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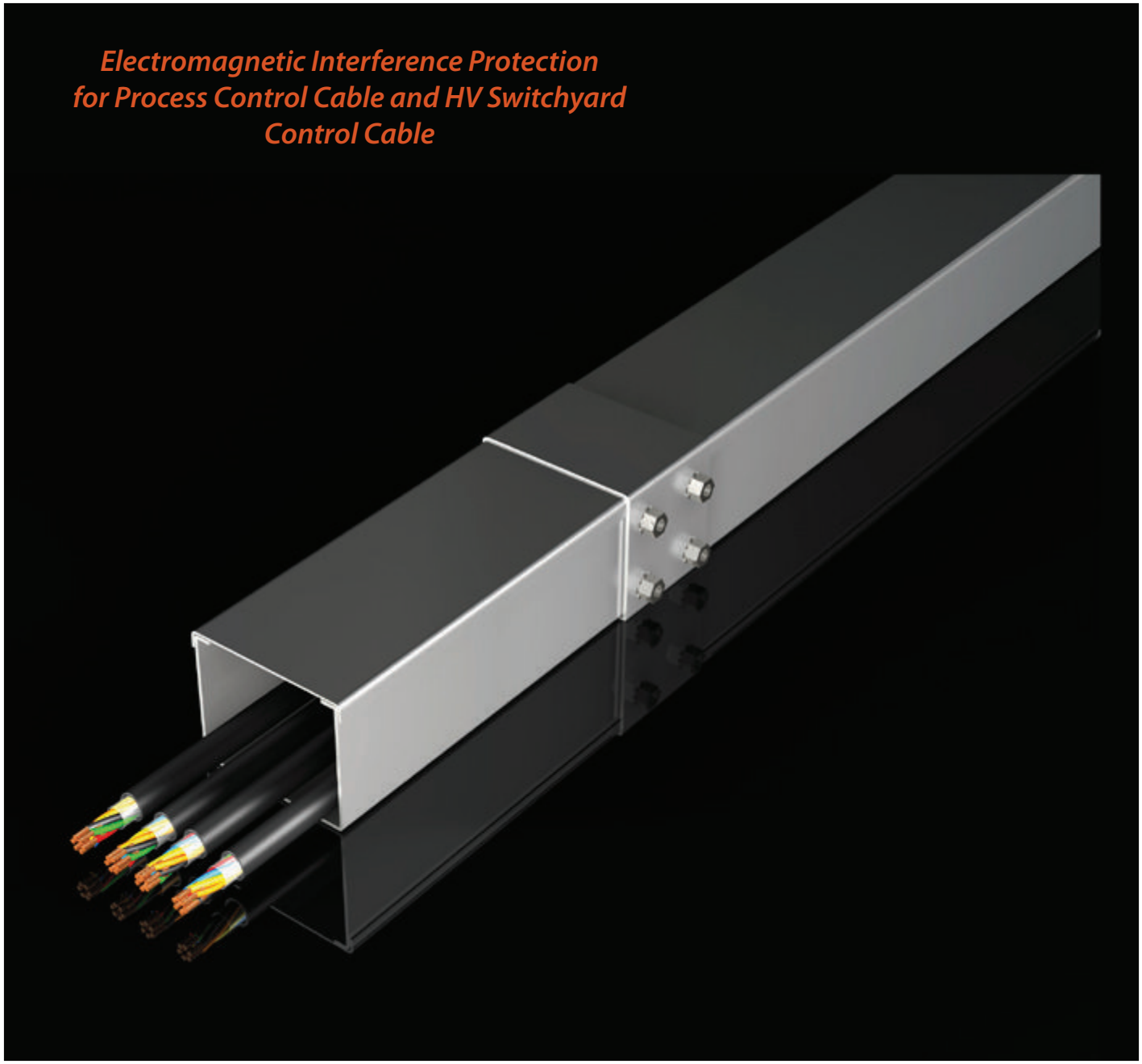
CABLE TRAY & CABLE BUS

Husky EMI Tray

Electromagnetic Interference Protection

Electromagnetic Interference Protection for Process Control Cable and HV Switchyard Control Cable



Husky EMI Enclosed Tray

EMI - Electromagnetic Interference Protection

With the widespread use of computerized processing equipment in industrial facilities, the minimization of interference induced in the communication link between the in-plant transducers or primary elements and controllers is critical. Depending upon the installation, this link, in most cases a pair of electrical conductors, may be very short, or run for several hundred feet. The longer the control signal cable, the more susceptible it is to induced electrical noise. Shielding these cables with a copper braid or metallic tape will protect them from each other, but for long runs a better method of shielding is necessary for protection against external interferences. To shield these cables individually is impractical because of the large number used in a complex industrial control system. Numerous control signal cables can be protected from interference by using a properly designed and shielded enclosure.

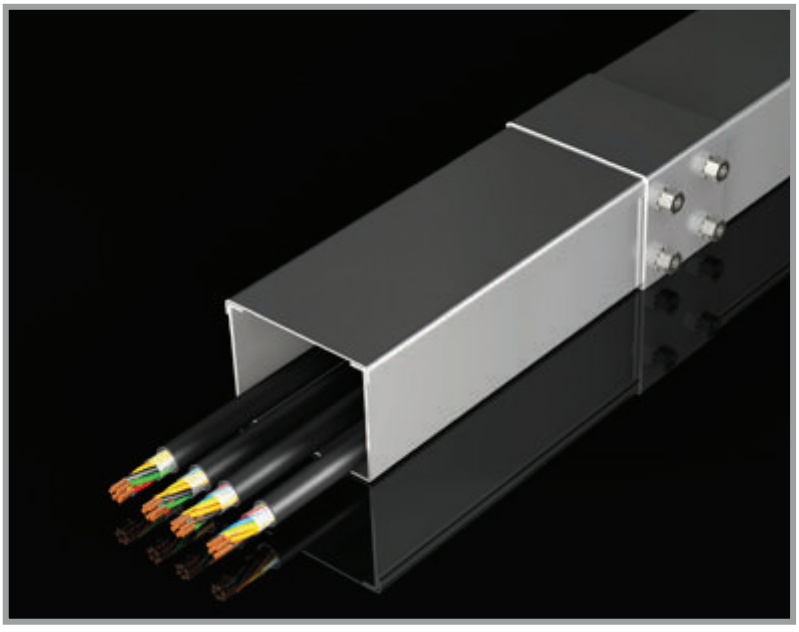
Undesirable voltage can be induced into the control signal cables by five methods:

1. **Electrostatic Fields**
2. **Electromagnetic Fields**
3. **Plane Wave Radiation**
4. **Cross Talk**
5. **Common Mode**

Cross talk and common mode interference are functions of the control circuits themselves and must be handled through the proper selection of cable and grounding methods. Plane wave radiation, which is of concern at very high frequencies (30MHz), is generally not a problem in the typical industrial or utility environments.

Electrostatic and Electromagnetic fields are important and directly influence the selection of shield cable enclosures.

Electrostatic interference is caused by stray capacitance between the control signal cable and other conductors and machinery in the area. This stray capacitance can be reduced by completely enclosing the control signal cable in a shielded enclosure which is a good electrical conductor. The measure of electrical effectiveness in this situation is the electrostatic attenuation. This attenuation is determined by measuring the undesirable induced voltage in the control signal cable within the shielded cable enclosure. The enclosure must be properly grounded if it is to act as an electrostatic field.



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EMI - Electromagnetic Interference Protection

Electromagnetic interference is caused by the mutual inductance between the control signal cables and other surrounding power cables and machinery. This mutual inductance can be reduced (shielding the control cable) if the control signal cable is completely enclosed in a good magnetic material. An electromagnetic attenuation parameter can be defined in the same manner as the electrostatic attenuation. Unfortunately, good electrical conductors are not effective magnetic (high permeability) materials. The converse is also true. In most industrial installations, shielding must be provided against both electrostatic and electromagnetic fields. Thus a compromise must be made.

The attenuation parameters (electrostatic and electromagnetic) may be measured under laboratory conditions. A test setup is used to create the proper type of field, and the induced voltage "e^1" in a control signal cable is measured with the cable suspended in free air. Then the test is repeated with the control signal cable enclosed in the shielded enclosure and the induced voltage "e^1" is measured. The shielding effectiveness is given by the ratio of these voltages.

$$S = \frac{e^1}{e}$$

The greater the ratio, the better the shield. Due to the wide dynamic range of "S" for different types of shields, the attenuation is usually expressed as twenty times the logarithm to the base ten of "S".

$$A = 20 \text{ Log}_{10} S$$

or

$$A = 20 \text{ Log}_{10} \text{ to } \frac{e^1}{e}$$

The attenuation parameters are both functions of frequency and therefore are usually shown by a graphical display of "A_s". (Electrostatic Attenuation) and "A_m" (Electromagnetic Attenuation) plotted versus frequency.

Protection of Process Control and Instrumentation Cable

The type of signal transmitted by the primary element to the controller determines how sensitive the signal is to extraneous electrical interference. For example, the lower the voltage the higher the impedance and the more susceptible the circuit is to interference.

Since most process type primary elements operate at low voltages and amperes, care must be taken when electing shielding requirements. Typical levels of operation range between less than 100MV to 5V on voltage type elements and 1MA to 50MA on current systems.

Many companies who utilize automated process control find that high additional costs are incurred in eliminating interference in systems, not in the installation, but rather in the check-out and start-up stages of construction.

Protection of Process Control and Instrumentation Cable

Most of the additional cost can be eliminated in the engineering stages by proper selection of cable and EMI enclosures. The following guidelines will ensure the most acceptable method of installing instrumentation:

A. Use twisted parallel pairs - shielded and grounded.
B. Separate control wires by frequency and voltage level.
C. Route control circuits to avoid power cables and machinery.
D. Install control cable in a Husky EMI enclosure.
E. Ground the shielded EMI enclosure.

Husky EMI enclosures offer excellent attenuation characteristics while providing a low cost economical installation that allows for additional control cables, check-out and re-wiring. (See Figures 1 and 2 on the following page)

High Voltage Station Switchyard Control Cable Protection

For switchyards with primary system voltages of 230KV and above, control and instrumentation cables must be protected from induced voltages that can cause control cable insulation breakdown and damage to control components. This problem becomes more acute when solid state devices, which are even more susceptible to damage by over-voltage, are used on new installations.

The interfering induced voltages are caused by surge voltages which are either continuous wave or impulse wave types. The over voltages are present due to periodic transients, switching surges, circuit breaker or GAP flashover. Typically, induced voltages on the control cables can be in the order of 10-15KV if not adequately shielded. A shielded control cable enclosed in an EMI enclosure offers the best overall protection and provides economies in cable installation. EMI enclosures facilitate the placement of control cables above ground where rewiring or additions can be added without the high costs and corrosion problems associated with underground methods.

Tests conducted at a special high voltage test facility demonstrated that Husky's EMI enclosures offer exceptional protection by attenuating the high surge voltages to acceptable levels.

	Without Enclosure*		With EMI Enclosure **	
Surge Voltage	Type A	Type B	Type A	Type B
600 KV	7.3 KV	2.9 KV	51 Volts	17 Volts
1000 KV	16.9 KV	10.4 KV	53 Volts	26 Volts
1400 KV	24.8 KV	16.0 KV	113 Volts	23 Volts

Type A - Control cable with copper tape and drain wire
Type B - Control cable with lead shield
*Shield floating
**Shield grounded at both ends

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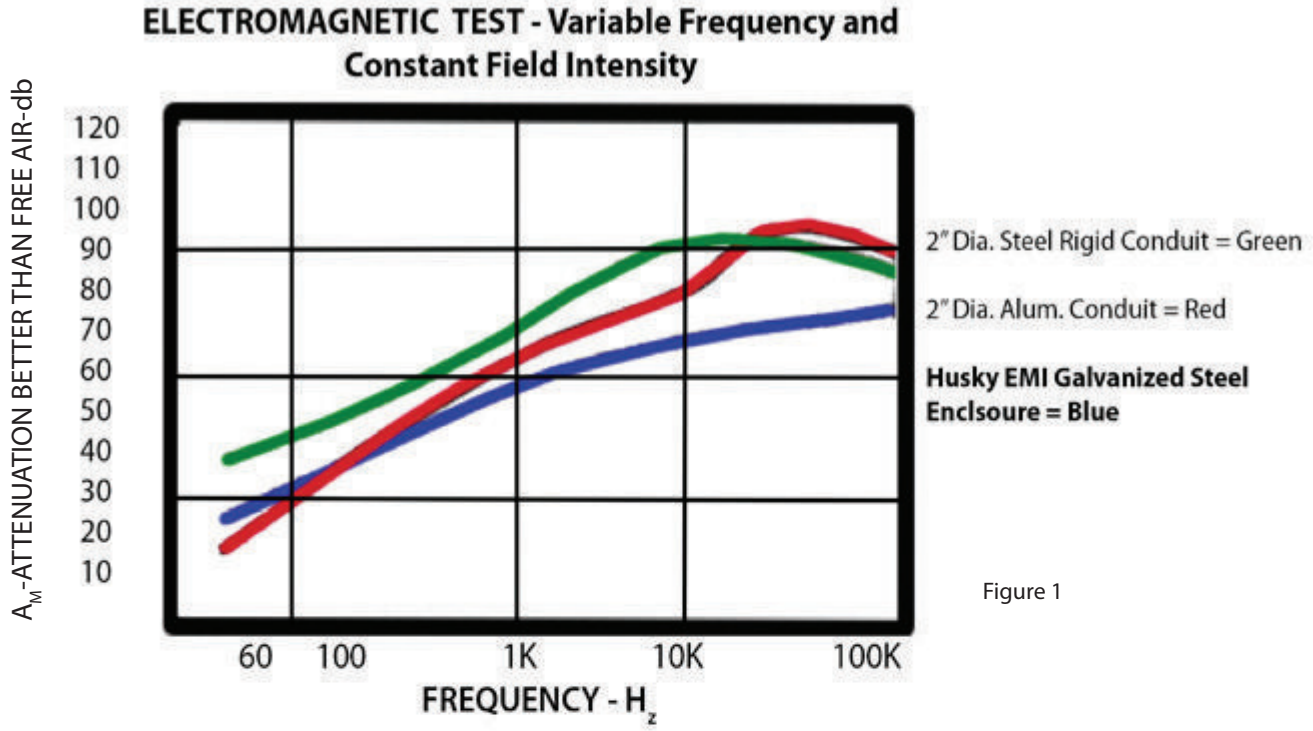


Figure 1

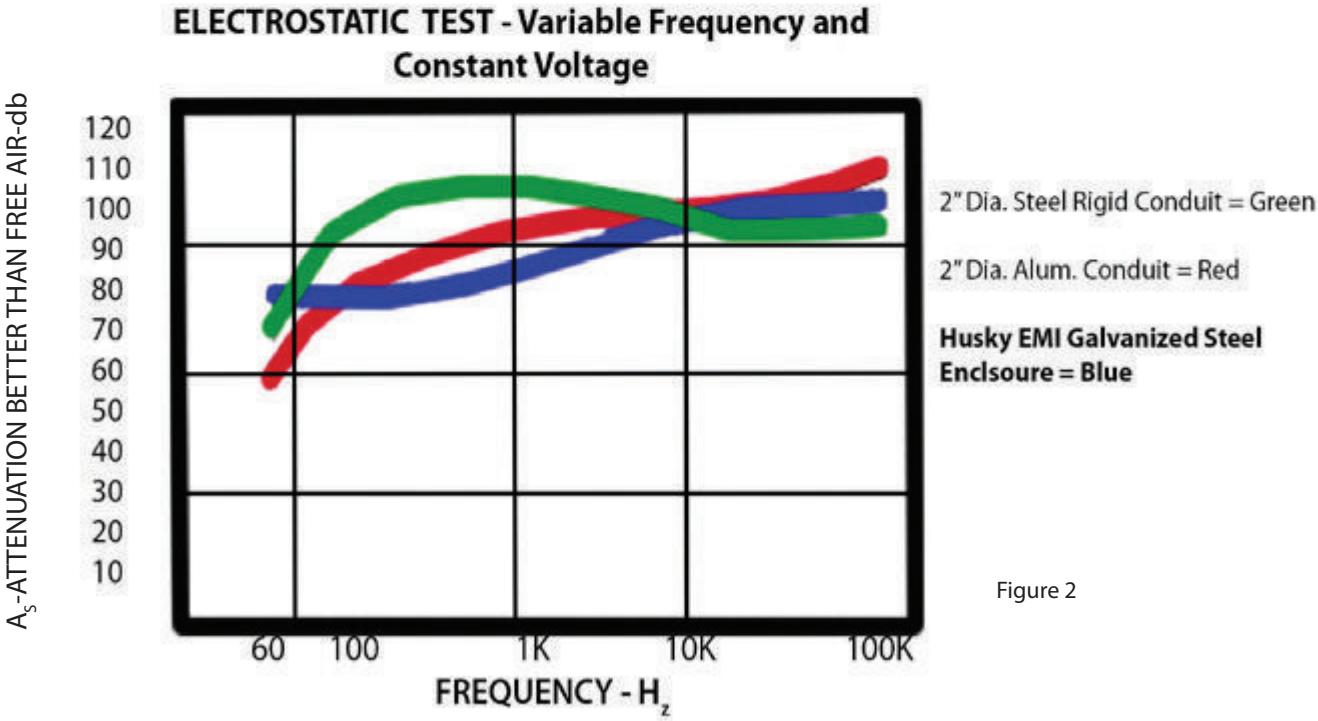
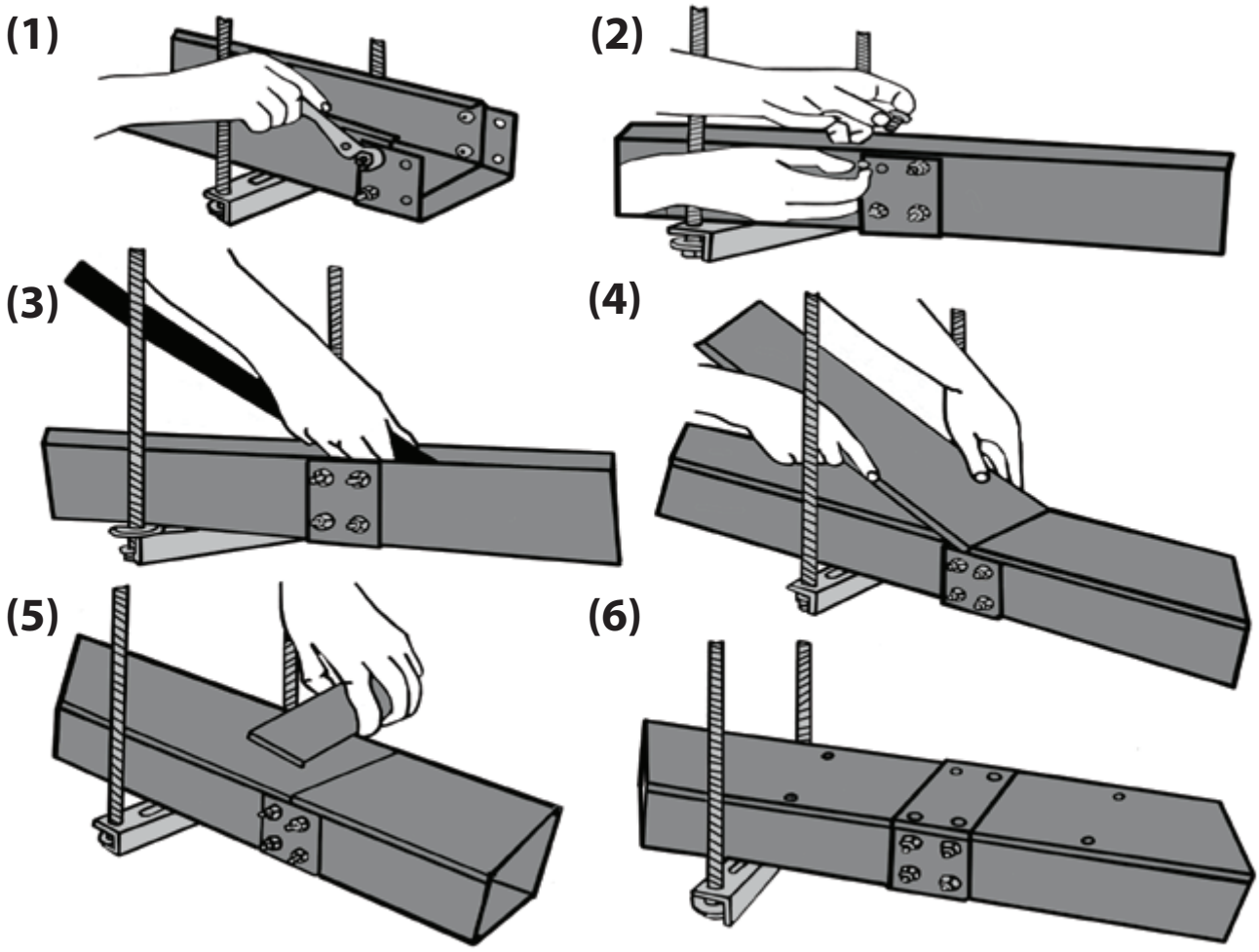


Figure 2

Installation Instructions

Husky EMI enclosures can be installed using the same conventional practices and supports associated with standard cable tray.

1. After the support material is in place, clamp the EMI enclosure to the support structure.
2. When joining sections of EMI enclosures use the lower half of the two piece wrap-around splice to connect the sections (1) and (2).
3. After all cables have been installed in the EMI enclosures (3), fasten covers in place (4), making sure that the upper half (or cover) for the wrap-around splice is placed over and secured to the butting enclosure covers (5).
4. EMI enclosure covers should be fastened down on two foot centers to maintain the Husky recommended attenuation (6). By decreasing the cover hold-down centers to one foot, an increase in attenuation of 2db would be realized across the frequency spectrum.



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Specification for Husky EMI Enclosures

1.0 General

1.01 Scope

This specification shall include all the necessary materials to provide an EMI enclosure system with a high degree of electrostatic and electromagnetic shielding for low level control circuits. The enclosures shall be designed and constructed to equal or better the EM-shielding attributes herein specified, over the frequency range of 60 H_z to 100 KH_z.

1.02 Basic Design

To meet the requirements of this specification the cable tray and cover must totally enclose the specified cables, circuits, and/or devices with metal. Non-metallic materials are not acceptable for this purpose.

2.0 Attenuation Requirements

2.01 Electrostatic Attenuation

The minimum acceptable electrostatic (electric field) shielding efficiency for the enclosure to be supplied for this installation shall be 86 db in the range of 60H_z to 100 KH_z.

2.02 Electromagnetic Attenuation

The minimum magnetic field shielding efficiency shall increase from 9 db to 55 db over the frequency range of 60 H_z through 100 KH_z.

2.03 Certification

The enclosure manufacturer shall certify in writing that the EMI enclosure to be provided will, in fact, equal or better the shielding efficiency of Paragraphs 2.01 and 2.02. Such certification will consist of a report of evaluation tests performed by the manufacturer or by an independent testing laboratory. The report will describe the enclosure, the test methods used to evaluate the product and technical data (graphics, charts, etc.) supporting the shielding performance claims for the product.

3.0 Additional Requirements

3.01 General

In addition to the above attenuation requirements, it is intended that the completed EMI enclosure system be readily accessible for installation, re-arrangement, and inspection of cables supported. Additionally, the enclosure provided shall meet the following electrical and mechanical requirements.

3.02 Electrical Continuity and Grounding

All components of the enclosure system shall be thoroughly grounded to conform with the grounding requirements of the N.E.C. A bare copper bonding cable shall be installed in the enclosure to provide adequate grounding continuity. Each section of the enclosure and all fittings shall be securely bonded to the ground bus in the enclosure with suitable grounding fitting to ascertain continuity to ground throughout the enclosure system.

3.03 Material Specifications

All members of the enclosure system, unless specifically stated herein, shall be made from ASTM A653-G90 Steel, and all EMI enclosures shall be hot-dip mill galvanized. Application of design rules and fabrication shall be in accordance with ASTM Specifications and A.W.S. Standards. The hot-dip galvanize protective covering shall conform to ASTM Standards.

3.04 Approval of EMI Enclosure

The Contractor shall submit for approval, as soon as practical and within thirty days after the award of contract and before the purchase of material, a complete schedule of the materials and equipment proposed for installation, including the specified data. Data to be submitted for approval shall consist of the Manufacturers name and the following items for each type of enclosure to be furnished: Typical Sample, Certified Attenuation Data .

Numbering / Ordering Information

EM4-12-144			
EM	**(D)-**	**(W)-**	**144**
Tray Type	**Depth**	**Width**	**Length**

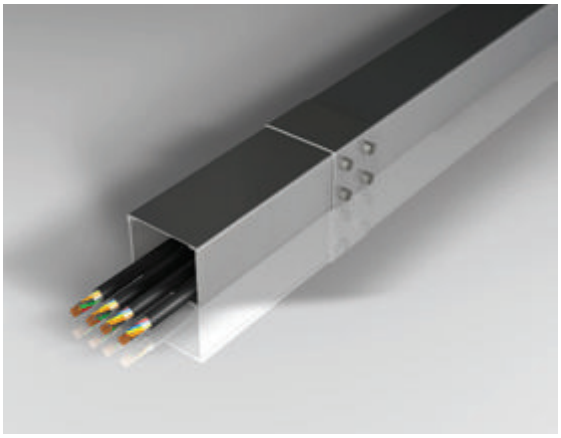
Tray Type:
EMI
Enclosure

Depth:
4″
6″

Width:
6″
9″
12″
18″
24″

Length:
12′ (144″)

Other Technical Data



Material:
ASTM-A653 G90 Steel

Standard Finish:
Hot-dip mill-galvanized. (Other finishes available upon request)

Parts Included:
Each straight includes cover, wrap-around splice, hardware and self-drilling cover screws.

Other:
EMI is manufactured and tested in accordance with NEMA VE-1 and is installed in accordance with NEMA VE-2 "Cable Tray Installation Guidelines".

(For other tray sizes or specifications, please consult the factory)

MADE IN USA

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		SPAN FEET							
		6		8		10		12	
(D) Depth (inches)	(W) Width (inches)	Load	Deflection	Load	Deflection	Load	Deflection	Load	Deflection
	24	222*	.17	130	.32	83	.50	58	.72
	18	230	.18	130	.32	83	.50	58	.72
4	12	230	.18	130	.32	83	.50	58	.72
	9	230	.18	130	.32	83	.50	58	.72
	6	230	.18	130	.32	83	.50	58	.72
	24	221*	.06	185	.16	118	.25	82	.36
	18	296*	.08	185	.16	118	.25	82	.36
6	12	328	.09	185	.16	118	.25	82	.36
	9	328	.09	185	.16	118	.25	82	.36
	6	328	.09	185	.16	118	.25	82	.36

**Indicates allowable load is limited by the load carrying capacity of the transverse member.*

Cover Holding Devices

Catalog No. B-26 (Phillips Head)
Catalog No. B-55 (Hex Head)

All holding devices should be located on 2 foot centers, or less.
Standard - Self drilling sheet metal screws.

Optional Holding Devices

Banding - Available in 302 Stainless Steel, is an economical way of securing the cover to the enclosure.

Item	Catalog Number
100' roll 1/2" wide	SCCB-100
Clips - 1/2" wide	SCCB-C
Strapping Tool	CCB-T

Clamps

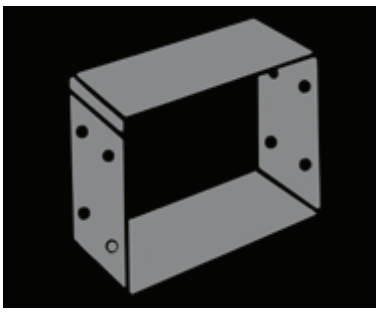
Permit the easy removal of cover and access to cable. Reusable.

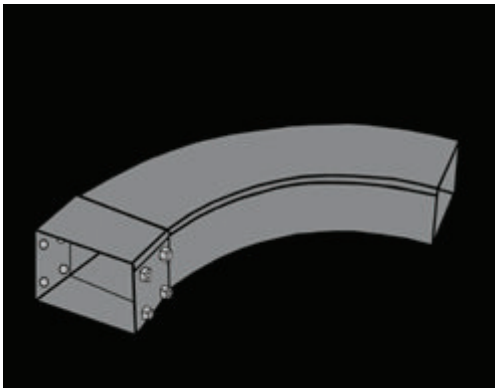
Length	Catalog Number
4"	JCC
6"	MCC

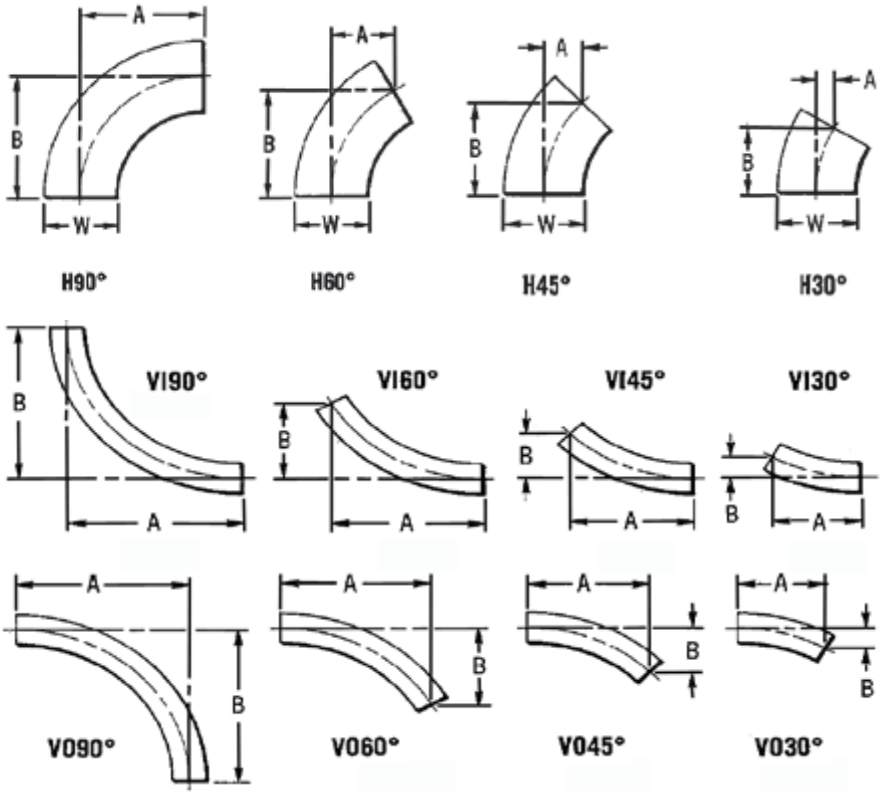
Wrap-Around Splice

Catalog No. EMS(D)-(W)

Specify size of splice by inserting depth & width in place of "D" and "W". The splice is supplied with all necessary hardware.







Horizontal Bend

		90 Degree		60 Degree		45 Degree		30 Degree	
(W) Width (inches)	(R) Radius (inches)	A	B	A	B	A	B	A	B
	24	36	36	18	31-3/16	10-9/16	25-7/16	4-13/16	18
24	12	24	24	12	20-3/4	7	17	3-1/4	12
	24	33	33	16-1/2	28-9/16	9-11/16	23-5/16	4-7/16	16-1/2
18	12	21	21	10-1/2	18-3/16	6-1/8	14-7/8	2-13/16	10-1/2
	24	30	30	15	26	8-13/16	21-3/16	4	15
12	12	18	18	9	15-9/16	5-1/4	12-3/4	2-7/16	9
	24	28-1/2	28-1/2	14-1/4	24-11/16	8-3/8	20-11/16	3-13/16	14-1/4
9	12	16-1/2	16-1/2	8-1/4	14-5/16	4-13/16	11-11/16	2-3/16	8-1/4
	24	27	27	13-1/2	23-3/8	7-15/16	19-1/16	3-5/8	13-1/2
6	12	15	15	7-1/2	13	4-3/8	10-5/8	2	7-1/2

Vertical Inside and Outside Bend

		90 Degree		60 Degree		45 Degree		30 Degree	
Tray Depth (inches)	(R) Radius (inches)	A	B	A	B	A	B	A	B
	24	26	26	22-1/2	13	18-3/8	7-5/8	13	3-1/2
4	12	14	14	12-1/8	7	9-7/8	4-1/8	7	1-7/8
	24	27	27	23-3/8	13-1/2	19-1/16	7-15/16	13-1/2	3-5/8
6	12	15	15	13	7-1/2	10-5/8	4-3/8	7-1/2	2

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