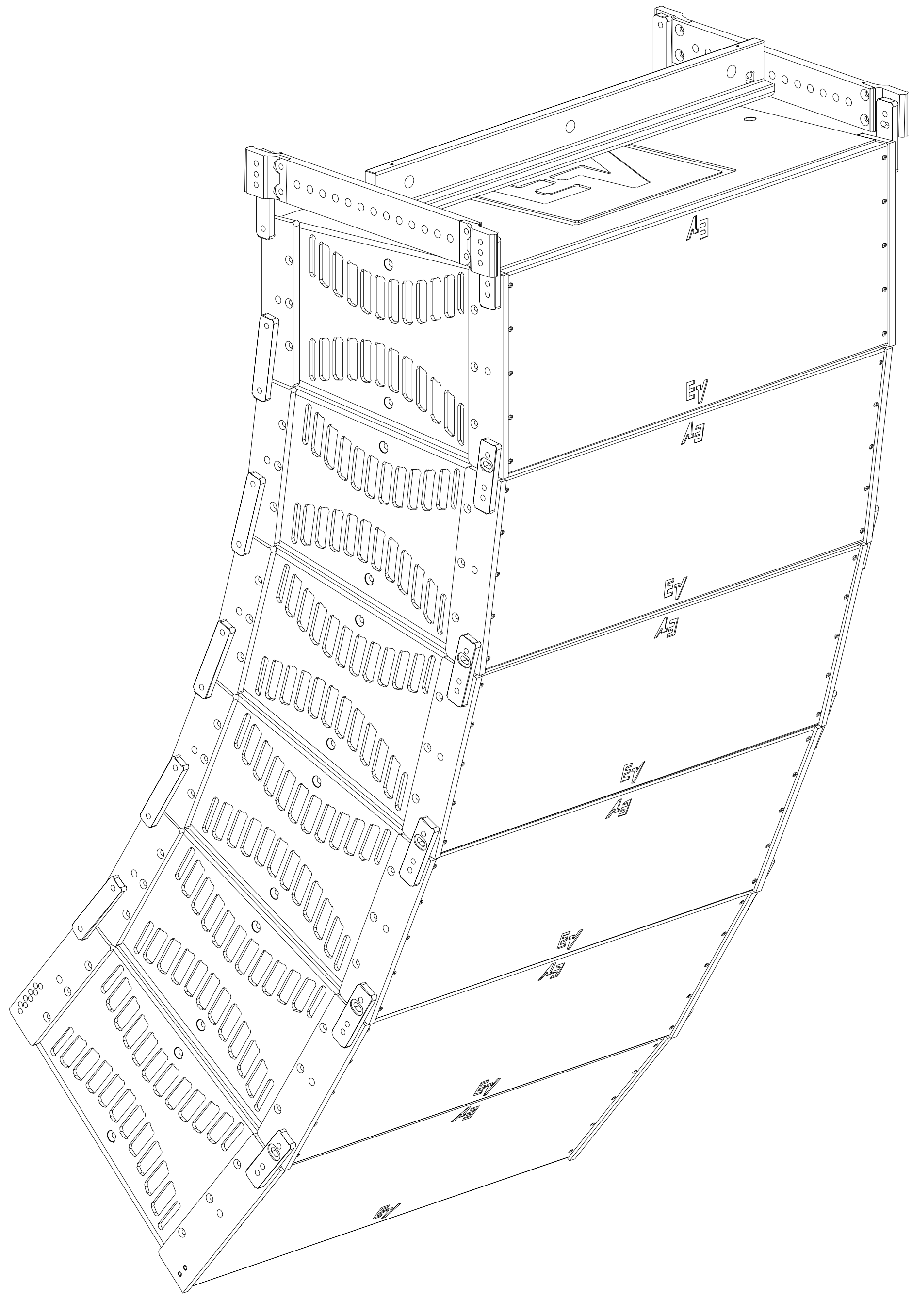
X^LC^i Rigging Manual



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Rigging-Safety Warning

This document details general rigging practices appropriate to the entertainment industry, as they would apply to the rigging of Electro-Voice X^{LC}i loudspeaker systems. It is intended to familiarize the reader with standard rigging hardware and techniques for suspending X^{LC}i loudspeaker systems overhead. Only persons with the knowledge of proper hardware and safe rigging techniques should attempt to suspend any sound systems overhead. Prior to suspending any Electro-Voice X^{LC}i loudspeaker systems overhead, it is essential that the user be familiar with the strength ratings, rigging techniques and special safety considerations outlined in this manual. The rigging techniques and practices recommended in this manual are, of necessity, in general terms to accommodate the many variations in loudspeaker arrays and rigging configurations. As such, the user is expressly responsible for the safety of all specific X^{LC}i loudspeaker array designs and rigging configurations as implemented in practice.

All the general rigging material contained in this manual is based on the best available engineering information concerning materials and practices, as commonly recognized in the United States, and is believed to be accurate at the time of the original printing. As such, the information may not be directly applicable in other countries. Furthermore, the regulations and requirements governing rigging hardware and practices may be superseded by local regulations. It is the responsibility of the user to ensure that any Electro-Voice loudspeaker system is suspended overhead in accordance with all current federal, state and local regulations.

All specific material concerning the strength ratings, rigging techniques and safety considerations for the X^{LC}i loudspeaker systems is based on the best available engineering information concerning the use and limitations of the products. Electro-Voice continually engages in testing, research and development of its loudspeaker products. As a result, the specifications are subject to change without notice. It is the responsibility of the user to ensure that any Electro-Voice loudspeaker system is suspended overhead in accordance with the strength ratings, rigging techniques and safety considerations given in this document and any manual update notices. All non-Electro-Voice associated hardware items necessary to rig a complete X^{LC}i loudspeaker array (grids, chain hoists, building or tower supports and miscellaneous mechanical components) are the responsibility of others.

Electro-Voice
July, 2003

0. Introduction

The X^{LC}i (X-Line Compact Install) loudspeaker systems represent an important step in line-array technology for small- and medium-scale sound reinforcement. The individual loudspeaker drivers, acoustic lenses, acoustic waveguides, enclosures and rigging hardware were all designed specifically for the X^{LC}i product line to not only achieve the highest acoustic output with the highest fidelity, but also to produce a precise wavefront from each element to achieve state-of-the-art line-array performance. A brief description of the product line is included below. The X^{LC}i loudspeaker systems are shown in Figure 1 with key dimensions and weights.

X^{LC}i-127: Three-way, LF/MB/HF loudspeaker system with a 120°H x 7.0°V coverage pattern. The system includes one DL12ST 12-inch (305-mm) LF driver, two DM65 6.5-inch (165-mm) MB drivers and two DH2T-16 2-inch (51-mm) HF drivers. The X^{LC}i-127 has a switchable crossover that allows either biamp or triamp operation. The X^{LC}i-127 utilizes an enclosure that is trapezoidal in the vertical plane (with an 8° total included angle) and has the standard X^{LC}i 8° rigging plates secured to the left and right enclosure sides.

X^{LC}i-127+: Three-way, LF/MB/HF loudspeaker system with a 120°H x 7.0°V coverage pattern. The system includes one DL12ST 12-inch (305-mm) LF driver, two DM65 6.5-inch (165-mm) MB drivers and two ND6-16 3-inch (76-mm) HF drivers. The X^{LC}i-127+ has a switchable crossover that allows either biamp or triamp operation. The X^{LC}i-127+ utilizes the same 8° trapezoidal enclosure as the XLCi-127 and has the same standard X^{LC}i 8° rigging plates secured to the left and right enclosure sides.

X^{LC}i-118: Subwoofer loudspeaker system with one EVX180B 18-inch (457-mm) woofer. The X^{LC}i-118 utilizes an enclosure that is trapezoidal in the vertical plane (with a 12° total included angle) and has the standard X^{LC}i 12° rigging plates secured to the left and right enclosure sides.

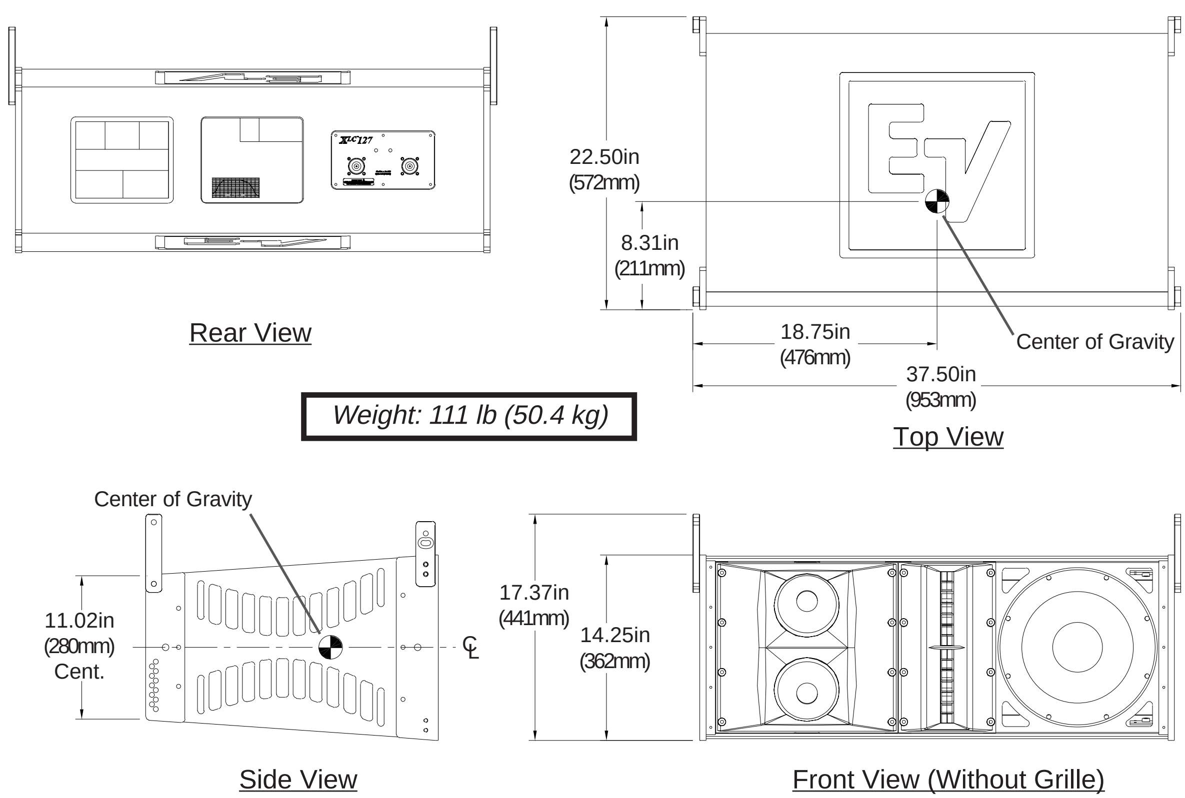


Figure 1a: *X^{LC}i-127 Loudspeaker System*

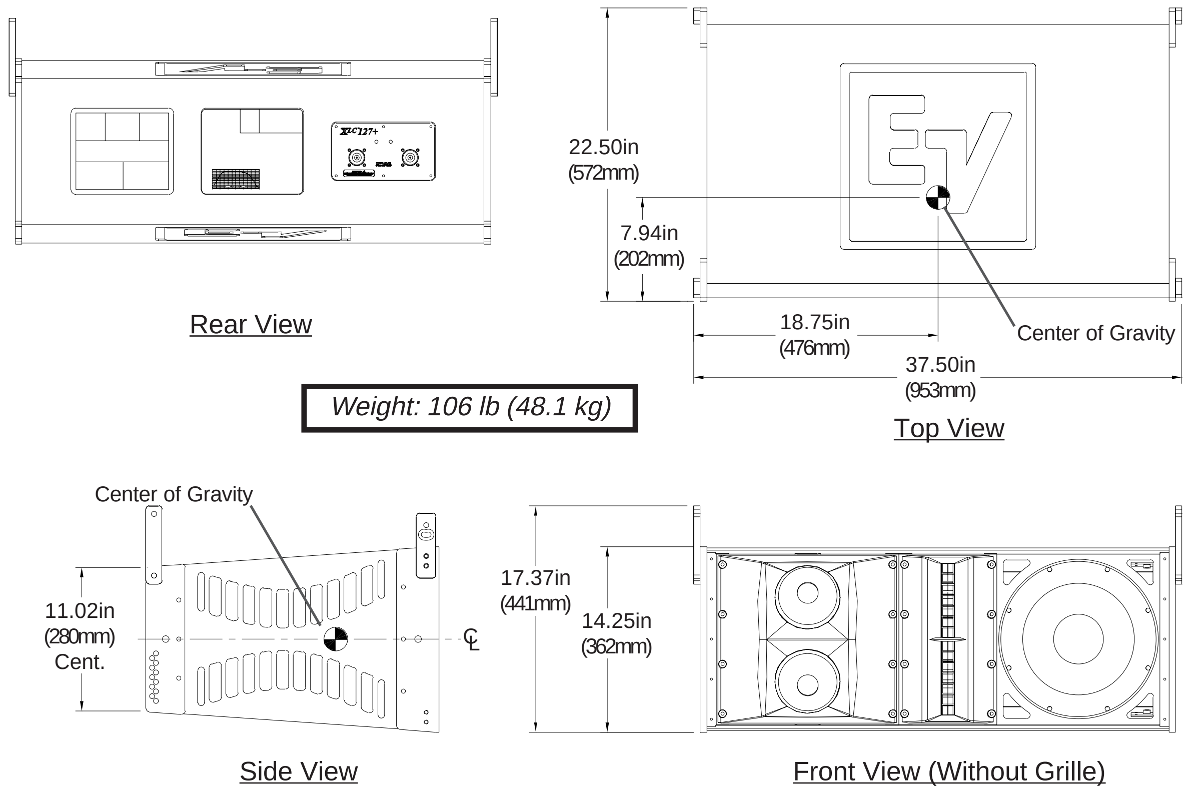


Figure 1b: *X^LCi-127+ Loudspeaker System*

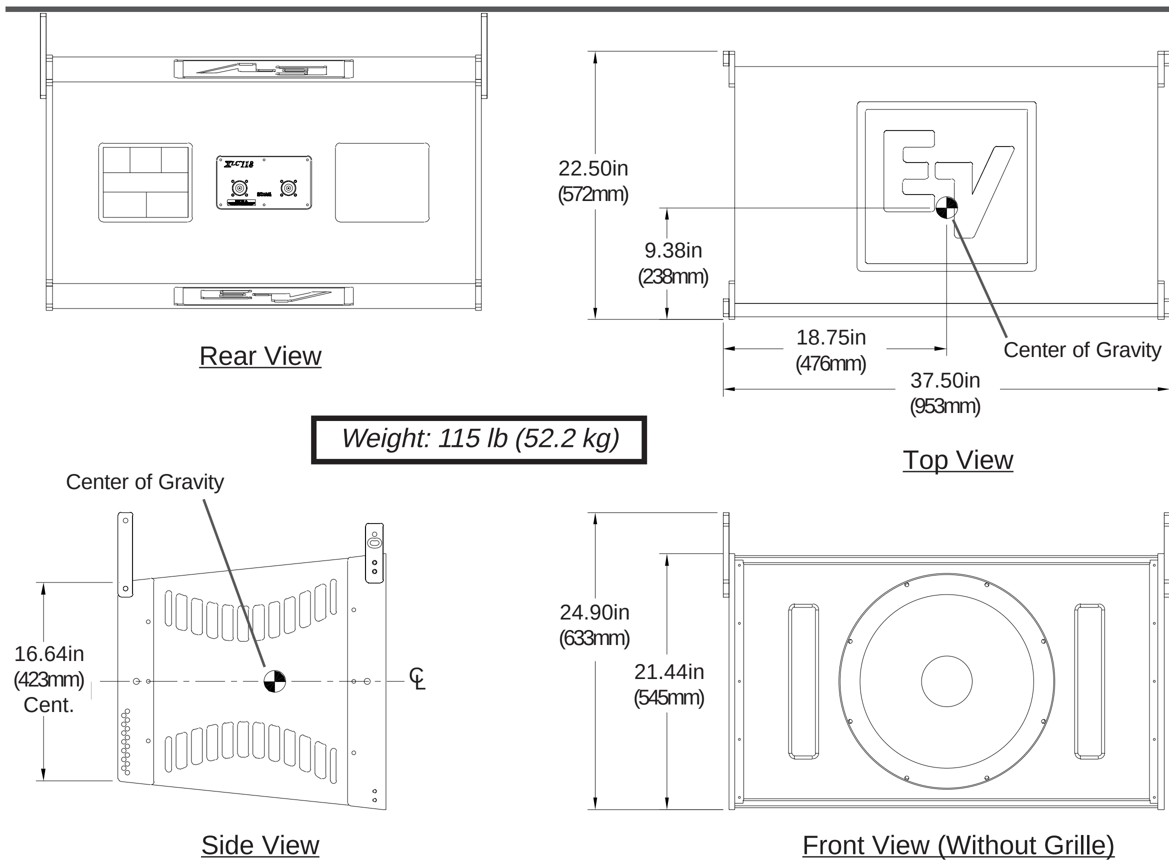


Figure 1c: *X^LCi-118 Loudspeaker System*

1. X^{LC}i Rigging System

1.1 Overview of the X^{LC}i Flying System

The X^{LC}i loudspeaker systems have been designed to construct acoustic line arrays. Acoustic line arrays typically consist of independent columns of loudspeaker systems. This simplifies the rigging system.

The X^{LC}i loudspeaker enclosures utilize a hinged rigging system that makes constructing arrays easy, predictable and repeatable. This front-hinging rigging concept allows arrays to be constructed with the least possible spacing between enclosures. The front and back rigging hardware for linking two enclosures together are captured as an integral part of the side rigging frames.

A basic array is shown in Figure 2 that illustrates the integral components that make up a typical X^{LC}i flying system. The X^{LC}i enclosures are vertically trapezoidal - taller at the front than at the back. The enclosures are hinged at the front corners using rigging hardware specially designed for the X^{LC}i system. The enclosures are linked at the rear using rigging arms that have multiple attachment positions. The different positions adjust how close the back corners of the enclosures are pulled together; hence, adjusting the vertical angle of the bottom enclosure.

1.2 X^{LC}i Enclosure Rigging Hardware Details

On each side of the enclosure there are two X^{LC}i rigging plate assembies. The structural load is transmitted through the plate minimizing the load on the loudspeaker enclosure shell. Figure 3 illustrates the X^{LC}i enclosure rigging hardware components. Figures 4a and 4b show key dimensions for the rigging hardware.

On the side of the enclosure towards the front is the Front Rigging Plate. The front rigging plate has two threaded holes at the top and bottom for attaching the Front Connector Bar with the included hardware. There is also a hole in the middle of the front rigging plate that accepts a Rigging Handle. The rigging handles aid in positioning cabinets while assembling and flying an array, and are intended for temporary use only.

The Front Connector Bar has 3 circular holes and one crescent shaped hole through it. The end with two holes gets bolted to the top of the front rigging plate. The opposite end with the crescent shaped recess is bolted to the front rigging plate of the cabinet above.

On the side of the enclosure towards the rear is the Rear Rigging Plate. There is a series of holes at the bottom of the plate, and a single hole at the top. A Rear Connector Bar is bolted through the top hole of the plate from an enclosure below and then bolted through one of the holes in the pattern, linking the two cabinets together. The vertical tilt angle of the bottom enclosure is then determined by the hole in which the rear connector bar is bolted through.

The X^{LC}i-127 and X^{LC}i-127+ enclosures may be angled from 0° to 8° in 1° increments, while the X^{LC}i-118 enclosure may be angled from 0° to 12° in 1° increments. The angle adjustment holes are detailed in figures 4a and 4b. The bolts fix the distance the back corners of the enclosures may be separated.

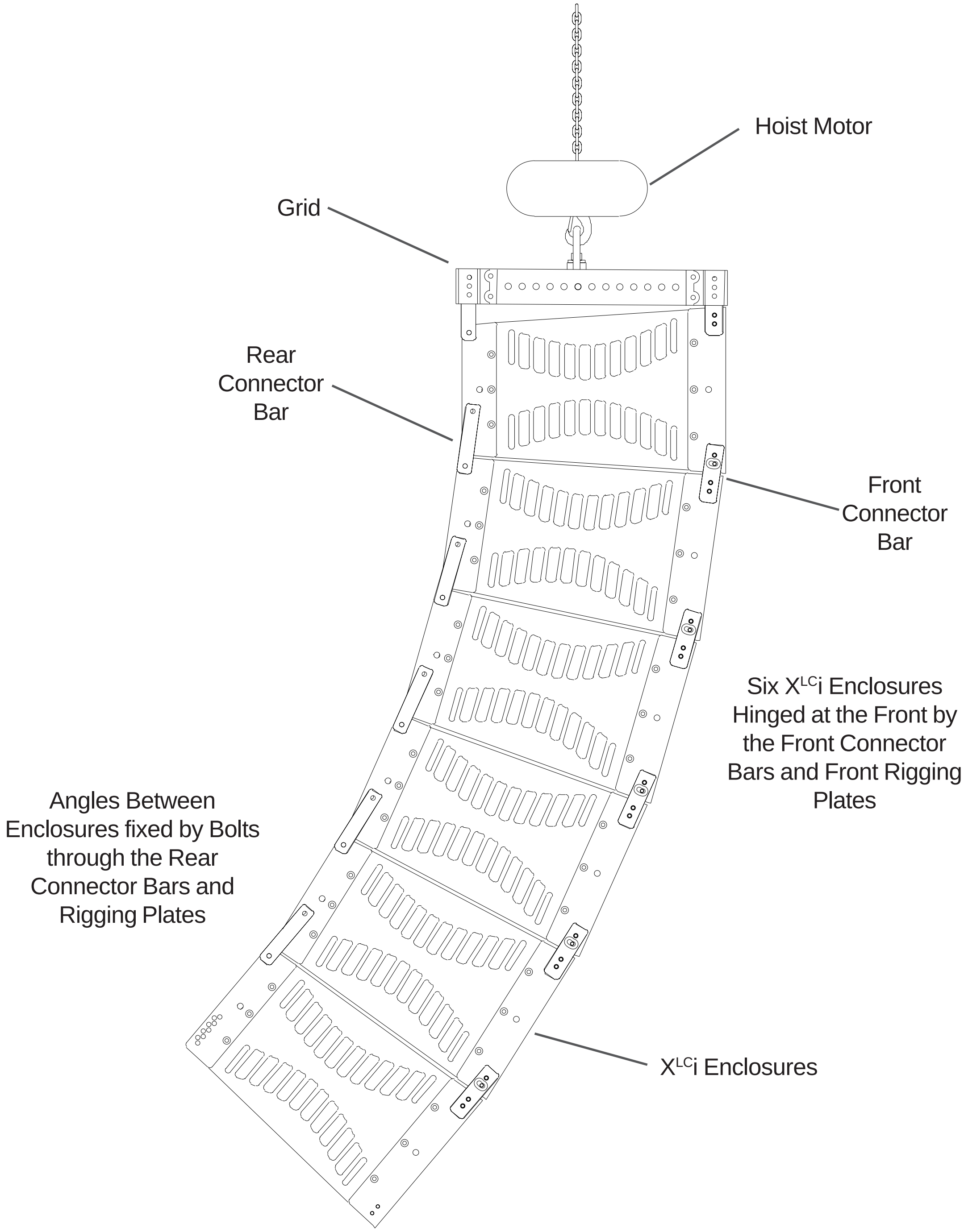


Figure 2:
Typical X^{LC}i Flying System

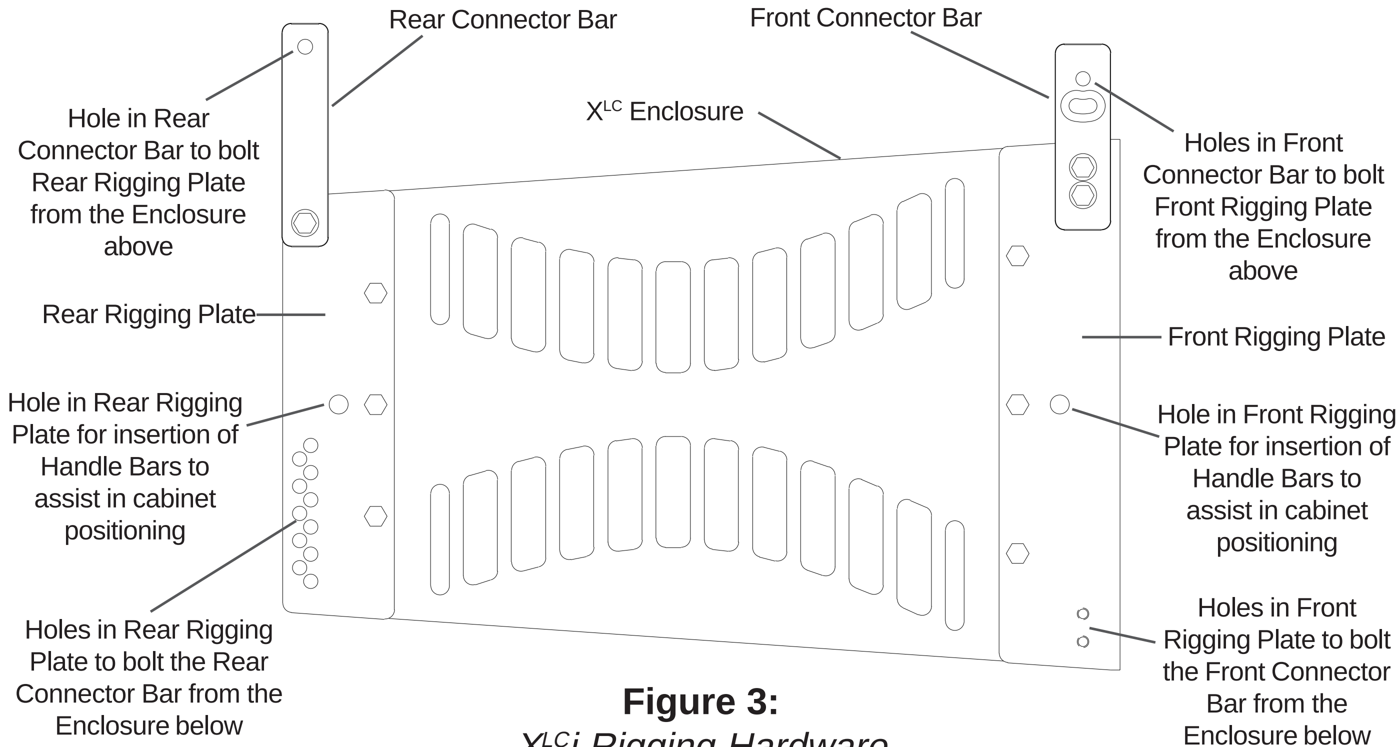


Figure 3:
X^{LC}i Rigging Hardware

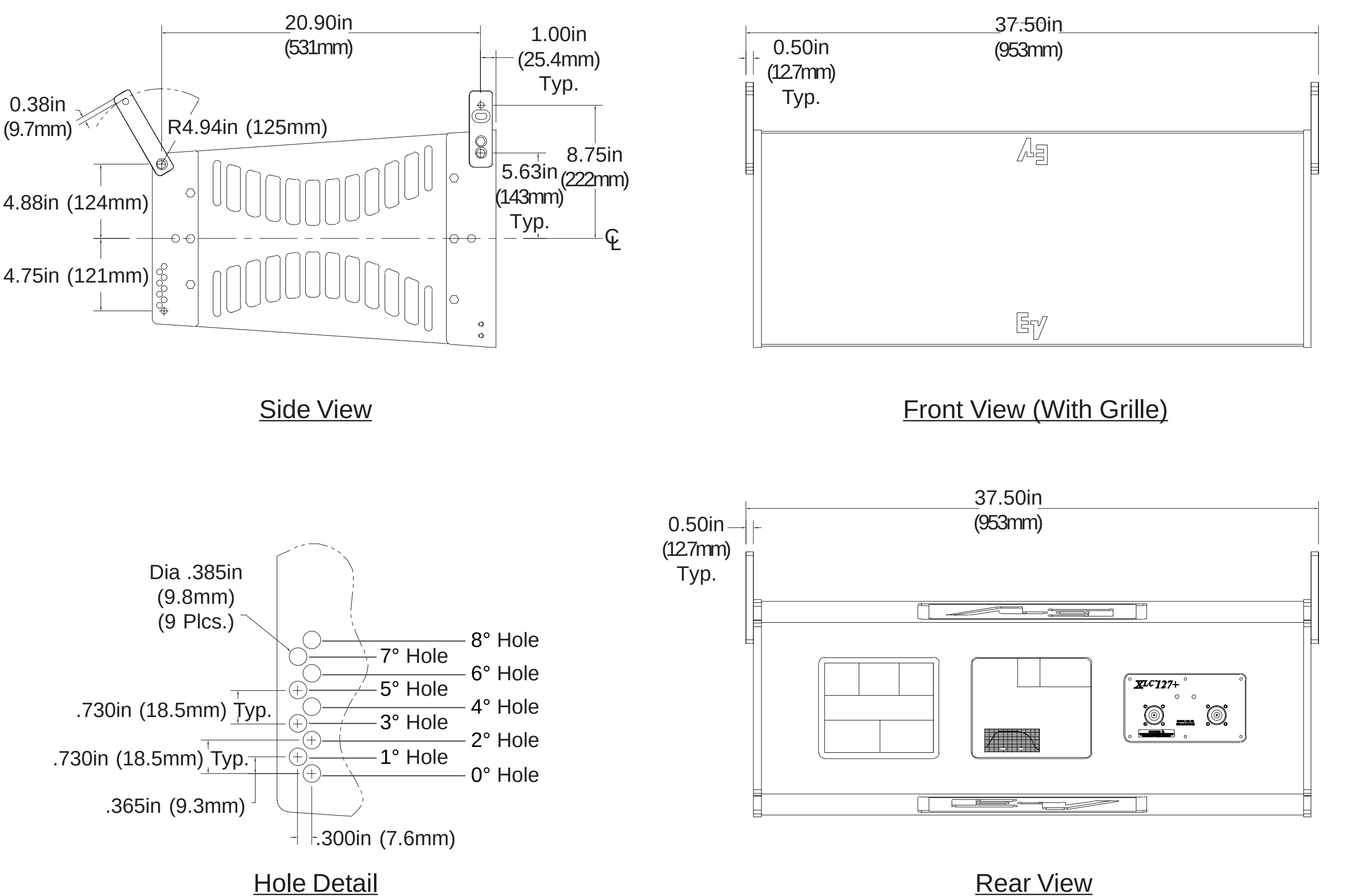
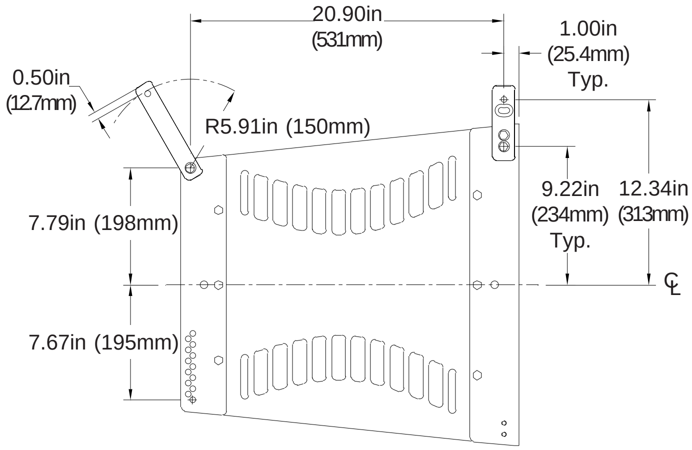
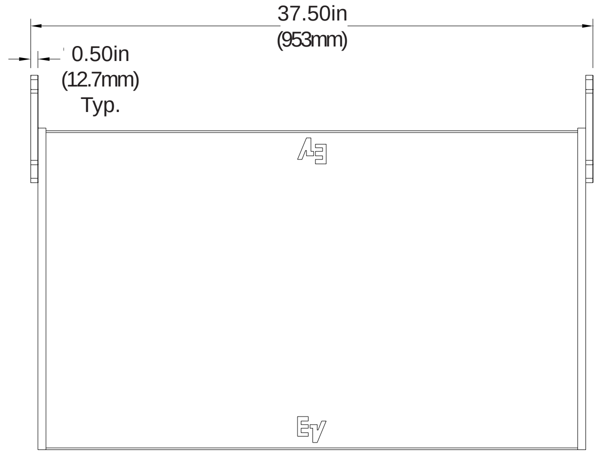


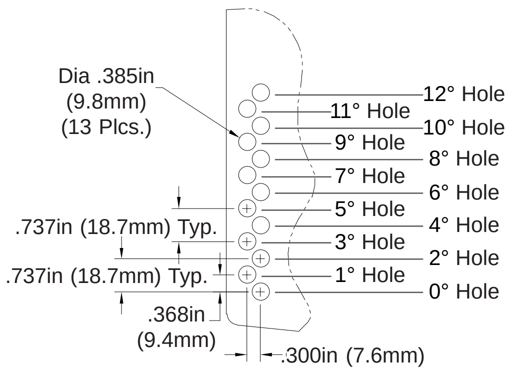
Figure 4a:
X^{LC}i-127 and X^{LC}i-127+ Rigging Dimensions



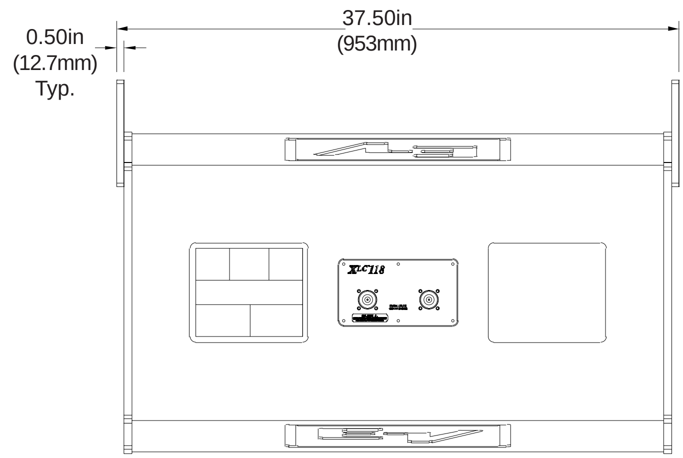
Side View



Front View (With Grille)



Hole Detail
Scale = 3:1



Rear View

Figure 4b:

X^LC^i-118 Rigging Dimensions

2. X^{LC}i Rigging and Flying Techniques

2.1 Array Considerations

The X^{LC}i loudspeaker systems have been specifically designed to construct acoustic line-arrays. Line-array systems typically consist of independent columns of loudspeaker enclosures. The most common implementation would be a stereo sound reinforcement system with two columns (left and right). Additional columns of loudspeakers are sometimes added to cover different seating sections of a venue – seating areas that wrap around the side or back of a stage, for example.

The X^{LC}i line arrays will consist of columns of X^{LC}i-127 or X^{LC}i-127+ 120°H x 7°V full-range systems. The exact number of X^{LC}i loudspeaker systems in a column will vary depending on the vertical acoustic coverage required for the specific venue. Furthermore, the relative vertical angles between the boxes will also depend on the venue's acoustic coverage requirements. (Acoustic design techniques are outside the scope of this document and the reader is directed to the X^{LC}i modeling software available from the Electro-Voice website for acoustic design assistance.) It is also possible to construct subwoofer line arrays using the X^{LC}i-118 systems.

Although the full-range X^{LC}i loudspeaker systems shown in Figure 1 are not physically symmetrical, their acoustical polar responses are substantially symmetrical because the high-frequency sections are in the center of the enclosures. Thus, stereo left and right arrays, or left-center-right arrays may be constructed with the loudspeakers in their normal right-side-up orientation as shown in Figure1.

X^{LC}i-127 AND X^{LC}i-127+ LOUDSPEAKER SYSTEMS SHOULD NOT BE MIXED IN THE SAME LINE-ARRAY COLUMN BECAUSE THEIR ACOUSTIC TIME AND PHASE RESPONSE IS DIFFERENT. BOTH THE X^{LC}i-127 AND X^{LC}i-127+ HAVE AN INTERNAL CROSSOVER THAT MAY BE SWITCHED IN OR OUT, ALLOWING THE SYSTEMS TO BE TRIAMPED OR BIAMPED. TRIAMPED AND BIAMPED SYSTEMS MUST NOT BE MIXED IN THE SAME LINE-ARRAY COLUMN BECAUSE THEIR ACOUSTIC TIME AND PHASE RESPONSE IS DIFFERENT.

2.2 Rigging an X^{LC}i Array

The X^{LC}i loudspeaker systems utilize a rigid rigging system to suspend the enclosures. When flying an X^{LC}i system, it is recommended that the entire array be assembled in smaller clusters of two or 3 cabinets rather than one large array.

WHEN ASSEMBLING TWO CABINETS TOGETHER, IT IS RECOMMENDED THAT THE HARDWARE IS TIGHTENED FINGER TIGHT UNTIL BOTH CABINETS ARE COMPLETELY LINKED.

First, attach the front and rear connector bars to the top of the front and rear rigging plates located on the sides of the enclosure using the included hardware, as shown in Figure 5a. Using the rigging handles, position the cabinet so that the front and rear rigging bolts can be attached to the second enclosure. To make it easier for the front and rear rigging plates to be attached between the two enclosures, the bolts and washers should initially only be finger tightened. Once all four pieces of linking hardware are installed between the two enclosures, the hardware should be tightened to a torque spec of 70-90 in-lbs (84-108 cm-kg).

ON EACH ENCLOSURE, ALWAYS MAKE SURE THAT THE LEFT AND RIGHT REAR CONNECTOR BARS ARE BOLTED INTO THE SAME HOLE FOR THE SAME VERTICAL SPLAY ANGLE.

MAKE SURE ALL LINKING HARDWARE IS TIGHTENED TO 70-90 IN LBS. BEFORE ADDING ADDITIONAL ENCLOSURES TO THE ARRAY.

Attach the top enclosure in the array to the grid, as shown in Figure 5b. (Only an X^{LC}i compatible grid can be used with an X^{LC}i array.) The front connector bars bolt through the bottom two holes on the front of the grid sidearm, and the rear connector bar bolts through the top hole on the rear of the grid sidearm.

MAKE SURE ALL LINKING HARDWARE IS TIGHTENED TO 70-90 IN LBS. AND THE QUICK-RELEASE PINS ARE FULLY LOCKED INTO THE SPREADER BAR BEFORE LIFTING THE ARRAY.

Begin to lift the grid and first cluster. Additional enclosures may be added one at a time, to the bottom of the first cluster, or additional smaller clusters can be added to speed assembly time using the previous steps. To disassemble the array, reverse the steps outlined in this section.

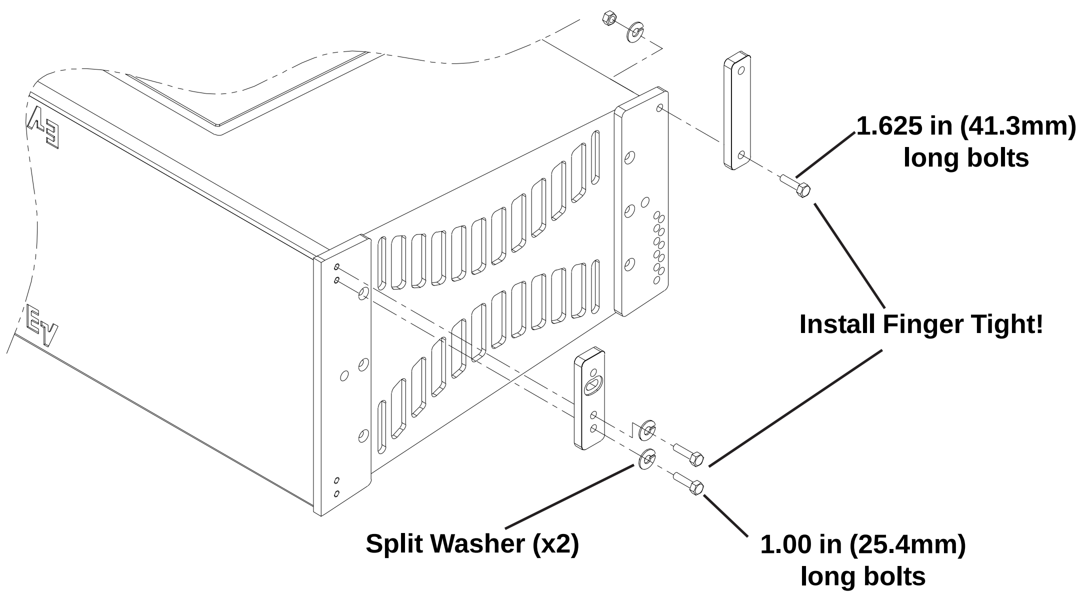


Figure 5a:
Flying X^{LC}i Systems - Step 1

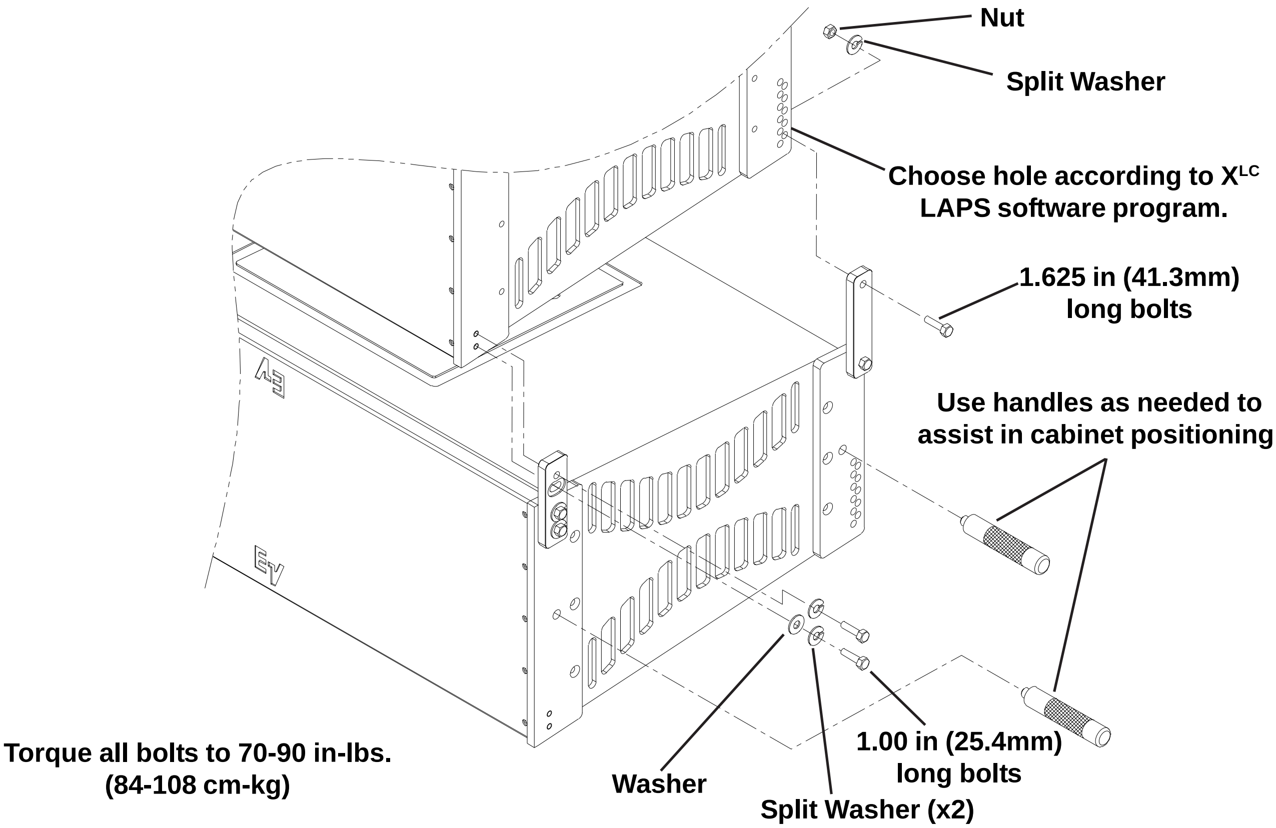


Figure 5b:
Flying X^{LC}i Systems - Step 2

2.3 X^{LC}i Grid Installation and Assembly

Assemble the sidearms to the enclosure rigging plates using the hardware shown to a torque spec of 70-90 in-lbs (84-108 cm-kg) as shown in Figures 6a and 6b.

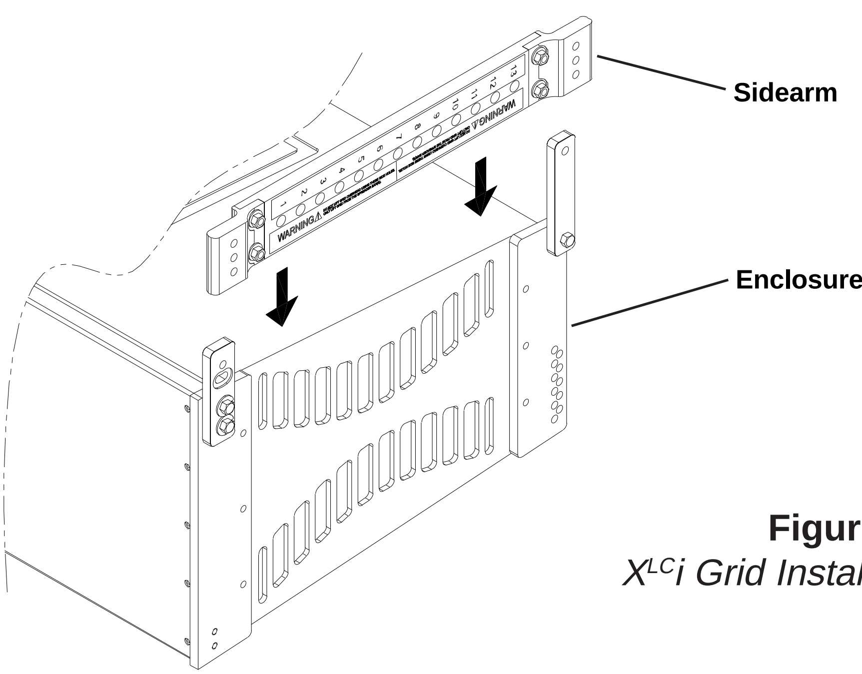


Figure 6a:
X^{LC}i Grid Installation - Step 1

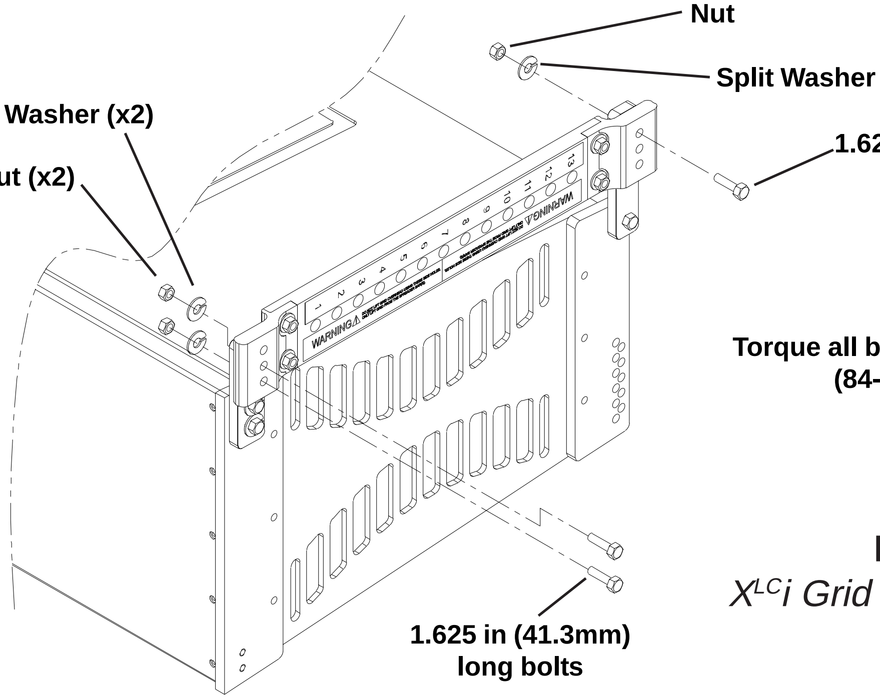


Figure 6b:
X^LC^i Grid Installation - Step 2

Once both sidearms are assembled, install spreader bar(s) between sidearms and lock into numbered hole with attached quick-release pins as shown in Figure 6c.

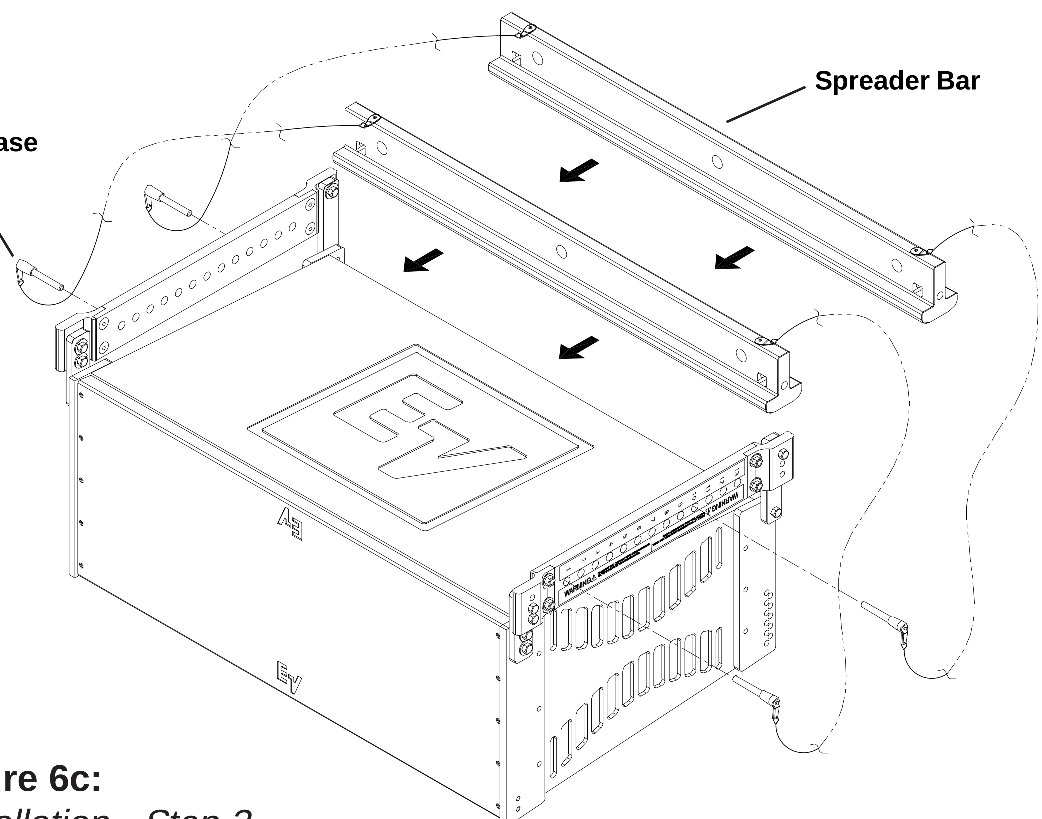


Figure 6c:
X^LC^i Grid Installation - Step 3

Once spreader bar(s) have been assembled, lift grid and array using the pull-up points shown in Figure 6d.

DO NOT LIFT GRID OVERHEAD USING SIDE HOLES ON SIDEARMS. ONLY LIFT GRID FROM THE SUPPLIED SPREADER BARS.

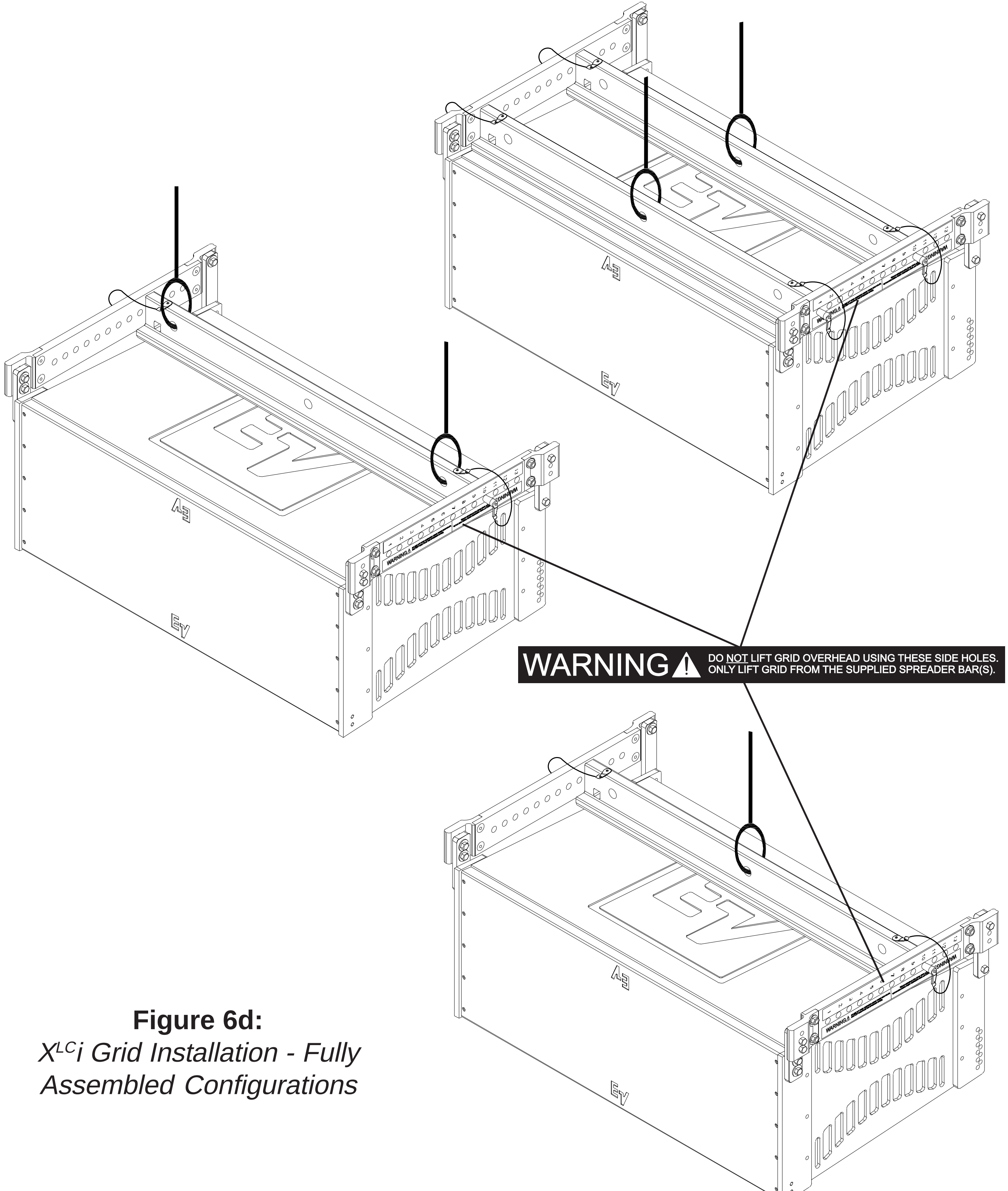


Figure 6d:
X^{LC}i Grid Installation - Fully Assembled Configurations

3. Rigging-Strength Ratings, Safety Factors, and Special Safety Considerations

3.1 Working-Load Limit and Safety Factor Definitions

The structural ratings for all of the X^{LC}i rigging components and complete loudspeaker systems are based on test results in which parts were stressed to failure. Manufacturers typically present the structural-strength ratings of mechanical components or systems as either the working-load limit (WLL) or the ultimate-break strength. Electro-Voice chooses to present the structural-load ratings of the X^{LC}i loudspeaker systems as the working-load limit. The working-load-limit rating represents the maximum load that should ever be applied to a mechanical component or system.

THE USER SHOULD NEVER APPLY A LOAD THAT EXCEEDS THE WORKING-LOAD LIMITS OF ANY OF THE RIGGING COMPONENTS OR COMPLETE LOUDSPEAKER SYSTEMS DESCRIBED IN THIS MANUAL.

The working-load limits for the X^{LC}i rigging components and complete loudspeaker systems described in this manual are based on an 7:1 safety factor. The safety factor is defined as the ratio of the ultimate-break strength divided by the working-load limit, where the ultimate-break strength represents the force at which a part will structurally fail. For example, if a part has working-load limit of 1,000 lb (454 kg), it would not structurally fail until a force of at least 7,000 lb (3,629 kg) was applied, based on a 7:1 safety factor. However, the user should never apply a load to that part that exceeds 1,000 lb (454 kg). The safety factor provides a margin of safety above the working-load limit to accommodate normal dynamic loading and normal wear.

CAUTIONS for Working-Load Limits and Safety Factors

The working-load limits defined by the manufacturer of any rigging component should never be exceeded. Electro-Voice bases the working-load limits of its X^{LC}i products on an 7:1 safety factor. Other manufacturers of rigging components may base their working-load limits on safety factors other than 7:1. For example, 5:1 safety factors are fairly common amongst rigging manufacturers because many regulatory agencies call for a minimum safety factor of 5:1.

When an X^{LC} loudspeaker system is installed where local regulations only require a safety factor of 5:1, Electro-Voice insists that the working-load limits of the X^{LC}i rigging never be exceeded and that an 7:1 safety factor be maintained for the X^{LC}i loudspeakers.

The user is cautioned that some local regulations may require safety factors higher than 7:1. In that circumstance, Electro-Voice insists that the user maintain the higher safety factor as required by the local regulations throughout the entire X^{LC}i installation. It is the responsibility of the user to make sure that any X^{LC}i installation meets any applicable local, state or federal safety regulations.

3.2 Structural Rating Overview

There are two independent strength ratings that, together, give a complete description of the overall structural performance capabilities of any X^{LC}i loudspeaker system. They are defined as follows:

1. The strength of each individual rigging point; which is the combined strength of the rigging frame, the rigging frame components (front button bars, rear swing arm, quick-release pins, etc.) and the enclosure.

2. The total strength of the overall enclosure; which is a function of the combined forces from all of the rigging points acting on the rigging frames and enclosure as a whole.

The array designer must be aware of the working-load-limit ratings and the loads being applied to the individual rigging points and the overall enclosure. An X^{LC}i loudspeaker system is only as strong as its weakest link. It is usually the case that one of the working-load limits will be approached sooner that the other.

WHEN SUSPENDING ANY X^{LC}i LOUDSPEAKER SYSTEM OVERHEAD, THE WORKING-LOAD LIMITS MUST NEVER BE EXCEEDED FOR EACH INDIVIDUAL RIGGING POINT, OR THE OVERALL ENCLOSURE.

The forces acting on each individual rigging point and on the overall enclosures in an X^{LC}i flying system will vary with each array configuration. Determining the forces throughout an array requires complex mathematical calculations. Electro-Voice engineers have, however, defined a set of simplified structural-rating guidelines that eliminate the need for the complex calculations for most array configurations. The interaction of the complex forces throughout arrays were analyzed to develop this set of conservative guide-lines, presented below, to enable a rigger to immediately determine on site whether or not an array is safe without having to make weight-distribution calculations. The structural-strength ratings of the individual rigging points and the overall X^{LC}i enclosures are also presented below so that a complex structural analysis can be made for any array configuration. The reader should consult an experienced structural engineer to perform the complex structural analysis.

The reader is directed to the References section of this manual for a list of rigging references (for background in general rigging practice) and mechanical engineering references (for background in structural engineering analysis).

3.3 Simplified Structural-Rating Guidelines

Electro-Voice engineers have defined a set of simplified structural-rating guidelines that will enable a rigger to immediately evaluate the safety of an X^{LC}i system on site without having to make complex force-distribution calculations. A combination of destructive testing and computer modeling were used to analyze the complex forces throughout arrays. Conservative working-load ratings were utilized to simplify the guidelines. Therefore, array configurations other than those illustrated in these simplified guidelines may be permissible for those applications, consult section 3.4 Complex Structural-Rating Analysis for a detailed structural analysis.

The simplified structural-rating guidelines are shown in Figure 7. (Note that there is a label on the back of each flying X^{LC}i loudspeaker enclosure that includes the graphics shown in Figure 7.)

These guidelines provide a simplified rating for typical arrays based on the:

1. Vertical angle of each enclosure
2. Total weight of that enclosure plus all of the enclosures and rigging hung below it.
3. Angles of the force components on the front connector bars and the rigging plates relative to the enclosures.
4. Angles of the force components on the rear connector arms and rigging plates relative to the enclosures.

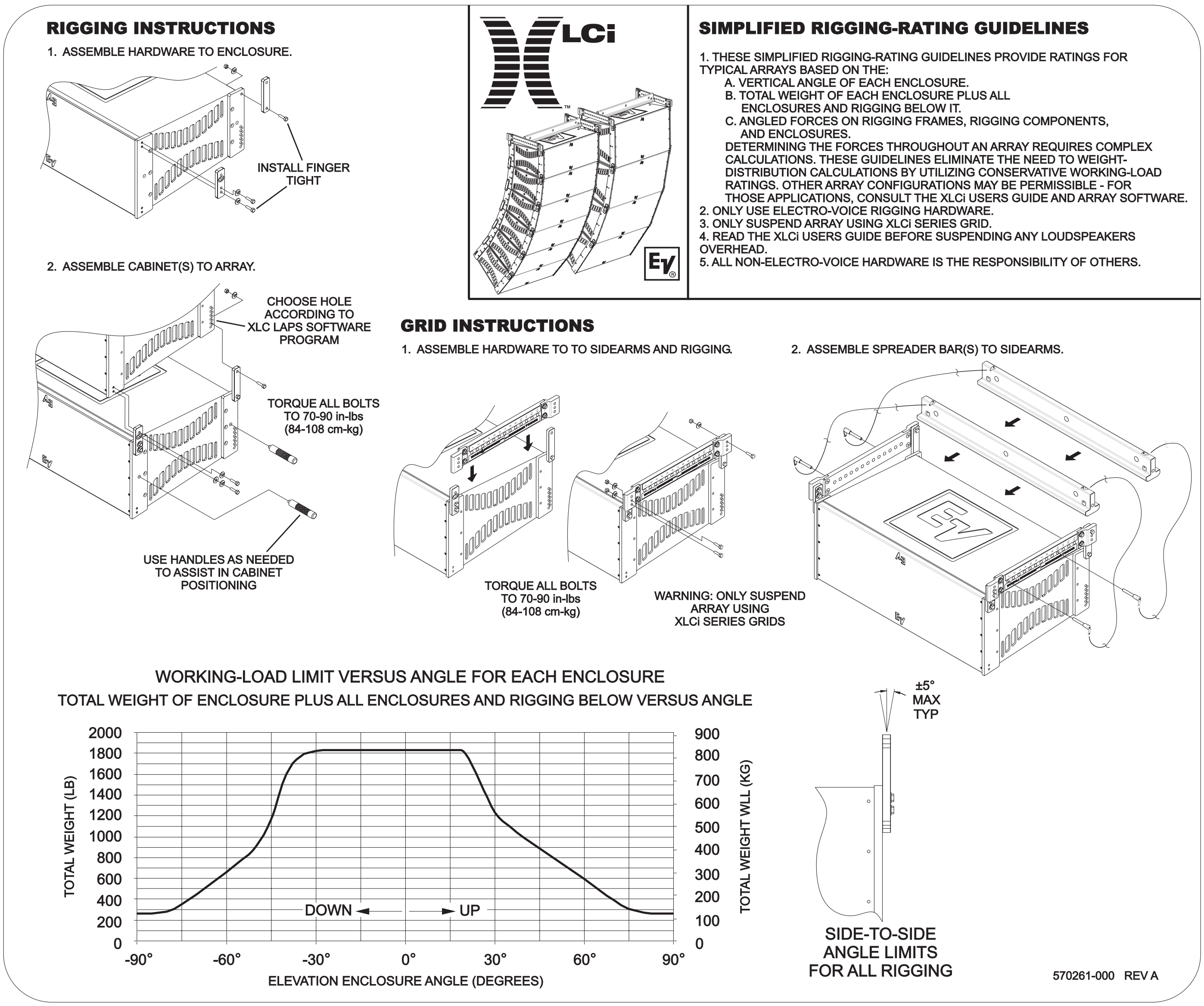


Figure 7:

Simplified X^LCi Rigging-Rating Guidelines

Figure 7 includes a graph of the working-load weight-versus-angle limit rating for the X^{LC}i enclosures. This working-load weight limit is applicable to every enclosure in an array, and includes the weight of that enclosure plus the total weight of all enclosures and rigging hardware suspended below it. The absolute enclosure angle is the vertical angle of that enclosure, where 0° represents an upright enclosure facing straight ahead (0° elevation angle). These working-Ioad-versus-angle limits take into account the complex forces generated in the front connector bars, the rear connector bars, the rigging plates, the enclosures and the (optional) pull-up line, as a result of the complex weight distribution throughout the array.

Also included in the simplified structural-rating guidelines in Figure 7 are side-to-side and front-to-back angle limits for the front connector bars and rear connector bars on the top enclosure.

WHEN APPLYING THE SIMPLIFIED STRUCTURAL RATING GUIDELINES TO ANY X^{LC}i LOUDSPEAKER SYSTEM SUSPENDED OVERHEAD, THE USER MUST OBEY THE FOLLOWING RULES:

1. Never exceed the working-Ioad-versus-angle limit for any enclosure in the array.
2. Never exceed the side-to-side angle limits for the front connector bar assemblies on any enclosure.
3. Never exceed the side-to-side angle limits for the rear connector bar assemblies on any enclosure.
4. Always make sure that every front connector bar is securely bolted to the front rigging plate on every enclosure (and grid, when applicable) before lifting overhead.
5. Always make sure that every rear connector bar is securely bolted to the rear rigging plate with the supplied hardware on every enclosure (and grid, when applicable) before lifting overhead.
6. If a pull-up grid is used, never exceed the side-to-side angle limits for the pull-up grid.

Discussion of Array Examples: For example, if the top enclosure in a column was angled down 30°, the enclosure working-Ioad-versus-angle limit from the simplified structural-rating guidelines shown in Figure 7 would indicate that a total of 1820 pounds (885 kg) could be safely suspended. This would include the weight of the top enclosure plus all of the enclosures and rigging suspended below.

If, however, the top enclosure in a column was angled up 30°, the total allowable weight would then only be 1220 lb (554 kg) - including the weight of the top enclosure plus all of the enclosures and rigging suspended below. The enclosure working-load-versus-angle limit shown in Figure not only applies to the top enclosure in an array column, but also applies to every enclosure in an array column. In arrays where a pull-up grid is not used, the top enclosure is always the limiting factor because it supports the most weight. However, in arrays where a pull-up grid is used to achieve substantial downward angles, it is possible that a lower enclosure could be the limiting factor.

3.4 Complex Structural-Rating Analysis

For a complete structural-rating analysis, the forces in each individual piece of attachment hardware throughout the X^{LC}i system must be determined, as well as the forces on each enclosure. Determining these forces requires complex mathematical calculations. All of these forces must then be compared to the working-load limits detailed below for each of the rigging points and the overall enclosures.

The reader should consult an experienced structural engineer to perform the complex structural analysis.

WHEN SUSPENDING ANY X^{LC}i LOUDSPEAKER SYSTEM OVERHEAD, THE WORKING-LOAD LIMITS MUST NEVER BE EXCEEDED FOR EACH INDIVIDUAL RIGGING POINT, AND THE OVERALL ENCLOSURE.

X^{LC}i-127, X^{LC}i-127+ and X^{LC}i-118 Front Rigging Structural-Strength Ratings

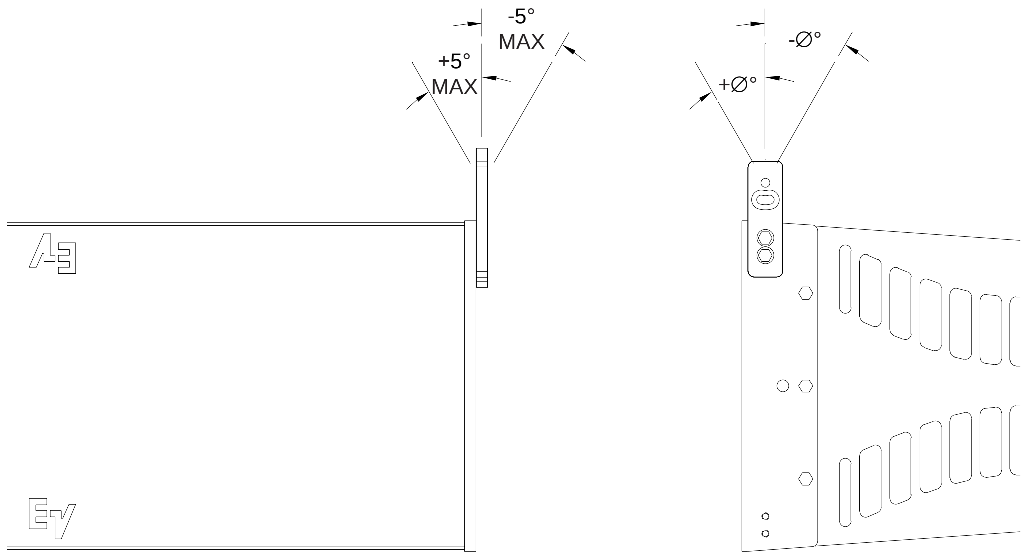
The working-load limit of each of the front rigging points on the X^{LC}i enclosures is dependent upon the front connector bar, bolts, front rigging plate, the enclosure and the angle of pull. The structural-strength ratings for the front rigging points are identical for the X^{LC}i-127, X^{LC}i-127+ and X^{LC}i-118, and are shown in Figure 8. The enclosures have two rigging points at the front. The structural ratings shown in Figure 8 are for a single rigging attachment point. Each rigging point has the same rating.

The front-to-back structural-strength ratings for the front rigging points shown in Figure 8 cover a full 360° rotation. Although it is not possible to put the front connector bars into tension over 360°, it is possible for the front connector bars to go into compression with some array configurations. Therefore, the 360° rating is necessary to accommodate both tension and compression. It also should be noted that the X^{LC} front rigging is only rated for use over side-to-side pull angles of a maximum of ±5°.

X^{LC}i-127, X^{LC}i-127+ and X^{LC}i-118 Rear Rigging Structural-Strength Ratings

The working-load limit of each of the rear rigging points on the X^{LC}i enclosures is dependent upon the rear connector bar, bolts, rear rigging plate, the enclosure and the angle of pull. The structural-strength ratings for the rear rigging points are identical for the X^{LC}i-127 and X^{LC}i-127+, and are shown in Figure 9. The structural-strength ratings for the rear rigging points on the X^{LC}i-118 are shown in Figure 10. The enclosures have two rigging points at the rear. The structural ratings shown in Figures 9 and 10 are for a single rigging attachment point. Each rigging point has the same rating

It should be noted that the front-to-back-angle range shown in Figure 10 for the X^{LC}i-127 and X^{LC}i-127+ consists of two 8° arc segments, while the front-to-back-angle range shown in Figure 11 for the X^{LC}i-118 consists of two 12° arc segments. When both the front and rear rigging are installed, the front connector bar always prevents the rear connector bar from having any kind of front-to-back force. Thus, it will always be axially loaded. For the X^{LC}i-127 and X^{LC}i-127+, a tensile force can only be applied over an angle range of negative 0°-8°, while the X^{LC}i-118 can only be over a range of negative 0°-12°. The angles are negative because the boxes can only be angled downward. (Imagine two boxes facing straight ahead. The bottom enclosure can only be tilted downward because the rear rigging can only be adjusted to bring the rear corners of the enclosures together.) Under compression, the forces would be from positive 172°-180° for the X^{LC}i-127,and X^{LC}i-127+ and positive 168°-180° for the X^{LC}i-118. It also should be noted that the X^{LC}i rear rigging is only rated for use over side-to-side pull angles of a maximum of ±5°.



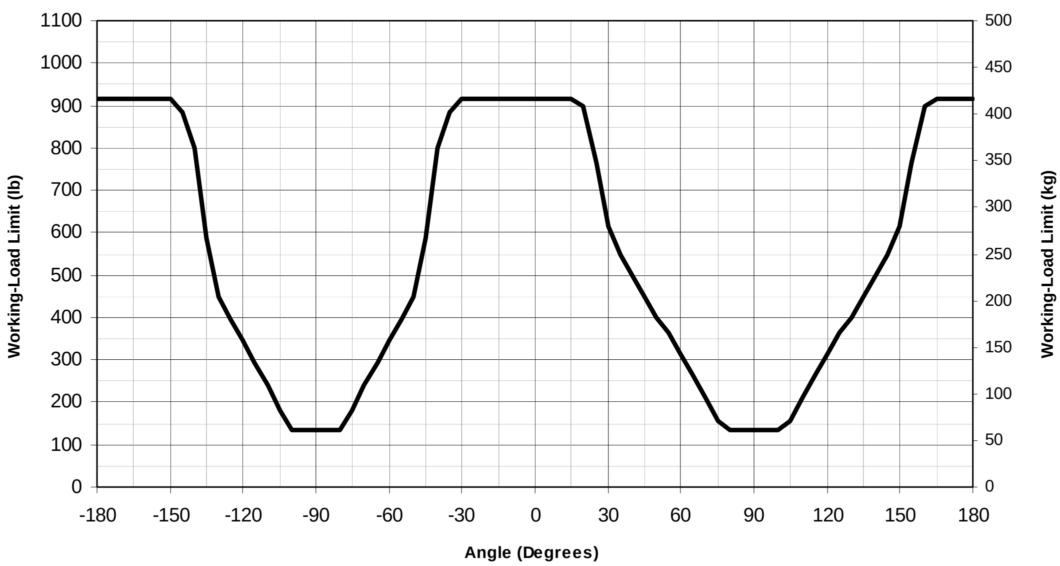
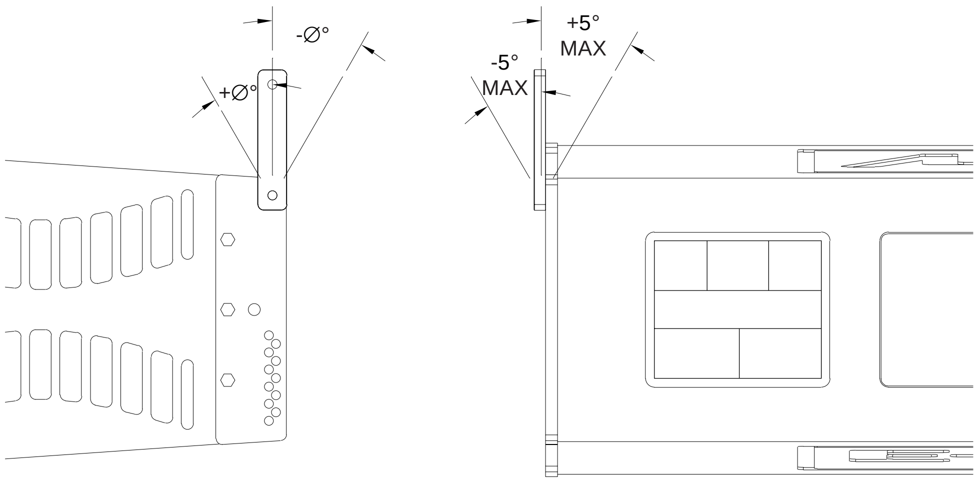


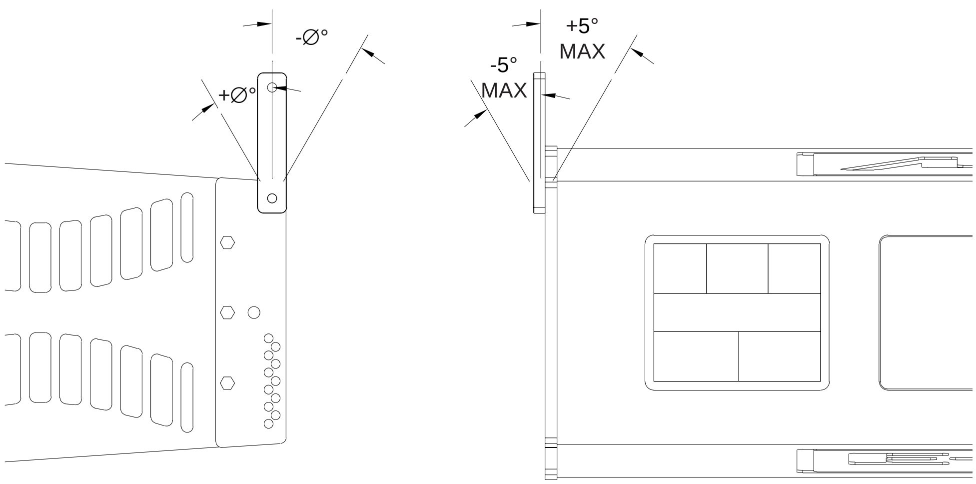
Figure 8:

X^LC^i-127, X^LC^i-127+ and X^LC^i-118 Front-Rigging-Point Structural Ratings



Working-Load Limit
915 lb (415 kg)
From 0° to -8° (Connector Bar in Tension)
From +172° to +180° (Connector Bar in Compression)
This is the Only Possible Angle Range

Figure 9:
X^LC i-127 and X^LC i-127+ Rear-Rigging-Point Structural Ratings



Working-Load Limit 915 lb (415 kg) From 0° to -12° (Connector Bar in Tension) From +168° to +180° (Connector Bar in Compression) This is the Only Possible Angle Range

Figure 10:
X^LC^i-118 Rear-Rigging-Point
Structural Ratings

Total Column Weight
Working-Load Limit
1830 lb (830 kg)

Figure 11:
X^{LC}i-127, X^{LC}i-127+ and X^{LC}i-118 Overall Enclosure Structural Ratings

X^{LC}i-127, X^{LC}i-127+ and X^{LC}i-118 Overall Enclosure Structural-Strength Ratings

The actual strength of the X^{LC}i enclosures will depend on the complex total of the combined forces from each of the rigging points acting on the enclosure as a whole and will vary with the array configuration. However, for the sake of simplicity, Electro-Voice chooses to define the working-load limit of the overall enclosures as the sum total of the weight of that enclosure plus the weight of all of the enclosures and rigging hardware suspended below. This simplified working-load weight rating of the overall enclosures is defined as being independent of the angles of pull on the individual rigging points. The Electro-Voice engineers have chosen to define the working-load limits of the individual rigging points as a function of pull angle so that they take into account any variations in enclosure strength that might occur as a function of pull angle. This approach allows the enclosure working-load limit to be defined as independent of pull angles, making the complex structural rating analysis easier. The overall enclosure strength ratings are identical for the X^{LC}i-127, X^{LC}i-127+ and X^{LC}i-118, and are shown in Figure 11.

CAUTIONS for a Complex Structural Rating Analysis

WHEN APPLYING A COMPLEX STRUCTURAL RATING ANALYSIS TO ANY X^{LC}i LOUDSPEAKER SYSTEM SUSPENDED OVERHEAD, THE USER MUST OBEY THE FOLLOWING RULES:

1. Never exceed the front-to-back angle limits for the front connector bar assemblies on any enclosure. Never exceed the side-to-side angle limits for the front connector bar assemblies on any enclosure.
2. Never exceed the front-to-back angle limits for the rear connector bar assemblies on any enclosure. Never exceed the side-to-side angle limits for the front connector bar assemblies on any enclosure.
3. Always make sure that all connector bars are secured to the rigging plates with the supplied hardware on every enclosure before lifting overhead.

3.5 Wind Loading

The X^{LC}i loudspeaker systems have been designed to withstand winds of up to 60 miles per hour (96.6 kilometers per hour) if the bottom cabinet is rigidly secured. For obvious safety reasons, Electro-Voice urges the user not to suspend any loudspeaker systems overhead outdoors when high winds are expected. When suspending X^{LC}i loudspeaker systems outdoors, the user is strongly encouraged to rigidly tie off the bottom cabinets in all arrays as a safety precaution against unexpected high winds.

A pull-up grid with an attached strap may be used to secure the bottom cabinets. The tie-off assembly must have a working-load rating of 2,000 lb (907 kg). A ratchet strap with a 2,000-lb working-load rating must be used for the pull-up assembly.

3.6 Electro-Voice Structural-Analysis Procedures

Electro-Voice maintains a structural pull-test facility in Burnsville, Minnesota USA which includes load cells with digital-electronic display and recording. The load cells are calibrated annually by an independent laboratory to a standard traceable to the United States National Bureau of Standards. This pull-test facility is capable of pulling to destruction both individual rigging components and complete loudspeaker systems.

Electro-Voice utilizes state-of-the-art computer-modeling programs for structural analysis throughout the development of loudspeaker systems. The computer modeling enables the complex forces in the rigging components and enclosures to be analyzed for loudspeakers assembled into arrays in both static and dynamic conditions.

Structural testing and computer modeling were used throughout the engineering development of all the X^{LC}i individual rigging components and complete loudspeaker systems described in this manual. Testing and modeling involving both anticipated use and anticipated misuse were performed as part of the analysis. Engineering prototypes were stressed to failure and designs were revised based on those test results. Production systems and components were stressed to failure for verification of the final designs.

4. Rigging Inspection and Precautions

Electro-Voice X^{LC}i Loudspeaker Systems:
Prior to each use, inspect the loudspeaker enclosures for any cracks, deformations, missing or damaged components that could reduce enclosure strength. Inspect the rigging plates on the enclosures for any cracks, deformations, corrosion, missing or loose screws which could reduce the flying hardware strength. Replace any loudspeaker systems that are damaged or missing hardware. Never exceed the limitations or maximum recommended load for the X^{LC}i systems.

Electro-Voice X^{LC}i Front Rigging Connector Bar Assemblies: Prior to each use, inspect the front rigging connector bars and the front rigging plates for any cracks, burrs, deformations, corrosion or missing or damaged components that could reduce connector bar assembly strength. Replace any connector bars that are damaged or missing hardware. Always double check that each connector bar is securely bolted into position on the front rigging plates of the X^{LC}i enclosures and grids before lifting. Never exceed the limitations or maximum recommended load for the X^{LC}i rigging hardware.

Electro-Voice X^{LC}i Rear Connector Bar Assemblies: Prior to each use, inspect the rear rigging connector bars and rear rigging holes for any cracks, burrs, deformations, corrosion or missing or damaged components that could reduce connector bar assembly strength. Replace any connector bars that are damaged or missing hardware. Always double check that each connector bar is securely bolted to the rear rigging holes. Never exceed the limitations or maximum recommended load for the XLCi rigging hardware.

Pick-Up Grid Assemblies: Prior to each use, inspect the pick-up grid bar assembly any for cracks, burrs, deformations, corrosion or missing or damaged components that could reduce the pick-up assembly strength. Replace any pick-up grids that are damaged or missing hardware. Always double check that each pick-up grid is securely bolted to the front connector bar assemblies and the rear connector bar assemblies on the X^{LC}i enclosures before lifting. Never exceed the limitations or maximum recommended load for the pick-up grids.

Pull-Up Grid Assemblies: Prior to each use, inspect the pull-up grid bar assembly any for cracks, burrs, deformations, corrosion or missing or damaged components that could reduce the pull-up assembly strength. Replace any pull-up grids that are damaged or missing hardware. Always double check that each pull-up grid is securely bolted to the front connector bar assemblies and the rear connector bar assemblies on the X^LC^i enclosures before lifting. Never exceed the limitations or maximum recommended load for the pull-up grids.

Chain Hoists: Prior to each use, inspect the chain hoist and associated hardware (including motor, if applicable) for any cracks, deformation. Broken welds, corrosion, missing or damaged components that could reduce the hoist strength. Replace any damaged chain hoists. Never exceed the limitations or maximum recommended load specified by the hoist manufacturer. Always follow manufacturers' recommendations for operation, inspection, and certification. Always raise and lower the load slowly and evenly, avoiding any rapid changes in speed or shifting loads that could result in a sudden jolt to the suspended system.

Building, Tower or Scaffold Supports: Prior to each use, the strength and load-bearing capabilities of the building, tower or scaffold structural supports should be evaluated and certified by a professional engineer as being adequate for supporting the intended rigging system (including the loudspeakers, grids, chain hoists and all associated hardware). Prior to each use, inspect the building, tower or scaffold structural supports for any cracks, deformation, broken welds, corrosion, missing or damaged components that could reduce the structural strength. Damaged structural supports should be replaced or repaired and recertified by a professional engineer. Never exceed the limitations or maximum recommended load for the supports.

Miscellaneous Mechanical Components: Prior to each use, inspect all mechanical components (chain, wire ropes, slings, shackles, hooks, fittings, ratchet straps, etc.) for any cracks, deformation, broken welds, slipping crimps, fraying, abrasion, knots, corrosion, chemical damage, loose screws, missing or damaged components that could reduce the maximum strength specified by the component manufacturer. Replace any damaged mechanical components. Never exceed the limitations or maximum recommended load for the mechanical components.

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