Exloc Instruments, Inc.

Installation, Operation and Maintenance Manual for Exloc Instruments Continuous Flow (Model CF) "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 RLVs incorporate a metal foam Spark Arrestor to prevent sparks being ejected from the PE through the RLV aperture. For Model CF systems the RLV can have the option code –CF (when a Continuous Flow calibrated orifice is built-in. The Relief Valve design is patented.

Many Exloc Type CF systems have a third item: a calibrated purge Outlet Orifice usually combined with a Spark Arrestor, Type SA or SAU.

Model CF Exloc systems are covered by this manual. They are described on the following paragraphs.

0.1 Continuous Flow systems, Model CF A "Continuous Flow" system (Model CF), as the name suggest, allows air to flow through the PE continuously by having a fixed outlet aperture which does not have any means of closure. The act of pressurizing the enclosure forces air to "leak" through the outlet aperture. The Control Unit admits sufficient air at the inlet to the PE to compensate for the air leaking out of the outlet aperture as well as from any other accidental leakage paths, even if the PE had no accidental leakage there would still be a flow from the outlet aperture.

A continuous flow of air can be necessary where the PE has equipment that needs cooling or where there is a possible source of release of flammable gas inside which will need dilution.

In addition to the normal Control Unit and Relief Valve a Continuous Flow system has the following item:

An **Outlet Orifice** which has been pre-calibrated so that the pressure drop at the desired flow rate is known. The Minimum Pressure Sensor within the Control Unit will be set to the same figure as the pressure drop. When the PE pressure exceeds the calibrated pressure the Continuous Flow must be taking place.

There are three ways of providing the calibrated Outlet Orifice in current production. Please consult the system specification sheet to determine which has been supplied. The choice:

Type SAU** where the Outlet Orifice disk is removable and can be easily changed by the user to give different flow rates according to the size of the Pressurized Enclosure and the available air supply capacity. (** denotes the metric thread size of the SAU body)

SA** where the orifice size is fixed, the way to change the flow rate is either to change the setting of the Minimum Pressure Sensor or to replace the SA with one of another size. (** denotes the nominal thread size of the SA body)

For low flow rates, the Outlet Orifice may be incorporated within the Relief Valve making use of the existing metal foam Spark Arrestor. The Relief Valve will then have a suffix /CF**, where ** is the orifice size in millimetres.
The flow rate is constant both during purging and thereafter. The purge time is based on the constant flow rate.
In a CF system the Relief Valve is fitted solely as a safety device and does not open in normal operation.

Section 1 Installation of the system

1.1 Installation of the Exloc Instruments CF System

.1 The Exloc 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 Exloc 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 to be allowed for purging using the Exloc system purging flow rate chosen. It is the user's responsibility to verify or enter this data on the PE and/or Exloc Instruments system name plate. Ask Exloc Instruments if in doubt.

Example calculations:

a) If the PE external dimensions give a volume of 10 cubic feet, and the PE is NOT a motor, multiply the volume by four to get the Purging Volume i.e. 40 cubic feet. Divide the Purging Volume by the purge rate e.g. 3.2 cubic feet per minute, and round up to the next even minute above, i.e. 13 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 26 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 Exloc purge system e.g. pressures, continuous flow (dilution) rate and type of protective gas are correct for the specific application.

.7 More than one PE can be protected by a single system. If PE's 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 Relief Valve may be fitted at any convenient location except where it has the option code /CF in which case it must be fitted on the last 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 system, a valve with the same, or larger, thread size as the inlet fitting shall be fitted externally.

.3 The tubing and fittings used must conform to 1.1.2 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 The Purge systems have a Minimum Pressure/Flow Sensor set to a pressure of at least 0.1" wc (0.25mb). (When supplied with an SAU the Pressure/Flow Sensor can be set to 1.0" wc (2.5nb), check the specification sheet). 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, either

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/Flow 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 Com plete" 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 NFPA 496:2003

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 Many Exloc CF "X-Purge" systems can be retrofitted in the field by the user to have an "Alarm Only" action on pressure or flow failure (additional /OA Kit). 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 system.

.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 The Exloc Instruments purge systems 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___min utes at a flow rate of___.”

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
.

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 – 5/32” (4mm) OD nylon tube].

2.2 Commissioning a Continuous Flow (CF) “X” Purge system

On CF “X” Purge systems proceed as follows:

.1 Open the supply shutoff valve. On “X” Purge systems check that the internal gauge reads 30psi (2bar).

.2 Adjust the Flow Control Valve (FCV) so that the enclosure pressure rises to the point where the “Pressurized” indicator turns green.

.3 Continue to raise the PE pressure until the Relief Valve (RLV) opens. Verify that the RLV opens at or below the figure specified in the documentation. Repeat the test several times.

.4 Lower the PE pressure until the “Pressurized” indicator turns red. Verify that the indicator turns red at or above the pressure specified in the documentation. Check the external alarm contacts (if fitted).

Note: On Exloc CF systems the Minimum Pressure Sensor set point may be significantly above the minimum of 0.1”wc (0.25mb) since it doubles as both a Pressure and Purge Flow Sensor. Set points of 1”wc (2.5mb) are common. Please check the documentation for the actual setting.

.5 Open the FCV again and set the PE pressure to a level somewhere between the Minimum Pressure Sensor set point and the RLV opening pressures. This “working” pressure is not critical. Enough pressure to keep the Pressurized indicator green is sufficient.

.6 On “X” Purge systems the purge timer will start as soon as the Pressurized indicator turns green. Check that the time delay between the indicator turning green 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 Once the purge time has completed the “Purge Complete” indicator turns Green. With both indicators Green, the power has been turned on by the Control Unit, using the FCV reduce the PE pressure to the point where both indicator turn Red and check that the power is automatically turned off. When the PE pressure is restored the system should repurge the PE before power is once again turned on.

.8 Some “X” Purge CF systems can have the “Action on Pressure Failure” (normally “Alarm and Trip”) adjusted by the user to become “Alarm Only” (additional /OA Kit) in accordance with *NFPA496 Clause 4.-10.1, exception;* please contact your Exloc Instruments Sales office for further details.

2.3 Normal operation

“X” 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 the Outlet Orifice (if separate from the RLV) fitted correctly?
Is debris stuck on the face of the Relief Valve disk, holding the valve open?
Has the PE door been closed and all conduit/cable glands sealed?

Possible cause 3: 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 1⁄2" NB.

Possible cause 4: 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 Continuous Flow rate.

Possible cause 5: 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 6: System fault?
Has the pressure sensing tube been damaged?
If checks 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 turn 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)

Cause 1: The PE pressure is too high. The Flow Control Valve (FCV) is open to far. Adjust the FCV as described in Section 2 above.

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: 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 “Purge Complete” indicator turned Green after the purge time?
b) Is the logic pressure gauge at 30 psi (-0, +10%)
c) Check the small indicator on the timer valve. When the timer has timed out it should return out when depressed.
d) Is there pressure at the Power Switch output bulkhead and at the Power Switch itself? Is the Switch set at 15psi?
e) 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.
f) Note the timer setting and reset the timer to the minimum available purging period. If it works OK, gradually increase the time until either the time is correct, or it 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 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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