I-LINE® II BUSWAY
for the professional

BUSWAY
for the professional

This handbook was written to help answer many of the questions commonly asked by engineers, architects and contractors. Section 1 describes I-LINE® II busway and the various applications for which it was designed. Section 2 describes how to do a busway take-off from blueprints. Section 3 provides hints to properly layout and measure a busway job. Section 4 outlines things to consider prior to the installation of I-LINE II busway. Section 5 gives physical data of the different types of busway and Section 6 provides plug-in unit application data.

If, after reviewing this handbook, there are still questions which have not been answered, your Square D field representative and product specialists will be pleased to lend their assistance.

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SECTION 1
What is I-LINE II Busway?

I-LINE II busway is a new, ultra-modern version of the time proven I-LINE busway design. Available in ratings from 800 through 5,000 amperes, this new low-impedance, "sandwich type" plug-in (see Figure 1) and feeder (see Figure 2) busway accepts all existing I-LINE plug-in units and matches up to "original" I-LINE busway runs by use of a 1′-0″ adapter length. (You only pay for the 1′-0″ length of busway, there are no additional charges.)

I-LINE II busway utilizes a new, totally redesigned, common silhouette housing with many improvements over the original I-LINE busway housing. Paramount among these new standard features are:

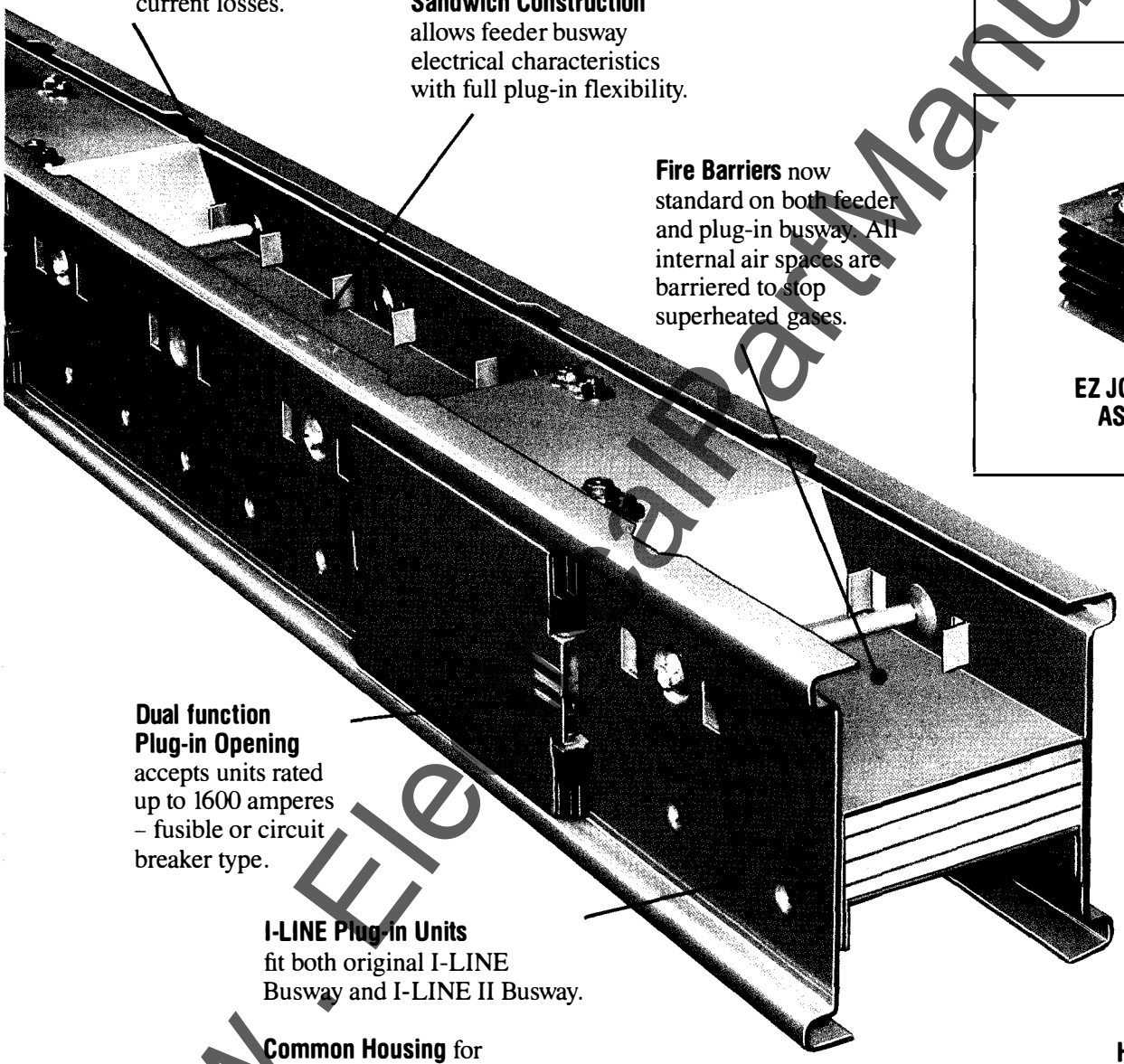
1. An improved, Integral Ground Bus (IGB) system,
2. The new flexible EZ JOINT PAK™ assembly,
3. A universal tie channel (one tie channel fits all I-LINE II Busway).

Plug-In Busway FIGURE 1

Steel/Aluminum housing construction on both feeder and plug-in busway reduces hysteresis and eddy current losses.

Sandwich Construction allows feeder busway electrical characteristics with full plug-in flexibility.

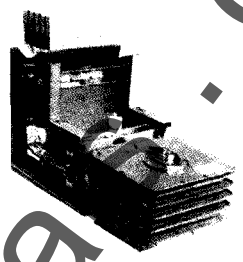
Fire Barriers now standard on both feeder and plug-in busway. All internal air spaces are barriered to stop superheated gases.



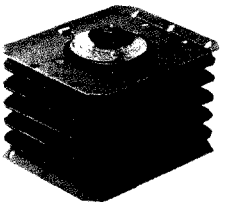
Dual function Plug-in Opening accepts units rated up to 1600 amperes – fusible or circuit breaker type.

I-LINE Plug-in Units fit both original I-LINE Busway and I-LINE II Busway.

Common Housing for I-LINE II feeder and plug-in busway. Same accessories fit both.



EDGEWISE ELBOW



EZ JOINT PAK™ ASSEMBLY

Hangers fit both feeder and plug-in busway. Simplifies pre-installation labor.

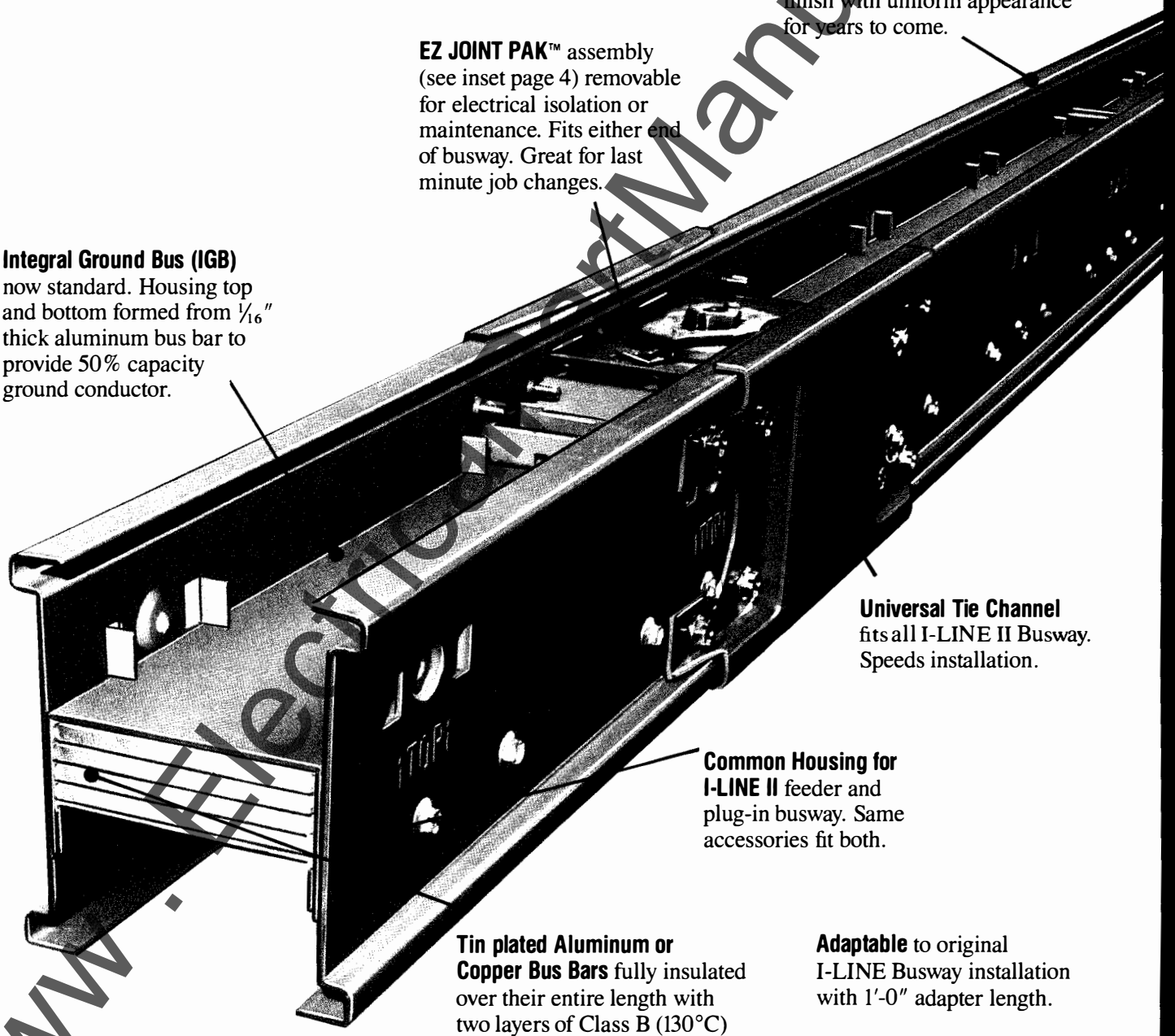
Feeder Busway FIGURE 2

Installation Labor is Low. EZ JOINT PAK assembly, VISI-TITE™ bolt, common hangers. All help to make the installed cost of I-LINE II Busway highly competitive.

Electrodeposition Paint Process provides a durable finish with uniform appearance for years to come.

EZ JOINT PAK™ assembly (see inset page 4) removable for electrical isolation or maintenance. Fits either end of busway. Great for last minute job changes.

Integral Ground Bus (IGB) now standard. Housing top and bottom formed from 1/16″ thick aluminum bus bar to provide 50% capacity ground conductor.



Universal Tie Channel fits all I-LINE II Busway. Speeds installation.

Common Housing for I-LINE II feeder and plug-in busway. Same accessories fit both.

Tin plated Aluminum or Copper Bus Bars fully insulated over their entire length with two layers of Class B (130°C) polyester film.

Adaptable to original I-LINE Busway installation with 1′-0″ adapter length.

Standard Features

Integral Ground Bus and How it Works

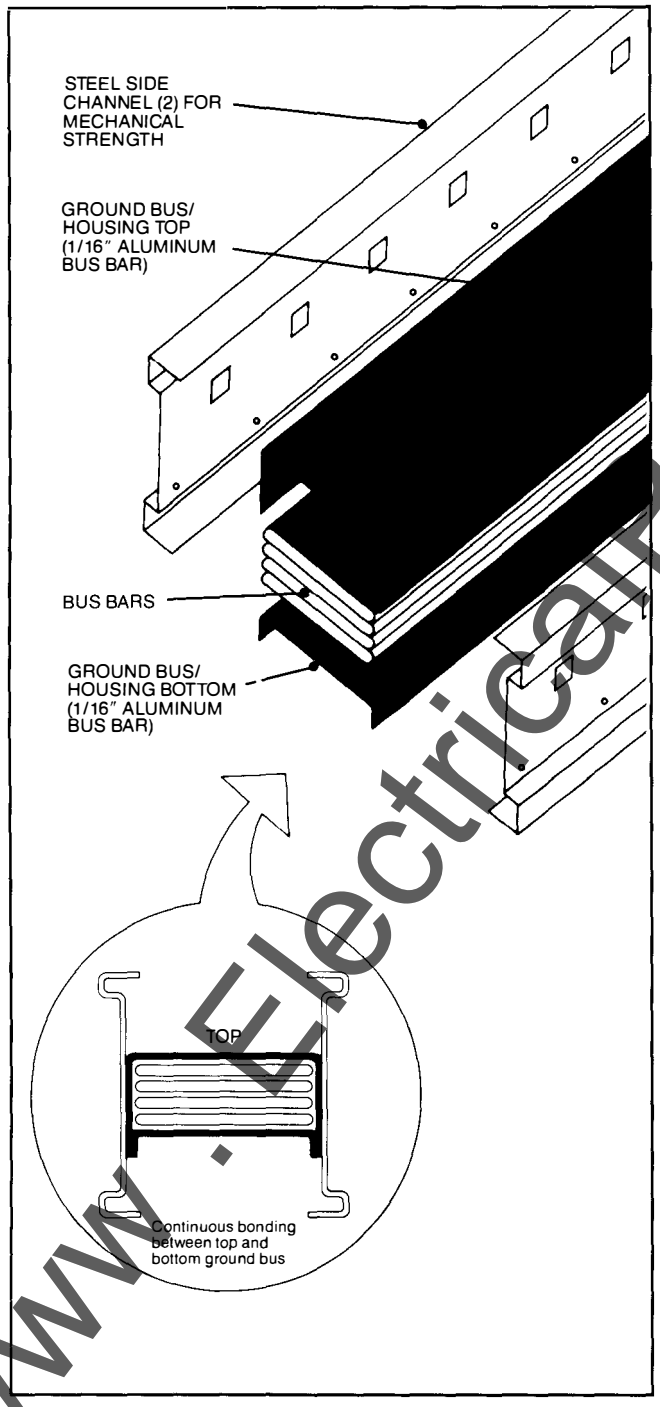


FIGURE 3

Integral Ground Bus. I-LINE II Busway includes Integral Ground Bus (IGB) as a standard feature. That's correct! IGB is now standard on all I-LINE II busway. We believe that a properly designed ground should be included on all distribution systems. I-LINE II busway with standard IGB is the most modern, efficient busway distribution system on the market.

EZ JOINT PAK. I-LINE II busway offers an improved single bolt type joint package, the EZ JOINT PAK assembly, which can be removed to electrically isolate busway sections for load shifting, maintenance, etc. It can even be relocated to the other end of a piece of busway to take care of last minute job changes or mixups. The new EZ JOINT PAK assembly is shipped preassembled with each I-LINE II busway length or fitting. This feature provides minimum jobsite installation labor. Our innovative VISI-TITE® torque indicating joint bolt is a standard feature on all EZ JOINT PAK assemblies.

Voltage Drop. I-LINE II plug-in busway offers even lower impedance than existing I-LINE busway. Now voltage drop values are lower than before, especially at lower power factors. This provides a more stable voltage supply to the delicate electronic and computer equipment which is so much a part of today's business world.

Finish. I-LINE II busway housing appearance has been substantially enhanced by the addition of a multi-million dollar Cationic Electro-deposition paint system. This new, automated paint process, the most modern in the industry, offers I-LINE II busway users a tough, durable, uniform "E-COAT" epoxy paint finish that will allow their busway installation to remain functional and attractive for years to come.

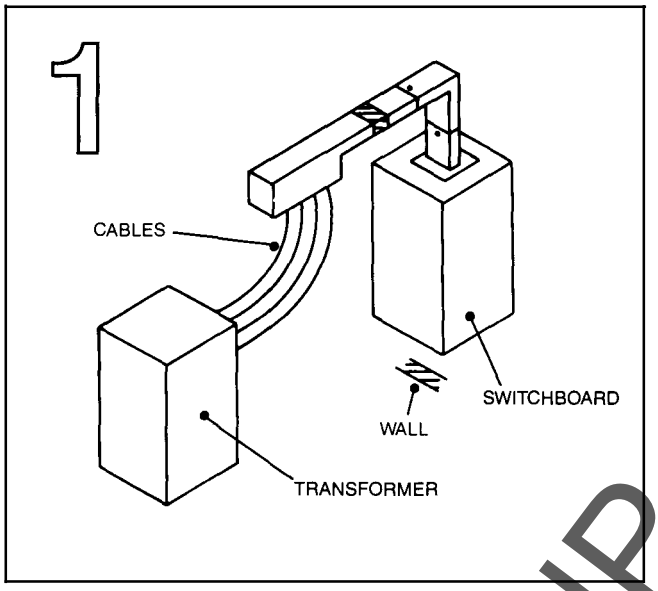
Other features include: Standard internal fire stops on both feeder and plug-in busway; improved end design to reduce handling/shipping damage; common feeder/plug-in hanger system including a simplified vertical hanger and a steel/aluminum housing to reduce hysteresis and eddy current losses on both feeder and plug-in busway. Of course, all the time-proven design features of original I-LINE busway are included as standard on I-LINE II busway.

Where should I-LINE II Busway be used?

Basically there are only four types of busway applications. Figures 4A-4D illustrate the basic systems.

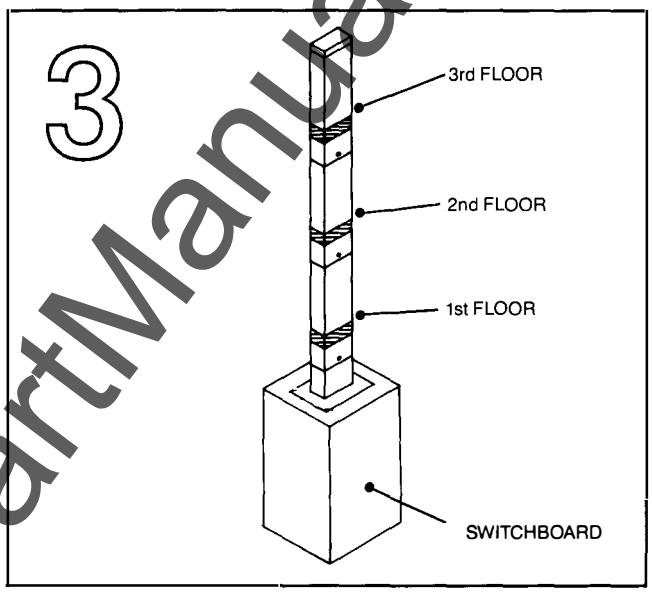
Details on each basic system can be found on pages 8 through 17.

The Four Types of Busway Runs



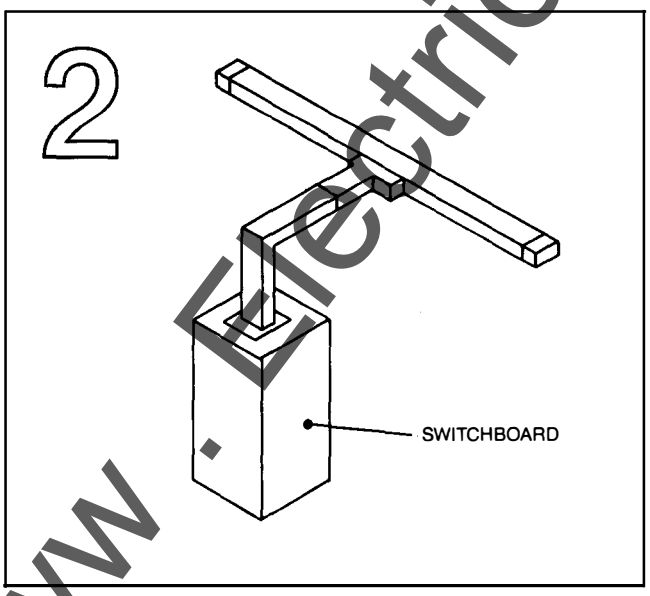
SERVICE ENTRANCE RUNS

FIGURE 4A a typical service entrance run from a utility transformer to a switchboard utilizing cables directly connected to the busway.



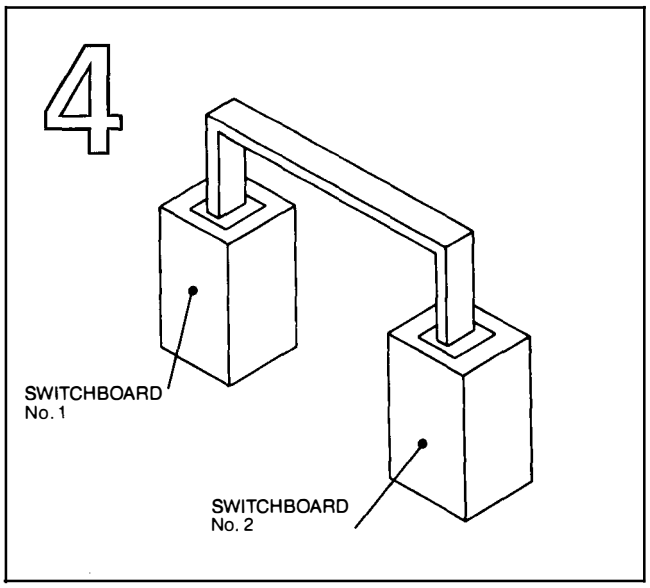
PLUG-IN TYPE VERTICAL RISER

FIGURE 4C a simple plug-in riser fed by a switchboard.



PLUG-IN TYPE HORIZONTAL RUN

FIGURE 4B a simple plug-in run fed by a switchboard through a plug-in tee.



FEEDER TYPE TIE RUN

FIGURE 4D a typical feeder run between two switchboards.

1 Service Entrance Runs

I-LINE II busway can be used as a service entrance conductor to bring power from a utility transformer into a distribution switchboard. The connection to the transformer is done by cable or solid bussing.

When the transformer is connected to the busway via cables the governing electrical code may specify height clearance requirements for the cables.

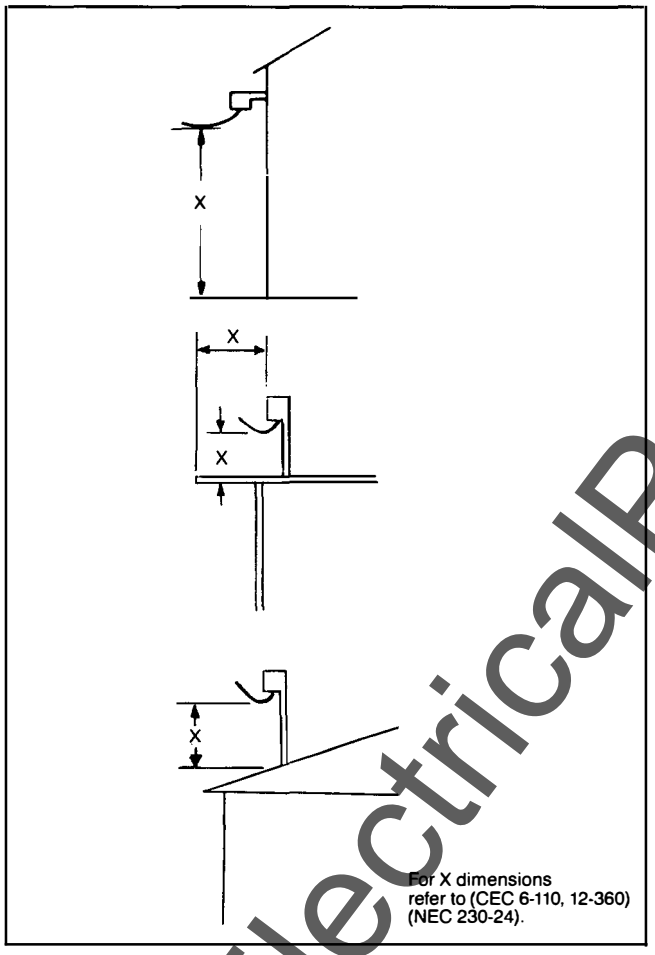


FIGURE 5A Illustrates the dimensions which should be considered when planning this type of run. For specific dimensional requirements refer to (CEC 6-110, 12-310) (NEC 230-24).

Service Heads

If the busway specifications or local utility requirements call for the service entrance cable-to-busway termination to be enclosed in a weatherproof box, then a service head should be ordered.

Figure 4A on Page 7 illustrated a flatwise service head (SHF) application. The busway is running in a horizontal flatwise mounting position.

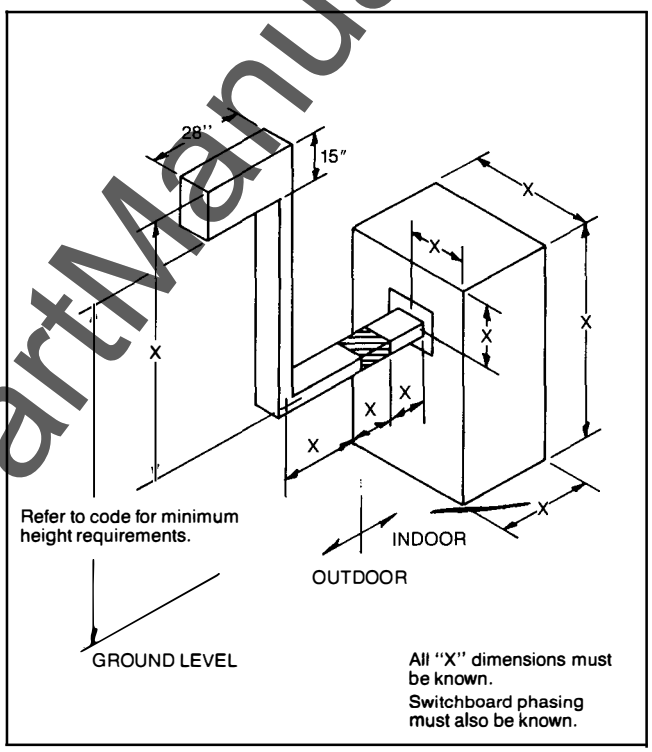


FIGURE 6A Typical vertical service head application.

If the flatwise busway elevation is too low to allow a cable connection that would comply with the electrical code, another solution is the vertical service head (SHV). The vertical service head can be attached to busway which exits the rear of the switchboard (see Figure 6A) and is turned upward or can be attached to busway which exits the top of a switchboard and penetrates the roof utilizing a drip hood and roof collar (see Figure 6B on Page 9).

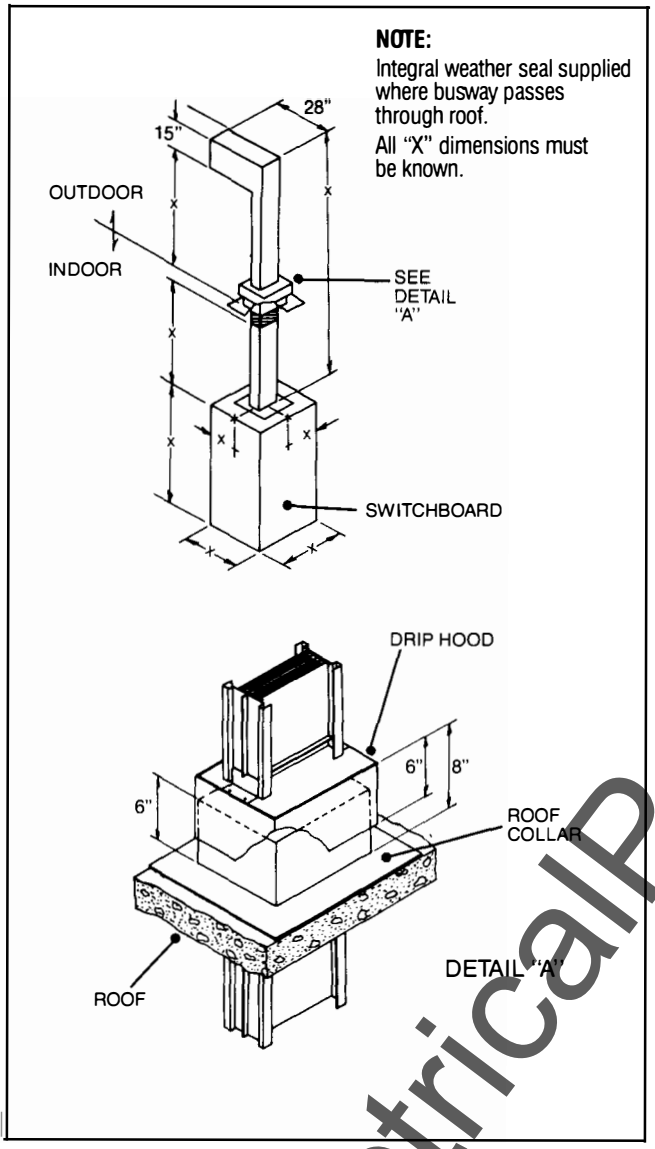


FIGURE 6B Vertical Service Head Penetrating a Roof.

If a vertical service head extends through a roof, the roof must be sealed around the busway. To do this a fixed collar must be factory assembled onto the section of busway which penetrates the roof. The contractor can then flash from the collar to the roof. A roof flange kit can be ordered from the factory to make the flashing job easier. The kit consists of a drip hood and a roof collar. When installed the roof collar must be sealed to insure that no moisture gets indoors. The roof flange kit will accommodate a roof slope up to one inch per foot. See detail A in Figure 6B.

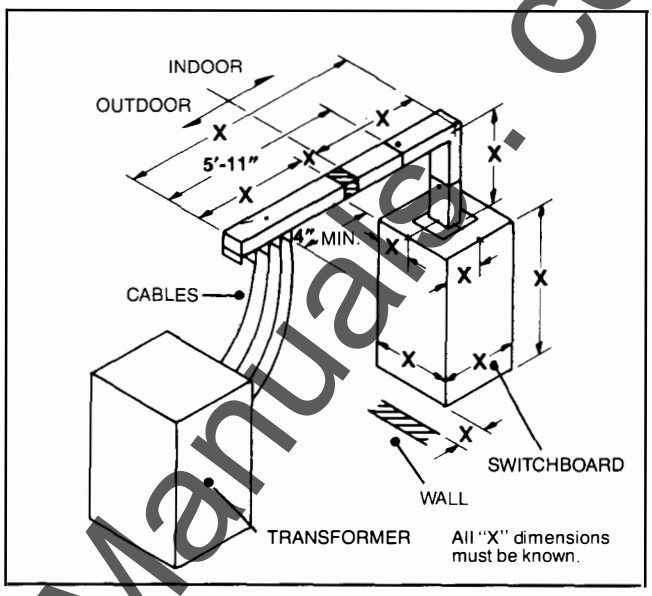


FIGURE 7 Transformer tap for 1-3Ø Transformer (TSF).

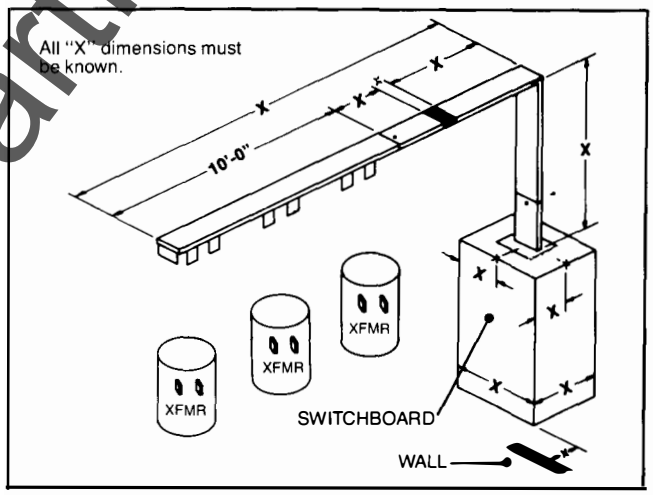


FIGURE 8 Transformer Tap for 3-1Ø Transformers (TTF).

Transformer Taps

A transformer tap performs the same function as a service head except that the lugs and bussing to which the service entrance cables are connected are not enclosed in a weatherproof enclosure.

A flatwise service head (SHF) with the box removed is a transformer tap (TSF). A TSF is a transformer tap for 1-3 phase transformer. Figure 7 illustrates a typical TSF service entrance run.

If 3-1 phase transformers are supplied by the utility to deliver power to the customer, a separate transformer tap has been designed for this application. This transformer tap is known as a TTF and is shown in Figure 8. It is important to note that a TTF must always be phased so that the A phase is on top.

Bussed Transformer Connections

If required, the factory can provide a bussed transformer connection. Normally, this type of connection will include flexible connectors from the low voltage spades of the transformer to the busway connectors. These flexible connectors are used to allow for busway expansion and contraction on the low voltage spades. Positioning of these flexible connectors is critical for proper alignment between the busway and transformer.

Bussed transformer connections are usually made to two types of transformers. One type has a low voltage throat and the other is a padmount type with a low voltage compartment (shown in Figures 9 and 10 on Pages 10 and 11 respectively).

Phasing

When a bussed transformer connection is to be used it is essential that the phasing of the transformer and of the switchboard it supplies be properly coordinated. It is sometimes best to let Square D coordinate the phasing. Simply supply the name of the transformer manufacturer, and phasing details of the low voltage side.

Other Service Entrance Connections

Occasionally, the customer or local utility will require a service entrance connection that differs from our standard. In this case, be sure to let the factory know of any special dimensions, such as required height of service head from ground or floor, spacing between phase bars, number and type of lugs, distance from lugs to wall, phasing, etc.

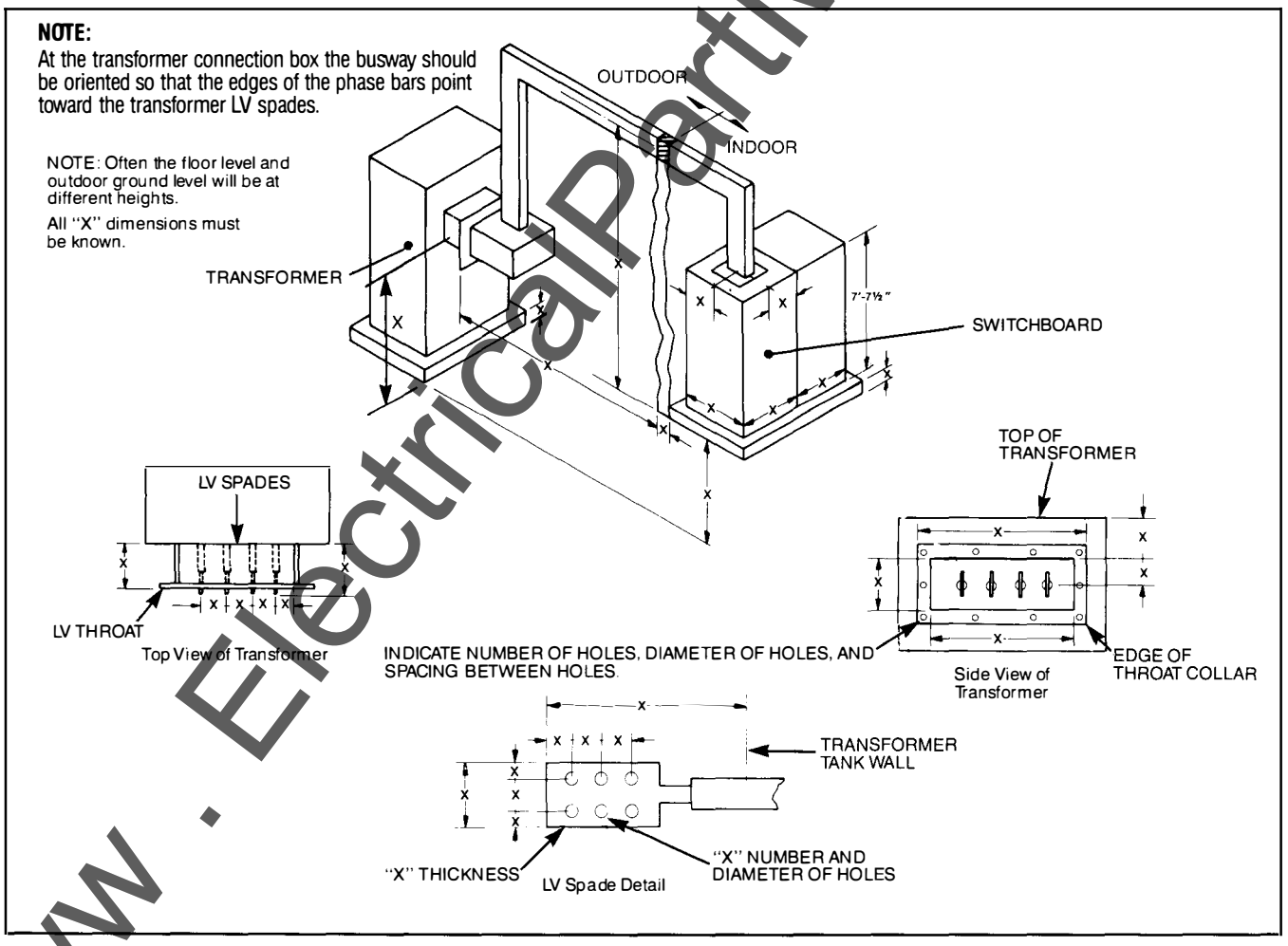


FIGURE 9 Measurements needed for Bussed Transformer Connection (Throat Type).

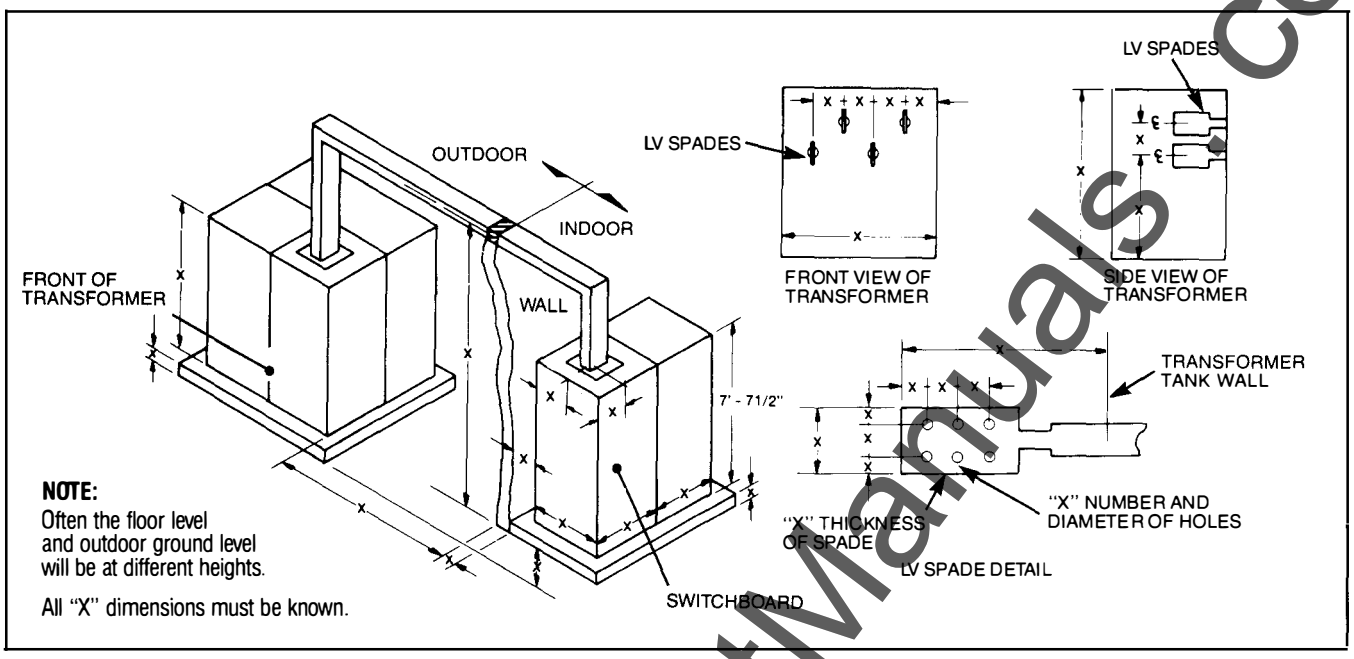


FIGURE 10 Measurements Needed for Bussed Transformer Connection (Pad Mount Type).

2 Plug-In Busway Horizontal Run

Plug-in busway is used as a means of bringing power from a distribution switchboard to multiple loads throughout a building.

Phasing

A typical I-LINE II plug-in run is shown in Figure 11. The phasing shown on the plug-in busway is GABCN top to bottom, with the top located as shown for a horizontal run. This phasing arrangement must always be followed so that proper phasing of the plug-in units will be assured (Figure 11, Detail A). Because this busway phasing must be followed, it is the busway that determines the phasing of the switchboard in Figure 11. Note that plug-in busway has the integral ground bus plug-in jaw on the top side only.

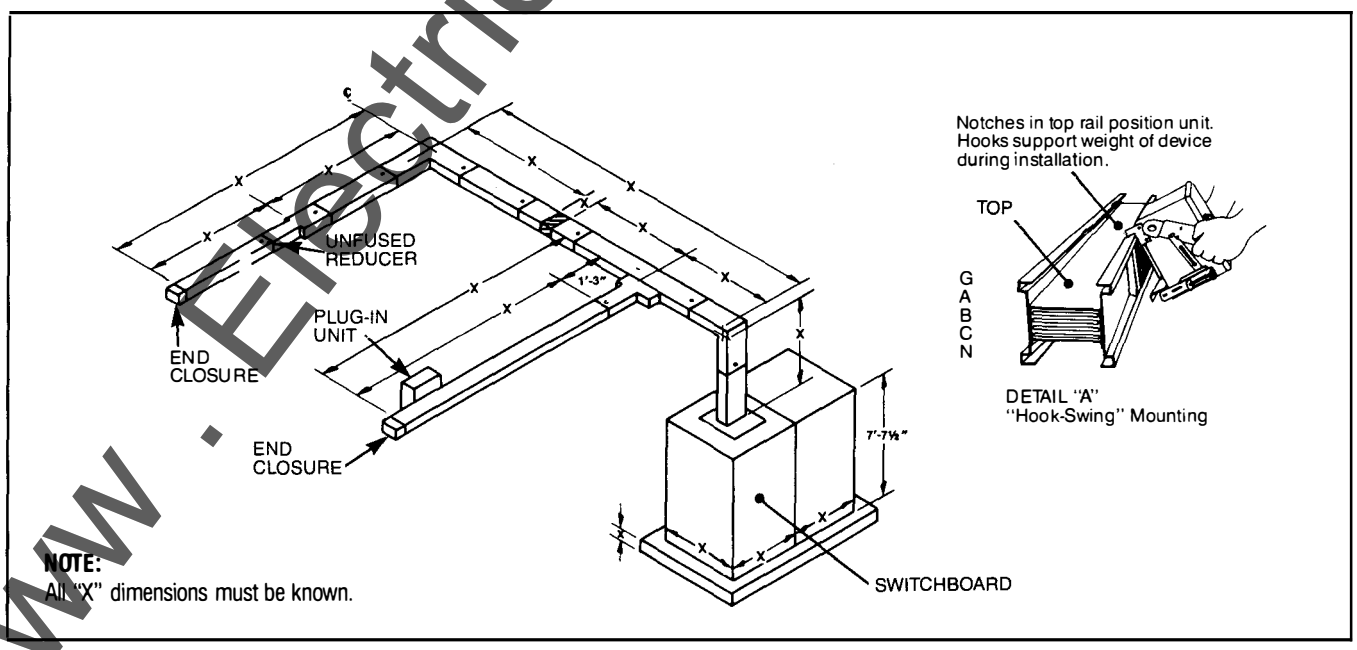


FIGURE 11 Measurements Needed for a Typical Plug-In Type Run.

NOTE:
In the low voltage compartment the busway should be oriented so that the edges of the phase bars point toward the transformer LV spades.

Busway Fittings

Busway fittings is a term which encompasses every busway component (i.e. flanged ends, elbows, tap boxes, service heads, tees, reducers, expansion fittings, end closures, hangers, etc.) except straight lengths and plug-in units. The Square D Digest has a page exclusively for the majority of I-LINE II busway fittings.

All fittings on 800A. and above plug-in runs are made with feeder busway.

All fittings under 800A. are made with plug-in busway. No feeder to plug-in connections can be made under 800A. Connections to switchboards under 800A. are normally made with plug-in tap boxes (see Figure 12), however flanged ends are available.

Busway Through Walls and Floors

When 800A. and above busway extends through a wall or floor, I-LINE II feeder or plug-in busway can be used. For runs under 800A., plug-in busway will be used throughout. In this case wall or floor location must be specified so that fire barriers may be factory installed.

According to the C.E.C. (12.2006) and the N.E.C. (364-4) busway must be installed so that supports and joints are accessible for maintenance purposes after installation. This implies that no part of the joint channel can be inside the wall. Therefore, the distance from the center line of the joint to the wall must be at least equal to the distance from the center to the edge of the joint channel (see Figure 13). If the dimensions of the joint channel cannot easily be determined, it is best to keep the joint at least one foot from wall. This will ensure proper joint clearance for any type of busway passing through a wall.

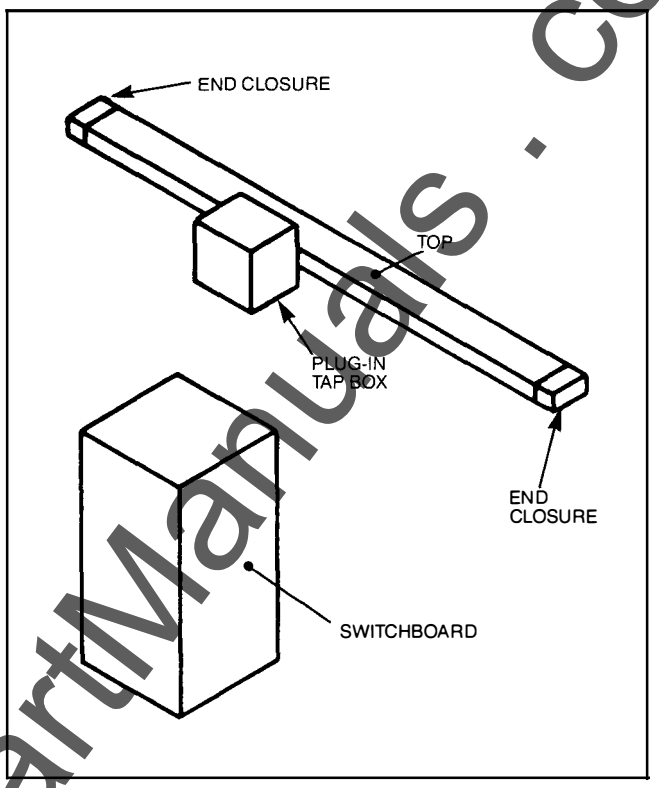


FIGURE 12 Typical Plug-In Run fed by plug-in tap box.

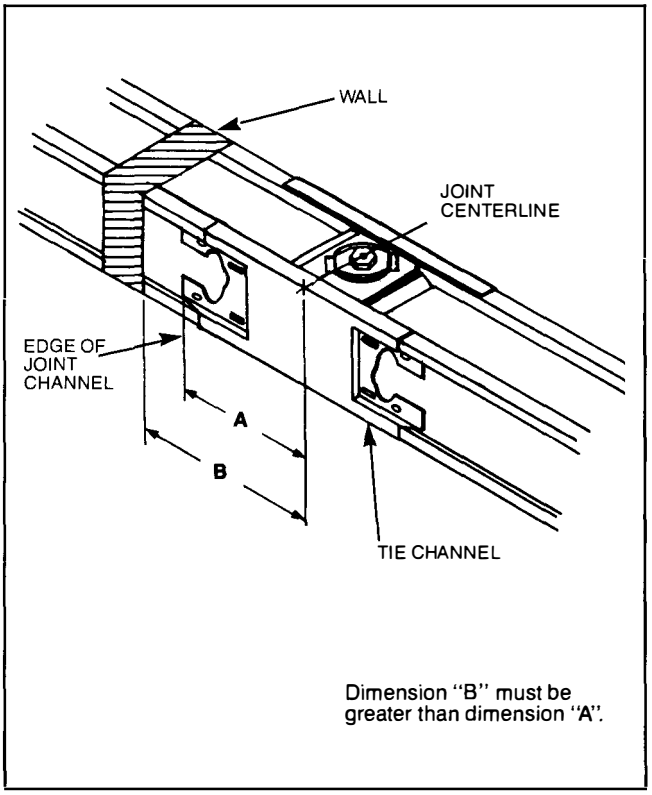


FIGURE 13 Joint Accessibility Requirements.

Wall and Floor Flanges

Wall and floor flanges are meant to be used for covering the hole in a wall or floor where busway passes through. These flanges will not aid in maintaining the fire rating of the wall or floor. They are not required for installation, but are often requested to provide a finished appearance.

Tees

I-LINE II bolt-on tees are used for branch runs that tee off a run of plug-in busway from a plug-in opening. The tee does not have to be the same amperage as the main run. If not, electrical code restrictions on reduction must be followed.

Bolt-on tees can be used at any plug-in opening on the run. When the branch run must be located at a particular point, it is important to know that all plug-in openings are on 2-foot centres. Feeder tees for branches above 800A. can be ordered from the factory.

As Figures 4B and 11 on Pages 7 and 11 respectively illustrate, bolt-on tees can be used to feed a run of busway.

225A.- 600A. bolt-on tees have a bolt end and must be connected to the slot end of the next piece of busway.

800A.- 1600A. bolt-on tees have the EZ JOINT PAK™ Assembly which allows a connection to the slot or bolt end of the next piece of busway.

Reducing

The C.E.C. and the N.E.C. state that when reducing without an overcurrent device at the point of reduction, the smaller busway cannot extend more than 15 metres (C.E.C. 12-2012) or 50 feet (N.E.C. 364-22), or have a current rating less than one-third of the overcurrent device next back on the line (see Figure 14). For applications where the reduced run must have an overcurrent device built in, an adapter cubicle can be ordered from the factory. In Figure 11, Page 11 reducing is accomplished by both a reducer and a bolt-on-tee.

Expansion Joints

Typical expansion joint locations are shown in Figure 15. However, Square D recommends their use **only** when crossing a building expansion joint. The busway expansion joint allows ± 1½" movement of the steel at the building expansion joint.

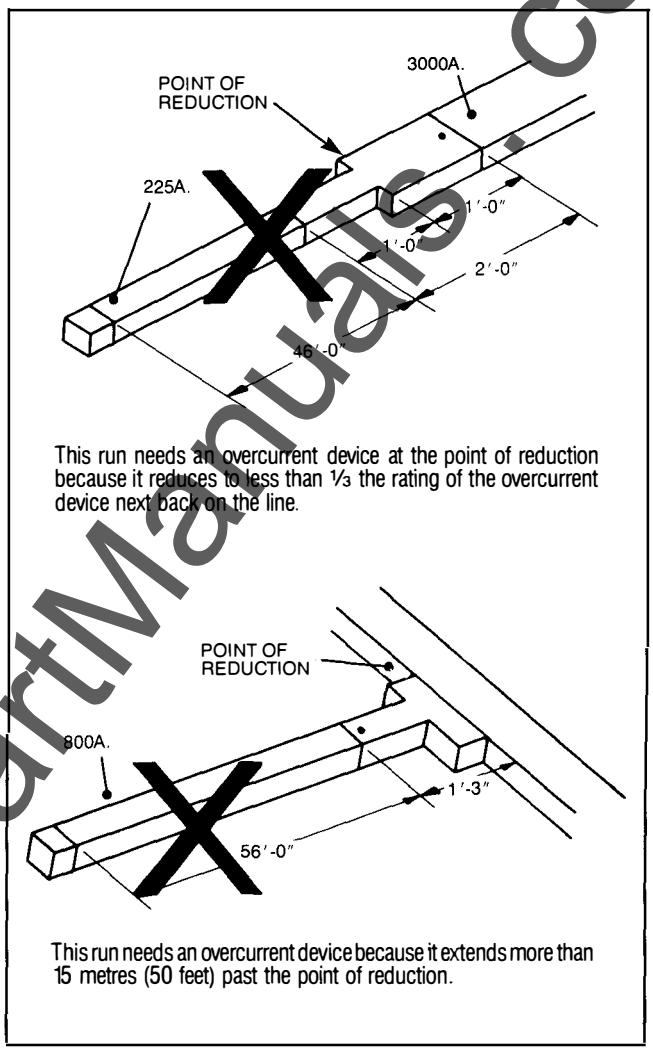


FIGURE 14 Electrical Code restrictions on busway reductions.

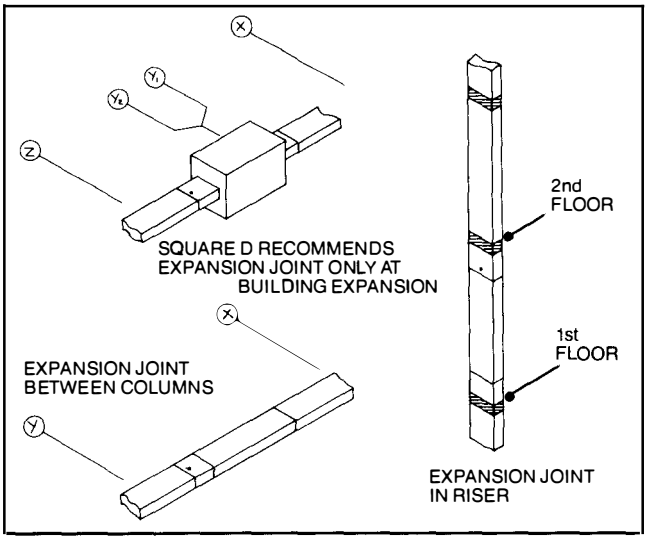


FIGURE 15 Typical Expansion Joint locations.

3 Plug-In Risers

I-LINE II plug-in busway can be utilized for the entire vertical riser. There is no need to use feeder busway to penetrate the floors. This feature will enable the customer to use more plug-in openings per floor of the riser. For plug-in risers under 800A., plug-in busway is again used throughout, but fire barriers are needed where the busway passes through a floor.

Dimensions

Figure 16 shows typical dimensions that must be known before release: floor to floor height, floor thickness, exact layout of multiple run riser, closet dimensions, the type and quantity of plugs per floor, which side of the busway the plugs should mount on, and (if necessary) the desired height of the plugs from the floor.

The riser in Figure 16 has been dimensioned in Figure 17. Note that the two 10′-0″ sections of busway on the 2nd and 3rd floors do not have a joint located in or near the floor. See Page 12 and Figure 13 for a discussion and detail, respectively, of joint accessibility requirements.

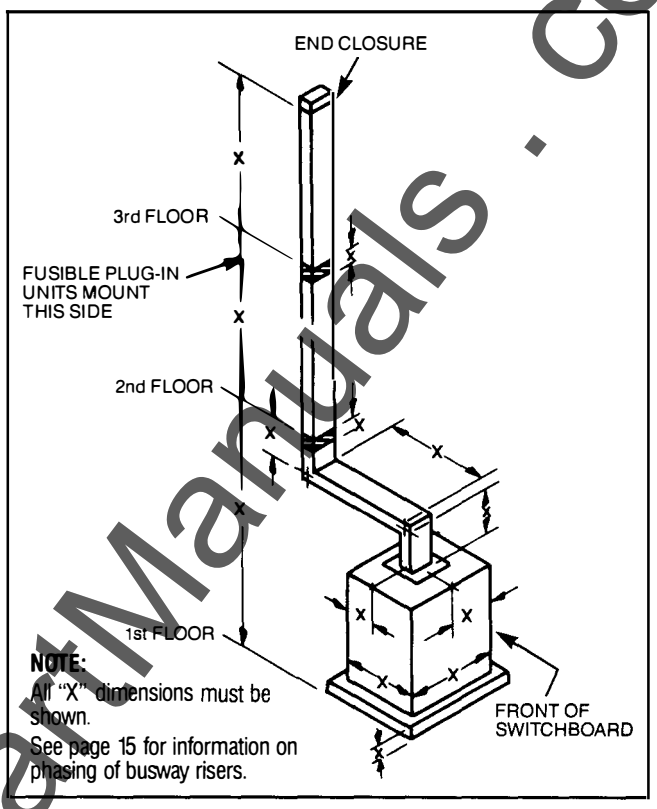


FIGURE 16 Typical Information needed for Riser.

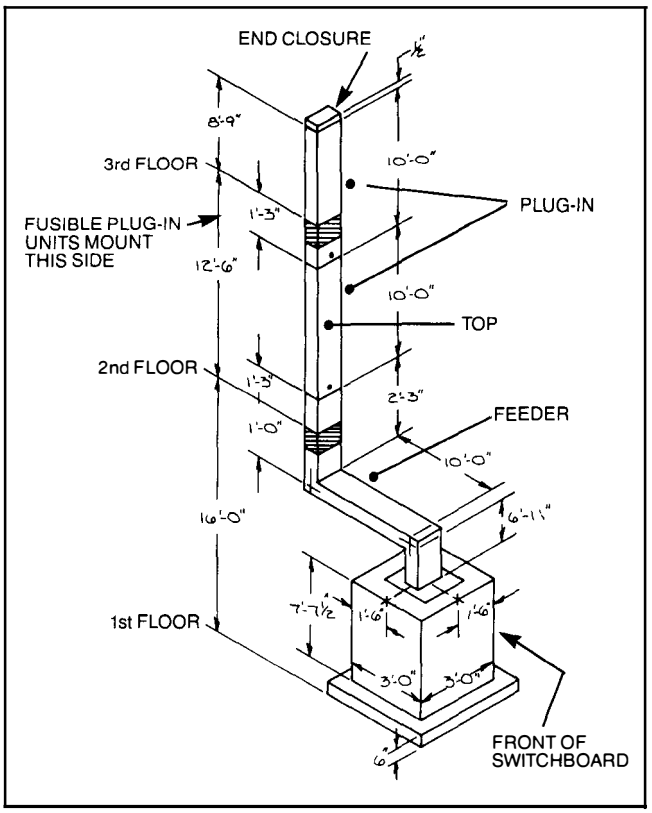


FIGURE 17 Typical Layout 800A. and Above Riser.

Phasing

When fusible plugs are being supplied, the location of the plug determines the phasing of the busway. Article 14.502 of the C.E.C. and article 380-6 of the N.E.C. state that Single-throw knife switches shall be mounted so that gravity will not tend to close them. If a 400A-600A fusible plug is mounted as shown in Figures 18A and 18C, gravity will tend to open the switch (note where the TOP label is). If a 400A or 600A switch is mounted on the other side of the riser (Figure 18B), gravity would tend to close the switch. This is a violation of the Code. Therefore it is essential that the busway be oriented with the correct side available for plugs.

Square D can help you to determine the correct busway orientation. Just let us know where the fusible plugs should mount. We will then notify the assembly plant of the correct busway phasing at the switchboard.

Circuit breaker plugs and all except 400A to 600A fusible plugs can be mounted on either side of the busway.

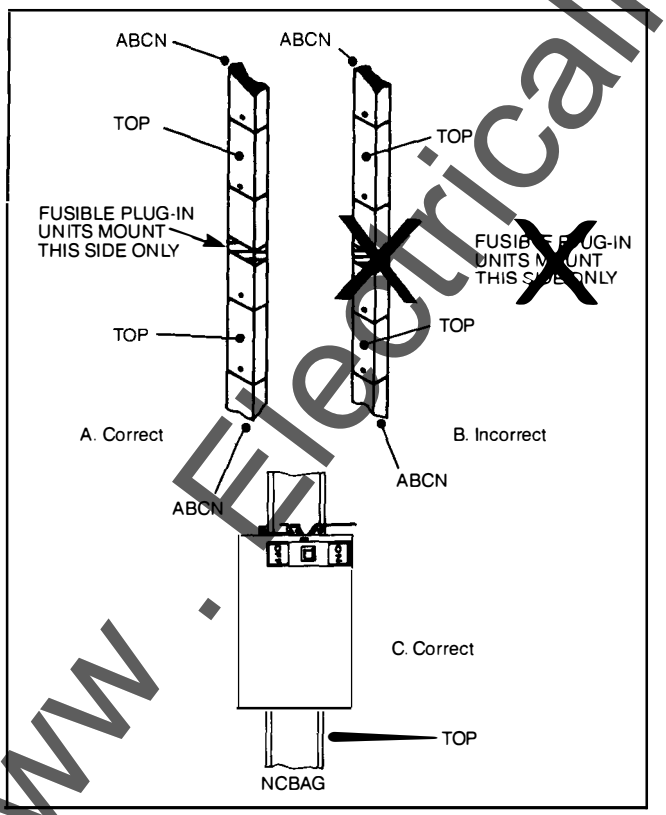


FIGURE 18 Mounting 400A-600A Fusible Units on Risers.

Special Manufacturer's Recommendation

Square D recommends that a waterproof curb (see Figure 19) be installed at each floor opening where busway passes through. An unprotected floor opening acts as a funnel for plumbing leaks, sprinkler system leaks, fluid spills and other types of contamination.

The cost of removing a contaminated busway riser, having it repaired, then re-installing the busway far exceeds the cost for including a waterproof curb when the floors are poured.

Once busway is installed through a floor opening, the remaining unused area should be filled to prevent smoke from passing floor-to-floor (chimney effect) in case of fire in the building. Some recommended materials available are fire rated foam and caulk. Grouting is also acceptable but must be applied in a very dry form to prevent water and contaminants from entering the busway once the grouting cures and the water leeches out.

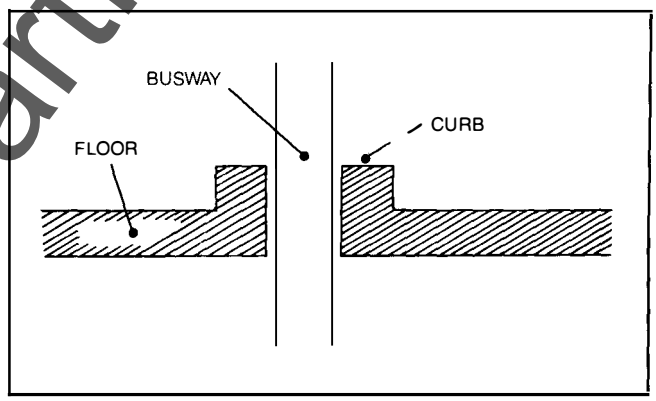


Figure 19 Waterproof Curb Recommended at Floor Opening.

Plug-In Units

When entering an order, the factory must know not only which side of the busway the plugs will mount on, but also the type and quantity of plugs to be used on each floor. Also, notify the factory if the plugs need to be mounted at a certain height from the floor.

Hangers

Square D recommends the use of fixed hangers on all I-LINE II Busway riser installations. When using fixed hangers, the weight of the riser is evenly distributed between each floor. Spring hangers can be ordered, but these floating hangers sometimes necessitate frequent adjustment of the springs due to load changes. They also may require the use of flexible conduit on plug-in units.

4 Feeder Runs

Feeder type runs are normally used for distributing power to loads that are concentrated in one area. Typical connections are switchboard to switchboard tie runs, and a switchboard feeding a remote MCC (see Figure 20).

Through Walls

With the new design of I-LINE II plug-in busway, feeder or plug-in busway can be installed through walls and floors. See previous discussion on code requirements on Page 12.

Feeder Elbows (800A.-5000A.)

As Figure 21 illustrates, there are two standard types of 90° elbows: flatwise and edgewise. No matter what orientation the busway is installed, the busbars of flatwise elbows stay in the same plane after elbowing and edgewise elbow busbars change planes.

Since feeder elbows are symmetrical, there are no TOP or FRONT sides. Note in Figure 21 that the phasing will run across the 5.88″ dimension of the busway.

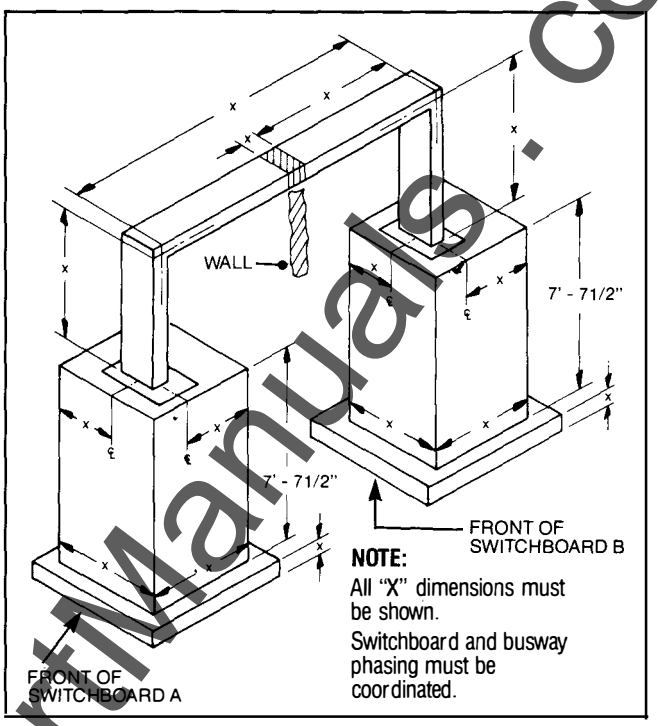


FIGURE 20 Measurements needed for Feeder Type Run.

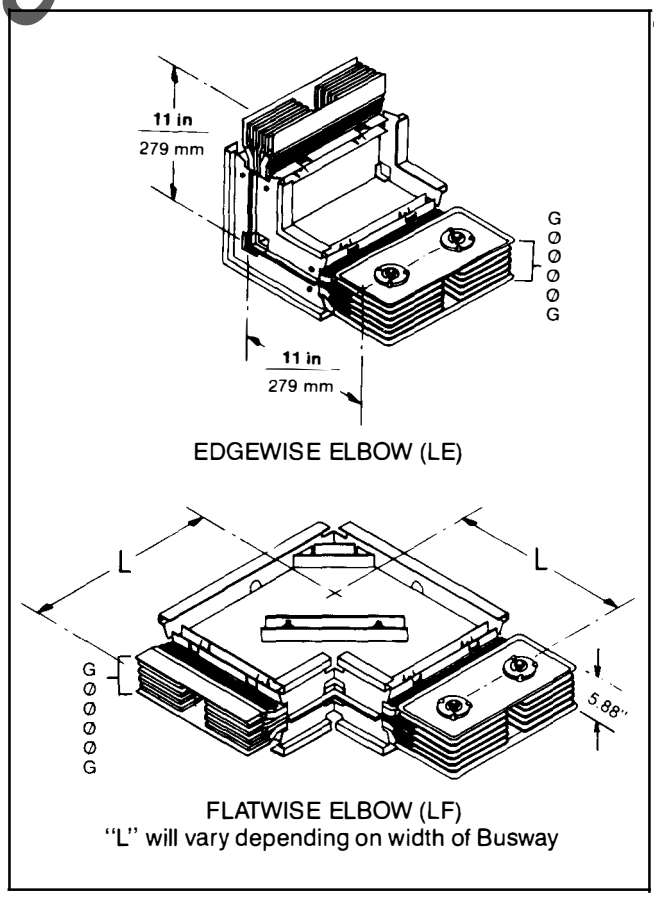


FIGURE 21 Elbows: 800A.-5000A. Feeder.

Flanged Ends – Switchboard Connections

A flanged end (see Figure 22) is a feeder busway fitting that allows busway to be interconnected to other equipment such as motor control centers and switchgear.

Occasionally, a customer wants to make a cable connection to his switchboard. As Figure 22 illustrates, standard flanged ends are designed for a single bolt type connection and the spacing between phases may be inadequate for adding lugs.

Square D can manufacture flanged ends with lugs to accommodate the customer's needs. The phase spacing, size, type and quantity of lugs will need to be known to order the flanged end with lugs.

Tap Boxes

Square D manufactures two types of tap boxes. One style, the plug-in tap box, is designed to connect to plug-in busway at any of the plug-in openings. The plug-in tap boxes range from 225A.-1600A. (see Figure 23).

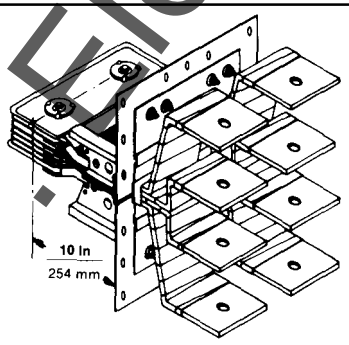
The other style of tap box is the end cable tap box (see Figure 23). As the name implies, the end tap box mounts on the end of either a Plug-in or feeder run.

All tap boxes are constructed of all-steel enclosures for use with cable and conduit. Screw type mechanical lugs are standard. If a larger lug than normal or a compression lug is required, notify Square D at time of quotation.

Joint Channels

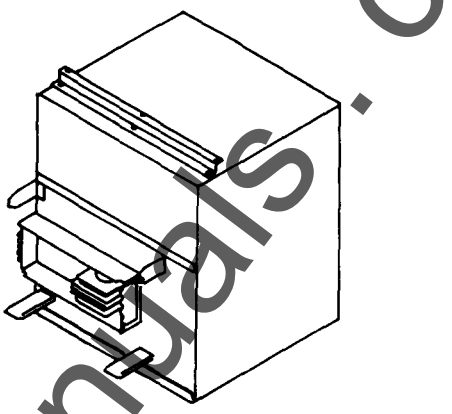
As previously mentioned in Section I and illustrated in Figure 2, for all I-LINE II busway combinations (i.e. plug-in-to-plug-in, feeder-to-feeder, feeder-to-plug-in) 800A.-5000A., there is only one style joint channel. Figure 24 again illustrates the time saving universal tie channel.

Basically joint (or tie) channels are used to cover the sides of busway when a joint connection is made. These channels also provide mechanical strength at the joint.

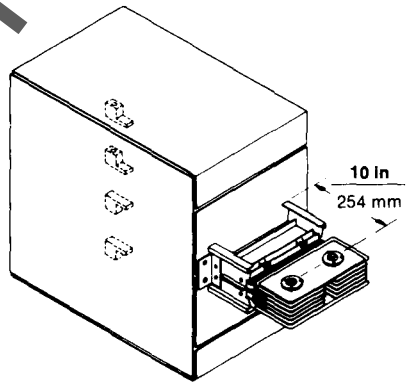


FLANGED END

FIGURE 22 Standard Flanged End with 10″ Busway Stub.

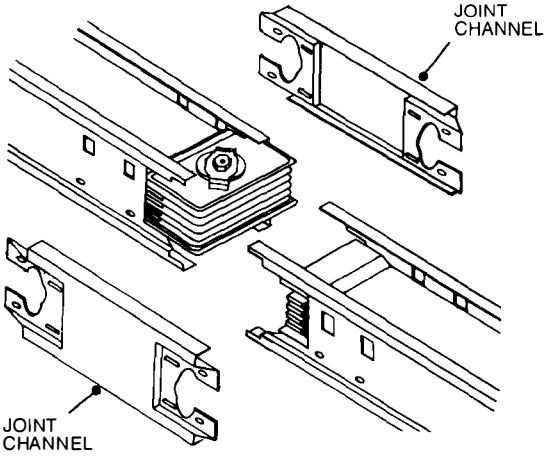


PLUG-IN TAP BOX (800A. - 1600A. Style Shown)
(For connection into plug-in opening 225A. - 1600A.)



END CABLE TAP BOX
(For connection to end of busway run 800A. - 5000A.)

FIGURE 23 Plug-In and End Cable Tap Boxes.



NOTE: Weatherproof tie channels also include gasketing but otherwise are identical to indoor tie channels

FIGURE 24 Universal Joint (or Tie) Channel.

SECTION 2
How to do a Busway take-off from blueprints

The guidelines listed below should allow you to perform a busway take-off in the field.

1 First check the drawing list to ensure you have all the drawings for a complete and accurate take-off. Generally, you will need the steel and mechanical drawings to confirm the busway has an unobstructed path.

2 Carefully read the specifications and note any variations to Square D's I-LINE II busway. If there are discrepancies between what is specified and what can be provided, the final quotation must list the exceptions.

3 Check the one-line electrical diagrams and count the number of busway runs. If the voltage, ampacity, and run designations (i.e. busway run MCC 1) are stated, list these items. When the take-off is complete, this listing can be used to ensure that your bill-of-material is complete.

4 If multiple busway runs are shown on each drawing and are continued on subsequent drawings, a complete run-by-run take-off is recommended. Check the scale on each drawing and detail, sometimes they vary.

5 To obtain the busway footage and the number of fittings (i.e. elbows, flanged ends, wall flanges, etc.):

a Measure the footage of the busway by scaling from centerline to centerline of the busway and fittings.

b If time permits, a simple sketch of each busway run is very helpful. Reference dimensions from known column lines to the busway and show them on your sketch, also note the busway elevation(s).

c List the number of fittings for each busway run.

6 Once all the busway runs have been grouped according to amperage ratings, the busway footage pricing and busway fittings charges found in the Square D Digest can be utilized to obtain the busway costs.

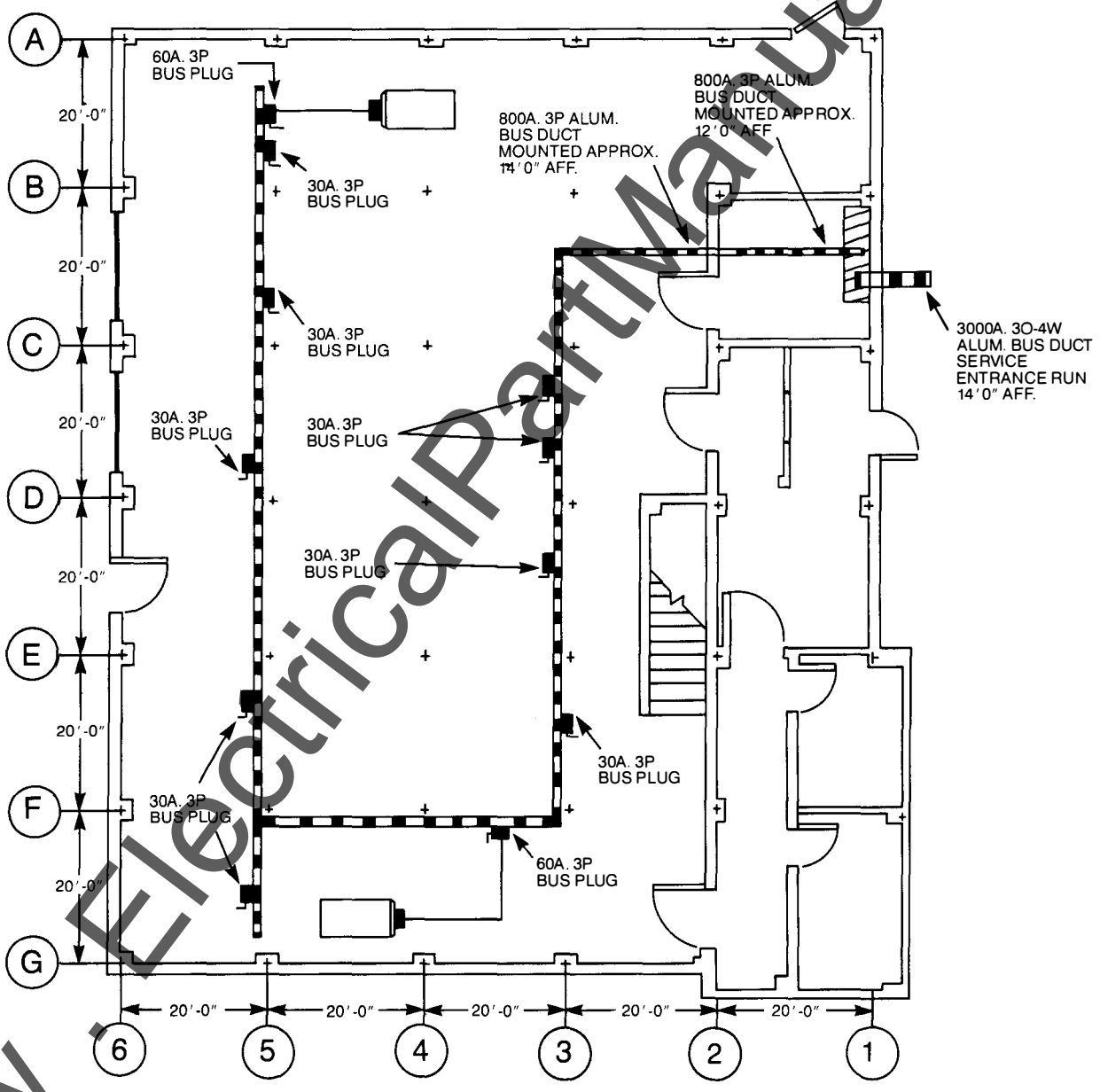
7 If busway tap boxes and overcurrent devices are not listed as part of the take-off, a careful examination of the drawings needs to be made to compile the list. The prices for overcurrent devices are given in the Square D Digest.

Take-off Exercise

The example below illustrates a typical customer drawing. As an exercise it is recommended that you perform a take-off from this drawing and develop a single line sketch.

Page 20 provides guidelines on how to develop a single line sketch and shows an example.

Page 21 provides a checklist which outlines the information you should obtain when performing a take-off. Page 21 also shows a typical pricing format.



EXAMPLE 1
Typical Customer Drawing

NOTE: Top of switchboard elevation is 7'-0" AFF. "AFF" means above finished floor.

FIGURE 25

How to Make a Single Line Sketch

As previously mentioned in the take-off instructions, a single line sketch can be very helpful. The procedure outlined here will help you to develop one.

1 Draw a single line to represent the center line of the busway. Label each line carefully. (By busway catalog number if possible.)

2 Look up the symbols for the fittings included in your take-off from the table below. Add these to your single line. Plug-in units are not normally shown unless location is critical. If this is the case, note this clearly on your sketch.

3 Add symbols from the table below to indicate busway orientation.

4 Indicate the phasing at each end of the run.

5 Add dimensions and elevations. Remember to show all wall and floor locations.

6 If a run contains more than one type of busway (e.g. feeder and plug-in) be sure to indicate the locations of each type.

7 List the plugs (if any) that fit on the busway run.

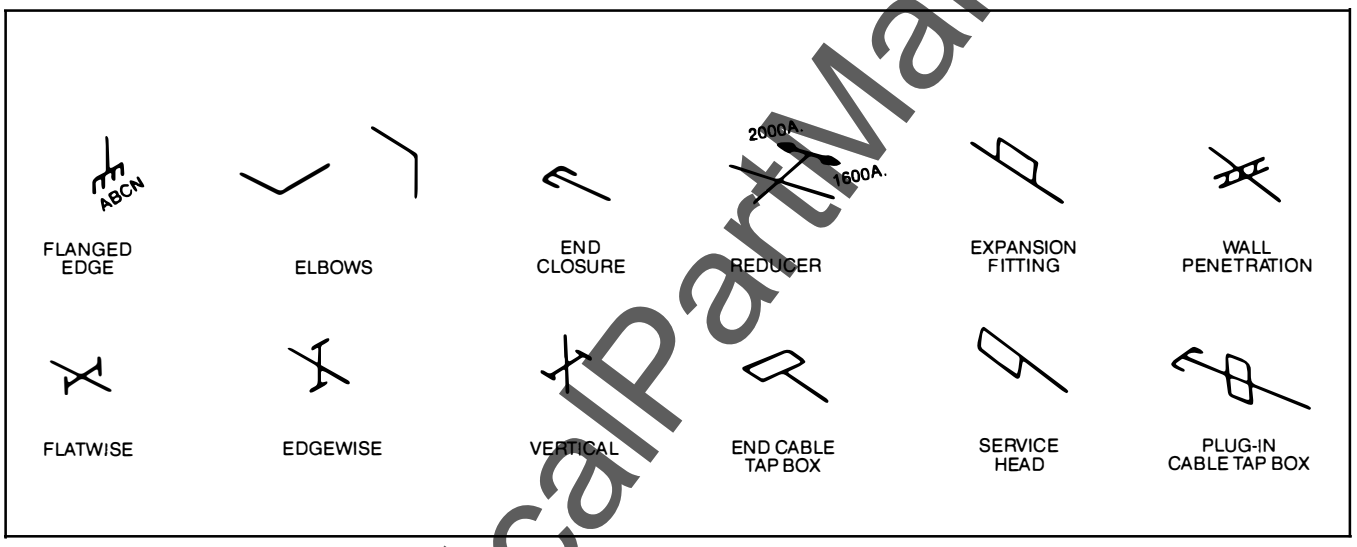


FIGURE 26 Typical symbols used when making a single line drawing.

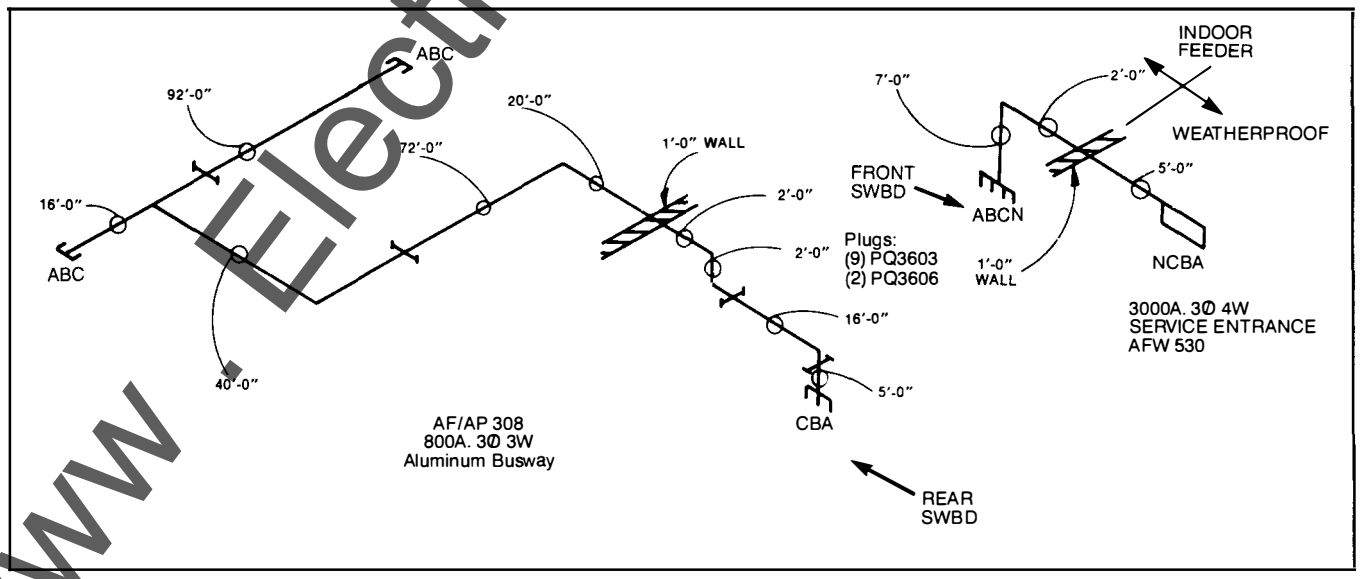


FIGURE 27 Typical single line drawings. Note that these correspond to the customer drawing on Page 19.

Busway Take-off Checklist

The following information should be obtained when performing a take-off.

I.

☐	Ampere Rating	225 Thru 5000A.
☐	Type of Busway	PLUG-IN: Std. or High Short Circuit Bracing. FEEDER: Indoor or Weatherproof, Std. or High Short Circuit Bracing.
☐	Busbar Material	Aluminum. Copper.
☐	Number of Poles	3Ø 3W., or 3Ø 4W.

II.

- ☐ Phasing shown on all switchboards, transformers and runs.
- ☐ Front or rear markings shown on switchboards and transformers.
- ☐ Location of busway runs entering switchboards and transformers.
- ☐ Complete dimensions supplied on low voltage section of transformers.
- ☐ Clear indication of busway mounting positions (edgewise, flatwise or vertical).
- ☐ Location of walls and thicknesses.
- ☐ Quantity of wall flanges needed.
- ☐ Location of all fittings such as elbows, cable tap boxes, expansion joints, tees and reducers.

III. Risers Only

- ☐ Designation of side that plugs are to be mounted on.
- ☐ Indication of type and quantity of plugs to be supplied per floor.
- ☐ Height of plugs from floor.
- ☐ All closet dimensions supplied.
- ☐ Floor to floor height.
- ☐ Floor thickness.

Typical Pricing Format

PLUGS	
9 PQ3603G	$
2 PQ3606G	$
TOTAL	**$**
266′ AF2/AP2 308G	$
5 Elbows	$
1 Tee	$
1 Flanged end	$
2 End closures	$
TOTAL	**$**
6′ AFW2-530G	$
9′ AF2-530G	$
1 Flanged end	$
1 Service head	$
1 Elbow	$
1 Vapor barrier	$
TOTAL	**$**

Note that this sample corresponds to the customer drawing on Page 19 and the single line diagrams on Page 20.

SECTION 3
Helpful hints to layout and measure a Busway job

Laying out and measuring a busway job does not require specialized tools or skills. The following list of tools should handle all applications:

100′ tape measure	plumb bob/chalk line
25′ × 1″ tape measure	felt tip marker or
6′ wood rule	crayon

Let's assume you want to feed a new Motor Control Center (MCC) with busway from a new distribution switchboard. Using illustrations, we'll go step-by-step through the layout process to determine the busway orientation and dimensions. When completed, we will have a single line isometric drawing showing the proposed busway layout.

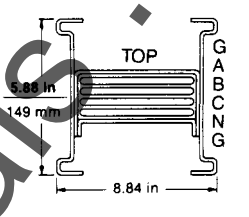
Known Information

From the bid documents, specifications, and/or factory drawings the following information is known:

- Busway is to be 1600A., 3Ø - 4W 50% GND aluminum feeder busway (Width is determined to be 8.84″).
- Switchboard (SWBD) is 7′-7½″ High, 3′-0″ Wide, 2′-0″ Deep, busway connection to be in top center.
- Motor Control Center is 7′-7½″ High with a 1′-0″ additional height pull box for busway connection. 20″ Wide, 20″ Deep busway connection in top center.
- Bottom of busway (B.O.B.) to be installed 16′-0″ above finished floor (AFF) unless obstructed.

How to Begin

1 Determine the physical size of the busway housing. This information let's you know how far to stay away from obstructions. In our example, the busway is 8.84″ Wide and 5.88″ High (9×6 Nominal).



2 Review the area where the busway could be installed (if not already specified). Note any special conditions such as: building expansion joints, steel changes, HVAC equipment, plumbing lines, etc.

3 All dimensions should be measured from fixed points such as: columns, walls, or other building structures. Try to leave a minimum of 4″ between the busway and any obstructions.

* A sketch (Figure 28 Page 23) showing the SWBD and MCC location, the obstructions, and the dimensions to fixed points is very helpful.

4 If the busway originates from a SWBD, start dimensional layout from the fixed end.

Sketch the proposed busway routing making notes about elevations and obstructions (see Figure 29 Page 23).

5 Unless specified, for most industrial applications the busway should be run above the bottom chord of the building steel. This will protect the busway from damage by fork-lifts or other equipment. Also keep in mind that busway must be supported by drop rods or from below. Do not route busway where it cannot be supported.

6 When selecting the elevation for plug-in busway remember that the overcurrent devices (plug-in units) require different mounting clearances.

Going back to the sample busway layout (Figure 29), enough information is known to tabulate the amount of busway footage needed and the required fittings (i.e. flanged ends, elbows, etc.) The sketch, Figure 29, could be given to the local Square D representative for pricing and forwarded on to the factory for record or approval drawings and returned to the customer.

Figure 30 on Page 24 represents a typical dimensioned one-line drawing from which one could confirm the busway dimensions and the busway routing.

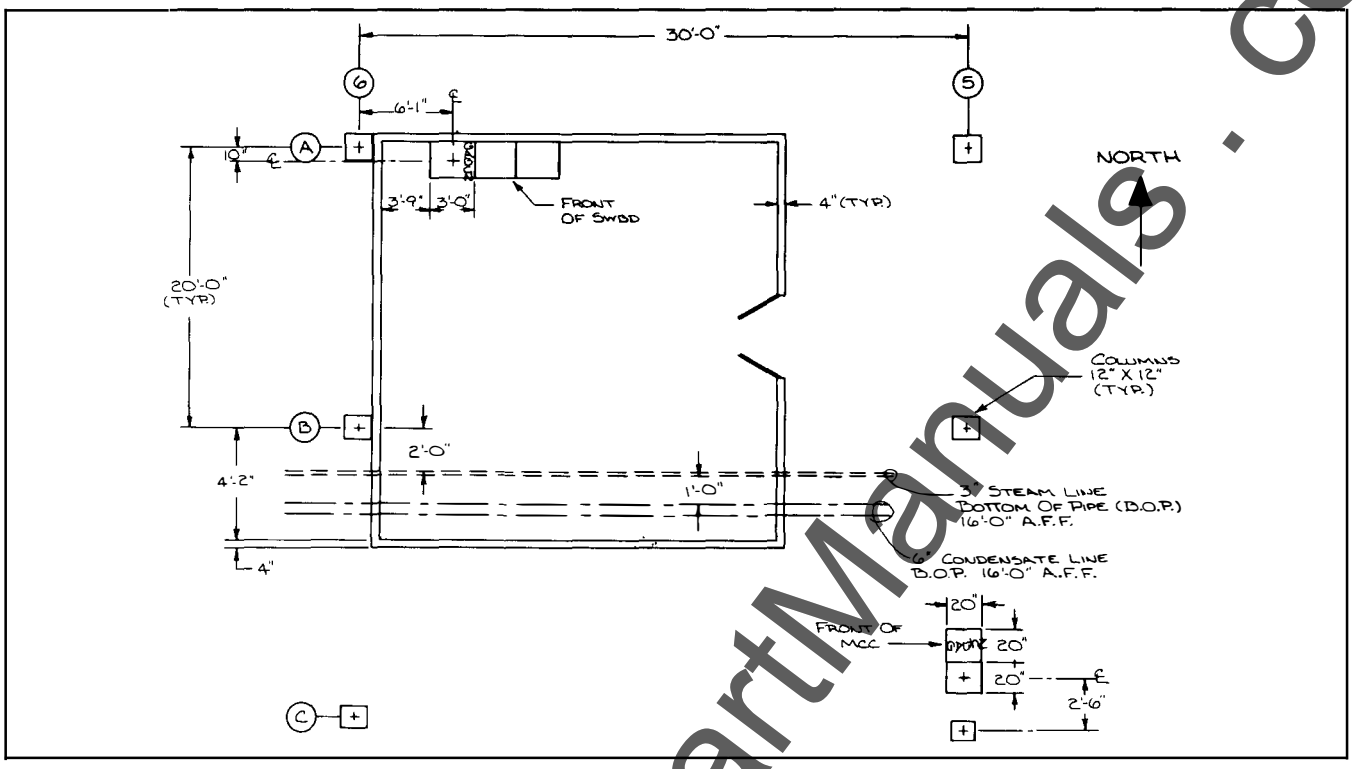


FIGURE 28 Plan View of SWBD, MCC and Obstructions.

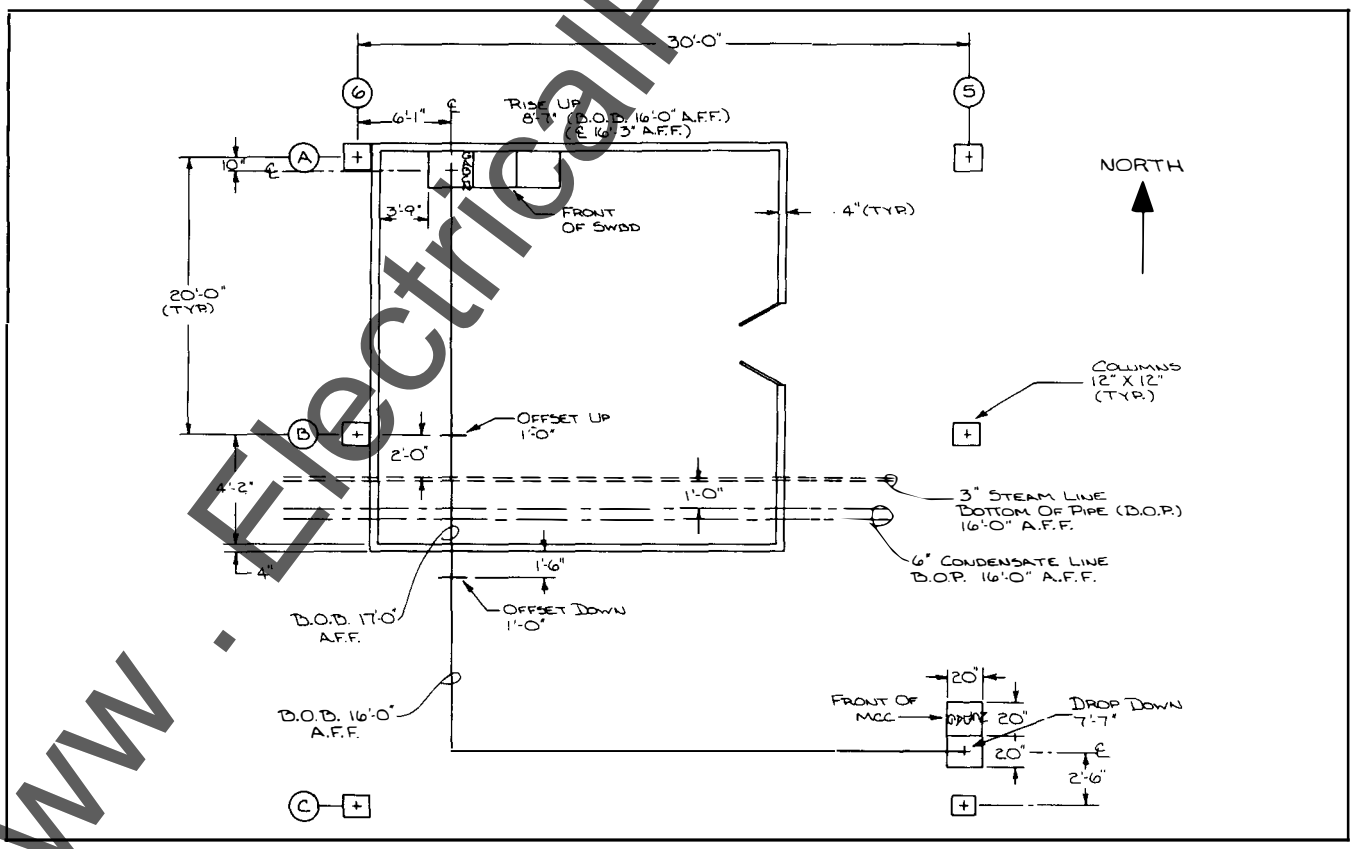


FIGURE 29 Proposed Busway Layout.

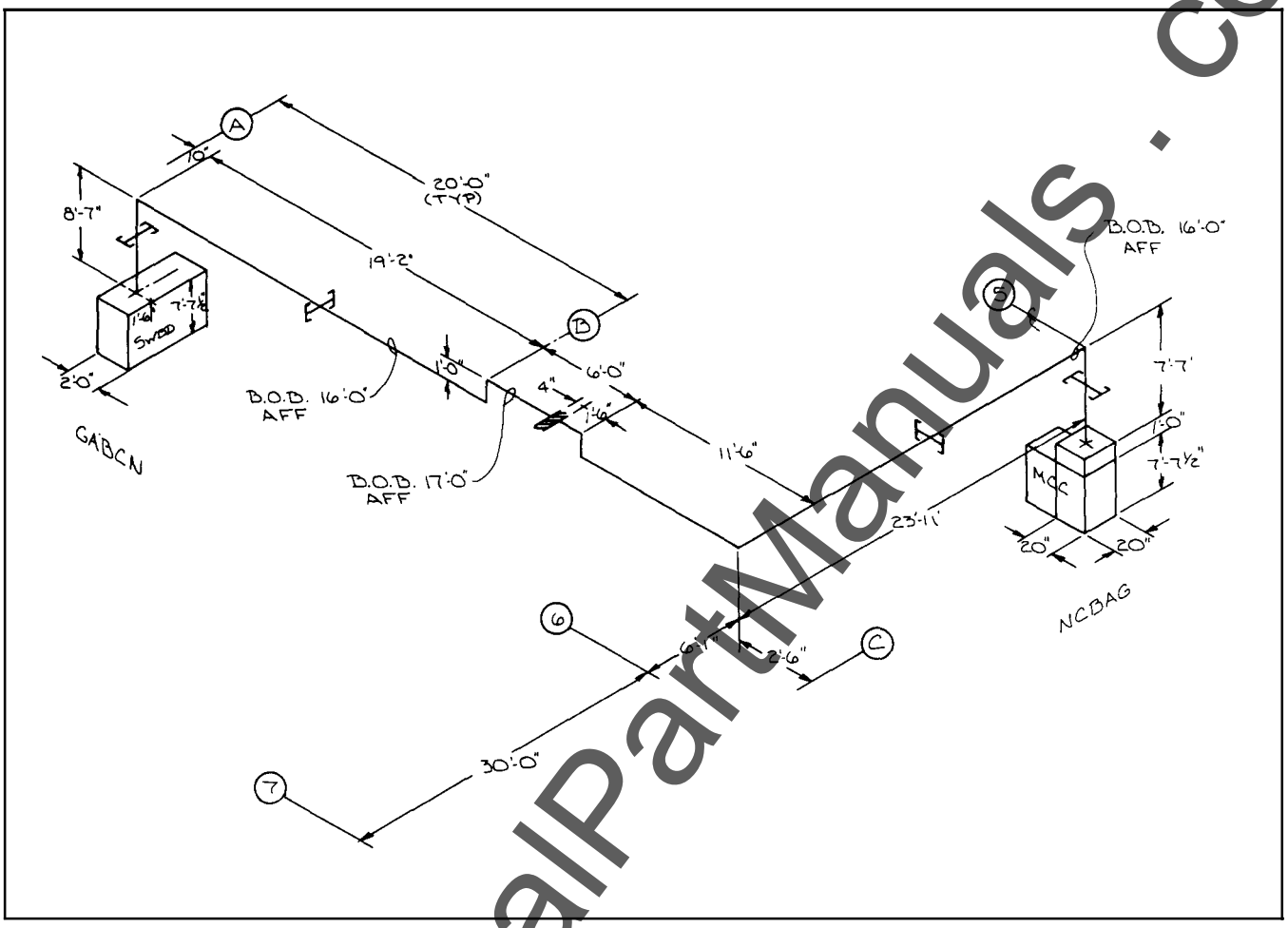


FIGURE 30 Single Line Drawing of Completed Busway Layout.

Busway riser applications (apartments, high-rise office, condo, etc.) are easier to layout and measure. Once the busway is brought over to the electrical closet or floor penetration area, generally the busway is routed straight up.

The dimensions needed for riser applications were discussed under the "Plug-In Riser" section, Page 14.

SECTION 4
Preparing to install I-LINE II Busway

To make the busway installation proceed as quickly and efficiently as possible, a few preliminary steps should be taken.

1 Familiarize yourself with the busway routing. If record drawings were supplied by the factory, have a copy accessible to the installers.

2 Inspect busway for damage when received. Store busway in a clean, dry location.

3 Carefully read the installation instructions for all devices before the actual installation. Note the instructions call for the busway to be "meggered" before and after installation.

4 Install busway hangers and supports. The most common method of supporting the busway hangers is threaded drop rods (or all thread) which the installer must supply.

5 Anticipate the weight of the objects being installed so the necessary lifting devices and manpower are available.

6 Have the following recommended tools available for the busway installation:

a ½" nut driver or socket and rachet.

b Straight blade screwdriver.

c Torque wrench or breaker bar with ⅝" head.

d ¾" socket for torque wrench or breaker bar.

e Busway assembly tool (AT-2) for 800A.-5000A. (provided by Square D)

f Level.

g Tape measure or 6′ wood rule.

h Busway insulation tester. ("Megger," 1000V. recommended).

7 If any problems are encountered or questions arise, contact a Square D representative.

SECTION 5
Physical Data

The following tables are self-explanatory and provide useful information when installing and selecting I-LINE II busway.

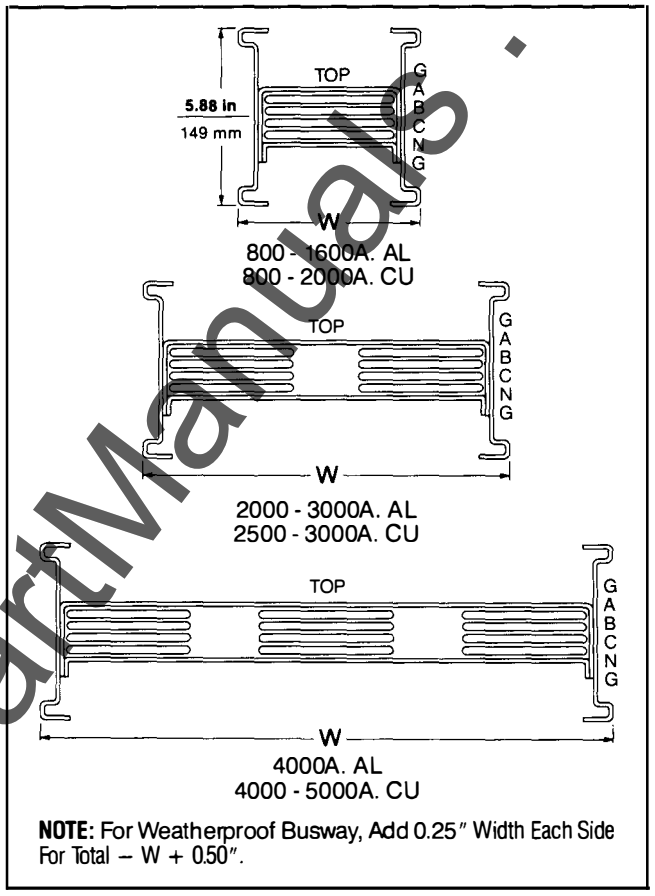


FIGURE 31

Table 1 Cross-Sections, Short Circuit Rating, Weights

ALUMINUM BUSWAY

Ampere Rating	Width "W" mm	Width "W" in	Bus Bars Per Phase mm	mm	Bus Bars Per Phase in	in	Short Circuit Rating - Amperes AF2	AP2	AFH2,AFW2	APH2	Weights - Feeder 3-Pole Lbs/Ft	3-Pole KG/M	4-Pole Lbs/Ft	4-Pole KG/M	Weights - Plug-In 3-Pole Lbs/Ft	3-Pole KG/M	4-Pole Lbs/Ft	4-Pole KG/M
800	**110**	4.34	One	**6 × 76**	One	.25 × 3.0	50,000	50,000	85,000	75,000	9.1	13.5	10.0	14.9	11.2	16.7	12.1	18.0
1000	**136**	5.34	One	**6 × 102**	One	.25 × 4.0	50,000	50,000	100,000	100,000	10.1	15.0	11.3	16.8	12.2	18.2	13.4	19.9
1200	**161**	6.34	One	**6 × 127**	One	.25 × 5.0	50,000	50,000	100,000	100,000	11.1	16 5	12.5	18.6	13.2	19.6	14.6	21.7
1350	**186**	7.34	One	**6 × 152**	One	.25 × 6.0	50,000	50,000	100,000	100,000	12.1	18.0	13.8	20.5	14.2	21.1	15.9	23.7
1600	**225**	8.84	One	**6 × 191**	One	.25 × 7.5	50,000	50,000	100,000	100,000	13.8	20 5	15 8	23.5	15 9	23.7	17.9	26.6
2000	**323**	12.72	Two	**1 × 114**	Two	.25 × 4.5	100,000	125,000	150,000	150,000	19.1	28.4	22 5	33.5	21.1	31 5	24.6	36.6
2500	**412**	16.22	Two	**6 × 152**	Two	.25 × 6.0	100,000	125,000	150,000	150,000	22.1	32.9	26.7	39.7	24.2	36.0	26.8	39.9
3000	**475**	18.72	Two	**6 × 191**	Two	.25 × 7.5	100,000	125,000	150,000	150,000	25.1	37 3	30.6	45.5	27.2	40 5	32.7	49.7
4000	**650**	25.60	Three	**6 × 165**	Three	.25 × 6.5	150,000	200,000	200,000	–	33.9	50.4	40.4	60.1	36.0	53 6	42.5	63.2

COPPER BUSWAY

Ampere Rating	Width "W" mm	Width "W" in	Bus Bars Per Phase mm	mm	Bus Bars Per Phase in	in	Short Circuit Rating - Amperes CF2	CP2	CFH2,CFW2	CPH2	Weights - Feeder 3-Pole Lbs/Ft	3-Pole KG/M	4-Pole Lbs/Ft	4-Pole KG/M	Weights - Plug-In 3-Pole Lbs/Ft	3-Pole KG/M	4-Pole Lbs/Ft	4-Pole KG/M
800	**98**	3.84	One	**6 × 64**	One	.25 × 2.5	50,000	50,000	85,000	75,000	12 1	18.0	14 6	21.7	14.2	21.1	16.7	24.8
1000	**110**	4.34	One	**6 × 76**	One	.25 × 3.0	50,000	50,000	85,000	75,000	13 8	20.5	16.7	24.9	15 9	23.7	18.8	28.0
1200	**136**	5.84	One	**6 × 102**	One	.25 × 4.0	50,000	50,000	100,000	100,000	16.8	25.0	20.8	31.0	18.9	28.1	22.9	34.1
1350	**148**	5.84	One	**6 × 114**	One	.25 × 4.5	50,000	50,000	100,000	100,000	18.3	27.2	22 8	33.9	20.4	30.4	24.9	37.1
1600	**171**	6.74	One	**6 × 137**	One	.25 × 5.4	50,000	50,000	100,000	100,000	21.1	31.4	27 5	40.9	23 2	34.5	29.6	44.0
2000	**199**	7.84	One	**6 × 165**	One	.25 × 6.5	50,000	50,000	100,000	100,000	24.3	36.2	30.8	45.8	26.4	39.3	32.9	49.0
2500	**323**	12.72	Two	**6 × 114**	Two	.25 × 4.5	100,000	125,000	150,000	150,000	38.7	57.6	47.7	71.0	40 8	60.7	49.8	74.1
3000	**387**	15.22	Two	**6 × 127**	Two	.25 × 5.0	100,000	125,000	150,000	150,000	42.7	63.5	51.7	76.9	43.8	65.2	53.8	80.1
4000	**599**	23.60	Three	**6 × 114**	Three	.25 × 4.5	150,000	200,000	200,000	–	59.1	87.9	72.6	108.0	61.2	91.1	74.7	111.2
5000	**638**	25.10	Three	**6 × 152**	Three	.25 × 6.0	150,000	200,000	200,000	–	72.6	108.0	90 6	134.8	74.7	111.2	92.7	137.9

Table 2 Required Wall Openings

Ampere Rating		Straight Length		Flanged End		Flatwise Elbow							Edgewise Elbow						
							Wall Thickness (in.)							Wall Thickness (in.)					
Aluminum	Copper						4	8	12	16	20	24		4	8	12	16	20	24
		Y	W	Y	W	W	Y						Y	W					
	800	6		10	15		9	11	13	15	17	19	6						
800	1000	6		10	15		10	12	14	16	18	20	7						
1000	1200	7		11	15		12	14	16	18	20	22	7						
	1350	8		12	15		12	14	16	18	20	22	8						
1200		8		13	15		13	15	17	19	21	23	8						
1350	1600	9		14	15		14	16	18	20	22	24	9						
	2000	10		17	21		15	17	19	21	23	25	10						
1600		11		17	21		17	19	21	23	25	27	11						
			8			8								12	14	16	18	20	22
2000	2500	15		19	21		22	24	26	28	30	32	15						
	3000	17		23	21		26	28	30	32	34	36	17						
2500		18		23	21		27	29	31	33	35	37	18						
3000		21		26	21		31	33	35	37	39	41	21						
	4000	26		32	21		37	39	41	43	45	47	26						
	5000	27		32	21		40	42	44	46	48	50	27						
4000		28		32	21		40	42	44	46	48	50	28						

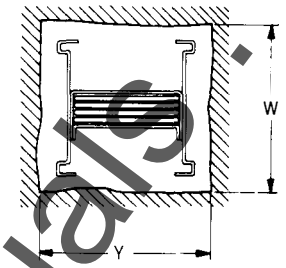
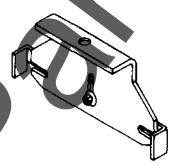
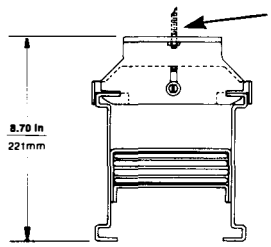


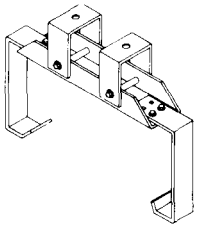
Table 3a Flatwise Hangers

Ampere Rating		Catalog Number
Aluminum	Copper	
	800	HF-38-F
800	1000	HF-43-F
1000	1200	HF-53-F
	1350	HF-58-F
1200		HF-63-F
	1600	HF-67-F
1350		HF-73-F
	2000	HF-78-F
1600		HF-88-F

Ampere Rating		A		Catalog Number
Aluminum	Copper	in	mm	
2000	2500	4.42	112	HF-13-F
	3000	6.92	176	HF-15-F
2500		7.82	201	HF-16-F
3000		10.12	257	HF-19-F
	4000	15.30	386	HF-24-F
	5000	16.80	427	HF-25-F
4000		17.30	439	HF-28-F







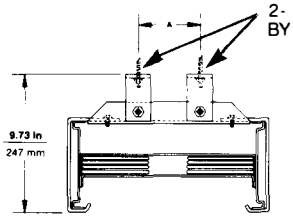
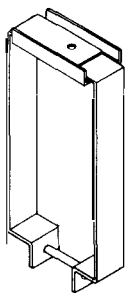
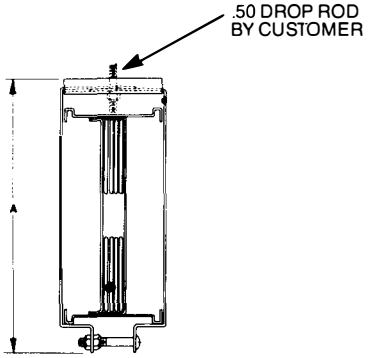


Table 3b Edgewise Hangers

Ampere Rating		A		Catalog Number
Aluminum	Copper	in	mm	
800	800	8.36	212	HF-43-E
	1000	8.36	212	HF-43-E
1000	1200	9.86	250	HF-58-E
	1350	9.86	250	HF-58-E
1200	1600	10.86	276	HF-57-E
1350	2000	11.86	301	HF-78-E
1600		13.86	339	HF-88-E
2000	2500	17.24	438	HF-13-E
	3000	19.74	501	HF-15-E
2500		20.74	527	HF-16-E
3000		24.12	613	HF-19-E
	4000	28.12	714	HF-24-E
4000	5000	29.62	752	HF-26-E





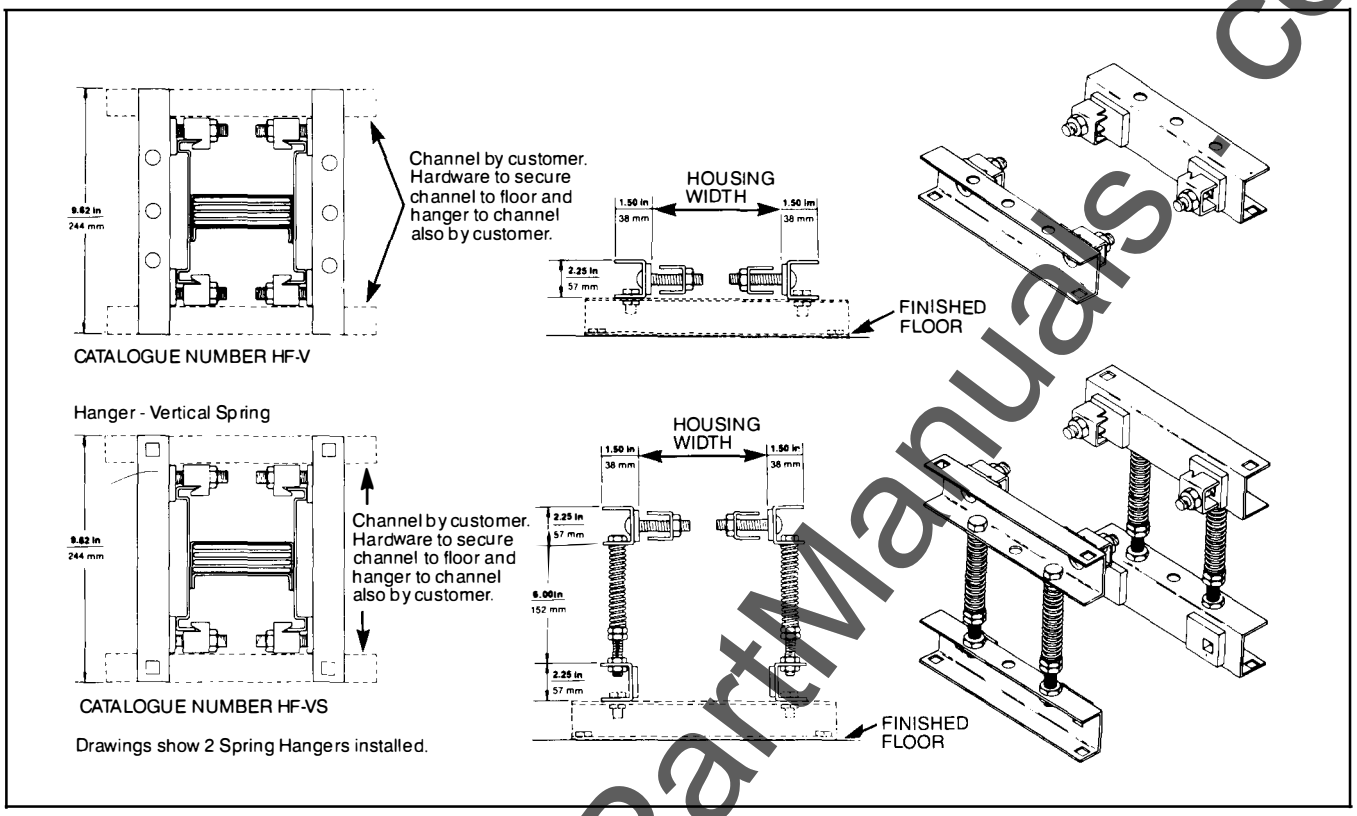


FIGURE 32 Vertical Hangers

Voltage Drop

I-LINE II Busway voltage drop is low. This helps to maintain a stable voltage supply to delicate electronic and computer equipment. Even at low power factors, the extremely low reactance of I-LINE II Busway helps to minimize the instantaneous voltage dips which can be caused by motor starting inrush currents, etc.

The voltage drop values shown below are based on a single, concentrated load at the end of the busway run. For distributed loading, multiply values shown by 0.5.

Table 4: I-LINE II Busway Voltage Drop

Ampere Rating	Aluminum Busway		Copper Busway	
	R	X_{60}	R	X_{60}
800	2.21	.88	1.47	1.04
1000	1.66	.69	1.22	.88
1200	1.35	.60	.95	.69
1350	1.12	.48	.83	.63
1600	.92	.38	.70	.54
2000	.76	.32	.58	.44
2500	.58	.23	.42	.32
3000	.46	.18	.38	.30
4000	.37	.17	.28	.20
5000	–	–	.22	.17

60 Hz Impedance Values – Line-to-Neutral
Milliohms per 100 Feet ($10^{-3}\Omega$/100 ft.)

Table 5: 60 Hz Voltage Drop – Average, 3-Phase, Line-to-Line Volts per 100 Feet at Rated Load (V/100 ft.)

Ampere Rating	Power Factor – Aluminum Busway							Power Factor – Copper Busway						
	100	95	90	85	80	75	70	100	95	90	85	80	75	70
800	3.06	3.29	3.29	3.25	3.18	3.10	3.01	2.04	2.39	2.46	2.49	2.49	2.48	2.46
1000	2.88	3.11	3.11	3.07	3.02	2.95	2.87	2.11	2.48	2.57	2.60	2.61	2.59	2.57
1200	2.81	3.06	3.07	3.04	2.99	2.93	2.86	1.98	2.32	2.40	2.43	2.44	2.43	2.41
1350	2.62	2.84	2.85	2.82	2.77	2.71	2.64	1.94	2.30	2.39	2.43	2.44	2.43	2.41
1600	2.56	2.75	2.75	2.72	2.67	2.61	2.54	1.94	2.31	2.40	2.44	2.45	2.45	2.43
2000	2.63	2.85	2.85	2.82	2.77	2.71	2.64	2.01	2.39	2.47	2.51	2.52	2.52	2.50
2500	2.51	2.70	2.69	2.66	2.61	2.54	2.47	1.82	2.16	2.24	2.28	2.29	2.28	2.26
3000	2.39	2.56	2.56	2.52	2.47	2.41	2.34	1.98	2.36	2.46	2.50	2.52	2.51	2.50
4000	2.56	2.80	2.82	2.80	2.76	2.70	2.64	1.94	2.28	2.35	2.40	2.38	2.37	2.35
5000	–	–	–	–	–	–	–	1.91	2.27	2.36	2.40	2.41	2.40	2.39

Notes: 1. For balanced 3-Phase, Line-to-Neutral voltage drop, multiply values from table by 0.577.

2. For other than rated current, multiply values from table by $\frac{\text{Actual Current}}{\text{Rated Current}}$

3. For different lengths, multiply values from table by $\frac{\text{Actual Footage}}{100 \text{ ft.}}$

SECTION 6
I-LINE II Busway Plug-in Units Application Data

When the professional selects fusible or circuit breaker plug-in units to tap power from the I-LINE II Plug-in Busway, care must be taken to ensure that proper mounting clearances are maintained.

The diagram and tables list required clearances for Square D plug-in units. Care should also be taken to meet the clearance requirements of the governing Electrical Code.

More detailed information about the individual plug-in units can be obtained from your local Square D representative.

Table 6A: Plug-in unit mounting clearances

Fusible Switch		A		B		C	
Cat. No. Prefix	Ampere Rating	in	mm	in	mm	in	mm
PQ	30	20.13	511	2.25	57	10.00	254
	60	21.88	556	2.25	57	10.00	254
	100	25.63	651	4.00	101	12.00	305
	200	27.50	699	15.00	381	15.00	381
PS	200	27.50	699	9.00	229	12.00	305
PBQ	400	53.65	1363	7.00	178	17.00	432
PBQ	600	60.00	1524	7.25	184	18.00	457
PTQ	800	53.90	1369	8.75	222	18.00	457
	1000	53.90	1369	8.75	222	18.00	457
	1200	52.45	1332	10.25	260	24.00	610
	1600	52.45	1332	10.25	260	24.00	610

Table 6b:

Circuit Breaker		A		B		C	
Cat. No. Prefix	Ampere Rating	in	mm	in	mm	in	mm
PFA, PFH	15-100	20.87	530	2.12	54	10.00	254
PIF	15-100	25.63	651	2.38	73	11.00	279
PKA, PKH	125-225	25.63	651	2.38	80	11.00	279
PIK	125-225	25.63	651	2.38	80	11.00	274
PBLA,PBLH	250-400	35.69	906	5.82	142	15.00	381
PBIL	250-400	35.00	889	8.00	203	20.00	508
PBMA,PBMH	500-600	35.00	889	5.20	132	18.00	457
PTMA,PTMH	700-1000	35.20	894	6.25	159	18.00	406
PTPA,PTPH	1000-1600	52.45	1332	10.25	280	24.00	610

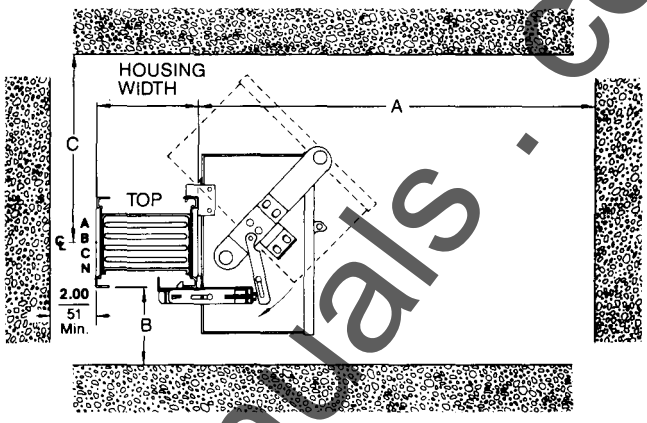


FIGURE 33: Plug-in unit mounting clearances

Vertical Mounting

Fusible switch plug-in units 400A.-600A. mount on busway in the position shown in Figure 34, so that switch blades open downward to comply with the C.E.C. (14.502) and the N.E.C. (380.6). In this position the operating handle is located on the front of the unit and the door opens downward. Operating handle of 200A. type "PS" unit is on right hand side of unit and door opens sidewards.

Circuit breaker plug-in units and all except 400A.-600A. fusible units can be mounted in the position shown with the handle on top (500A.-1600A. are front cover operated) and the door opening downward or on the opposite side of the busway with the handle on the bottom and the door opening upward.

IMPORTANT: Orientation of the busway is essential for proper mounting of 400A - 600A plug-in units. The busway must be positioned as shown in Figure 34 so that the top marking is to the right and the neutral position is to the left.

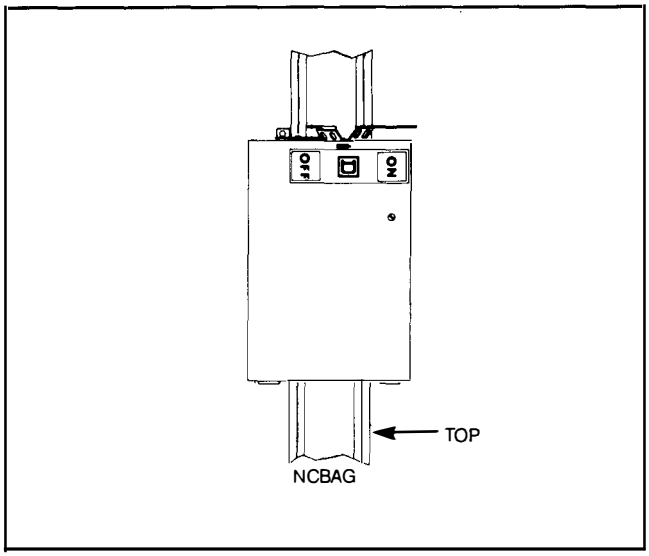


FIGURE 34

CONCLUSION

It is not possible to compress years of knowledge and experience into a small handbook which will allow you, the professional, to handle every situation that arises. If there are particular areas where you need additional information, there is a network of Square D personnel available to answer all your questions.

A properly designed and installed power distribution system utilizing Square D I-LINE II Busway, will provide years of reliable power distribution.

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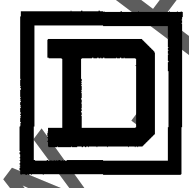

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