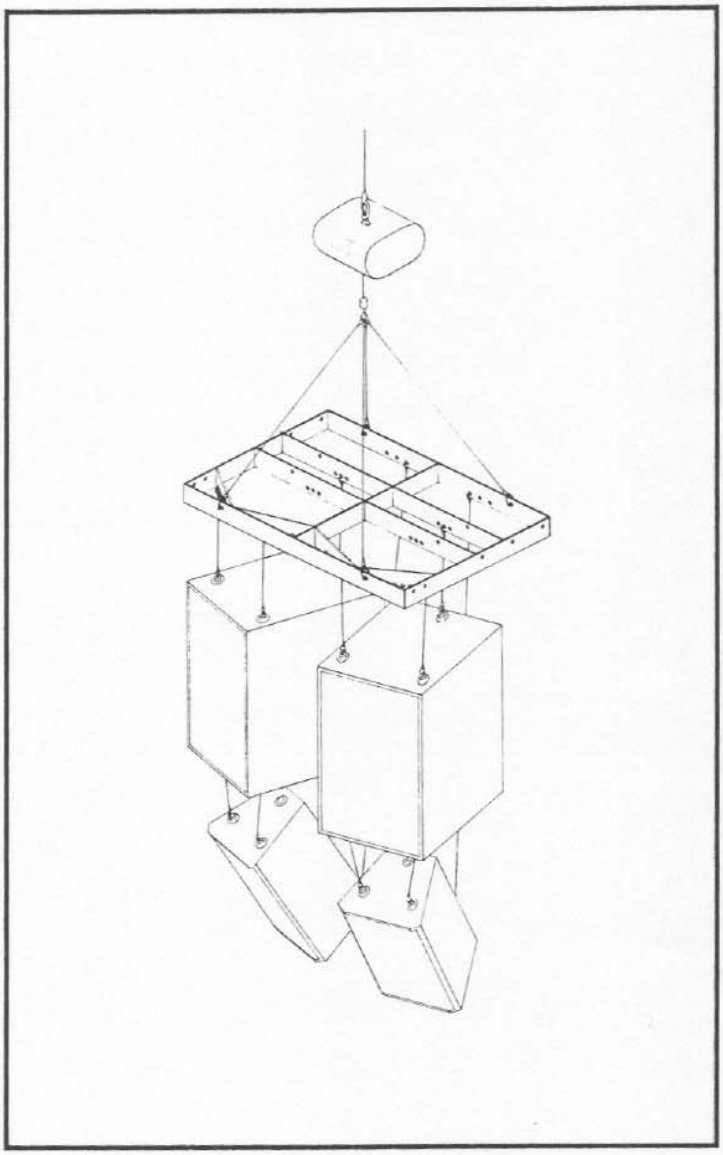
Electro-Voice®
THE DeltaMax™ SYSTEM

FLYING MANUAL



DML-2181F LOUDSPEAKER

THE DML CONCEPT

The DeltaMax™ DMC/DML-2181 system consists of the DML-2181 high-performance Manifold Technology® subwoofer speaker system and the companion DMC-2181 electronic controller. The DMC/DML-2181 is intended for high-level sound reinforcement in touring sound and permanent installation applications. The electronic-protection technology incorporated into the controller allows the subwoofer to operate at full capacity with maximum fidelity and reliablity. The compact enclosure allows tight-cluster designs, enabling maximum mutual coupling and single-point-source arrays.

The DML-2181 is a vented-box design comprised of two DL18MT 18-inch woofers, each facing into a manifold chamber at the center of the cabinet. Manifold Technology® (U.S. Patent No. 4,733,749) results in increased acoustic loading, yielding increased low-frequency efficiency and reduced distortion over conventional direct-radiating designs.

The DML-2181F flying version includes three steel-reinforced, aircraft-type pan fittings on the top and bottom of enclosure. These fittings ease the hanging of multi-cabinet arrays.

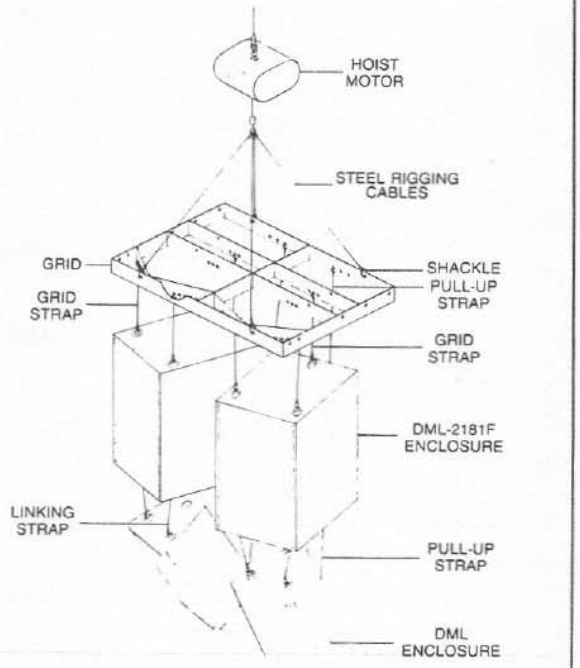


FIGURE 1 — The Anatomy of a DML Flying System

THE DML BASIC PRIMER

Anatomy of the DML Flying System

A basic four-cabinet flying system is shown in Figure 1, illustrating integral components that make up a typical DML system. The top cabinets (shown as DML-2181F enclosures) are the starting points for constructing the array. These cabinets are first secured to a grid through the use of three straps per cabinet. There are a variety of methods of making the actual attachment, and these techniques will be detailed later; however, for now, the securement line will be generically referred to as a strap assembly. The DML cabinets are equipped with three recessed aircraft-type pan fittings (two at the front and one at the back) on both the top and bottom of the enclosure. Special quick-release ring fittings are used to attach to the studs in the pan fittings on the enclosure. The ring on the quick-release fitting is then secured to the grid strap assembly. The remaining end of the grid strap is secured to cross members of the grid. The relative positioning of the straps along the cross members determine the relative horizontal angle between the two adjacent cabinets. A second row of cabinets may be added below the original two by utilizing linking straps that attach from the three pan fittings on the bottom of the first cabinets to the fittings on the top of the second cabinets (the bottom cabinet may be another DML-2181F or a wide-range cabinet such as the DML-1122F or DML-1152F for a full-range array). If sharp vertical angles are required, it is necessary to attach a pull-up strap from the rear point on the bottom of the cabinet to be angled back to the grid (as shown in Figure 1 for the bottom two cabinets). More than two cabinets may be hung in succession in this fashion as long as the load ratings of the enclosures, strap assemblies, grids, rigging cables and hoist motors are not exceeded. The loudspeaker array grid assembly is then raised into position by a hoist motor(s) of sufficient load rating. Note that the weight of such an array can be quite substantial, and the building structural supports to which the hoists are attached must be capable of supporting a load with a sufficient safety factor. In permanent installations, the hoist motors are often eliminated with the grid assembly being secured directly to the building structure.

The Hardware

The DML flying system utilizes the most high-tech aircraft hardware available for securing heavy loads. Mounted in each enclosure are six recessed aircraft-type pan fittings (Aeroquip 32206). The pan fittings are secured to steel brackets that are an integral part of the DML flying enclosure. The flypoint locations and the center of gravity for the DML-2181F are shown in Figure 2.

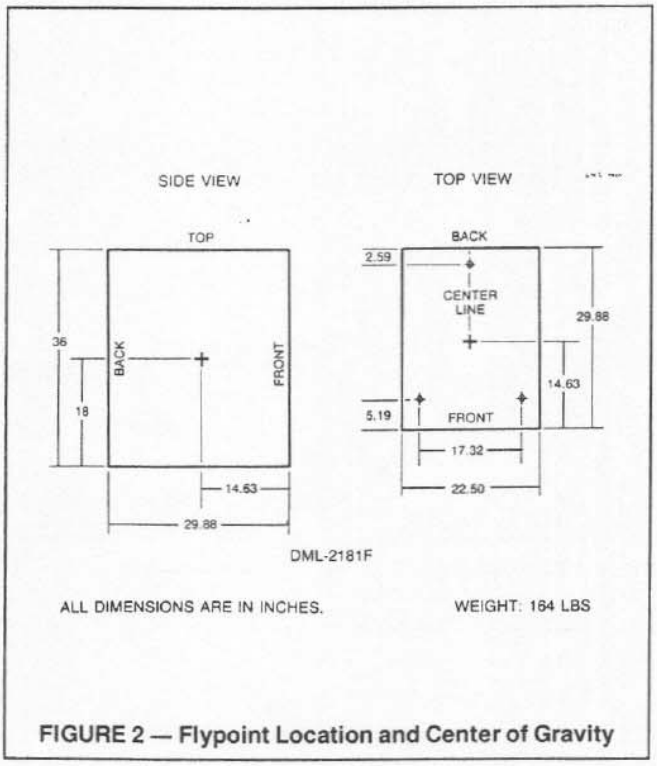


FIGURE 2 — Flypoint Location and Center of Gravity

The quick-release ring fittings that mate with the pan fittings on the enclosures are the Aeroquip 32326 and 32343. To attach the rigging points, grasp the ring fitting as shown in Figure 3 (page 3), and depress the sleeve locking pin. Slide the sleeve back over the locking pin. Position the ring fitting over the stud on the pan fitting on the cabinet. Slide the sleeve toward the pan until the locking pin reappears. The locking pin is spring loaded and should extend so that the sleeve may not move. ALWAYS CHECK TO MAKE SURE THAT THE FITTING IS SECURELY LOCKED INTO POSITION AND THAT THE SLEEVE IS IMMOVEABLE BEFORE LIFTING ANY ENCLOSURE. To remove the ring fitting, depress the locking pin, slide the sleeve back over the pin, and lift the fitting from the stud.

A variety of strap and rigging assemblies are offered by Electro-Voice for rigging DML flying systems as shown in Figure 4 (page 3). The DMS-1 is a fixed-length grid strap to secure the top cabinet in an array to the grid. The safety hook on the top is perfectly suited for attaching directly to the grid (through a 7/8-inch diameter hole in

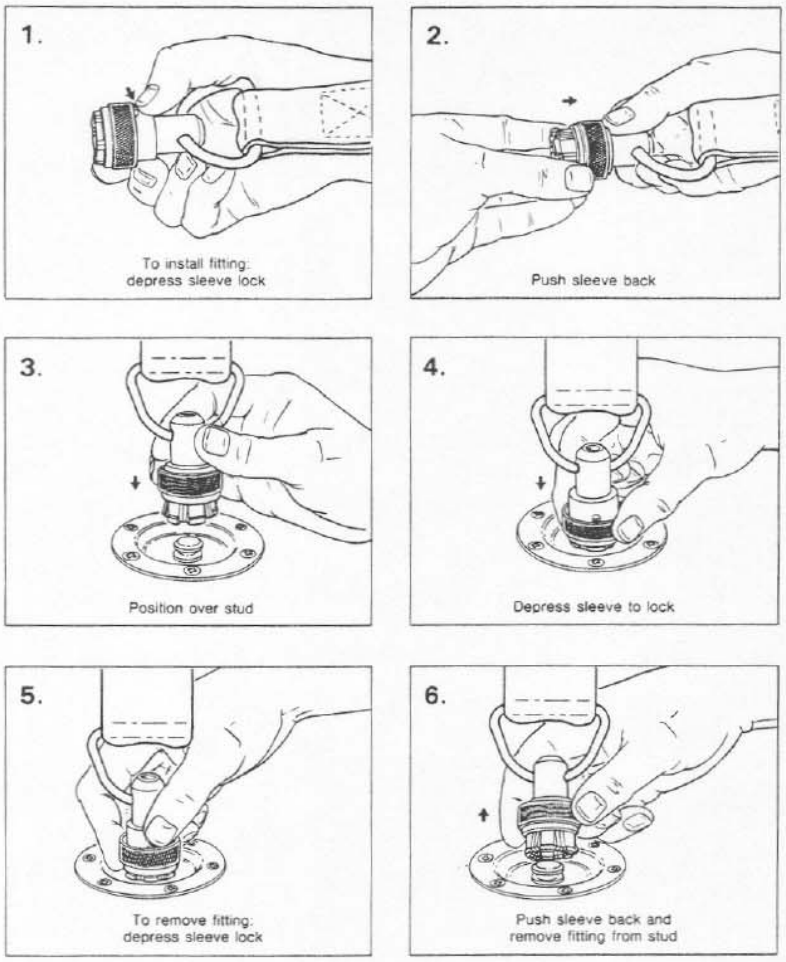


FIGURE 3 — Attaching the Rigging Points

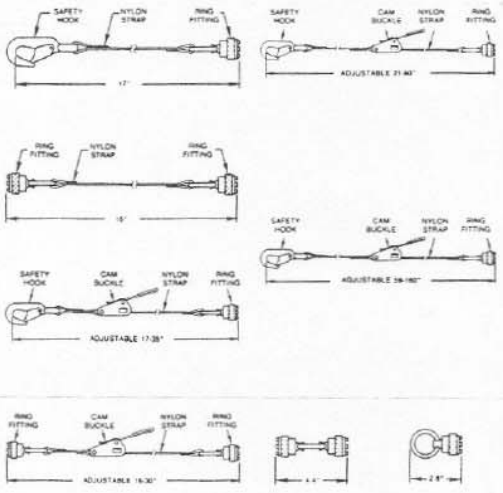


FIGURE 4 — DML Rigging Accessories

the grid barstock material), or to a variety of standard hardware attachments (including ⅜-, ½-, and ⅝-inch anchor shackles, "quick-link" threaded-chain connectors and "carabiner"-type snap hooks as shown in Figure 5). The DMS-2 is a fixed-length linking strap used to hang one cabinet below another. The DMS-3 is an adjustable-length grid strap. When used in conjunction with the DMS-1, the vertical angle of a cabinet can be adjusted by lengthening the strap. The DMS-4 is an adjustable-length linking strap that can be used with the DMS-2 to adjust the vertical angle of one cabinet attached to another. The DMS-5 and DMS-6 are adjustable-length pull-up straps used for pulling up the bottom of a cabinet to achieve a sharp downward vertical angle. The DMS-5 and DMS-6 are of different lengths to allow many ranges of adjustment.

The DMS-1 through DMS-6 rigging straps utilize nylon webbing strap material with a 9500-pound ultimate break-strength rating. Nylon webbing was chosen for its tremendous strength and because of its dynamic flexing capabilities. The force from any sudden jolt or shift in load is absorbed by the strap rather than transmitted directly to the speaker enclosure. Additionally, nylon is a flexible material that is easy to handle. The user is cautioned, however, that in certain permanent installation applications, the nylon material may not meet local fire regulations. If exposed to direct sunlight for long periods, the nylon material may deteriorate, resulting in reduced strength capability. The material may also deteriorate with extended exposure to hot, dry environments. In such instances, steel cable assemblies may have to be substituted.

The DMS-7 consists of two fittings that share a common ring, and allow the closest possible spacing between two cabinets. The DMS-8 is a single fitting with a round ring that is useful for custom applications. For instance, a cabinet could be secured directly to the grid using a DMS-8 fitting and a shackle, quick-link, or carabiner (see Figure 5). Additionally, cabinets could be linked together using two DMS-8 fittings and a quick-link or carabiner. Vertical angles can be adjusted using different sizes or combinations of quick-links or carabiners. The DMS-8 ring fitting can also be used for fabricating steel cable assemblies.

FIGURE 5 — Useful Rigging Hardware

Electro-Voice strongly urges that the user maintain a safety factor of at least 5:1 when implementing a DML flying system. In the United States, OSHA (the Occupational Safety and Health Administration) requires a minimum of 5:1 for overhead lifting, while BOCA (the Building Officials and Code Administrators) requires a 3.75:1 minimum. The safety factor is defined as the ratio of the break-strength (weight) rating of the system to the actual suspended weight. The weakest component of a DML flying system determines the strength of the entire system. This includes the DML enclosures, the DMS strap assemblies, the grid, the hoist, and all hardware. **THE DML FLYING ENCLOSURES AND DMS RIGGING STRAPS ARE LOAD RATED AND CERTIFIED BY INDEPENDENT LICENSED STRUCTURAL ENGINEERS.** The ultimate break-strength rating ranges from 1250 TO 4500 POUNDS depending on the angle of pull of the DML-2181F enclosure for each individual rigging point.

All mechanical components to be used with a DML flying system should be load rated. All load-rated hardware will have its load rating stamped on each piece in a visible location. Typical ratings are denoted as the static-working load (SWL), or the working-load limit (WLL). These ratings generally assume a safety factor of 5:1 (this would result in a component with a working-load rating of 1000 pounds having a break-strength rating of 5000 pounds); however, the user should consult the manufacturer to confirm the rating. Occasionally, (as with the DML flying hardware), the load rating is given as the ultimate break strength. This allows the user to calculate the safety factor directly for a given load.

CONSTRUCTING ARRAYS

Array Design

The electronically controlled DML loudspeaker systems are all time and phase aligned. This simplifies array design, allowing multiple loudspeakers to be assembled into an array which acoustically behaves as a section of a radiating spherical surface. Desired horizontal coverage can be obtained by simply splaying adjacent cabinets as necessary, or by adding additional cabinets, increasing the arc of the array. Cabinets may be hung from one another and angled independently to create the necessary vertical arc. The DML cabinets may be hung upside down or right side up.

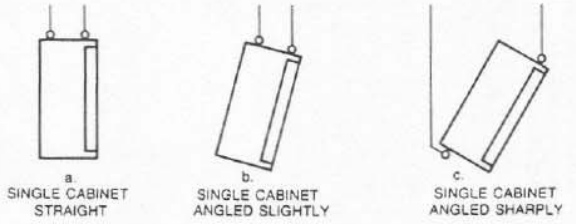


FIGURE 6 — Adjusting the Angle of a Single DML Cabinet

Horizontal array construction is a relatively trivial task; however, vertical array construction is a more complex procedure. The DML-2181F cabinets are balanced so that when supported from the front two points alone, they will hang with a slight upward angle (approximately 30°). The addition of a strap at the third point at the rear allows the adjustment of vertical angles. With straps of equal length the cabinet will hang perfectly straight, as shown in Figure 6a, with the weight of the cabinet split approximately equally between the front and back points. Lengthening the front straps (or shortening the rear straps) results in a downward angle. This can be achieved by using a DMS-1 fixed-length grid strap at the rear and DMS-3 adjustable grid straps at the front. Alternatively, one DMS-8 ring fitting could be used with a shackle at the rear point, while a DMS-8 linked to a shackle with a quick-link could be used at the front points. Both shackles and quick-links come in different sizes. Utilizing different combinations, a variety of angles may be achieved. Note that as the downward angle is increased, more of the load is transferred to the rear point. Eventually, a maximum angle will be reached (approximately 30° for the DML-2181F) where all the weight will be supported by the rear point. For reasons of safety and stability, the load should be distributed over three points. The user is cautioned to never hang the DML-2181F in this fashion with an angle greater than 25°. For sharper angles, the cabinet should be supported by the front two points with a pull-up strap attached to the rear point of the bottom cabinet as shown in Figure 6c. The DMS-1 fixed-length strap (or a shackle/quick-link/carabiner combination with a DMS-8) should be used at the front locations. It is recommended practice to secure a third fixed-length strap (not shown in Figure 6c) from the rear flypoint at the top of the cabinet back to the grid to serve as a safety line.

Figure 7 illustrates the techniques used to fly two DML cabinets in a vertical array. Figure 7a shows both cabinets pointed straight ahead. For the top cabinet, DMS-1 straps (or shackle/quick-

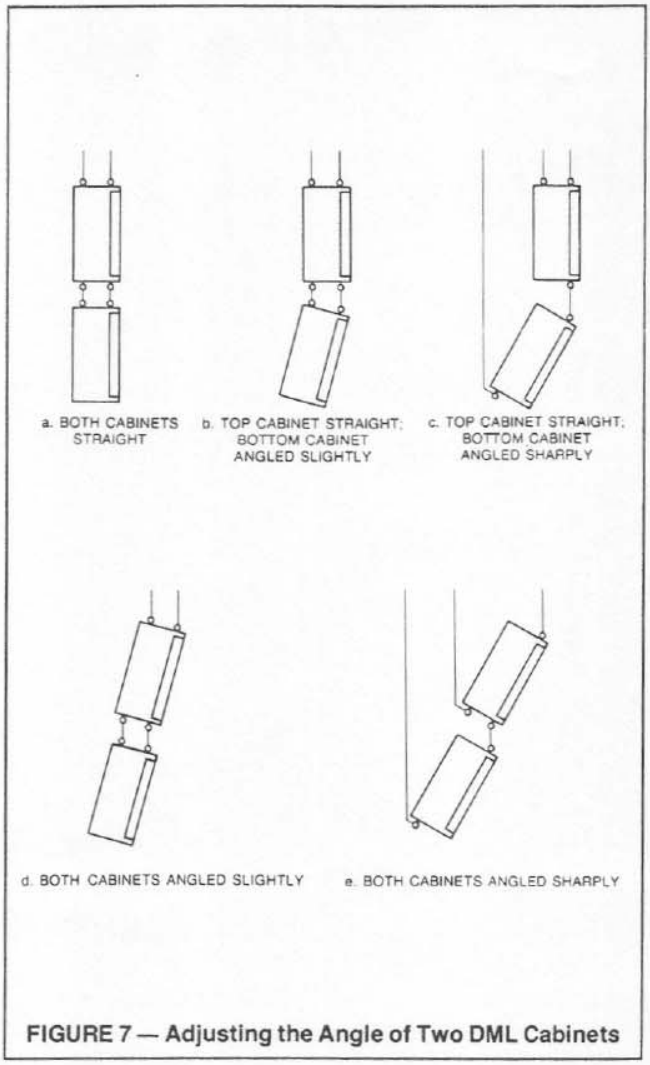


FIGURE 7 — Adjusting the Angle of Two DML Cabinets

link/carabiner combinations with a DMS-8) should be used. Either the DMS-2 linking strap or the DMS-7 dual-ring fitting could be used between the cabinets. The DMS-7 is ideal because it enables the closest possible spacing between the cabinets. Figure 7b shows the top cabinet straight with the bottom cabinet angled. The same techniques that were used for angling a single box apply when dealing with the bottom box of a vertical array. In this case, the DMS-2 fixed-length linking strap is used at the rear and DMS-4 adjustable-length linking straps at the front. DMS-8 ring fittings with combinations of quick-links or carabiners may also be used. As was the case with single DML-2181F cabinets, downward angles greater than 30° require the DMS-6 pull-up strap to be attached from the bottom rear point of the cabinet back to the grid. This situation is shown in Figure 7c. For medium angles, DMS-7 dual fittings may be used at the front points to maintain minimum spacing between cabinets. For sharp downward angles, DMS-2 fixed-length straps (or DMS-8 fittings linked with quick-links or carabiners) will be necessary to provide clearance for the rear corners of the cabinets. If a slight downward angle is desired for the top box, adjustable grid straps can be substituted for the front two points. A safety-strap connection between the two adjacent rear points of the two cabinets is recommended. A unique configuration is shown in Figure 7d where both cabinets have the same downward angle. DMS-7 dual fittings are used to link the cabinets together, with a fixed-length grid strap at the rear top point and adjustable-length grid straps at the front points. As the front straps are lengthened, both cabinets will tilt downward, maintaining the same angle. The load on the rear point at the top increases with increasing angles, reaching a maximum at approximately 15° for the DML-2181F, where the weight of the entire array is supported solely by the rear point. This condition is to be avoided, and the user is cautioned to never hang the DML-2181F enclosures in this configuration with the angle greater than 12°. Figure 7e shows two cabinets hung together with sharp downward angles. Both cabinets use pull-up straps such as the DMS-5 or DMS-6 to allow individual angle adjustments for each cabinet. DMS-1 grid straps (or shackle/quick-link/carabiner combinations) are used at the front two points of the top cabinet to secure to the grid. DMS-2 linking straps, DMS-7 dual fittings, or a pair of DMS-8 fittings with quick-links or carabiners may be used to link the enclosures together at the front two points. A safety strap should be secured from the top rear point of the upper box back to the grid.

All of the techniques for constructing vertical arrays as shown in Figure 7 may be expanded to create vertical arrays utilizing more than two cabinets as long as a sufficient safety factor is maintained. The user is reminded that the top cabinet in an array supports the weight of all the cabinets hung beneath it, and that the distribution of the load between the points secured to the grid will depend on the exact configuration. Typically, the configurations shown in Figure 7a, 7c and 7e result in the weight of the entire array being distributed over several of the top points, and the configurations in Figures 7b and 7d result in the load being concentrated on the top rear point; however, it is the expressed responsibility of the user to determine the load distribution and the resulting safety factor. If the load distribution is unknown, the user should assume that the weight of the entire array is being supported by a single rigging point when calculating the safety factor.

Note that the arrays previously discussed and shown in Figure 7 illustrate the use of identical cabinets. The systems need not be identical. For example, a full-range array may be constructed by hanging a DML-2181F subwoofer at the top with one or more wide-range systems (such as the DML-1122F or DML-1152F) below, angled down to achieve the desired coverage. The number of cabinets hung in a row is limited only by the total weight of that column of cabinets as supported by the top cabinet. Note that when hanging a "small" cabinet (such as a DML-1122F) from a "large" cabinet (such as a DML-2181F), or vice versa, the angle of pull on the pan fittings depends on the length of the straps (the longer the strap, the less the angle). This is due to the fact that the center-to-center spacing of the pan fittings is less on a smaller cabinet than on a larger one. This discrepency results in vertical angular differences when stringing unlike cabinets together. The strength of the flying hardware is a function of the angle of pull. In addition, the ultimate break strength may vary from one cabinet type to another. The array designer is instructed to consult the individual specifications of each cabinet type to determine the ultimate break strength of a specific array.

Grid Designs

Electro-Voice does not manufacture grids for supporting DML loudspeaker arrays. In the case of permanent installations, it is generally most effective and cost efficient to design a support system specific to the installation, taking into account the loudspeaker array(s) and the building structure. It may even be possible, in some circumstances, to eliminate the grid and secure the loudspeakers directly to the building structural supports. The sound system designer is instructed to evaluate each individual situation and design a support system tailored to the specific application.

In the case of portable or touring sound, the array format shown in Figure 1 occurs with great frequency. An "all-purpose" grid that would accommodate this format and allow variations would be particularly useful. A grid that can accommodate two columns of DML-2181F enclosures hung three high (or up to 600 pounds per column) is shown in Figure 8 (see page 7). The grid uses common ¼-inch thick structural steel barstock and requires only simple welding techniques. The grid will allow the cabinets to be pointed straight ahead or splayed outward horizontally with angles adjustable to greater than 30°.

Most typical arrays require full-range sound reproduction. This can be achieved by hanging one (or more) DML-2181F enclosures at the top with wide-range DML systems below. Two examples might be one DML-2181F system at the top with three DML-1122F systems underneath; or two DML-2181F systems at the top with two DML-1152F systems below. The only limitations are that a DML-2181F enlcosure must be at the top and the total weight of each column of DeltaMax™ systems be no more than 600 pounds. In these configurations with the columns splayed outward 30°, i.e., the sides of the trapezoidal cabinets parallel, downward angles of nearly 90° (straight down) are possible for the DML-1122F and DML-1152F systems.

Suggested lifting configurations for the various arrays are shown in Figure 9 (see page 8). The weight distribution of the grid will vary from front to back, depending on the particular array configuration. The lift configuration shown in Figure 9a allows independent support of the weight distribution. The lift configurations shown in Figures 9b, 9c and 9d do not allow independent control; however, a variety of attachment points along the side of the grid are provided that enable a balance of the load to be achieved. If the load is not balanced front to back, the grid could tilt. A seriously imbalanced condition could have potentially disastrous results. Used properly, these flying configurations utilize the full-strength capability of the suggested grid design, maintaining the maximum safety factor. The user is cautioned that other lifting configurations may lessen the safety factor.

Attachment to the top of the grid is made with ⅝-inch shackles for hoisting. Attachment to the bottom of the grid is made directly with the safety hook of the DMS-1, 3, 5, and 6 strap assemblies for the loudspeakers (⅜-, ½-, or ⅝-inch anchor shackles, "quick-link" threaded-chain connectors or "carabiner"-type snap hooks may be used with DMS-8 ring fittings on the bottom). 36-inch-long wire rope (⅜-inch 6x19 IPS-IWRC) slings are used for securement to the hoist(s). Flat washers (¾ inch) should be used with the shackles to center the load on the eyebolt.

The load should always be raised (or lowered) slowly and evenly. Any sudden jolts or dynamic changes (occurring from rapid changes in speed, shifting loads, etc.) can result in impact forces many times greater than static dead-weight load.

Electro-Voice offers this grid design only as a suggestion, and offers no guarantee of performance. If fabricated as detailed in Figure 8 and utilized as detailed in Figure 9, a safety factor in excess of 10:1 is theoretically achieved for the grid for the worst case load of two columns of loudspeakers, each having a total weight of 600 pounds with a DML-2181F enclosure at the top. Variances in the quality of materials and workmanship can substantially affect the strength of the grid. The user is responsible for determining the strength of the constructed grid.

STRENGTH RATINGS AND SAFETY FACTORS

The strength ratings given by Electro-Voice are "ultimate break strength" and are a function of the angle of pull relative to the pan fitting and the surface on which it is mounted. The strength rating of each individual rigging point on the DML-2181F enclosure are shown in Figure 10 (page 9) and are identical for use with any of the DMS rigging accessories. THE DML ENCLOSURES AND DMS RIGGING STRAPS HAVE BEEN CERTIFIED FOR STRENGTH BY INDEPENDENT STRUCTURAL ENGINEERS. The strength ratings indicated are contingent upon using stock Electro-Voice DML-2181F enclosures and DMS rigging accessories. Other products, no matter how similar in appearance, cannot be construed as acceptable substitutes. If substitutes are made, the user assumes the responsibility of determining the strength rating of the system. All strength ratings are based upon a straight tensile pull of the strap assemblies. Any twisting or bending of the strap material may result in a signficant reduction of strength. The weakest component of a DML flying system determines the strength rating of the entire system. Electro-Voice does not endorse, recommend, or rate any of the auxiliary equipment (grids, hoist motors, mechanical hardware, etc.) necessary for completing a DML flying system. It is the expressed responsibility of the system user to verify the strength ratings of all equipment not manufactured by Electro-Voice.

It is the responsibility of the user to determine the safety factor of all load-bearing points. The safety factor for a given load-bearing point is defined as:

$$\text{Safety Factor} = \frac{\text{Ultimate Break Strength}}{\text{Actual Load}}$$

The safety factor for an entire array will be determined by the lowest safety factor of all the load-bearing points. The user is reminded that the load distribution on the rigging points will vary with array configuration and that it is the expressed responsibility of the user to calculate the load distribution. Figure 2 provides the information necessary for calculating load distributions. If the load distribution is not known, the user should assume that the entire load is supported by a single rigging point.

Securement strength requirements should take into consideration any dynamic loading and other contributing factors affecting the flown system. It is the responsibility of the user to determine the proper safety factor in specific applications and the required strength rating of the connection points. **ELECTRO-VOICE STRONGLY RECOMMENDS THAT THE DML FLYING SYSTEM BE USED IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS, AND STRONGLY URGES THE USER TO REVIEW AND COMPLY WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS RELATIVE TO PROPER SECUREMENT OF FLYING OR HANGING LOADS PRIOR TO USAGE.**

INSPECTION, MAINTENANCE AND PRECAUTIONS

DML System Hardware

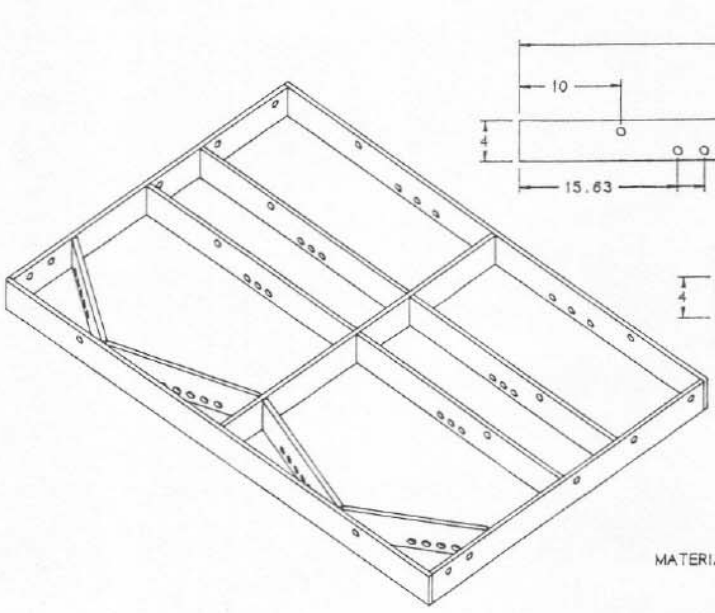
DML Loudspeaker Enclosures. Prior to each use inspect the enclosure for any cracks, deformations, missing or damaged components which could reduce enclosure strength. Inspect the pan fittings and support brackets on the top and sides of the enclosure for any cracks, deformations, missing or loose screws which could reduce the flying hardware strength. Replace or repair damaged speaker systems. Never exceed the limitations or maximum recommended load specified by Electro-Voice for the DML enclosures.

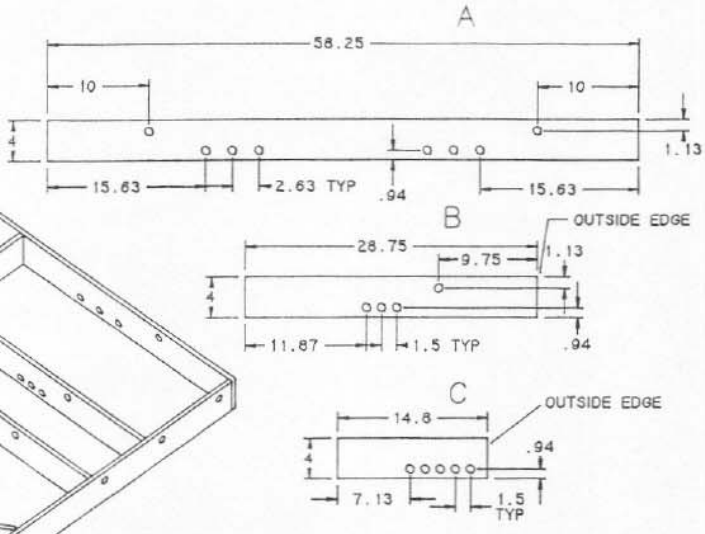
DMS Strap Assemblies. Prior to each use inspect the webbing for cuts, abrasion, tears, knots, chemical damage, burns and broken stitches which could reduce assembly strength. Inspect the fittings and hooks for any cracks, burrs, deformation, missing or damaged components which could reduce strap assembly strength. Replace any strap assembly with damaged webbing. Replace or repair any strap assembly with damaged hardware. Always double check that each fitting on the rigging-strap assemblies is securely locked into position in the pan fittings on the DML enclosures before lifting.

Associated Hardware

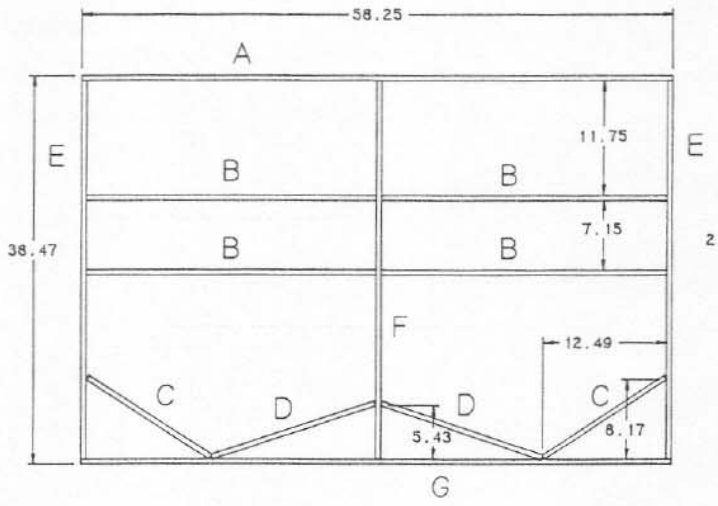
Grid Assembly. Prior to each use inspect the grid assembly and associated hardware for any cracks, deformations, broken welds, corrosion, missing or damaged components which could reduce the grid assembly strength. Replace or repair damaged grid assemblies. Never exceed the limitations or maximum recommended load intended for grid assembly design.

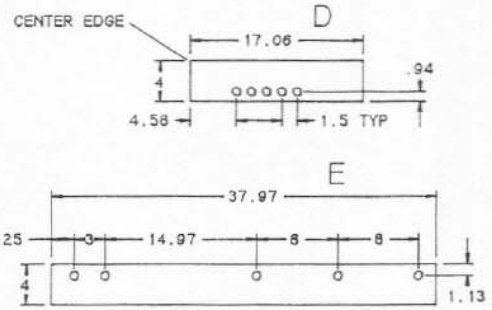
Hoist Motors. Prior to each use inspect the hoist motor and associated hardware for any cracks, deformation, broken welds, corrosion, missing or damaged components which could reduce the hoist motor strength. Replace or repair damaged hoist motors and hardware. Never exceed the limitations or maximum recommended load specified by the hoist manufacturer. 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.





MATERIAL: 4" x 1/4" THICK 1018 STRUCTURAL STEEL





NOTES

1. WELD 1/4" FILLET BOTH SIDES OF ALL JOINTS
2. ALL DIM IN INCHES
3. ALL HOLES 7/8" DIAMETER
4. TOLERANCE ± 1/16"

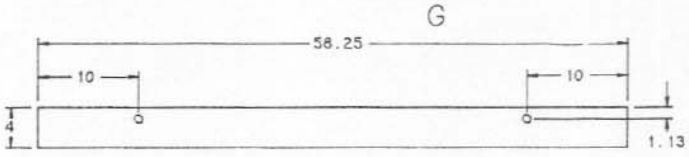
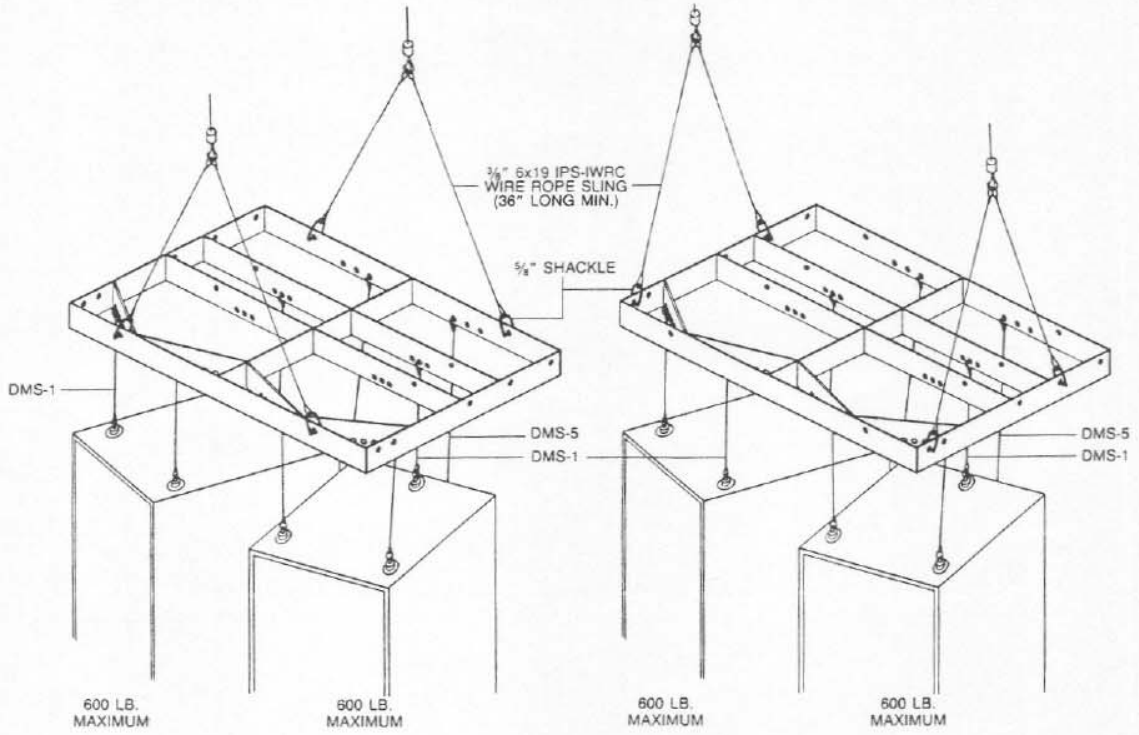
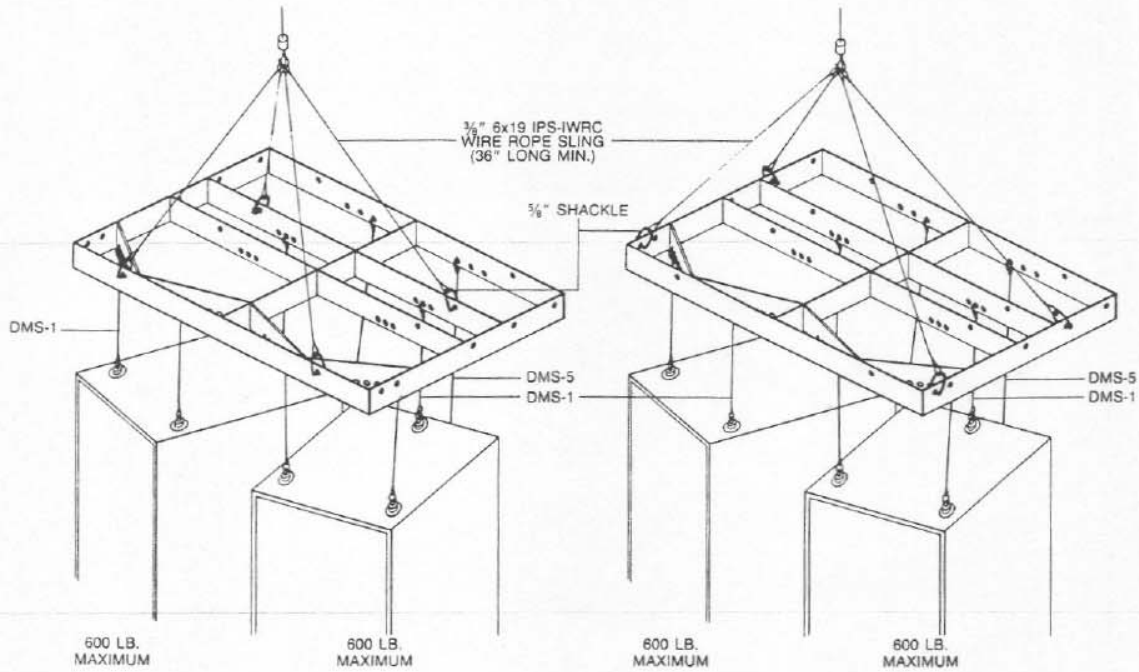


FIGURE 8 — Suggested Grid for DML-2181F Flying Systems



9a. Two Lift Points (front and back attachment)

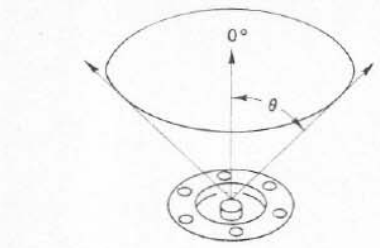
9b. Two Lift Points (side attachment)



9c. One Lift Point (front and back attachment)

9d. One Lift Point (side attachment)

FIGURE 9 — Suggested Flying Configurations for DML-2181F Flying Systems



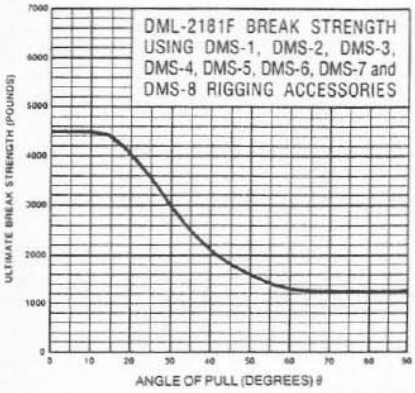


FIGURE 10 — DML-2181F Systems Ultimate Break Strength Rating of Each Rigging Point

Building Structural Supports. Prior to usage the strength and load-bearing capabilities of the building structural supports should be evaluated and certified by a professional engineer as being adequate for supporting the intended DML system. Prior to each use inspect the building structural supports for any cracks, deformation, broken welds, corrosion, missing or damaged components which would reduce the structural strength. Damaged building structural supports should be replaced or repaired and recertified.

Mechanical Connections. Prior to each use inspect all mechanical connections (chains, wire ropes, slings, shackles, hooks, fittings, etc.) for any cracks, deformation, broken welds, slipping crimps, fraying, abrasion, knots, corrosion, chemical damage, loose screws, missing or damaged components which would reduce the maximum strength specified by the connector manufacturer.

WARRANTY (Limited)

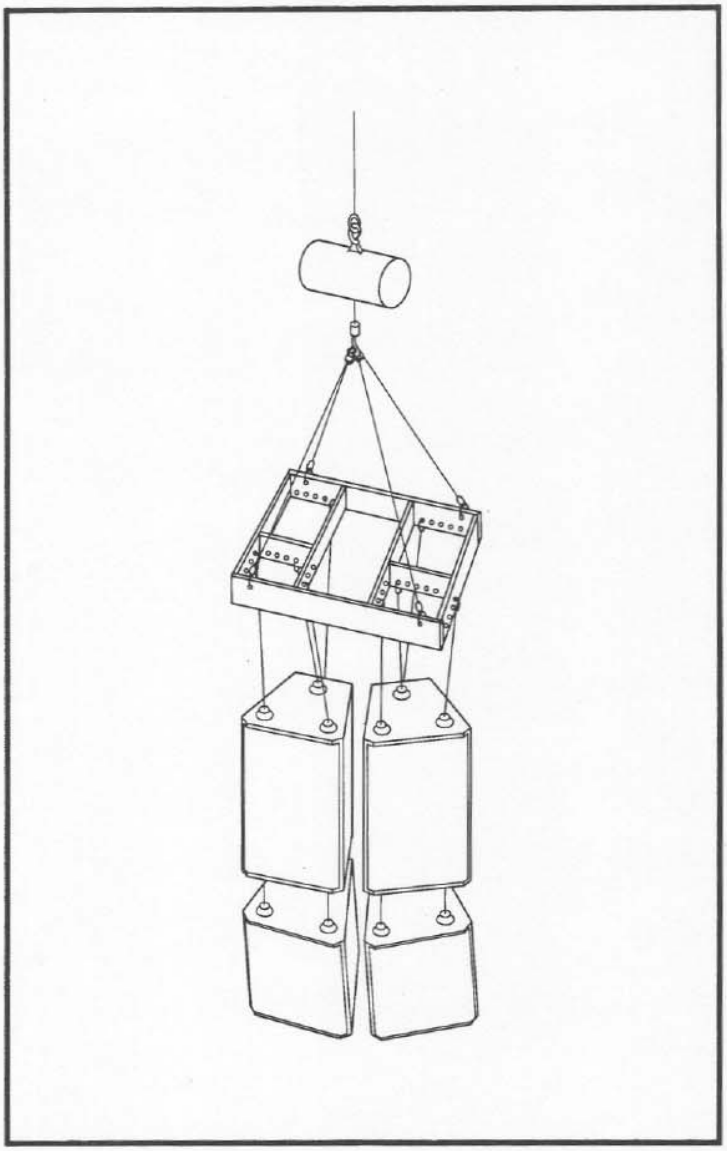
Electro-Voice DML Speakers and Speaker Systems (excluding active electronics) are guaranteed for five years from the date of original purchase against malfunction due to defects in workmanship and materials. Electro-Voice DML flying hardware (DMS rigging straps and enclosure-mounted flying hardware) is guaranteed for one year from date of original purchase against malfunction due to defects in workmanship and materials. Electro-Voice Professional Sound Electronic Components are guaranteed for two years from date of original purchase against malfunction due to defects in workmanship and materials. Warranty does not extend to finish, appearance items, burned coils, or malfunction due to abuse or operation under other than specified conditions, nor does it extend to incidental or consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you. If such malfunction occurs, unit will be repaired or replaced (at our option) without charge for materials or labor if delivered prepaid to the proper Electro-Voice service facility. Unit will be returned prepaid. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee. A list of authorized warranty service agencies is available from Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107 (AC/616-695-6831); Electro-Voice, Inc., 3810 148th Ave. N.E., Redmond, WA 98052 (AC/206-881-9555); and/or Electro-Voice West, 8234 Doe Ave., Visalia, CA 93291 (AC/209-651-7777). Or Electro-Voice Div., 345 Herbert St., Gananoque, Ontario, Canada K7G 2V1 (AC/613-382-2141); Electro-Voice, S.A., Keltenstrasse 5, CH-2563 IPSACH, Switzerland (41)32-51-58-33; Electro-Voice, Ltd., 2-5-60 Izumi, Suginami-ku, Tokyo, Japan 168, (81)3-325-7900; Electro-Voice Germany, Larchenstrasse 99, 6230 Frankfort/Main 80, Germany (49)69-380-100; Electro-Voice Pty., 59 Waratah St., Kirrawee N.S.W. 2232, Australia (61)2-521-5322. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

Service and repair address for this product:
Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107.

Specifications subject to change without notice.

Electro-Voice®
THE DeltaMax™ SYSTEM

FLYING MANUAL



DML-1122AF/DML-1152AF LOUDSPEAKERS

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THE DML CONCEPT

The DeltaMax™ DMC/DML-1122A and DMC/DML-1152A systems consist of the DML-1122A and DML-1152A-series two-way, biamped high-performance speaker systems and the companion DMC-1122A and DMC-1152A electronic controllers. The DML-1122A and DML-1152A are full-range loudspeaker systems, intended for high-level sound reinforcement in touring-sound and permanent-installation applications. The electronic-protection technology incorporated into the DMC-1122A and DMC-1152A controllers allow the loudspeakers to be operated at full capacity with maximum fidelity and reliablity. The trapezoidal cabinet shape allows tight cluster designs, enabling maximum mutual coupling and single-point-source arrays.

The DML-1152A employs a DL15X 15-inch woofer for low-frequency reproduction, and a standard 2-inch-exit DH1A compression driver. The DML-1122A utilizes a DL12X-variant 12-inch woofer and a 1.3-inch-exit DH1A-variant high-frequency driver. Both systems use flat-front, constant-directivity high-frequency horns which are based on the Electro-Voice HP series (U.S. Patent No. 4,685,532) and are geometrically optimized for performance from 1,250 Hz to 20,000 Hz. The DML-1122A maintains a nominal 80° x 55° coverage pattern, while the DML-1152A maintains a 60° x 40° pattern.

The electronic circuits are designed to provide optimum audio performance even when the audio drive level is increased for maximum loudness. A high-performance compressor is controlled by special speaker modeling circuits to provide speaker excursion protection, speaker temperature protection and amplifier anti-clipping limiting.

The DeltaMax™ flying versions, models DML-1122AF and DML-1152AF versions, include three steel-reinforced aircraft-type pan fittings on both the top and bottom of the enclosures to facilitate the hanging of multi-cabinet arrays.

The DML-1122A- and DML-1152A-series loudspeaker systems are improved versions that replace the older DML-1122 and DML-1152 series. The primary difference is the change in the electrical input connectors from the ITT-Cannon EP type to the Neutrik Speakon™ type. The newer models are as follows: the DML-1122AP and DML-1152AP (painted finish like the older DML-1122 and DML-1152 models) and the DML-1122APF and DML-1152APF (painted finish with flying hardware like the older DMl-1122F and DML-1152F models).

The DML-1122AF- and DML-1152AF-series loudspeaker systems are identical to the older DML-1122F and DML-1152F versions in size, weight, center of gravity, rigging hardware type and placement. The new versions are completely compatible with all of the DMS rigging accessories and the techniques described in the DML-1122F/DML-1152F Loudspeaker Flying Manual. However, the strength ratings of the newer DML-1122AF and DML-1152AF versions have been increased over that of the DML-1122F and DML-1152F versions. With the exception of the strengh rating difference, the older and newer models may be mixed without any special considerations. If there is any confusion when mixing older and newer units, the lower strength ratings should be used. Complete strength-rating specifications for both the older and newer versions are presented in this manual. There were inaccuracies in the strength-rating specifications given in the original DML-1122F/DML-1152F Loudspeaker Flying Manuals (EV Part No. 531102) and, hence, the user should use the specifications used in the "STRENGTH RATINGS AND SAFETY FACTOR" section in this manual when designing arrays for any of the DML-1122F-, DML-1152F-, DML-1122AF- or DML-1152AF-series loudspeaker systems.

THE DML BASIC PRIMER

Anatomy of the DML Flying System

A basic four-cabinet flying system is shown in Figure 1, illustrating the integral components that make up a typical DML system. The top cabinets are the starting points for constructing the array. These cabinets are first secured to a grid through the use of three straps per cabinet. There are a variety of methods of making the actual

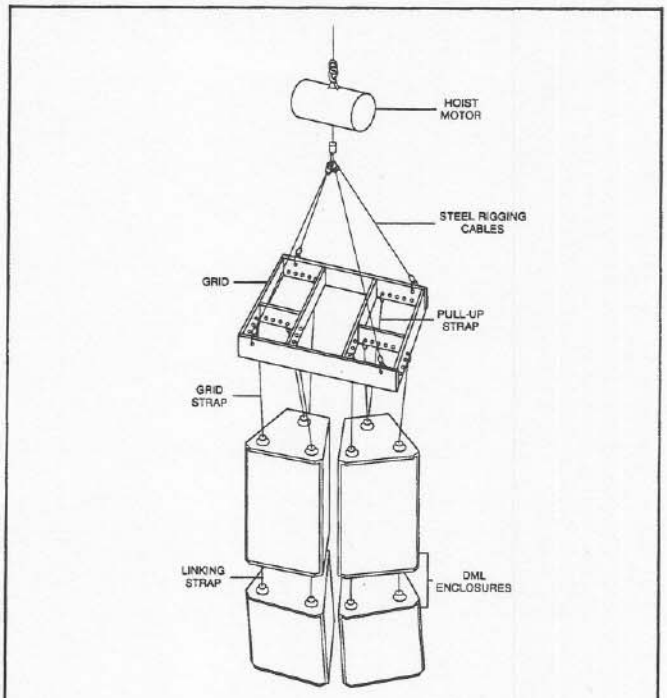


FIGURE 1 — The Anatomy of a DML Flying System

attachment, and these techniques will be detailed later; however, for now, the securement line will be generically referred to as a strap assembly. The DML cabinets are equipped with three recessed aircraft-type pan fittings (two at the front and one at the back) on both the top and bottom of the enclosure. Special quick-release ring fittings are used to attach to the studs in the pan fittings on the enclosure. The ring on the quick-release fitting is then secured to the grid strap assembly. The remaining end of the grid strap is secured to cross members of the grid. The relative positioning of the straps along the cross members determine the relative horizontal angle between the two adjacent cabinets. A second row of cabinets may be added below the original two by utilizing linking straps that attach from the three pan fittings on the bottom of first cabinets to the fittings on the top of the second cabinets. If sharp vertical angles are required, it is necessary to attach a pull-up strap from the rear point on the bottom of the cabinet to be angled back to the grid (as shown in Figure 1 for the bottom two cabinets). More than two cabinets may be hung in succession in this fashion as long as the load ratings of the enclosures, strap assemblies, grids, rigging cables and hoist motors are not exceeded. The loudspeaker array grid assembly is then raised into position by a hoist motor(s) of sufficient load rating. Note that the weight of such an array can be quite substantial, and the building structural supports to which the hoists are attached must be capable of supporting a load with a sufficient safety factor. In permanent installations, the hoist motors are often eliminated with the grid assembly being secured directly to the building structure.

The Hardware

The DML flying system utilizes the most high-tech aircraft hardware available for securing heavy loads. Mounted in each enclosure are six recessed aircraft-type pan fittings (Aeroquip 32206). The pan fittings are secured to steel brackets that are an integral part of the DML flying enclosure. The positioning of the flypoints is shown in Figure 2.

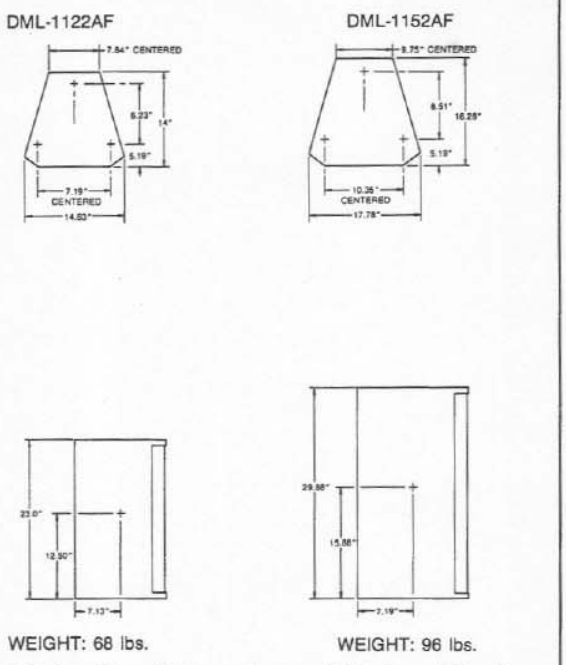


FIGURE 2 — Flypoint Location and Center of Gravity

The quick-release ring fittings that mate with the pan fittings on the enclosures are the Aeroquip 32326 and 32343. To attach the rigging points, grasp the ring fitting as shown in Figure 3, and depress the sleeve locking pin. Slide the sleeve back over the locking pin. Position the ring fitting over the stud on the pan fitting on the cabinet. Slide the sleeve toward the pan until the locking pin reappears. The locking pin is spring loaded and should extend so that the sleeve may not move. ALWAYS CHECK TO MAKE SURE THAT THE FITTING IS SECURELY LOCKED INTO POSITION AND THAT THE SLEEVE IS IMMOVEABLE BEFORE LIFTING ANY ENCLOSURE. To remove the ring fitting, depress the locking pin and slide the sleeve back over the pin. The fitting may now be lifted from the stud.

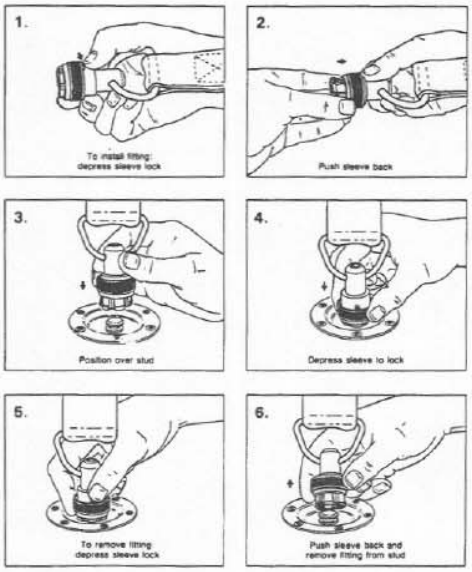


FIGURE 3 — Attaching the Rigging Points

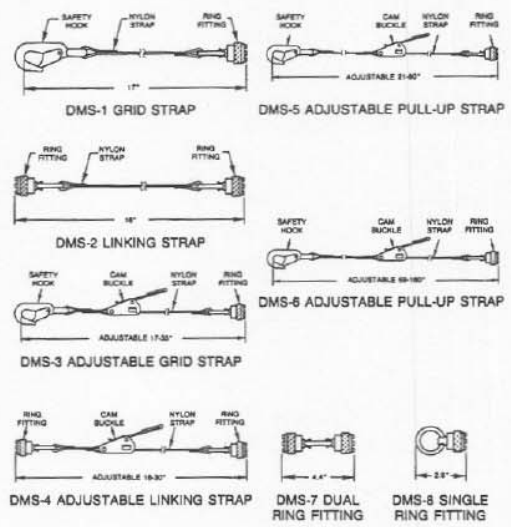


FIGURE 4 — DML Rigging Accessories

A variety of strap and rigging assemblies are offered by Electro-Voice for rigging DML flying systems as shown in Figure 4. The DMS-1 is a fixed-length grid strap to secure the top cabinet in an array to the grid. The safety hook on the top is perfectly suited for attaching directly to the grid (through a 7/8-inch diameter hole in the grid bar stock material), or to a variety of standard hardware attachments (including 3/8-, 1/2-, and 5/8-inch anchor shackles, "quick-link" threaded chain connectors, and "carabiner"-type snap hooks as shown in Figure 5). The DMS-2 is a fixed-length linking strap used to hang one cabinet below another. The DMS-3 is an adjustable-length grid strap. When used in conjunction with the DMS-1, the vertical angle of a cabinet can be adjusted by lengthening the strap. The DMS-4 is an adjustable-length linking strap that can be used with the DMS-2 to adjust the vertical angle of one cabinet attached to another. The DMS-5 and DMS-6 are adjustable-length pull-up straps used for pulling up the bottom of a cabinet to achieve a sharp downward vertical angle. The DMS-5 and DMS-6 are of different lengths to allow many ranges of adjustment. The DMS-1 through DMS-6 rigging straps utilize nylon webbing strap material with 9500-pound ultimate-break-strength rating. Nylon webbing was chosen for its tremendous strength and because of its dynamic flexing capabilities. The force from any sudden jolt or shift in load is absorbed by the strap rather than transmitted directly to the speaker enclosure. Additionally, nylon is a flexible material that is easy to handle. The user is cautioned, however, that in certain permanent installation applications, the nylon material may not meet local fire regulations. If exposed to direct sunlight for long periods of time, the nylon material may deteriorate, resulting in reduced strength capability. The material may also deteriorate with extended exposure to hot, dry environments. In such instances, steel cable assemblies may have to be substituted.

The DMS-7 consists of two fittings that share a common ring, and allow the closest possible spacing between two cabinets. The DMS-8 is a single fitting with a round ring that is useful for custom applications. For instance, a cabinet could be secured directly to the grid using a DMS-8 fitting and a shackle, quick-link, or carabiner (see Figure 5). Additionally, cabinets could be linked together using two DMS-8 fittings and a quick-link or carabiner. Vertical angles can be adjusted using different sizes or combinations of quick-links or carabiners. The DMS-8 ring fitting can also be used for fabricating steel cable assemblies.

ANCHOR SHACKLE | CARABINER-TYPE SNAP HOOK | QUICK-LINK THREADED CHAIN CONNECTOR

FIGURE 5 — Useful Rigging Hardware

Electro-Voice strongly urges that the user maintain a safety factor of at least 5:1 when implementing a DML flying system. In the United States, OSHA (the Occupational Safety and Health Act) requires a minimum of 5:1 for overhead lifting, while BOCA (the Building Officials and Code Administrators) requires a 3.75:1 minimum. The safety factor is defined as the ratio of the ultimate-break-strength rating of the system to the actual applied load. In other words, the ultimate-break strength of each of the mechanical components in the system must be at least five times greater than the actual force applied to the components. The weakest component of a DML flying system determines the strength of the entire system. This includes the DML enclosures, the DMS strap assemblies, the grid, the hoist and all hardware. The ultimate-break-strength rating for each individual rigging point on either the DML-1122AF or DML-1152AF enclosure varies from 1,200 to 4,500 pounds depending on the angle of pull. The ultimate-break-strength rating for either of the enclosures is 6,750 pounds for a total suspended weight. For a 5:1 safety factor, the working-load limit for each individual point varies from 240 to 900 pounds and the overall enclosure working-load limit becomes 1,350 pounds. For the older DML-1122F and DML-1152F models, the ultimate-break-strength rating for each individual rigging point varies from 1,200 to 3,600 pounds, depending on the angle of pull, with an overall enclosure ultimate-break-strength rating of 5,400 pounds. For a 5:1 safety factor, the working-load limit for each individual point on these systems varies from 240 to 720 pounds and the overall enclosure working-load limit becomes 1,080 pounds. The user should consult the "STRENGTH RATINGS AND SAFETY FACTOR" section in this manual before attempting to suspend any DML systems overhead.

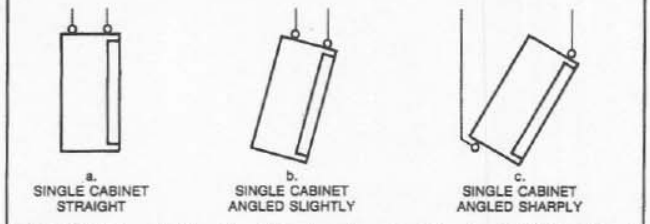
All mechanical components to be used with a DML flying system should be load rated. All load-rated hardware will have its load rating stamped on each piece in a visible location. Typical ratings are denoted as the static-working load (SWL), or the working-load limit (WLL). These ratings generally assume a safety factor of 5:1 (this would result in a component with a working load rating of 1000 pounds having a break strength rating 5000 pounds); however, the user should consult the manufacturer to confirm the rating. Occasionally, the load rating is given as the ultimate breaking strength. This allows the user to calculate the safety factor directly for a given load.

CONSTRUCTING ARRAYS

Array Design

The electronically controlled DML loudspeaker systems are all time and phase aligned. This simplifies array design, allowing multiple loudspeakers to be assembled into an array which acoustically behaves as a section of a radiating spherical surface. Desired horizontal coverage can be obtained by simply splaying adjacent cabinets as necessary, or by adding additional cabinets, increasing the arc of the array. Cabinets may be hung from one another and angled independently to create the necessary vertical arc. The DML cabinets may be hung upside down or right side up.

Horizontal array construction is a relatively trivial task; however, vertical array construction is a more complex procedure. The DML cabinets are balanced so that when supported from the front two points alone, they will hang with a slight upward angle (approximately 10°-15°). The addition of a strap at the third point at the rear



a. SINGLE CABINET STRAIGHT | b. SINGLE CABINET ANGLED SLIGHTLY | c. SINGLE CABINET ANGLED SHARPLY

FIGURE 6 — Adjusting the Angle of a Single DML Cabinet

allows the adjustment of vertical angles. With straps of equal length the cabinet will hang perfectly straight, as shown in Figure 6a, with the weight of the cabinet split approximately equally over all three points. Lengthening the front straps (or shortening the rear straps) results in a downward angle as shown in Figure 6b. This can be achieved by using a DMS-1 fixed-length grid strap at the rear and DMS-3 adjustable grid straps at the front. Alternatively, one DMS-8 ring fitting could be used with a shackle at the rear point, while a DMS-8 linked to a shackle with a quick-link could be used at the front points. Both shackles and quick-links come in different sizes. Utilizing different combinations, a variety of angles may be achieved. Note that as the downward angle is increased, more of the load is transferred to the rear point. Eventually, a maximum angle will be reached (approximately 20° for the DML-1122AF and DML-1152AF) where all of the weight will be supported by the rear point. For reasons of safety and stability, the load should be distributed over three points. The user is cautioned to never hang the DML-1122AF and DML-1152AF in this fashion with an angle greater than 15 degrees. For sharper angles, the cabinet should be supported by the front two points with a pull-up strap attached to the rear point on the bottom of the cabinet as shown in Figure 6c. The DMS-1 fixed-length strap (or a shackle/quick-link/carabiner combination with a DMS-8) should be used at the front locations. It is recommended practice to secure a third fixed-length strap (not shown in Figure 6c) from the rear flypoint at the top of the cabinet back to the grid to serve as a safety line.

Figure 7 illustrates the techniques used to fly two DML cabinets in a vertical array. Figure 7a shows both cabinets pointed straight ahead. For the top cabinet, DMS-1 straps (or shackle/quick-link/carabiner combinations with a DMS-8) should be used. Either the DMS-2 linking strap or the DMS-7 dual ring fitting could be used between the cabinets. The DMS-7 is ideal because it enables the closest possible spacing between the cabinets. Figure 7b shows the top cabinet straight with the bottom cabinet angled. The same techniques that were used for angling a single box apply when dealing with bottom box of a vertical array. In this case, the DMS-2 fixed-length linking strap is used at the rear and DMS-4 adjustable-length linking straps at the front. DMS-8 ring fittings with combinations of quick-links or carabiners may also be used. As was the case with single DML-1122AF and DML-1152AF cabinets, downward angles greater than 15 degrees require the DMS-6 pull-up strap to be attached from the bottom rear point of the cabinet back to the grid. This situation is shown in Figure 7c. For medium angles, DMS-7 dual fittings may be used at the front points to maintain minimum spacing between cabinets. For sharp downward angles, DMS-2 fixed-length straps (or DMS-8 fittings linked with quick-links or carabiners) will be necessary to provide clearance for the rear corners of the cabinets. If a slight downward angle is desired for the top box, adjustable grid straps can be substituted for the front two points. A safety strap connection between the two adjacent rear points of the two cabinets is recommended. A unique configuration is shown in Figure 7d where both cabinets have the same downward angle. DMS-7 dual fittings are used to link the cabinets together, with a fixed-length grid strap at the rear top point and adjustable length grid straps at the front points. As the front straps are lengthened, both cabinets will tilt downward, maintaining the same angle. The load on the rear point at the top increases with increasing angles, reaching a maximum at approximately 10 degrees for the DML-1122AF and DML-1152AF, where the weight of the entire array is supported solely by the rear point. This condition is to

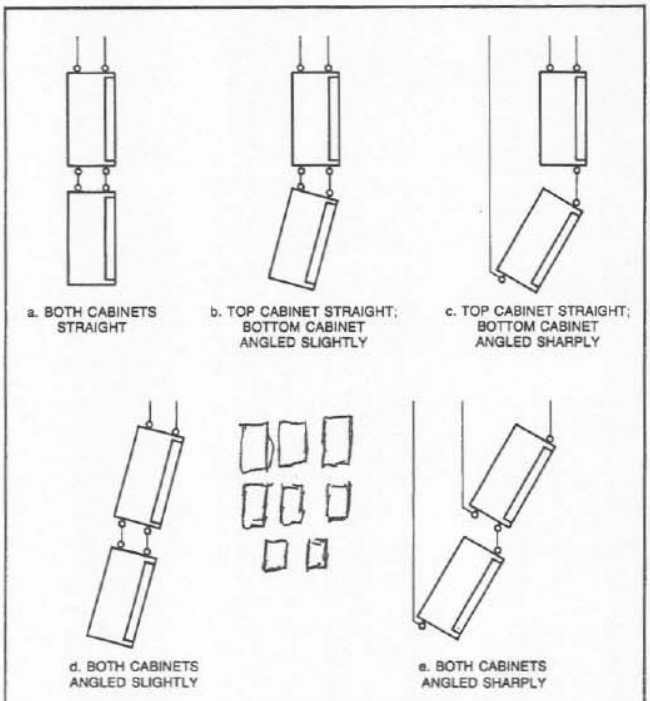


FIGURE 7 — Adjusting the Angle of Two DML Cabinets

be avoided, and the user is cautioned to never hang the DML-1122AF and DML-1152AF enclosures in this configuration with the angle greater than 6 degrees. Figure 7e shows two cabinets hung together with sharp downward angles. Both cabinets use pull-up straps such as the DMS-5 or DMS-6 to allow individual angle adjustments for each cabinet. DMS-1 grid straps (or shackle/quick-link/carabiner combination) are used at the front two points of the top cabinet to secure to the grid. DMS-2 linking straps, DMS-7 dual fittings, or a pair of DMS-8 fittings with quick-links or carabiners may be used to link the enclosures together at the front two points. A safety strap should be secured from the top rear point of the upper box back to the grid.

All of the techniques for constructing vertical arrays as shown in Figure 7 may be expanded to create vertical arrays utilizing more than two cabinets as long as a sufficient safety factor is maintained. The user is reminded that the top cabinet in an array supports the weight of all the cabinets hung beneath it, and that the distribution of the load between the points secured to the grid will depend on the exact configuration. Typically, the configurations shown in Figures 7a, 7c and 7e result in the weight of the entire array being distributed over several of the top points, and the configurations in Figures 7b and 7d result in the load being concentrated on the top rear point; however, it is the expressed responsibility of the user to determine the load distribution and the resulting safety factor. If the load distribution is unknown, the user should assume that the weight of the entire array is being supported by a single rigging point when calculating the safety factor.

Note that the arrays previously discussed and shown in Figure 7 illustrate the use of identical cabinets. The systems need not be identical. For example, a full-range array may be constructed by hanging a DML-2181AF subwoofer at the top with one or more wide-range systems (such as the DML-1122AF or DML-1152AF) below, angled down to achieve the desired coverage. The number of cabinets hung in a row is typically limited by the total weight of that column of cabinets as supported by the top cabinet. Note, however, that when hanging a "small" cabinet (such as a DML-1122AF) from a "large" cabinet (such as a DML-2181AF), or vice versa, the relative angle of pull of the rigging straps between the two cabinets is no longer 0° because the center-to-center spacing of the pan fittings is less on a smaller cabinet than on a larger one. These vertical angle differences will result in tensions (i.e., forces) in the rigging straps that are greater than the total suspended weight. It should be remembered that the strength of the rigging hardware varies as a function of the angle of pull. In addition, the ulimate-break strength may vary from one cabinet type to another. The array designer is instructed to consult the individual specifications of each cabinet type to determine the ultimate-break strength of a specific array.

Grid Designs

Electro-Voice does not manufacture grids for supporting DML loudspeaker arrays. In the case of permanent installations, it is generally most effective and cost efficient to design a support system specific to the installation, taking into account the loudspeaker array(s) and the building structure. It may even be possible, in some circumstances, to eliminate the grid and secure the loudspeakers directly to the building structural supports. The sound system designer is instructed to evaluate each individual situation and design a support system tailored to the specific application.

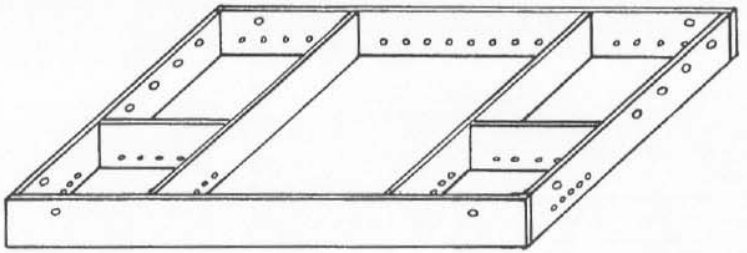
In the case of portable or touring sound, the array format shown in Figure 1 occurs with great frequency. An "all-purpose" grid that would accommodate this format and allow variations would be particularly useful. A grid that can accommodate two columns of either DML-1122AF or DML-1152AF enclosures hung three high is shown in Figure 8. The grid uses common ¼-inch thick structural steel barstock and requires only simple welding techniques. The grid will allow the cabinets to be splayed horizontally inward or outward, with the angles adjustable up to 50 degrees. With the cabinets splayed outward 30 degrees, i.e., the sides of the cabinets parallel, downward angles of 45 degrees are possible for the DML-1122AF and 30 degrees for the DML-1152AF. Sharper angles may be obtained with less splay.

Suggested lifting configurations for the various arrays are shown in Figure 9. The weight distribution of the grid will vary from front to back, depending on the particular array configuration. The lift configuration shown in Figure 9a allows independent support of the weight distribution. The lift configurations shown in Figures 9b, 9c and 9d do not allow independent control; however, a variety of attachment points along the side of the grid are provided that enable a balance of the load to be achieved. If the load is not balanced front to back, the grid could tilt. A seriously imbalanced condition could have potentially disastrous results. Used properly, these flying configurations utilize the full-strength capability of the suggested grid design, maintaining the maximum safety factor. The user is cautioned that other lifting configurations may lessen the safety factor.

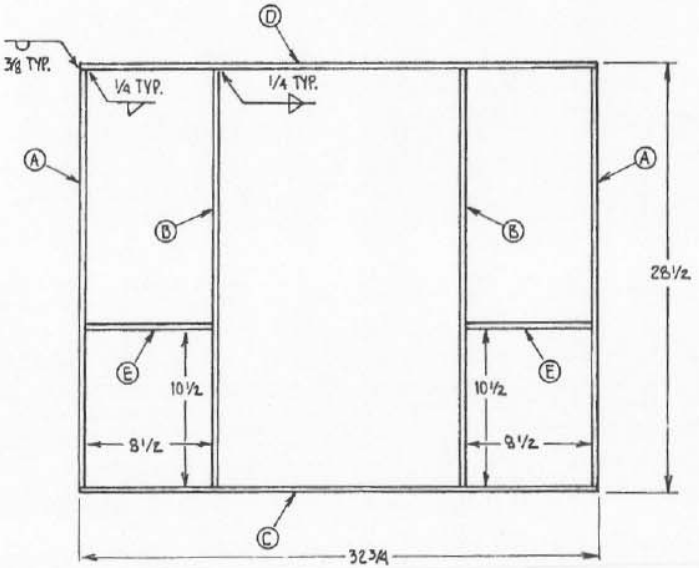
Attachment to the grid is made with ⅝-inch shackles on the top for hoisting and ⅜-inch quick-link threaded chain connectors on the bottom for the loudspeakers. The DMS-1 straps attach from the loudspeaker to the quick-links, and 36-inch-long wire-rope (⅜-inch 6x19 IPS-IWRC) slings are used for securement to the hoist(s). Flat washers (¾ inch) should be used with the shackles to center the load on the eyebolt.

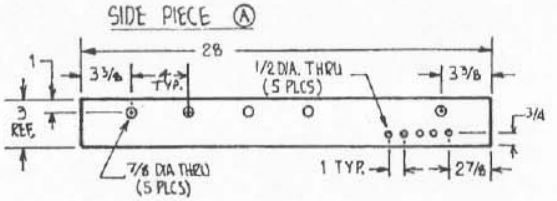
The load should always be raised (or lowered) slowly and evenly. Any sudden jolts or dynamic changes (occurring from rapid changes in speed, shifting loads, etc.) can result in impact forces many times greater than static dead-weight load.

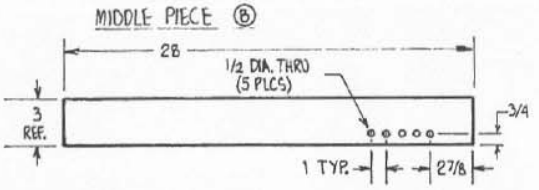
Note from Figure 9 that the wire rope slings are not hanging at a 0° vertical angle. These vertical angle differences will result in tensions (i.e., forces) in the slings that are greater than the weight suspended below the slings. Also, note that as different rigging attachment points are selected along the grid crossmembers to adjust the horizontal angles of either the DML-1122AF or DML-1152AF enclosures, the relative angle of the grid straps may not be 0° because the grid attachment points may not be located directly above the enclosure rigging points. These vertical angle differences will result in tensions in the rigging straps that are greater than the weight suspended below the straps. It should be remembered in addition, that the strength of the rigging hardware varies as a function of the angle of pull. While the forces due to the

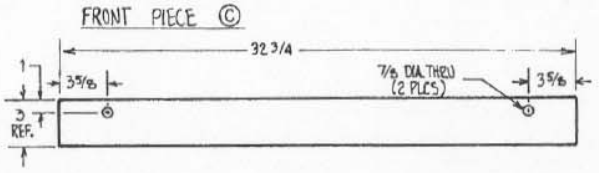


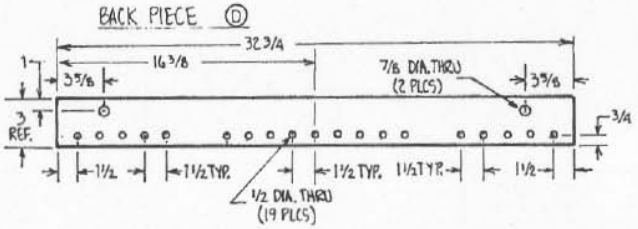
MATL : 3" X 1/4" THICK 1018 STRUCTURAL STEEL











NOTES:

1. WELD 1/4" FILLET BOTH SIDES OF EACH TEE JOINT.
2. WELD 1/4" FILLET INSIDE OF CORNER JOINT AND 3/8" BACKING OUTSIDE OF CORNER JOINT.
3. ALL DIMENSIONS IN INCHES.
4. TOLERANCE ± 1/32".

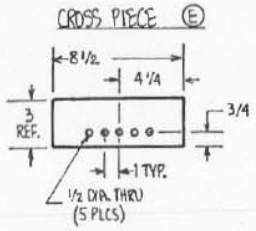
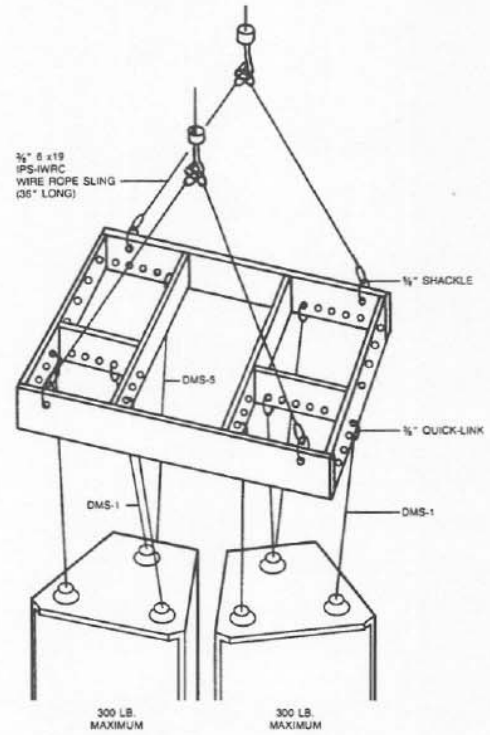
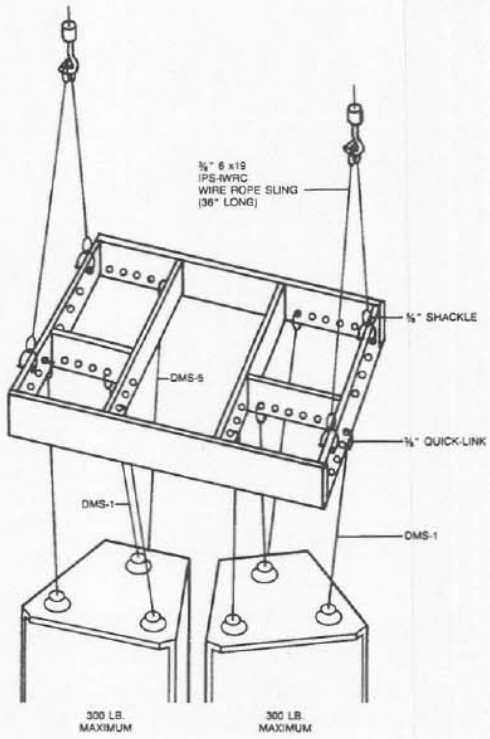


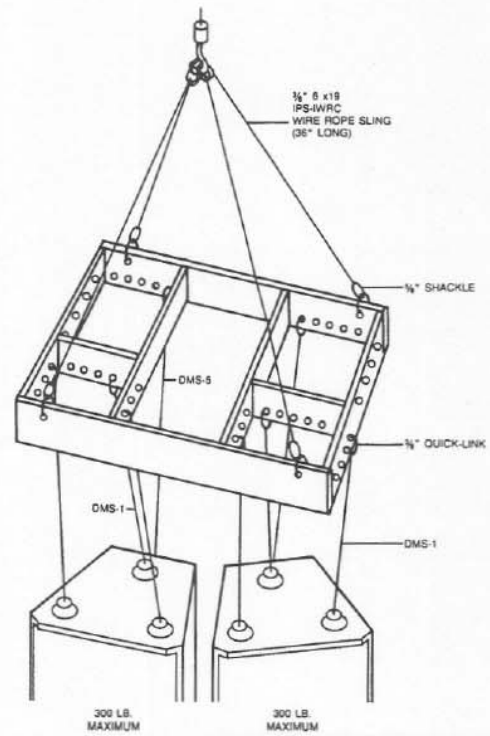
FIGURE 8 — Suggested Grid for DML-1122AF and DML-1152AF Flying Systems



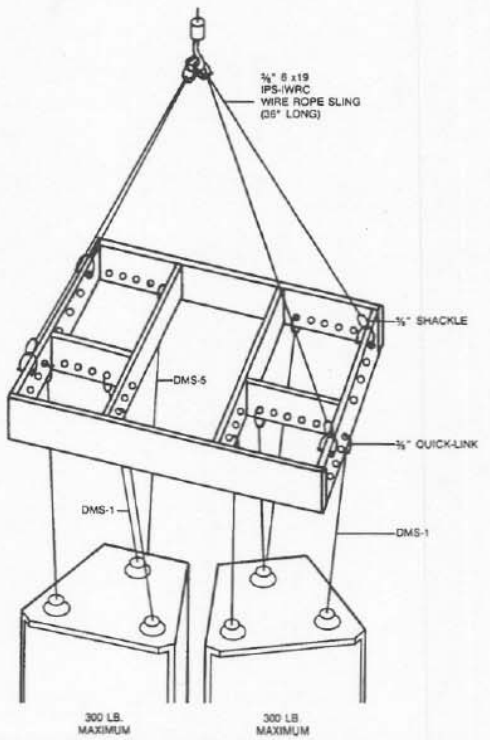
9a. Two Lift Points (front and back attachment)



9b. Two Lift Points (side attachements)



9c. One Lift Point (front and back attachment)



9d. One Lift Point (side attachment)

FIGURE 9 — Suggested Flying Configurations for DML-1122AF and DML-1152AF Systems

relative angle differences have been taken into account in the design of the grid shown in Figure 8, any modifications of the design or use in configurations other than those specified may result in greater stresses on the grid, the rigging straps, the rigging attachment hardware and the enclosure, which, in turn, might reduce the safety factor of both the grid and the loudspeaker rigging hardware. Electro-Voice offers this grid design only as a suggestion and makes no guarantee of performance. If fabricated as detailed in Figure 8 and utilized as detailed in Figure 9, a safety factor in excess of 10:1 is theoretically achieved for the grid for the worst case of two columns of either DML-1122AF or DML-1152AF loudspeaker systems, each having a total weight of 300 pounds. For this grid design Electro-Voice recommends a working-load limit of 300 pounds for the total weight of each column of loudspeakers and urges the user not to exceed it. Variances in the quality of materials and workmanship can substantially affect the strength of the grid. It is the expressed responsibility of the array designer and user to determine the structural forces in any grid/loudspeaker array assembly and to determine the overall safety factor.

STRENGTH RATINGS AND SAFETY FACTORS

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

1. **The strength of each individual rigging point;** which varies as a function of the angle of pull relative to the pan fitting and the surface on which it is mounted.
2. **The total strength of the enclosure;** which is a function of the combined forces from each of the rigging points acting on the enclosure as a whole.

Electro-Voice provides strength ratings for the DML loudspeaker systems in two formats; the "ultimate-break strength" (i.e., the force required to cause structural failure of the loudspeaker enclosure or rigging hardware) and the "working-load limit" based on a 5:1 safety factor (i.e., the actual ultimate-break-strength ratings divided by a factor of 5). The ultimate-break-strength ratings should be used when calculating the safety factor of the array or when comparing the actual forces acting on the loudspeaker enclosure and rigging hardware to the ultimate-break strength of the enclosure and hardware. The working-load limit ratings are useful in those circumstances where there is a given requirement that a DML loudspeaker array must meet or exceed a safety factor of 5:1 (minimum safety factor requirements of 5:1 are common in local, state and federal regulations). This requirement is met if the actual forces acting on the loudspeaker enclosure and rigging hardware do not exceed the working-load limits. The use of the working-load limit can save time over safety-factor calculations when it is only necessary to know if the array meets minimum safety requirements of a 5:1 safety factor. If, however, the requirements are for a safety factor other than 5:1, the safety factors must be calculated directly using the ultimate-break-strength ratings.

The ultimate-break strength of each individual rigging point on the DML enclosures is dominated primarily by the strength of the rigging attachment hardware and is a function of the angle of pull relative to the pan fitting and the surface on which it is mounted. The ultimate-break strength for each rigging point on either the DML-1122AF or DML-1152AF enclosure varies from 1,200 pounds for a 90° pull angle to 4,500 pounds for a 0° pull angle and is shown in as a function of angle in Figure 10a. The rating is identical for use with any of the DMS rigging accessories. (The user is reminded that in an array the forces, or tensions, in the rigging straps will be greater than the suspended weight when the straps are not hanging with a 0° vertical angle.)

The actual break strength of a DML enclosure will depend on the combined forces from each of the rigging points acting on the enclosure as a whole and will vary with the array configuration (relative angles of the cabinets, relative angles of the rigging straps, the weight of each loudspeaker system strung together in a vertical array, the weight distribution throughout the array, etc.). For the sake of simplicity, we will choose to define the ultimate-break strength of the entire enclosure as a limit on the total suspended weight regardless of the array configuration. In other words, in an array where a number of enclosures are hung one from another (in such a fashion that the top cabinet supports the weight of the entire column), the top enclosure will structurally fail if the total weight of the top cabinet plus all those strung beneath it exceeds the break-strength rating. The total enclosure ultimate-break strength for the DML-1122AF and DML-1152AF enclosures is 6,750 pounds as indicated in Figure 10b.

The working-load limit (for a 5:1 safety factor) of each individual rigging point on the DML enclosures is simply the ultimate-break strength previously given for each point divided by a factor of 5 and, like the break strength, varies as a function of the angle of pull. The working-load limit for each rigging point on either the DML-1122AF or DML-1152AF enclosure varies from 240 pounds for a 90° pull angle to 900 pounds for a 0° pull angle and is shown as a function of angle in Figure 11a. The rating is identical for use with any of the DMS rigging accessories. (The user is reminded that in an array the forces, or tensions, in the rigging straps will be greater than the suspended weight, when the straps are not hanging with a 0° vertical angle.)

The working-load limit (for a 5:1 safety factor) of a DML enclosure is simply the ultimate-break strength previously given for the enclosure divided by a factor of 5 and, like the break strength, is defined as a limit on the total suspended weight regardless of the array configuration. In other words, in an array where a number of enclosures are hung one from another (in such that the top cabinet supports the weight of the entire column), the total weight of the top cabinet plus all those strung beneath it must not exceed the working-load limit if a minimum safety factor of 5:1 is to be maintained. The working-load limit for the DML-1122AF and DML-1152AF enclosures is 1,350 pounds as indicated in Figure 11b.

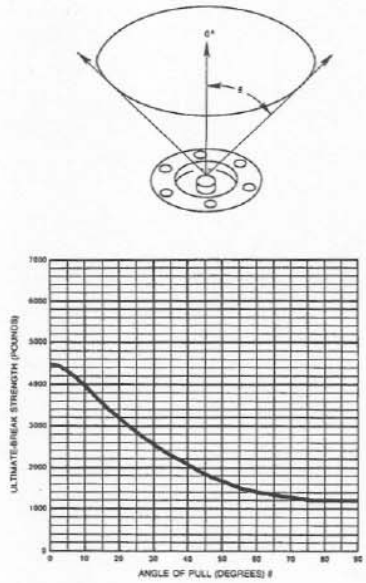
The ultimate-break strength for each rigging point on either the DML-1122F or DML-1152F enclosure varies from 1,200 pounds for a 90° pull angle to 3,600 pounds for a 0° pull angle and is shown as a function of angle in Figure 12a. The total enclosure ultimate-break strength for the DML-1122F and DML-1152F enclosures is 5,400 pounds as indicated in Figure 12b. The working-load limit for each rigging point on either the DML-1122F or DML-1152F enclosure varies from 240 pounds for a 90° pull angle to 720 pounds for a 0° pull angle and is shown as a function of angle in Figure 13a. The working-load limit for the DML-1122F and DML-1152F enclosures is 1,080 pounds as indicated in Figure 13b.

The DML-1122AF- and DML-1152AF-series loudspeaker systems are identical to the older DML-1122F and DML-1152F versions in size, weight, center of gravity, rigging hardware type and placement. The new versions are completely compatible with all of the DMS rigging accessories and the techniques described in the DML-1122F/DML-1152F Loudspeaker Flying Manual. However, the strength ratings of the new DML-1122AF and DML-1152AF versions are greater than that of the DML-1122F and DML-1152F versions. With the exception of the strength rating difference, the older and new models may be mixed without any special considerations. If there is any confusion when mixing older and new units, the lower strength ratings should be used. Complete strength-rating specifications for both the older and newer versions are presented in this manual. The reader is cautioned that there were inaccuracies in the original DML-1122F/DML-1152F Loudspeaker Flying Manuals (EV Part No. 531102). Hence, the user should use the specifications given in this section of this manual when designing arrays for the DML-1122F-, DML-1152F-, DML-1122AF- and DML-1152AF-series loudspeaker systems.

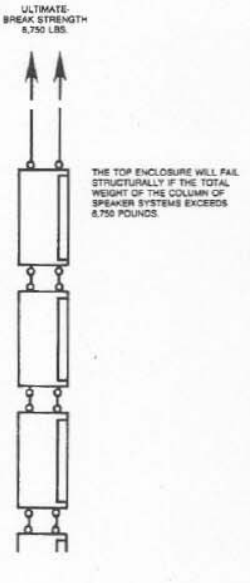
INSPECTION, MAINTENANCE AND PRECAUTIONS

DML System Hardware

DML Loudspeaker Enclosures. Prior to each use inspect the enclosure for any cracks, deformations, missing or damaged components which could reduce enclosure strength. Inspect the pan fittings and support brackets on the top and sides of the enclosure for any cracks, deformations, missing or loose screws

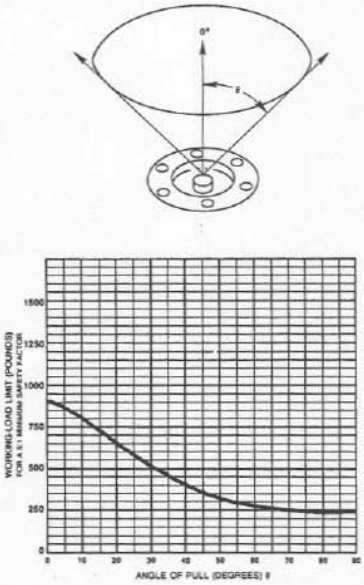


10a. Break-Strength Rating of Each Individual Rigging Point

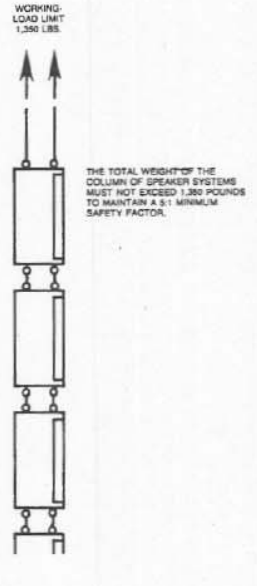


10b. Break-Strength Rating of Overall Enclosure

FIGURE 10 — DML-1122AF and DML-1152AF Systems Ultimate-Break-Strength Ratings

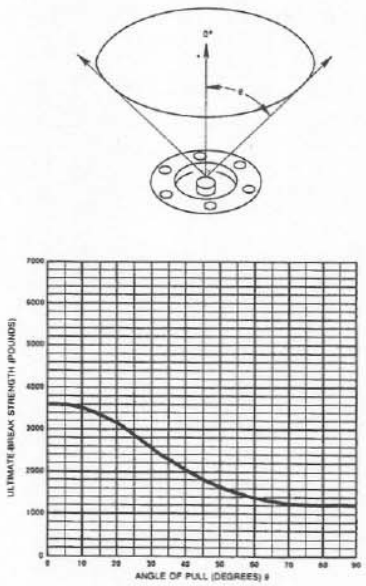


11a. Working-Load Limit of Each Individual Rigging Point for a 5:1 Minimum Safety Factor

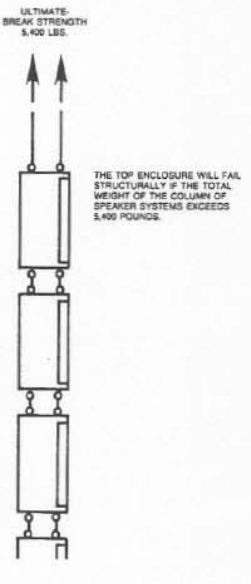


11b. Working-Load Limit of Overall Enclosure for a 5:1 Minimum Safety Factor

FIGURE 11 — DML-1122AF and DML-1152AF Systems Working-Load Limit (for 5:1 safety factor)

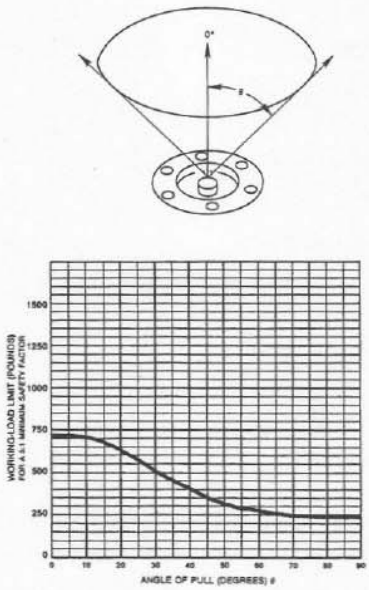


12a. Break-Strength Rating of Each Individual Rigging Point

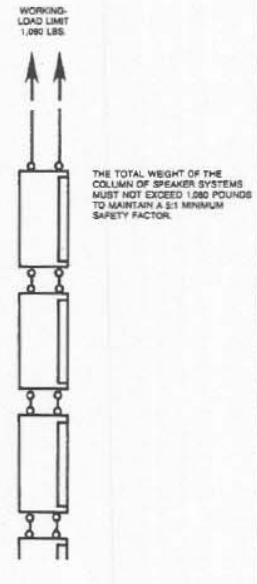


12b. Break-Strength Rating of Overall Enclosure

FIGURE 12 — DML-1122F and DML-1152F Systems Ultimate-Break-Strength Ratings



13a. Working-Load Limit of Each Individual Rigging Point for a 5:1 Minimum Safety Factor



13b. Working-Load Limit of Overall Enclosure for a 5:1 Minimum Safety Factor

FIGURE 13 — DML-1122F and DML-1152F Systems Working-Load Limit (for 5:1 safety factor)

which could reduce the flying hardware strength. Replace or repair damaged speaker systems. Never exceed the limitations or maximum recommended load specified by Electro-Voice for the DML enclosures.

DMS Strap Assemblies. Prior to each use inspect the webbing for cuts, abrasion, tears, knots, chemical damage, burns and broken stitches which could reduce assembly strength. Inspect the fittings and hooks for any cracks, burrs, deformation, missing or damaged components which could reduce strap assembly strength. Replace any strap assembly with damaged webbing. Replace or repair any strap assembly with damaged hardware. Always double-check that each fitting on the rigging strap assemblies is securely locked into position in the pan fittings on the DML enclosures before lifting.

Associated Hardware

Grid Assembly. Prior to each use inspect the grid assembly and associated hardware for any cracks, deformations, broken welds, corrosion, missing or damaged components which could reduce the grid assembly strength. Replace or repair damaged grid assemblies. Never exceed the limitations or maximum recommended load intended for grid assembly design.

Hoist Motors. Prior to each use inspect the hoist motor and associated hardware for any cracks, deformation, broken welds, corrosion, missing or damaged components which could reduce the hoist motor strength. Replace or repair damaged hoist motors and hardware. Never exceed the limitations or maximum recommended load specified by the hoist manufacturer. 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 Structural Supports. Prior to usage the strength and load-bearing capabilities of the building structural supports should be evaluated and certified by a professional engineer as being adequate for supporting the intended DML system. Prior to each use inspect the building structural supports for any cracks, deformation, broken welds, corrosion, missing or damaged components which would reduce the structural strength. Damaged building structural supports should be replaced or repaired and recertified.

Mechanical Connections. Prior to each use inspect all mechanical connections (chains, wire ropes, slings, shackles, hooks, fittings, etc.) for any cracks, deformation, broken welds, slipping crimps, fraying, abrasion, knots, corrosion, chemical damage, loose screws, missing or damaged components which would reduce the maximum strength specified by the connector manufacturer.

WARRANTY (Limited)

Electro-Voice DML Speakers and Speaker Systems (excluding active electronics) are guaranteed for five years from the date of original purchase against malfunction due to defects in workmanship and materials. Electro-Voice DML flying hardware (DMS rigging straps, fittings and enclosure-mounted flying hardware) is guaranteed for one year from date of original purchase against malfunction due to defects in workmanship and materials. Electro-Voice DMC electronic controllers are guaranteed for two years from date of original purchase against malfunction due to defects in workmanship and materials. Electro-Voice DML speaker accessories are guaranteed for one year from date of original purchase against malfunction due to defects in workmanship and materials. If such malfunction occurs, unit will be repaired or replaced (at our option) without charge for materials or labor if delivered prepaid to the proper Electro-Voice service facility. Unit will be returned prepaid. Warranty does not extend to finish, appearance items, burned coils, or malfunction due to abuse or operation under other than specified conditions, nor does it extend to incidental or consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee. A list of authorized warranty service agencies is available from Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107 (AC/616-695-6831); Electro-Voice West, 8234 Doe Ave., Visalia, CA 93291 (AC/209-651-7777). Or Electro-Voice Div., 345 Herbert St., Gananoque, Ontario, Canada K7G 2V1 (AC/613-382-2141); Electro-Voice, S.A., Keltenstrasse 5, CH-2563 IPSACH, Switzerland (41)32-51-58-33; Electro-Voice, Ltd., 2-5-60 Izumi, Suginami-ku, Tokyo, Japan 168, (81)3-325-7900; Mark IV Vertriebs GmbH, Larchenstrasse 99, 6230 Frankfort/Main 80, Germany (49)69-380-100; Electro-Voice Pty., 59 Waratah St., Kirrawee N.S.W. 2232, Australia (61)2-521-5322. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

Service and repair address for this product:
Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107.

Specifications subject to change without notice.

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