ETS·LINDGREN®
An ESCO Technologies Company

LRW Series Filters
Single & Dual Line Filters

Installation and Maintenance Manual

December 2019

1705591 Rev B

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Revision Record
MANUAL, LRW SERIES FILTERS | Part # 1705591 Rev A

Revision	Description	Date
A	Initial Release	September, 2019
B	Note added to Maintenance section	December, 2019

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NOTES, CAUTIONS, AND WARNINGS

	**Note:** Denotes helpful information intended to provide tips for better use of the product.
CAUTION	**Caution:** Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.
WARNING	**Warning:** Denotes a hazard. Failure to follow instructions could result in **SEVERE** personal injury and/or property damage. Included text gives proper procedures.

SAFETY INFORMATION

	**Refer to Manual:** When product is marked with this symbol, see the instruction manual for additional information. If the instruction manual has been misplaced, download it from www.ets-lindgren.com, or contact ETS-Lindgren Customer Service.
	**High Voltage:** Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.
	**High Voltage:** Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.
	**Protective Earth Ground (Safety Ground):** Indicates protective earth terminal. You should provide uninterruptible safety earth ground from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

See the ETS-Lindgren **Product Information Bulletin** for safety, regulatory, and other product marking information.

GENERAL SAFETY CONSIDERATIONS

	Before power is applied to this instrument, ground it properly through the protective conductor of the AC power cable to a power source provided with the protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal could result in personal injury.
 	Before servicing: contact ETS-Lindgren – servicing (or modifying) the unit by yourself may void your warranty. If you attempt to service the unit by yourself, disconnect all electrical power before starting. There are voltages at many points in the instrument which could, if contacted, cause personal injury. Only trained service personnel should perform adjustments and/or service procedures upon this instrument. Capacitors inside this instrument may still be CHARGED even when instrument is disconnected from its power source.
	Only qualified personnel should operate (or service) this equipment.

INTRODUCTION

ETS-Lindgren's LRW Series single and dual line filters are all UL Listed. LRW series filters come with mounting penetration and hardware for direct installation through a shielded wall. All LRW Power Line Filters are designed and manufactured to the most current version of UL-1283 and in accordance with the Low Voltage Directive (2006/95/EC) and IEC 60939.

ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren Product Information Bulletin included with your shipment for the following:

- Warranty information
- Safety, regulatory, and other product marking information
- Steps to receive your shipment
- Steps to return a component for service
- ETS-Lindgren calibration service
- ETS-Lindgren contact information

PRECAUTIONS

WARNING

LETHAL VOLTAGES PRESENT. THIS UNIT SHOULD BE INSTALLED AND MAINTAINED BY A QUALIFIED ELECTRICIAN.

AUTOMATIC BLEEDER RESISTORS DISCHARGE THE CAPACITORS TO 50 V FIVE (5) SECONDS AFTER POWER IS REMOVED.

USE A SHORTING STICK TO TOUCH ALL EXPOSED METAL SURFACES PRIOR TO TOUCHING THE FILTER.

FILTER COMPONENTS

Filter Elements

The filter consists of filter components enclosed in a filter can and termination connections.

There are **NO USER SERVICEABLE PARTS** inside the filter.

Should a filter be determined to be defective, contact ETS-Lindgren to order a replacement or to schedule its return or replacement.

Terminations

Input

Only qualified personnel should operate or service this equipment.

The source conductors are brought through an opening made in the field on the dirty side wiring compartment of the filter. The opening should be of sufficient diameter to allow the free passage of conductors. The conductors should then be directly terminated to the filter terminals or lugs (if provided), or equivalent.

Output

The output conductors are brought into the clean side wiring compartment of the filter through a conduit penetration (if provided) or a circular opening in the back of the filter panel. The conductors should then be directly terminated to the filter terminals or lugs (if provided), or equivalent.

The output terminals of the filter are EMI isolated from the inputs.

Filter Penetrations

All filter penetrations include attached conductive elastomeric gaskets to maintain shielding effectiveness and environmental seal.

Automatic Discharge

Some signal filter contain bleeder resistors that will automatically reduce the voltage on any component to less than 50 V within five (5) seconds after the removal of input power. Contact ETS-Lindgren for details. Always discharge filters as described in the SHORTING STICK section of this manual.

Shorting Stick (Not Provided)

Only qualified personnel should operate or service this equipment.

A shorting stick (grounding rod) should be used by qualified service personnel to ensure all capacitors and other energy storage elements are discharged and in a safe state. All terminals accessible to service personnel and capable of retaining stored energy in the event of automatic discharge circuit failure are accessible and should be shorted to ground with a shorting stick or equivalent.

ELECTRICAL PERFORMANCE CHARACTERISTICS

Voltage (RMS)

60 Hz Filters -- Nominal	
Line-to-Ground	0 - 277 VAC / 300 VDC
Line-to-Line	0 - 480 VAC / 600 VDC

The filter may operate with DC voltages or lower frequencies up to the maximum rated AC voltage.

Operating filters without power correction coils will cause excessive reactive current to flow even with no load present.

Voltage Drop

The total AC voltage drop from input to output is designed to be no more than 1% of the rated voltage, when measured into a unity power factor.

Overload Current

The filter can withstand an overload current of 1.4 times the rated current in amperes for a period of fifteen (15) minutes and maintain filtering during this period per MIL-F-15733. The filter can also survive without degradation or damage, a short circuit current of 10,000 A for five (5) cycles.

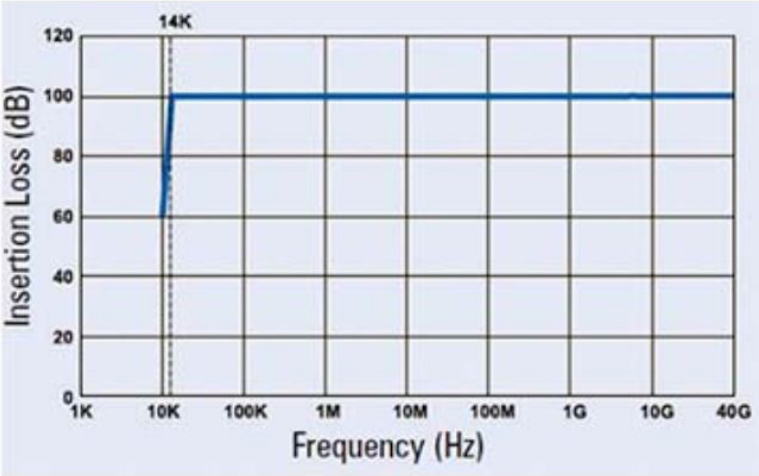
Power Filter Characteristics

UL listed filters will bare a UL listing label. LRW series filters comply with current revisions of MIL-F-15733, UL-1283, and IEC60939.

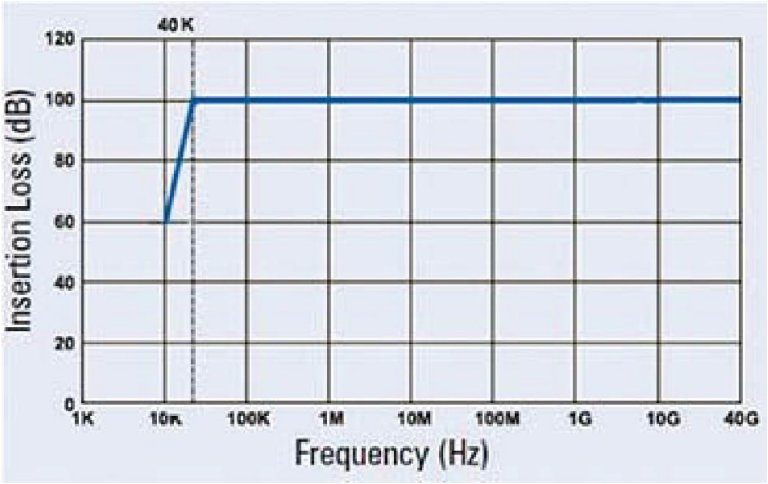
Insertion Loss (Stop Band)

Insertion loss for the LRW series filters is 100 dB minimum from 14 kHz to 40 GHz per MIL-STD-220.

Series LRW Insertion Loss No Load (14K)

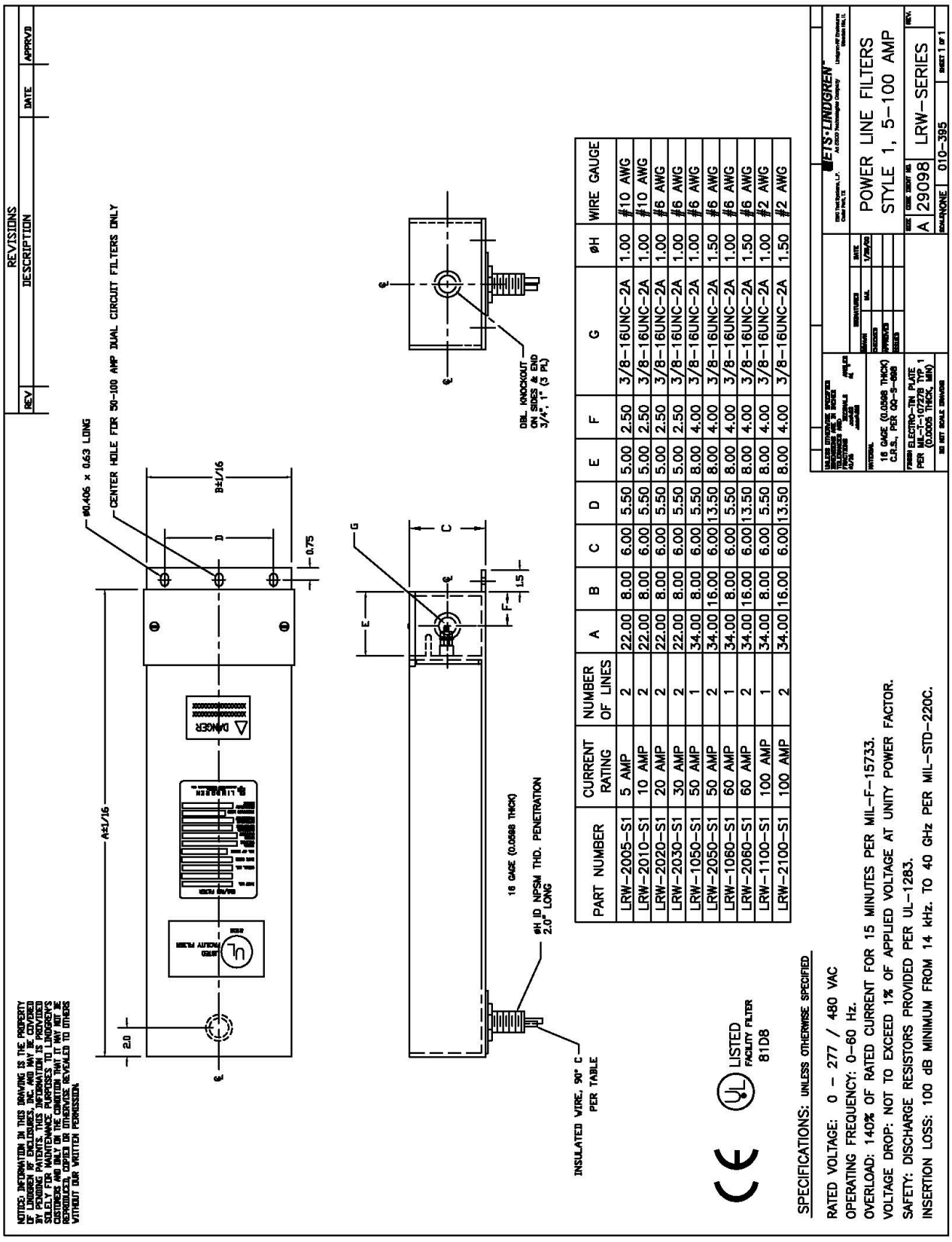


Series LRW Insertion Loss Full Load (40K)



Current, Physical, and Environmental Specifications

As specified on filter label. Filter may be operated up to the filter's rated maximum current. This is an RMS rating and is a continuous 100% duty cycle rating. The filter may be operated on DC up to the same rating.



ENVIRONMENTAL SPECIFICATIONS

Attribute	Operating	Non-Operating
Temperature	-45° C to + 65° C	-55° C to +85° C
Altitude	Sea Level to 8,000 ft	Sea level to 40,000 ft
Humidity	Relative humidity between 10% and 90% at air temperatures between +25° C and +32° C	Relative humidity as low as 14% at an air temperature of +71° C and as high as 100% at temperatures from -33° C to +33° C with condensation at all temperatures lower than +30° C

INSTALLATION

Uncrate all parts. Check all parts for any shipping damage. Ensure adequate space is available for installing the filter.

CAUTION Electrical connection should only be performed by a qualified electrician and in compliance with all applicable regulatory agencies.

Connection to the filter should be made by qualified electricians. Refer to the TERMINATIONS section for further details.

Wiring should be done in accordance to the wiring schematic provided in the ILLUSTRATIONS section of this manual and applicable local and national electrical codes and guidelines.

Installation of the conduit penetration and EMI gasket should be done in accordance with the drawing provided in the ILLUSTRATIONS section of this manual.

If a power correction coil needs to be installed, follow the wiring schematic provided in the ILLUSTRATIONS section of this manual.

POWER ON

Prior to applying power to the filter, verify wiring is correct. Use an ohmmeter to verify there are no shorts from any line to ground or neutral.

CAUTION Electrical wiring verification should only be performed by a qualified electrician and in compliance with all applicable regulatory agencies.

In-Rush Current

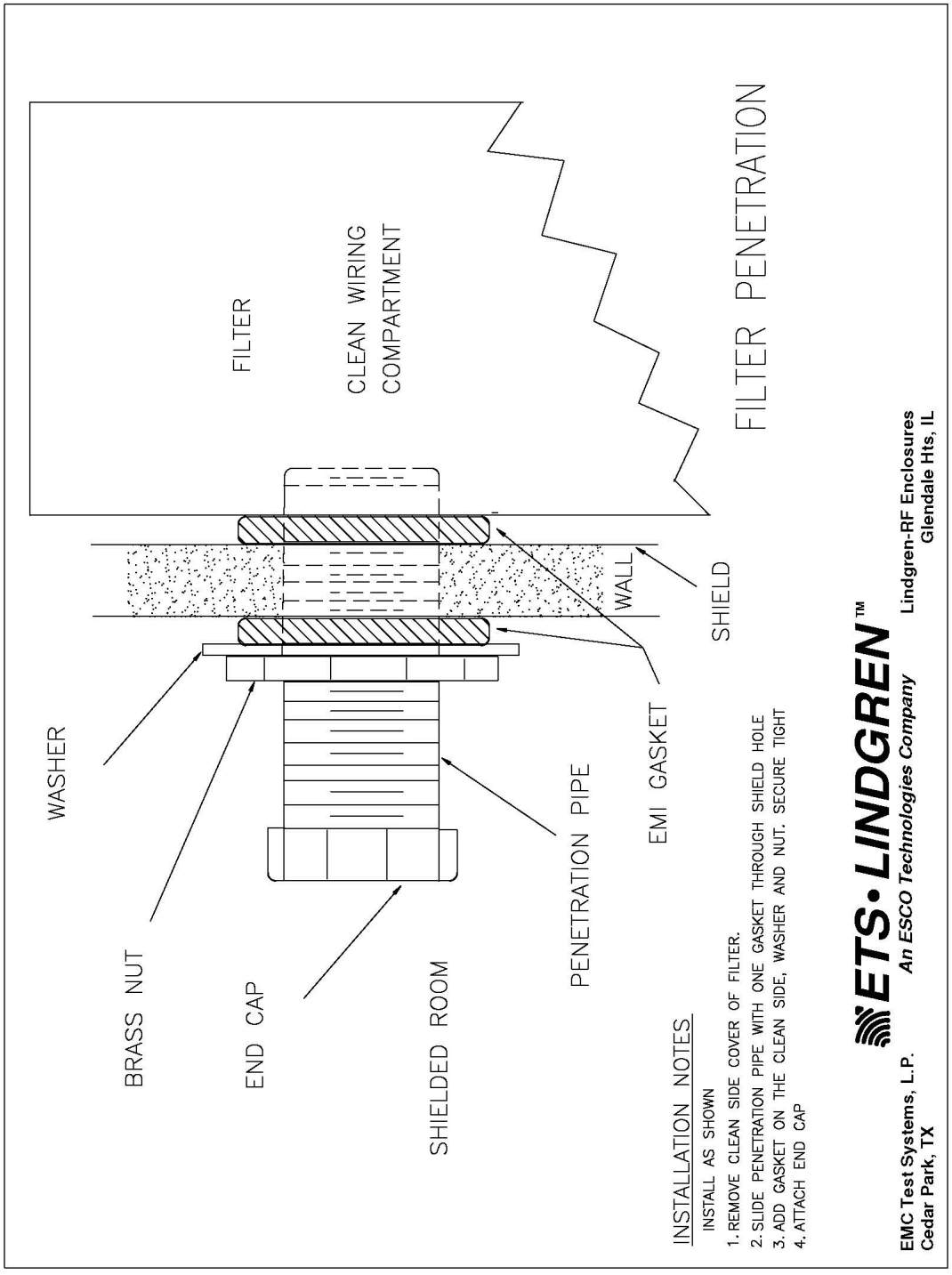
In-rush current is not a concern with filters as it is not a function of the rated current of the filter. In-rush current will be determined mainly by the load connected after the filters. The filter itself is capable of withstanding high in-rush currents created by the load for several seconds.

Reactive (Leakage) Current

Reactive current is the normal presence of current on the filter lines even when no load is connected. A closer examination of reveals that when voltage is applied to the filter, there will be a normal current drain. This normal current drain is usually around 10% to 15% of the rated current of the filter. The presence of this current does not indicate a problem unless it is above the level expected. Contact ETS-Lindgren for specific current drains for any particular filter model.

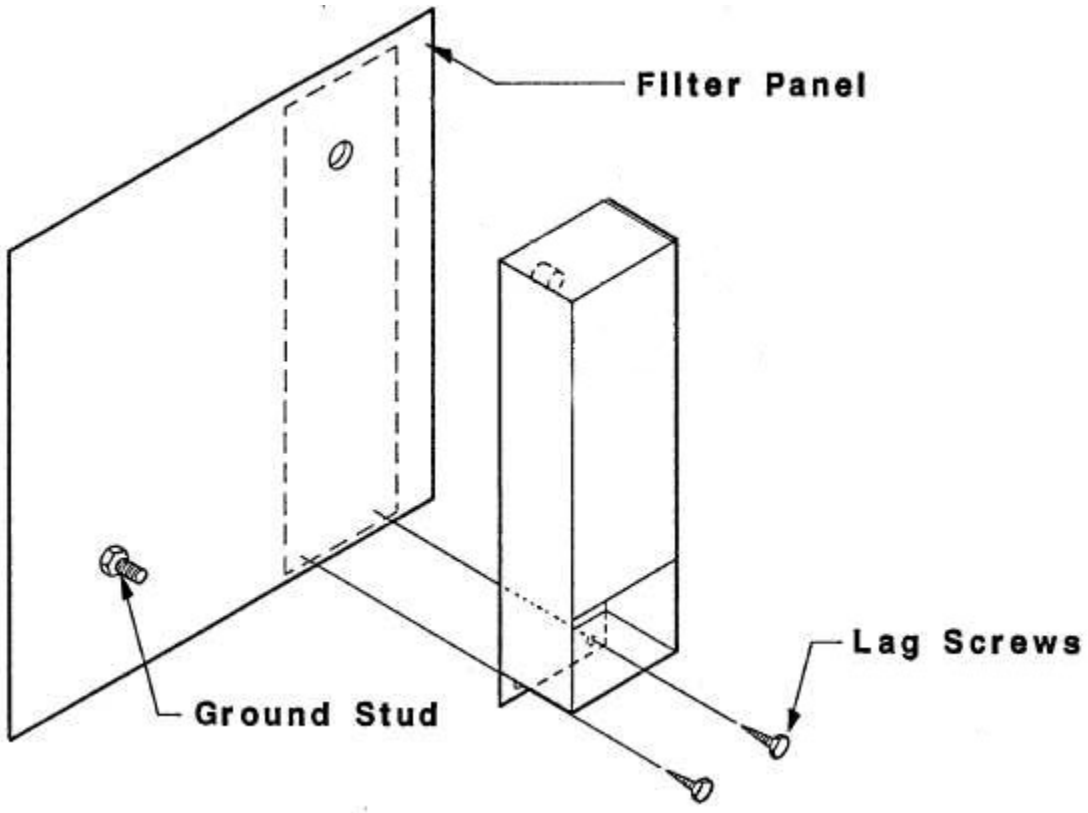
ILLUSTRATIONS

Filter Penetration



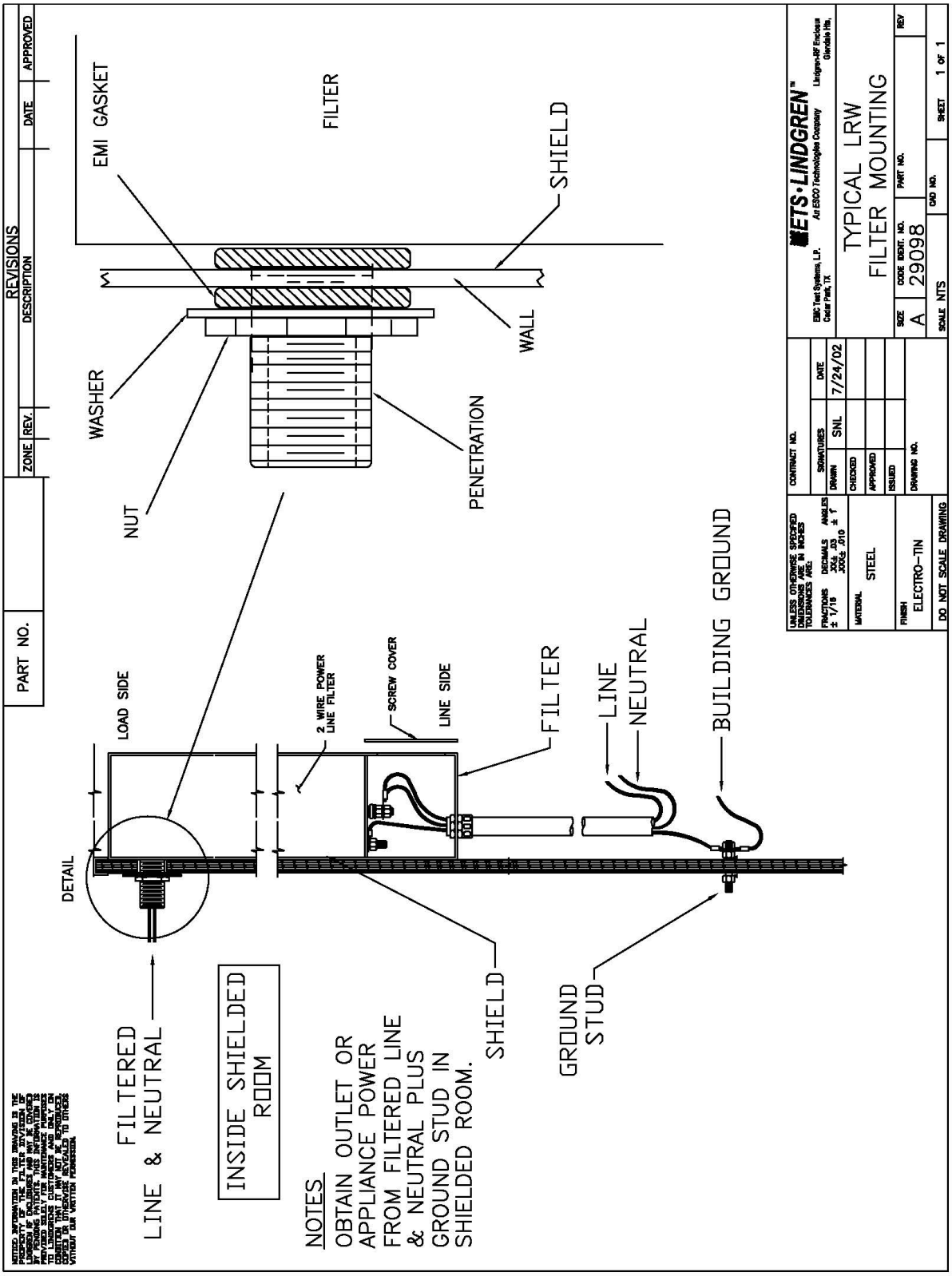
Filter penetrations should be installed as shown

Filter Installation On Shield



Installation on shield is straight forward as shown

Filter Mounting



Typical LRW Filter Mounting

MAINTENANCE

WARNING

LETHAL VOLTAGES PRESENT. RISK OF ELECTRIC SHOCK.

AFTER REMOVING POWER FROM THE UNIT, THE AUTOMATIC BLEEDER RESISTORS WILL DISCHARGE THE UNIT TO 50 V IN FIVE (5) SECONDS.

USE A SHORTING STICK (NOT INCLUDED) TO TOUCH ALL METALLIC SURFACES EXPOSED BEFORE TOUCHING THE FILTER.

Only qualified personnel should operate or service this equipment.

Periodically power down the filter and remove the wiring compartment lids to check inside for dirt, debris and corrosion. Oil, dirt, debris and corrosion inside the filter compartments should be removed according to appropriate procedures. User's own procedures for the removal of spills, dirt, debris and corrosion should suffice. Should EMI gasket become torn or unusable, contact ETS-Lindgren to order replacement part E-903-008 or E-903-016, depending on the size of filter.

Once a filter is properly installed it typically does not require maintenance under normal operating conditions. However, if there is an extraordinary event affecting the filters (such as a severe voltage overload or water entering the wiring compartments), then the following procedures should be followed depending on the nature of the event. Follow the INSPECTION AND CLEANING OF WIRING COMPARTMENTS procedure after an event that causes abnormal contamination of filter wiring compartments with liquid or debris. Follow the CAPACITANCE MEASUREMENT INSPECTION PROCEDURE following an event that causes abnormal voltage overloads or spikes beyond that which the filters are designed to accommodate.

Frequency of maintenance is at the discretion of the user and may be included in a routine maintenance schedule for the connected equipment. However, filters in clean, industrial environments typically do not require maintenance.

Inspection and Cleaning of Wiring Compartments

1. Remove power from the filter(s).
2. Wait at least sixty (60) seconds, then remove the wiring compartment covers.
3. Short the filter terminals to the filter case using a conductive shorting stick (not included) to ensure that the filter capacitors are fully discharged.
4. Inspect the filter terminals and insulators for contamination and/or damage.
5. If the terminals or insulators are cracked or damaged replacement in the field is not possible. Call ETS-Lindgren for instructions.
6. Clean the terminals and insulators as necessary and remove any loose debris from the wiring compartments.
7. Re-install the wiring compartment covers. Ensure even compression of the RF gasket around the RF tight wiring compartment. Begin by torquing all of the cover screws to 1 N-m, starting in the center of each flange and working out towards the corners. Then using the same pattern torque all screws to 5 N-m.
8. Re-apply power to the filter(s).

Capacitance Measurement Inspection Procedure

1. Remove power from the filter(s).
2. Wait at least sixty (60) seconds, then remove the wiring compartment covers. Use a voltmeter to ensure no voltage is present.
3. Short the filter terminals to the filter case using a conductive shorting stick (not included) to ensure that filter capacitors are fully discharged.
4. Disconnect the phase and neutral electrical wiring from the electrical termination points.
5. Inspect the filter terminals and insulators for contamination and/or damage.
6. If the terminals or insulators are cracked or damaged replace the damaged component in accordance with the directions provided with the replacement part.
7. Measure the line to ground capacitance of each phase. Using an LCR bridge measure the capacitance of each phase at 120 Hz. Contact ETS-Lindgren for expected values (please provide model number of filter). The reading should be according to these values ±20%. A DF measurement should be done at the same time and recorded. DF readings above 0.08 should be noted and ETS-Lindgren should be called for advice before re-applying power to the filter.
8. Clean the terminals and insulators as necessary and remove any loose debris from the wiring compartments.
9. Re-install the phase and neutral electrical wiring to the electrical termination points. Torque the bolts and/or nuts to the specified torque noted next to the termination point.
10. Re-install the wiring compartment covers. Ensure even compression of the RF gasket around the RF tight wiring compartment. Begin by torquing all of the cover screws to 1 N-m, starting at the center of each flange and working out toward the corners. Then using the same pattern, torque all screws to 5 N-m.
11. Re-apply power to the filter(s).

WARRANTY STATEMENT

ETS-Lindgren Inc., hereinafter referred to as the Seller, warrants that the RF filters purchased under this contract will be free from defects in workmanship performed by the Seller, and will conform to the applicable specifications and/or drawings.

This warranty is limited to either giving credit, repairing or replacing with reasonable promptness after written notice from the buyer of such defect promptly after discovery of same and in no case later than the warranty period after shipment by Seller. The Buyer shall notify the Seller in writing of any defect and include a complete description of the defect within fourteen (14) days after discovery of same to allow the Seller to arrange for appropriate action to make good this warranty, should the Seller determine that the claim is valid.

This warranty does not extend to any portion of the material which has been subject to misuse, neglect, accident, installation or operations not in accordance with the Seller's installation Procedure, nor does it extend to any portion of the material which has been repaired or altered by other than the Seller. The Buyer, upon request shall furnish to the Seller reasonable evidence that the defect arose from causes other than those contained in the preceding sentence.

THIS WARRANTY IS EXCLUSIVE. NO OTHER WARRANTY, WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES PROVIDED BY THIS WARRANTY ARE THE BUYER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT IS THE SELLER LIABLE FOR ANY DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

If the Seller is required to take corrective action under the terms of this warranty, it shall be done at no cost to the Buyer. If after proper determination it is found that any claim of defect is indeed the result of causes not covered by this warranty, the Buyer shall pay all costs including reasonable profit to the Seller for expenses incurred during investigation of the Seller of the unwarranted claim.