
ASSEMBLY INSTRUCTIONS
for a
MODULAR CELL TYPE
RADIO FREQUENCY (RF) SHIELDED ENCLOSURE



LINDGREN RF ENCLOSURES

400 High Grove Boulevard
Glendale Heights, IL 60139

Phone: (630) 307-7200
Fax: (630) 307-7571

Issued: 05/24/94

NOTICE: Information in this manual is the property of Lindgren RF Enclosures, Inc. and may be covered by pending patents. This information is provided solely for maintenance purposes to Lindgren RF Enclosures' customers and only on condition that it may not be reproduced, copied or otherwise revealed to others without our written permission.

MODULAR-CELL TYPE ASSEMBLY INSTRUCTIONS

TABLE OF CONTENTS

1. INTRODUCTION

- A. General
- B. Tools
- C. Preparation of Area

2. INSTALLATION

- A. General, Quality Control
- B. Material Description
- C. General Procedure
- D. Floor
- E. Walls
- F. Doors
- G. Ceiling
- H. Final Inspection

3. ELECTRICAL POWER

4. HEATING, VENTILATION, & AIR CONDITIONING

5. TESTING

6. FINAL

- A. Maintenance
- B. Certification

7. LAYOUT DRAWING

8. ENCLOSURE BROCHURE

9. ANECHOIC ABSORBER DATA SHEETS

1. INTRODUCTION

A. GENERAL

The purpose of any RF shielded enclosure is to provide a controlled environment in the presence of electromagnetic energy (radio waves). This is accomplished by sealing a six sided metal shield with essentially no holes which would permit these same electromagnetic waves to penetrate.

Lindgren's Modular-Cell Shielded Enclosure accomplishes maximum shielding effectiveness without requiring full soldering by virtue of positive contact of clean metal to metal surfaces under pressure. For this reason it is imperative that the panel be properly inserted into the framing members and that all screws be installed and tightened securely to provide positive and continuous mechanical contact. If this is not accomplished, the overall performance of the enclosure will be greatly affected and deficiencies will be noted when an RF Test is performed.

B. TOOLS

The following tools will be required:

- Screw gun w/ adjustable torque (Hilti preferred)
- Torx head bits (supplied by Lindgren)
- Ladder, minimum height 8', maximum height depends on enclosure size
- "T" Brace made from 2 x 4 lumber will be required for spans > 9 feet
- 3 Foot level
- Plumb bob
- Awl
- (2) Standard screw drivers
- (2) 1" Putty knives
- (1) Utility Knife
- Work horses or platform

In addition, a small amount of de-greasing solvent will be necessary. Use a chemical such as 1,1,1-trichloroethane. **WARNING: This chemical is hazardous, it is essential that the manufacturer's instructions for use, handling, and storage be read and followed by all persons using this chemical.** Denatured alcohol is also acceptable for cleaning and is preferred.

C. PREPARATION OF AREA

A suitable working area is required to store and sort the materials. This should be approximately as large as the enclosure to be erected and adjacent to it. Refer to the packing list to determine sequence required for opening crates in order to insure that the material will be available as needed.

The area in which the RF shielded enclosure is to be erected must be clean, dry, and free of any obstructions. The enclosure should not make contact with any metal surface, i.e., pipe, ducts, conduits, etc. For proper installation, the floor surfaces must be clean, smooth, and level to within 1/8" over 10 feet measured diagonally between corners.

2. INSTALLATION

A. GENERAL, QUALITY CONTROL

Panels are carefully inspected by Lindgren prior to shipment, but nevertheless, we suggest a physical inspection of all panels and edges. To remove dents, burrs, or any deformities which may have occurred in shipment, handling etc., carefully flatten them out with a hammer. If punctures are evident, repair the holes with solder.

Mark off with a chalk line the floor area being careful to conform to all dimensions as indicated on the drawings. Make certain that the diagonal dimensions are double checked for squareness.

B. MATERIAL DESCRIPTION

1. Standard floor, wall, and ceiling panels without notches or cutouts and identical in appearance, will be identified with a prefix or number, per the drawings as follows, see Figure 1: Legend :

- 4'-0" x 8'-0" panels will be marked their counterpart number per the drawings
- 4'-0" x 10'-0" will be marked their counterpart number per the drawings
- Odd size panels will be marked with their counterpart number per the drawings

2. All other panels such as prefabricated corners and trenches will be identified with a prefix or number, per the drawings, similarity as follows, see Figure 1: Legend :

3. The floor, wall, and ceiling framing members consist of hat channels & flat pieces as well as U & W coves. These framing members are attached with 1/4"-20 screws x 3/4" and 1-1/2" long. They are identified with a FJ, WJ, or CJ prefix part number, which will correspond to the notations on the enclosed drawings.

4. In the event that the section contains two or more places to make up the required length, refer to the cutting schedule. Cove sections are respectively identified with FJC, WJC, CJC, PJC prefixes on their part numbers.

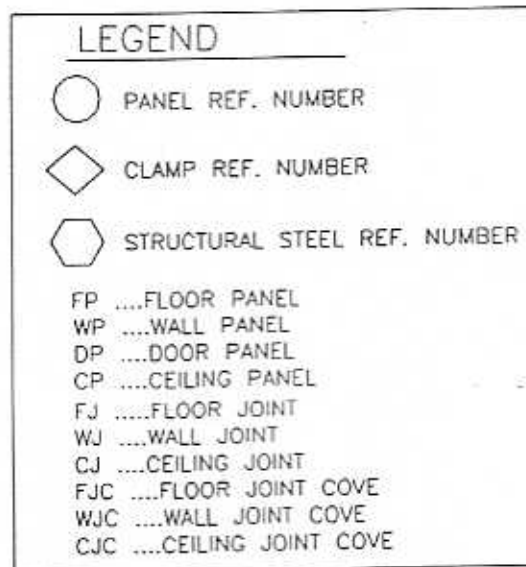


FIGURE 1: LEGEND

C. GENERAL PROCEDURE

The installation of all panels is such that a clearance exists between the panel edge and the hat channel and coves. For this reason, proper installation requires extreme care to insure that the dimensions and location of framing members be exactly as indicated on the drawings. If this is not followed, the room will be improperly installed.

You must maintain the $3/4"$ spacing between the panels and $1-3/16"$ from outside face of shield to edge of floor, ceiling and wall panel. See Figure 2.

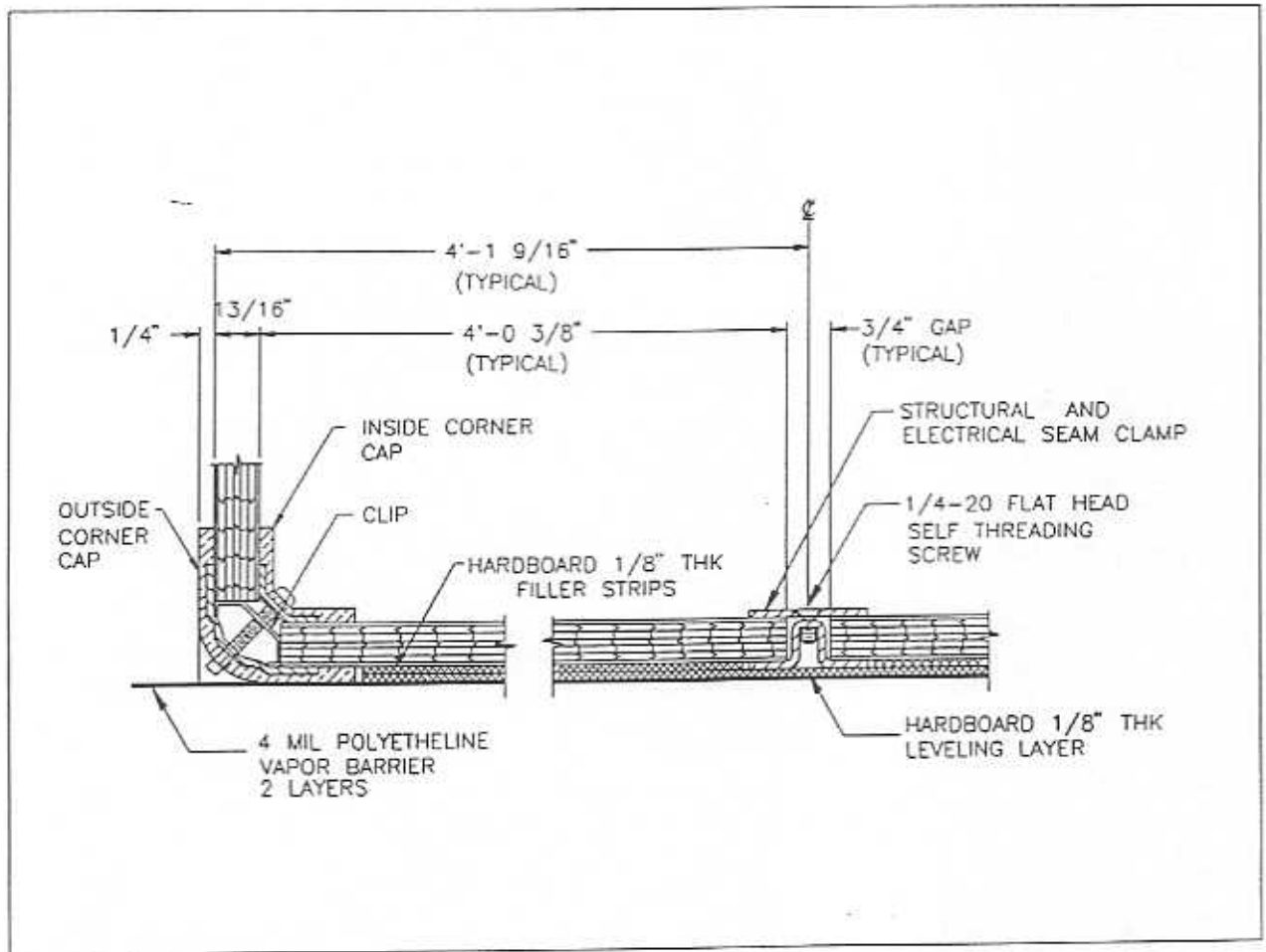


FIGURE 2: SECTION @ FLOOR/WALL CORNER

D. FLOOR

Prior to the installation of hat sections, remove a 2" flat and wipe clean all contact surfaces with a cleaning agent. Wipe all panel edges with the same solvent to insure no oil or fingerprints remain on the contact areas.

Before starting the installation, sweep clean the floor on which the enclosure is to be erected. Then lay down the 6 Mil polyethylene sheet which is furnished. Then lay down over the polyethylene the 1/8" thick hardboard leveling layer which is furnished. See Figure 2.

Standing at the far end of the floor, lay down the hat channels, hardboard filler strips, floor panels, and the perimeter cove assemblies. The center line of the first butt joint will be 4'-1-9/16" to the outside face of the enclosure. See Figure 2.

The 1/8" thick hardboard leveling layer must be notched for corner caps, 5" x 5". Then take a piece of the polyethylene 2'-0" square and fold it into a triangle and put it under the 6 Mil polyethylene in each corner, making three layers of polyethylene to prevent the corner cap from grounding.

The other floor panels and framing members are located such that the center line dimension will be 4'-0 3/4". When these dimensions and diagonals have been checked, all intermediate screws are put in place and tightened to 90 inch pounds torque. The floor section is now complete.

Refer to Figure 4 for the proper installation of the copper foil for all framing joints and room corners. Refer to Figure 3 for the insertion of RF steel mesh plugs. Note RF plugs are not required for hospital and corona room installations. They are required on high performance enclosures such as anechoic chambers.

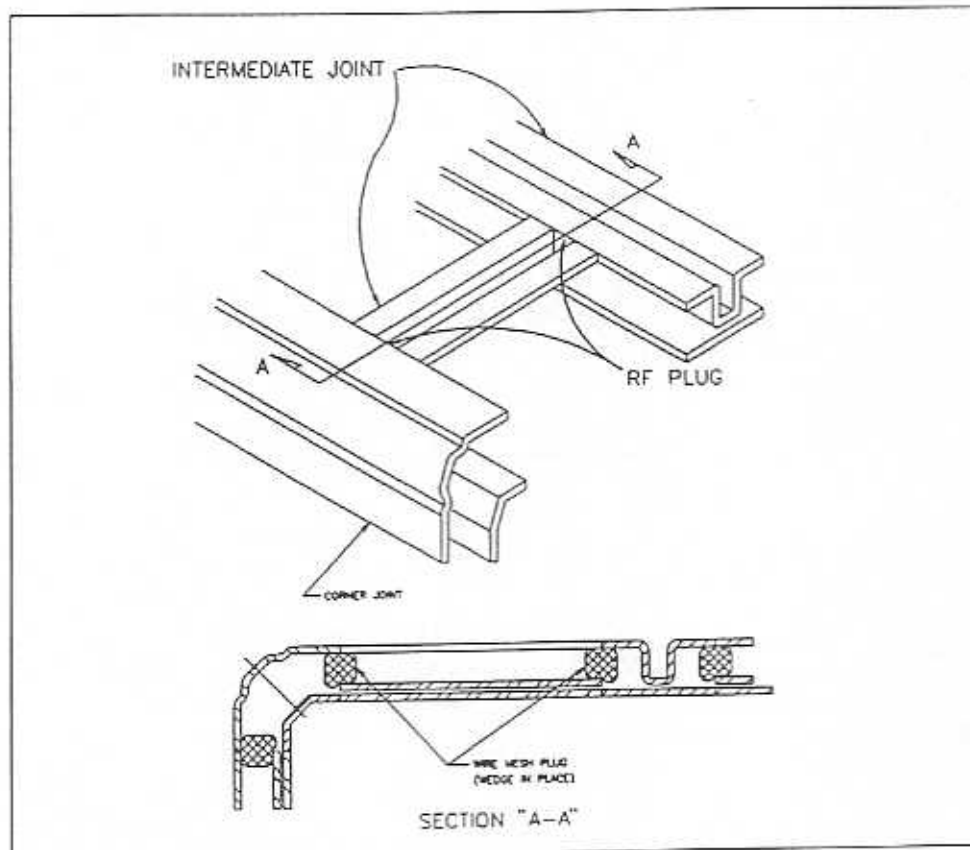


FIGURE 3: MESH PLUG INSERTION

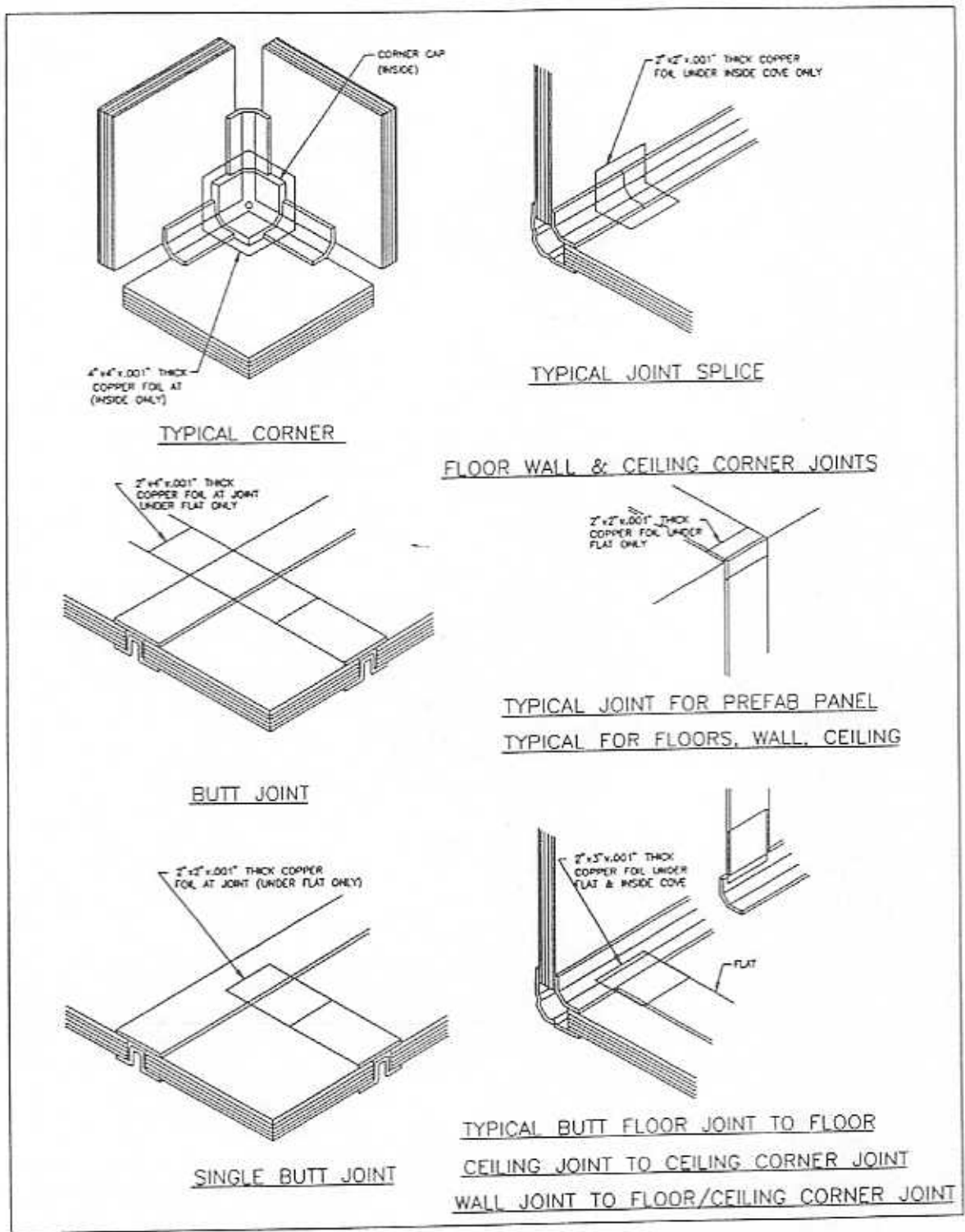


FIGURE 4: COPPER FOIL INSERTION

E. WALLS

The next operation is the construction of the far corner wall. For location of each panel, see plans. The cove assemblies have been installed under the first step of "D Floors".

The inside cove is next bolted loosely to the outside cove to hold the two parts in temporary alignment. Install one corner wall panel in cove section of the wall; panel should be in line with each edge of the floor panel. Tighten three (3) screws at each side wall panel; make sure the chair clip is seated; then tighten the rest of screws. Set outside section of corner cap in place. Install second corner wall panel with the same procedure as the first, holding the vertical section loosely in the corner. Then tighten screws in the vertical cove, making certain the wall panels are against the chair clips. Install the inside section of the corner cap. See Figure 2. Tighten all bolts at vertical cove to 90 inch pounds torque. This corner is now complete.

The same procedure is followed at the opposite corner of the short dimension. Extreme care must be taken that these corners are both plumb and level to insure proper alignment of other parts. After the corner wall coves have been securely tightened, install the plastic caps over the protruding screws at exposed corners to protect personnel from these screws.

The intermediate wall panels are now put in place and again the alignment of framing members is carefully checked. Care must be taken to insure that the vertical framing members rest on the inside sheet with gaps of no greater than 1/16". If excessive space exists, it is an indication that the relationship between the wall panels and the outside cove at the floor is wrong. Recheck the dimensions since all parts are jig cut, improper fit in the field is impossible if the floor is level and the parts are positioned properly. Proceed with all the walls in the same manner checking plans for location of special panels such as doors, service panels, vents, etc.

F. DOORS

Install doors utilizing a carpenter's level or plumb bob and insure panel is plumb and level before tightening framing screws at periphery of door. Doors are installed identical to wall panels due to their jamb style.

G. CEILING

The ceiling panels are installed last. The inside and outside coves are loosely bolted together at the ceiling starting at end wall; panels are properly positioned. If the previous instructions have been followed carefully, placing the ceiling panel in position against the shoulder of the outside wall will place everything in correct alignment. The corner caps are installed and the bolts on the corner channels tightened to 90 inch pounds. Proceed in a similar manner to install the intermediate ceiling panels using the "T" brace until the framing member can be tightened. Check line dimensions as described for the floor.

Inside corner cap must be lined with two (2) pieces of copper foil. After installing cap cut off excess foil.

H. FINAL INSPECTION

The Modular Cell Enclosure is designed in such a manner that a maximum of 1/16" clearance may occur where framing members meet or intersect. If gaps in excess of this are visible, the installation is improper and all dimensions should be rechecked to pull in the panels and framing members.

After all panel parts are installed in place, examine the room carefully to insure that there are no gaps between the various panel members nor panel edges visible. Recheck the enclosure to be assured that you have good pressure contact and that all bolts are at 90 inch pounds torque. This tightening procedure should be repeated so that the entire room has been tightened twice.

See figure 4 for copper foil installation and figure 3 for mesh plug installation. At times, additional packing of bronze wool is needed inside the corner caps, IJC and miter corners.

3. ELECTRICAL POWER

All wires entering this enclosure will have to be provided with suitable RF filters. The shield room will effectively eliminate airborne radiated RF signals but power line filters must be provided to eliminate the same signals from being conducted into the area with the power lines or other wires. Normally these filters will have the same attenuation and frequency range as the shielded room and one will be as effective as the other.

1. Prior to assembling the filter to the panel, the periphery of the hole, filter flange nut, and the 1" threaded penetration are to be wiped with a cleaning agent.

Insert the 1" penetration through the hole, from the outside of the room and secure the filter with the brass flange nut furnished.

The flange nut must be tightly secured, as in addition to supporting the filter, it provides the electrical bonding of the filter to the shield. See Figure 5. The filter flange may never be used to secure any other item to the wall. See Figure 6 for multiple filters installation.

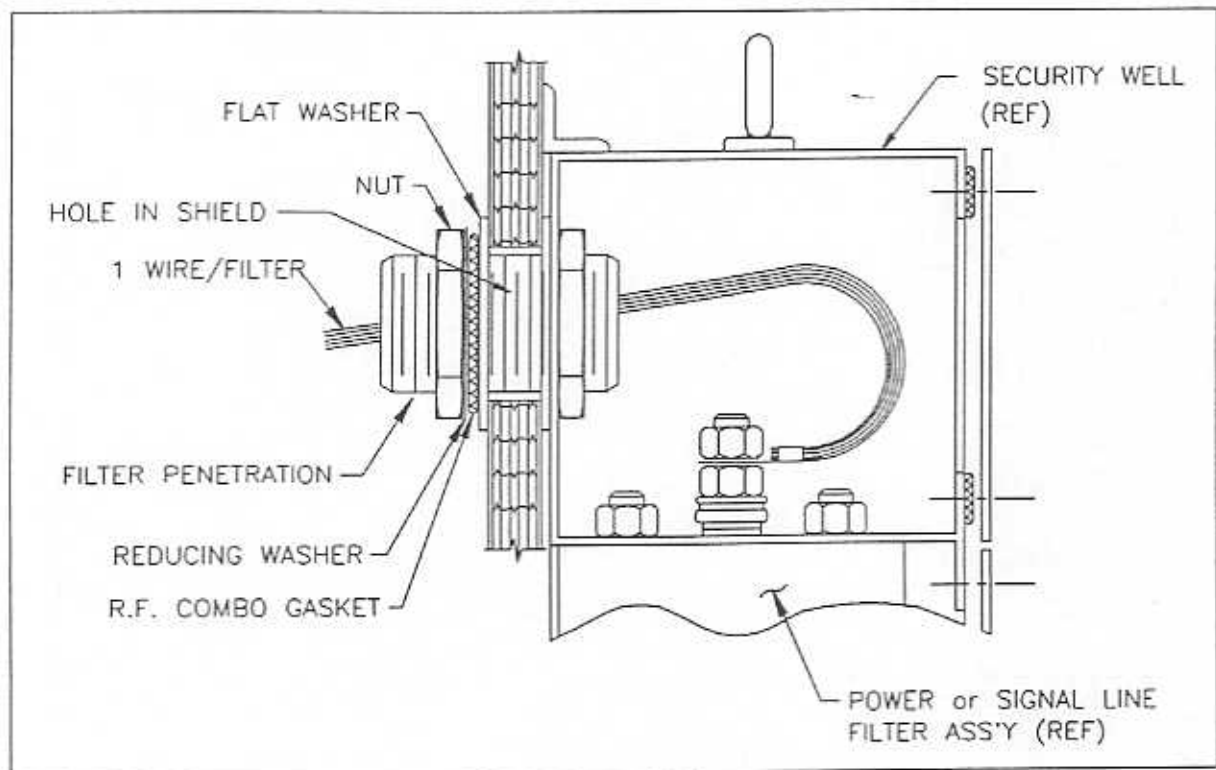


FIGURE 5: ELECTRICAL FILTER SECTION

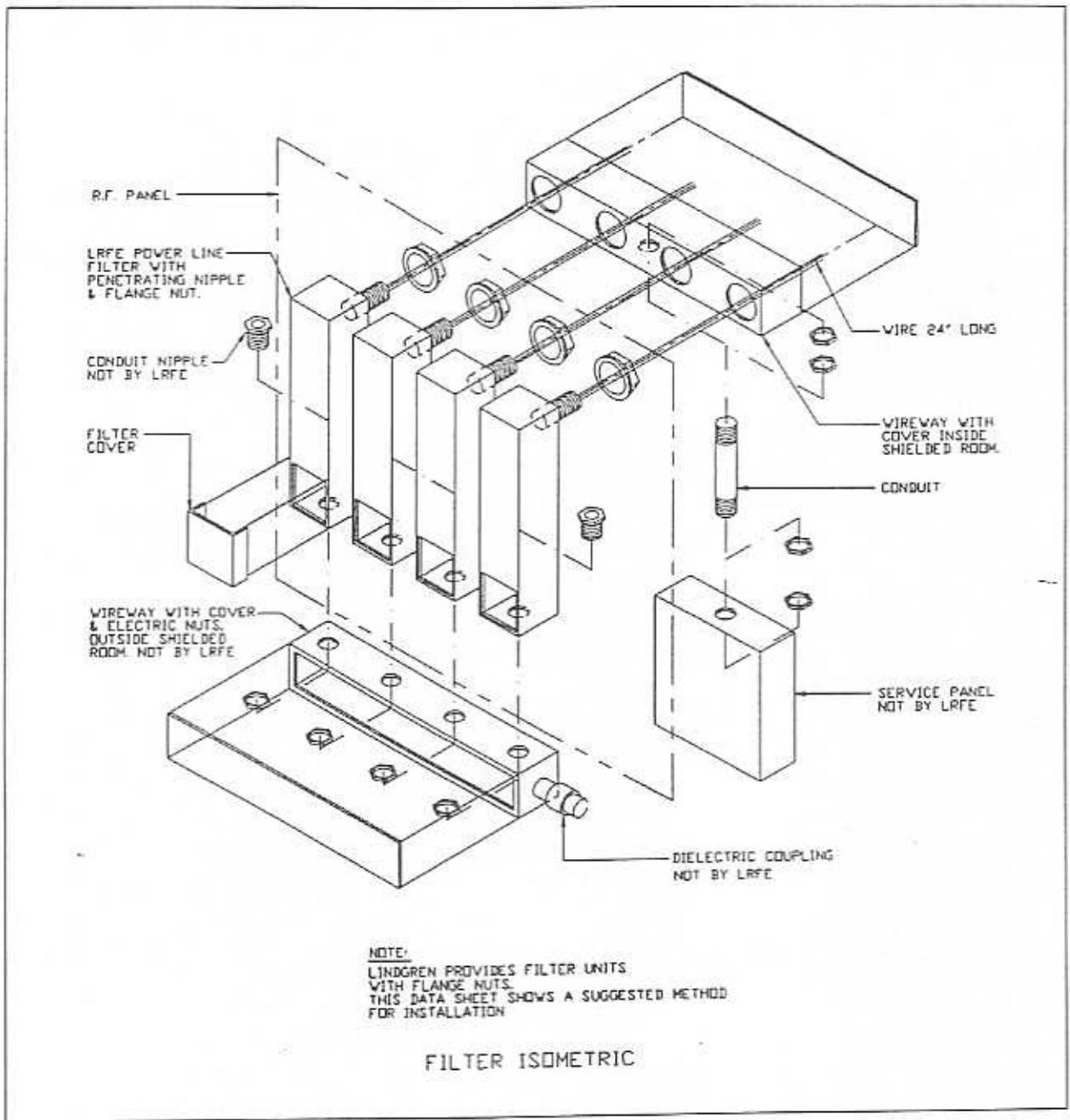


FIGURE 6: MULTIPLE FILTERS INSTALLATION

2. Grounding of the RF shielded enclosure is required to insure life safety prior to energizing any of the electrical circuits connected to the enclosure. The RF shielded enclosure must be grounded in accordance with the NFPA 70, National Electric Code, State Codes and Local Codes. The ground connection to the enclosure is made at the ground stud. See Figure 7.

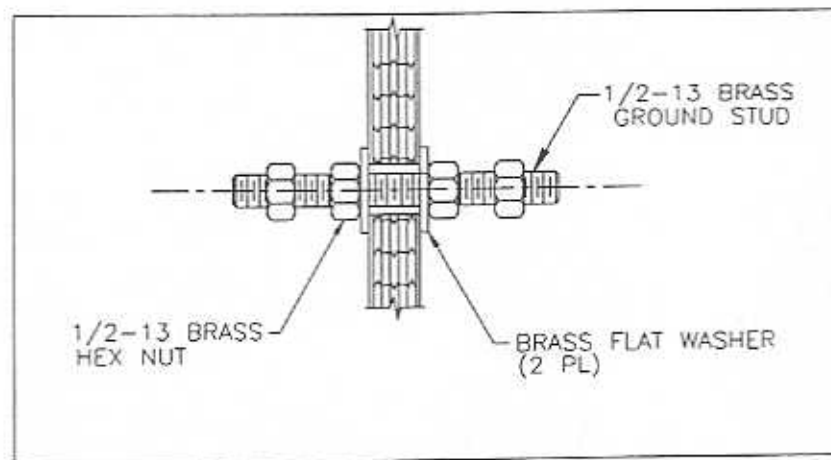


FIGURE 7: GROUND STUD

The actual ground can be a water pipe, sprinkler pipe, ground rod or approved grounding point identified by governing codes. The use of a dedicated, isolated ground conductor is preferred to reduce levels of ambient interference.

The grounding of the shielded room has no effect on the performance and is only required to eliminate any dangerous potentials which the electrical filters impress upon it in relation to ground. This potential can be in the range of 80 volts. Extreme care should be used in the handling of the filters. Do not attempt work on the filters unless the power has been turned off and the terminals have been shorted to ground.

3. Filters are located in the field, usually at the instructions of the general contractor or electrical contractor. A 1-5/16" hole must be drilled for each standard W type filter in the appropriate panel. Refer to Figures 5 & 6 for complete instructions.

For "X" type filters the following holes must be circled:

- 1-3/8" Diameter hole for 5 AMP Filter Cabinet
- 1-3/8" Diameter hole for 30 AMP Filter Cabinet
- 2" Diameter hole for 100 AMP Cabinet
- 3" Diameter hole for 200 AMP Cabinet

A 9/16" hole must be drilled for the brass ground stud in the appropriate panel. Refer to Figure 7 for reference.

4. Conduit and receptacle installation within the enclosure will be made in the conventional manner utilizing conduit secured to panels with #8 x 5/8" screws. A starter hole for the screw is to be made by punching through the shield with an awl which will splay and displace the metal. Not a drill which will remove the metal. Extreme care should be taken not to pierce both sides of the shield.

4. HEATING VENTILATION AND AIR CONDITIONING

The Modular Cell Enclosure is equipped with waveguide beyond cutoff RF shielded air vents. These are a honeycomb type of vent designed to provide for passage of air into and out of the RF shield without effecting the shielding system. This type of vent is 80% open area and has a pressure drop of 0.02" of water at 600 FPM.

Connections will be made to the outside flange provided by means of a canvas or rubber boot and then to the sheet metal duct. See Figure 8.

Within the enclosure, duct or diffuser connections can be made directly to the flange provided with no requirement for a canvas boot; also internal ducts can be supported directly from the ceiling panels. Any internal attachments to the structure can be made directly into the panel using a #8 x5/8" sheet metal screw that will not touch the outside skin. Wall thickness is 13/16". Other penetrations for water, air, drains, etc, will be made by connecting a short section of non-metallic pipe to the outside of the inlet provided on the wall panel. This is to eliminate grounding at this point. Internal connections are made to this inlet in the conventional manner.

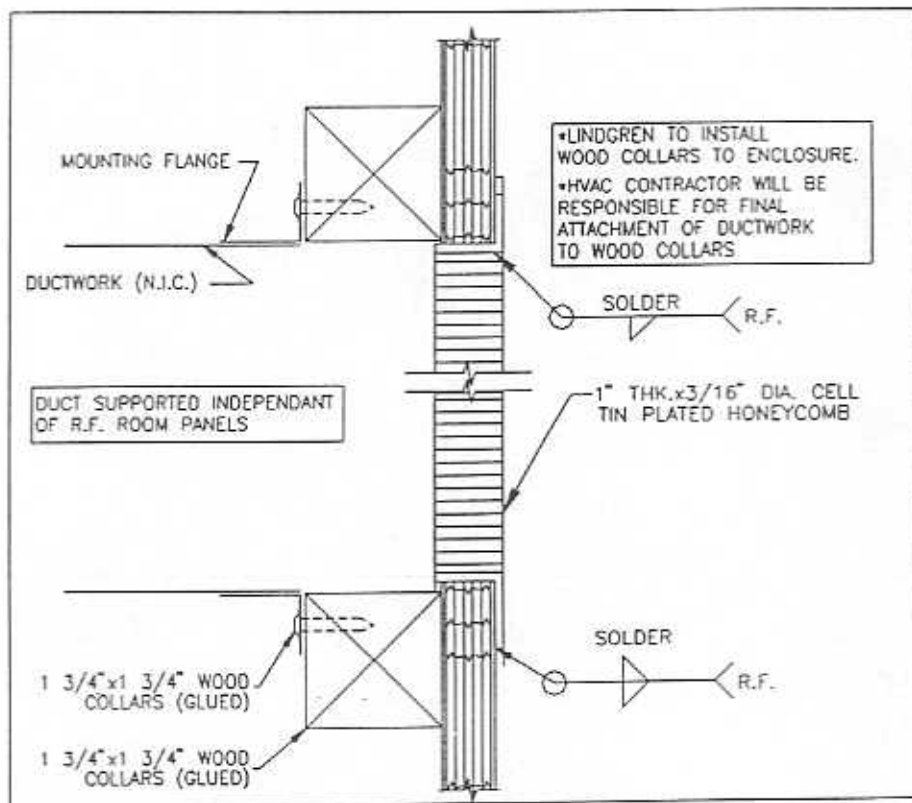


FIGURE 8: WAVEGUIDE AIR VENT/HVAC CONNECTION

5. TESTING

NOTE: Performed by Lindgren RF Enclosures, Inc. if it is part of the contract.

1. Testing of the Modular Cell Enclosure should be accomplished in accordance with MIL-STD-285 which requires that a complete procedure be followed.
2. The general procedure covered by MIL-STD-285 consists of setting up a transmitter outside of the enclosure 12" away and a receiver a like distance away within the enclosure, then comparing levels with and without the shield room present. The attenuation resulting herein will be derived from the formula:

$$\text{Attenuation (dB)} = 20 \text{ Log}_{10} E1/E2 \text{ or}$$

$$\text{Attenuation (dB)} = 10 \text{ Log}_{10} P1/P2$$

This procedure will be followed at 200 KHz, 1 MHz, 18 MHz, electric (High Impedance) and Magnetic (Low Impedance) fields.

3. Measurements made at 400 MHz require the transmitting antenna to be located 72" away from the shield. This is a plane wave measurement and will indicate leakage in the room without repositioning.

6. FINAL

A. MAINTENANCE

Separate "Operations and Maintenance Manual" is enclosed for certain types of doors. The standard double knife edge door (DKE) requires visual inspection of the handle and fingers on occasion. Door fingers are the most critical component of keeping the maintenance of the door on track and preventing leaking of the enclosure. The enclosure itself does not require any extra special maintenance attention besides from the normal cleaning if required. Visual checks for loose fasteners is the easiest way to prevent future problems. All foreign connections to the shield should be visually checked to prevent grounding of the shield. Vibrations which would lead to contact onto parent structures and surfaces in areas where surrounding air space is minimal should be addressed over time, especially in seismic zones.

B. CERTIFICATION

Lindgren's Modular Cell shielded enclosures are certified to meet the performance requirements. A serial number is recorded which allows us to review our design and manufacturing procedures should any complaints be received. It is our intent to maintain high quality control not only on the manufacturing process, but to pass this onto the user in the form of a well engineered product. We welcome your suggestions or comments.

7. LAYOUT DRAWINGS

A complete set of drawings is included in the crated shipment for installation. The framing and panel layout sheet is typically used as the main reference for installation of the enclosure. This sheet contains an exploded layout of each panel along with notes, descriptions, quantities, and sizes of components used to construct the shield. See figure 9.

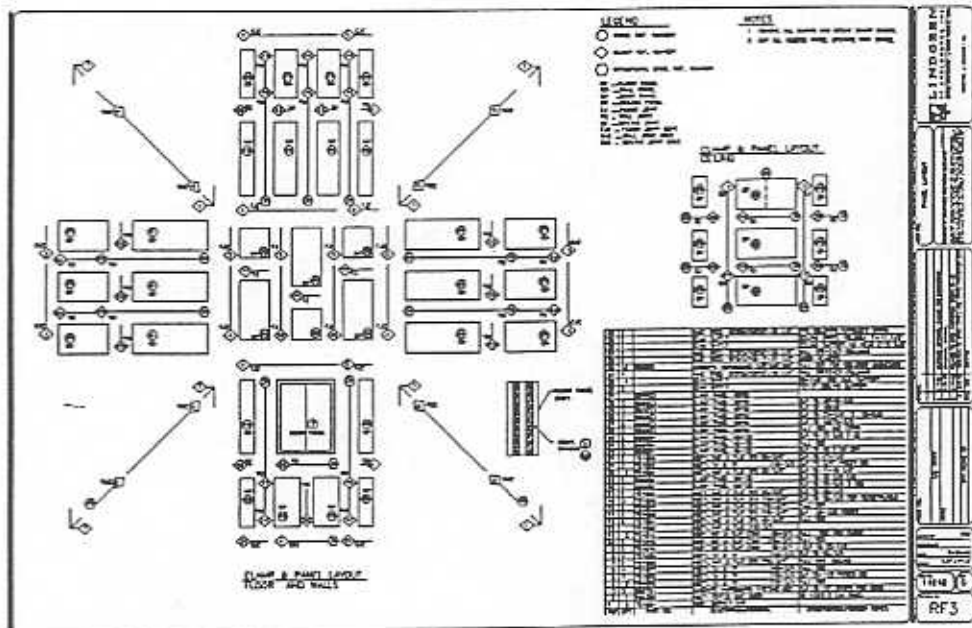


FIGURE 9: LAYOUT DRAWING

8. CELL TYPE ENCLOSURE BROCHURE

Included as separate insert.

9. ABSORBER DATA SHEETS

Included as separate insert.