or explosionproof even if it is fitted within the Pressurized Enclosure.

The Alarm switch can also be located in a nearby non-classified location. To get the best response time the switch should be as close as possible to the CU and the maximum length of tubing between the CU and the Alarm switch should not exceed 150 feet (30m) unless "Quick Exhaust Valves" are used (please ask for help). See clauses:

4.10.1 Cut off the power automatically for 'X 'Purge
4-8.4 If an indicator is used...

.2 No valves may be fitted between the Control Unit and the alarm switch.

1.4 Power supplies and their isolation

.1 All power entering the PE shall be provided with a means of isolation. This requirement also applies to any external power sources which are connected to "dry contacts" or "volt-free contacts" within the PE.

Exception: Power to Intrinsically Safe, or other apparatus which is already suitable for the location need not be isolated by the Purge system.

Tip: It is much better to fit dry or volt-free contacts in the non-classified area or inside an explosionproof box rather than inside the PE. Please ask Exloc Instruments about ""X" Purge Interface Units" (XIU).

In the case of "X" Pressurization, the isolation of the power must be controlled by the Control Unit using the "Purge Complete" pneumatic signal to operate a "Power Switch" in a similar manner to that described in 1.3.1 above.

.2 The electrical installation shall conform to the local codes and the following clauses from NFPA496: 2003

4.4.6 Power supplies for "double pressurized" installations
4.10.1 Power Cutoff Switch to de-energize all circuits not approved for Division 1 on failure of the protective gas supply.
Exception: The power may remain connected for a short period if immediate cutoff could result in a more hazard ous condition and if audible and visual alarms are provided in a constantly attended location.

.3 Type 1XLC, 2XLC and 3XLC systems can be retrofitted in the field by the user to have an "Alarm Only" action on pressure or flow failure. It is then the responsibility of the user to de-energize the protected equipment as soon as possible.

.4 The Power (cutoff) Switch must be approved for the location or located in a non-classified area.

.5 No valves are permitted between the Power switch and the Control Unit.

.6 For “X” Pressurization, the PE door shall have fasteners that can be opened only by the use of a tool or key. Otherwise the following clauses from NFPA 496:2003 apply:

5.5.2 Door switch interlock
5.5.2.1 Approved for Division 1

1.5 Marking

.1 All Exloc Instruments purging system carry a nameplate giving specification data such as serial and models numbers, Pressure Sensor settings, flow rates and purge time. The same data is also given in the specification sheet accompanying the system.

.2 Other marking required by the standard includes:

4.11.1 Pressurized Enclosure
“WARNING - PRESSURIZED ENCLOSURE
This enclosure shall not be opened unless the area is known to be free of flammable materials or unless all de vices within have been de-energized”
5.3.1 Start-up Markings
“Power shall not be restored after the enclosure has been opened until the enclosure has been purged for___ minutes at a flow rate of___.”

Exloc Instruments Note: It is understood that Clause 4.11.1 requires the de-energization of all devices that are not suitable for the hazard e.g. devices that are not Explosionproof or Intrinsically Safe. An explosionproof anti-condensation heater for example would not have to be de-energized.

.3 If Inert Gas is used as the Protective Gas and a risk of asphyxiation exists, a suitable warning plate should be fitted to the PE.

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Section 2 Operation of the system

2.1 Initial Commissioning

.1 Check that the system has been installed in accordance with Section 1 of this manual.

.2 Disconnect the supply pipe from the inlet to the Control Unit and blow air through for at least 5 seconds per foot of length (15sec/metre) to remove any debris, oil and condensation.

.3 Connect a temporary pressure gauge or liquid manometer to the PE or Control Unit “Pressure Test Point” on the L.P. sensor, by removing the Red plug in the fitting, – 5/32” (4mm) OD nylon tube.

2.2 Commissioning a Leakage Compensation (LC) “X” Purge system

On LC “X” Purge systems proceed as follows:

.1 Open the Leakage Compensation Valve (LCV) to about 50% of its travel.

.2 Open the supply shutoff valve SLOWLY and allow the PE pressure to rise until the Relief Valve (RLV) opens. Check that the RLV opens at or below the figure specified in the documentation. Repeat the test several times.

.3 Open the supply shutoff valve fully and the purging flow will start.

.4 Check that the internal logic gauge reads 30psi (2bar). If not, adjust the logic pressure regulator to suit (lift the red ring to unlock the knob first)

.5 At this time the “Pressurize” indicator should be Green and the “Purging” indicator should be Yellow. If the Yellow indicator remains Black the flow through the Relief Valve is below the minimum for which the Flow Sensor has been calibrated. Check the air supply pressure at the inlet to the Control Unit while purging is taking place. It must be above the minimum specified. 3XLC Purge system has a built-in gauge on the filter for this purpose.

.6 All XLC purge systems the purge timer will start as soon as the “Purging” indicator turns Yellow. Check that the time delay between the indicator turning Yellow and the application of power to the PE is not less than the minimum time required to purge the PE. Times in excess of the minimum are permitted and a tolerance of +20% is normally acceptable. If the time is too short it must be adjusted accordingly.
The system uses a pneumatic incremental timer which is adjusted by fully opening or closing one or more of five screwdriver-operated valves, arranged in a block on the control logic manifold – see GA Drawing. The opening of each valve incrementally provides a fixed number of minutes of purging time as in the following table

Valve:	1	2	3	4	5	Minutes:	2	4	8	8	16

Thus for a 12 minute purge time, valves 2 and 3 would be open and the others closed. For twenty-four minutes, 4 and 5 would be open and the others closed. **At least one valve must always be open and the screws must be at the appropriate limit of travel.**

.7 After the power has been turned on by the Control Unit, the Purging Valve will close and the air flow into the enclosure will be controlled by the Leakage Compensation valve (LCV). The initial setting of 50% open may be too high or too low. It should now be adjusted to set the PE pressure and leakage.
There are three possible situations:

a) Air continues to come out through the RLV Spark Arrestor after power has been turned on in considerable quantity. The LCV is open to far and the air flow is holding the RLV open continuously. Close the LCV slowly observing the manometer or gauge (see item 2.3 above). The PE pressure will start to fall as the flow decreases but eventually the RLV will close and the pressure rise again. At this point the Relief Valve may start to open intermittently as the PE pressure rises to the point where the RLV recloses and the enclosure pressure starts to rise again. This is entirely normal for this type of RLV. Proceed now to b) below:

b) If the Relief Valve is opening intermittently the LCV is open to far. Observe the manometer or gauge. When the RLV opens the enclosure pressure falls quickly to the point where the RLV recloses and the enclosure pressure starts to rise again. This is entirely normal for this type of RLV and shows that it is working correctly.

Then continue to close the LCV until the cycling stops and the enclosure pressure starts to fall. Carefully adjust the LCV until the PE pressure is approximately 50% of the RLV opening pressure and stable. This pressure may be around 2"w. c.(5mb) and will be the "normal working pressure".
We recommend that the setting of the Minimum Pressure Sensor is checked at this time. Note the position of the LCV knob. (A pencil mark placed on the knob at "12 o'clock" can be used). Slowly lower the PE pressure by closing the LCV further counting the number of turns from the "normal working pressure" position. Note the pressure at which the "Pressurized" indicator turns Red and check that it is not lower than the figure given in the documentation. Check also the "Alarm" electrical contacts (if fitted).

As soon as the "Pressurized" indicator turns Red, the enclosure power will be switched off (see also .8 below) and the system will start to repurge.

While it is re-purging return the LCV to its "Normal working pressure" position so that, at the end of purging the enclosure pressure should immediately settle down at the correct "normal" pressure. Finally re-adjust the LCV if necessary.

c) If, at the end of purging, the PE pressure falls below the Minimum Pressure Sensor setting the LCV is not open far enough. The system will start to purge again. While it is purging, open the LCV fully and check the enclosure for leakage. This time, at the end of purging, the enclosure should stay pressurized and the Relief Valve action be as in a) or b) above. It is likely that there is significant leakage from the enclosure and attempts to reduce the leakage will be time well spent.

.8 Some "X" Purge LC systems can have the "Action on Pressure Failure" (normally "Alarm and Trip") adjusted by the user to become "Alarm Only" in accordance with NFPA496 Clause 410.1, exception; please contact your Exloc Instruments Sales office for further details.

2.3 Normal operation

XLC purge systems: Turn the air supply valve On or Off to start or stop the system, After this the Pressurizing and Purging sequence is entirely automatic.

Section 3 Maintenance of the system

The maintenance recommended for the system consists of the following items, supplemented by any additional local requirements imposed by the authority having jurisdiction.

3.1 Commissioning

The tests to be performed during commissioning are described in Section 2 of this manual. They include checking the opening pressure of the Relief Valve, the setting of the Minimum Pressure Sensor, the "Normal Working Pressure" of the enclosure and, for "X" purge systems, the setting of the purge timer.

3.2 Routine maintenance

.1 Exloc recommend that the commissioning tests be performed again within six months. In addition the following checks are also recommended at that time:-

Check the RLV and any other Spark Arrestors.
Remove any debris or corrosion, or replace the Spark Arrestor with a spare.
Check the condition of the air supply filter element. Clean or replace it as necessary.

.2 At least every two years check the following additional items:

Apparatus is suitable for the Hazardous location
There are no unauthorised modifications
The source of air (purge medium) is uncontaminated
The interlocks and alarms function correctly
Approval labels are legible and undamaged
Adequate spares are carried
The action on pressure failure is correct

Section 4 Fault Finding – CF systems

4.1 General

If the system does not perform in the manner described above there is a fault. Some of the more likely faults are dealt with below. If a cure cannot be effected by following the procedure shown below please call Exloc Instruments or your supplier for further assistance.

The system has been designed for ease of fault finding and many of the components fitted are plug-in or sub-base mounted. Check components by substitution only after establishing that such action is necessary. If the system is less than 12 months old, parts under warranty should be returned to Exloc Instruments for investigation, with a full report of the fault and the system serial number. A "Returns Authorization Number" must be obtained before returning any unit.

NOTE: As with any pneumatic system the greatest enemies are water, oil and debris in the air supply but this is also true for the electrical components within the PE. For this reason a dust and water filter is always fitted. Debris can enter from other sources and it is vital that the procedures described in Section 2 is carried out before using the system for the first time, or following any disconnection of the pipework. Failure to perform this work may cause damage which will not be covered under warranty.

Fault Finding
NOTE: Before making the following checks verify that the main supply pressure is between 60 and 115 psi (4-8bar) at the Control Unit and, for X-Purge systems, the regulated pressure on the logic gauge is 30 psi (2 bar)

4.2 Minimum Pressure alarm is on continuously ("Pressurized" indicator is red)

Possible cause 1: The Pressurized Enclosure (PE) pressure is too low. Try increasing the setting of the Flow Control Valve (FCV) to raise the pressure in the PE.

Possible cause 2: Enclosure fault?
Is the ACTUAL PE pressure below the setting of the Minimum Pressure Sensor? Check it with a manometer or gauge.
Is there debris stuck on the face of the Relief Valve disk, perhaps held there because of the magnetic material?
Has the PE door been closed and all conduit/cable glands sealed?
Is the PE leaking too much?
Has the pressure sensing tube been damaged?

Possible cause 3: System fault?

If checks in (a) above reveal that the PE is correct, the fault probably lies in the Control Unit. The basic operation of the Minimum Pressure Sensor can be checked by unscrewing the 2.4" (60mm) diameter diaphragm and, by using a finger, block the threaded hole in the top of the valve module. The valve should operate and the indicator turns green. If this works correctly and the enclosure pressure is above the setting of the Minimum Pressure Sensor it is likely that the Pressure Sensor diaphragm needs recalibrating or replacing. (See below)

4.3 Relief Valve open (continuously or intermittently)

Possible cause 1: The PE pressure is too high.
The Leakage Compensation Valve (LCV) is open to far. Adjust the LCV as described in Section 2 above.

Possible cause 2: Debris on the RLV disk allowing air to leak from the valve. Remove the RLV cover and clean the valve disk. The disk and spring may be removed from the RLV without affecting the calibration.

4.4 System fails to switch power on after the purge time has elapsed?

Possible cause 1: Insufficient purging Flow due to inadequate air supply pressure. Check the air supply pressure at the inlet to the CU when flow is taking place. Excessive pressure drop in the supply pipe is a very common cause of this problem. The supply pipe must be at least as big as the CU inlet fitting, i.e. at least ½" NB (12mm).
The 3XLC Purge systems with ¾" or 1" connections must have AT LEAST this internal diameter for supply and outlet tubing. Due to the high flows demanded from these large systems the need for adequate supply tubing is VITAL. If in doubt, or for long distances, install tubing that is at least 50% larger than the inlet size!

Possible cause 2: Excessive Pressurized Enclosure (PE) leakage. Check around the PE when flow is taking place. Any significant leakage must be cured. Has a Leakage Test been done? The total leakage should not exceed 10% of the Purge Flow Sensor setting. Check for leakage down the conduit through unsealed stopping boxes.

Possible cause 3: PE not strong enough. Repeat the PE pressure test. FM recommend that the PE is tested to three times the Relief Valve opening pressure e.g. 12”wc (30mb) for many systems. Has this been done?

Possible cause 4: The tubing from the RLV Flow Sensing point to the Purge Flow Sensor is not air-tight e.g. fitting nuts not tightened or tube damaged. Check and repair as necessary.

Possible cause 5: The Purge Flow Sensor is not operating correctly or out of calibration. The basic operation of the Purge Flow Sensor can be checked by unscrewing the 2.4” (60mm) diameter diaphragm and by using a finger, block the threaded hole in the top of the valve module. The valve should operate and the indicator turn amber. If this works correctly and the flow through the Relief Valve is above the minimum required WITH THE RELIEF VALVE COVER FIRMLY SECURED IN PLACE the Sensor diaphragm needs recalibrating or replacing.

4.5 System fails to switch power on after the purge time has elapsed? (“X”-Purge systems only)

Possible cause 1: Is power available? Is the power disconnect closed? Are the fuses or circuit breaker OK?

Possible cause 2: System fault? Timer not timed out?

a) Has the “Purging” indicator been amber for the whole of the purge time?

Is the logic pressure gauge at 30psi (2bar) ±10%.

Check the small indicator on the timer valve. When the timer has timed out it should return out when depressed.
Is there pressure at the Power Switch output bulkhead and at the Power Switch itself? Is the Switch set at 15psi (1bar)? Is the pipe to the Power Switch airtight? The signal to the Power Switch bulkhead has a restrictor which limits the permissible leakage from the pipe.

Note the timer setting. Reset the timer to the minimum available purging period (see Para. 2.2.6) and check operation on that purge time. If it works OK, increase the time progressively until either it is correct, or the system ceases to time out at all. In the latter case, there is an air leak in the timer circuit. (A leak in the timing circuit can cause the timer not to time out.) If possible establish the source of the leak with soapy water and retest the system. This will involve removing the chassis from the control unit – be sure this is the cause before starting the work. It is VERY unusual!!

Ensure that the timer is returned to its original setting and the purge time checked before putting the system back into service.

Possible cause 3: Faulty Power Switch. Check the operation of the Power Switch. It should close above 20psi (1.4 bar).

4.6 Pressure Sensor calibration

If it is decided that the Minimum Pressure Sensor or Purge Flow Sensor needs recalibrating it can either be returned to Exloc Instruments for this service or it can be done by the user as follows:
Disconnect the pressure sensing pipe from the top of the diaphragm. (It is a “push-in” quick release fitting; firmly push inwards the collar surrounding the pipe where it enters the fitting, and then pull the pipe outwards while maintaining the pressure on the collar). Unscrew the 2.4” (60mm) diameter diaphragm housing from the top of the Sensor. Invert it and note the brass adjusting screw in the centre. Turning the screw inwards (clockwise) will lower the setting. It is likely that the screw will be very stiff due to the locking sealant. If the screw cannot be moved the application of gentle heat in the area of the brass screw can often help. DO NOT OVERHEAT!

4.7 Filter cleaning

If the filter element needs cleaning the transparent bowl can be unscrewed and removed. The filter element also unscrews and can then be cleaned in soapy water. Do not use solvents on any part of the filter assembly.
Exloc Instruments tip: It is sometime easier, if the bowl is very tight, to remove the filter by undoing the fitting that holds the filter into the Control Unit. It can help gain access by removing the Minimum Pressure Sensor diaphragm first.

Section 5 Annex of options fitted

Refer to the annex of this manual for any options fitted as designated by the model code of the system.

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