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IONPURE®

LX CEDI Modules

Operation & Maintenance Manual

IP-MAN-LX-1220-EN
Rev 3
December 2020

This manual covers model numbers:

- **IP-LXM - - EU-4**
- **IP-LXM - - HI-3**
- **IP-LXM - - X-4**
- **IP-LXM - - Z-5**

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DISCLAIMER STATEMENT

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 the associated text.

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

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

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OPERATING MANUAL REVISION HISTORY

Event	Date	Description
First publication	05-2018	LX Family Operation & Maintenance Manual.
Rev 1	09-2018	Corrections on Table 6-1 (LX-4). Added cleaning chemical grade suggestions (6.8).
Rev 2	10-2019	2.3 Added metric wire sizes. 3.4 Added terminal strip torque specification and corrected junction box connection hole size.
Rev 3	12-2020	Updated LX-Z to reflect change from -4 to -5. Removed obsolete parts from LX adapter list. Updated L&E drawing in Appendix B1.

1. INTRODUCTION

1.1. LX Product Family Overview

Ionpure LX modules are medium flow rate CEDI devices. Their compact state-of-the-art design assures ease of installation, maintenance, and service. LX modules are available in the following sizes:

Size	Nominal Flow	Description
IP-LXM04	2.0 gpm (0.45 m^3/h)	4-cell
IP-LXM10	5.0 gpm (1.14 m^3/h)	10-cell
IP-LXM18	9.0 gpm (2.05 m^3/h)	18-cell
IP-LXM24	12.5 gpm (2.84 m^3/h)	24-cell
IP-LXM30	15.0 gpm (3.4 m^3/h)	30-cell
IP-LXM45	22.5 gpm (5.1 m^3/h)	45-cell

For more information on the LX module specifications and flow rates, see Section 2.4 and Appendix A of this Manual.

There are four different types of LX modules (see Appendix D), each of which is available in the six sizes listed above:

EU-4 For European Pharmacopeia (EP) applications
HI-3 For U.S. Pharmacopeia (USP) applications, hot water sanitizable (HWS)
X-4 For USP, NSF (drinking water) and general use (worldwide) applications
Z-5 For General Industry, with improved Cl_2 tolerance

Figure 1-1: LX Module (Cathode/Plumbing Side Shown)

HI type (BSP Female)

EU / X / Z type (BSP Male)

1.2. Using This Manual

Service technicians should review this manual prior to going to the installation 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 modules. It also contains information on basic troubleshooting (See Section 7).

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

1.3. Installation Precautions

⚠WARNING

- During operation, the electrode wiring inside the module junction boxes are at high voltage and present a shock hazard. THEREFORE, BEFORE TOUCHING THE INSIDE OF THE JUNCTION BOX, CONFIRM THAT AC POWER TO THE DC POWER SUPPLY HAS FIRST BEEN DISCONNECTED AND LOCKED OUT ACCORDING TO STANDARD LOCKOUT/ TAGOUT PROCEDURES.
- To minimize the possibility of electric shock, confirm that all ground wires are properly connected.

⚠CAUTION

- Do not open the LX module. Opening the module will void the warranty and cause irreversible damage.
- The module must be operated according to the design specifications for temperature and humidity.
- Metal piping should never be connected directly to the module. Non-metallic piping adapters are required at the module inlets and outlets. It is then allowable to transition to metallic piping.
- Pipe sections prepared for installation must be inspected, and be free of debris from storage or cutting tool particles. This must be done before installation.
- Because LX modules have narrow flow distribution channels, plugging by particles can cause permanent damage. Always install pressure gauges, sampling ports, sensors, etc. in tee fittings. Do not drill or tap into piping.

- Always flush out the piping to remove any debris before operating the LX module.
- 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.
- Never block off (dead-head) 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 requirements, 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.
  - Check torque on tie bar nuts and tighten as required.

1.5. Shutdown Precautions

- Confirm that the pressure in the unit is relieved until all pressures inside the unit are atmospheric (i.e., all pressure gauges should read zero).
- Drain standing water and valve off or plug all inlets and outlets. This is to minimize bacteria growth and prevent drying of ion exchange resins during shutdown.

2. PRE-INSTALLATION: PREPARATION & REQUIREMENTS

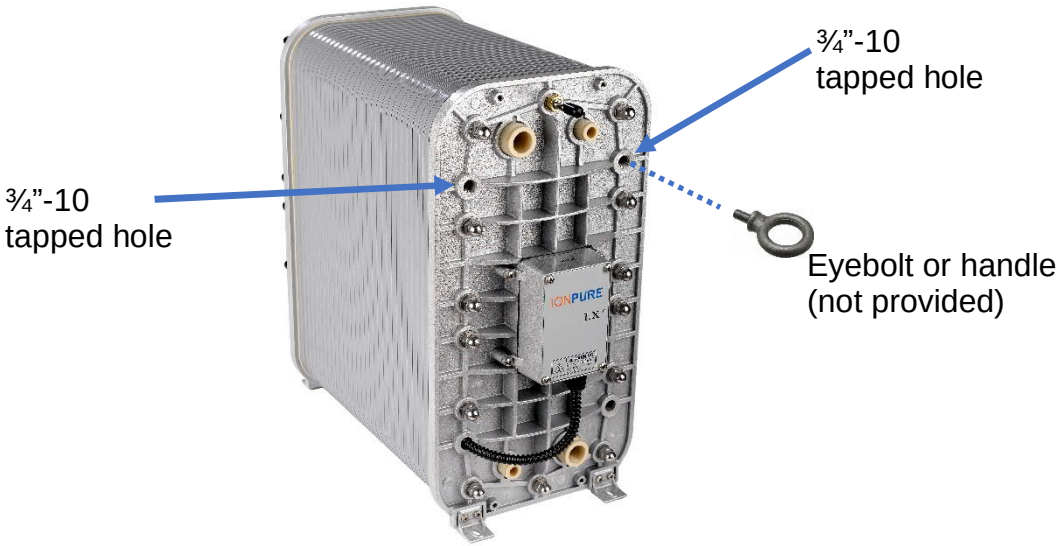
2.1. Tools Required

- Dolly or forklift to move the module into place
- Cords, cables or straps to secure module to dolly or forklift
- Slip joint pliers, for tightening of plumbing connectors
- Wire cutters/strippers, for wiring connections inside junction box
- Screwdrivers (flat blade and Phillips head) to connect wires at terminal strip
- Adjustable torque wrench with 10-50 ft-lb (14-68 N-m) range, 3/8" (10 mm) drive
- 19 mm extra deep socket (Ionpure part number W2T210908)
- 19 mm open end wrench

2.2. Unpacking and Moving LX Modules

- After uncrating the module, inspect it for any signs of damage. If damage is apparent, immediately notify the carrier and your CEDI System Provider.
- The LX modules can weigh 70-330 lbs. (32-150 kg) dry, depending on size, and may require mechanical assistance for lifting and moving into position. Both LX endplates have two ¾-10 tapped holes for installation of lifting eyebolts, if desired.
- Ensure that lifting apparatus has appropriate load rating.

Figure 1-2: LX Module Lifting Points (Cathode/Plumbing Side Shown)



2.3. Electrical and Plumbing Connection Requirements

- Two electrical junction boxes are included with all LX modules, one on each of the LX endplates. A single conduit connection is required through a 1/2" NPT hole on the bottom of either junction box to provide power to the CEDI module.
- Connection of the DC power supply to the LX module should be made with 12 or 10 AWG (4.0 or 6.0 mm^2) wire. All wiring should be done in accordance with local electrical codes.
  - Terminal strip screws should be tightened to 7.0 in-lb_f (0.8 N-m).
- Ionpure LX modules have four (4) connection points, identified in Table 2-1, below. The hot water sanitizable (HI) modules have female connections while the non-hot water sanitizable (EU, X, Z) modules have male connections. This is done to prevent accidental installation of a non-HWS module into an HWS system.
- The LX modules require special plumbing adapters, which are not included with the modules. A list of various adapters is given in Appendix C. Adapter drawings are available upon request.

⚠WARNING

- 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 near the module.
  - For sanitary applications, a grounding cap can be used, Ionpure part number W3T83436, which is actually a ¾" TC cap with a welded stud to be wired to ground.
  - For non-sanitary applications, a ¼" SS threaded grounding rod can be used, Ionpure part number W2T211647.

Table 2-1. LX Module Plumbing Connections

Connection	EU, X, Z modules	HI modules
Dilute in	1-1/4" BSP Male	1-1/4" BSP Female
Dilute out (product)	1-1/4" BSP Male	1-1/4" BSP Female
Concentrate in	3/4" BSP Male	3/4" BSP Female
Concentrate out (reject)	3/4" BSP Male	3/4" BSP Female

2.4. Operating Requirements

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

2.4.1. Operating Environment

The LX module requires indoor installation out of direct sunlight. The maximum ambient 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 the LX modules are given in appendix A.1. In addition to the size of the module itself, the arrangement of the piping and the electrical connections will determine the amount of space the module needs to operate. This arrangement varies from site to site. Space should be allowed for module servicing/replacement.

2.4.3. Module Orientation

The LX modules must be installed vertically and fastened to the system frame by the L-shaped feet on the bottom of the module.

2.4.4. DC Electrical Requirements

The LX module DC power requirements are listed in Table 2-2. In all cases the cathode must be at ground potential. Connections are shown in section 3.4 and Appendix B3.

Table 2-2. DC Power Requirements for the LX Modules

LX Model ►	EU, X, Z		HI	
LX Size ▼	Max DC Volts	DC Amps	Max DC Volts	DC Amps
IP-LXM04	27	1-6	50	1-10
IP-LXM10	67	1-6	125	1-10
IP-LXM18	120	1-6	225	1-10
IP-LXM24	160	1-6	300	1-10
IP-LXM30	200	1-6	375	1-10
IP-LXM45	300	1-6	565	1-10

NOTE: *The DC3 power supply (maximum 600 VDC) can be used with all LX models. The DCR power supply can also be used but requires correct sizing of isolation transformer.*

2.4.5. Feed Water Requirements

Feed water for the LX module must always meet the specifications outlined in Table 2-3. In most cases, pre-treating LX module 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 on site with the feed water requirements listed below.

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: "Process and System Design for Reliable Operation of RO/CEDI Systems", Jonathan Wood and Joe Gifford, International Water Conference, 2004 (Paper 47).*

Table 2-3. CEDI Feed Water (RO Permeate) Requirements - Also See Appendix A.2

Parameter	EU, X	Z	HI
FCE* (µS/cm)	≤ 40 µS/cm	≤ 40 µS/cm	≤ 40 µS/cm
Total hardness (as $CaCO_3$)	≤ 1.0 ppm	≤ 1.0 ppm	≤ 1.0 ppm
Total chlorine (as Cl_2)	≤ 0.02 ppm	≤ 0.05 ppm	≤ 0.02 ppm
Silica (ppm as SiO_2)	≤ 1.0 ppm	≤ 1.0 ppm	≤ 1.0 ppm
Iron, manganese, sulfide	≤ 0.01 ppm	≤ 0.01 ppm	≤ 0.01 ppm
TOC (ppm as C)	≤ 0.5 ppm	≤ 0.5 ppm	≤ 0.5 ppm
Operating pH range	4 – 11	4 – 11	4 – 11
Feed water temperature	41 - 113 °F (5 – 45 °C)	41 - 113 °F (5 – 45 °C)	41 - 140 °F (5 – 60 °C)
Inlet pressure	≤ 100 psig (6.9 bar)	≤ 100 psig (6.9 bar)	≤ 100 psig (6.9 bar)

*FCE stands for feed (water) conductivity equivalent)
FCE = measured µS/cm + (ppm CO_2)(2.79) + (ppm SiO_2)(2.04)

2.4.6. Drain Requirements

Place the LX module near a drain that can accommodate 100% of the total feed flow.

2.5. Flow Rates and Pressure Drops

See Appendix A, Table A.2.

3. LX MODULE INSTALLATION

3.1. Preparation

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

⚠WARNING

- Remove any packaging materials and move the module to its operating location. Use safe lifting practices when moving the module (see Section 2.2).

- To avoid corrosion, the piping adapters must be non-metallic.
- LX modules are shipped without connection adapters and with dust plugs installed.
- Plumbing adapters available from Ionpure are listed in Appendix C. Some adapter drawings are available from Ionpure if you choose to make your own adapters.

⚠CAUTION

- Remove all four red dust plugs that seal the inlet and outlet ports on each LX module (Figure 3-1 below shows the bottom dust plugs for both type LX endblocks). Failure to remove red dust plugs can cause permanent damage to the modules.

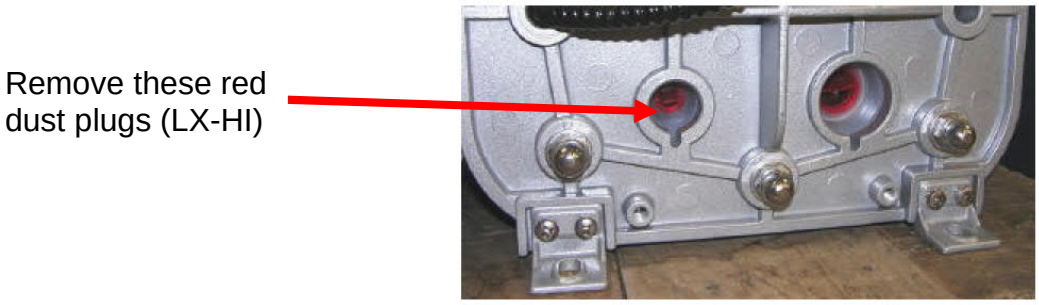


Figure 3-1a LX HI modules (BSPF) with red shipping plugs

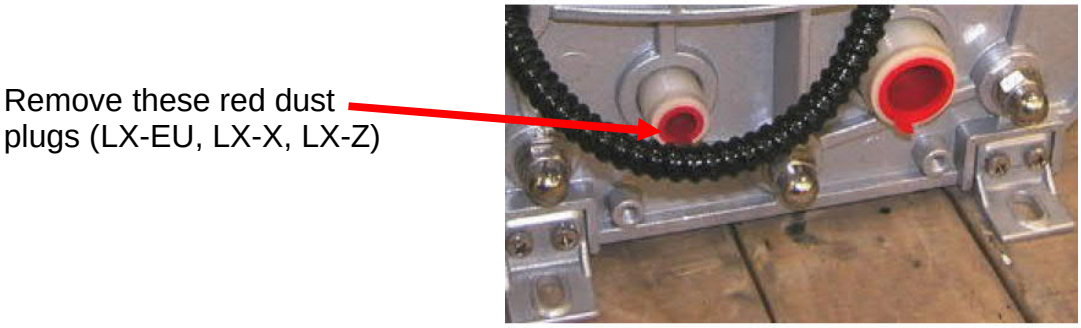


Figure 3-1b LX-EU, LX-X, LX-Z modules (BSPM) with red shipping plugs

3.2. Checking Tie Bar Torque

⚠CAUTION

The nuts on the threaded tie bars can loosen during shipment, and if not retightened the pressure from the incoming water can cause permanent damage. Therefore, the **tie bar nut torque must be checked and the module tightened as required after any transport and before flowing water into the module**. Refer to Figure 3-1 and re-torque as required. Not all modules will require retightening but all should be checked.

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.

3.2.1. Tightening End Plate Tie-bar Nuts

Figure 3-2 shows the sequence in which to re-torque the tie bars. Start the torqueing process with #1, and finish with #14. Use the following procedure:

- Use a 19 mm open ended wrench to hold the acorn nuts on the plumbing (cathode) end of the module.
- Set the torque wrench to 15 ft-lbs (20 N-m). Using a 19 mm extra deep socket (such as IONPURE part number W2T210908 ▼) on the torque wrench, turn all 14 tie-bar brass hex nuts (anode end) to 15 ft-lbs (20 N-m) following the sequence in Figure 3-2.

- Reset the torque wrench to 25 ft-lbs (34 N-m) and repeat the sequence as required until all tie bars are at 25 ft-lbs (34 N-m). Use caution to avoid over tightening. Do not exceed 25 ft-lbs (34 N-m) of torque without consulting Ionpure Technical Support.

Figure 3-2
LX Tightening Sequence

3.3. Water Connection Configuration and Fittings

⚠CAUTION 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 passages inside the LX Module.

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

Ionpure LX modules have a cast aluminum endplate with through-holes to allow access to the endblock piping connections described in Table 2-1. There are four (4) connection points:

- Product (Dilute) Inlet – top left
- Product (Dilute) Outlet – bottom right
- Reject (Concentrate) Inlet – top right
- Reject (Concentrate) Outlet – bottom left

The above connection descriptions are for co-current, downflow (top-to-bottom) operation, which has been the preferred mode of LX module operation for nearly 20 years. LXHI-3 and LXZ-5 modules must be operated downflow for optimum performance. LXEU-4 and LXX-4 modules can also be operated upflow, which may be convenient due to piping constraints in certain situations. Please check with your local Ionpure Technical Support if you are considering upflow operation.

Detailed dimensions of the LX module port locations are given in the layout and elevation drawings in Appendix B, Drawings B1 (EU, X, Z) and B2 (HI).

3.3.1. LX Piping Adapter Sealing Mechanism – EU, X, Z Modules (BSP Male)

The endblocks used in LX models EU, X and Z are made of thermoplastic elastomer, (TPE) which is molded through (4) hard plastic fittings with Male BSP parallel threads. The TPE covers the face of the threaded fittings, making a flat surface for sealing of the external piping adapters. The end block threads are NOT TAPERED pipe threads and the threads DO NOT CREATE the seal, they allow the sealing surfaces to move towards each other and they hold the piping adapters in place. The seal comes from the TPE through-port gasket that isolates the endplate and creates a sealing surface directly to the internal LX spacer. See Figure 3-3, below.

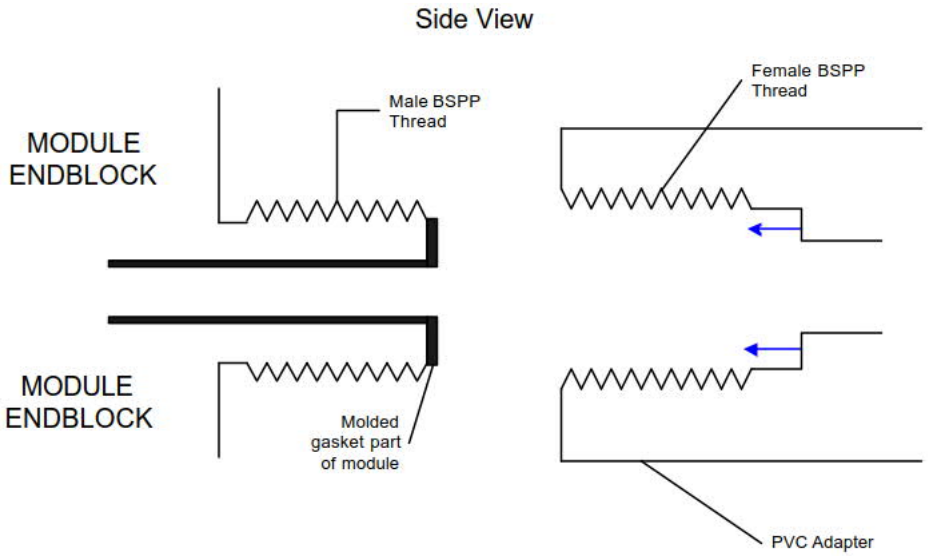


Figure 3-3 LX Piping Adapter Sealing Mechanism: Non-HWS Modules

3.3.2. LX Piping Adapter Sealing Mechanism – HI Modules (BSP Female)

The female threads in the LX HI module endblock are BSP parallel threads. They are NOT TAPERED pipe threads and the threads DO NOT CREATE the seal, they allow the sealing surfaces to move towards each other and they hold the piping adapter in place. The seal comes from a separate flat silicone gasket inserted in the endblock. See Figure 3-4, below.

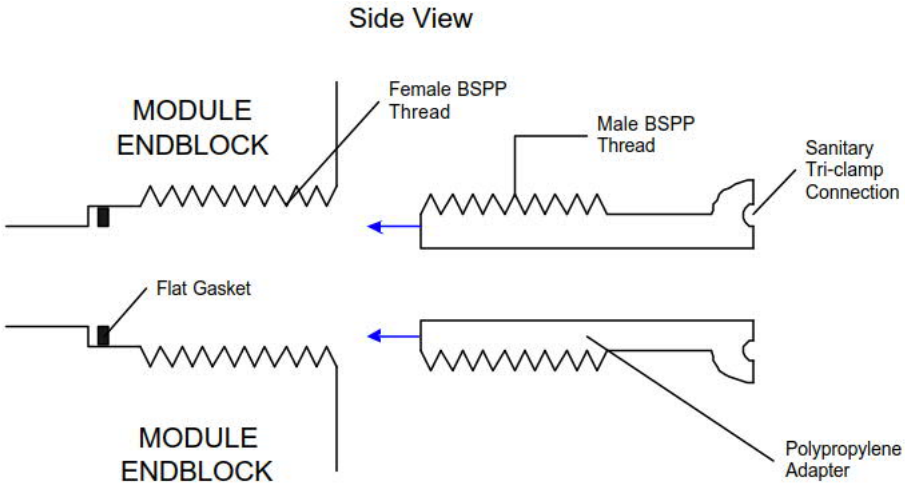


Figure 3-4 LX Piping Adapter Sealing Mechanism: HWS Modules

NOTE: *Do NOT use Teflon® tape or any other pipe sealant (such as pipe dope) on the BSP thread adapters, whether male or female. The use of these products on the BSP threads will prevent proper sealing of the adapters.*

3.4. Electrical Connections

All LX modules have two electrical junction boxes (one on each endplate) to allow convenient connection of the module to the DC power supply that provides the driving force for the electrodeionization process. Only one electrical connection is required per module, and either junction box can be used. Power connections to the terminal strip inside the module junction box (see Figure 3-5 and Appendix B3) should be made with 12 or 10 AWG (4.0 or 6.0 mm^2) wire and conduit or cord connections should be supplied via the 1/2" NPT hole on the bottom of the junction box.

The DC wire color conventions used on the LX modules are as follows:

- Red/White (+) to DC positive terminal of power controller
- Black/White (–) to DC negative terminal of power controller
- Green/Yellow to earth ground

Terminal strip screws should be tightened to 7.0 in-lb_f (0.8 N-m). Wire stripping length is 7.0 mm (0.276").

Figure 3-5 Inside the LX Junction Box

3.4.1. Electrical Precautions

⚠WARNING

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

⚠CAUTION

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

- CAUTION Ensure that polarity of DC connections is correct before applying DC power. Operation with polarity reversed will permanently damage the cathode. It is critical that the red and black wires are correctly oriented on the positive (+) and negative (-) terminal blocks.
- The ground in the junction box must be connected to earth ground.
- 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 this manual and the local codes.
- Power connections for the modules must be connected to a suitable DC power supply capable of meeting the DC power requirements of the module (see Table 2-2).

3.5. RO/CEDI System Design Considerations

- Direct feed of an RO system to the CEDI system requires use of a pressure relief valve or rupture disk between the RO and CEDI to prevent accidental overpressure of the CEDI.
- If the CEDI system is fed from a tank instead of directly from an RO system, there are two requirements:
  - The CEDI feed pump must be sized so that its dead-head pressure does not exceed the 100 psig (6.9 bar) pressure limit of the CEDI modules.
  - **There must be prefiltration directly upstream of the CEDI system** (5 micron suggested) as experience has shown tanks and repumping to be a common source of particulate contamination.
- The CEDI DC power supply must be interlocked with the RO feed pump or the CEDI feed pump (whichever is appropriate) to ensure that the power supply can't be energized if the pump is not running.
- In addition, the EDI system must have low flow protection for both the product and reject.
- Piping to the CEDI modules should be designed to minimize mechanical stress on the CEDI piping connectors.
- CAUTION Start/stop systems should have provisions to automatically divert RO permeate to drain upon startup from standby condition. This is necessary because the initial RO permeate is usually worse quality than the RO feed water! It is better to flush for a set time (3-5 minutes) rather than to a conductivity endpoint.
- Systems that reclaim CEDI reject and send it back to the RO inlet should have provisions for venting the electrode gases.
- Automatic valves downstream of the CEDI should be designed to close slowly (>3 seconds) and must avoid momentary dead-heading of the CEDI module.

4. PREPARATION FOR STARTUP

4.1. Verify Feed Water Meets LX Quality Requirements

Check the LX feed water quality by running the RO system to drain and testing to make sure the feed water quality meets all the feed water requirements given in Table 2-3. Below are some of the test kits or devices that may be useful:

Table 4-1 Useful Equipment for Feed Water Testing

Analyte	Model	Minimum Increment
Conductivity	Myron L Ultrameter II 4P	0.1 µS/cm
CO_2	Hach CA-23 (#143601)	1.25 mg/l
Cl_2	Hach CN-70 (#1454200)	0.02 mg/l
Hardness	Hach HA-71A (#145201)	1.0 mg/l
Silica	Hach SI-7 (#2255000)	0.05 ppm

4.2. Estimate DC Current Required

An important part of the startup process for the LX module is setting the operating current correctly for each application.

The amount of DC current required depends on the following site-specific conditions:

- Flow rate per module
- CEDI feed water conductivity equivalent (FCE)
  - Measured feed water conductivity (may require a portable conductivity meter)
  - Feed water carbon dioxide concentration (requires test kit such as above)
  - Feed water silica concentration (usually low enough to be neglected)
- Product water quality required

The best way to determine the amount of DC current required is to use the Ionpure projection tool, IP-PRO: https://ippro.evoqua.com/

Alternatively, it can be estimated using the equation below (based on Faraday's Law). **NOTE:** *Contact local Ionpure Technical support for assistance.*

DC amps = (1.31)(product flow, L/min/cell)(FCE, µS/cm)/current efficiency, %

Where FCE = measured µS/cm + (ppm CO_2)(2.79) + (ppm SiO_2)(2.04)

5. START-UP PROCEDURE

5.1. Test Interlocks

- Test flow switches and other interlocks, including the RO interlock if applicable
- Test pressure relief if applicable
- Set alarm points

5.2. Startup of LX Modules

- Make sure that modules are correctly connected to the DC power source.
- Make sure that the LX product line is directed to drain.
- Turn on the feedwater. Adjust pump and/or valves to obtain the desired flows and pressures in the product and reject streams. The reject flow is typically set at about 11% of the product flow (this gives a water recovery of 90%). See Section 5.4, below.
- Valves are adjusted so the product outlet pressure is about 2 to 5 psig (0.1 to 0.3 bar) higher than the reject outlet pressure at the desired flow rates.
- Adjust the DC power supply to the current setting determined in section 4.2.
- Test all flow switches and interlocks to ensure LX DC power is 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 outlet pressure 2 to 5 psi (0.1 to 0.3 bar) above the reject outlet pressure.
- Record operating data daily on suitable log sheet (see example in section 7.0). The CEDI system should achieve steady-state operation in a few days,

5.3. Minimum Reject Flow Rate

Table 5-1 Minimum Reject Flow Rates for Various LX Module Sizes

Module Size	gpm	L/min
IP-LXM 04	0.07	0.26
IP-LXM 10	0.16	0.61
IP-LXM 18	0.27	1.02
IP-LXM 24	0.36	1.36
IP-LXM 30	0.44	1.67
IP-LXM 45	0.66	2.50

5.4. Water Recovery

- Percent water recovery = (100)(product flow)/(product flow + reject flow)

- The maximum allowable LX water recovery depends on feed water concentrations of silica and hardness, as shown in Table 5-2, below.
- 95% recovery may not be attainable below nominal product flow, because minimum reject flow must be satisfied (see Table 5-1, above).

Table 5-2 Allowable LX Recovery (All LX Modules)

Hardness, ppm as $CaCO_3$	Silica, ppm as SiO_2	Recovery %
≤ 0.2	≤ 0.5	95
0.2 – 1.0	0.5 – 1.0	90

5.4.1. Example calculation of recovery

If LX30 product flow = 15 gpm and reject flow = 1.5 gpm

Then $\%R = (100)(Q_P)/(Q_P + Q_R) = (100)(15)/(15 + 1.5) = 90.9\%$

5.4.2. Example calculation of reject flow

If LX45 product flow = 5 m^3/h and maximum allowable recovery = 90%

Then $Q_R = [(100)(Q_P)/(\%R)] - Q_P = [(100)(5)/(90)] – 5 = 0.56\ m^3/h$

6. MAINTENANCE AND TROUBLESHOOTING

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.

The cleaning chemical volumes & flows detailed in this section are for a single LX module. Multiply chemical volumes by number of modules in system.

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.

6.1. General Maintenance Guidelines

6.1.1 Operating Data Log Sheet

LX system log sheets must 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 in Section 7. Because instrumentation may vary depending on the type of system the module is installed into, this log sheet may not apply to your system. The system manual should contain log sheets more appropriate for your system. **However, the items in bold must be filled out to maintain module warranty.**

6.1.2 Periodic Maintenance

Perform the following tests at least once every six months.

- Check for any water leakage from the module. If leakage is observed, see the Troubleshooting subsection for possible solutions.
- Periodically tighten all electrical connections
- Periodically check calibration of instrumentation
- Test function of critical interlocks such as low flow protection

6.2. Approved Cleaning Procedures

Periodically, the LX module may need cleaning or sanitization. Cleaning the module removes scale and resin/membrane foulants. The LX modules can be cleaned and sanitized with five (5) 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 – this sequential cleaning protocol of caustic, percarbonate, brine and acid is recommended for heavily biofouled systems.

NOTE: ***If you are unsure whether the module is scaled or organically fouled, flush first with brine, then clean with NaCl/NaOH followed by brine followed by HCl.***

6.3. Cleaning and Sanitization Prompts

The module may need CLEANING if:

- The product differential pressure increases by 50% without a change in temperature and flow, or
- The reject differential pressure increases by 50% without a change in temperature and flow, or
- The product quality declines without a change in temperature, flow, or feed conductivity, or
- The module's electrical resistance increases by 25% 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.

The system may require periodic SANITIZATION if

- The product water calls for low levels of bacteria (a user-specific requirement).

6.4. Clean-In-Place (CIP) System Construction

The main components of a clean-in-place (CIP) system are a tank, circulating pump, cartridge filter, and various valves and hoses for connection to the CEDI system and control of flows and pressures. The following general guidelines apply to CIP systems:

- Typical CIP system is shown in Figure 6.1

- All components of CIP system must be constructed of material compatible with the cleaning solutions listed in Section 6.2. Plastics generally work well with most cleaning chemicals.
- The tank should be large enough to accommodate solution volumes shown in Section 6.7.
- It is best if the tank is fully drainable (false or conical bottom).
- Thoroughly flush all plumbing and other equipment before cleaning or sanitization to remove debris or old chemicals that might damage the CEDI system.
- Flexible hose is ideal for connecting cleaning equipment to the system.
- The CIP pump must provide a minimum discharge pressure of at least 30 psig (2 bar) and maximum pressure of 100 psig (7 bar) at the flow rate given in Table 6-1, below.

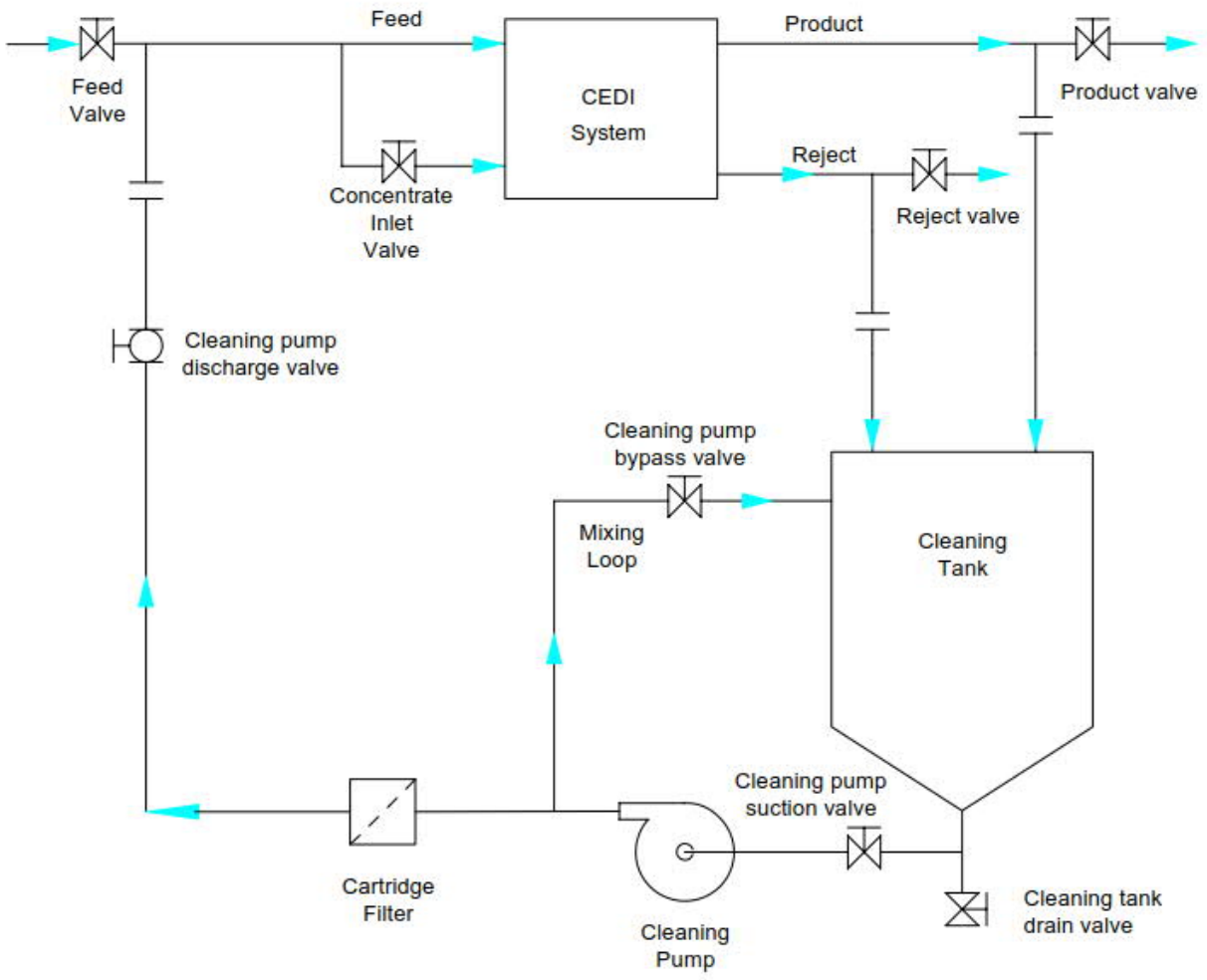


Figure 6-1: Typical CEDI CIP System

Table 6-1 LX CEDI Cleaning Flow Rates (per module)

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Product gpm	1.0-3.0	2.5-7.5	4.5-13.5	6.3-18.8	7.5-22.5	11.3-33.8
m^3/h	0.23-0.68	0.6-1.7	1.0-3.1	1.4-4.3	1.7-5.1	2.6-7.7
Reject gpm	0.5-1.5	1.3-3.8	2.3-6.8	3.2-9.4	3.8-11.3	5.7-16.9
m^3/h	0.11-0.34	0.3-0.9	0.5-1.5	0.7-2.1	0.9-2.6	1.3-3.8
Pump gpm	3	7.5	13.5	18.8	22.5	33.8
Capacity m^3/h	0.7	1.7	3.1	4.3	5.1	7.7

The preferred cleaning flow rates are nominal product flow (midpoint of the ranges above) and reject flow of 0.5 x nominal product flow.

6.5. Chemical Cleaning and Sanitization Precautions

WARNING

- Avoid direct skin contact with cleaning chemicals. Use appropriate Personal Protective Equipment (PPE), such as safety glasses, gloves and protective clothing. **Consult SDS from chemical supplier, or International Chemical Safety Card if available. See https://www.ilo.org/safework/info/publications/WCMS_113134/lang--de/index.htm .**

- Flush all hoses and rinse tank with clean water BEFORE adding chemicals.
- Pressure-test CIP system and connecting hoses with water before adding chemicals to tank.
- To reduce the possibility of chemical sprays, relieve the pressure in chemical lines before disassembly.

CAUTION

- Follow the manufacturer's chemical safety instructions on the container labels.

- Check the pH level in any solution before letting it flow to the drain. Adjust pH as required to comply with any discharge restrictions.
- Do not run a cleaning solution through the system when DC power is applied to the module. Make sure the DC power is off before cleaning.

6.6. Typical Procedure for Cleaning or Sanitization

NOTE: *The following cleaning procedure is based on the CIP system shown in Figure 6-1. If your CIP system is different, you may need to adapt this procedure.*

6.6.1 Preparation

- Turn off the DC power supply.
- Drain most of water from the CEDI system (to avoid dilution of cleaning solution).
- Close the CEDI system feed valve and product valve.
- Connect the discharge of the cleaning pump to the LX system feed CIP connection.
- Install new filters in CIP system.
- Connect the CEDI system reject and product CIP connections to the cleaning tank.
- Verify that all piping connections are secure.
- Close cleaning pump discharge valve until ready to pump the cleaning solution into the LX system.

6.6.2 Cleaning

- Follow the instructions in Section 6.6.1 (above) to prepare the LX system for chemical cleaning.
- Make sure the tank drain valve is closed.

- Fill the tank with the required amount of water, according to the applicable solution recipe in Section 6.7.
- Circulate water through the CEDI system, check CIP apparatus for leaks, fix any leaks if present.
- Mix the required amount of chemical (from the applicable recipe in Section 6.7) with the water in the tank. In the case of HCl, additional acid may be required during the recirculation period.
- Open the pump suction and pump bypass valves.
- Start the cleaning pump and circulate the solution through the pump bypass to mix the contents of the tank.
- When the solution is 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 Section 6.4, Table 6-1.
- Recirculate the solution through the module for 30-60 minutes. Longer contact time may be desirable in some instances. See Ionpure Service Bulletin 2007-02b. Contact Ionpure Technical Support if you have further questions.

6.6.3 Return to service

- Turn off the cleaning pump.
- Check pH of solution in tank. Neutralize if necessary, then drain the CIP system tank.
- Refill the tank with water.
- Optional step: make brine solution, circulate through CEDI and then drain tank. This helps remove chemicals from CEDI and may speed rinse up to quality.
- Refill tank with water, circulate through CEDI and then drain tank.
- Close the cleaning pump discharge valve. Keep product and reject lines directed to drain and disconnect the CIP equipment from the CEDI system.
- Turn on the feed water supply to the CEDI system. Gradually allow RO product water to flow through the module to drain.
- Flush residual cleaning solution from the CEDI system for five minutes, then apply the DC power.
- Flush water to drain with DC power on until reaching desired CEDI product water quality, then send product water to use.

6.7. Cleaning Solution Recipes

WARNING **Use appropriate PPE when using any of below chemicals for cleaning CEDI modules. Consult SDS from chemical supplier.**

Table 6-2 Hydrochloric acid, 2%

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	4 gal (15 L)	9 gal (35 L)	16 gal (60 L)	21 gal (80 L)	26 gal (100 L)	40 gal (150 L)
HCl, 36.5%	0.2 gal (0.7 L)	0.5 gal (1.7 L)	0.8 gal (2.9 L)	1.0 gal (3.9L)	1.3 gal (4.8 L)	1.9 gal (7.2 L)
Best use: removal of scale or metal fouling **NOTES:** *[1] use brine flush and water rinse between low pH and high pH cleaning* *[2] add acid as required to maintain pH of 0.5-1.0*						

Table 6-3 Sodium chloride (5%)/sodium hydroxide (1%) mixture (brine/caustic)

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	4 gal (15 L)	9 gal (35 L)	16 gal (60 L)	21 gal (80 L)	26 gal (100 L)	40 gal (150 L)
NaCl	1.7 lbs (0.8 kg)	4.0 lbs (1.8 kg)	7.0 lbs (3.2 kg)	9.3 lbs (4.2 kg)	11.6 lbs (5.3 kg)	17.4 lbs (7.9 kg)
NaOH pellets	0.33 lb (0.15 kg)	0.78 lb (0.35 kg)	1.33 lb (0.61 kg)	1.77 lb (0.81 kg)	2.22 lb (1.01 kg)	3.33 lb (1.52 kg)
or 50% NaOH	0.05 gal (0.2 L)	0.12 gal (0.46 L)	0.21 gal (0.79 L)	0.28 gal (1.06 L)	0.35 gal (1.32 L)	0.52 gal (1.99 L)
Best use: removal of organic fouling **NOTE:** *must be preceded by salt flush*						

NOTE: *It is thought that performing high pH cleaning first may be more effective for removal of organic matter than when low pH cleaning for scale is done first. A high pH cleaning should be preceded by a brine flush to displace hardness.*

Table 6-5 Sodium chloride, 5%

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	4 gal (15 L)	9 gal (35 L)	16 gal (60 L)	21 gal (80 L)	26 gal (100 L)	40 gal (150 L)
NaCl	1.7 lbs (0.8 kg)	4.0 lbs (1.8 kg)	7.0 lbs (3.2 kg)	9.3 lbs (4.2 kg)	11.6 lbs (5.3 kg)	17.4 lbs (7.9 kg)
Best use: displacement of hardness before high pH cleaning **NOTE**: *once-through preferred, use minimum dilute flow*						

Table 6-6 Sodium percarbonate (1.5%) – mix sodium carbonate & hydrogen peroxide

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	4 gal (15 L)	9 gal (35 L)	16 gal (60 L)	21 gal (80 L)	26 gal (100 L)	40 gal (150 L)
Na_2CO_3, solid	0.34 lb (0.15 kg)	0.79 lb (0.36 kg)	1.36 lb (0.62 kg)	1.81 lb (0.82 kg)	2.26 lb (1.03 kg)	3.39 lb (1.54 kg)
H_2O_2, 30%	0.06 gal (0.22 L)	0.14 gal (0.52 L)	0.24 gal (0.89 L)	0.31 gal (1.19 L)	0.39 gal (1.49 L)	0.59 gal (2.23 L)
Best use: for sanitization and biofilm removal Sodium percarbonate is $2Na_2CO_3 \bullet 3H_2O_2$ **NOTE:** *must be preceded by salt flush and water rinse*						

Table 6-7 Peracetic acid, 0.04% (100:1 dilution)

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	3.9 gal (14.85 L)	9.2 gal (34.65 L)	15.7 gal (59.4 L)	20.9 gal (79.2 L)	26.2 gal (99 L)	39.2 gal (148.5 L)
Peracetic acid	0.04 gal (0.15 L)	0.09 gal (0.35 L)	0.16 gal (0.6 L)	0.21 gal (0.8 L)	0.26 gal (1.0 L)	0.4 gal (1.5 L)
Best for disinfection/bacteria control (not very effective for biofilm removal) **NOTE**: *[1] Quantity based on Minncare: 20% Hydrogen Peroxide & 4% peracetic acid.* *[2] Dilute 120:1 for Oxonia P3* *[3] Must be preceded by salt flush and water rinse*						

Table 6-8 Sodium hydroxide (2%)

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	4 gal (15 L)	9 gal (35 L)	16 gal (60 L)	21 gal (80 L)	26 gal (100 L)	40 gal (150 L)
NaOH pellets	0.7 lb (0.3 kg)	1.6 lb (0.7 kg)	2.7 lb (1.2 kg)	3.6 lb (1.6 kg)	4.5 lb (2.0 kg)	6.7 lb (3.1 kg)
or 50% NaOH	0.11 gal (0.40 L)	0.25 gal (0.94 L)	0.42 gal (1.61 L)	0.57 gal (2.14 L)	0.71 gal (2.68 L)	1.06 gal (4.01 L)
Best use: for sanitization and biofilm removal **NOTE:** *must be preceded by salt flush and water rinse*						

Table 6-4 Water for initial post-cleaning flush

	4-cell	10-cell	18-cell	24-cell	30-cell	45-cell
Water	15 gal (57 L)	38 gal (144 L)	68 gal (255 L)	90 gal (340 L)	115 gal (435 L)	170 gal (643 L)
This represents a 10-minute flush at minimum product flow and reject flow 0.5X product flow.						

6.8. Recommended Grades for Cleaning Chemicals

6.8.1 Hydrochloric Acid
Technical or SEMI grade (32-38%)

6.8.2 Sodium Chloride
Food grade (granular, 99.9% NaCl)

6.8.3 Sodium Hydroxide
Rayon grade (50% solution – caustic soda)
Technical grade (solid pellets)

6.8.4 Sodium Percarbonate
Hydrogen peroxide – technical grade, 30%
Sodium carbonate – natural dense or synthetic light

6.8.5 Peracetic Acid
Target concentration is 0.2% H_2O_2, 0.04% CH_3COOOH
Minncare – dilute 100:1
P3 Oxonia Active – dilute 125:1

6.9. Hot Water Sanitization (HWS)

⚠CAUTION

Only the LX-HI series of Ionpure CEDI modules is compatible with hot water sanitization at 80-90°C.

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

Water used for HWS must meet all feed water specifications for continuous operation given in Table 2-3 (except temperature).

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.*

NOTE: *The following HWS procedure is based on the piping setup shown in Figure 6.1. Many other sanitization configurations are possible. If uncertain about the suitability of a sanitization configuration, contact Ionpure Technical Support.*

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

6.8.1 HWS Phase 1 – Hot Water Introduction

- Follow the instructions in section 6.6.1 to prepare the module for cleaning.
- Confirm the tank drain valve is closed.
- Confirm the discharge valve is closed.
- Fill the tank with RO permeate or CEDI product water. CEDI product water is preferred to prevent CEDI module fouling/scaling and/or resin exhaustion.
- Open the sanitization pump suction valve and open the bypass valve completely.
- Turn on the sanitization pump.
- Slowly open the pump discharge valve. Adjust the bypass valve to maintain the system feed pressure below 30 psig. If there is no backpressure present, a sanitization pressure of 10-15 psi should be sufficient.
- Confirm that the DC power supply is off.
- Turn on the hot water heater (not shown in Figure 4-1) and increase the water temperature to 185°F ± 9°F (85°± 5°C). The water heater can be an electric immersion heater or a steam-driven heat exchanger.

6.8.2 HWS Phase 2 – Temperature Hold

- Maintain configuration described in the previous step.
- Set the temperature control system to maintain water temperature of 185° ± 9°F (85°C ± 5°C)

- Continue re-circulation for 1 hour.

6.8.3 HWS Phase 3 – Return to service

- Turn off water heater and sanitization pump.
- Close pump discharge valve.
- Drain tank following all local discharge limitations.
- Disconnect the sanitization system. Divert product and reject output lines to drain.
- With the DC power off, turn on the inlet water and flush through the module to drain for 5 to 10 minutes.
- Adjust flows to normal operating values.
- Once proper flows and pressures are established, return the power supply to normal operating DC current.
- Monitor the product water quality. When the quality of the product water is within acceptable parameters, return the module to normal operating configuration.
- Readjust flows and pressures as necessary.

7. 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 module end plate on the plumbing end.

Table 7-1: Troubleshooting Procedures for LX modules

PROBLEM	CAUSE	SOLUTION
Module leaks	Module has loosened during shipment, movement, or operation	Contact Ionpure Technical support
	Module is faulty	Contact your Local Service Provider
Plumbing leaks	Module adapters are loose	Tighten adapters (See Section 3.3)
Poor water quality with DC power ON	Operating current too low or too high	Measure feed conductivity and CO_2. Recalculate current according to Section 4 and adjust as necessary.
	Incorrect module electrical connection polarity	Confirm correct DC+ and DC- connections (check product and reject conductivity) Note: Incorrect polarity can cause permanent damage
Loss of flow and/or increase in feed pressure	Module is fouled, scaled, or oxidized	See Troubleshooting flow 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).

TYPICAL LX MODULE LOG SHEET

Site Name: _____ Module Serial Number: _____

DATE						
TIME OF DAY						
Feed water temperature	**°C**					
Feed water total hardness	**ppm as $CaCO_3$**					
Feed water total chlorine	**ppm as Cl_2**					
Feed water carbon dioxide	ppm as CO_2					
Feed water conductivity	µS/cm					
Product water resistivity	MΩ-cm					
DC potential	volts					
DC current	amps					
Module resistance (volts/amps)	ohms					
Product flow rate	gpm (or m^3/h)					
Reject flow rate	gpm (or m^3/h)					
Dilute inlet pressure	**psig (or bar)**					
Dilute outlet pressure	psig (or bar)					
Product ΔP ($Dilute_{in}$ – $Dilute_{out}$)	psig (or bar)					
Concentrate inlet pressure	psig (or bar)					
Concentrate outlet pressure	psig (or bar)					
Concentrate ΔP ($Conc_{in}$ - $Conc_{out}$)	psig (or bar)					
COMMENTS:						

NOTE: *See Ionpure module warranty for system monitoring that is required to maintain CEDI module warranty*
Good operating data is critical to system troubleshooting

Troubleshooting Flow Chart - Increase in DC Volts

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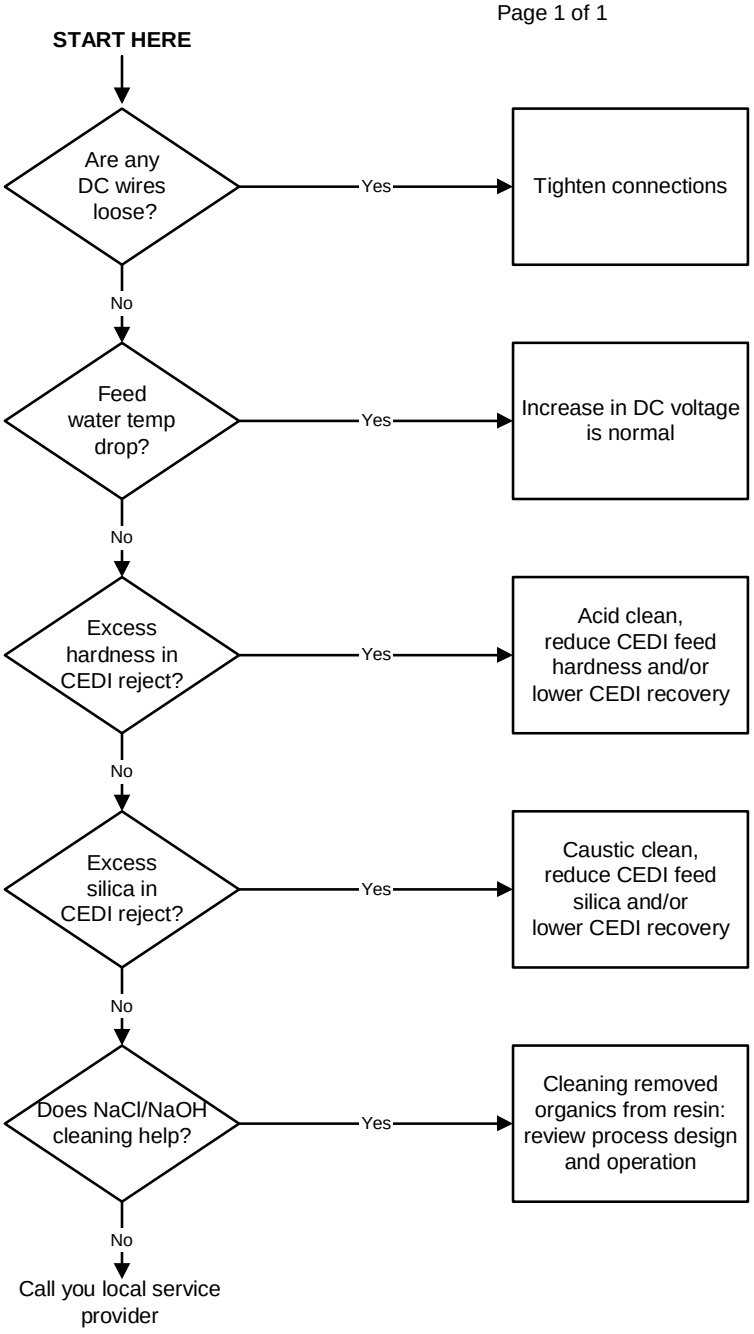

Troubleshooting Flow Chart - Low CEDI Product or Reject Flow

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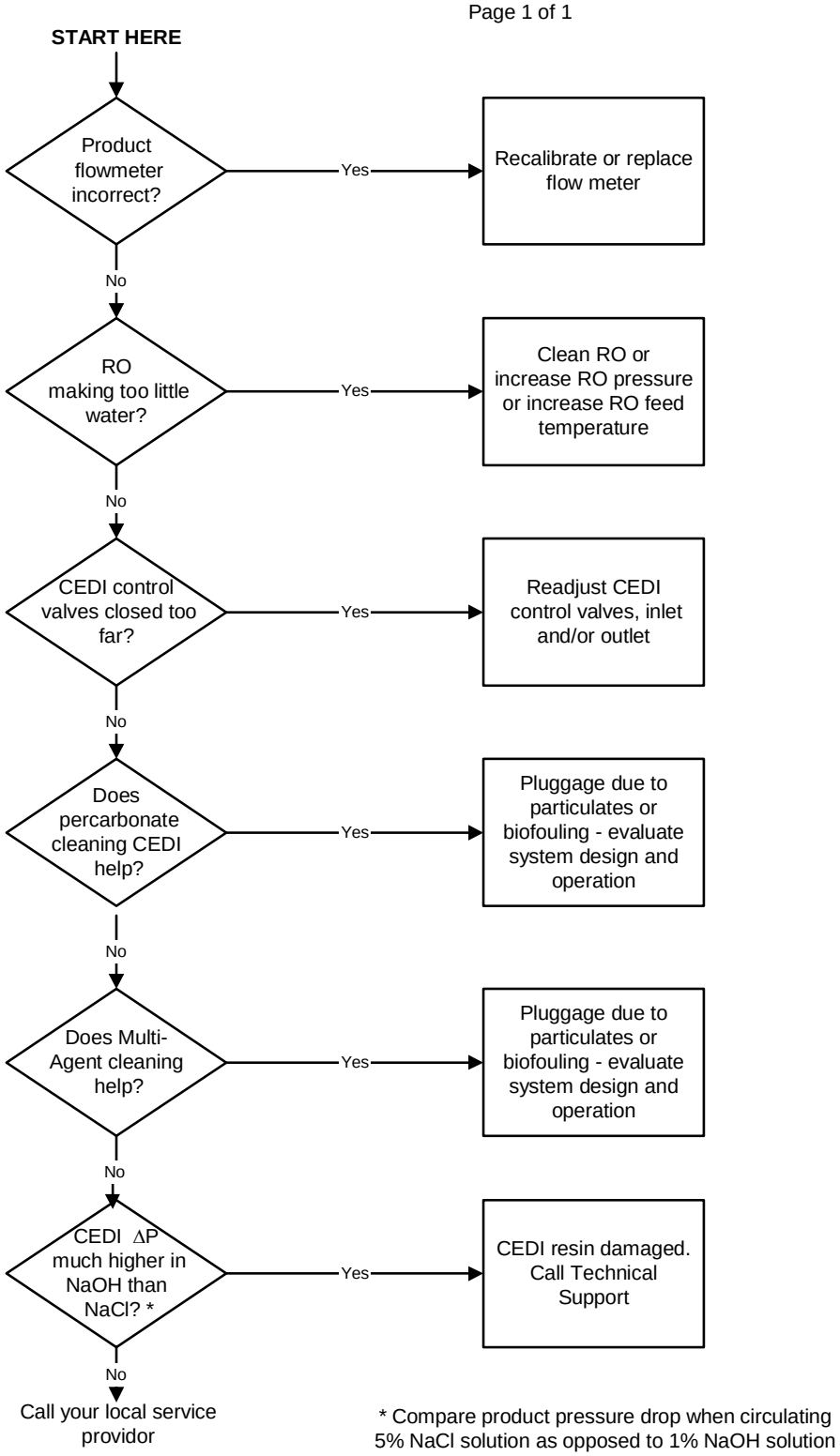

* Compare product pressure drop when circulating 5% NaCl solution as opposed to 1% NaOH solution

Troubleshooting Flow Chart - Low CEDI Product Water Quality

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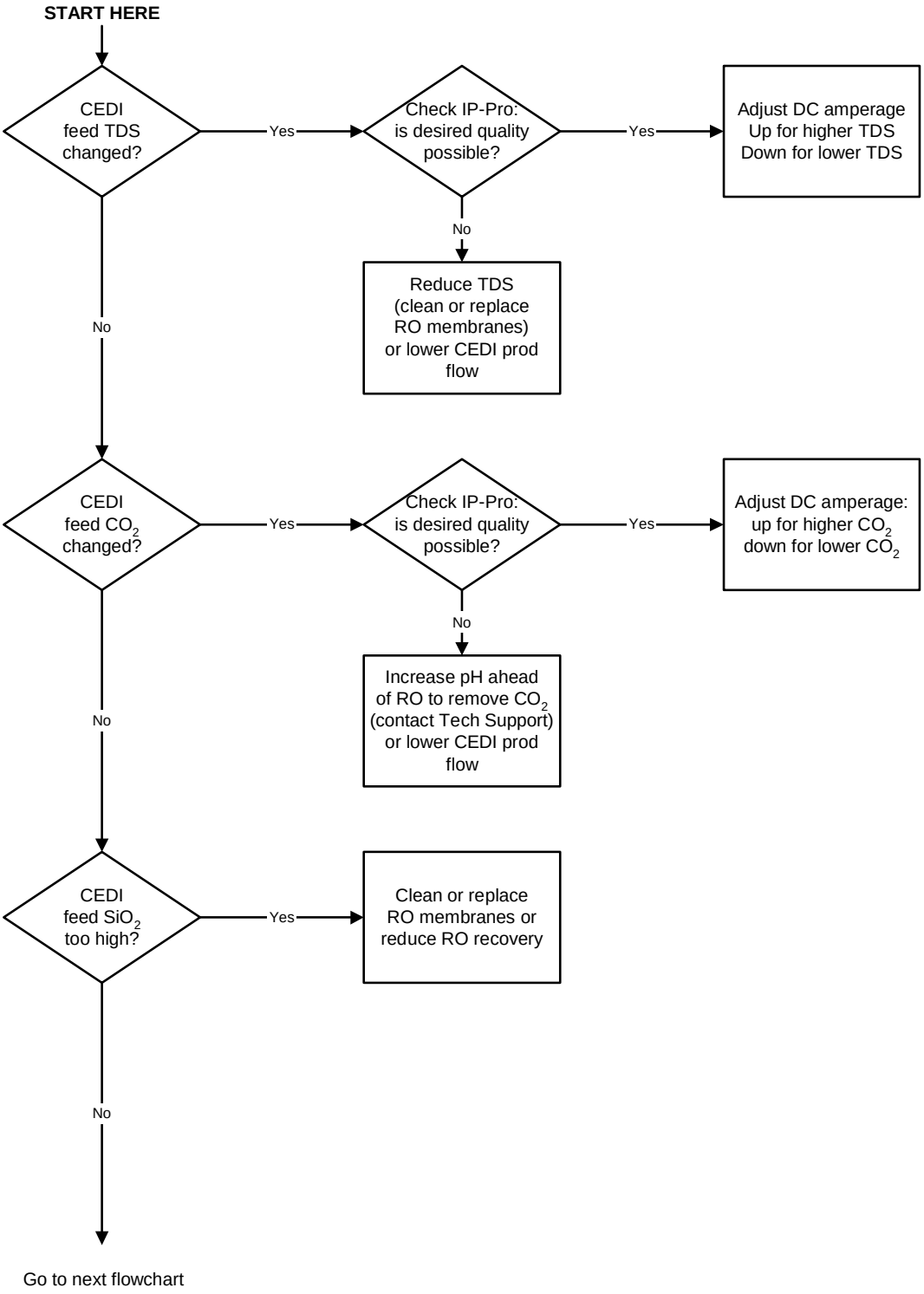

Troubleshooting Flow Chart - Low CEDI Product Water Quality

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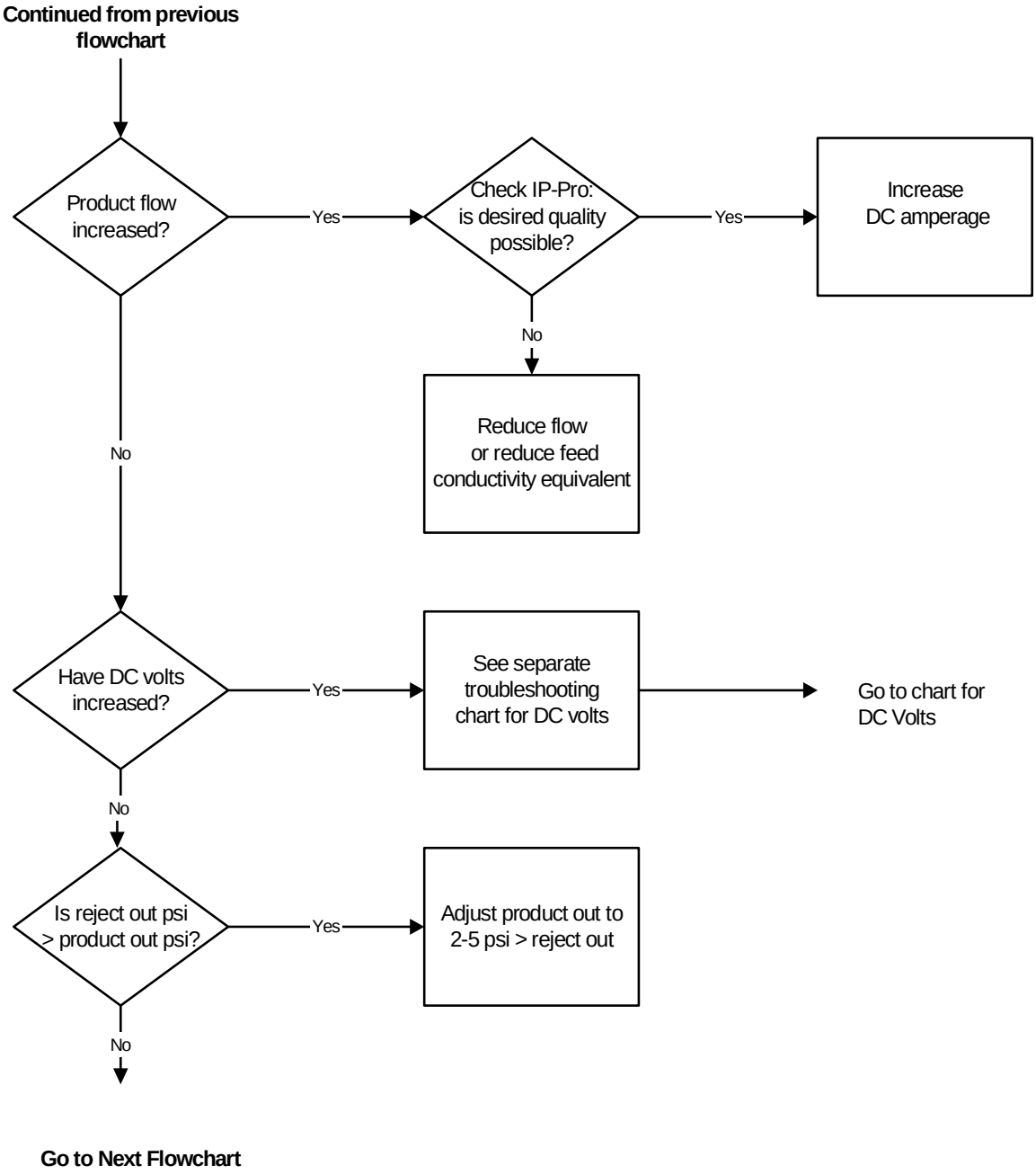

Troubleshooting Flow Chart - Low CEDI Product Water Quality

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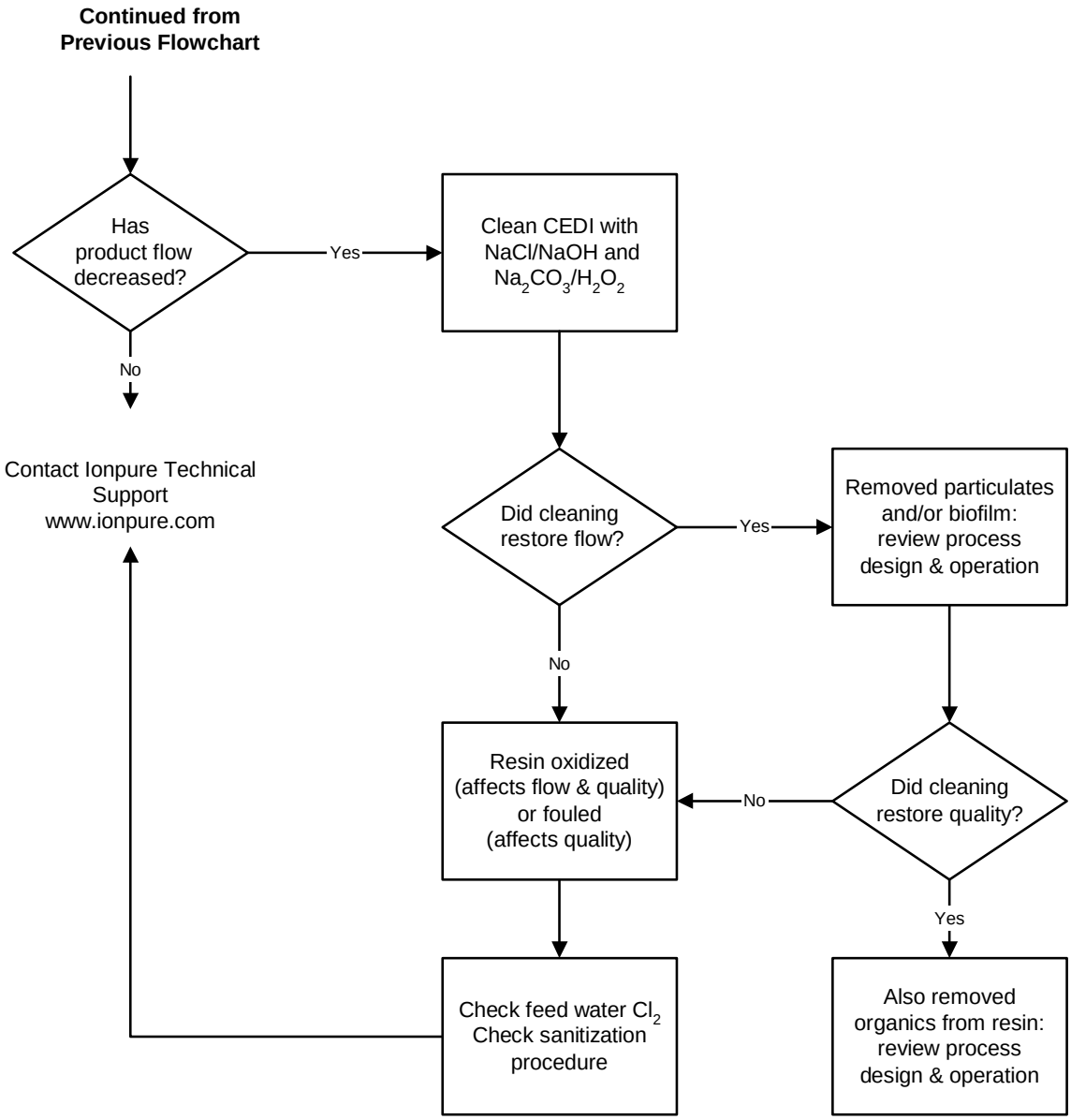


8. SHUTDOWN AND STORAGE

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

8.1. System Shutdown

- For off-line periods ≥ 7 days, follow steps below:
- Shut off feed water to LX module(s).
- Drain standing water out of LX module(s).
- Close isolation valves to prevent evaporation of water in membranes and resins.

8.2. Startup After Shutdown

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

8.3. Rebuild or Repair

- Ionpure presently rebuilds LX modules only at approved factories. Due to transportation costs, rebuilding Ionpure LX modules that are installed outside of North America may not be cost-effective compared to the cost of a new module. Contact your OEM or local Ionpure representative for details.

8.4. Disposal

- Perform a 5 minute once-through flush with DC power off using a 5% NaCl solution at a product flow rate between minimum and nominal flow, and at about 90% recovery.
- Then flush the modules with tap water (drinking water quality) at minimum flow (also with DC power off) for 10-30 minutes.
- The modules can then be discarded as normal (non-hazardous) waste.

APPENDIX A: LX MODULE SPECIFICATIONS

A.1 LX Module Dimensions and Weight

Module	Height inches (mm)	Width inches (mm)	Length inches (mm)	Shipping weight lbs (kg)	Service weight lbs (kg)
LX-04 HI	23.84 (605.5)	12.54 (318.5)	11.81 (300.0)	140 (64)	79 (36)
LX-10 HI	23.84 (605.5)	12.54 (318.5)	15.29 (388.6)	180 (82)	122 (55)
LX-18 HI	23.84 (605.5)	12.54 (318.5)	19.91 (505.7)	215 (98)	161 (73)
LX-24 HI	23.84 (605.5)	12.54 (318.5)	23.38 (593.9)	248 (113)	197 (89)
LX-30 HI	23.84 (605.5)	12.54 (318.5)	27.42 (696.5)	286 (130)	238 (108)
LX-45 HI	23.84 (605.5)	12.54 (318.5)	35.72 (907.3)	431 (196)	325 (148)
LX-04 EU, X, Z	23.84 (605.5)	12.54 (318.5)	10.12 (257.0)	130 (59)	69 (31)
LX-10 EU, X, Z	23.84 (605.5)	12.54 (318.5)	13.69 (347.7)	171 (78)	113 (51)
LX-18 EU, X, Z	23.84 (605.5)	12.54 (318.5)	19.22 (488.2)	217 (99)	163 (74)
LX-24 EU, X, Z	23.84 (605.5)	12.54 (318.5)	23.69 (601.7)	254 (115)	203 (92)
LX-30 EU, X, Z	23.84 (605.5)	12.54 (318.5)	27.42 (696.5)	291 (132)	243 (110)
LX-45 EU, X, Z	23.84 (605.5)	12.54 (318.5)	35.72 (907.3)	451 (205)	345 (157)

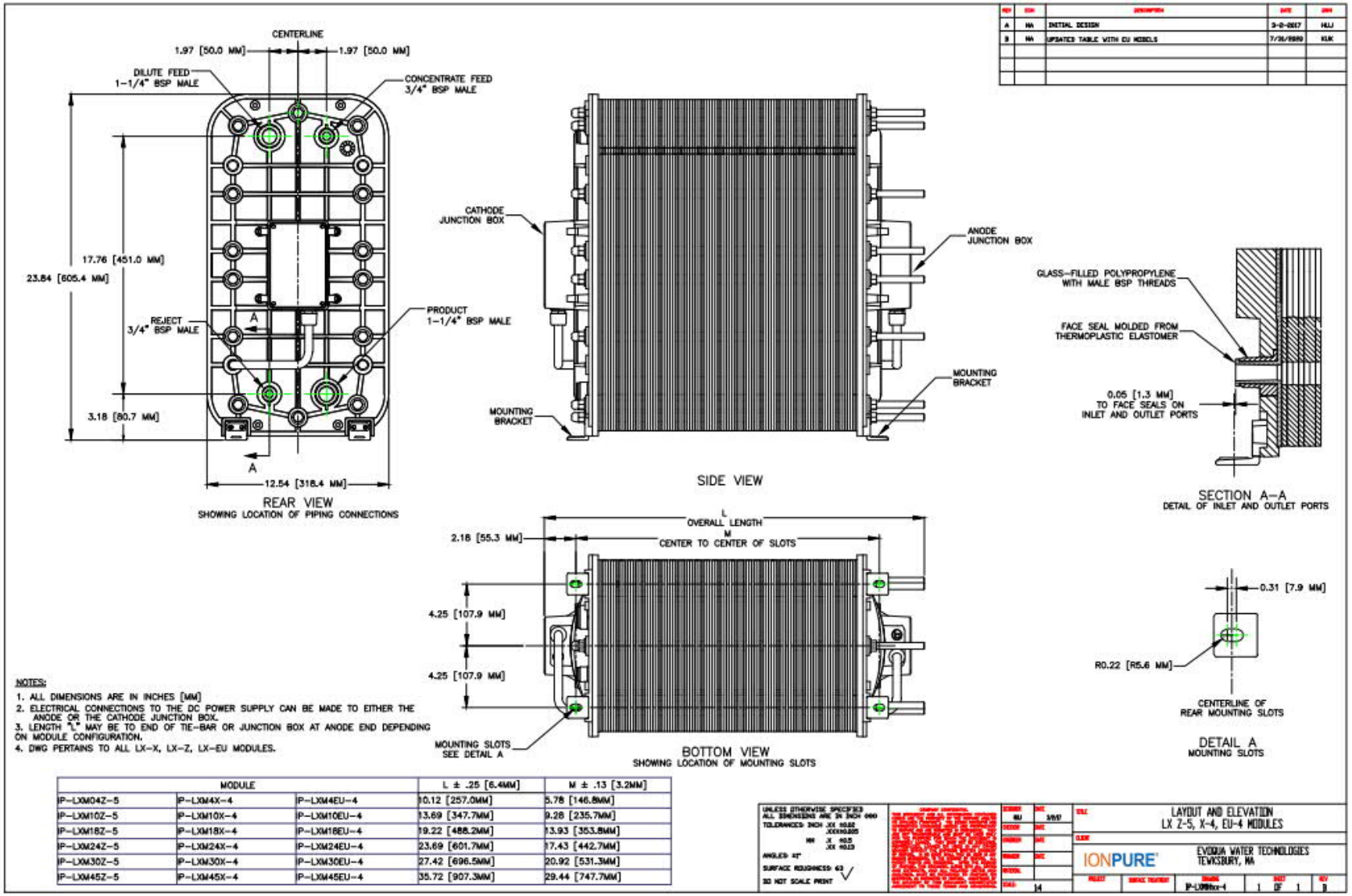
NOTE: shipping weight includes crate

A.2 Typical LX Module Flow Rates, Pressure Drops & Performance

Module		LX-04	LX-10	LX-18	LX-24	LX-30	LX-45
Product flow Minimum	gpm (m^3/hr)	1.0 (0.22)	2.5 (0.55)	4.5 (1.1)	6.3 (1.4)	7.5 (1.65)	11.3 (2.55)
Product flow Nominal	gpm (m^3/hr)	2.0 (0.44)	5.0 (1.1)	9.0 (2.0)	12.5 (2.8)	15.0 (3.3)	22.5 (5.1)
Product flow Maximum	gpm (m^3/hr)	3.0 (0.67)	7.5 (1.65)	13.5 (3.1)	18.8 (4.2)	22.5 (5.1)	33.8 (7.7)
Reject flow Minimum	gpm (L/min)	0.07 (0.26)	0.16 (0.61)	0.27 (1.02)	0.36 (1.36)	0.44 (1.67)	0.66 (2.50)
Typical ΔP for EU, X, Z @ nominal flow, 25°C	psid (bar)	25-37 (1.7-2.5)	25-37 (1.7-2.5)	25-37 (1.7-2.5)	25-37 (1.7-2.5)	25-37 (1.7-2.5)	25-37 (1.7-2.5)
Typical ΔP for HI @ nominal flow, 25°C	psid (bar)	20-30 (1.4-2.1)	20-30 (1.4-2.1)	20-30 (1.4-2.1)	20-30 (1.4-2.1)	20-30 (1.4-2.1)	20-30 (1.4-2.1)
FCE, µS/cm		≤ 40	≤ 40	≤ 40	≤ 40	≤ 40	≤ 40
Typical Product Resistivity, MΩ-cm * (EU, X, Z)		≥17.0	≥17.0	≥17.0	≥17.0	≥17.0	≥17.0
Typical Product Resistivity, MΩ-cm * (HI)		≥15.0	≥15.0	≥15.0	≥15.0	≥15.0	≥15.0
Feed temperature, EU, X, Z,	°F (°C)	41-113 (5-45)	41-113 (5-45)	41-113 (5-45)	41-113 (5-45)	41-113 (5-45)	41-113 (5-45)
Feed temperature, HI,	°F (°C)	41-140 (5-60)	41-140 (5-60)	41-140 (5-60)	41-140 (5-60)	41-140 (5-60)	41-140 (5-60)
Recovery, %		90-95	90-95	90-95	90-95	90-95	90-95

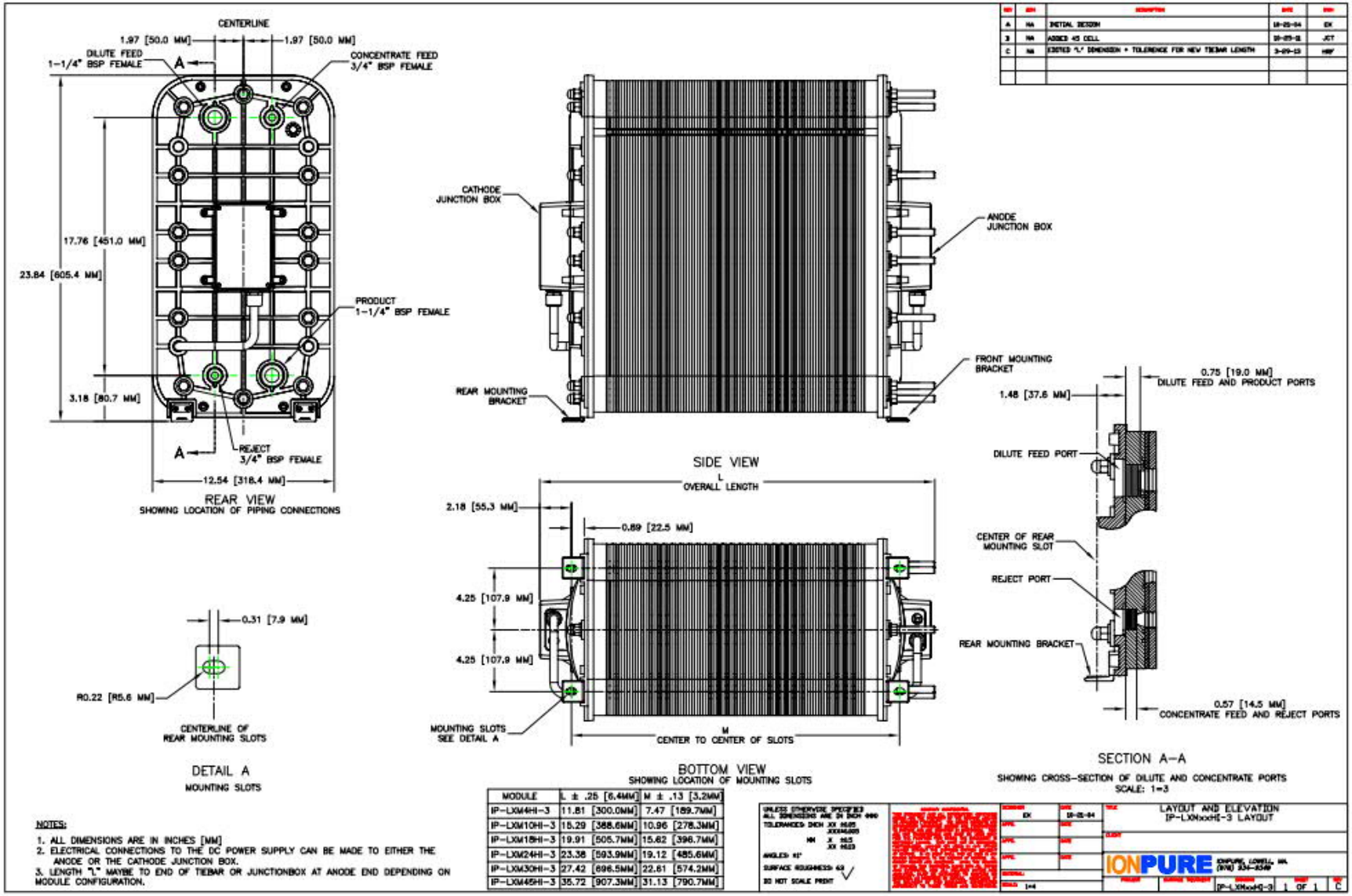
*** Above values are typical but may vary depending on site-specific operating conditions. Actual performance can be evaluated using IP-PRO projection software available from Ionpure. Contact Ionpure if specific performance guarantees are required.**

APPENDIX B1: LX LAYOUT & ELEVATION DRAWING (EU, X, Z)



MODULE			L ± .25 [6.4MM]	M ± .13 [3.2MM]
IP-LXM04Z-5	IP-LXM4X-4	IP-LXM4EU-4	10.12 [257.0MM]	5.78 [146.8MM]
IP-LXM10Z-5	IP-LXM10X-4	IP-LXM10EU-4	13.69 [347.7MM]	9.28 [235.7MM]
IP-LXM18Z-5	IP-LXM18X-4	IP-LXM18EU-4	19.22 [488.2MM]	13.93 [353.8MM]
IP-LXM24Z-5	IP-LXM24X-4	IP-LXM24EU-4	23.69 [601.7MM]	17.43 [442.7MM]
IP-LXM30Z-5	IP-LXM30X-4	IP-LXM30EU-4	27.42 [696.5MM]	20.92 [531.3MM]
IP-LXM45Z-5	IP-LXM45X-4	IP-LXM45EU-4	35.72 [907.3MM]	29.44 [747.7MM]

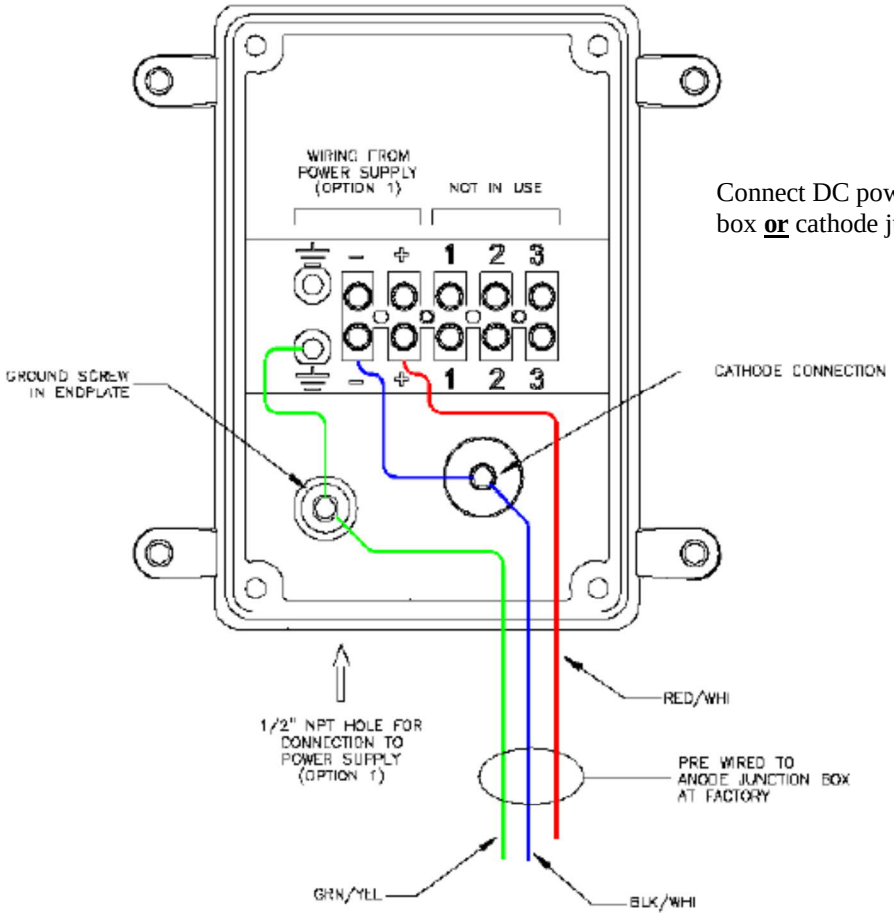
APPENDIX B2: LX LAYOUT & ELEVATION DRAWING (HI)



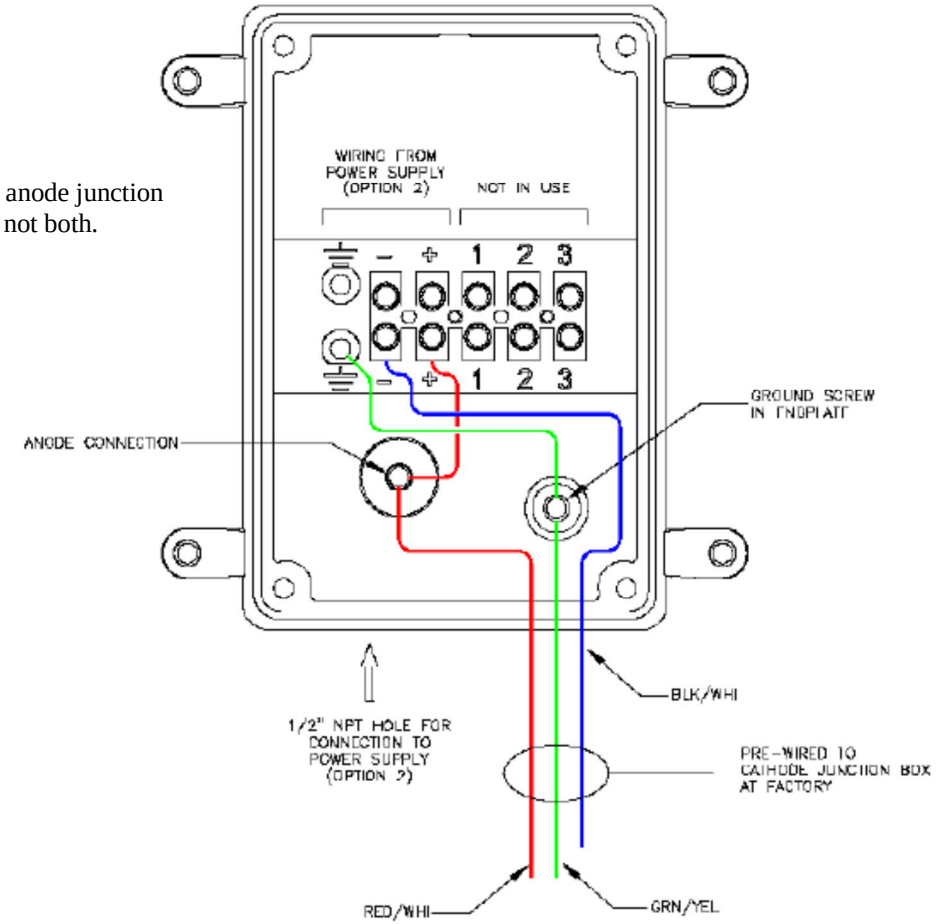
MODULE	L ± .25 [6.4MM]	M ± .13 [3.2MM]
IP-LXM4HI-3	11.81 [300.0MM]	7.47 [189.7MM]
IP-LXM10HI-3	15.29 [388.6MM]	10.96 [278.3MM]
IP-LXM15HI-3	19.91 [505.7MM]	15.62 [396.7MM]
IP-LXM24HI-3	23.38 [593.9MM]	19.12 [485.6MM]
IP-LXM30HI-3	27.42 [696.5MM]	22.61 [574.2MM]
IP-LXM45HI-3	35.72 [907.3MM]	31.13 [790.7MM]

APPENDIX B3: LX JUNCTION BOX DRAWING (ALL MODELS & SIZES)

Connect DC power supply to anode junction box **or** cathode junction box, not both.



FACTORY WIRING INSIDE CATHODE JUNCTION BOX



WIRING INSIDE ANODE JUNCTION BOX

APPENDIX C: LX ADAPTER LIST

Old Part Number	New Part Number	Description	Material	Module Type	Use
LBE0070	W2T211271	0.75" FBSP X MINI TRI-CLAMP	PP	EU, X, Z	Reject
LBE0071	W2T211272	1.25" FBSP X MAXI TRI-CLAMP	PP	EU, X, Z	Product
LBEP137	W2T211321	0.75" MBSP x 0.5" Tri-clamp	PP	HI	Reject
LBEP136	W2T211322	1.25" MBSP x 1.0" Tri-clamp	PP	HI	Product
	W3T17232	Gasket set for LX HI	Neoprene	HI	Both
9925	W2T210206	Nut, 1-1/4” FBSP	PP-20% GF	EU, X, Z	Product
9926	W2T210207	Barb, 1” ID Hose	PP-20% GF	EU, X, Z	Product
9927	W2T210546	Nut, 3/4” FBSP	PP-20% GF	EU, X, Z	Reject
9928	W2T210547	Barb, 3/4” ID Hose	PP-20% GF	EU, X, Z	Reject

APPENDIX D: LX MATERIALS OF CONSTRUCTION & APPROVALS

All IONPURE CEDI Modules

Wetted Component	Material	US / FDA*	EU
Anion Exchange Membrane	Heterogeneous: PE/AER	21 CFR 173.20	2002/72/EC[1]
Cation Exchange Membrane	Heterogeneous: PE/CER	21 CFR 173.20	2002/72/EC[1]
Anode[2]	Platinized titanium	N/A	N/A
Cathode[2]	316 stainless steel	N/A	N/A
Ion exchange resin	Styrene/DVB	21 CFR 173.25	N/A

LX-HI: Hot Water Sanitization Pharmaceutical‡

Wetted Component	Material	FDA* (US)	NSF (US)	EU
Dilute & Concentrate Spacer	Polysulfone	21 CFR 177.1655	ANSI/NSF 61[3] ANSI/NSF 51[4]	EC 1935/2004
End-Block	Polypropylene	21 CFR 177.1520 21 CFR 182.70 21 CFR 182.90 21 CFR 175.300	N/A	EC 1935/2004
O-rings	Silicone Rubber	21 CFR 177.2600	N/A	EC 1935/2004[7] EC 10/2011

APPENDIX D: LX MATERIALS OF CONSTRUCTION & APPROVALS (Continued)

LX-EU: European Union (non-HWS)

Wetted Component	Material	FDA* (US)	NSF (US)	EU
Dilute & Concentrate Spacer	Polysulfone	21 CFR 177.1655	ANSI/NSF 61[3] ANSI/NSF 51[4]	2002/72/EC
Endblock Gaskets	Thermoplastic Elastomer (TPE)	21 CFR177.2600[8]	ANSI/NSF 51	2003/11/EC
O-rings	Silicone Rubber	21 CFR 177.2600	N/A	EC 1935/2004[7] EC 10/2011

LX-X: Food and Beverage and Pharmaceutical (Non-HWS)

Wetted Component	Material	FDA* (US)	NSF (US)	EU
Dilute & Concentrate Spacer	CPVC	N/A	ANSI/NSF 61[3] ANSI/NSF 14[6]	N/A
O-rings / Gaskets	Thermoplastic Elastomer (TPE)	21 CFR177.2600	ANSI/NSF 51	2003/11/EC

LX-Z: General Industrial Modules

Wetted Component	Material	FDA* (US)	NSF (US)	EU
Dilute & Concentrate Spacer	CPVC	N/A	ANSI/NSF 61[3] ANSI/NSF 14[6]	N/A
O-rings / Gaskets	Thermoplastic Elastomer (TPE)	21 CFR177.2600	ANSI/NSF 51	2003/11/EC

Appendix D footnotes

* United States FDA, Title 21 of the Code of Federal Regulations (CFR 21) as safe to use in contact with food

‡ LX-HI Spacer material in compliance with United States Pharmacopeia (USP) criteria for Class VI Plastics.

[1] Polyethylene binder ONLY, does not apply to ion exchange resin powder COMMISSION DIRECTIVE 2002/72/EC of 6 August 2002 relating to plastic materials and articles intended to come into contact with foodstuffs. See COMMISSION DIRECTIVE 2002/72/EC of 6 August 2002; Article 1 (3).

[2] Cathode & Anode are only in contact with reject stream.

[3] ANSI/NSF 61 – Drinking Water System Component – Health Effects

[4] ANSI/NSF 51 – Plastic Material and Components Used in Food Equipment

[5] Olefin polymers

[6] NSF/ANSI 14-2015 – Plastic Piping System Components and Related Materials

[7] Approximation of the laws of the Member States relating to materials and articles intended to come into contact with foodstuffs

[8] INDIRECT FOOD ADDITIVES: POLYMERS, Rubber articles intended for repeated use.