IONPURE®

LX-HI
CEDI Modules

Operation & Maintenance Manual

IP-LX3HIMAN
June, 2014
Revision H

Manual Covers Part#:

IP-LXM04HI-3
IP-LXM10HI-3
IP-LXM18HI-3
IP-LXM24HI-3
IP-LXM30HI-3
IP-LXM45HI-3

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The operation and maintenance manual should provide complete and accurate information to meet your operating and/or service requirements based on the information available at the time of publication.

The information in this manual may not cover all operating details or variations or provide for all conditions in connection with installation, operation and maintenance. Should questions arise which are not answered specifically in this manual, contact your water system supplier.

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MANUAL USER'S GUIDE

This manual describes the procedures necessary to install, operate, and maintain your IONPURE Continuous Electrodeionization modules. Please read this manual carefully before installing and operating your modules. The module warranty may be voided if installation or operation instructions are not followed correctly.

Notes, Warnings, Cautions are used to attract attention to essential or critical information in a manual. Warnings and Cautions will appear before the text associated with them, and notes can appear either before or after associated text.

NOTE: *Notes are used to add information, state exceptions, and point out areas that may be of greater interest or importance.*

Cautions indicate a situation that may cause damage or destruction of equipment or may pose a long term health hazard.

Warnings indicate condition, practices, or procedures which must be observed to avoid personal injury or fatalities.

IONPURE continually strives to provide safe, efficient, trouble-free equipment using the optimum technology for your application. If problems should develop, IONPURE's worldwide network of technical support will be available to provide assistance. For service, sales, parts, or additional manual copies, please visit the website: www.ionpure.com.

OPERATING MANUAL REVISION HISTORY

EVENT	DATE	DESCRIPTION
Original publication	June 2004	Operation and maintenance instructions
Rev A	October 2004	Modified flow rates for cleaning Section 4.0, Revised Appendix B
Rev B	January 2005	Changed torque sequence
Rev C	April 2005	Corrected Section 3.2.3 in torque sequence
Rev D	May 2005	Increased Concentrate flow rates for cleaning
Rev E	July 2005	Updated Table 2.1, 3.1 Added UNC, Update Figure 4.1, clarified text on “turning on power’
Rev F	Sept 2005	Corrected toll free number
Rev G	April 2014	Complete document update
Rev H	June 2014	Updated Layout & Elevation Drawing (pg 45), DC current requirement

1 Introduction

This section contains the following instructions:

- **LX module overview -** Brief introduction to components and models
- **Using this Manual -** How to use this Manual
- **Precautions -** Precautions to prevent personal injury or equipment damage during installation

1.1 LX Module Overview

LX Modules are designed to be installed in either single module or multiple module Continuous Deionization LX systems. Their compact state-of-the-art design assures ease of installation, maintenance, and service. The module sizes are designed in optimal flow configurations stated below to ensure cost effective water system integration.

Table 1-1: Model numbers and nominal flow rates.

Order Number	Model Number	Nominal Flow	Description
W3T17316	IP-LXM04HI-3	2 gpm [0.44 m^3/hr]	Single LX Type – 4 Cell
W3T17287	IP-LXM10HI-3	5 gpm [1.1 m^3/hr]	Single LX Type – 10 Cell
W3T17293	IP-LXM18HI-3	9 gpm [2.0 m^3/hr]	Single LX Type – 18 Cell
W3T17298	IP-LXM24HI-3	12.5 gpm [2.8 m^3/hr]	Single LX Type – 24 Cell
W3T17304	IP-LXM30HI-3	15 gpm [3.3 m^3/hr]	Single LX Type – 30 Cell
W3T226955	IP-LXM45HI-3	22.5 gpm [5.1 m^3/hr]	Single LX Type – 45 Cell

For more information on the LX module specifications and flow rates, see Appendix A of this Manual.

Figure 1-1 LX30 HI

1.2 Using this Manual

⚠CAUTION

Service technicians should review this manual prior to going to the site. It lists tools and materials needed to install the modules. It also outlines the site information required to prepare for installation.

NOTE: The warranty may be void if installation or operation instructions contained in this manual are not followed exactly.

This Manual describes the installation, operation, and routine maintenance of the LX-HI Series CEDI modules. It also contains information on basic troubleshooting. (See Section 4.5)

IONPURE strongly recommends all users read the entire contents of the manual. If the LX Series module is not operating properly after going through the basic troubleshooting exercises, contact your local service provider.

1.3 General Installation Precautions

⚠CAUTION

CHECK THE MODULE TORQUE.

THE NUTS ON THE THREADED TIE BARS MAY HAVE LOOSENED DURING SHIPMENT. THE PRESSURE FROM THE INCOMING WATER CAN CAUSE PERMANENT DAMAGE IF THE TORQUE IS NOT SET PROPERLY. (SEE SECTION 3.2)

BOLT TORQUE MUST BE CHECKED AND THE MODULE TIGHTENED AS REQUIRED BEFORE FLOWING WATER INTO THE MODULE. (REFER TO FIGURE 3-1 AND TABLE 3-1) TIGHTEN AS REQUIRED. NOT ALL MODULES WILL NEED TIGHTENING.

OPERATIONAL LOG SHEETS ARE NECESSARY TO ENSURE CONSISTENT OPERATION, DETERMINE CLEANING REGIMENS, TROUBLE SHOOTING, AND AS A REQUIREMENT FOR MODULE WARRANTY.

⚠CAUTION

DO NOT OPEN THE LX MODULE. OPENING THE MODULE WILL VOID THE WARRANTY AND DO IRREVERSIBLE DAMAGE

THE MODULE MUST BE OPERATED INSIDE ITS DESIGN SPECIFICATIONS FOR TEMPERATURE AND HUMIDITY. (SEE SECTION 2.4.1)

IMPORTANT - PIPE SECTIONS PREPARED FOR INSTALLATION MUST BE INSPECTED, AND BE FREE OF DEBRIS FROM STORAGE OR CUTTING TOOL PARTICLES. **THE FEED WATER SYSTEM SHOULD BE THOROUGHLY RINSED TO ENSURE THAT PARTICULATES AND CONSTRUCTION DEBRIS ARE REMOVED FROM THE FEED WATER SYSTEM**

LX MODULES HAVE NARROW FLOW DISTRIBUTION CHANNELS THAT CAN BECOME PLUGGED BY PARTICLES CAUSING PERMANENT DAMAGE. ALWAYS INSTALL PRESSURE GAUGES, SAMPLING PORTS, SENSORS, ETC. IN TEE FITTINGS. DO NOT DRILL OR TAP INTO PIPING. AFTER INSTALLING GAUGES, SAMPLING PORTS, SENSORS, ETC., ALWAYS FLUSH OUT THE PIPING TO REMOVE ANY DEBRIS BEFORE CONNECTING TO THE LX MODULE.

⚠WARNING

DURING OPERATION, THE ELECTRODE WIRING INSIDE THE MODULE JUNCTION BOXES ARE AT HIGH VOLTAGE AND PRESENT A SHOCK HAZARD.

BEFORE TOUCHING THE INSIDE OF THE JUNCTION BOX, CONFIRM THAT AC POWER HAS FIRST BEEN DISCONNECTED AND LOCKED OUT ACCORDING TO STANDARD LOCKOUT/TAGOUT PROCEDURES.

TO ELIMINATE THE POSSIBILITY OF ELECTRIC SHOCK, CONFIRM THAT ALL GROUND WIRES ARE PROPERLY CONNECTED.

THOROUGHLY READ ALL THE INFORMATION IN THIS MANUAL BEFORE OPERATING THE LX MODULE.

- Keep the top of the unit clear of tools, nuts, screws, etc. to prevent these items from damaging the unit.
- Installation of the LX module must be completed in accordance with the procedures outlined in this manual. If deviations from the prescribed procedures are deemed necessary to achieve the desired performance, consult your local Service Provider.

1.4 Operating Precautions

DO NOT APPLY POWER TO THE LX MODULE UNTIL PROPER FLOW AND PRESSURE HAVE FIRST BEEN CHECKED AND VERIFIED. Irreparable damage may result.

NEVER BLOCK OFF (DEAD-HEAD) ANY OF THE LX OUTLETS. Dead-heading the outlets can result in over-pressurization, leading to permanent damage.

Do not operate the module under conditions other than those stated in the module manual. The prescribed feed water and electrical requirements, and flow configurations, must be followed at all times. If the feed water quality or the product water requirements change, contact the IONPURE Technical Support department for assistance.

Once every six months:

- Make sure all wiring connections are tight
- Test safety interlocks such as flow switches or connections to upstream equipment

1.5 Shutdown Precautions

- Confirm that the pressure in the unit is relieved. All pressures inside the unit should be at atmospheric pressure. (i.e., all pressure gauges should read zero).
- For short shutdown periods of less than 1 week, the module should be valved off or plugged to ensure that module internals cannot dry out.
- For extended shutdowns longer than 1 week - Drain standing water and plug all inlets and outlets to ensure that module internals cannot dry out.

2 Pre-Installation Preparation & Requirements

This section contains the following pre-installation information:

- **Tools and equipment** - Tools and equipment needed to install the module
- **Module Inspection** - Inspecting the LX module for damage
- **Operating conditions** - Temperature range, space requirements, electrical connections, feed water specifications, plumbing and drain requirements

2.1 Tools and Equipment

- Dolly or fork lift for moving module into place
- Cords, cables or straps to secure to dolly or fork lift
- Wire cutters/strippers
- Adjustable torque wrench with 10-50 ft-lbs. (14-68 N-m) range, 3/8” (10 mm) drive
- 19 mm extra deep socket (IONPURE part number W2T210908)
- 19 mm open end wrench
- Screwdrivers (flat blade and Phillips head)

2.2 Electrical and Plumbing Supplies

The amounts, sizes, and types of these supplies will vary from site to site. Check before hand to determine the site needs.

- Conduit, wires and appropriate conduit connectors to run the DC power and ground from the DC power controller to the module. Size wire in accordance with local electrical code.
- Fittings to connect the 1 1/4” and 3/4” BSPM ports on the module to the module plumbing.

⚠WARNING **Grounding Module Piping** - To avoid the risk of electrical shock, some form of grounding must be used on any stream where the plumbing is stainless steel or if there are samples points or instrumentation in close proximity to the module. For sanitary applications, a grounding cap can be used, IONPURE part number W3T83436, which is actually a 3/4” TC cap with a welded stud to be wired to ground. For non-sanitary applications, a 1/4” SS threaded grounding rod can be used, IONPURE part number W2T211647 (see Figure 2-1).

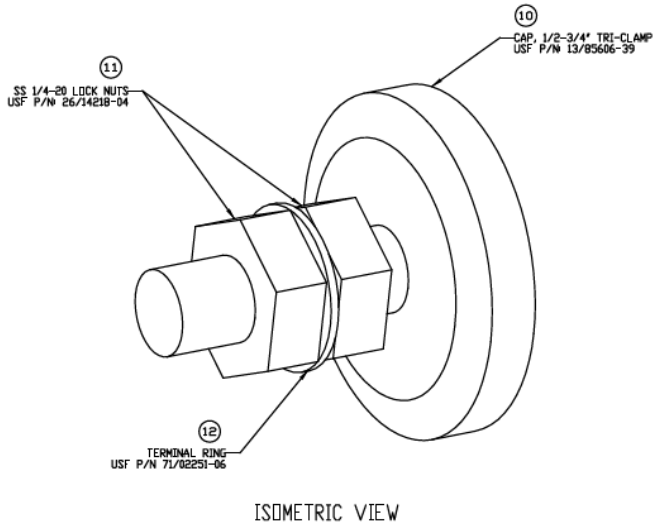


Figure 2-1 Grounding Rod (P/N W3T83436)

2.3 Inspect the Module

Do not uncrate the module prior to moving it into its final location. After uncrating the module, inspect it for any possible signs of damage. If damage is apparent, immediately notify your Local Service Provider and the carrier.

2.4 Operating Requirements

In order to operate to specification, LX modules must have the following conditions present. If any of these conditions are unmet, do not attempt to install LX modules without specific instructions from your Local Service Provider Technical Support.

2.4.1 Operating Environment

LX modules require indoor installation out of direct sunlight. The maximum ambient room temperature should not exceed 113 °F (45° C). The module can tolerate humidity of up to 90%, as long as condensation does not occur.

2.4.2 Space Requirements

- The physical dimensions of LX Modules are given in Appendix A.
- In addition to the size of the module itself, the arrangement of the piping and electrical connections determines the amount of space the module needs to operate. This arrangement varies from site to site, depending on the conditions at a particular location.

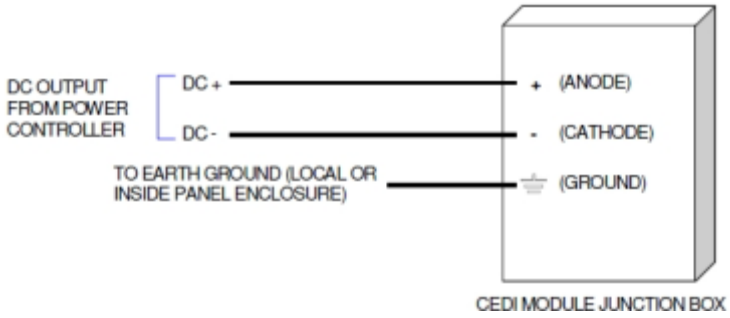
2.4.3 Electrical Requirements

- Power requirements for the LX modules are listed in Table 2-1
    - Connections using Ionpure® power controller are shown in Figure 2-2 and Appendix B.
    - If using third party power supplies ensure that the local earth ground and cathode are at the same electrical potential to ensure safe operation and avoid electrode corrosion. Contact Ionpure technical support for additional questions.

Table 2-1 LX Series Power Requirements

2009 - NEW POWER GUIDELINES – Tech Bulletin 2009-01					
Module Type	**No. Cells**	**Electrode pairs**	**Max VDC/cell**	**Design DC volts**	**Design DC Amps**
LXM4HI-3	4	1	13.3	53	10
LXM10HI-3	10	1	13.3	133	10
LXM18HI-3	18	1	13.3	240	10
LXM24HI-3	24	1	13.3	320	10
LXM30HI-3	30	1	13.3	400	10
LXM45HI-3	45	1	13.3	600	10

Figure 2-2 Module wiring to Ionpure power controller



2.4.4 Feed Water Requirements – RO Permeate

Feed water for LX modules must always meet the specifications outlined in Table 2-2 below. In most cases, pre-treating LX modules feed water with reverse osmosis (RO) will bring it within these specifications. Depending on the conditions, however, some sites may require additional pretreatment. To determine if additional pretreatment is required, compare the LX feed water (RO Permeate) on site with the feed water requirements listed below.

Table 2-2 Feed Water Specifications

Feed water source	**RO permeate**
Feed water conductivity equivalent including CO2 *	< 40 µS/cm
Silica (SiO2)	< 1 ppm
Iron, Manganese, Sulfide	< 0.01 ppm
Total chlorine	< 0.02 ppm as Cl2
Total Hardness	< 1.0 ppm as CaCO3
Dissolved organics (TOC)	< 0.5 ppm
Operating pH range	4 – 11
Continuous Operating Temperature	41 - 140 °F (5 – 60 °C)
Inlet pressure	<100 psi (7 bar)

Note: Recycling the LX reject to the RO feed will cause the CO_2 load on the LX to increase, and may have an impact on the LX product water quality. Please refer to Ionpure.com for additional reject stream system design guidance including the following paper from Jonathan Wood and Joe Gifford: "*Process and System Design for Reliable Operation of RO/CEDI Systems"*

2.4.5 Drain Requirements

Place the LX module(s) near a drain that can accommodate at least 100% of the total feed flow.

2.5 Flow Rates and Pressure Drops

See Appendix A

3 LX Module Installation & Operation

This section contains the following installation information:

- **Moving and unpacking** - Moving the Module into place and unpacking it
- **Connecting the Module** - Connecting the plumbing and electrical.

3.1 Moving the LX Module into Place

Confirm that the pre-installation requirements outlined in Section 2 are met and the system is ready for LX Module installation.

- Remove shrink wrap (if applicable) and move the module to its operating location. Threaded holes (3/4 –10 UNC) are provided on each endplate to allow installation of eye bolts.
- Remove the plugs or caps that seal each of the inlet and outlet ports.

Use safe lifting practices when moving the module.

Failure to remove plugs can cause permanent damage to the modules.

3.2 Checking Module Torque

If the nuts on the threaded tie bars have loosened during shipment, the pressure from the incoming water can cause permanent damage. Therefore the bolt torque must be checked and the module tightened as required before flowing water into the module. (Refer to Figure 3-1 and Table 3-1) Re-torque as required. Not all modules will need re-torquing.

Always drain water from the LX module before tightening the endplate tie bar nuts. This relieves pressure in the module. Failure to do so can result in irreversible damage.

Do not open the LX Module. Opening the module will void the warranty and do irreversible damage.

Tightening End Plate Tie-bar Nuts

- **Sequence**: Figure 3-1 shows the sequence in which to re-torque the tie bars. In other words, start the torquing process with # 1, and finish with # 14.

- **Torque Specification**: Table 3-1 gives the finished torque specification for each tie-bar, as numbered in Figure 3-1.

Tighten the end plate tie-bar nuts on the LX Module following these steps:

1. Using a 19 mm open ended wrench, hold the acorn nuts on the plumbing (cathode) end of the module.

2. Set the torque wrench to 10 ft-lbs. Using the 19 mm extra deep socket (IONPURE part number W2T210908) mounted on the torque wrench and turn all 14 tie-bar hex nuts (anode end) to 10 ft-lbs following the sequence in Fig. 3-1.

3. Re-set the torque wrench to 12.5 ft-lbs and tighten positions 1-8 and 11-14 to this specification.

4. Re-set the torque wrench to 25 ft-lbs and tighten positions 1-8 to this specification.

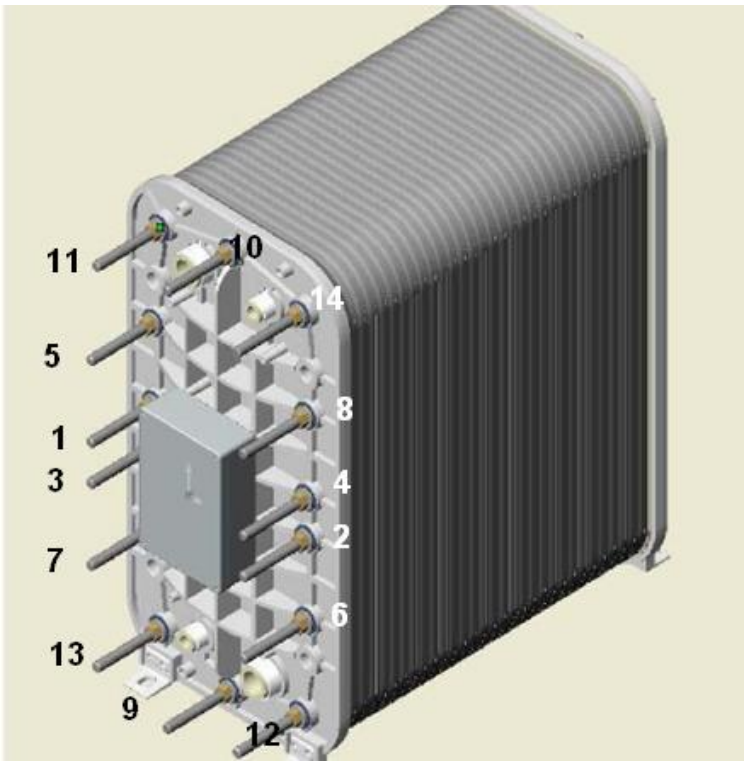


Figure 3-1 Module Tightening Sequence

5. Confirm that 11-14 are still at 12.5 ft-lbs and 9 &10 are still at 10 ft-lbs. If not, re-tighten. Use caution to avoid over tightening. Do not exceed torque specified in Table 3-1.

Table 3-1 Tie bar torque specifications

Tie-bars	Torque
1-8	25 ft. lbs.
11-14	12.5 ft. lbs.
9 &10	10 ft. lbs.

3.3 Connect Plumbing Fittings

CAUTION

Pre-Flushing - **Make sure all upstream pretreatment equipment and piping have been thoroughly flushed with particle-free water before connecting them to the LX Module**. Flushing removes any particles left in the piping from cutting and assembly. If particles remain, they could plug the small internal passages inside the LX Module.

NOTE – Failure to properly flush pretreatment water system of installation debris to drain prior to flowing water to the CEDI can result in particulate fouling that may be irreversible.

The drawing in Appendix C shows the location and pipe sizes for plumbing connections to the module. The module pipe connections are male BSP thread and are designed to seal against the flat gasket. Do not use Teflon tape or other sealant on these ports.

Sealing Mechanism - The seal is created by a compressing the flat gasket elastomer that has been over-molded onto the male BSM threaded connection ports. The threads are NOT TAPERED pipe threads and DO NOT CREATE the seal. The BSP parallel threads allow the sealing surfaces to move towards each other to effectively compress the elastomer.

Use of Sealants - DO NOT use Teflon® tape or any other pipe sealant (e.g. Dope) on the BSP thread adapters. The use of these products on the BSP thread adapter will prevent good sealing.

CAUTION

3.4 Electrical

3.4.1 Electrical Precautions

Do not run AC and DC wiring within the same conduit. This may cause interference and lead to malfunctions.

Disconnect power before opening any enclosure and follow acceptable Lockout/Tagout procedures when working on the system.

All wiring done in the field must conform to local electrical codes. Consult your local service provider if there is a conflict between the instructions in the manual and the local codes.

Loose wire connections can cause electrical arcing and must be avoided. Ensure that all terminal connections are properly tightened.

3.4.2 Electrical Connections

Run conduit and wires from the DC power supply to the terminal strip inside the anode or cathode junction box. (See drawing in Appendix B). There should be one lead for the anode (+), one lead for the cathode (-), and one for the ground (see Figure 2-2). Insure the DC wiring is correctly connected to the DC power supply and meets local electrical code. Incorrect polarity could cause permanent damage to the module.

Power connections to the module junction box should be made with 12AWG (3.31mm^2) wire.

Power connections from the modules should be connected to a suitable power supply capable of meeting the DC power requirements of the module. (See Table 2-1)

3.4.3 Determine Operating DC Current Prior to Startup

Test the LX feed water quality by running the RO system / CEDI feed water to drain and testing with the following individual test kits:

Table 3-2 Feed water test kits

Analyte	Hach Model	Smallest increment
CO_2	CA-23 (#143601)	1.25 mg/l
Cl_2	CN-70 (#1454200)	0.02 mg/l
Hardness	HA-71A (#145201)	1 mg/l
Silica	SI-7 (#2255000)	0.02 ppm

Set the electrical current at the specific setting required to meet product water quality specifications as estimated below.

The DC current set point is determined based on the following site conditions:

- Feed water conductivity in µS/cm.
- Feed water carbon dioxide concentration in ppm.
- Flow rate per module in liters/min.

Visit our Website at www.ionpure.com to download Startup Current Calculator. This program will calculate the necessary current setpoint based on the site conditions listed above. A manual determination can also be made using the procedure outlined below.

The following equation will calculate the current to be applied to one LX module. For multiple systems, each one should be controlled individually and set to this current.

Equation 3-1 Current calculation equation

To determine the current setting (amps), follow these steps:

a) Calculate **Feed Conductivity Equivalent (FCE)**

FCE = (measured conductivity) + (CO_2 ppm x 2.79)

b) Calculate Current (I)

$$I = \frac{(1.31)\ (Q \text{ liters/min})\ (FCE)}{(\text{dilute cells})\ (c.e)}$$

Where: Q = Product flow (liters/min) (See Appendix A)

FCE = Feed Conductivity Equivalent

I = Current (amps)

c.e.= %Current Efficiency (10 to 20 is typical)

dilute cells = number of product (dilute) compartment cells (LX4 has 4 product compartment cells, LX10 has 10 product compartment cells, LX30 has 30 product compartment cells, and LX45 has 45 product compartment cells)

Example - for one LX30:

Product Flow = 15 gpm = 56.8 liters/min

Dilute cells = 30 cells

Feed conductivity = 2.0 µS/cm

Feed carbon dioxide = 3.75 ppm CO_2

1. FCE = 2.0 + (3.75) (2.79) = 12.46
2. I = [(1.31) (56.8 lpm) (12.46 µS/cm)] / [(30cells) (20)] = 1.5 Amps

Example Above - SET THE CURRENT AT 1.5 AMPS

NOTE: The above calculations assume 20% current efficiency, which is suitable for many applications. However, certain applications, such as those requiring high silica removals, may require operating at 10% current efficiency, or two times the amperage calculated above. The modules should be set to operate with a constant current allowing the voltage to fluctuate with changes in temperature, flow, etc.

3.5 START-UP Procedure

- Test LX module feed water to ensure that feed water parameters are within the required ranges. The most common tests are listed in Table 3-2.
- Test flow switches and other interlocks, including the RO interlock. (if applicable)
- Test pressure relief. (if applicable)
- Set alarm points.

3.5.1 Start-up LX module

- Make sure that modules are correctly connected to the DC power source.
- Make sure that the LX product piping line is directed to drain.
- Turn on the feedwater. Adjust valves to obtain the desired flows and pressures in the product and reject streams. Standard LX reject flow is typically set at about 11% of the product flow (this gives a water recovery of 90%). See Section 3.6 on recovery, hardness, and silica for additional information regarding recovery. **Valves are adjusted so the product outlet pressure is about 2 to 5 psig higher than the reject (concentrate) outlet pressure at the desired flow rates. This pressure balance is critical to ensure optimal CEDI performance.**
- Adjust the DC power supply to the current setting calculated in Section 3.4.3. Or use the DC Startup Current Calculator available on Ionpure.com.
- Test all flow switches and interlocks to ensure LX DC power will shut off when flow is interrupted.
- Continue to direct the product water to drain until it reaches the desired quality.
- Once product reaches the desired quality, connect to process. Readjust pressures as required to maintain product (dilute) outlet pressure 2-5 psi above the reject (concentrate) outlet pressure. (See Appendix A)
- When the system is at steady state (water quality in specification and in stable operation), record operating data on the data sheet provided in Section 4.4.

3.6 Recovery, Silica and Hardness

LX recovery of 95% is limited to systems with feed water total hardness of less than or equal to 0.2 ppm as $CaCO_3$. Reduction of hardness is normally accomplished with ion-exchange

softening or with two-pass RO. In addition there is a minimum reject (concentrate) flow with requirements listed below in Table 3-3. Therefore, 95% recovery is not always attainable for less than nominal product flow rates.

For recovery of 90-95%, feed water silica must be ≤ 1 ppm as SiO_2

Table 3-3 Minimum Concentrate Flow Rates

Module Type	No. cells	Minimum Concentrate Flow Rate
LXM4HI-3	4	0.07 gpm [15.8 lph]
LXM10HI-3	10	0.16 gpm [36.3 lph]
LXM18HI-3	18	0.27 gpm [61.3 lph]
LXM24HI-3	24	0.36 gpm [81.7 lph]
LXM30HI-3	30	0.44 gpm [99.9 lph]
LXM45HI-3	45	0.66 gpm [149.9 lph]

NOTE: The concentrate flow rates per module should never drop below the recommendations in Table 3-3. Failure to maintain necessary concentrate (reject) flow rates can create improper flow distribution (channeling), decrease product quality and potentially permanently damage the CEDI module through overheating.

Equation 3-2 Recovery Equation

$$\%\,\text{Recovery} = \frac{\text{Product Flow Rate}}{\text{Feed Flow Rate}} \times 100 \qquad \text{Feed Flow Rate} = \frac{\text{Product Flow Rate}}{\%\,\text{Recovery}} \times 100$$

4 Maintenance and Troubleshooting

Read and understand the MSDS for all chemicals in this section.

The following section details the maintenance procedures for the LX module. It contains general maintenance information and specific maintenance information for cleaning and sanitizing the modules.

NOTE: The cleaning chemical volumes & flows detailed in this section are per a single module.

This section also lists possible problems and troubleshooting procedures for the LX module. All operators and personnel involved with the module should read and become familiar with all maintenance and troubleshooting procedures.

4.1 General Maintenance Guidelines

4.1.1 Operating Data Log Sheets

LX system log sheets should be filled out daily to provide early detection of problems that could jeopardize the warranty and potentially damage the module. A typical log sheet is included at the end of this section 4.1.1. Because instrumentation may vary depending on the type of system the module is installed into, this log sheet may not apply to your particular system. The system manual should contain log sheets more appropriate for your particular system. **However, the items in bold must be filled out to maintain module warranty.**

4.1.2 Periodic Maintenance

Perform the following tests at least once every six months. Check the Troubleshooting portion of this Section for any recommendations that are not listed below.

- Check for any water leakage from the module. If leakage is observed, see the Troubleshooting subsection for possible solutions.
- Closely inspect the module for any buildup of sodium chloride on the spacers, endblocks, or endplates. If sodium chloride buildup is apparent, turn off power and rinse sodium chloride from the module.
- Periodically tighten all electrical connections.
- Check torque on module bolts per section 3.2.

4.2 Specific Maintenance Guidelines

Periodically, the LX module may need cleaning or sanitization. Cleaning the module removes scale and other resin/membrane foulants.

Before starting any cleaning or sanitization procedure, see Section 4.3 for recommended cleaning solutions and use. Ensure that all necessary chemical material safety standards are followed.

Make sure that DC power is OFF before cleaning.
Do not run cleaning or sanitization solution through the LX modules when DC power is applied to the modules.

4.2.1 Cleaning Circumstances

The module may need CLEANING if:

- Product (dilute) differential pressure increases by 50% without a change in temperature and flow, or
- Reject (concentrate) differential pressure increases by 50% without a change in temperature and flow, or
- Product quality declines without a change in temperature, flow, or feed conductivity, or
- The module's electrical resistance increases by 50% without a change in temperature.

The above factors may indicate module fouling or scaling. Contact your Local Service Provider to determine if the module needs cleaning or for the best cleaning procedure. These operational circumstances can be noted through periodic reviews of module trends using the daily operational log sheets.

4.2.2 Sanitization Circumstances

The system may require periodic SANITIZATION if the product water calls for low levels of bacteria (a user specific requirement). Through the use of electrical current to drive ions into dilute and concentrating compartments, the CEDI module establishes a bacteriostatic environment that does not promote bacterial growth. However, high feed water bacterial counts may necessitate sanitization.

4.2.3 Required Cleaning and Sanitizing Equipment

⚠WARNING **The following cleaning equipment and descriptions must be constructed of materials compatible with the recommended cleaning solutions.**

During cleaning, the following equipment is required (See Figure 4.1):

Tank

Connect a 50-gallon (190-liter) or larger tank to LX system. The tank should be large enough to accommodate solution volumes as shown in this section. The cleaning solution will be prepared in this tank. It should be possible to completely drain the cleaning tank. Conical-bottom tanks are ideal.

Pump

Install a cleaning pump between the system and the cleaning tank. The pump must provide a minimum discharge pressure of at least 30 psig (2 bar) at the flow rate given in Table 4-1. The construction materials of the wetted surfaces in the pump must be compatible with the cleaning solutions. Plastics generally work well with most cleaning chemicals.

During cleaning or chemical sanitization, adjust flow rates as recommended in Table 4.1.

Filtration

Particulate filtration is required equipment on the cleaning skid to ensure that any solids or foulants that are removed from the LX module during cleaning or sanitization are not recycled back into the feed ports of the LX CEDI module. The internal LX cell distribution contains small channels and can become blocked if particulates are not removed from the cleaning/sanitization fluid. Ionpure recommends a polypropylene high quality 5 micron nominal (90% efficiency) depth filter cartridge for the cleaning skid arrangement. Filter materials must be compatible with the cleaning and sanitization fluids.

Table 4-1 Recommended Cleaning Flow Rates per LX Modules

LX Compartment	Flow Rates (gpm)					
	LX-4 HI	**LX-10 HI**	**LX-18 HI**	**LX-24 HI**	**LX-30 HI**	**LX-45 HI**
Product	2	5	9	12	15	22.5
Reject (Concentrate)	1	2.5	4.5	6	7.5	11.25
Pump Capacity	3	7.5	13.5	18	22.5	33.75
Use the highest flow rates possible up to the values above.						

Valves and Hoses

Figure 4-1 shows a typical flow diagram for cleaning or sanitizing a LX system. Valves are needed for mixing, cleaning, and draining the tank.

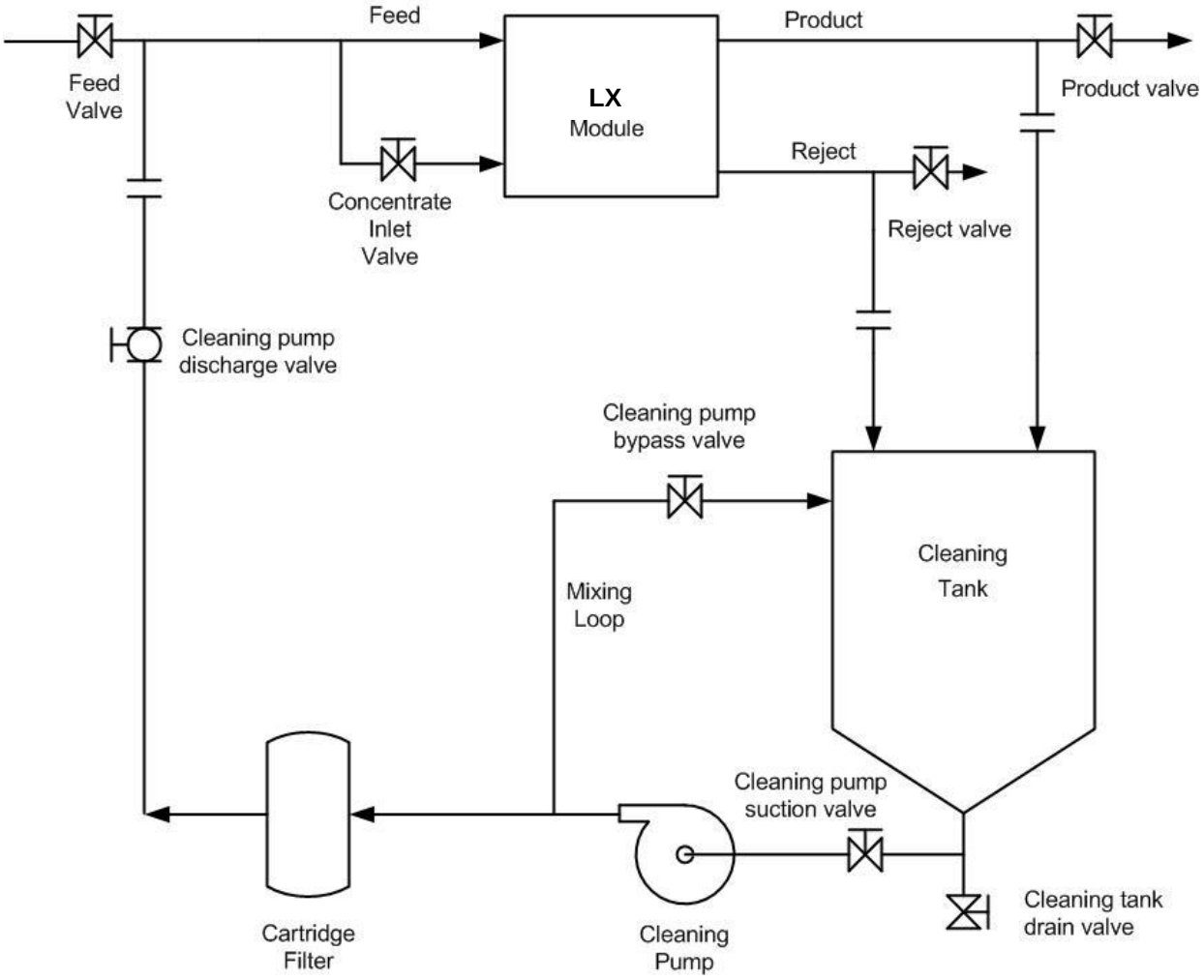
Flexible hose is ideal for connecting cleaning equipment to the system. Verify that the construction materials of the valves and hose are compatible with the cleaning solutions.

4.2.4 System Preparation for Cleaning or Sanitization

NOTE: The following cleaning procedures are based on the piping set up shown in Figure 4-1. If your piping setup is different, you may need to alter these procedures.

1. Turn off the DC power supply.
2. Close the following valves to the LX system: Feed valve and Product valve.
3. Connect the discharge of the cleaning pump to the LX feed CIP (Clean in Place) connection.
4. Connect the module's feed, reject and product CIP connections to the cleaning tank.
5. Verify that all piping connections are secure.
6. Close cleaning pump discharge valve until ready to pump the cleaning solution into the LX module.

Figure 4-1 Typical cleaning skid arrangement



4.3 Cleaning and Chemical Sanitization Procedures

⚠WARNING

1. Avoid direct skin contact with cleaning chemicals. Wear safety glasses and protective clothing.
2. Pressure test the cleaning skid with water before adding chemicals to the tank.
3. Flush all hoses and tank with clean water BEFORE adding chemicals.
4. To reduce the possibility of chemical sprays, relieve the pressure in chemical lines before disassembly.
5. Follow the manufacturer's chemical safety instructions on the container labels.
6. Check the pH level in any solution before letting it flow to the drain. Follow all local discharge limitations.

⚠CAUTION **Make sure the DC power is off before cleaning.** Do not run a cleaning solution through the system when DC power is applied to the module.

The system can be cleaned and sanitized with any of five (6) different solutions, depending on what needs to be removed:

- Hydrochloric acid (2%) – **For removing scale and metal oxides.**
- Sodium chloride/sodium hydroxide (5% brine/1% caustic) – **For removing organic foulants and biofilm.**
- Sodium percarbonate – **For removing organic foulants, reducing pressure drop, and sanitizing.**
- Peracetic Acid – **Used for routine sanitizing to discourage the growth of bacterial films.**
- Aggressive Multi-Agent cleaning **for Biofilm**– Recommended for general biofouling with increase in pressure drop. This aggressive cleaning protocol consists of 5% sodium chloride followed by a 2% sodium hydroxide and then followed by a 1% sodium percarbonate with a final 5% sodium chloride flush. The combination of these treatments performed sequentially has proven to be more effective than any single treatment performed separately.
- Aggressive Multi-Agent **cleaning for Fouling/scaling –** Recommended for fouling and scale remediation with drop in performance combined with increased electrical stack resistance. Aggressive sequential cleaning protocol of sodium chloride (5% sodium chloride) then followed by brine caustic (5% sodium chloride and 1% sodium hydroxide) intermediate sodium chloride flush (5% sodium chloride) and then followed by acid (2% hydrochloric acid). [see Service Bulletin 2007-02]. Extended soaking or increasing the acid concentration in the range from 2% - 4% HCl based on the severity of electrical stack resistance increase increases the benefits of this treatment.

NOTE: *If you are unsure whether the module is scaled or organically fouled, follow the multi-agent cleaning recommended above for fouling/scaling [service bulleting 2007-02].*

4.3.1 Cleaning with 2.0% Hydrochloric Acid (HCl)

⚠WARNING **Hydrochloric acid is a corrosive chemical. Wear safety glasses, gloves, and protective clothing when using this or any corrosive chemicals**.

Cleaning with Hydrochloric Acid involves three steps:

1. Hydrochloric acid treatment (2% HCl) followed by a,
2. Sodium chloride flush (5% NaCl), and then a
3. Water flush.

STEP 1: Recirculating The HCl Solution

NOTE: The quantities in Table 4-2 represents the minimum amount of HCl required. It may be necessary to use additional HCl to effectively clean a scaled Module. Monitor the pH of the solution during the recirculation period. If the pH begins to rise, add more HCl to maintain a pH of approximately 0.5.

Circulating HCl through the system removes scale and metal oxides from the module.

Table 4-2 HCl preparation

Chemicals necessary for Step 1 (2% HCl)	**LX-4 HI**	**LX-10 HI**	**LX-18 HI**	**LX-24 HI**	**LX-30 HI**	**LX-45 HI**
Water (RO permeate or CEDI prod)	6.5 gal (25 liters)	13 gal (50 liters)	20 gal (76 liters)	26 gal (100 liters)	33 gal (125 liters)	49 gal (185.5 liters)
36.5% Hydrochloric Acid (HCl)	0.28 gal (1.06 liters)	0.55 gal (2.15 liters)	0.9 gal (3.4 liters)	1.1 gal (4.2 liters)	1.4 gal (5.3 liters)	2.0 gal (7.6 liters)

NOTE: The following cleaning procedures are based on the piping setup shown in Figure 4-1.

1. Prepare the LX system for chemical cleaning. Follow the instructions in Section 4.2.4.
2. Make sure the tank drain valve is closed.
3. Fill the tank with the required amount of water.
4. Open the pump suction and pump bypass valves completely.
5. Start the cleaning pump.
6. Mix the required amount of 36.5% (concentrated) HCl with the water in the tank. **Note**: Additional HCl may be required during the recirculation period.
7. Allow tank to re-circulate until the chemicals are well mixed.
8. When chemicals are well mixed, gradually open the pump discharge valve while closing the pump bypass valve to adjust the product and reject flow rates to the values given in Table 4-1.
9. Re-circulate the solution through the module for at least 30 minutes. **Note:** Monitor the pH of the solution during the recirculation period. If the pH begins to rise, add more HCl to maintain a pH of approximately 0.5.
10. Turn off the cleaning pump.
11. Close discharge valve.
12. Check pH. Neutralize if necessary.
13. Drain the tank following all local limitations.

STEP 2: Sodium chloride Flush To Drain

This sodium chloride flush rinses the cleaning solution from the module, and returns the ion exchange resin to the sodium and chloride forms.

Chemicals necessary for Step 2 (5% NaCl)	**LX-4 HI**	**LX-10 HI**	**LX-18 HI**	**LX-24 HI**	**LX-30 HI**	**LX-45 HI**
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (136 liters)	47 gal (180 liters)	60 gal (227 liters)	90 gal (340.5 liters)
Sodium chloride (NaCl)	5 lbs (2.25 kg)	10 lbs (4.5 kg)	15 lbs (6.8 kg)	20 lbs (9 kg)	25 lbs (11.4 kg)	37.5 lbs (17 kg)

1. Remove product and reject outlet lines from the cleaning tank, and direct to drain.
2. Confirm the discharge and drain valves are closed.
3. Fill the tank with the water.
4. Completely open the pump suction valve and the by-pass valve.
5. Start the cleaning pump.
6. Slowly pour the sodium chloride (NaCl) in the water.
7. Allow to re-circulate until the sodium chloride is totally dissolved.
8. Open the discharge valve and close the bypass valve.
9. Flush through the module to drain for about three minutes.
10. Turn off the cleaning pump.
11. Close the discharge valve and open the drain valve.
12. Drain the tank following all local discharge limitations.

STEP 3: Water Flush To Drain

1. Confirm the pump discharge valve is closed.
2. Disconnect the cleaning equipment from the module.
3. Keep product and reject lines directed to drain.
4. Turn on the feed water supply to the system. Slowly open the feed valve to allow RO product water to flow through the module to drain.
5. After flushing all residual cleaning solutions from the system, follow the initial start-up procedures in Section 3.5 of this manual. **Start without the DC power applied to the LX module for five minutes** and then slowly ramp up to normal DC power.

4.3.2 Cleaning with 5% Brine/1% Caustic Solution

Sodium Hydroxide is a corrosive chemical. Wear safety glasses, gloves, and protective clothing when using this or any corrosive chemicals.

A 5% sodium chloride (NaCl)/1% sodium hydroxide (NaOH) solution works well for removing organic foulants from the module. Use this solution for both routine cleaning and removing organic foulants.

This procedure involves two steps:

Optional Initial sodium chloride flush. (Perform if module resin may contain hardness)
1. Brine/caustic cleaning.
2. Water flush.

STEP 1: Cleaning Solution Re-circulation

This step removes organic foulants from the module.

Table 4-3 Brine / Caustic Cleaning Chemicals

Chemicals necessary for Step 1- brine/caustic	**LX-4 HI**	**LX-10 HI**	**LX-18 HI**	**LX-24 HI**	**LX-30 HI**	**LX-45 HI**
Water (RO permeate or CEDI prod)	6.5 gal (25 liters)	13 gal (50 liters)	20 gal (75 liters)	26 gal (100 liters)	33 gal (125 liters)	45 gal (169 liters)
Sodium chloride (NaCl)	2.25 lbs (1 kg)	5.5 lbs (2.5 kg)	8.3 lbs (3.8 kg)	11 lbs (5 kg)	14 lbs (6.35 kg)	21 lbs (9.5 kg)
Sodium hydroxide (NaOH) pellets	0.55 lbs (0.25 kg)	1.1 lbs (0.5 kg)	1.7 lbs (0.75 kg)	2.2 lbs (1 kg)	2.75 lbs (1.25 kg)	4.13 lbs (169 kg)
OR 50% NaOH (Liquid)	0.09 gal (0.34 liters)	0.17 gal (0.65 liters)	0.26 gal (1.0 liter)	0.34 gal (1.29 liters)	0.43 gal (1.6 liters)	0.645 gal (2.44 liters)

NOTE: The following cleaning procedures are based on the piping setup shown in Figure 4-1.

1. Prepare the LX system for chemical cleaning. Follow the instructions in Section 4.2.4
2. Make sure the tank drain valve is closed.
3. Fill the tank with the required amount of water.
4. Open the cleaning pump bypass valve and suction valve completely.
5. Start the cleaning pump.
6. Slowly pour the specified amount of sodium chloride into the water.
7. Allow to re-circulate until fully dissolved.
8. Mix the specified amount of sodium hydroxide (NaOH) into the water.
9. Allow tank to re-circulate until fully dissolved.
10. When chemicals are well mixed, gradually open the cleaning pump discharge valve while closing the bypass valve, adjusting the product and reject flow rates to the values given in Table 4-1.
11. Re-circulate the solution through the module for 30-60 minutes.
12. Turn off the cleaning pump.
13. Close discharge valve.
14. Check pH. Neutralize if necessary. Drain the tank following all local discharge limitations.

STEP 2: Water Flush To Drain

This Step flushes the cleaning solution out of the system, and prepares the system for return to operation.

1. Remove product and reject lines from the cleaning tank and direct to drain.
2. Close the cleaning pump discharge valve.
3. Turn on the feed water supply to the system.
4. Slowly open the feed valve to allow RO product water to flow through the module to drain.
5. After flushing all residual cleaning solutions from the system disconnect the cleaning equipment.
6. Reconnect the module and follow the initial start-up procedures in Section 3.5 of this manual. **Start without the DC power applied to the LX module for five minutes** and then slowly ramp up DC power to normal levels.

4.3.3 Cleaning or Sanitizing with Sodium Percarbonate

WARNING **Sodium percarbonate, sodium carbonate, and hydrogen peroxide are corrosive chemicals. Avoid contact with these chemicals.**

CAUTION Do not use powdered sodium percarbonate. It may contain impurities that can harm the module.

Sodium percarbonate is a combination of sodium carbonate (soda ash) and hydrogen peroxide. It is an effective biocide and it reduces organic fouling and plugging. In addition, it is an effective cleaner for removal of biofilms.

- **Flush the LX module with a 5% Sodium Chloride (NaCl) solution both before and after sodium percarbonate sanitization. The initial NaCl rinse removes metal ions, particularly calcium and magnesium ions, from the module.**

The sanitization procedure using sodium percarbonate involves five steps:

1. An initial sodium chloride flush.
2. A water flush.
3. The percarbonate cleaning.
4. A second sodium chloride flush.
5. A final water flush.

STEP 1: Initial Sodium chloride Flush To Drain

This initial 5% NaCl rinse removes any metal ions, particularly calcium and magnesium ions, from the module.

Chemicals necessary for Step 1 (5% NaCl)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (135 liters)	47 gal (180 liters)	60 gal (225 liters)	90 gal (340 liters)
Sodium chloride (NaCl)	5 lbs (2.25 kg)	10 lbs (4.5 kg)	15 lbs (6.8 kg)	20 lbs (9 kg)	25 lbs (11.4 kg)	37.5 lbs (17 kg)

NOTE: The following cleaning procedures are based on the piping setup shown in Figure 4-1.

1. Prepare the LX system for chemical cleaning. Follow the instructions in Section 4.2.4.
2. Confirm the tank drain valve is closed.
3. Confirm the discharge valve is closed.
4. Fill the tank with the required amount of water.
5. Open the cleaning pump suction valve and bypass valve completely.
6. Turn on the cleaning pump.
7. Slowly pour the required amount of sodium chloride (NaCl) in the tank water.
8. Allow the tank to re-circulate until the sodium chloride is totally dissolved.
9. Divert the product and reject to drain
10. When chemicals are well mixed gradually open the cleaning pump discharge valve while closing the cleaning pump bypass valve to adjust the product and reject flow rates to the values given in Table 4-1.
11. Flush the sodium chloride solution through the module to drain for about 3 minutes.
12. Turn off the cleaning pump and close the discharge valve.
13. Drain the tank following all local discharge limitations.

STEP 2: Water Flush To Drain

Water flush rinses the sodium chloride solution from the module before cleaning solution is introduced.

Chemicals necessary for Step 2 (Water Flush)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (135 liters)	47 gal (180 liters)	60 gal (225 liters)	90 gal (335.5 liters)

1. Confirm the drain and discharge valves are closed.
2. Fill the tank with the required amount of water.
3. Open the discharge valve.
4. Start the cleaning pump and flush through the module to drain for about three minutes.
5. Turn off the cleaning pump.
6. Close the discharge valve.
7. Drain the tank.

STEP 3: Cleaning Solution Recirculation

This 1% sodium percarbonate step removes organics and biofilm.

Chemicals necessary for Step 3 (1% $2Na_2CO_3$ $3H_2O_2$):	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	6.5 gal (25 liters)	13 gal (50 liters)	20 gal (75 liters)	26 gal (100 liters)	39 gal (148 liters)	54 gal (200 liters)
100% Sodium carbonate (Na_2CO_3)	0.55 lbs (0.25 kg)	1.1 lbs (0.5 kg)	1.7 lbs (0.75 kg)	2.2 lbs (1 kg)	3.3 lbs (1.5 kg)	4.5 lbs (2 kg)
30% Hydrogen peroxide (H_2O_2)	0.15 gal (0.55 liters)	0.3 gal (1.1 liters)	0.44 gal (1.65 liters)	0.6 gal (2.2 liters)	0.9 gal (3.4 liters)	1.31 gal (4.5 liters)

1. Confirm the discharge and drain valves are closed.
2. Connect the product and reject lines to the cleaning tank.
3. Fill the tank with the required amount of water.
4. Open fully the pump suction valve and bypass valve.
5. Turn on the cleaning pump.
6. Slowly pour the sodium carbonate (Na2CO3) into the water.
7. Allow to re-circulate until the sodium carbonate is fully dissolved.
8. Slowly pour the 30% hydrogen peroxide (H2O2) into the solution in the tank.
9. When chemicals are well mixed gradually open the cleaning pump discharge valve while closing the bypass valve to adjust the product and reject flow rates to the values given in Table 4-1.
10. Re-circulate the solution through the module for 30 minutes. Some gas will be produced. In addition, the module pressure drop will increase during this procedure.
11. Turn off the cleaning pump.
12. Close the pump discharge valve.
13. Check pH. Neutralize if necessary. Drain the tank following all local discharge limitations.

STEP 4: Sodium chloride Flush To Drain

This sodium chloride flush rinses the cleaning solution from the module and returns the ion exchange resin to the sodium and chloride forms.

Chemicals necessary for Step 4 (5% NaCl)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (135 liters)	47 gal (180 liters)	60 gal (225 liters)	90 gal (335.5 liters)
Sodium chloride (NaCl)	5 lbs (2.25 kg)	10 lbs (4.5 kg)	15 lbs (6.8 kg)	20 lbs (9 kg)	25 lbs (11.4 kg)	37.5 lbs (17 kg)

1. Remove product and reject outlet lines from the cleaning tank and direct to drain.
2. Confirm the discharge and the drain valves are closed.
3. Fill the tank with the required amount of water.
4. Fully open the pump suction valve and the bypass valve.
5. Start the cleaning pump.
6. Slowly pour the required amount of sodium chloride (NaCl) in the water.
7. Allow the tank to re-circulate until the sodium chloride is fully dissolved.
8. Open the discharge valve while closing the bypass valve and flush through the module to drain for about three minutes.
9. Turn off the cleaning pump.
10. Close the discharge valve.
11. Drain the tank following all local discharge limitations.

STEP 5: Water Flush to Drain

This step flushes the cleaning solution out of the system, and prepares the system for return to operation.

1. Keep product and reject lines directed to drain and disconnect the cleaning equipment from the module.
2. Turn on the feed water supply to the system.
3. Slowly open the feed valve to allow RO product water to flow through the module to drain.
4. After flushing all residual cleaning solutions from the system, reconnect the output plumbing and then follow the initial start-up procedures in Section 3.5 of this manual. **Start without the DC power applied to the LX module for five minutes** and then slowly ramp up DC power to normal levels.

4.3.4 Cleaning or Sanitizing with Peracetic Acid

Peracetic Acid is a mixture of corrosive chemicals. Avoid contact with these chemicals.

Do not run a sanitization solution through the system while DC power is being applied to the LX module.

Flush the LX module with a 5% Sodium Chloride (NaCl) solution both *before* and *after* Peracetic Acid sanitization. The initial NaCl rinse removes any metal ions, particularly calcium, and magnesium ions from the module.

The sanitization procedure for Peracetic Acid involves five steps:

1. An initial sodium chloride flush
2. A water flush
3. The Peracetic Acid cleaning
4. A second sodium chloride flush
5. A final water flush

STEP 1: Initial Sodium chloride Flush To Drain

This initial 5% NaCl rinse removes any metal ions, particularly calcium and magnesium ions, from the module.

Chemicals necessary for Step 1 (5% NaCl)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (135 liters)	47 gal (180 liters)	60 gal (225 liters)	90 gal (335.5 liters)
Sodium chloride (NaCl)	5 lbs (2.25 kg)	10 lbs (4.5 kg)	15 lbs (6.8 kg)	20 lbs (9 kg)	25 lbs (11.4 kg)	37.5 lbs (17 kg)

NOTE: The following cleaning procedures are based on the piping setup shown in Figure 4-1.

1. Prepare the LX system for chemical cleaning following the instructions in Section 4.2.4.
2. Confirm the tank drain and discharge valves are closed.
3. Fill the tank with the required amount of water.
4. Fully open the pump suction and the bypass valves.
5. Start the cleaning pump.
6. Slowly pour the required amount of sodium chloride (NaCl) in the tank water.
7. Allow the tank to re-circulate until the sodium chloride is totally dissolved.
8. Divert the product and reject to drain
9. When chemicals are well mixed, gradually open the cleaning pump discharge valve while closing the bypass valve and adjust the product and reject flow rates to the values given in Section 4.2.3.
10. Flush the sodium chloride solution through the module to drain for about 3 minutes.
11. Turn off the cleaning pump.
12. Drain the tank following all local discharge limitations.

STEP 2: Water Flush To Drain

Water flush rinses the sodium chloride solution from the module before cleaning solution is introduced.

Chemicals necessary for Step 2 (Water Flush)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (135 liters)	47 gal (180 liters)	60 gal (225 liters)	90 gal (335.5 liters)

1. Confirm the discharge and drain valves are closed.
2. Fill the tank with the required amount of water.
3. Fully open the pump suction valve.
4. Start the cleaning pump.
5. Flush through the module to drain for about three minutes.
6. Turn off the cleaning pump.
7. Closed the discharge valve.
8. Drain the tank.

STEP 3: Sanitization Solution Recirculation and Soak

This step sanitizes the system.

Chemicals necessary for Step 3 (Peracetic Acid)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	6.5 gal (25 liters)	13 gal (50 liters)	20 gal (75 liters)	26 gal (100 liters)	33 gal (125 liters)	50 gal (190 liters)
Peracetic Acid Solution*	0.07 gal (0.25 liters)	0.13 gal (0.5 liters)	0.20 gal (0.75 liters)	0.26 gal (1 liter)	0.33 gal (1.25 liters)	0.5 gal (1.90 liters)
* Quantity based on a peracetic acid solution of 20% Hydrogen Peroxide with 4% peracetic acid. Do not exceed a final concentration of 0.2% peroxide and 0.04% peracetic acid						

1. Confirm the cleaning pump discharge and drain valves are closed..
2. Connect the product and reject lines to the cleaning tank.
3. Fill the tank with the required amount of water.
4. Fully open the pump suction and bypass valves.
5. Start the cleaning pump.
6. Slowly pour the peracetic acid solution into the tank.
7. Allow the tank to re-circulate until fully mixed.
8. When chemicals are well mixed, gradually open the cleaning pump discharge valve while closing the bypass valve and adjust the product and reject flow rates to the values given in Section 4.2.3.
9. Re-circulate the solution through the module for 30 minutes.
10. Turn off the cleaning pump.
11. Close the discharge valve.
12. Allow the system to soak in the peracetic acid solution for up to 90 minutes.
13. Check pH. Neutralize if necessary. Drain the tank following all local discharge limitations.

STEP 4: Sodium chloride Flush To Drain

This sodium chloride flush rinses the cleaning solution from the module, and returns the ion exchange resin to the sodium and chloride forms.

Chemicals necessary for Step 4 (5% NaCl)	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Water (RO permeate or CEDI prod)	12 gal (45 liters)	24 gal (90 liters)	36 gal (135 liters)	47 gal (180 liters)	60 gal (225 liters)	90 gal (335.5 liters)
Sodium chloride (NaCl)	5 lbs (2.25 kg)	10 lbs (4.5 kg)	15 lbs (6.8 kg)	20 lbs (9 kg)	25 lbs (11.4 kg)	37.5 lbs (17 kg)

1. Confirm the discharge and drain valves are closed.
2. Remove product and reject outlet lines from the cleaning tank and direct to drain.
3. Fill the tank with the required amount of water.
4. Fully open the pump suction and bypass valves.
5. Start the cleaning pump.
6. Slowly pour the sodium chloride (NaCl) into the water.
7. Allow the tank to re-circulate until the sodium chloride is fully dissolved.
8. Open the discharge valve and close the bypass valve.
9. Flush through the module to drain for about three minutes.

10. Turn off the cleaning pump.
11. Close the discharge valve.
12. Drain the tank following all local discharge limitations.

STEP 5: Water Flush to Drain

This step flushes the cleaning solution out of the system, and prepares the system for return to operation.

1. Confirm the discharge and drain valves are closed.
2. Keep product and reject lines directed to drain.
3. Disconnect the cleaning equipment from the module.
4. Turn on the feed water supply to the system.
5. Slowly open the feed valve to allow RO product water to flow through the module to drain.
6. After flushing all residual cleaning solutions from the system follow the initial start-up procedures in Section 3.5 of this manual. **Start without the DC power applied to the LX module for five minutes**, then turn on the DC power and slowly ramp up to normal operating voltage and amperage.

4.3.5 Cleaning and Sanitizing with Multiple Cleaning Agents

NOTE: This section contains an outline of the steps required to accomplish the multiple agent cleaning. All chemical makeup requirements and procedures for these steps are covered in prior cleaning regimen sections. Please refer to the prior sections for exact procedural requirements for each step described in this section.

Hydrochloric Acid, Sodium Hydroxide, Sodium Percarbonate and Hydrogen Peroxide are hazardous chemicals. Avoid contact with these chemicals.

Do not use powdered Sodium percarbonate.

4.3.5.1 FOR BIOFILM

NOTE: Use this cleaning method only if the module is heavily biofouled, not for routine sanitizing.

This multiple step cleaning procedure uses sodium chloride brine, caustic, and percarbonate cleaning steps for aggressive treatment of biofouled modules.

This multi-agent cleaning procedure involves 7 steps:

1. Sodium chloride flush
2. Water flush
3. 2% Caustic treatment
4. Water flush
5. Percarbonate treatment
6. Sodium chloride flush
7. Water flush

4.3.5.2 FOR HIGH ELECTRICAL RESISTANCE

This multiple step cleaning procedure uses sodium chloride brine, caustic, and hydrochloric acid cleaning steps for aggressive treatment of high resistance modules.

This multi-agent cleaning procedure involves 6 steps:

1. Sodium chloride flush
2. Brine/caustic or caustic only (extended time soak if desired)
3. Sodium chloride flush
4. Hydrochloric Acid
5. Sodium chloride flush
6. Final water flush

4.4 Hot Water Sanitization

It is important to maintain LX feed pressure below 30 psig during hot water sanitization to prevent module damage.

NOTE: During the hot water sanitization process the rapid heating and cooling process may produce intermittent sounds from the expansion and contraction process. This is normal and should not be of any concern for those present in the area.

This process consists of the following steps:

1. Introduce the water at sanitization temperature.
2. Temperature hold for one to two hours in 185 ± 9 ºF (85 ± 5 ºC) water.
3. Return to service.

Step 1: Hot water Introduction

NOTE: The following cleaning procedures are based on the piping setup shown in Figure 4.1. Many other sanitization configurations are possible. If uncertain about the suitability of a sanitization configuration, contact Ionpure Technical Support.

NOTE: With the LX-HI model it is not necessary to gradually heat up before or cool down after hot water sanitization.

1. Follow the instructions in section 4.2.4 to prepare the module for cleaning.
2. Confirm the drain valve is closed.
3. Confirm the discharge valve is closed.
4. Fill the tank with RO permeate or CEDI product water. Note: CEDI water is preferred to prevent CEDI module fouling and/or resin exhaustion.
5. Open the cleaning pump suction valve and the bypass valve completely.
6. Turn on the cleaning pump.
7. Slowly open the pump discharge valve. Adjust the bypass valve to maintain the system feed pressure below 30 psig. If there is no back pressure present, a sanitization pressure of 10-15 psi should be sufficient.
8. Turn on the hot water heater (not shown in Figure 4-1) and increase the water temperature to 185ºF ± 9ºF (85º± 5ºC). The water heater can be an electric immersion heater or a steam-driven heat exchanger.

Step 2: Temperature Hold

1. Maintain configuration described in the previous step.
2. Set the temperature control system to maintain water temperature of 185º ± 9ºF (85ºC ± 5ºC)
3. Continue re-circulation for 1-2 hours.

Step 3: Return to Service

1. Maintain configuration described in the previous step.
2. Turn off water heater and cleaning pump.
3. Close pump discharge valve.
4. Drain tank following all local discharge limitations.
5. Disconnect the cleaning system. Divert product and reject output lines to drain.
6. Without turning the DC power on, turn on the inlet water and flush through the module to drain for 5 to 10 minutes.
7. Adjust flows to normal operating values.
8. At the end of the flush period, return the power supply to normal operating DC current.
9. Monitor the product water quality. When the quality of the product water is within acceptable parameters, return the module to normal operating configuration.
10. Readjust flows and pressures as necessary.

4.5 Troubleshooting

The troubleshooting chart in this Section is a diagnostic guide. If the LX system does not respond to the recommended solutions, do not attempt further repairs. Call your Local Service Provider.

Before calling:

- Become thoroughly familiar with the module and all troubleshooting procedures.
- Prepare a list of all problems encountered while operating the equipment.
- Have your monitoring log sheets at hand.
- Have your module's model and serial numbers at hand. This information can be found on the end plate on the plumbing side (Cathode).

PROBLEM	CAUSE	SOLUTION
Module leaks	Module has loosened during shipment, movement, or operation	Tighten module; see section 3.2.
	Module is faulty	Contact your Local Service Provider
Plumbing leaks	Module adapters are loose	Tighten adapters, check gaskets
Poor water quality with power ON to unit	Operating current incorrectly set	Measure feed conductivity and CO2. Recalculate current according to Section 3.4.3 and adjust as necessary.
	Confirm correct DC polarity	Correct DC polarity (see Appendix B) Note: Incorrect polarity can permanently damage the module.
Loss of flow and/or increase in feed pressure	Module is fouled, scaled, or oxidized	See Troubleshooting chart at the end of this section.
	Obstruction downstream	Check if a downstream valve is inadvertently closed.
	System is plugged with particulate matter or fouled	See Troubleshooting Flow Chart at the end of this section.
	Loss of feed flow	1. Check if an upstream valve is inadvertently closed. 2. Check for leaks or if an upstream bypass valve is inadvertently open. 3. Check feed source output (for example, a pump).

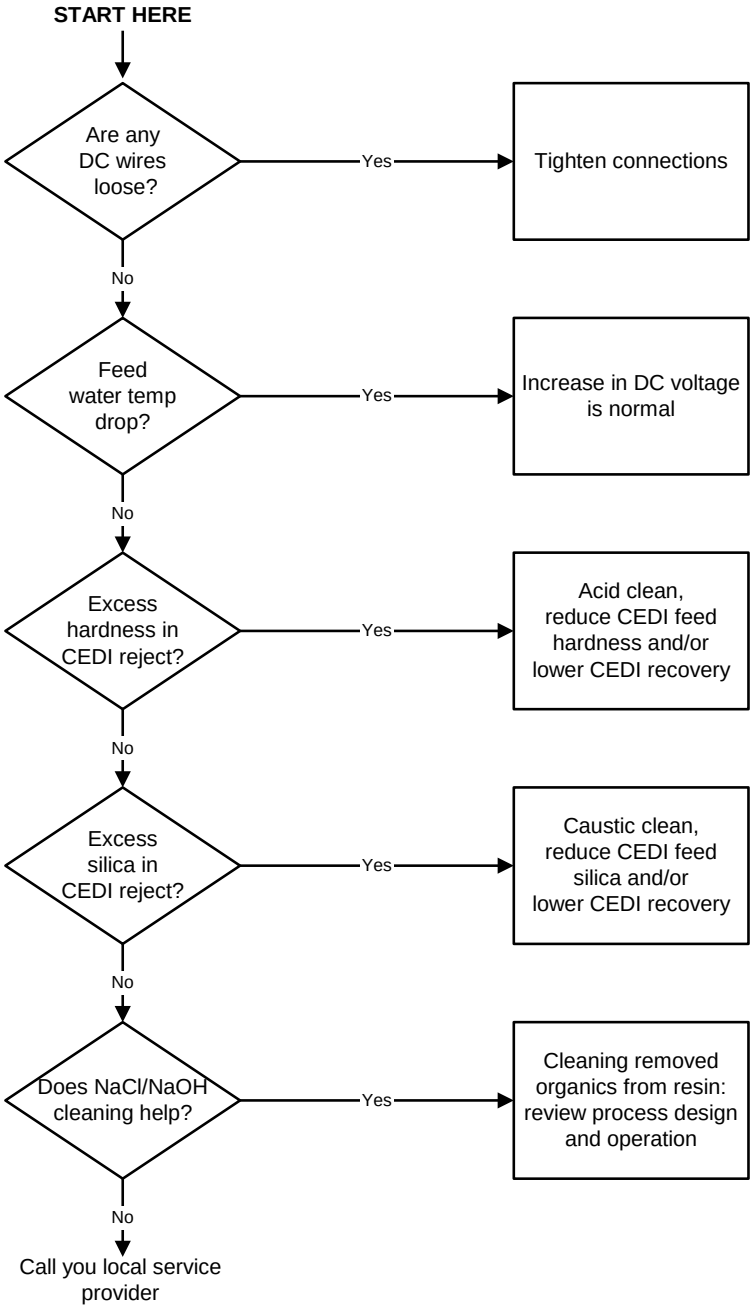
LX MODULE LOG SHEET

Customer Name: _____Module Serial Number: _____

DATE						
TIME OF DAY						
FEED WATER TEMPERATURE	°C					
FEED WATER TOTAL HARDNESS	ppm $CaCO_3$					
FEED WATER TOTAL CHLORINE	ppm as Cl_2					
FEED CARBON DIOXIDE	ppm as CO_2					
FEED CONDUCTIVITY	µmho/cm					
PRODUCT RESISTIVITY	Mohm-cm					
DC VOLTAGE	volts					
DC CURRENT	amps					
MODULE RESISTANCE (volts/amps)	ohms					
PRODUCT FLOW	gpm or m^3/h					
REJECT FLOW	gpm or m^3/h					
DILUTE INLET PRESSURE	psig or bar					
DILUTE OUTLET PRESSURE	psig or bar					
PRODUCT DP ($Dilute_{in}$ – $Dilute_{out}$)	psig or bar					
CONCENTRATE INLET PRESSURE	psig or bar					
CONCENTRATE OUTLET PRESSURE	psig or bar					
CONCENTRATE DP ($Conc_{in}$ - $Conc_{out}$)	psig or bar					
COMMENTS:						

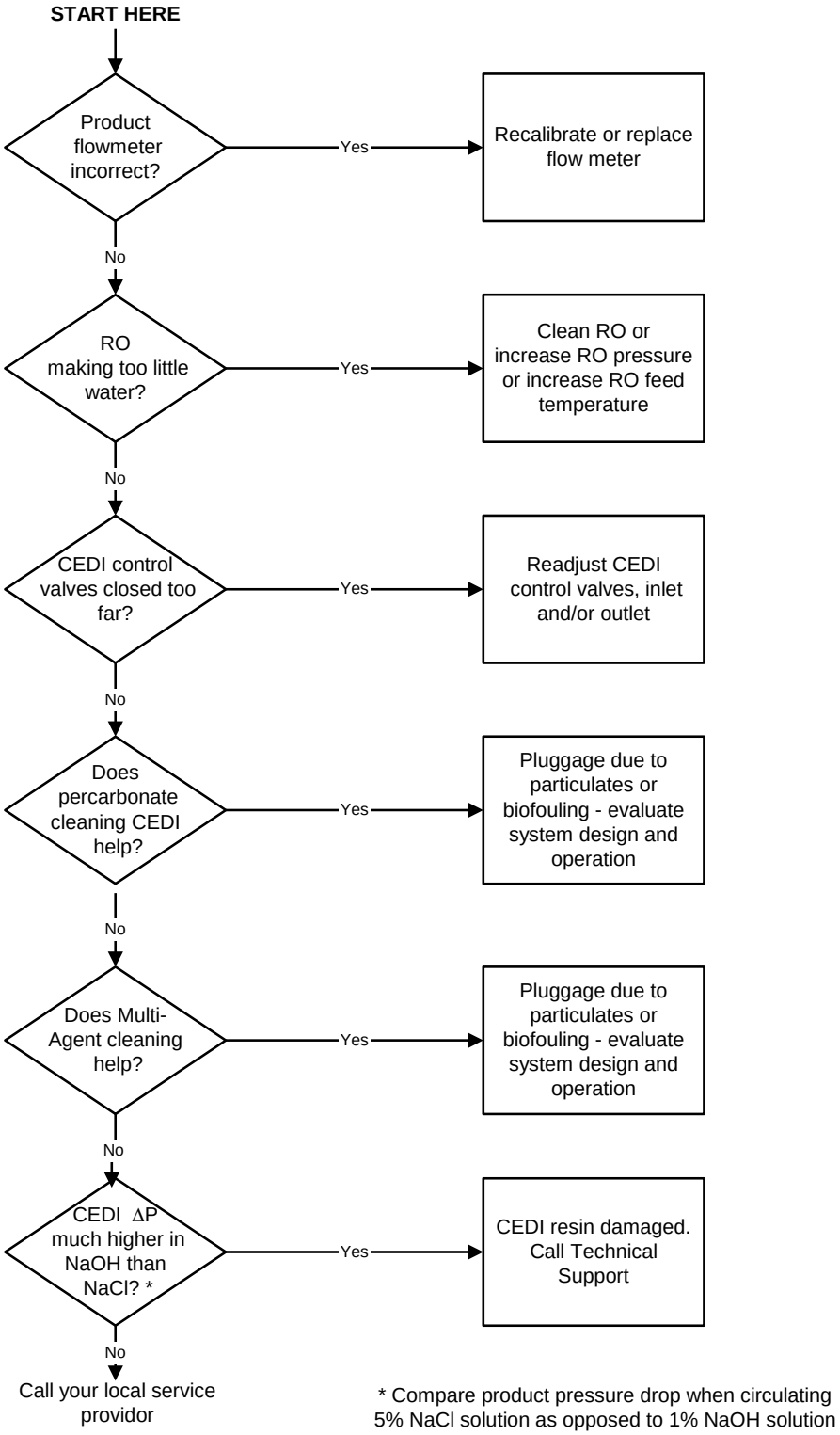
Troubleshooting Flow Chart - Increase in DC Volts

Page 1 of 1



Troubleshooting Flow Chart - Low CEDI Product or Reject Flow

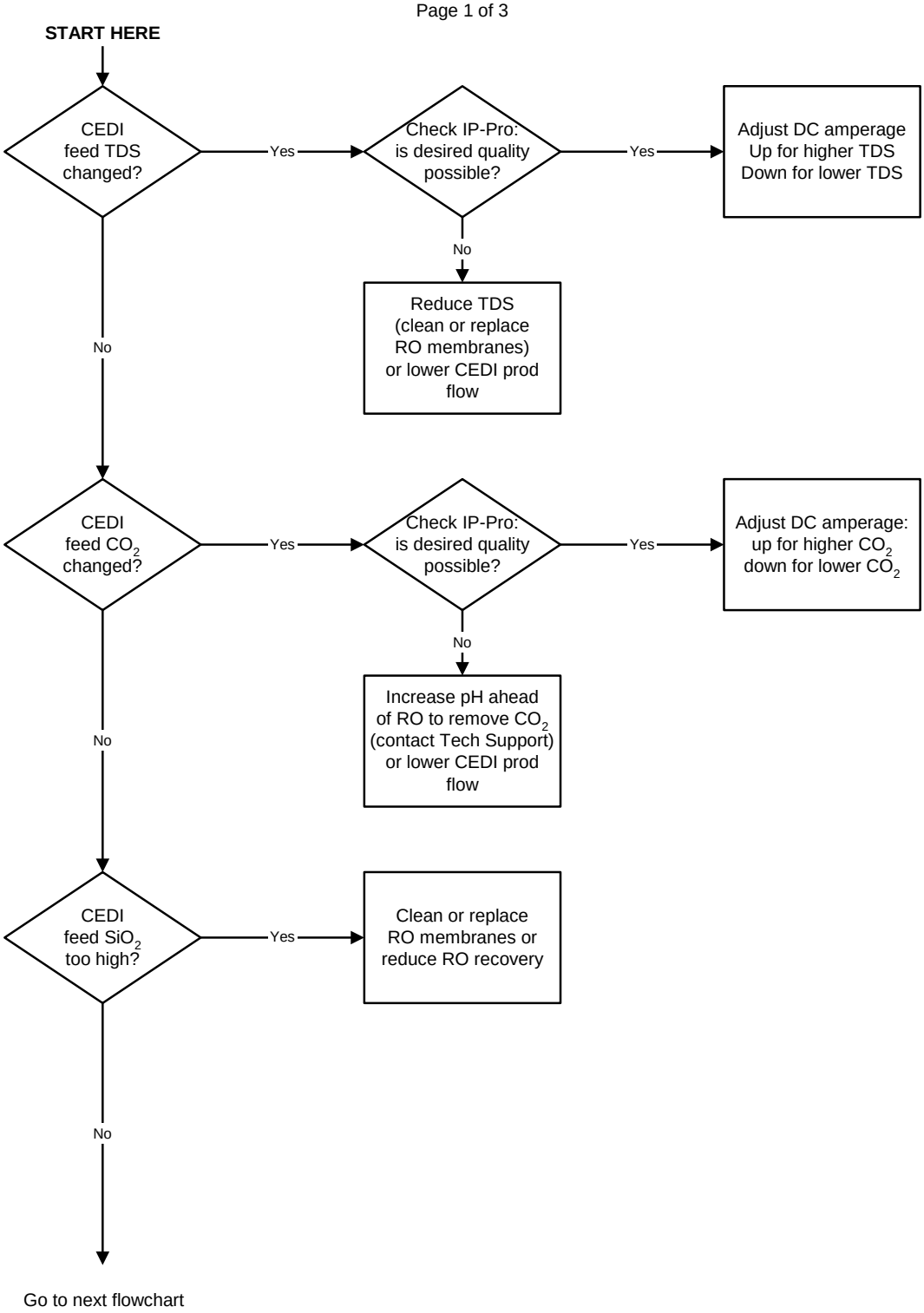
Page 1 of 1



* Compare product pressure drop when circulating 5% NaCl solution as opposed to 1% NaOH solution

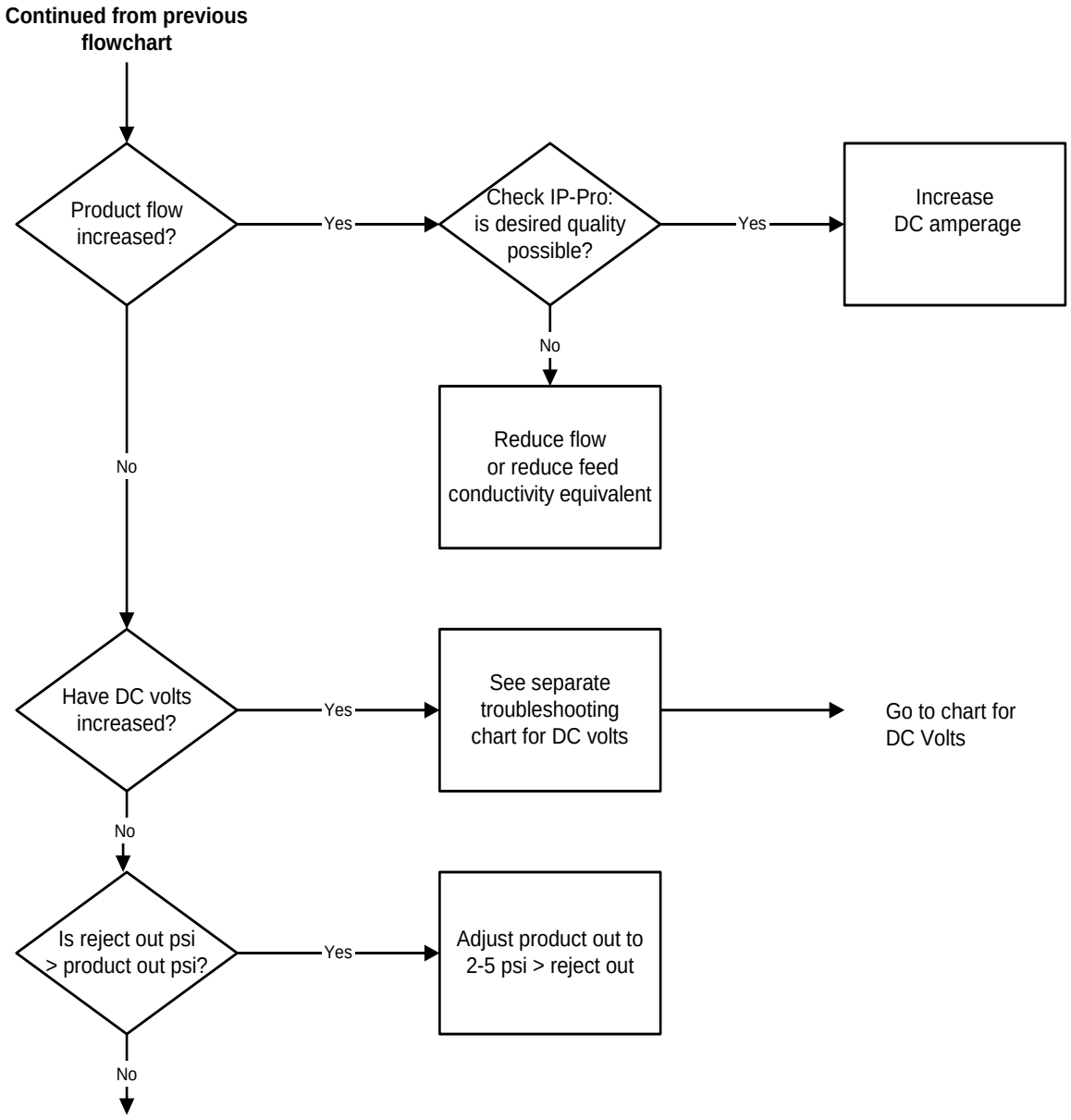
Troubleshooting Flow Chart - Low CEDI Product Water Quality

Page 1 of 3

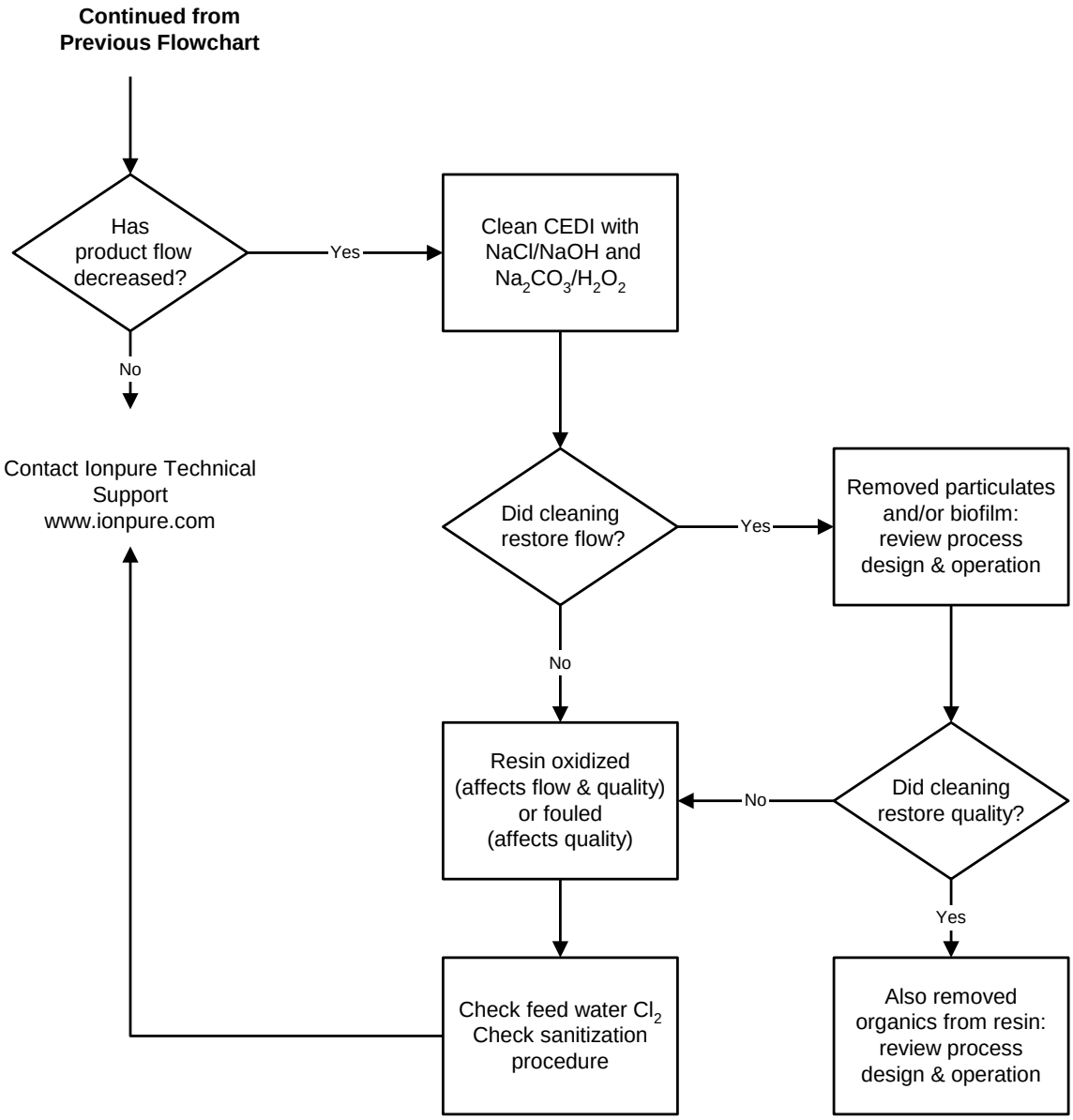


Troubleshooting Flow Chart - Low CEDI Product Water Quality

Page 2 of 3



Troubleshooting Flow Chart - Low CEDI Product Water Quality



5 Shutdown and Storage

This section contains shutdown procedures for LX modules. Under certain circumstances, bacterial growth can occur quickly in water left stagnant within each module and the overall system.

5.1 System Shutdown

- Shut off feed water to LX module(s).
- Drain standing water out of LX module(s) for shutdown periods exceeding 7 days.
- Close isolation valves to prevent evaporation of water in membranes and resins.

5.2 Startup after Shutdown

- Divert product outlet to drain.
- Turn on feed water to LX module(s).
- Operate unit with DC power on, flushing to drain.
- If desired, sanitize LX module(s).

5.3 Rebuild

- Modules can be returned to Ionpure for rebuild. Contact you OEM or Ionpure for options.

5.4 Disposal

- Perform a 5 minute flush with 5% NaCl solution.
- Flush the module(s) with tap water at minimum flow (with DC power off) for 2 hours.
- The module(s) can then be discarded as normal (non-hazardous) waste.

NOTE: For additional information on module recycling and disposal, please refer to our service bulletin **SB-2014-01_LX Module Recycling** available on ionpure.com

APPENDIX A: LX-HI Module Specifications

A. 1 Dimensions and Weight

Dimensions, Weight	LX-4 HI	LX-10 HI	LX-18 HI	LX-24 HI	LX-30 HI	LX-45 HI
Height:	23.8 in (60.5 cm)	23.8 in (60.5 cm)	23.8 in (60.5 cm)	23.8 in (60.5 cm)	23.8 in (60.5 cm)	23.8 in (60.5 cm)
Width:	12.6 in (32.0 cm)	12.6 in (32.0 cm)	12.6 in (32.0 cm)	12.6 in (32.0 cm)	12.6 in (32.0 cm)	12.6 in (32.0 cm)
Length (overall):	11.82 in (30.02 cm)	15.32 in (34.8 cm)	18.82 in (48.8 cm)	23.47 in (60.2 cm)	26.96 in (69.6 cm)	35.24 in (90.7 cm)
Length (from center of struts):	7.47 in (18.97 cm)	10.96 in (27.85 cm)	15.62 in (39.67 cm)	19.12 in (48.56 cm)	22.61 in (57.42 cm)	31.33 in (79.63 cm)
Weight (wet):	110 lb (50 kg)	150 lb (63.5 kg)	170 lb (81.6 kg)	200 lb (95.2 kg)	220 lb (109 kg)	270 lb (131.5 kg)

A. 2 LX-HI module inlet and outlet connections

Module Connections	Connection on modules
Dilute Inlet	1 1/4” BSP Male
Product (Dilute) Outlet	1 1/4” BSP Male
Concentrate Inlet	¾” BSP Male
Reject (concentrate) Outlet	¾” BSP Male

A. 3 LX-HI module product flow rates

FLOW	LX-4 HI gpm (m^3/hr)	LX-10 HI gpm (m^3/hr)	LX-18 HI gpm (m^3/hr)	LX-24 HI gpm (m^3/hr)	LX-30 HI gpm (m^3/hr)	LX-45 HI gpm (m^3/hr)
Minimum	1 (0.22)	2.5 (0.55)	4.5 (1.02)	6.3 (1.4)	7.5 (1.7)	11.3 (2.55)
Nominal	**2 (0.44)**	**5 (1.1)**	**9 (2.0)**	**12.5 (2.8)**	**15 (3.4)**	**22.5 (5.1)**
Maximum	3 (0.66)	7.5 (1.65)	13.5 (3.1)	18.8 (4.3)	22.5 (5.1)	33.8 (7.67)
Recovery	85-95% Recovery					

Note: 95% recovery requires two pass RO or ion exchange softening. See projection software on IP-PRO for application specific determinations available on Ionpure.com.

Note: Please refer to Section 3.6: Table 3-3 for minimum concentrate flow rates

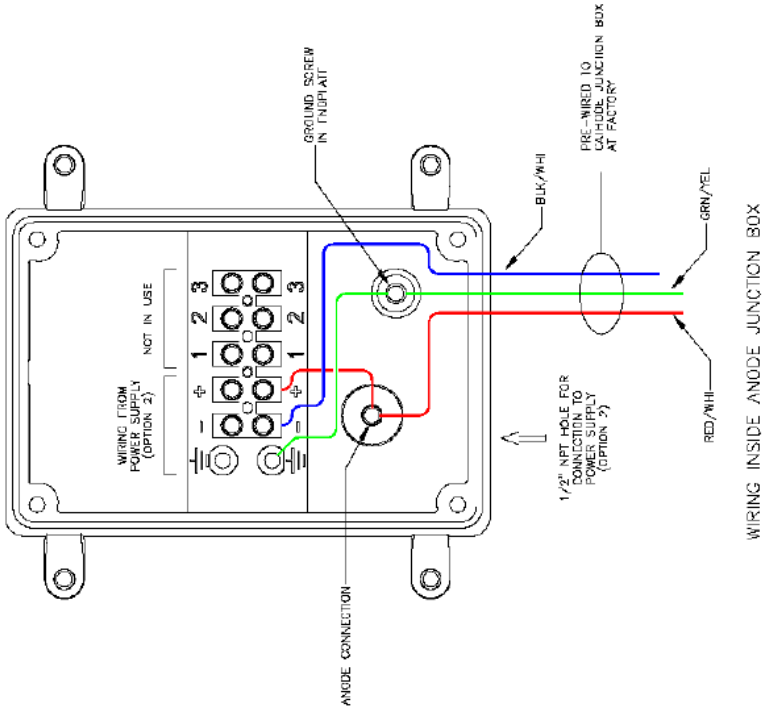
A. 4 Module pressure differential

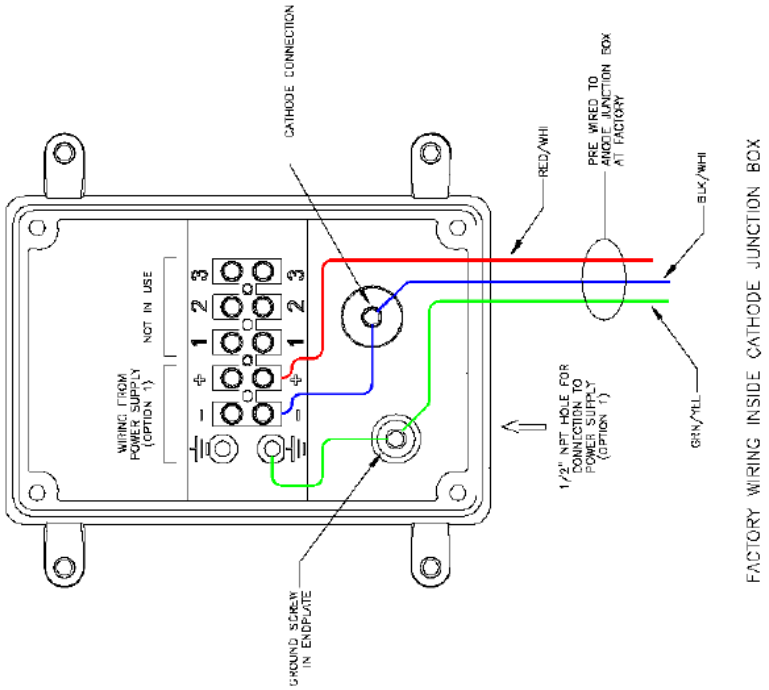
Pressure Differential (At nominal flow rates)	LX-HI PSID (bar)
Minimum	5-10 (0.3-0.7)
Design	20-30 (1.4-2.0)
Maximum	40-50 (2.7-3.4)

Note: For flow specific differential pressure expectations, please utilize our IP-PRO projection software available on Ionpure.com

Note: See Section 2.4: Table 2-2 for feed water specifications.

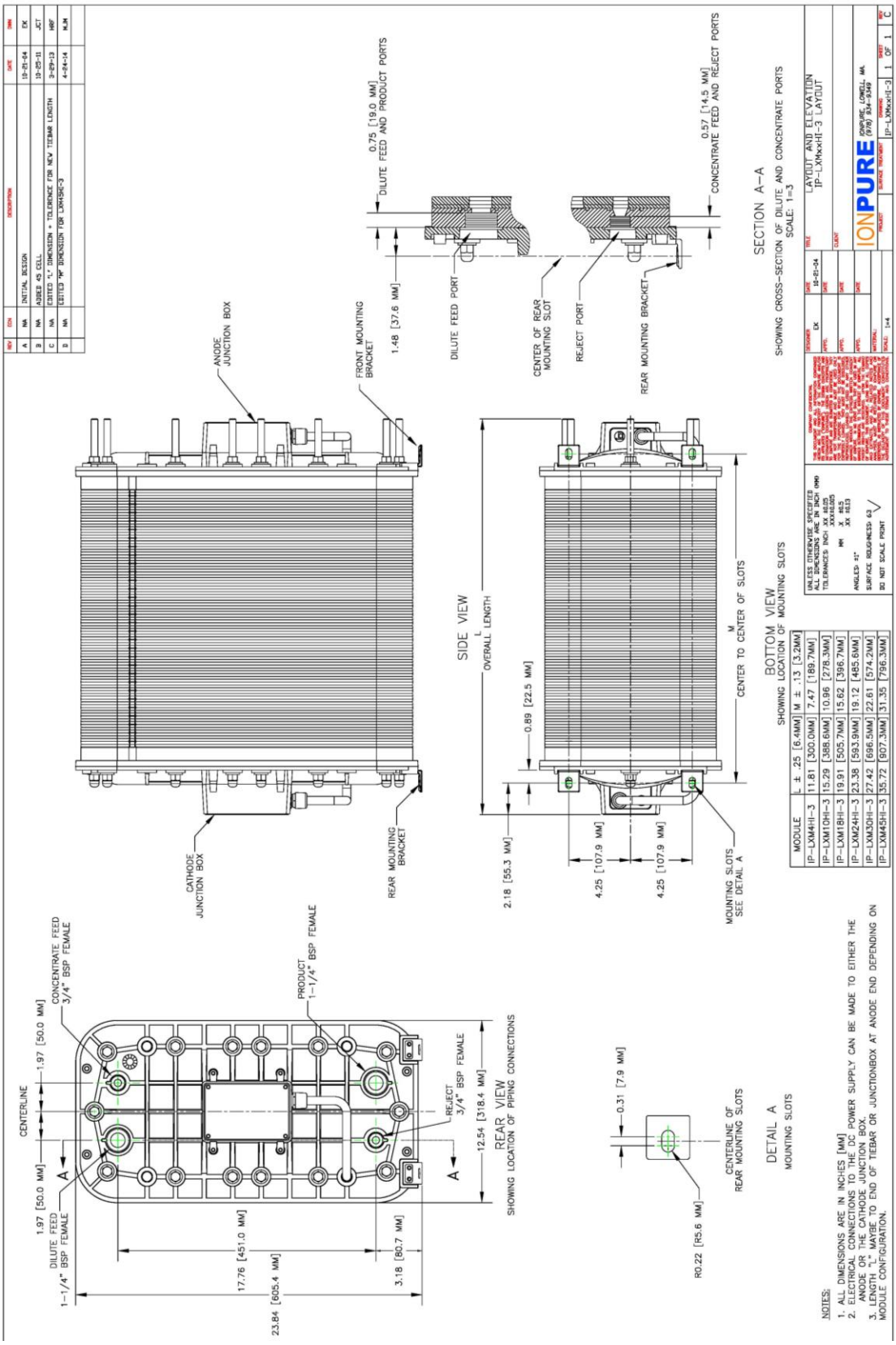
APPENDIX B: Junction Box Electrical Connections LX-HI





APPENDIX C: Layout and Elevation Drawing LX-HI

(Drawing in PDF or CAD format available on Ionpure.com)



APPENDIX D: MATERIALS OF CONSTRUCTION LX-HI

Wetted Component	Material	Federal Register
Dilute Spacer	Polysulfone	21 CFR 177.1655
Concentrate Spacer	Polysulfone	21 CFR 177.1655
End Block	Polypropylene	21 CFR 177.1520
Resin Compartment o-rings	Silicone Rubber	21 CFR 177.2600
Anion exchange resin 1	Styrene/DVB, strong base, Type I	21 CFR 173.25
Anion exchange resin 2	Styrene/DVB, strong base, Type II	21 CFR 173.25
Cation exchange resin	Styrene/DVB, strong acid	21 CFR 173.25
Anion exchange membrane	Heterogeneous: PE/AER	21 CFR 173.20
Cation exchange membrane	Heterogeneous: PE/CER	21 CFR 173.20
Anode	Platinized titanium	N/A*
Cathode	316 stainless steel	N/A*

* The electrodes contact only the reject, not the product water