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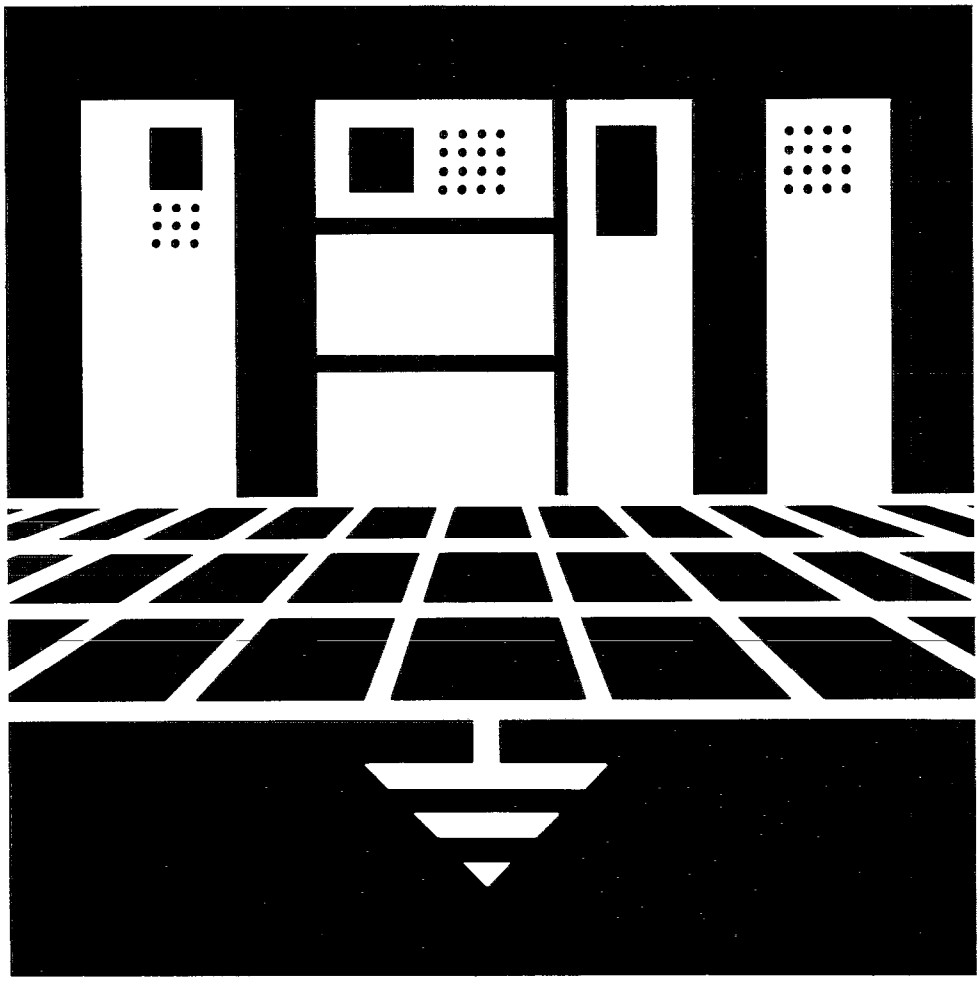
ELECTRICAL PRODUCTS



# SIGNAL REFERENCE GRIDS & COMPUTER ROOM GROUNDING

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# INTRODUCTION

Proper grounding and bonding of sensitive electronic systems including computer installations require careful consideration of all frequencies from DC to over 100 megahertz. The National Electrical Code (NEC) requirements for fault current and NFPA lightning protection must also be met.

The safety grounding system ("green wire") required by Code does not address the special requirements of noise immunity. An additional "grounding" system called the Signal Reference Grid (SRG) is needed to assure trouble-free equipment performance. There is no conflict between NEC safety requirements and the need for an SRG to protect computer data.

The ERICO Signal Reference Grid (SRG) is a low impedance network of conductors which establish an equipotential plane for high frequency, low voltage digital signals. Because signal voltages are low, their sensitivity to transient noise is very high – typically 1 volt for digital systems. In order to minimize the effects of noise, many computer manufacturers, users and government agencies have detailed specifications regarding computer grounding. Welded connections are often specified because they are the only connections proven to assure a "noise-free" bond. Normal shock and vibration jar mechanical connections, creating electronic noise. This causes relatively high Ldi/dt voltages due to a sudden change in connection impedance. This sudden change can result in pulses which can be coupled into the signal circuits. These unwanted signals can create false data or even cause permanent circuit damage. Corrosion, dirt and cleaning fluids cannot interfere with the molecular bond of a welded joint.

Recommendations on ERICO Signal Reference Grids are in full agreement with IEEE Std 1100-1992, *IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.*

SRG's are required because computers are sensitive to noise voltages which have a broad frequency band. At these frequencies:

**1.** Distributed capacitance and mutual inductance cannot be ignored. Coupling between adjacent power and data circuits and ground may introduce noise into data cables. Even nearby lightning strikes can be a real threat to proper operation.

**2.** Radiated fields are usually not a threat with the exception of nearby transmitters which may be a serious problem and require shielding.

**3.** An effective SRG has a multitude of conductors creating a very low impedance to noise at any frequency. SRG's typically use two foot spacing between their conductors which has proven to be adequate regardless of the computer operating speed.

**4.** Terminations must be a constant low impedance over the life of the facility. Welded connections are therefore needed so the ground path never changes.

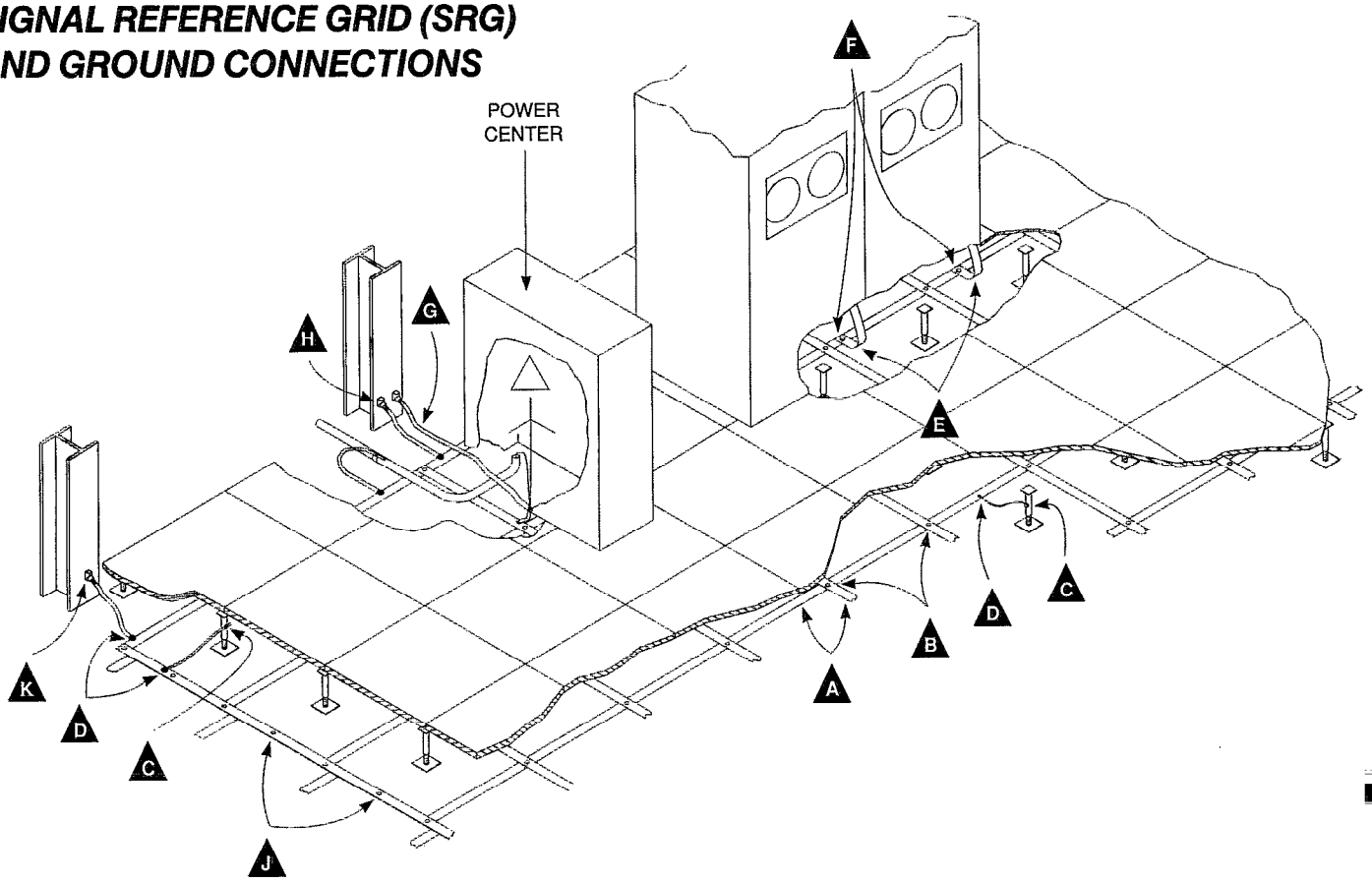
**5.** The multiple paths within the SRG allow the noise currents to divide at each crossover, which further reduces voltage drop.

Other means of creating a Signal Reference Grid exist. For example, brazed copper mesh made of round copper or copper clad wire has been used successfully. Mesh is commonly buried in the structural floor but it often costs more than flat strip SRG's. Raised floor stringers have been used but they have a tendency towards loose connections and low capacitance to computer cables. The result is higher impedance and less predictable performance.

The flat strip SRG is the most functional low impedance and cost effective "computer grounding" system available. Compared to the cost of equipment or the cost of corrupted information, an ERICO SRG is the best data insurance you can buy.

# ERICO SRG

## SIGNAL REFERENCE GRID (SRG) AND GROUND CONNECTIONS



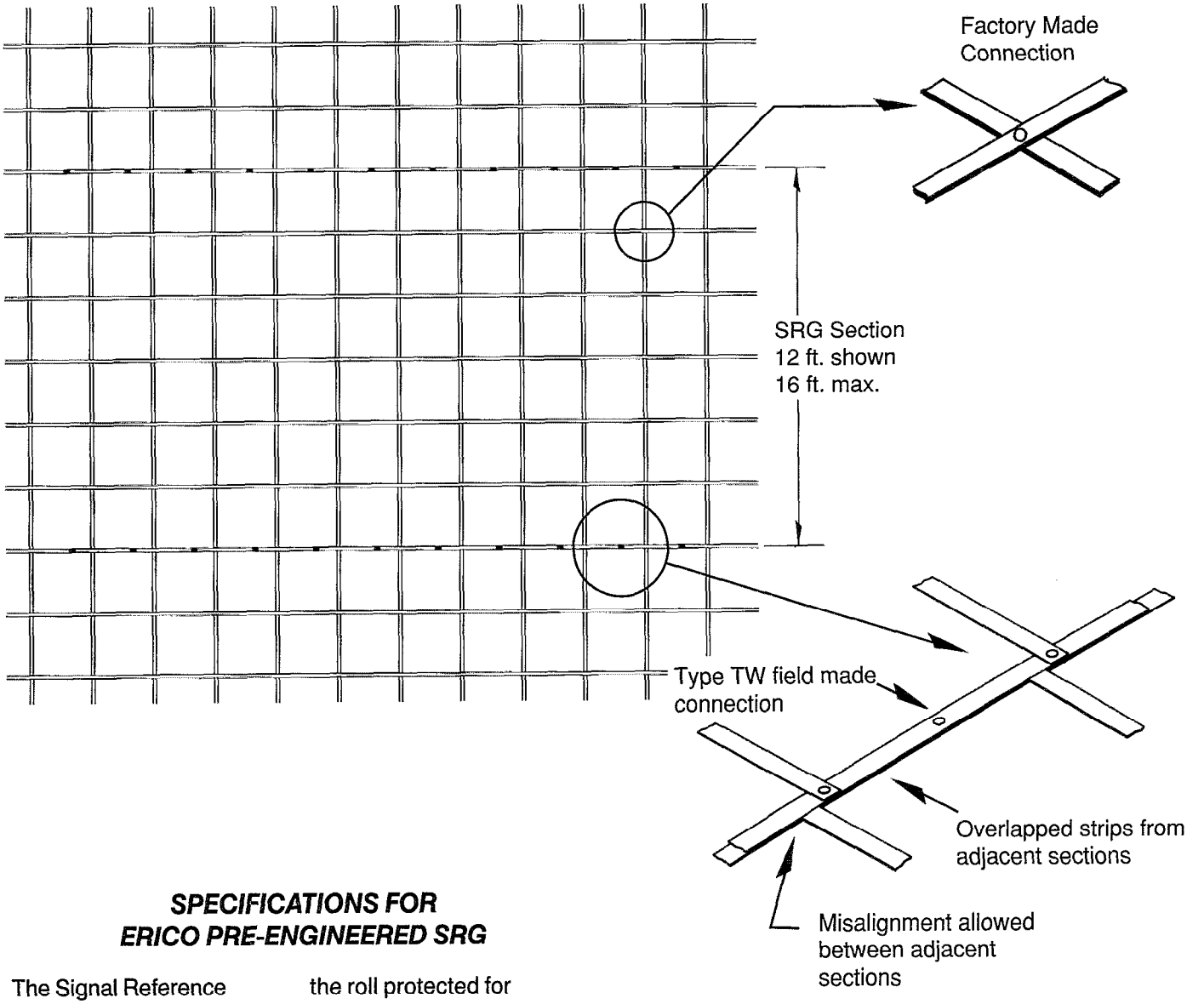

### NOTES:

**1.** NEC and local codes must be followed.
**2.** All equipment shall be bonded to the ERICO SRG using low impedance risers. Never connect to strip closest to outside wall.
**3.** All raised floors within the computer room should be the bolted stringer type.
**4.** Every 6th raised floor pedestal in each direction shall be connected to the SRG using a #6 AWG concentric copper conductor. The connection to both the pedestal and the SRG shall be CADWELD.
**5.** All columns, conduits, water pipes, ducts, etc. entering the computer room shall be bonded to the SRG (at each end of the room if these are horizontal).
**6.** Power distribution panels and power distribution center should be mounted directly to the building steel or bonded to it by a short length of grounding conductor equal to the "green wire ground" but at least a #4 AWG copper. The grounding wire inside any panel or enclosure supplying AC power to the computer must be bonded to its enclosure.

| KEY | |
|---|---|
| A | SRG strips – pre-engineered sections to 16 feet wide. |
| B | SRG CADWELD or arc-welded connection. |
| C | CADWELD connection, #6 AWG to pedestal. |
| D | CADWELD connection, #6 AWG to SRG. |
| E | Low impedance riser equipment bond. |
| F | CADWELD connection, low impedance risers to SRG. |
| G | Power center ground, #4 AWG minimum. |
| H | CADWELD connection, #4 AWG to steel column. |
| J | CADWELD connection between adjacent sections of SRG. |
| K | CADWELD connection, #6 AWG to steel column. |

**COMPUTER APPLICATIONS**

# *SIGNAL REFERENCE GRID (SRG)*



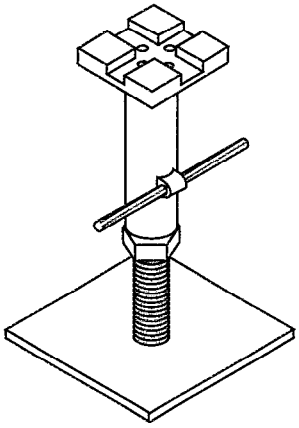

## *SPECIFICATIONS FOR ERICO PRE-ENGINEERED SRG*

The Signal Reference Grid (SRG) shall be manufactured from 2 inch wide by 26 AWG gage (0.0159 inch thick) copper strips on 2 foot centers. All crossovers shall be joined by welding. The SRG shall be furnished 4 to 16 feet wide. The sections shall be rolled on tubes with the outside of the roll protected for shipment. These sections shall be bonded to each other in the field with CADWELD connections.

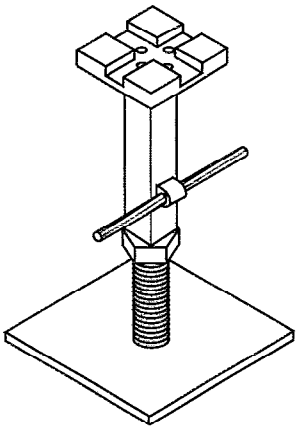
NOTES:

1. Other strip sizes are available.
2. Other spacing is available.
3. Roll weight usually limited to about 200 pounds gross weight for convenience (1200 sq. ft.).

# PEDESTAL CONNECTIONS
*for steel pedestals*



1″ round



7/8″ square

## CADWELD® STANDARD CONNECTIONS

| CONDUCTOR SIZE | PEDESTAL TYPE | CADWELD MOLD P/N | WELD METAL | HANDLE FRAME |
|---|---|---|---|---|
| #6 AWG-7 strand<br>#6 AWG-7 strand | 1″ round<br>7/8″ square | VTP1H005M<br>VGT1H004M | #15<br>#15 | B399CS<br>B399AS |
| #4 AWG-7 strand<br>#4 AWG-7 strand | 1″ round<br>7/8″ square | VTP1L003M<br>VGT1L010M | #15<br>#15 | B399CS<br>B399AS |
| #2 AWG-7 strand<br>#2 AWG-7 strand | 1″ round<br>7/8″ square | VTP1V004M<br>VGT1V004M | #15<br>#15 | B399CS<br>B399AS |

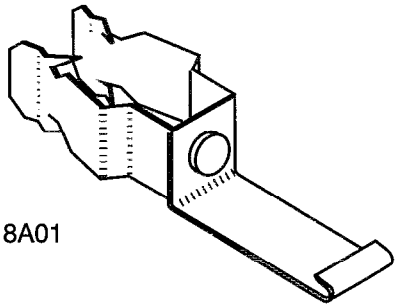
## CADWELD® EXOLON® LOW EMISSION WELDING PROCESS CONNECTIONS (1)

| CONDUCTOR SIZE | PEDESTAL TYPE | CADWELD MOLD P/N | WELD METAL | HANDLE FRAME |
|---|---|---|---|---|
| #6 AWG-7 strand<br>#6 AWG-7 strand | 1″ round<br>7/8″ square | XLVTP1H005M<br>XLVGP1H004M | XL15<br>XL15 | XLB399CS<br>XLB399BS |
| #4 AWG-7 strand<br>#4 AWG-7 strand | 1″ round<br>7/8″ square | XLVTP1L003M<br>XLVGP1L010M | XL15<br>XL15 | XLB399CS<br>XLB399BS |
| #2 AWG-7 strand<br>#2 AWG-7 strand | 1″ round<br>7/8″ square | XLVTP1V004M<br>XLVGP1V004M | XL15<br>XL15 | XLB399CS<br>XLB399BS |

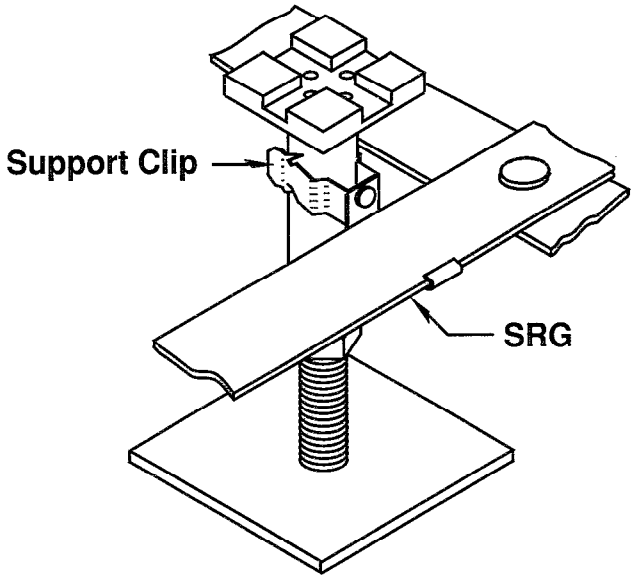
*(1) See EXOLON® note, page 8*

# SRG SUPPORT CLIP

When retrofitting an existing computer room, the SRG can be supported above the power and data cables with the ERICO SRG Support Clip. Part No. B818A01. The clip will fit both the 1″ round or 7/8″ square raised floor pedestal.

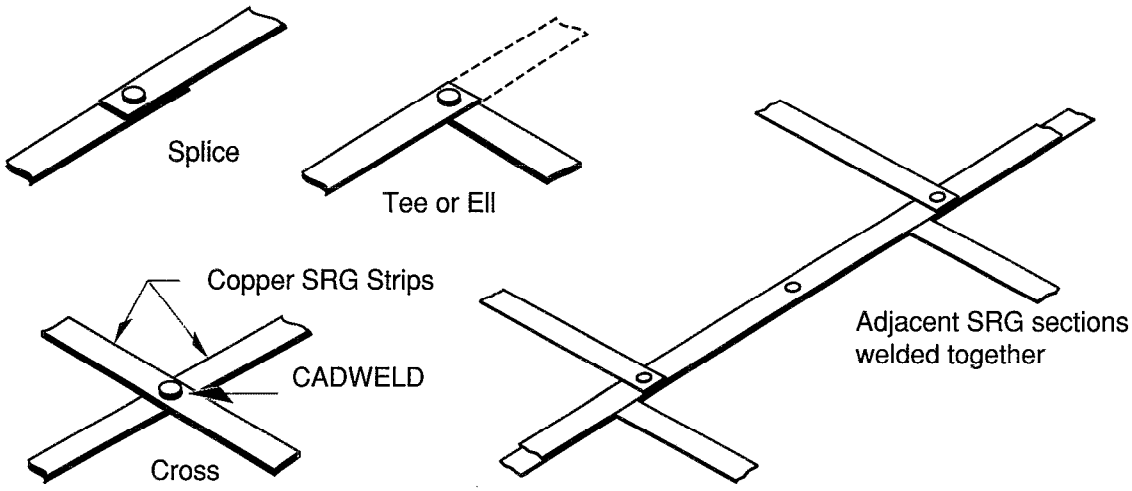


ERICO Part No. B818A01




**The SRG Support Clip is normally used only on retrofit construction where cables are already in place.**

# CADWELD TYPE TW CONNECTIONS

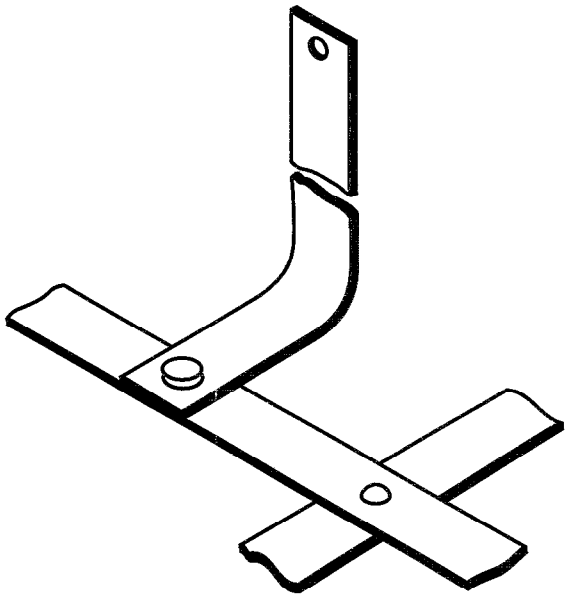



***26 GAGE x 2" COPPER***

| MOLD STYLE | MOLD PART NO. | WELD METAL | HANDLE CLAMP |
|---|---|---|---|
| EXOLON® (1) | XLTWR107A3 | XL32 | XLL160 |
| STANDARD | TWR107A3 | 32 | L160 |

*(1) See EXOLON® Note, Page 8*

# LOW IMPEDANCE RISER (LIR)



CADWELD Part No. B802D01A72

***SPECIFICATIONS***

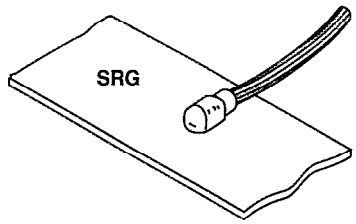
- 26 gage x 2″ x 72″ copper strip with 5/16″ hole in one end for connecting to equipment (same material as used in the SRG).
- 40,481 circular mils.
- 23 ohms impedance for 12″ length at 20 MHZ (see page 8).

The LIR is welded to the SRG using the Type TW mold listed in chart above.

# OTHER CADWELD CONNECTIONS

## BONDING CONDUCTOR TO 26 GAGE x 2" SRG

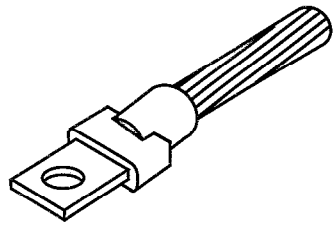
| CONDUCTOR SIZE | MOLD STYLE | MOLD PART NO. | WELD METAL | HANDLE CLAMP |
|---|---|---|---|---|
| #6-7 Strand | EXOLON® (1) STANDARD | XLHAC1H013 HAC1H013 | XL25 25 | XLL160 L160 |
| #4-7 Strand | EXOLON® (1) STANDARD | XLHAC1L020 HAC1L020 | XL32 32 | XLL160 L160 |
| #2-7 Strand | EXOLON® (1) STANDARD | XLHAC1V012 HAC1V012 | XL32 32 | XLL160 L160 |




*(1) See EXOLON® Note, Page 8*

## CADWELD TYPE LA LUG

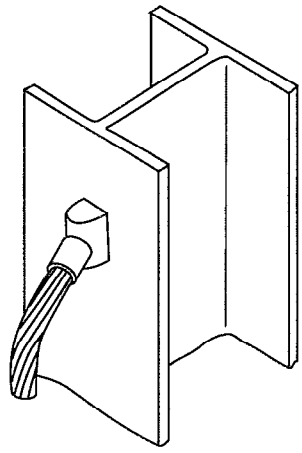
| CONDUCTOR SIZE | LUG PART NO. (1) | MOLD STYLE | MOLD PART NO. (2) | WELD METAL |
|---|---|---|---|---|
| #6-7 Strand | B101AA | EXOLON® (4) STANDARD | XLLAP1HAA (3) LAT1HAA (3) | XL25 25 |
| #4-7 Strand | B101AA | EXOLON® (4) STANDARD | XLLAP1LAA LAT1LAA | XL25 25 |
| #2-7 Strand | B101AA | EXOLON® (4) STANDARD | XLLAP1VAA LAT1VAA | XL32 32 |



*(1) 1/16 x 1/8 Copper lug with one hole for 1/4" screw*
*(2) Includes Handle Clamp*
*(3) Requires Sleeve B112*
*(4) See EXOLON® Note, Page 8*

## CADWELD TYPE VS TO STEEL STRUCTURE

| CONDUCTOR SIZE | MOLD STYLE | MOLD PART NO. | WELD METAL | HANDLE CLAMP |
|---|---|---|---|---|
| #6-7 Strand | EXOLON® (2) STANDARD | XLVSP1H (1) VST1H (1) | XL25 25 | Included Included |
| #4-7 Strand | EXOLON® (2) STANDARD | XLVSC1L VSC1L | XL45 45 | XLL160 L160 |
| #2-7 Strand | EXOLON® (2) STANDARD | XLVSC1V VSC1V | XL45 45 | XLL160 L160 |



*(1) Requires Sleeve B112*
*(2) See EXOLON® Note, Page 8*

# IMPEDANCE

The following chart lists calculated impedances for various conductors at 20 MHZ.

Note that 26 gage x 2 strip has a lower impedance than a 4/0 conductor, even though it is only 1/5 the cross sectional area.

| CONDUCTOR SIZE | CONDUCTOR TYPE | IMPEDANCE IN OHMS 12" LENGTH | 24" LENGTH | 36" LENGTH |
|---|---|---|---|---|
| #6 AWG | 7 STRAND | 35 OHMS | 81 OHMS | 130 OHMS |
| #4 AWG | 7 STRAND | 33 | 77 | 125 |
| 1/0 AWG | 7 STRAND | 30 | 70 | 114 |
| 4/0 AWG | 7 STRAND | 27 | 64 | 106 |
| 16GA x 1.5" | STRIP | 25 | 61 | 100 |
| 16GA x 2" | STRIP | 23 | 56 | 94 |
| 26GA x 2" | STRIP | 23 | 57 | 94 |

NOTE: Only 26 gage is available prefabricated. All other thicknesses must be field fabricated.

### *EXOLON® NOTE:*

***EXOLON** is a low emission welding process.*
*Required to start the **CADWELD® EXOLON®** reaction is the Relia-Start™ Battery XLB971A1.*
*Welding Tray XLB974B2 can be used under the mold to protect cables and equipment from hot materials. It is very useful on retrofit jobs.*

## *REFERENCES*

IEEE Std 1100-1992, "IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment"

*Grounding, Bonding and Shielding for Electronic Equipment and Facilities.* MIL-HDBK-419-A, Department of Defense, Washington, DC 20301, 29 December 1987

*Grounding, Bonding and Shielding for Long Haul/Tactical Communications Systems Including Ground Based Communications* – Electronics Facilities and Equipment. MIL-STD-188-124A, Department of Defense, Washington, DC 20301. 02 February 1984.

ANSI/NFPA 70-1993, "National Electrical Code" (NEC), National Fire Protection Association, Boston, MA 02210.

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