

## **bus duct manual**

Attached you will find the first three issues of the new Bus Duct Manual. This manual will be divided into several sections each section pertaining to a specific line of bus duct complete with all of the dimensions, voltage drop curves, and characteristics. There is a general application section that applies to all types of busway systems. These sections completely supersede AD 30-660, pages 24 through 80. In the near future, you will receive new sections of this manual covering High Frequency bus duct and the new Electric Utility bus duct. For the time being, please retain the section AD 30-660 pages 1 through 23 for reference to the Life-Line Busway.

We feel that this new form will greatly increase the information that we will be able to put into your hands because as new developments become available, we can immediately get the information to you without having to wait for a complete new revision of the manual.

### **3 new application data sections**

general information: AD 30-660  
plug-in bus duct: AD 30-661  
low impedance bus duct: AD 30-662



## **BUYING DATA**

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mailed to: E/250/AD,DB; D63-3,5D; C26-3,5G



# bus duct

## copper and aluminum bus bars

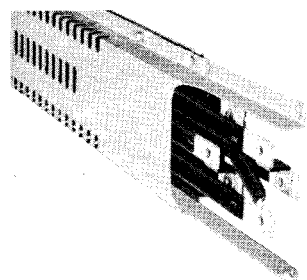
application, features, dimensions

application  
data

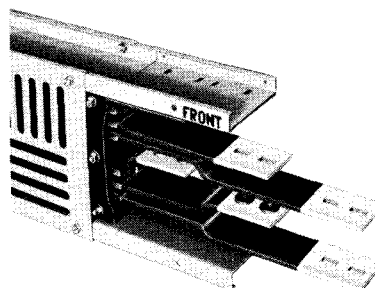
**30-660**

page 1

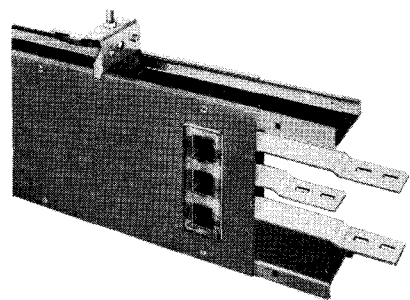
**Life-Line Busway**



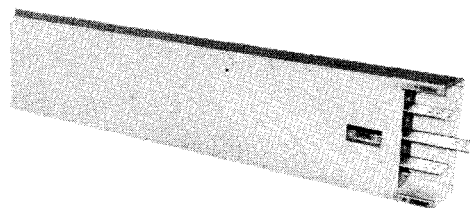
**low impedance**



**plug-in**



**conventional waterproof**



These four types of Westinghouse bus duct meet all the needs of secondary power distribution systems. The descriptions, drawings, dimensions, specifications, engineering and test data in this publication give the specific information needed to layout, specify and install them.

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July, 1957

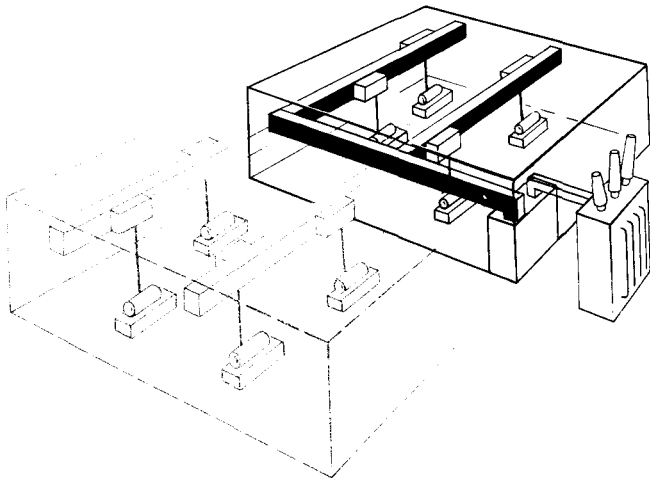
new information

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### flexibility and salvability

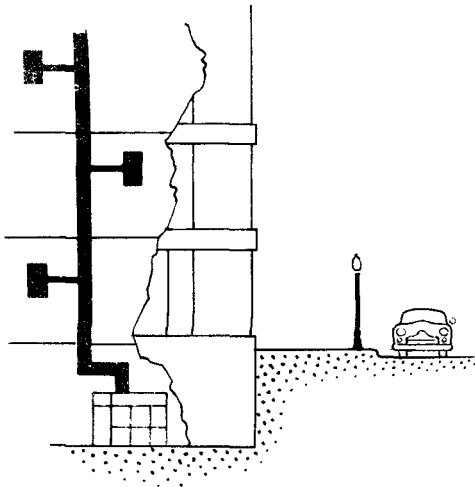
Westinghouse bus duct can be installed easily in any layout, around any obstruction. It is fully salvageable. When building alterations or expansion add to power load it can be simply dismantled, rearranged or expanded.



### reliability, safety and long life

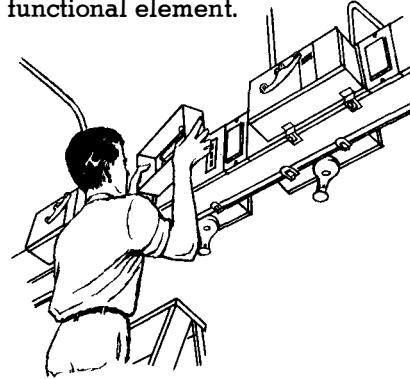
Westinghouse bus duct reduces the hazards of breakdowns due to overloads, overheating and damaged insulation—hazards which cause expensive schedule disruptions and production delays. Insulated plug-in openings, air insulation and, with Life-Line Busway, safety slide plug-in openings give workers and management an added safety margin.

### typical cost comparison



### convenience and modern appearance

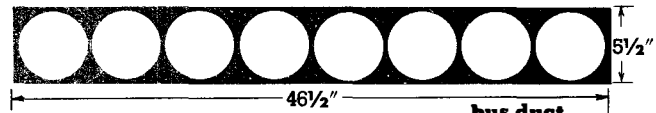
Bus duct brings power directly to the power consuming equipment and power can be taken off at one foot intervals. This cuts down time to a minimum when relocating or adding machinery. Smart and modern in appearance, Westinghouse bus duct blends easily into interior design and becomes a decorative as well as functional element.



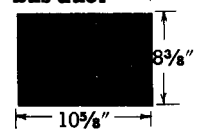
### more available capacity in less space

Up to 5000 amperes, Westinghouse bus duct has greater carrying capacity, pound for pound, and packs more power in less space than any other secondary power distribution equipment.

#### cable and conduit



To carry a 3000 amp load by cable, 8 conduits are required. Total area occupied—255 square inches. Bus duct carries same load in only 90 square inches—a space saving of more than one square foot.

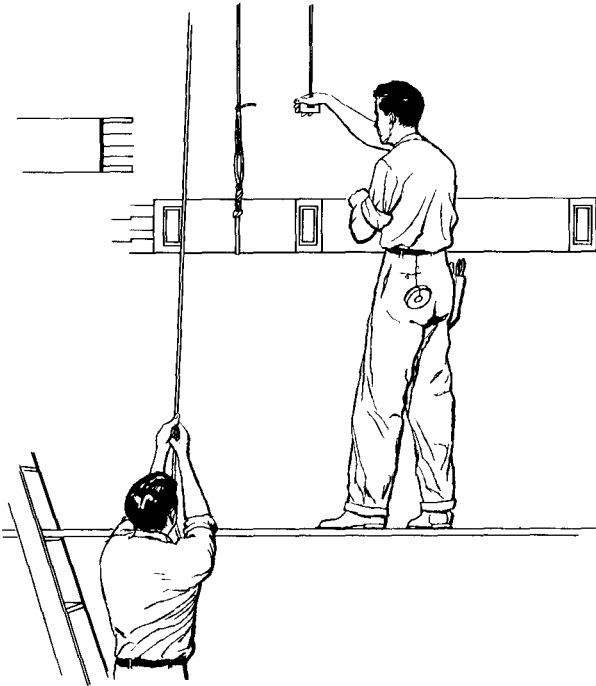


A detailed cost comparison was made between the use of bus duct and conduit and cable in a typical west coast department store. The results of this study are shown in graph form at the right. Even though the initial cost of bus duct was somewhat greater than of conduit and cable, labor and miscellaneous material savings more than offset this and brought the installed cost of bus duct well below that of conduit and cable.

In addition to the cost advantage, bus duct was installed in a smaller cross sectional area. This gave the customer more power in a given area, at a lower voltage drop and resulted in better voltage regulation. These and the other advantages listed for bus duct—better appearance, 100% reusability, speed of installation, a completely pre-engineered system, non deteriorating insulation and easily accessible joints for power take-off—made bus duct by far the best investment in secondary power distribution equipment.

### **ease of installation**

To install prefabricated Westinghouse bus duct workers just bolt each section together. Simple cantilever and clamp-on hangers require no special tools, can be installed in minutes. "C" type and special hangers are available to meet different field conditions.



### **economy**

Bus duct costs **less** to install, **less** to maintain. And, it costs **less** to add to bus duct or change it to meet future needs.

#### **material cost**

conduit and cable

bus duct

#### **labor-man hours**

conduit and cable

bus duct

#### **cost of complete job**

conduit and cable

bus duct

Design features of the various types of Westinghouse bus duct are covered in detail in each section under the heading "general information". The following features apply to all types.

### **meets all accepted standards**

Westinghouse bus duct meets all Underwriters' Laboratories, Inc. requirements and is built in accordance with NEMA standards.

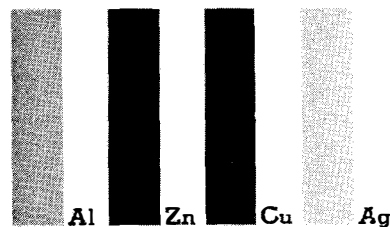


### **Bonderized after fabrication**

All Westinghouse bus duct housings including plug-ins and fittings receive this highly effective, anti-corrosive treatment. They are bonderized after fabrication to assure against rusting at bare spots and raw edges.

### **unmatched bus bar plating process**

To insure high conductivity and low heat rise, bus bars are heavily silver plated by an exclusive electrolytic process at joints and other contact surfaces. Prior to receiving their thick deposit of silver, aluminum bars go through 11 separate washing and plating steps including . . . alkaline etch with sodium hydroxide to remove insulating film of aluminum oxide . . . zinc plating and copper plating to eliminate the electrolytic action of dissimilar aluminum and silver. Copper bus bars are silver plated so that copper and aluminum bars can be joined and plug-in devices used with either type bar without danger of electrolysis.



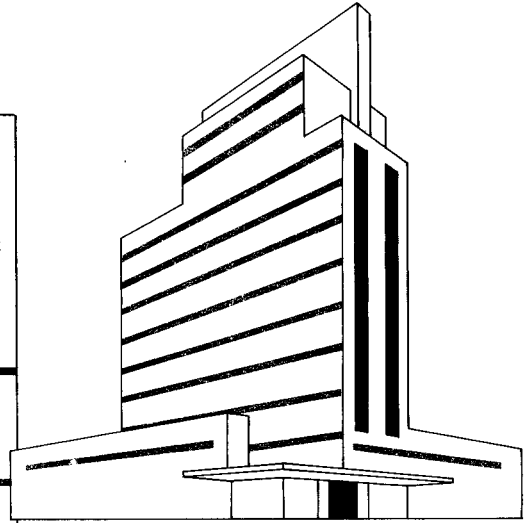
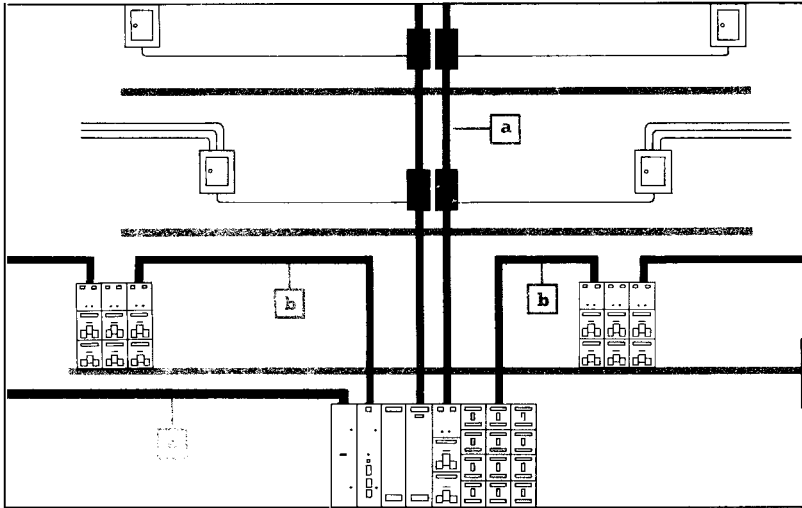
### **excellent insulators**

Insulators used to support bus bars and, in plug-in duct, to provide plug-in outlets are the finest available. Westinghouse cold-molded insulators are unaffected by heat and age, impervious to moisture. They are non-carbonizing, possess high dielectric strength and resist thermal and mechanical shock.



## Application

### commercial and institutional buildings



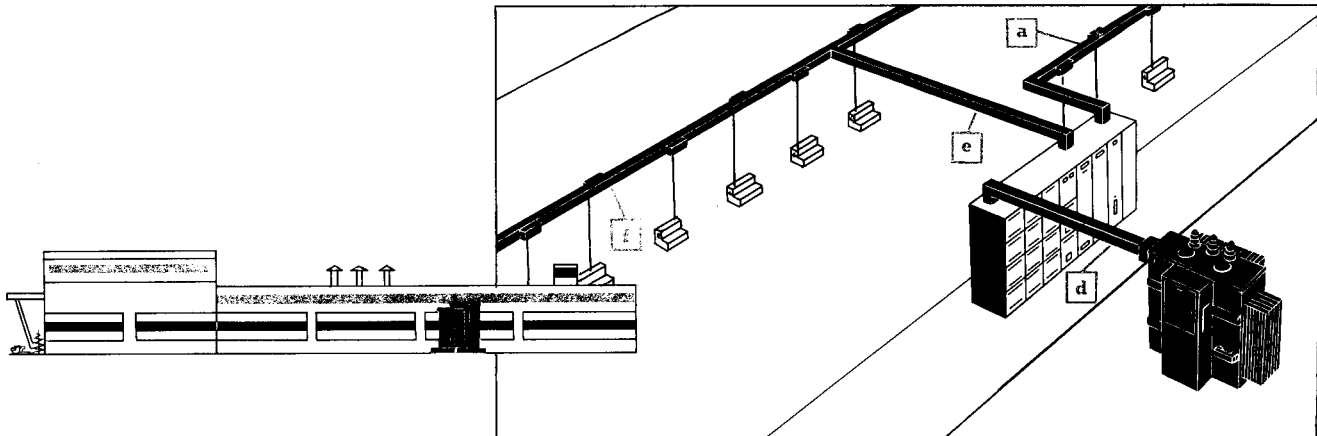
In the typical commercial or institutional building shown above . . .

**a** Life-Line Busway risers distribute power from switchgear in basement to top floor. Power take-off devices feed power to panelboards on each floor . . .

**b** low impedance bus duct carries current from switchgear to power centers located to serve main areas of power consumption and . . .

**c** conventional weatherproof duct brings power from outside to switchgear.

### industrial plants



The industrial plant illustrated above uses . . .

**a** Life-Line Busway, this time, taking power to machines and other electrical equipment where it provides 12 plug-in outlets every ten feet . . .

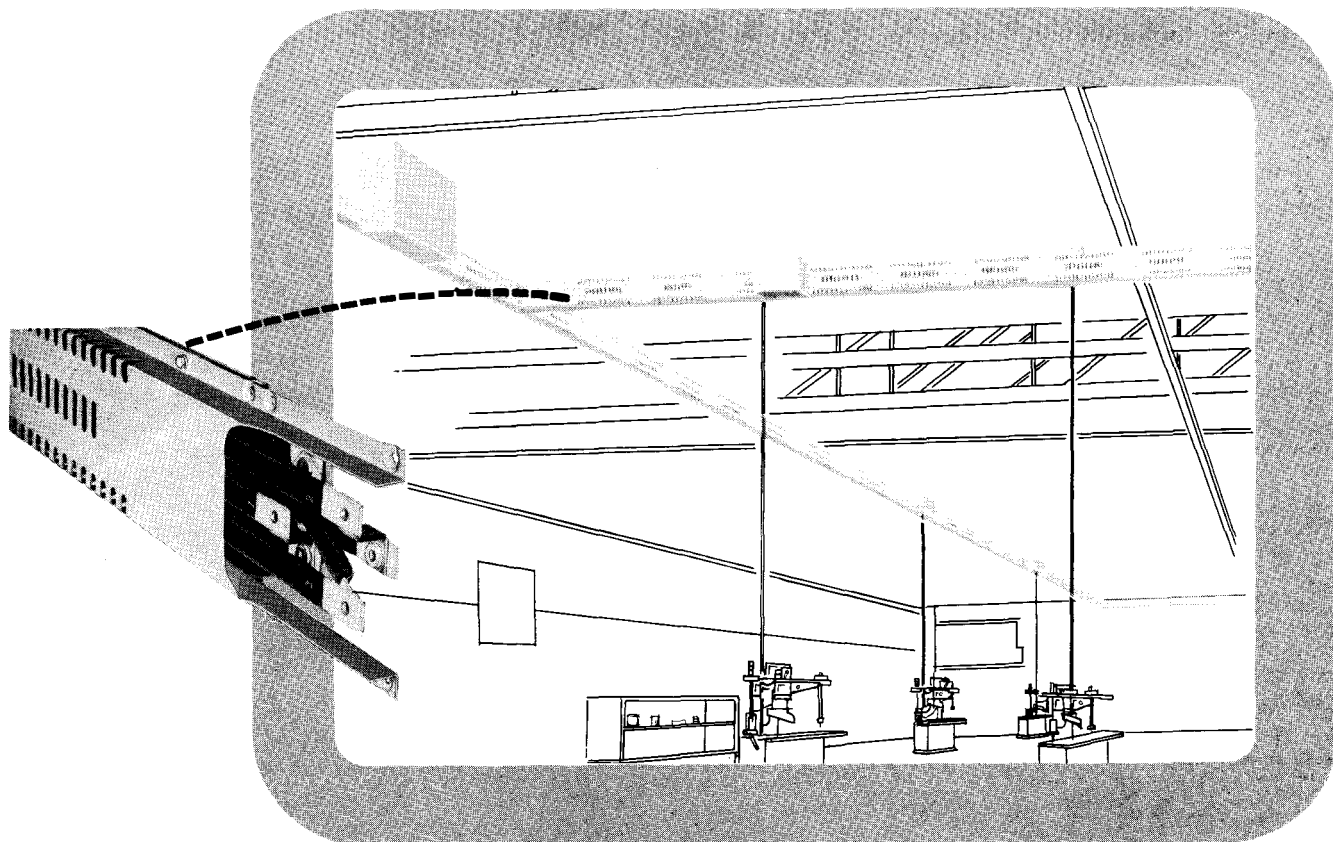
**d** weatherproof low impedance duct to carry power

from outdoor transformer to switchgear . . .

**e** ventilated low impedance for the long run without power take-offs from switchgear to . . .

**f** plug-in bus duct for distribution of current to panelboards, machine tools, welders, etc.

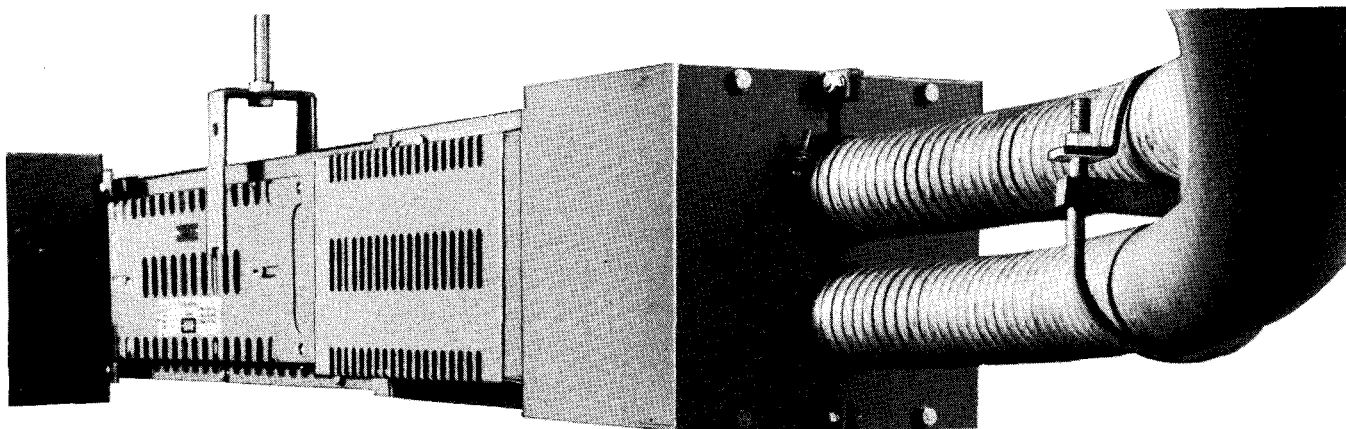
*straight lengths, flexible connectors, fittings,  
plug-in protective devices, hangers*


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## general information



## advantages

### low impedance characteristics with plug-in convenience

Life-Line Busway, available in ratings up to 1000 amperes in single runs and 4000 in multiple runs, provides 12 plug-in openings in each ten foot length, except the 225 amp rating which has six plug-in openings.

### flexibility and ease of design

The unique Life-Line Busway flexible connector can replace up to 90% of the costly custom fittings needed to build other busway systems. It simplifies field measurements and permits installation of Life-Line Busway to be started at any spot along the run. However, rigid type tees and crossovers are available for those installations where such standard fittings are desired or necessary.

### low voltage drop with high short circuit strength

Close bus bar spacing with phase collection at every joint provides low reactance and voltage drop combined with load equalized high momentary short circuit strength, up to 50,000 RMS amperes.

### light and compact

Life-Line Busway is much lighter than equivalent ratings of other busway. (Eight lbs. per foot vs. 17 lbs. per foot for 3-pole, 600 ampere plug-in duct.) This same type measures only  $3\frac{1}{8}$  by  $7\frac{3}{4}$  inches.

### safety

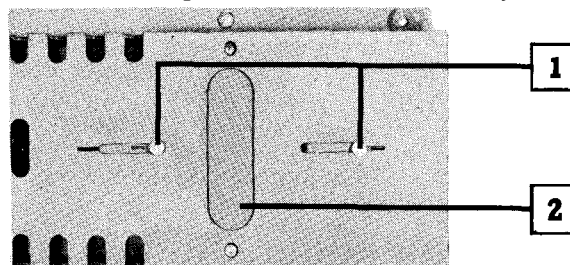
It is **impossible** to touch any live parts during installation or removal of plug-in devices. Interlocking safety slide closes plug-in openings until

plug-in is fastened to duct. Even when device is in place there are no live parts exposed when the cover is open.

Every part of the plug-in device is electrically dead, even after it has been mounted on the duct, and the safety slide may be kept closed until after the load side connection is made to assure complete safety.

Only after the cover has been closed can the primary contact operating handle be turned to the ON position. Then the secondary contact operating handle is turned ON to connect the load to the line.

Covers cannot be opened with the operating handle in the ON position and the device cannot be removed from the duct while the safety slide is open. Contacts are visible for positive assurance of safety.



1. Safety slide operators which can be moved with a screwdriver only after two interlock buttons are depressed by heavy studs located on the back of plug-in devices.

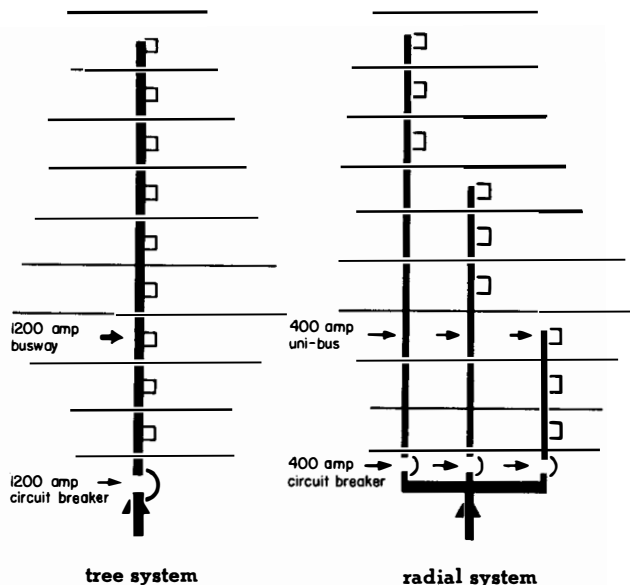
2. Heavy gauge steel safety slide which covers plug-in opening until plug-in device is locked to housing.

### ideal for radial systems

The sample lighting distribution systems shown here demonstrate the advantage of using Life-Line Busway in a radial system. It permits the use of lower cost branch circuit breakers. Provides capacity only where

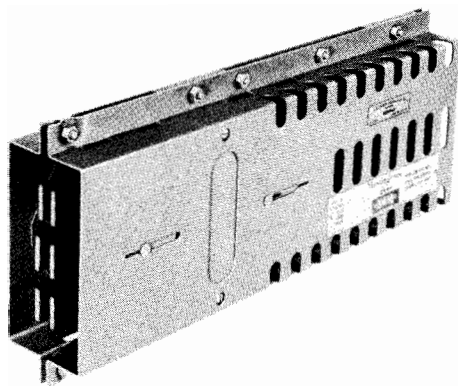
*straight lengths, flexible connectors, fittings, plug-in protective devices, hangers*

it is needed. Provides selective shutdown, and is less expensive than the high capacity busway needed in a tree system.



### construction

Life-Line Busway consists of insulated bus bars supported by molded insulators. These are enclosed in a Bonderized, ventilated steel housing.

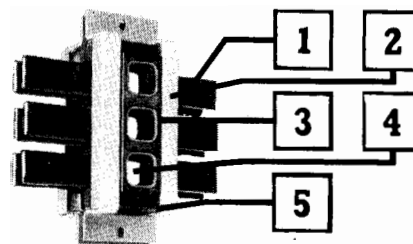


The 16-gauge steel housing is composed of two identical halves turned end-for-end and bolted together. Ventilating slots along the sides and edges of the housing and a small opening between its halves allow passage of great amounts of cooling air. Along the edge of the housing are small rectangular slots to receive plug-in unit clamps.

All ratings, except the 225 ampere, have two bars per phase, paired to reduce reactance. Each bar is wrapped with three layers of varnished cloth for its

entire length, except where the splice is made. At each plug-in opening there is an additional wrap of adhesive-back tape with a square pattern cut out to expose the side of the bus bar.

The sliding cover, or safety slide, on the inside of the enclosure is held in place by two flathead fasteners riding in grooves in the sheet metal housing. This safety slide is locked firmly in place by two spring-loaded interlock buttons.



1. bus bars wrapped in three layers of varnished tape
2. steel insulator support assembly
3. porcelain or Rosite insulator
4. exposed bare bus bar
5. corprene strips cushion bracket from insulator

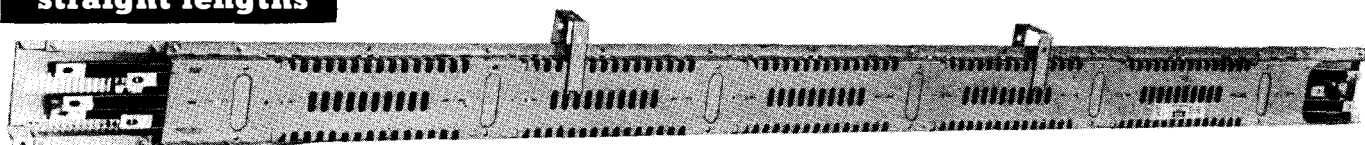
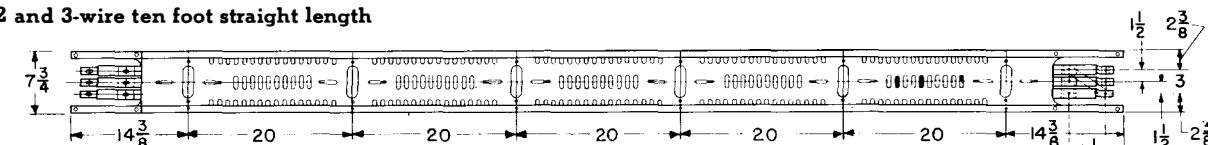
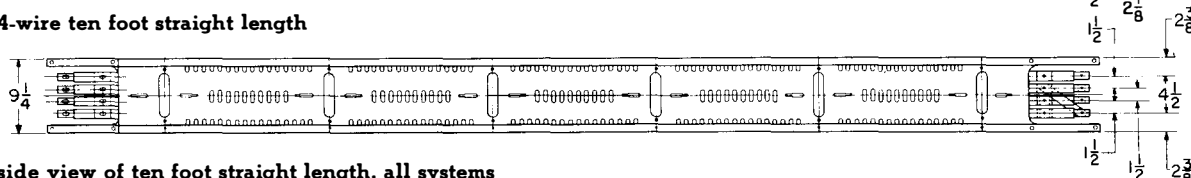
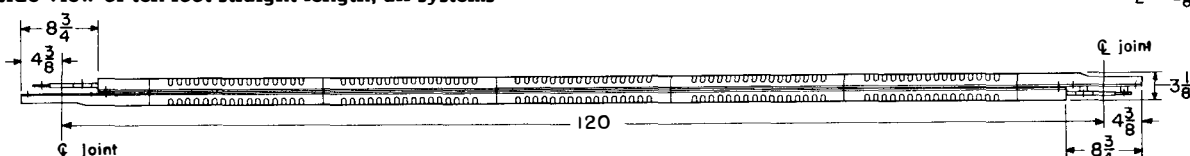
At each plug-in opening there is a pair of  $\frac{1}{8}$  inch thick steel brackets to reinforce the insulators and strengthen the bus support assembly. Corprene strips are used as a cushion between these brackets and the insulators. Standard Life-Line Busway uses insulators giving short-circuit ratings of 15,000 amperes for 225 ampere duct and 25,000 amperes for 400, 600, 800 and 1000 ampere. However, a stronger busway with a short-circuit rating of 50,000 amperes is available. It has Rosite insulators both in the plug-in openings and in special insulators without openings located midway between each plug-in.

All Life-Line Busway, in ratings from 225 up to and including 1000 amperes, is Underwriters' listed.

### assembly

Hangers are furnished for every five feet of duct, however, it is approved for mounting on ten foot spacing. Assembled sections are marked "TOP" and "FRONT". When assembling the system, the "TOP" and "FRONT" markings of adjacent sections must match. One end of each straight length has  $\frac{1}{8}$  inch thick connecting straps tying like phase bars together. Since the same phases are not in the same position on both sides of the duct, markings  $\emptyset$  1,  $\emptyset$  2 and  $\emptyset$  3 are stenciled on the bus bar insulation to aid identification.



**straight lengths****2 and 3-wire ten foot straight length****4-wire ten foot straight length****side view of ten foot straight length, all systems**

Straight sections are available in lengths of ten feet, five feet, 40, 35, 30, 25 and 20 inches, providing a margin of plus or minus  $2\frac{1}{2}$  inches in any given run. For all ratings except 225 amp, safety slide plug-in outlets are provided on 20 inch centers on both sides of the housing. They total 12 per ten foot and six per five foot length. For the 225 amp rating outlets are located on one side only and total six per ten foot and three per five foot length. There are no plug-in outlets on the 40 inch and shorter lengths.

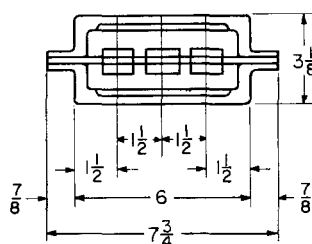
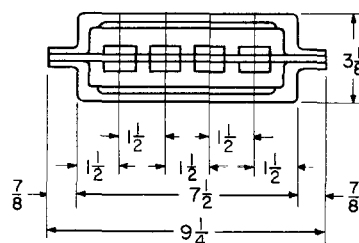
Two and 3-wire duct is designed for 600 volts maximum. Both use the same enclosure,  $7\frac{3}{4}$  inches deep. The 2-wire duct is, in all respects, identical with 3-wire except that center bus bars are omitted. Four-wire duct is designed for 277/480 volt maximum systems and the enclosure is  $9\frac{1}{4}$  inches deep. Ratings of 225 through 800 amp copper and 225 through 600 amp aluminum have housings  $3\frac{1}{8}$  inches wide while 1000 amp copper and 800 amp aluminum housings are  $3\frac{3}{8}$  inches wide.

**number and size of bus bars**

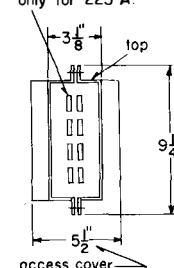
ampere rating	copper bus bar type		aluminum bus bar type	
	each pole	neutral for 4-wire half neutral type	each pole	neutral for 4-wire half neutral type
225	1— $.11 \times 1$	1— $.11 \times 1$	1— $\frac{5}{32} \times 1$	1— $\frac{5}{32} \times 1$
400	2— $.11 \times 1$	2— $.11 \times 1$	2— $\frac{5}{32} \times 1$	2— $\frac{5}{32} \times 1$
600	2— $\frac{5}{32} \times 1$	2— $.11 \times 1$	2— $\frac{1}{4} \times 1$	2— $\frac{1}{8} \times 1$
800	2— $\frac{1}{4} \times 1$	2— $\frac{1}{8} \times 1$	2— $\frac{3}{8} \times 1$	2— $\frac{3}{16} \times 1$
1000	2— $\frac{3}{8} \times 1$	2— $\frac{3}{16} \times 1$	.....	.....

**approximate net weights per foot (in lbs.)**

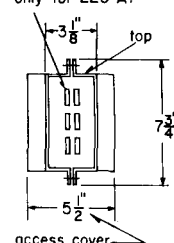
ampere rating	copper bus bar type				aluminum bus bar type			
	2-wire	3-wire	4-wire $\frac{1}{2}N$	4-wire	2-wire	3-wire	4-wire $\frac{1}{2}N$	4-wire
225	5.4	5.8	7.2	7.2	4.9	5.1	6.2	6.2
400	6.3	7.1	8.5	8.5	5.3	5.8	6.8	6.8
600	7.0	8.2	9.4	9.8	5.8	6.5	7.5	7.7
800	8.5	10.5	11.6	12.4	8.0	9.0	10.0	11.0
1000	12.0	15.0	17.0	19.0	.....	.....	.....	.....

**2 and 3-wire****4-wire****3 Ø 3-wire**

bars on this side only for 225 A.

**3 Ø 4-wire**

bars on this side only for 225 A.



*straight lengths, flexible connectors, fittings, plug-in protective devices, hangers*

### **duct joint**

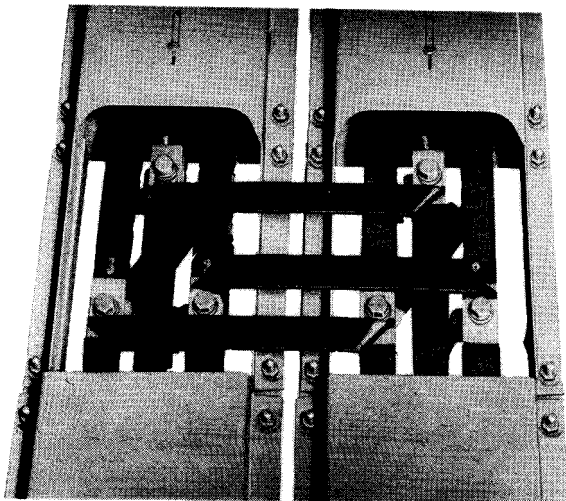
Silver plated bars at duct joints assure low-contact resistance. For ease of installation and inspection, an opening,  $8\frac{3}{4}$ -inches wide, is provided on two sides at each splice. The right end of each bus bar has pressed-in cadmium-plated plug nuts, the left end slotted holes. These captive nuts ease installation labor. The bars have a  $1\frac{3}{4}$ -inch overlap and are held together by one  $\frac{3}{8}$ -inch, high strength steel hex bolt.

Mechanical connection between housings of adjacent sections is made by a scarf joint for added strength. Ventilated for cooler operation, access covers are held in place with studs, instead of bolts, making it possible to remove either cover for inspection of the joint without disturbing the sheet steel housing connection. Load equalizer straps are installed on each right end. When running busway near ceiling or walls, allow approximately six-inch clearance for removal of access covers.

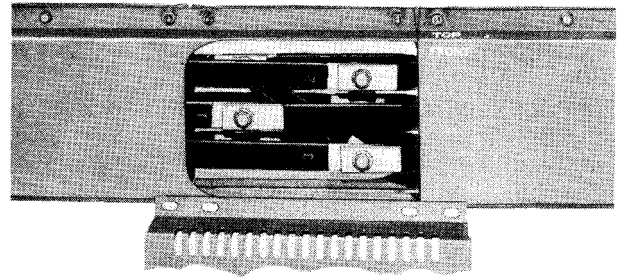
### **multiple runs**

For busways larger than 800 amperes with aluminum bars or 1000 amperes with copper bars, multiple runs of standard Life-Line Busway are installed on common hangers. Tie straps are furnished for electrical paralleling of the runs every 50 feet. This eliminates the unbalance inherent in bus bars of longer lengths. When these straps are used, an oversize access cover will straddle two runs. Special hangers space the runs so that take-off devices and tie straps will fit accurately.

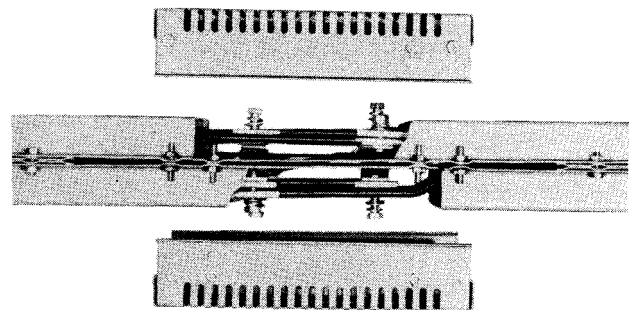
**tie straps paralleling two runs**



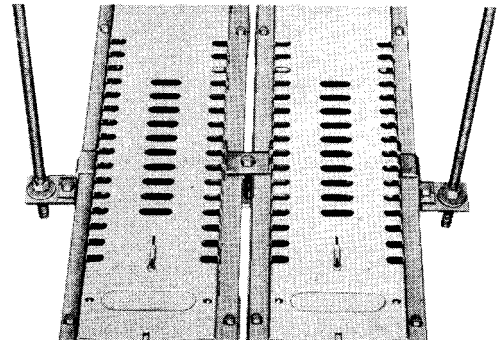
**top view of  $8\frac{3}{4}$ -inch wide opening at duct joint**



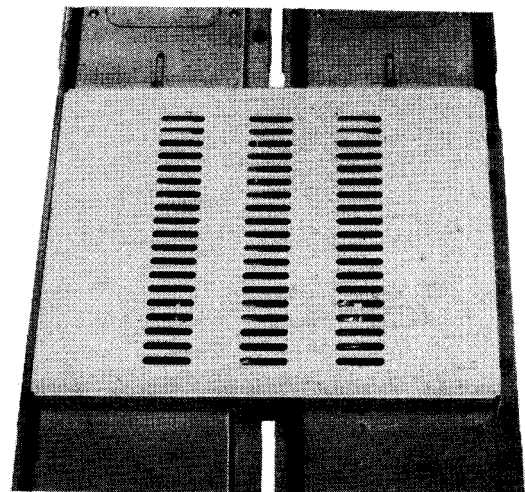
**side view of duct joint showing both access covers removed**

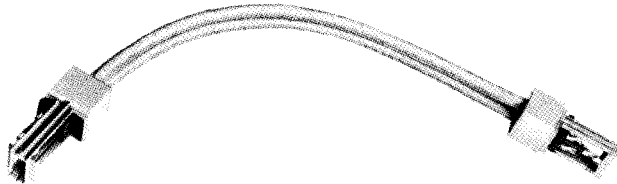


**multiple-run on trapeze type hangers**



**oversize access cover straddling two runs**



**flexible connectors****single runs**

These connectors are available in ratings of 225, 400, 600 and 800 amperes for 2, 3 and 4-wire service. All ratings are Underwriters' listed. They can be used for all types of elbows, offsets, expansion joints, or adapters from flatwise to edgewise mounting. If the busway is mounted edgewise, a turn to the left or right is made by an edgewise and a turn up or down by a flatwise connector.

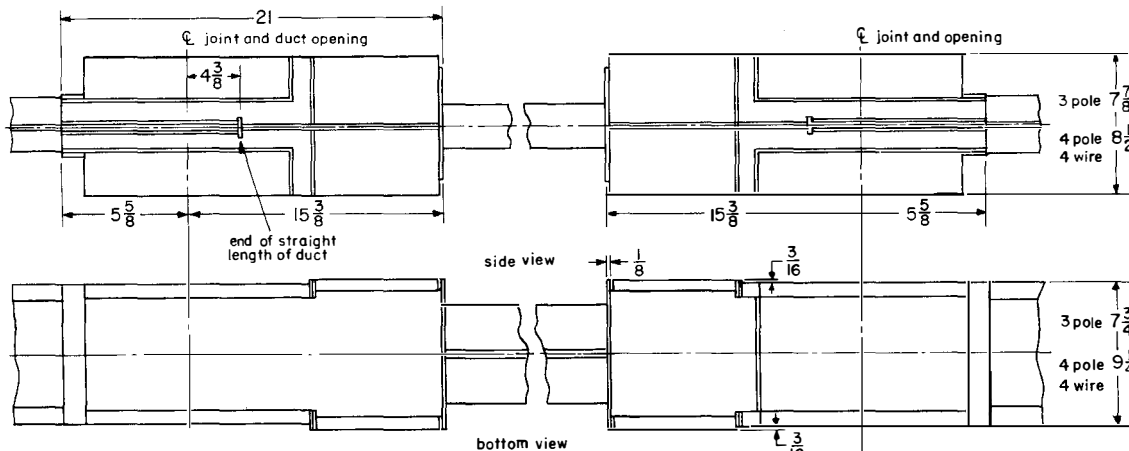
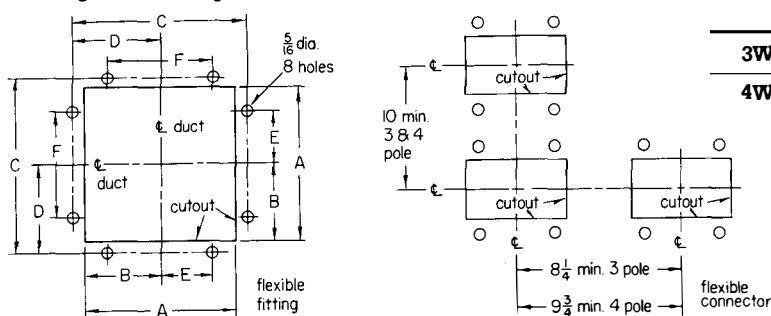
Flexible connectors consist of one or more copper cables enclosed in flexible steel conduit. The cables are terminated with lugs and located by an asbestos spacer so that they will bolt evenly onto the bus bars in the adjacent straight length. Attachment boxes to which the flexible conduit are joined also attach easily to adjacent straight lengths.

There are two types of flexible connectors, the standard and the universal. They are exactly the same except for their lengths. The universal type is flexible connectors to straight lengths

approximately 132 inches long and the standard approximately 83 inches. The leg dimensions  $A+B$  of the standard type must be exactly 92 inches, with either  $A$  or  $B$  having a minimum dimension of 36 inches. The universal type permits a variation in these leg dimensions ( $A+B$ ) of between 140 to 161 inches by varying the radius of bend. Either leg may have a minimum dimension of 36 inches. However, for greater versatility, it is recommended that either  $A$  or  $B$  leg have a minimum dimension of 66 inches so that the other leg will have the maximum variation.

When Life-Line Busway elbows into a switchboard, either the standard or universal flexible connector may be used for switchboard entrance by removing the attachment box on the switchboard end. The remaining flange plate is used for bolting to the switchboard and provides a minimum of  $11\frac{1}{2}$  inch cable leads with lugs into switchboard. (Longer cable leads can be provided on request.) **The drilling and cutout plan shown must be followed.**

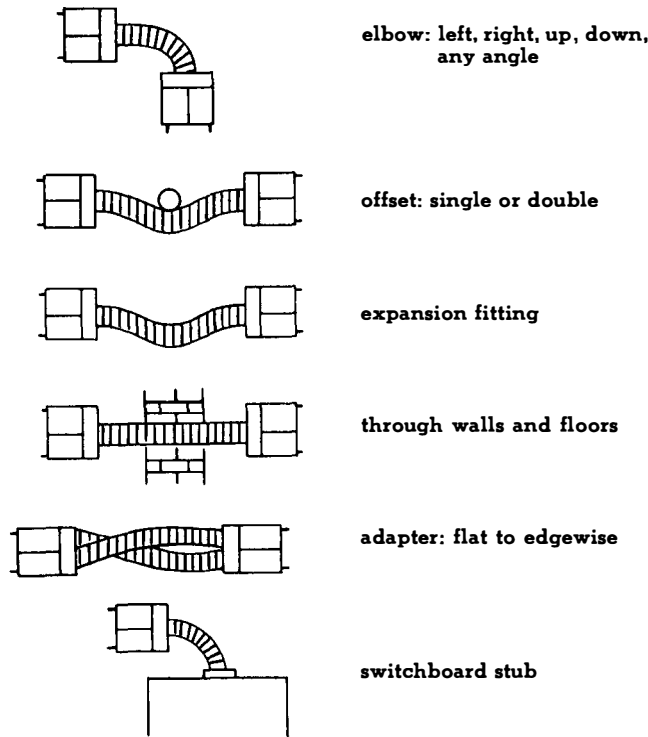
All flexible connectors may be used interchangeably on aluminum or copper bus bar systems. No accessories may be mounted at a joint between a flexible connector and a straight length.

**drilling and cutout plan**

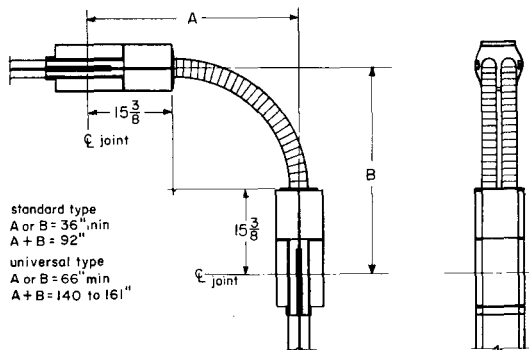
	A	B	C	D	E	F
3W	$6\frac{3}{4}$	$3\frac{3}{8}$	$7\frac{7}{16}$	$32\frac{3}{32}$	$2\frac{1}{2}$	5
4W	$8\frac{1}{4}$	$4\frac{1}{8}$	$8\frac{15}{16}$	$41\frac{5}{32}$	$3\frac{1}{4}$	$6\frac{1}{2}$

straight lengths, flexible connectors, fittings, plug-in protective devices, hangers

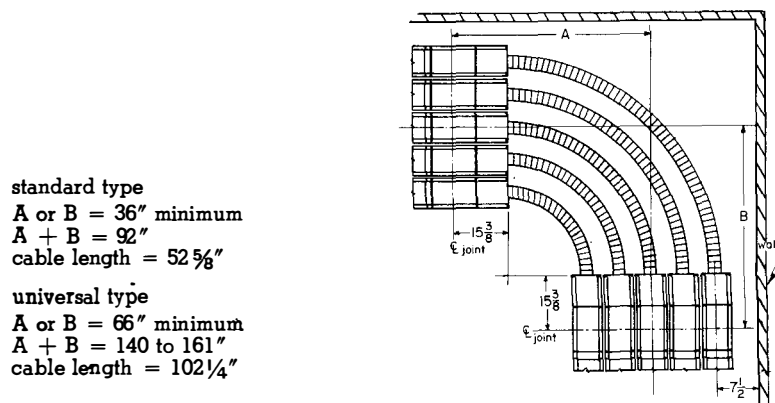
### uses of flexible connector



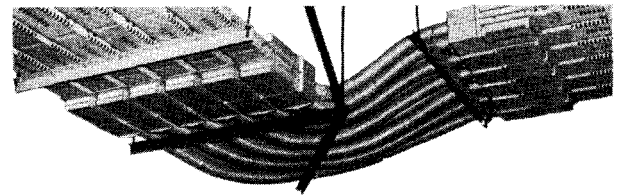
### dimensions



### dimensions flatwise



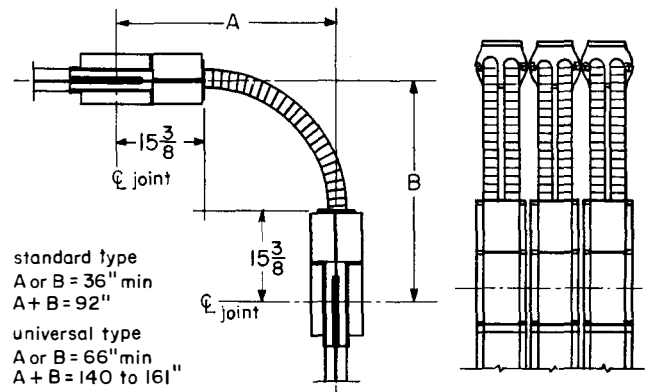
### multiple runs



Edgewise turns in multiple-run busways are made with two or more flexible connectors of the same length and the radius of bend is the same for all. Either the standard or universal type may be used and the A and B leg dimensions are the same as those shown for single runs.

Flatwise turns are made by using flexible connectors of different lengths, the one for the inside of the turn being a single-run flexible connector of standard lengths and the others increasingly longer. Dimensions of flatwise multiple-run flexible connectors are shown in the following table and drawing. Note that A and B leg dimensions are measured along the center-line of the complete system run and not the center-line of the individual units composing the system.

### dimensions edgewise



no. of runs	standard		universal	
	A + B	minimum A or B	A + B	minimum A or B
2 and 3-wire systems				
2	100	40	148-169	70
3	109	44	156-177	74
4	117	49	165-185	78
5	125	53	173-193	83
4-wire systems				
2	102	41	150-170	71
3	112	46	160-180	76
4	122	51	170-190	81
5	131	56	179-200	86



## flexible connectors

### dimension calculations

The graph below is used for determination of maximum and minimum lengths of Universal flexible connectors. It can also be used to determine the other leg of a standard connection after one leg has been fixed. Although curve shows "B" as fixed, "A" can also be fixed.

**Example:** If the "B" length is fixed at 70", the "A" length can vary between 71" and 97". If the "B" dimension is fixed, for example, at 75", the "A" length can vary between a minimum of 67" and a maximum 93". The difference in dimension is made up by varying the radius of the flexible connector.

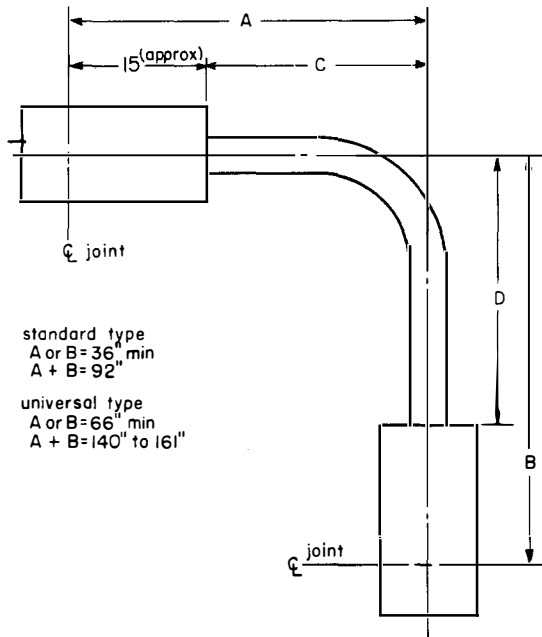
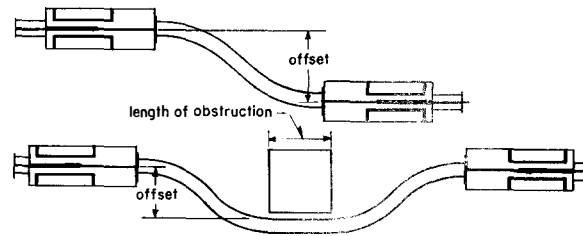
Although the upper limit for the A + B leg dimensions is given as 161", it may, according to the graph, exceed this limit in some cases.

**elbow:** When approaching a turn, stop the straight length at least 3½ feet back from the centerline of the busway after it has made the turn. Select desired length of flexible connector, carry it around the corner and let any surplus continue on into the straight run.

**single offset:** Select a flexible connector having a cable length at least 1.57 times the amount of offset. Let any surplus length continue onto the next straight run.

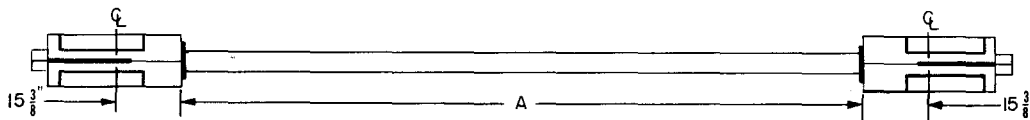
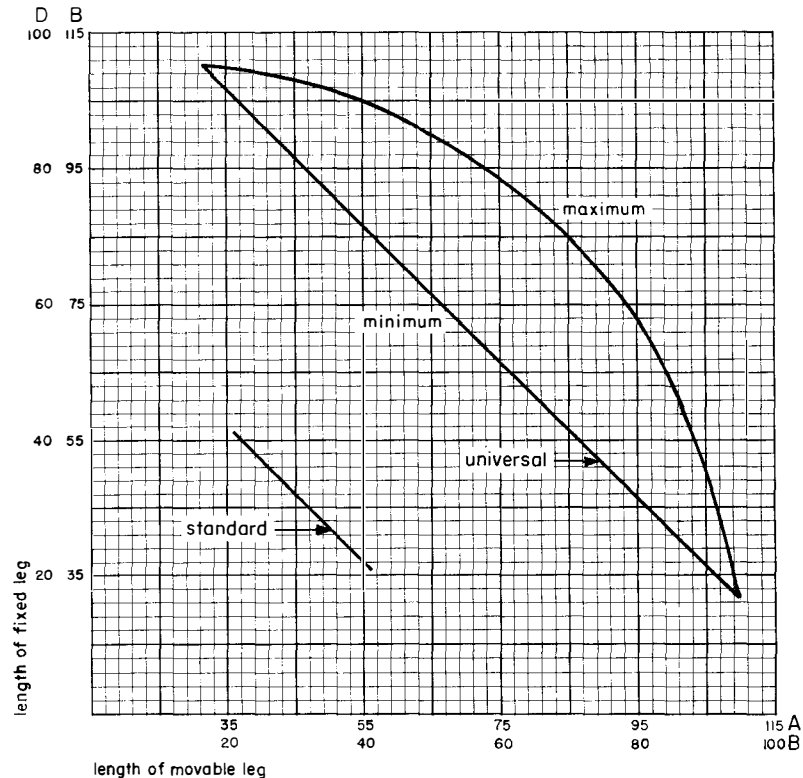
**double offset:** To go around an obstruction. Select a flexible connector having a cable length at least 3.15 times the amount of offset plus the length of the obstruction.

For exact calculation measurements of offsets refer to Westinghouse.



standard type  
A or B = 36" min  
A + B = 92"

universal type  
A or B = 66" min  
A + B = 140" to 161"



standard connector • A = 52¾"

universal connector • A = 102"

Longer lengths of special connectors are available on special order.

**fittings**

**junction boxes**

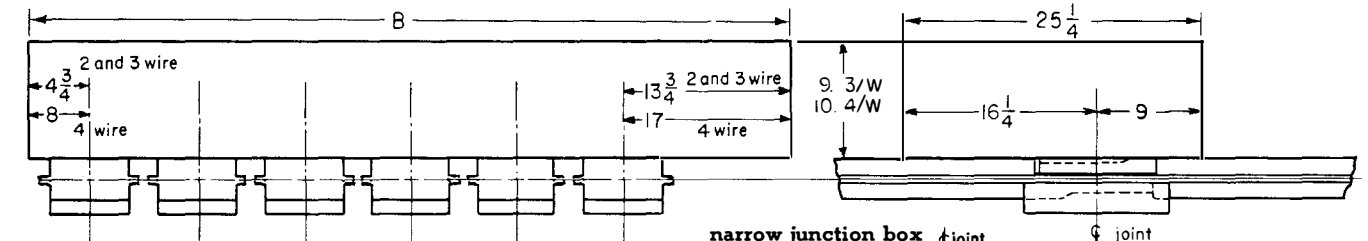
Junction boxes are used where a run of duct is fed by cable or as power tap-offs where equipment served by the duct is connected without overcurrent protection. They can be mounted at joints between straight lengths or at the end of a run. When used at the end of a run, end boxes should be ordered separately.

There are two types; narrow junction boxes, with a rating of 400 amperes, and full-capacity single and multiple-run boxes with ampere ratings the same as the run of duct.

Narrow junction boxes are the same width as bus duct housing. Terminals for the cable bolt directly to the splice of the bus bars in the duct. The narrow width of the box makes it necessary for conduit to enter the end opposite the terminals.

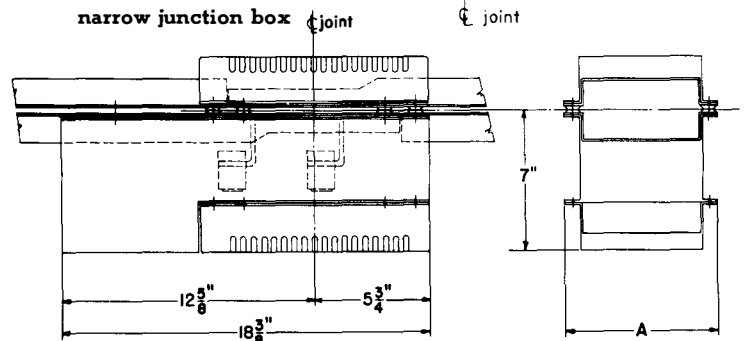
Standard junction boxes are made in all ratings of 400 and 800 amperes only. Conduit may be brought in either the side or the end of the box. These boxes are also made for power feed or take-off from two or more parallel runs. Solderless lugs for 1/0—600 MCM cable are furnished.

standard junction boxes, single and multiple-run



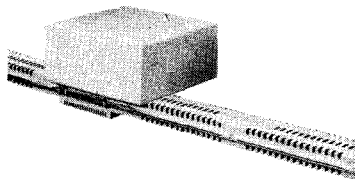
no. of runs	B dimensions (in ins.)		copper bars		aluminum bars	
	2 or 3W	4W	system rating	no. of lugs* per Ø & FN	system rating	no. of lugs* per Ø & FN
1	18 1/2	25	1000	2	800	2
2	26 3/4	34 3/4	1600	4	1200	3
3	35	44 1/2	2400	6	1800	5
4	43 1/4	54 1/4	3200	8	2400	6
5	51 1/2	64	4000	10	3000	8

\* for junction boxes the same ampere rating as the system rating.

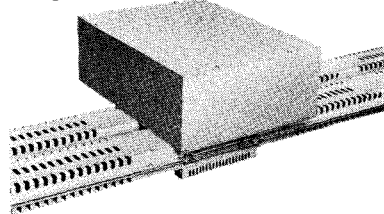


See page 8 for A dimension.

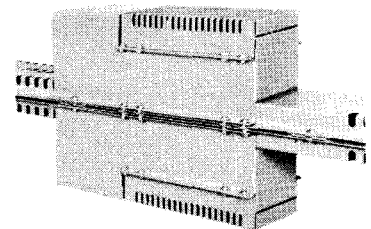
single run



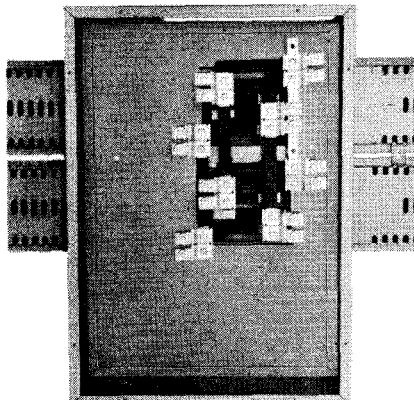
multiple run



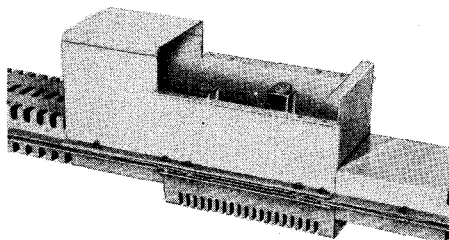
narrow type



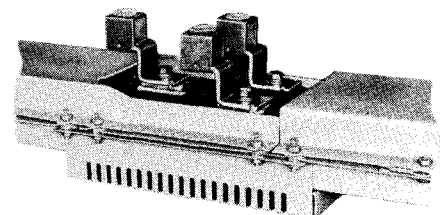
multiple run, open



narrow type, open



narrow type, terminals

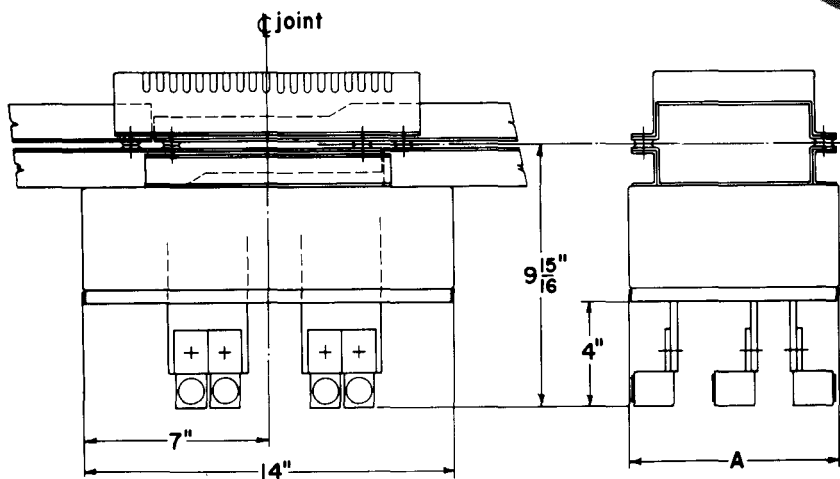
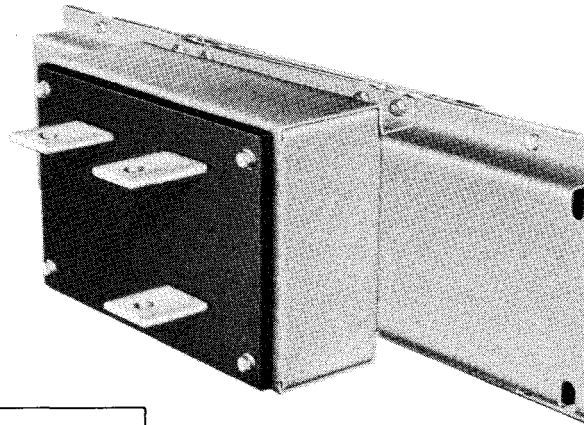




## fittings

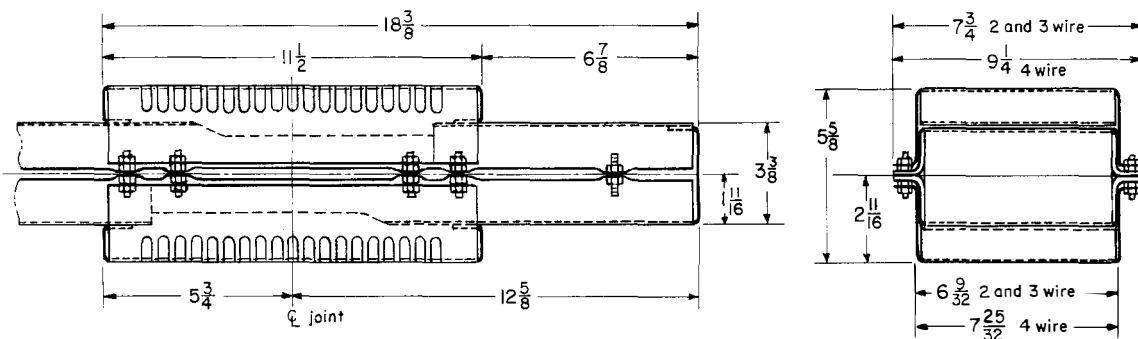
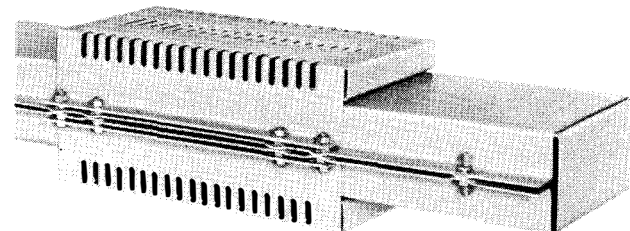
### transformer taps

Transformer tap fittings can be mounted at a joint between straight lengths or at the end of a run. The bus bars extend through the duct housing and connection to the transformer is made by cable in a drip loop. For three single-phase transformers connected to a 3-phase system, order three fittings, of the 3 or 4-wire type and use only appropriate connections. Each fitting includes two 1/0-600 MCM solderless lugs per phase.



### end boxes

End boxes terminate a bus duct run. Since Life-Line Busway housing is standardized, there are only two end boxes; one for two and three-wire and one for four-wire. These boxes are interchangeable and can be used on either the right or left end of a run.

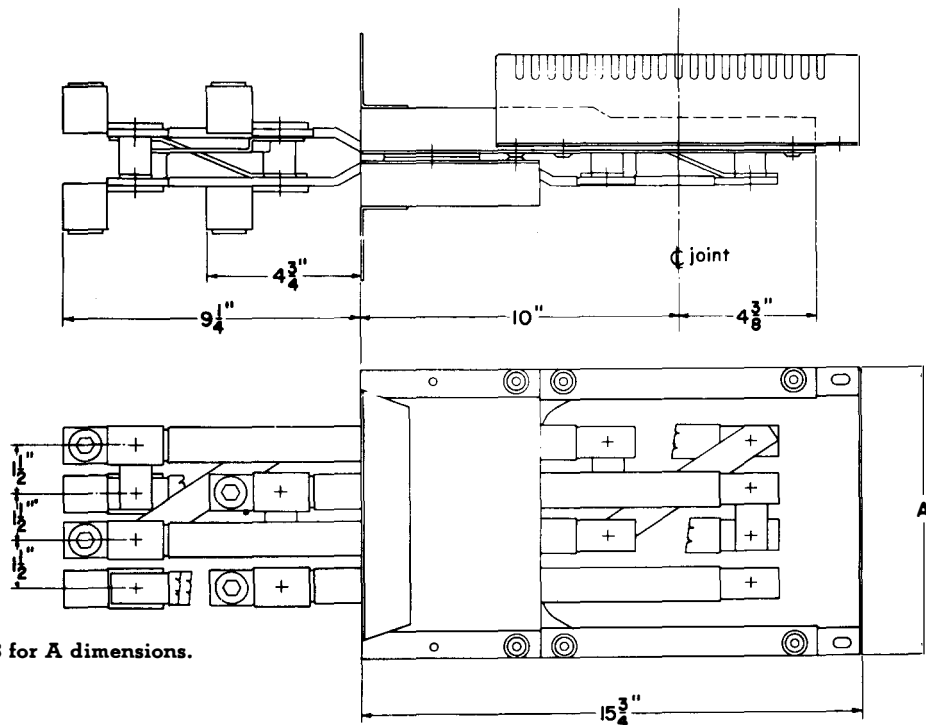
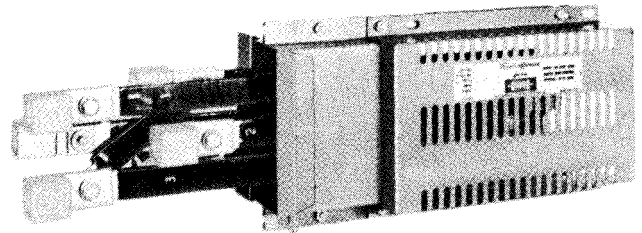


Dimensions shown are for duct ratings of 225 through 800 ampere copper and 225 through 600 ampere aluminum.

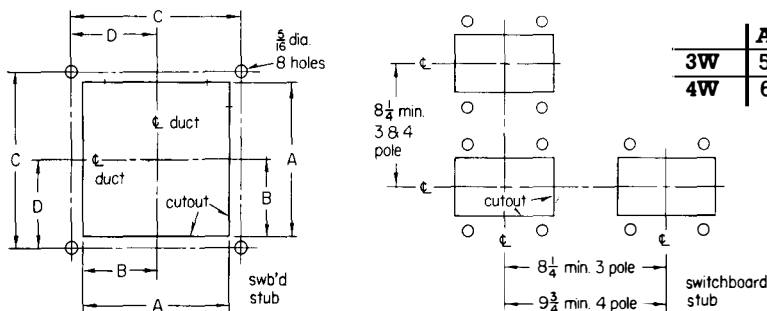
*straight lengths, flexible connectors, fittings, plug-in protective devices, hangers*

### switchboard stubs

Switchboard stubs are used when a straight run of busway enters a switchboard. However, they may also be used on the end of a flexible connector when it is necessary for the duct run to elbow out of a switchboard. These fittings are available for 2, 3 and 4-wire systems in ratings of 400 and 800 amperes. Switchboard stubs extend  $9\frac{1}{4}$  inches into switchboards and stand ten inches above them. Each one is shipped with two 1/0—600 MCM lugs per phase for the 800 ampere and one 1/0—600 MCM lug per phase for the 400 ampere size.



### drilling and cutout plan







## fittings

### rigid elbows

In certain cases, it may be desirable to make turns in a run of Life-Line Busway using standard fabricated fittings, rather than flexible connectors. For these jobs, rigid elbows are available.

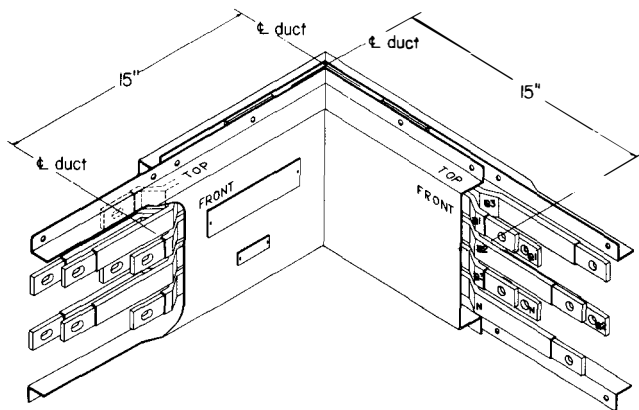
#### forward and rearward elbows

When Life-Line Busway is hung in the conventional edgewise mounting position, with the marking "TOP" up and "FRONT" toward the viewer, the bus bars are on edge, one above the other. If the run is to be extended forward a forward elbow is used and a rearward elbow if it is to be extended rearward.

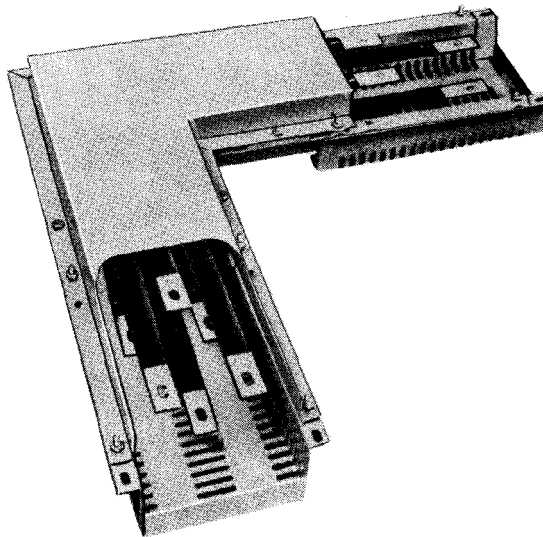
When a forward elbow is used at the right end of a run the end of the bus with spline nuts extends forward. When used at the left end of a run the end of the bus with slots extends forward.

When using a rearward elbow at the right end of a run the bus bars with spline nuts will extend rearward. When used at the left end, those with slots extend rearward.

#### forward elbow



elbow with top access covers removed



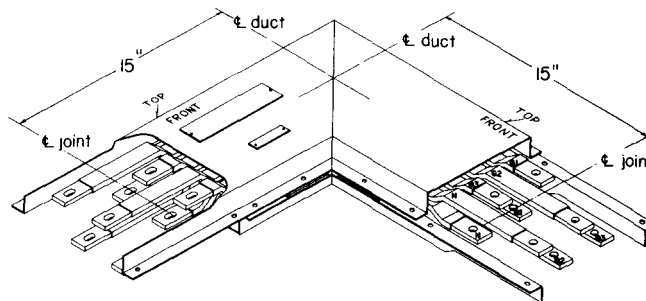
#### upward and downward elbows

When duct is hung in the conventional edgewise mounting position with the marking "TOP" up, an upward elbow is used to direct the run upward and a downward elbow to direct it downward.

When an upward elbow is used on the right end of a run the bus bars with spline nuts will extend upward. When used at the left end of a run the end of the bus with slots extend upward.

When a downward elbow is used on the right end of a run the end of the bus with spline nuts extends downward. When used at the left end, the bus bars with slots extend downward.

#### downward elbow



**rigid tees**

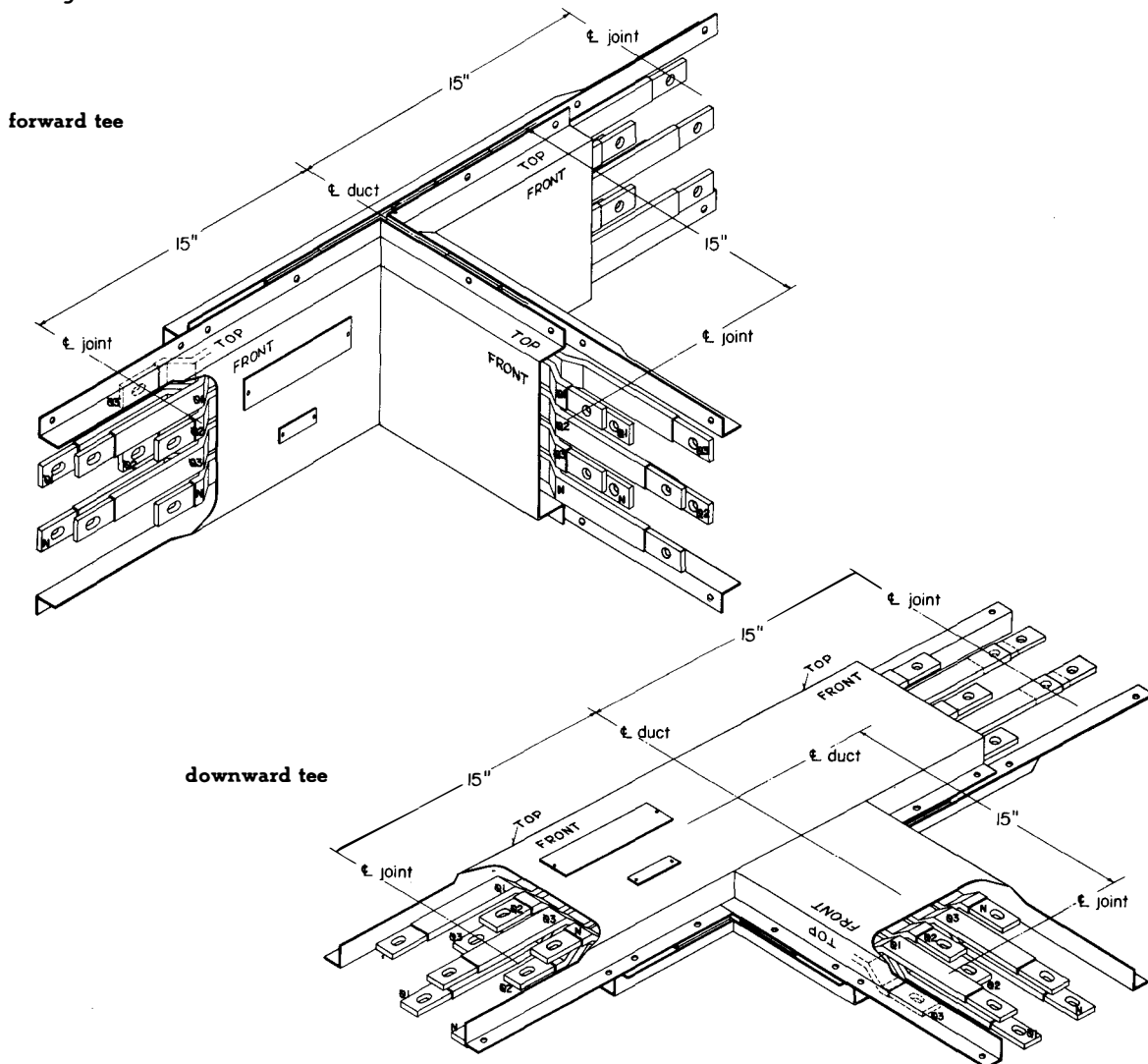
Life-Line Busway rigid tees are used to make connections in three directions. The four types available are forward, rearward, upward and downward.

**forward and rearward tees**

Facing the front of a forward tee with the marking "TOP" up, a 15 inch leg extends forward from the center of 30 inch section of duct. On a rearward tee, this leg extends to the rear.

**upward and downward tees**

An upward tee with the "TOP" marking up has the 15 inch center leg extending upward. On a downward tee it extends downward.





## plug-in protective devices

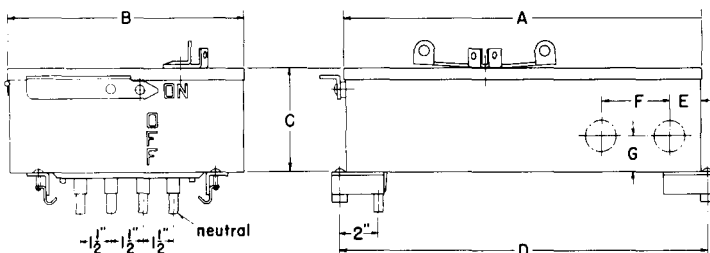
There are three types of plug-in overload protective devices used to tap power off Life-Line Busway: the molded-case circuit breaker type, the types GP and HP fusible switches.

The safety slide, covering the plug-in opening can be opened only after two interlock buttons are depressed by heavy studs on the back of the plug box. The safety slide can then be opened with a screw driver. When the safety slide is open, the plug is locked to the housing so that it cannot be removed. The safety slide may then be closed with the plug mounted on the housing. This gives absolute assurance that there are no live parts in the plug-in device. Plug-in covers cannot be opened unless the interlocked contact handle is in the OFF position.

Primary contacts are silver-plated copper rods supported in a molded compound carrier. Compression springs maintain a pressure as high as 2000 pounds per square inch on the primary contacts, which have a wiping action to assure clean, low-resistance contact.

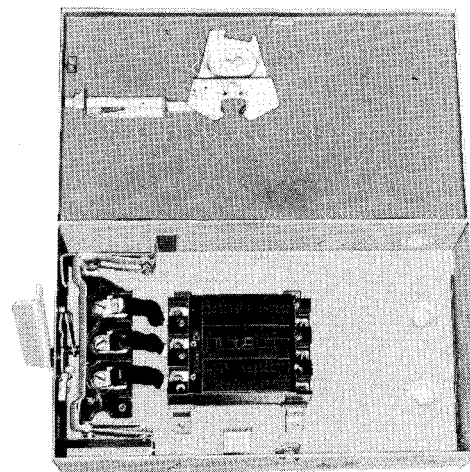
### circuit breaker plug-ins

These devices are available with types E, F or J breakers. The operating handle for the breaker is mounted on the cover and can be chain or hookstick operated. A separate handle, located on the end of the enclosure, opens and closes the primary contacts. An interlock between this handle and the breaker operating handle prevents opening or closing primary contacts except when the breaker is in the OFF position. Therefore, no current is interrupted on the bus bars. The 4-pole solid neutral type E and F plug-ins have lugs designed to accommodate a full-size neutral conductor. However, when a full-size neutral lug is required for a type J, it must be specified in the order write-up. **The 3 and 4-wire devices are not interchangeable.**



Quick-acting clamps hook onto busway, supporting the plug until clamps are tightened. Springs hold these clamps in position and captive screws eliminate the danger of clamps falling inside the duct housing. The clamps engage slots in the busway housing and guide rails on the back of the plug assure proper alignment. **The 3 and 4-wire plug-in devices are not interchangeable.**

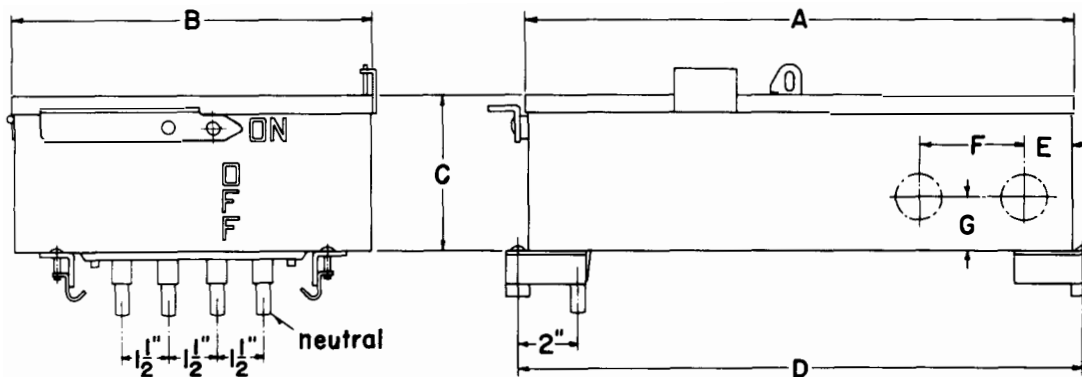
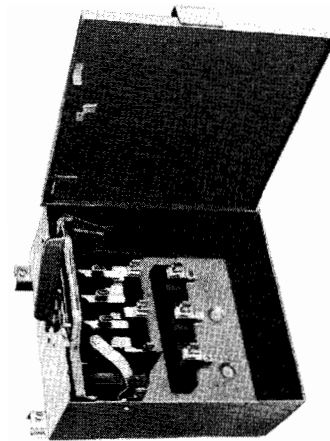
This is the recommended procedure for installing plug-in devices: 1. Hook quick-acting clamps onto duct housing and tighten the clamps. (Be sure studs on back of plug engage interlock buttons on safety slide.) 2. Wire load side connection to plug-in device and close cover. 3. Open safety slide with screw driver. 4. Move primary contact operating handle to ON position. (This is operating handle located on the end of the enclosure.) 5. Turn secondary contact operating handle which is located on the front of plug, to ON position. This connects the load to the line.



type	poles	dimensions (in inches)							KO size
		A	B	C	D	E	F	G	
E	2 & 3	17 1/2	10	5 1/2	18	1 3/4	3 3/4	2	3/4, 1, 1 1/4
E	3 Ø 4W	17 1/2	11 1/2	5 1/2	18	1 3/4	3 3/4	2	3/4, 1, 1 1/4
F	2 & 3	17 1/2	10	5 1/2	18	1 3/4	3 3/4	2	3/4, 1, 1 1/4
F	3 Ø 4W	17 1/2	11 1/2	5 1/2	18	1 3/4	3 3/4	2	3/4, 1, 1 1/4
J	2 & 3	23 1/2	10	6 1/16	24	2 1/2	...	2 3/4	2, 2 1/2, 3
J	3 Ø 4W	23 1/2	11 1/2	6 1/16	24	2 1/2	...	2 3/4	2, 2 1/2, 3

**fusible plug-in** type GP

Type GP, or general purpose, fusible plugs contain primary contacts which engage bus bars and retract into the enclosure when the cover is opened. Double-break secondary contacts, operated by the same handle as the primary contacts, make after the primary contacts close and open before they open so that no current is interrupted on the bus bars. When the operating handle is in the OFF position the secondary contacts are open but the primary contacts are still in contact with the bus bars. However, the operating handle is interlocked with the cover so that when it is opened the primary contacts are also opened. Type GP plugs are available in ratings of 30, 60, and 100 amperes for 2, 3, and 4-wire service. All 4-pole solid neutral units have proper lugs to accommodate a full-size neutral conductor. The 3 and 4-wire plug-in devices are not interchangeable.



ampere rating	volts	poles	dimensions (in inches)								horsepower ratings • 3-pole	
			A	B	C	D	E	F	G	KO size	NEC standard fuses	time delay fuses
30	240	3w 3 Ø 4w	12 12	10 11 1/2	5 1/4 5 1/4	12 1/2 12 1/2	1 1/2 1 1/2	3 3/8 3 3/8	1 11/16 1 11/16	3/4, 1, 1 1/4 3/4, 1, 1 1/4	3	7 1/2
	600 277/480	3w 3 Ø 4w	12 12	10 11 1/2	5 1/4 5 1/4	12 1/2 12 1/2	1 1/2 1 1/2	3 3/8 3 3/8	1 11/16 1 11/16	3/4, 1, 1 1/4 3/4, 1, 1 1/4	7 1/2 5	.... ....
60	240	3w 3 Ø 4w	12 12	10 11 1/2	5 1/4 5 1/4	12 1/2 12 1/2	1 1/2 1 1/2	3 3/8 3 3/8	1 11/16 1 11/16	3/4, 1, 1 1/4 3/4, 1, 1 1/4	7 1/2	15
	600 277/480	3w 3 Ø 4w	12 12	10 11 1/2	5 1/4 5 1/4	12 1/2 12 1/2	1 1/2 1 1/2	3 3/8 3 3/8	1 11/16 1 11/16	3/4, 1, 1 1/4 3/4, 1, 1 1/4	① 15	.... ....
100	240	3w 3 Ø 4w	17 1/2 17 1/2	10 11 1/2	5 1/4 5 1/4	18 18	1 3/4 1 3/4	.... ....	1 15/16 1 15/16	1 1/4, 1 1/2, 2 1 1/4, 1 1/2, 2	.... ....	.... ....
	600 277/480	3w 3 Ø 4w	17 1/2 17 1/2	10 11 1/2	5 1/4 5 1/4	18 18	1 3/4 1 3/4	.... ....	1 15/16 1 15/16	1 1/4, 1 1/2, 2 1 1/4, 1 1/2, 2	.... ....	.... ....

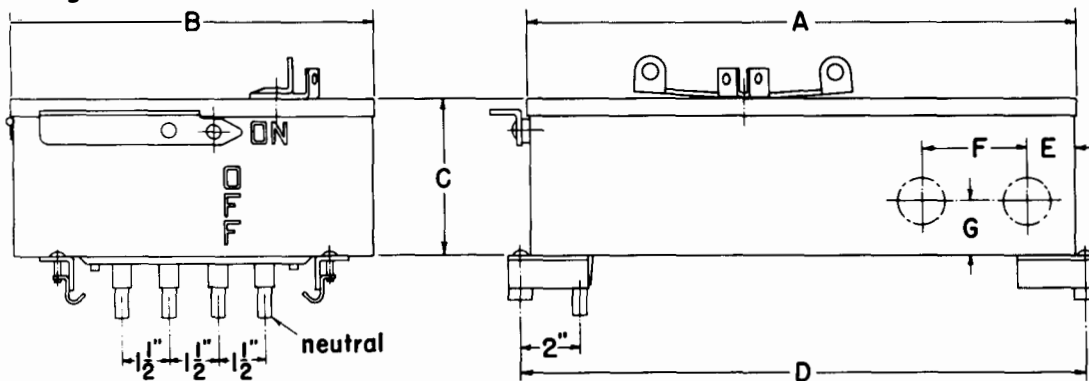
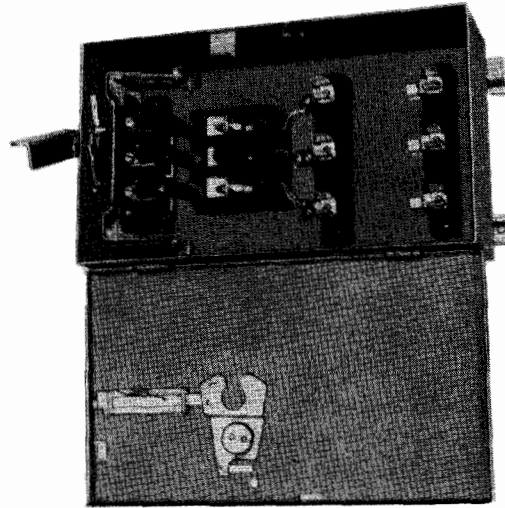
① 15 hp at 480 volts



## plug-in protective devices

### fusible plug-in type HP

Type HP plugs are heavy-duty plug-in devices that use the visible-contact De-ion switch as the secondary contact. Operating handle for the De-ion switch is located on the cover of the plug and can be chain or hookstick operated. Primary contact operating handle is mounted on the end of the plug box and is interlocked with the switch handle to prevent opening and closing of the primary contacts except when the De-ion switch is in the OFF position. This means that the current is always interrupted by the De-ion switch and never on the bus bars. Type HP plugs are available in ratings of 30, 60, 100 and 200 amperes for 2, 3 and 4-wire service. The 30, 60 and 100 ampere 4-pole solid neutral units have lugs designed to accommodate a full-size neutral conductor. However, if a full-size lug is needed on a 200 ampere unit, it must be specified in the order write-up. The 3 and 4-wire devices are not interchangeable.



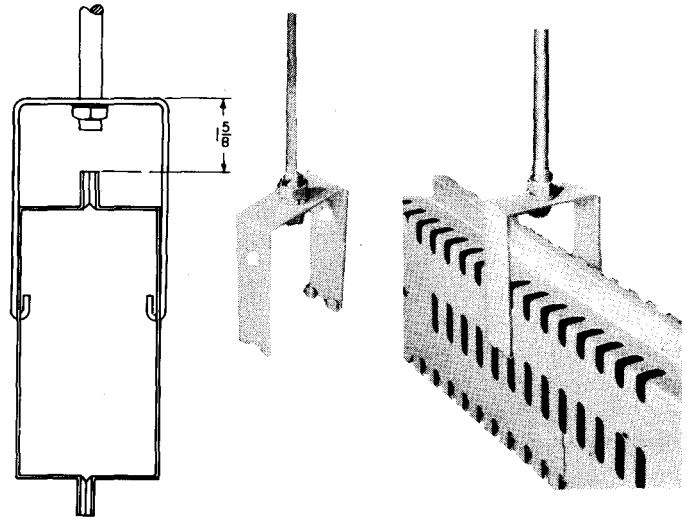
ampere rating	volts	poles	dimensions (in inches)								horsepower ratings • 3-pole	
			A	B	C	D	E	F	G	KO size	NEC standard fuses	time delay fuses
30	240	3w 3 Ø 4w	17½ 17½	10 11½	5½ 5½	18 18	1¾ 1¾	3¾ 3¾	2 2	¾, 1, 1¼ ¾, 1, 1¼	3	7½
	600 277/480	3w 3 Ø 4w	17½ 17½	10 11½	5½ 5½	18 18	1¾ 1¾	3¾ 3¾	2 2	¾, 1, 1¼ ¾, 1, 1¼	7½ 5	20 15
60	240	3w 3 Ø 4w	17½ 17½	10 11½	5½ 5½	18 18	1¾ 1¾	3¾ 3¾	2 2	¾, 1, 1¼ ¾, 1, 1¼	7½	15
	600 277/480	3w 3 Ø 4w	17½ 17½	10 11½	5½ 5½	18 18	1¾ 1¾	3¾ 3¾	2 2	¾, 1, 1¼ ¾, 1, 1¼	15 15	50 30
100	240	3w 3 Ø 4w	23½ 23½	10 11½	5½ 5½	24 24	1¾ 1¾	... ...	2 2	1¼, 1½, 2 1¼, 1½, 2	15	30
	600 277/480	3w 3 Ø 4w	23½ 23½	10 11½	5½ 5½	24 24	1¾ 1¾	... ...	2 2	1¼, 1½, 2 1¼, 1½, 2	30 25	50 50
200	240	3w 3 Ø 4w	31⅞ 31⅞	10⅞ 11⅞	6⅜ 6⅜	32 32	2½ 2½	... ...	2¾ 2¾	2, 2½, 3 2, 2½, 3	25	50
	600 277/480	3w 3 Ø 4w	31⅞ 31⅞	10⅞ 11⅞	6⅜ 6⅜	32 32	2½ 2½	... ...	2¾ 2¾	2, 2½, 3 2, 2½, 3	50 50	... ...

## hangers

### for straight lengths

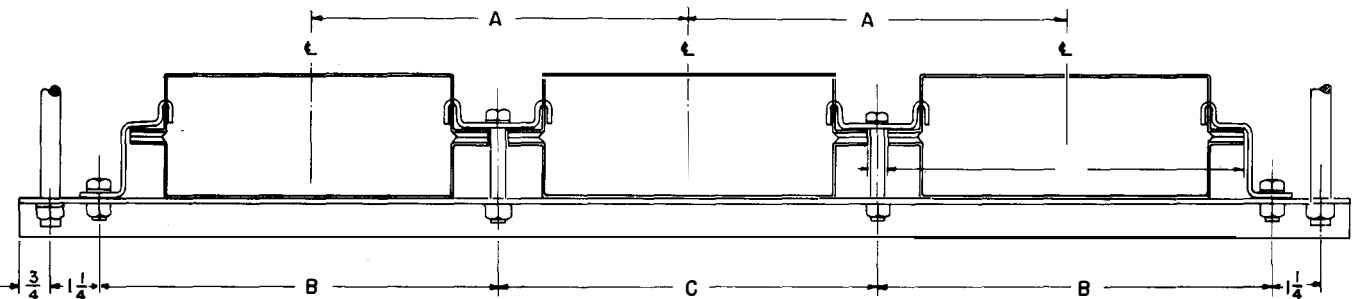
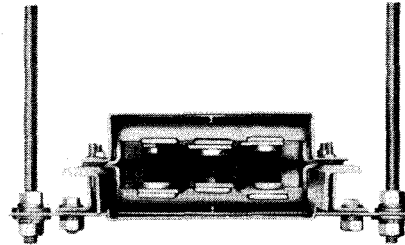
#### clip-on type

The clip-on hanger is used when mounting Life-Line Busway in the conventional edgewise position. It is the easiest and fastest of all bus duct hangers to install. Just snap the hanger onto the housing at any point. The hooks engage the center ventilating slot and the busway is firmly supported. A clamp bolt may be added if desired, as an insurance of positive positioning. When ordering, specify indoor or outdoor mounting and whether duct is 3 or 4-wire. Drop rods and nuts are not supplied by Westinghouse.



#### trapeze type

This type is used for mounting single runs in the flatwise position. It is also the standard hanger used for mounting multiple-run systems. An angle iron bracket supports the duct and the clamps accurately space the runs so that take-off devices will fit. Trapeze hangers may also be used for vertical mounting.



	A	B	C	D
3-wire	8 1/4	8 3/4	8 1/4	7 3/4
4-wire	9 3/4	10 1/4	9 3/4	9 1/4

#### vertical type

An adjustable spring type hanger is available for vertical-mounted duct. This hanger equalizes the weight of vertical mounted duct among all supports. Refer to Westinghouse for dimensions.



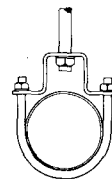
## hangers

### for flexible connectors

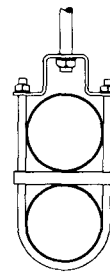
#### single runs

Hangers for flexible connectors consist of a U-bolt to support the connector and a channel shaped piece used for connection of the drop rod. There are three types available: one for 225 ampere duct which has a single conduit, one for 2-conduit edge-wise turns and one for 2-conduit flatwise turns. Drop rods and nuts are not supplied by Westinghouse.

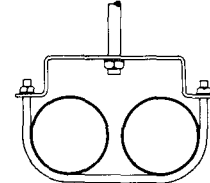
single conduit



edgewise



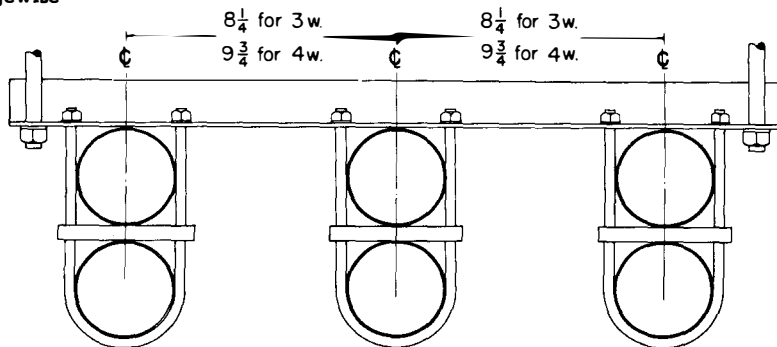
flatwise



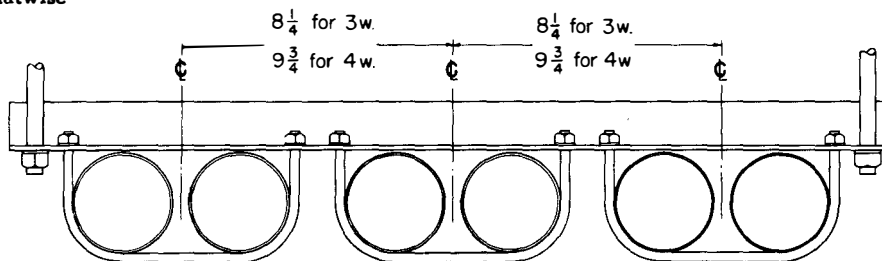
#### multiple runs

Hangers for multiple-run flexible connectors are made of U-bolts to hold and position the conduits and an angle iron piece to support the weight. There are two types; one for flatwise and another for edgewise turns. Drop rods and nuts are not supplied by Westinghouse.

edgewise



flatwise



**typical Life-Line Busway specifications**

Furnish and install a low-voltage-drop enclosed bus bar distribution system as shown on the plans and hereinafter specified. The material furnished shall be equal to Life-Line Busway as manufactured by the Westinghouse Electric Corporation.

A ventilated steel enclosure shall be furnished. The busway shall be supplied in 10-ft. lengths except where shorter lengths are required to suit installation conditions. Removable, ventilated covers shall be furnished at joint sections. Busway system shall be complete with necessary end boxes, junction boxes, together with such flexible connections and fittings as may be required to provide a complete busway system of the size and capacity shown on the plans. Bus bars shall be of copper (or aluminum), and all conductors shall be silvered at joints and contact points. Each bus bar shall be insulated for its entire length with the exception of joints and connection points for plug-in devices. Connections between adjacent sections shall be bolted; and for ease of installation, spline nuts shall be pressed into the bus bars into which a plated bolt is inserted for adequate mechanical and electrical connection. A duo-circuit arrangement shall be provided of low-reactance design and phase collection straps shall be furnished for each 10-ft. length. The design shall be such that three collection straps are capable of being removed in the event it is desired to provide two independent circuits within a single housing. Ceramic type insulators shall be provided on not greater than 20-inch centers. The insulator assembly shall support the bus bars in such a manner that the bus bar supports do not come in direct contact with the enclosing steel housing. Bus bar supports shall be set in steel brackets and provided with resilient mounting gaskets to prevent insulator shock or breakage.

All ferrous parts, including the steel housing, shall be treated by the Bonderite process to prevent rusting and the entire assembly finished with a durable coating of baked-on gray enamel.

Where necessary to provide current-carrying capacity as specified, multiple runs shall be installed in a parallel arrangement. The system shall be so designed that an individual run may be removed without disturbing adjacent sections. Short-circuit strength of each individual run shall be rated at not less than 15,000 RMS amperes for 225 ampere rating, 25,000 RMS amperes for 400, 600 and 800 ampere ratings.

The design shall be such that the busway may be mounted in either the edgewise, flatwise, or vertical riser positions and the construction shall meet requirements of the Underwriters' Laboratories for housing impact strength and vertical pull-out wherever used as risers.

The ampere rating of the individual plug-in runs shall be as shown on the drawings and capable of supplying rated current to points of load take-off within permissible limits of temperature rise and voltage drop. Each 10-ft. length of Life-Line Busway shall be provided with a minimum of 12 plug-in outlets for ratings 400 amp and larger. The 225 amp rating shall be provided with six plug-in outlets. The plug-in outlets shall be of such design as to permit direct connection to the insulated conductors of the system for purposes of power tap-offs or connection of capacitors or neutralizers. Each plug-in opening shall consist of a safety slide that is interlocked with the steel housing in such a manner that access to bus bars is possible only when the plug-in unit is attached to the housing. The safety slide shall be capable of being closed with the unit attached to the housing in the OFF position. When it is attached to housing the safety-slide feature shall prohibit removal of the plug through an interlock until switching mechanism is in OFF position.

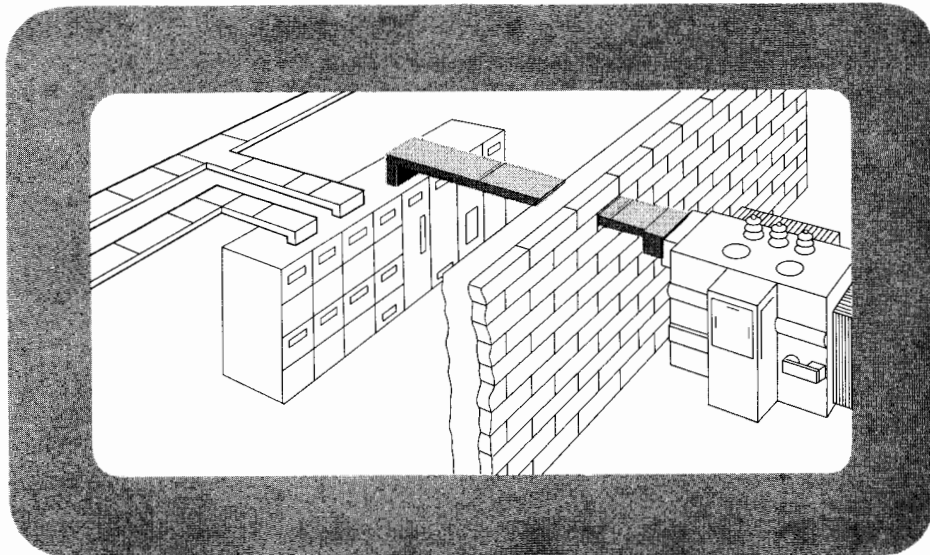
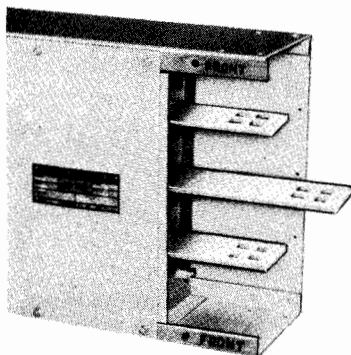
Each run shall be of similar construction and of matched impedance design. Expansion joints where necessary shall be provided in the busway system through the use of flexible connectors. The system shall be complete with rigid or flexible elbows and such other connections as may be required to provide a completely interconnected system from line side connections to point of power take-offs. Busway may be mounted in the plane or planes most satisfactory to suit installation conditions.

Plug-in units shall be of ratings as indicated on the drawings or as otherwise required. Each plug shall be furnished with safety interlocks to prohibit opening the door when switch is in ON position and which will prevent throwing switch to ON position when door is opened. In addition, the plug shall be of such design that it can be attached to the housing without making direct contact with the bus bars. It shall consist of a line side set of primary contacts and secondary set of switching contacts, disconnect switch, or circuit breaker for the making or breaking of load currents. Primary contact shall be of the retractable type and shall make contact with the bus bars prior to the operation of the secondary switching contacts. The secondary switching contacts shall break load currents prior to the withdrawal of the primary retractable contacts. Plug-in units shall be of molded case circuit breaker type or the fusible type suitable for conventional or high-interrupting-capacity type fuses as may be hereinafter specified.





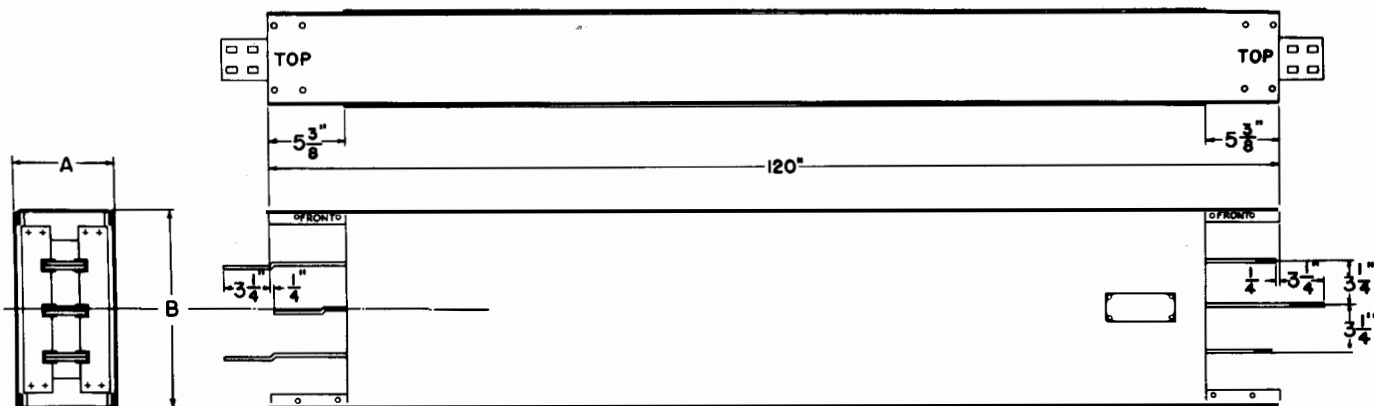
## conventional weatherproof duct



Conventional weatherproof duct consists of one bus bar per phase supported by micarta supports enclosed in a galvanized, Bonderized and painted steel housing. Front and back covers are flat and fastened to top and bottom channels with cadmium-plated bolts. A neoprene gasket is placed between top and bottom covers for weatherproofing and there are access covers on both sides of the duct.

It comes in ratings of from 400 to 1500 amperes with

copper bus bars and from 400 to 1000 amperes with aluminum. Fittings similar to those for plug-in and low impedance duct are available for conventional weatherproof. These include: elbows, tees, flange sections, weatherheads and end closers. Leg dimensions for standard fittings are the same as those listed for low impedance duct. Angle-iron hangers are furnished with the duct.



ampere rating		bars per phase & full neutral	housing dimensions		
copper	aluminum		depth	B—width across bars	
			A	3-W	4-W
400	.....	1— $\frac{1}{4}$ x $1\frac{1}{2}$	$5\frac{19}{32}$	$14\frac{7}{32}$	$17\frac{15}{32}$
600	400	1— $\frac{1}{4}$ x 2	$6\frac{3}{32}$	$14\frac{7}{32}$	$17\frac{15}{32}$
800	.....	1— $\frac{1}{4}$ x 3	$7\frac{3}{32}$	$14\frac{7}{32}$	$17\frac{15}{32}$
1000	600	1— $\frac{1}{4}$ x 4	$8\frac{3}{32}$	$14\frac{7}{32}$	$17\frac{15}{32}$
1250	800	1— $\frac{1}{4}$ x 5	$9\frac{3}{32}$	$14\frac{7}{32}$	$17\frac{15}{32}$
1500	1000	1— $\frac{1}{4}$ x 6	$10\frac{3}{32}$	$14\frac{7}{32}$	$17\frac{15}{32}$



bus duct  
copper and aluminum bus bars

low impedance section

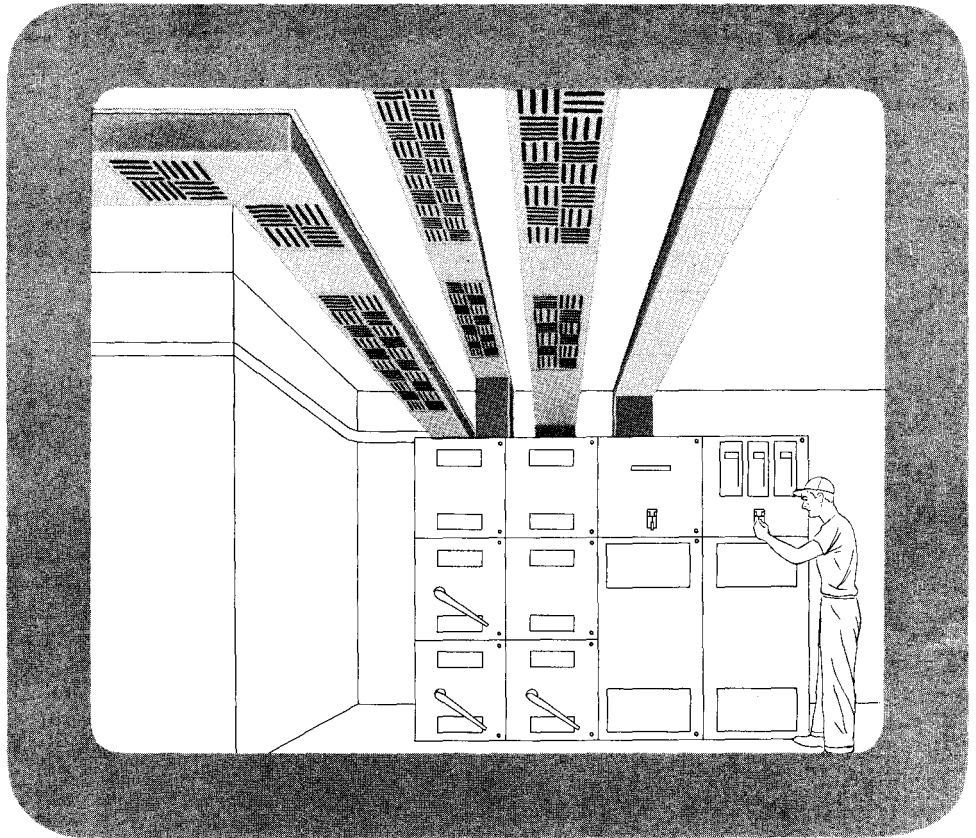
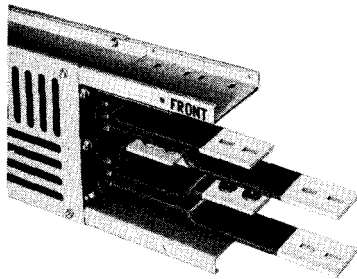
supplement  
application  
data  
30-660  
page 1

The low impedance section of application data 30-660, pages 25 to 42, is now incorrect. Bar sizes, dimensions and voltage drop curves have been changed.

A new low impedance section will be available in November.

Westinghouse Electric Corporation  
Standard Control Division: Beaver Plant • Beaver, Pa.  
printed in U.S.A.  
October 1, 1959  
new information  
mailed to: E/250/DB,AD; D63-3,5D; C26-3,5G



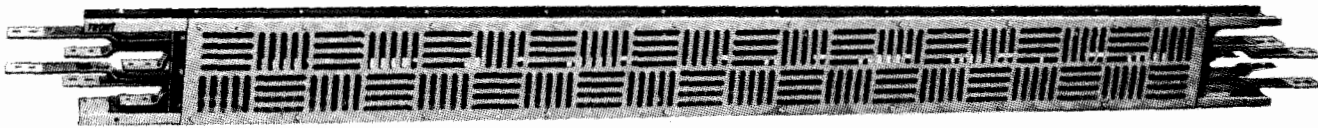
*straight lengths, fittings, hangers***in this section:**

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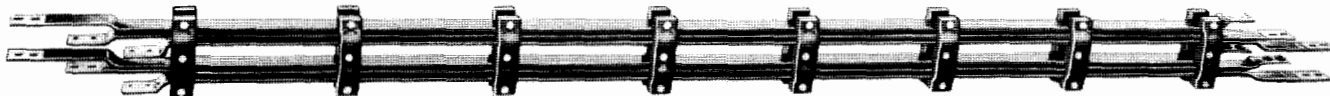


## general information

10 foot section of low impedance bus duct with ventilated housing



10 foot section with housing removed. Note polyvinyl insulating sheath and molded supports.



## application

Low impedance bus duct is ordinarily used to transport large amounts of power over long distances with a minimum voltage drop. It consists of insulated copper or aluminum bars, closely spaced, supported by clamp type supports. These are enclosed in a 16-gauge steel housing, utilizing the 4-channel interlocking type construction.

Low impedance duct is available in four different enclosures: 1. indoor ventilated, 2. indoor totally enclosed, 3. outdoor ventilated, 4. outdoor totally enclosed.

For most applications a totally enclosed housing is not necessary since the bus bars are fully insulated (except for a short space at the splice between sections where uninsulated portions are staggered). Therefore, ventilated bus duct is usually specified.

The two types of ventilated bus duct, indoor and outdoor, are identical in appearance. However, outdoor (or weatherproof) ventilated bus duct has a galvanized sheet steel housing that is both bonderized and painted. It also has special hardware and solid access covers.

Totally enclosed indoor duct is identical to the ventilated indoor except the front and back covers are solid. Totally enclosed weatherproof has solid front and back covers as well as solid access covers.

## construction

All hardware used in assembling low impedance duct is cadmium-plated. Sems fasteners (bolts with shakeproof washers permanently attached) are used to join sections of duct. These fasteners are inserted into drawn, threaded holes in the housing, providing a rigid mechanical connection between all sections of the system.

Bus bars of outdoor ventilated bus duct are insulated their entire length with a polyvinyl chloride plastic material and indoor ventilated bus duct is wrapped with an approved insulating tape except for the ends

which are silver-plated for good contact at lap joints. Instead of drilling the bus bars to make connections, steel inserts are forced under high pressure into one end and slotted holes are used in the other. These steel inserts have large collars on the side of the bar away from the lap. This, together with a large lock washer on the bolt, assures a very low-resistance splice when the bolt is drawn up tight. Joints are staggered so that there is always insulation on the bus bars adjacent to the splice, and are made with heat-treated cadmium-plated steel bolts having a tensile strength of 100,000 lbs. per square inch.

Bus bars of all ratings are insulated and firmly supported on  $\frac{3}{4}$ -inch centers by molded supports spaced at  $14\frac{9}{16}$ -inch intervals. Three  $\frac{5}{16}$ -inch steel bolts hold the supports and bus bars firmly in place. Bus bars of ratings using four bars per phase are supported on  $\frac{3}{4}$ -inch centers by maple blocks spaced at  $20\frac{1}{2}$ -inch intervals. These maple blocks are treated to make them moisture resistant and two  $\frac{3}{8}$ -inch, cadmium-plated, heat-treated steel bolts hold them and the bus bars firmly in place. For reduced reactance, bars of opposite polarity are interlaced to provide a repeating phase sequence.

## standards

Westinghouse low-impedance bus duct is manufactured to withstand short circuit stresses in accordance with NEMA short circuit ratings for busways. These ratings are listed on page 73.

It also meets the following ratings established by Underwriters' Laboratories: ventilated indoor duct from 600 to 5000 amperes using copper bars and from 600 to 4000 amperes with aluminum; ventilated weatherproof from 600 to 3000 amperes with copper bars and 600 to 2000 with aluminum bars. The following ratings are CSA approved: ventilated indoor duct in ratings from 800 to 5000 amperes using copper or aluminum bus bars; ventilated weatherproof duct in ratings from 800 to 5000 using copper bars and from 800 to 3000 amperes using aluminum.

# low impedance duct

straight lengths, fittings, hangers

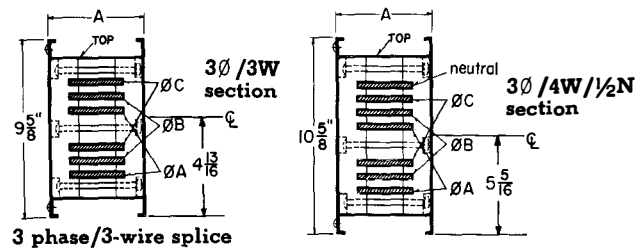
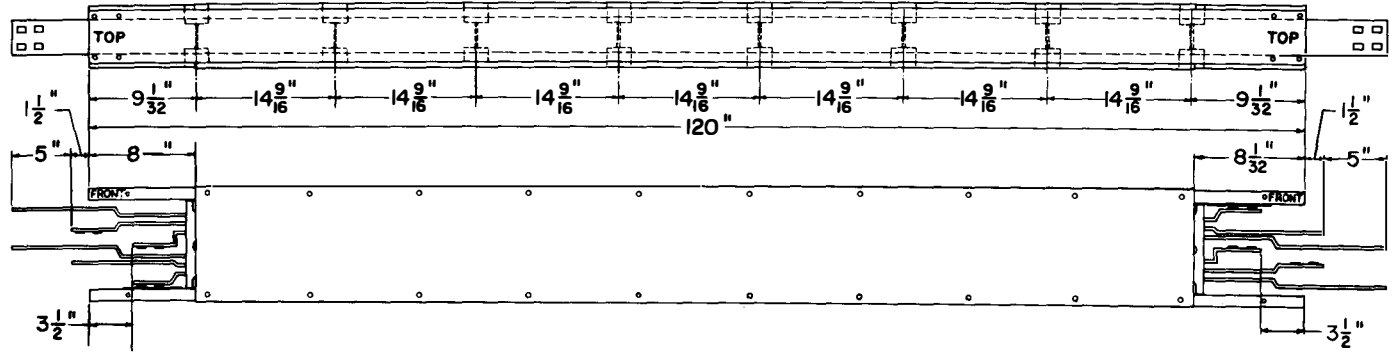
application  
data

30-660

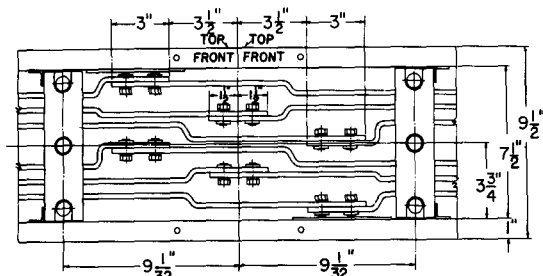
page 27

## straight lengths

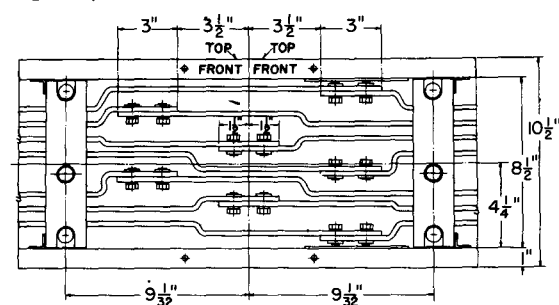
10 foot section top and front views



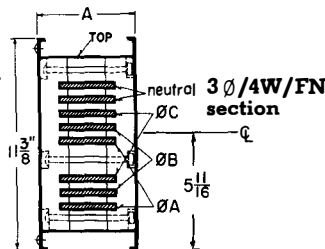
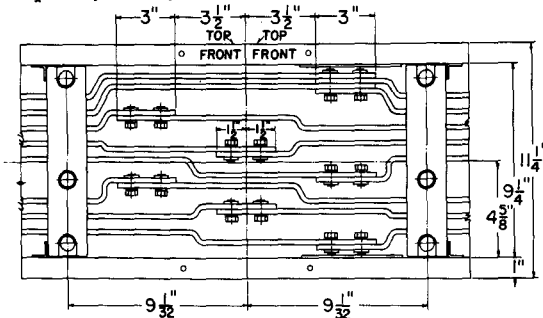
3 phase/3-wire splice



3 phase/4-wire/1/2 neutral splice



3 phase/4-wire/full size neutral splice



ampere rating	short-circuit rating
600	25000
800	25000
1000	50000
1350	50000
1600	50000
2000	75000
2500	75000
3000	75000
4000	100000

Low impedance bus duct can be braced at the factory to withstand short circuit stresses up to 75,000 amps for 2 bus bars per phase or 100,000 amperes for 4 bus bars per phase by the installation of additional bus bar supports.

## channel and bus bar dimensions 2-wire, 3-wire, and 3-phase, 4-wire

### copper low-impedance duct

ampere rating ventilated	ampere rating enclosed	bus bars		bus bars 1/2 neutral		bus bars FN		housing dimensions (inches) A	housing center-line dimensions (inches) A/2
		no.	size (inches)	no.	size (inches)	no.	size (inches)		
600	600	2	1/4 x 1	1	1/4 x 1	2	1/4 x 1	3 3/8	1 11/16
800	800	2	1/4 x 1 1/2	1	1/4 x 1 1/2	2	1/4 x 1 1/2	3 3/8	1 11/16
1000	1000	2	1/4 x 2	1	1/4 x 2	2	1/4 x 2	4 3/8	2 3/16
1350	1350	2	1/4 x 2 1/2	1	1/4 x 2 1/2	2	1/4 x 2 1/2	4 3/8	2 3/16
1600	1300	2	1/4 x 3	1	1/4 x 3	2	1/4 x 3	5 3/8	2 11/16
2000	1600	2	1/4 x 4	1	1/4 x 4	2	1/4 x 4	6 3/8	3 3/16
2500	2000	2	1/4 x 5	1	1/4 x 5	2	1/4 x 5	7 3/8	3 11/16
3000	2250	2	1/4 x 6	1	1/4 x 6	2	1/4 x 6	8 3/8	4 3/16
4000	2640	4	1/4 x 4	2	1/4 x 4	4	1/4 x 4	6 13/32	3 3/16
5000	3300	4	1/4 x 5	2	1/4 x 5	4	1/4 x 5	7 13/32	3 11/16
5600 ①	4000 ①	4	1/4 x 6	2	1/4 x 6	4	1/4 x 6	8 13/32	4 3/16

### aluminum low-impedance duct

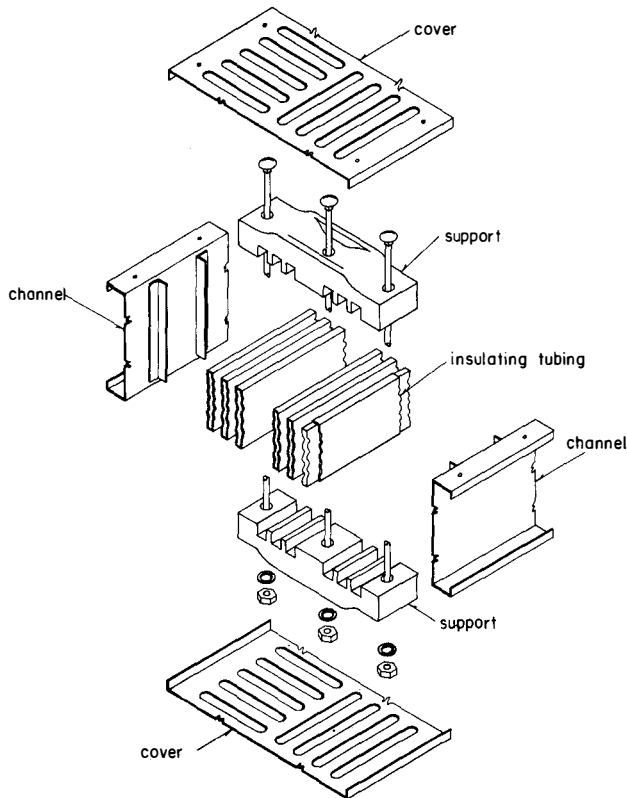
600	600	2	1/4 x 1 1/2	1	1/4 x 1 1/2	2	1/4 x 1 1/2	3 3/8	1 11/16
800	800	2	1/4 x 2	1	1/4 x 2	2	1/4 x 2	4 3/8	2 3/16
1000	1000	2	1/4 x 2 1/2	1	1/4 x 2 1/2	2	1/4 x 2 1/2	4 3/8	2 3/16
1350	1000	2	1/4 x 3	1	1/4 x 3	2	1/4 x 3	5 3/8	2 11/16
1600	1350	2	1/4 x 4	1	1/4 x 4	2	1/4 x 4	6 3/8	3 3/16
2000	1600	2	1/4 x 5	1	1/4 x 5	2	1/4 x 5	7 3/8	3 11/16
2500	2000	2	1/4 x 6	1	1/4 x 6	2	1/4 x 6	8 3/8	4 3/16
3000	2500	4	1/4 x 3	2	1/4 x 3	4	1/4 x 3	5 13/32	2 11/16
4000	3000	4	1/4 x 4	2	1/4 x 4	4	1/4 x 4	6 13/32	3 11/16
	4000	4	1/4 x 6	2	1/4 x 6	4	1/4 x 6	8 13/32	4 3/16

① Not U.L. listed. Higher capacities, made with special mountings, are available. Refer to Westinghouse for additional information.



## straight lengths

### construction details



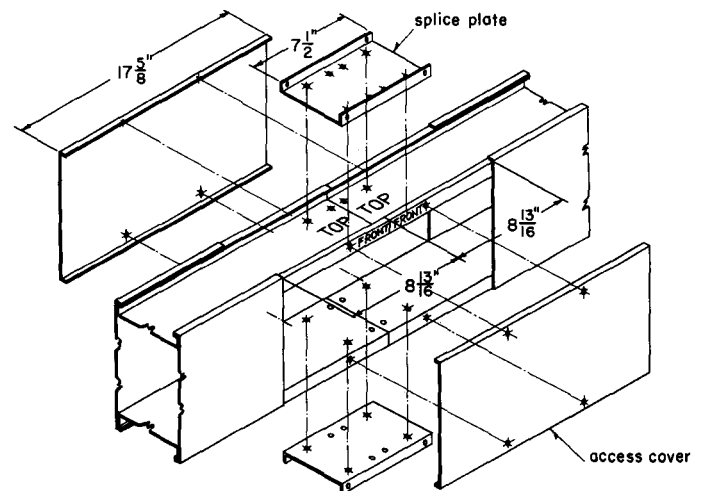
### duct joint

For ease of inspection of bus bar joints and to facilitate installation, access openings to bolted joints are provided on two opposite sides of the duct. This affords ample room for bolting of bus bars. After they are bolted, an access cover 17 $\frac{5}{8}$  inches wide for ventilated indoor and outdoor and totally enclosed indoor covers this opening. On totally enclosed weather-proof the cover is 14 $\frac{1}{2}$  inches wide.

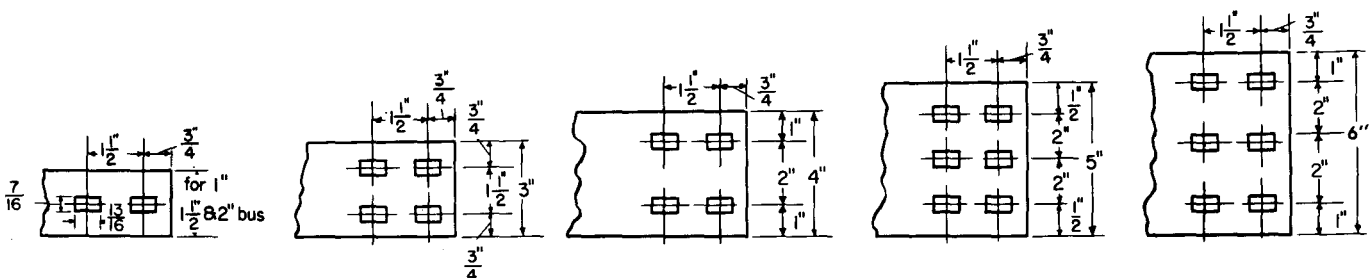
Bus bars are provided with threaded steel inserts at one end and slotted holes at the other for ease in making splices. Offsets near the end of each bar permit the making of neat lap splices.

Heavy 14-gauge steel splice plates telescope inside the top and bottom channels. They are attached by sems fasteners, insuring a strong mechanical connection between housings of adjoining sections.

### duct joint details

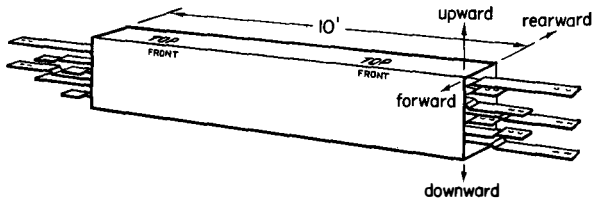


### bus slots for bolting bus bars together



## fittings

key to relationship of fittings to straight lengths.



There are ten basic fittings to meet every application need. These include: flange ends, elbows, tees, offsets, crossovers, reducers, adapter cubicles, ex-

## flange sections

Flange sections are used to make mechanical and electrical connection of busway to other apparatus. Flanges join bus duct housing to the switchgear or switchboard while specially fabricated bus bar extensions connect to the bus work of the apparatus.

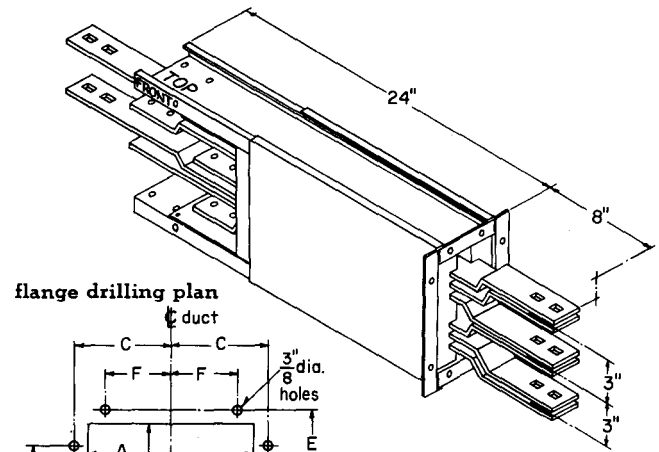
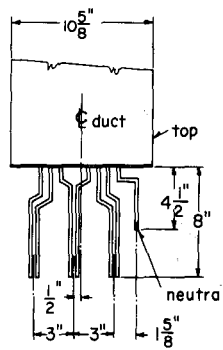
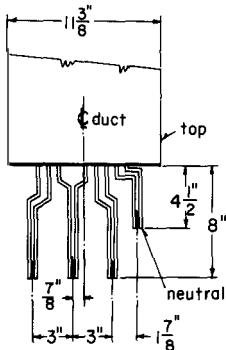
When bus duct extends out of switchgear the opening and flange drillings must be provided by the switchgear builder. In which case, the cutout dimensions and drilling plan shown must be followed. For proper coordination between bus duct and switchgear, detailed drawings must accompany the order.

Standard bus extensions are eight inches long and phase bars are brought together in the housing before extending through the flange. The slotted holes shown on joint details are furnished bus extensions. Flange and bus extension sections are fabricated for either right or left connection to the duct system. Viewing the "FRONT" of the duct system with the "TOP" marking up, the right flange section joins to the right and the left joins to the left end of the system.

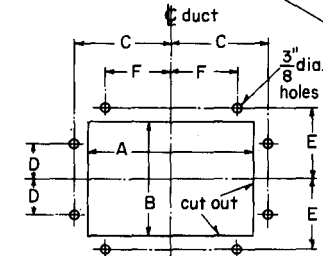
3Ø/4W/FN

3Ø/4W

3Ø/4W/1/2N



flange drilling plan



bus size	type*	A	B	C	D	E	F
1/4 x 1	①	7 1/2	3 1/4	4 3/8	5/8	2 1/4	3
1/4 x 1 1/2	①	7 1/2	3 3/4	4 3/8	7/8	2 1/2	3
1/4 x 2	①	7 1/2	4 1/4	4 3/8	1 1/8	2 3/4	3
1/4 x 2 1/2	①	7 1/2	4 3/4	4 3/8	1 3/8	3	3
1/4 x 3	①	7 1/2	5 1/4	4 3/8	1 5/8	3 1/4	3
1/4 x 4	①	7 1/2	6 1/4	4 3/8	2 1/8	3 3/4	3
1/4 x 5	①	7 1/2	7 1/4	4 3/8	2 5/8	4 1/4	3
1/4 x 6	①	7 1/2	8 1/4	4 3/8	3 1/8	4 3/4	3
1/4 x 1	②	8 1/2	3 1/4	4 7/8	5/8	2 1/4	3
1/4 x 1 1/2	②	8 1/2	3 3/4	4 7/8	7/8	2 1/2	3
1/4 x 2	②	8 1/2	4 1/4	4 7/8	1 1/8	2 3/4	3
1/4 x 2 1/2	②	8 1/2	4 3/4	4 7/8	1 3/8	3	3
1/4 x 3	②	8 1/2	5 1/4	4 7/8	1 5/8	3 1/4	3
1/4 x 4	②	8 1/2	6 1/4	4 7/8	2 1/8	3 3/4	3
1/4 x 5	②	8 1/2	7 1/4	4 7/8	2 5/8	4 1/4	3
1/4 x 6	②	8 1/2	8 1/4	4 7/8	3 1/8	4 3/4	3
1/4 x 1	③	9 1/4	3 1/4	5 1/4	5/8	2 1/4	3 11/16
1/4 x 1 1/2	③	9 1/4	3 3/4	5 1/4	7/8	2 1/2	3 11/16
1/4 x 2	③	9 1/4	4 1/4	5 1/4	1 1/8	2 3/4	3 11/16
1/4 x 2 1/2	③	9 1/4	4 3/4	5 1/4	1 3/8	3	3 11/16
1/4 x 3	③	9 1/4	5 1/4	5 1/4	1 5/8	3 1/4	3 11/16
1/4 x 4	③	9 1/4	6 1/4	5 1/4	2 1/8	3 3/4	3 11/16
1/4 x 5	③	9 1/4	7 1/4	5 1/4	2 5/8	4 1/4	3 11/16
1/4 x 6	③	9 1/4	8 1/4	5 1/4	3 1/8	4 3/4	3 11/16

\* ① 3Ø/3W ② 3Ø/4W/1/2N ③ 3Ø/4W/FN, maximum of two bars per phase. For more than two bars per phase refer to Westinghouse for dimensions.





## fittings

### elbows

Elbows are used to make 90° changes in the direction of busway runs. There are four types available with each leg of the standard elbow being 24 inches long.

#### forward and rearward elbows

Viewing the "FRONT" of a bus duct run with the marking "TOP" up, a forward elbow is used to direct the bus duct run forward. The marking "FRONT" on this elbow is always on the inside of the right angle.

Viewing the "FRONT" of a bus duct run with the "TOP" marking up, a rearward elbow directs run rearward. The marking "FRONT" is always on the outside of the right angle.

#### minimum leg dimensions

2-wire, 3-wire, and 3-phase, 4-wire duct

bus bar size (in inches)	left & right leg 2 & 4 bars per phase (in inches)
1/4 x 1	12
1/4 x 1 1/2	12 1/4
1/4 x 2	12 1/2
1/4 x 2 1/2	12 3/4
1/4 x 3	13
1/4 x 4	13 1/2
1/4 x 5	14
1/4 x 6	14 1/2

#### upward and downward elbows

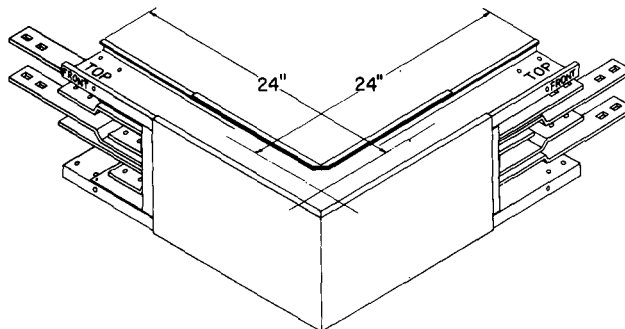
Facing the "FRONT" of a bus duct run with the "TOP" marking up, an upward elbow directs the run upwards.

Viewed from the same direction with the "TOP" marking up, a downward elbow is used to direct the run downward.

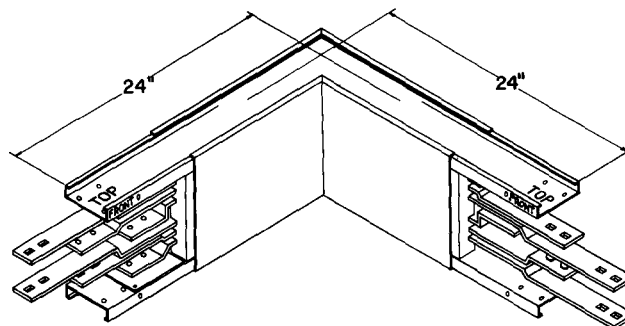
#### minimum leg dimensions

bus bar size (in inches)	left & right leg (in inches)			
	2 bars per phase			4 bars per phase
	2 & 3W	3Ø 4W HN	3Ø 4W FN	2W, 3W, & 3Ø 4W HN & FN
all sizes 1/4 x 1-1/4 x 6	14 7/8	15 3/8	15 3/4	24

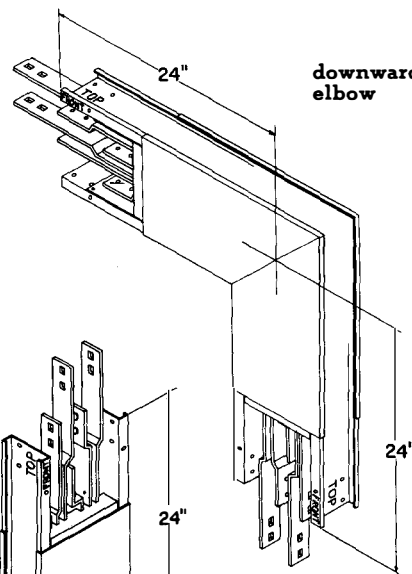
rearward elbow



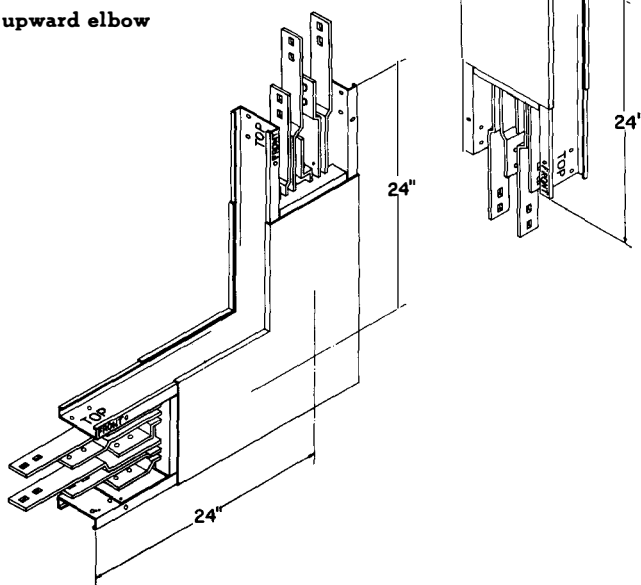
forward elbow



downward elbow



upward elbow



## tees

Tees are busway fittings for making T connections to bus duct. The four standard tees for low-impedance duct are: forward, rearward, upward, and downward. Each leg of a standard tee is 24 inches long, measured from the centerline of the duct to the end of the top or bottom channels.

### forward and rearward tees

Facing the "FRONT" with the marking "TOP" upward, a 24-inch leg extends forward on a forward tee and rearward on a rearward tee from the center of a four foot section of duct.

### minimum leg dimensions 2-wire, 3-wire, and 3-phase, 4-wire duct

bus bar size (in inches)	left, middle, & right leg 2 & 4 bars per phase (in inches)
1/4 x 1	12
1/4 x 1 1/2	12 1/4
1/4 x 2	12 1/2
1/4 x 2 1/2	12 3/4
1/4 x 3	13
1/4 x 4	13 1/2
1/4 x 5	14
1/4 x 6	14 1/2

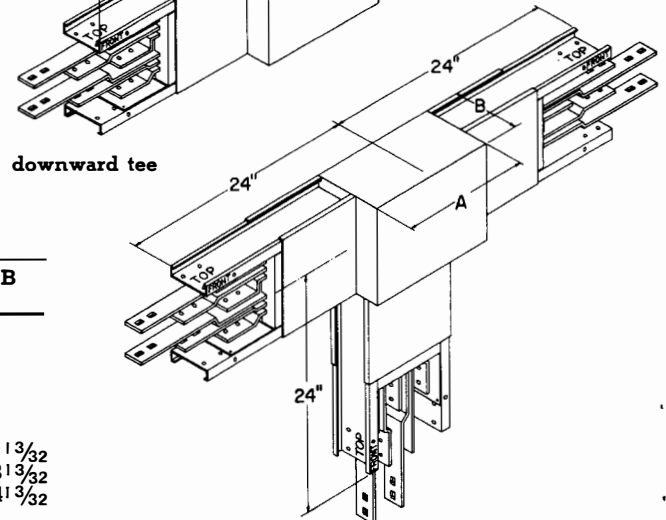
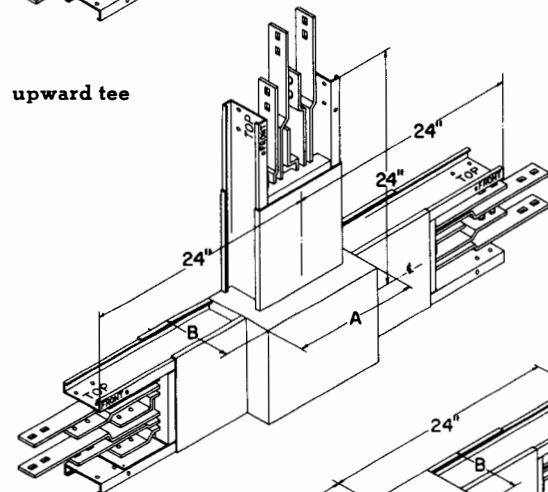
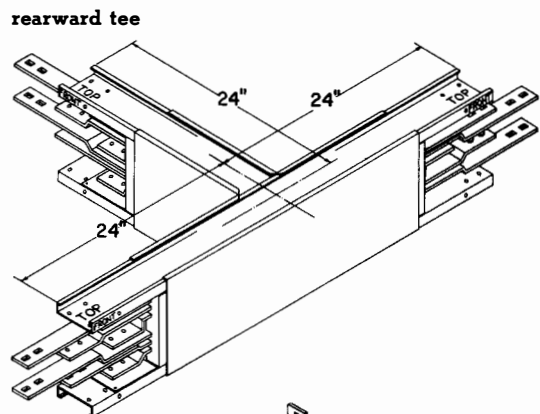
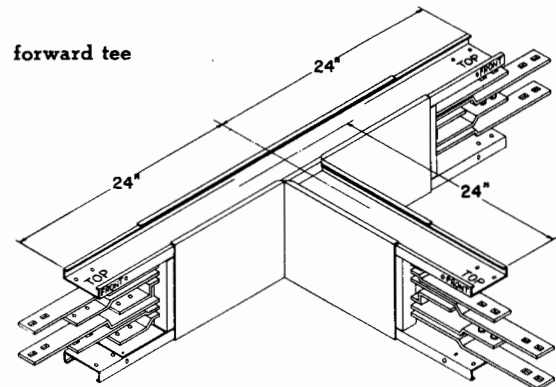
### upward and downward tees

Upward tees have a 24-inch leg extending upward from the center of a 4-foot section of duct with the "TOP" marking up.

With the "TOP" marking up, downward tees have a 24-inch leg extending downward from the center of a 4-foot section of duct.

### minimum leg dimensions left, middle, and right leg

bus bar size (in in.)	3-wire & 4-wire, HN 4-wire, FN						4 bars/phase		
	min. leg	A	B	min. leg	A	B	min. leg	A	B
1/4 x 1	15	11	4 7/8	16	13	4 7/8			
1/4 x 1 1/2	15 1/2	12	5 7/8	16 1/2	14	5 7/8			
1/4 x 2	16	13	6 7/8	17	15	6 7/8			
1/4 x 2 1/2	16 1/2	14	7 7/8	17 1/2	16	7 7/8			
1/4 x 3	17	15	9 3/8	18	17	9 3/8			
1/4 x 4	18	17	11 3/8	19	19	11 3/8	24	24 17/32	11 13/32
1/4 x 5	19	19	12 3/8	20	21	12 3/8	24	26 17/32	13 13/32
1/4 x 6	20	21	14 3/8	21	23	14 3/8	24	28 5/32	14 13/32





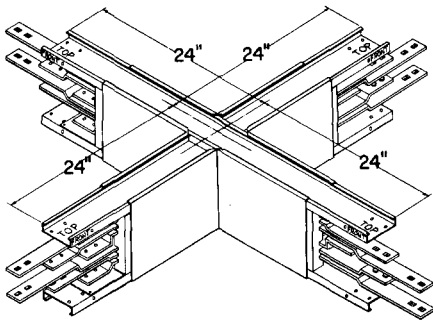
## fittings

### crossovers

A crossover is a busway fitting suitable for connection in four directions. It is used where two runs of duct cross each other in the same plane. There are two types; the forward-rearward and the upward-downward. Each leg is two feet long.

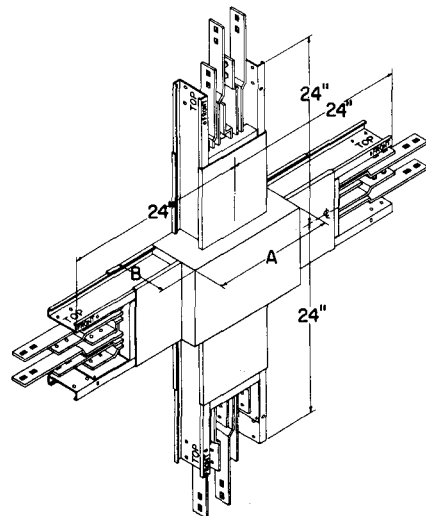
#### forward-rearward

Forward-rearward crossovers are used when two runs of edge-wise mounted duct cross each other in the same plane. They have two 24-inch right angle legs extending from the center of a four foot section of duct.



#### upward-downward

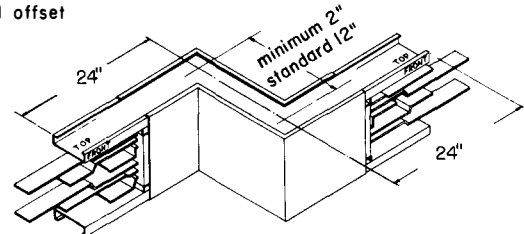
When two runs of flatwise-mounted duct cross each other in the same plane an upward-downward crossover is used. It, too, has two 24-inch right angle legs extending from the center of a four foot section of duct.



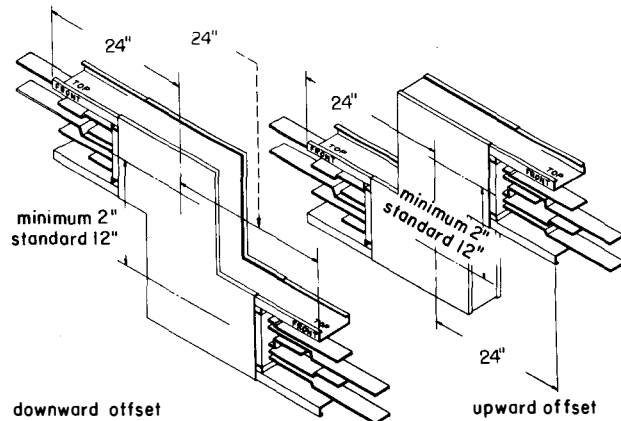
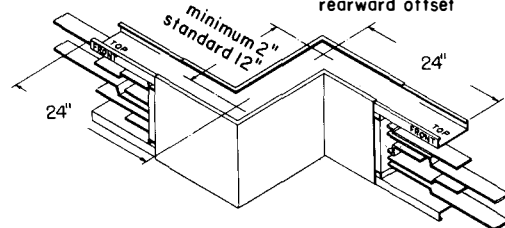
### offsets

An offset is used to avoid obstacles and to conform with building structure. It is simply two elbows fabricated into one unit for use where it is impossible to use a standard elbow because of space restrictions. The minimum left and right leg dimensions are the same as those listed for similar type elbows.

forward offset



rearward offset



downward offset

upward offset

# low impedance duct

straight lengths, fittings, hangers

application  
data

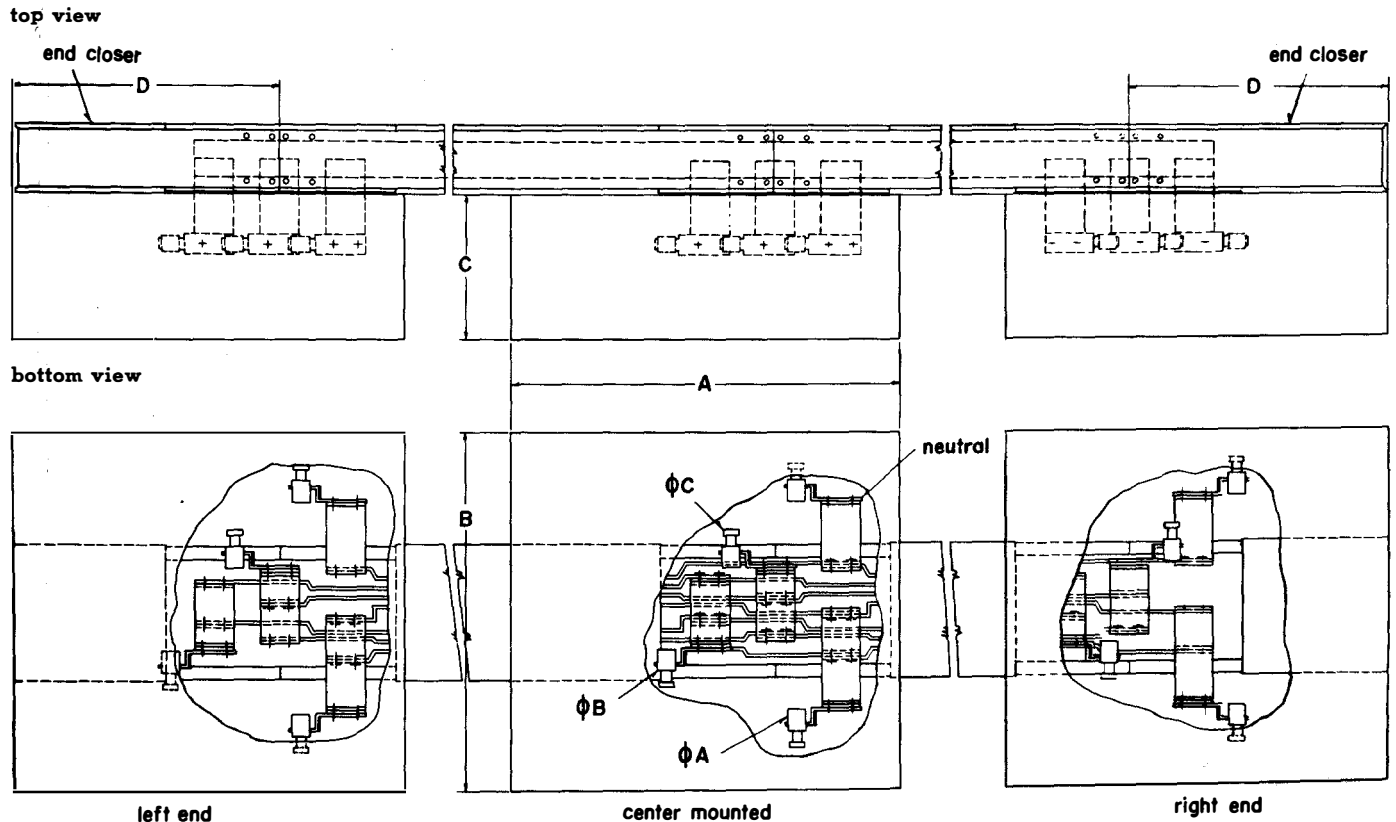
30-660

page 33

## cable tap box bolt-on

This cable tap box is bolted to the front or rear of duct at the splice between duct sections or at the end of a run. When used at the end of a run, it must be in conjunction with a special end closure. The box itself houses the copper bar and solderless lug

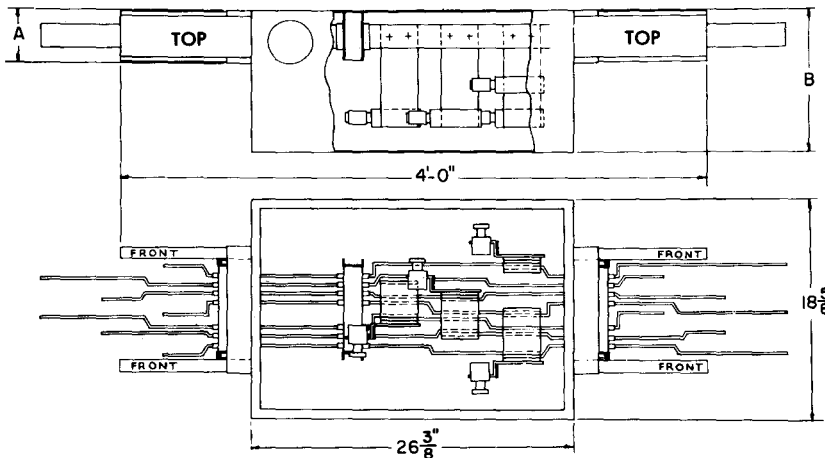
assembly and, since no copper is anchored to the box housing, greater flexibility is obtained. The front cover is removable for easy access to lugs. Number and size of the solderless lugs furnished are listed in the table below.



ampere rating	dimensions (in inches)								lugs used on std. boxes	
	3-wire				3Ø, 4-wire half & full neutral				per phase & full neutral	half neutral
	A	B	C	D	A	B	C	D		
600	30	22	8	20½	30	28	8	20½	2-500 MCM	2-4/0
800	30	22	8	20½	30	28	8	20½	3-350 MCM	3-4/0
1000	36	22	8	26½	36	28	8	26½	3-500 MCM	3-4/0
1350	36	22	8	26½	36	28	8	26½	4-500 MCM	4-4/0
1600	40	22	11⅞	30½	40	28	11⅞	30½	5-500 MCM	5-4/0
2000	40	22	11⅞	30½	40	28	11⅞	30½	7-500 MCM	7-4/0
2250	40	22	11⅞	30½	40	28	11⅞	30½	8-500 MCM	8-4/0
2500	40	22	13½	30½	40	28	13½	30½	9-500 MCM	9-4/0
3000	40	22	13½	30½	40	28	13½	30½	10-500 MCM	10-4/0
4000	40	26	13½	30½	40	28	13½	30½	12-500 MCM	12-4/0
5000	40	26	16½	30½	40	28	16½	30½	16-500 MCM	16-4/0

**fittings****cable tap box** built-in

Built into a 4-foot section of duct, this cable tap box is particularly advantageous when feeding panelboards from a vertical run. (For easy access to lugs, the front cover is removable.) The direction in which the lugs are to point, up or down, should be specified on the order.

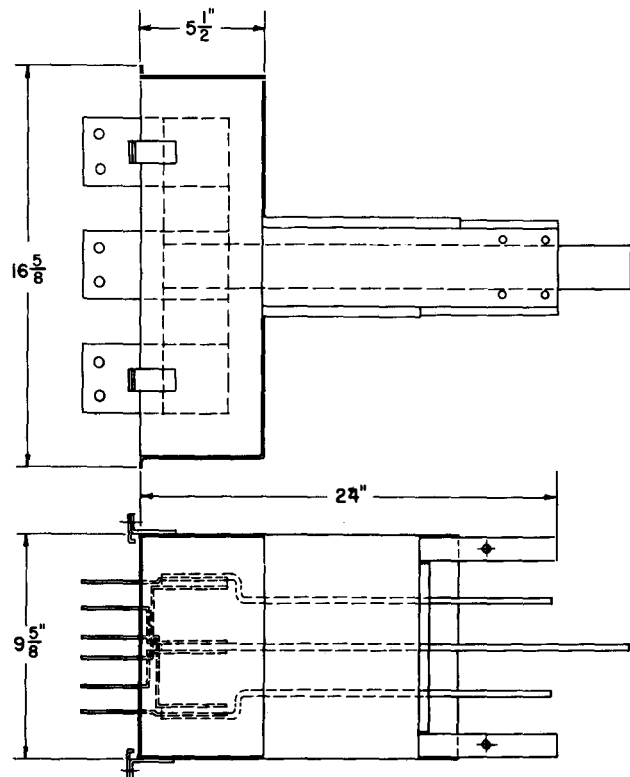


amp rating of tap box	lugs/phase	dimensions (in inches) B
600	2—500 MCM	① A + 4 1/2
800	3—350 MCM	A + 5
1000	3—500 MCM	A + 6
1350	4—500 MCM	A + 7 1/2
1600	5—500 MCM	A + 9
2000	7—500 MCM	A + 12

① refer to page 27 for A dimension

**bolt-on straight length**

By using this fitting, plug-in duct can be extended at right angles to low-impedance. To meet code requirements, the reduction in rating cannot be less than 1/3 of the feeder duct or the overcurrent protection next back on the line, nor can the extension be over 50 feet long without over-current protection at the point of reduction.



## cable tap boxes for panelboard connections

These cable tap boxes are designed for making connection from bus duct risers to power or lighting panelboards. There are two types. One bolts onto the joint between two sections of duct and covers those installations where the panelboard is mounted on the duct. The other type is mounted at the end of a bus duct run where bus duct enters a panelboard at either top or bottom. The drawings below show

panelboards mounted on top of cable tap boxes with the cable entering the bottom of the panelboard. However, cable tap boxes may be mounted on top of panelboards, in which case the cable would enter the top of the panelboard. Westinghouse furnishes a clamp that is fastened to the panelboard mounting holes and is secured to the bus duct by the same universal clamps used on plug-in devices.

## for power panelboards types CDP and NDP

Figure 1

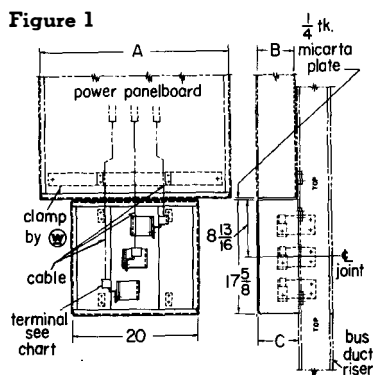
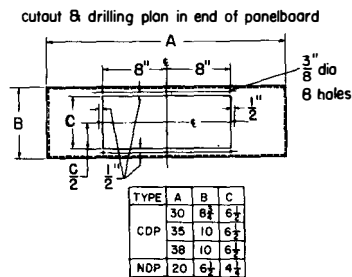
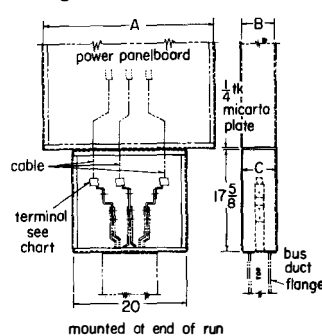


Figure 2

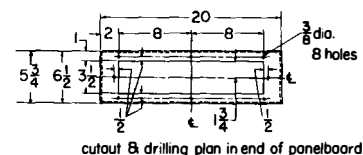
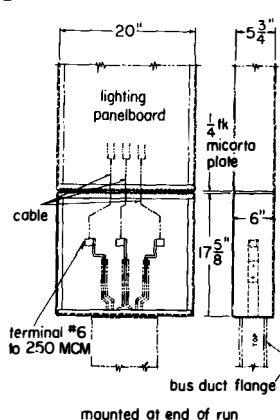
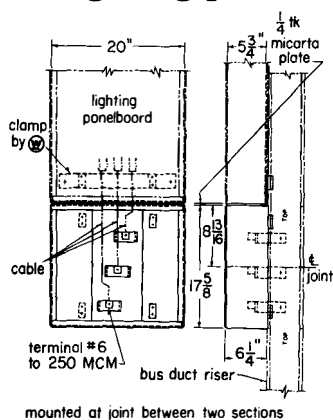


type	A	B	C
<b>CDP</b> Fig. 1	30 35 38	8 3/4 10 10	9 1/4 10 1/2 10 1/2
<b>CDP</b> Fig. 2	30 35 38	8 3/4 10 10	9 10 1/4 10 1/4
<b>NDP</b> Fig. 1	20	6 1/2	7
<b>NDP</b> Fig. 2	20	6 1/2	6 3/4

type CDP capacity & type	terminals in pullbox
400A main lug KL frame	1-1/0 to 600 MCM lug per phase
125A to 350A trip L frame	
125A to 350A trip	
600A or 800A main lugs KL frame	2-4/0 to 500 MCM lugs per phase
400A trip L frame	
400A to 600A trip	
1000A or 1200A main lugs	3-4/0 to 500 MCM lugs per phase

type NDP capacity & type	terminals in pullbox
100A or 225A main lugs E frame J frame KL frame	1-#6 to 250 MCM lug per phase
125A to 225A trip	
KL frame 250A to 400A trip 400A or 600A main lugs	2-4/0 to 500 MCM lugs per phase

## for lighting panelboards types NLAB and NAIB



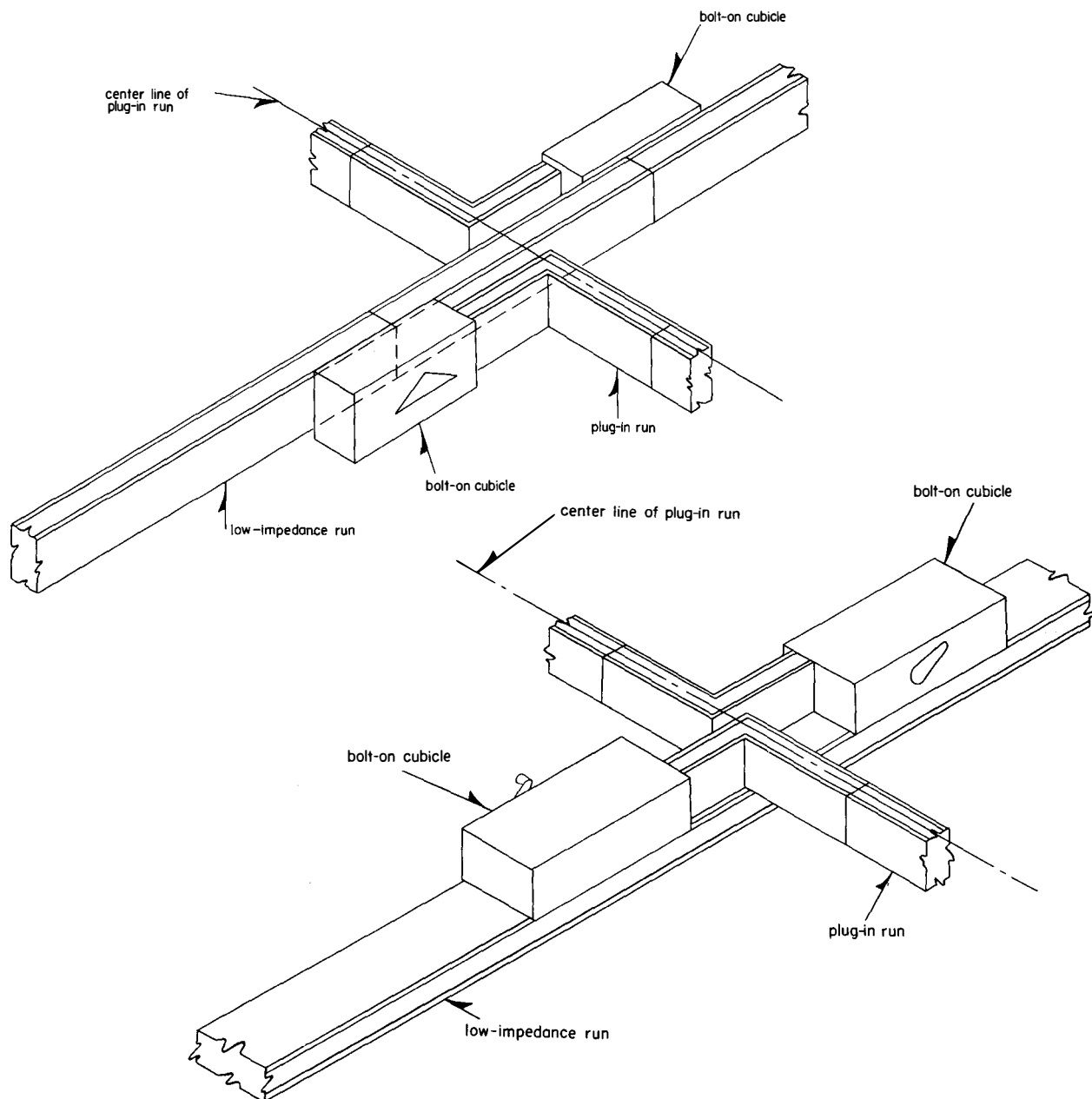


## fittings

### bolt-on cubicles

There are three types of bolt-on cubicles available to take power off of low impedance duct: circuit breaker cubicles using type F, J, KL, L and M breakers, fusible type COP in ratings of 100 and 200 amperes and fusible type TAP in ratings of 100 thru 600 amperes. These cubicles are used as a disconnecting means as well as providing overcurrent protection to branch runs. They are bolted onto duct at a joint.

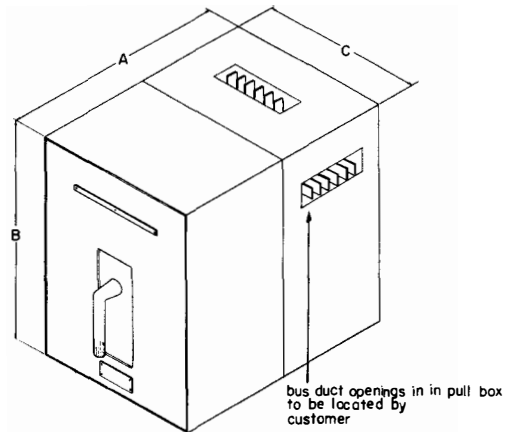
Figure A shows the duct mounted edgewise with the plug-in openings located as close as possible to the low impedance run and all bus duct in the same elevation. Plug-in bus duct elbows are built into the load end of the cubicle. If the duct is mounted flatwise, power can be taken off using an arrangement similar to that described above but with cubicles mounted on the same side of the duct as shown in Figure B.



## DB breaker cubicle

When a breaker with a rating higher than that of a 800 ampere Type M is needed, a DB breaker or its equivalent is used. They are available in continuous ratings of 400 to 4000 amperes with interrupting ratings up to 100,000 amperes.

They are usually used as a main breaker in a run of duct. However, they may be used in a branch circuit run where the larger rating duct enters one side of a pull box and the smaller rating duct leaves the other side. These breakers are furnished as bus duct components and are complete with pull box and provision for incoming and outgoing bus duct.



type breaker <sup>①</sup>	dimensions (in inches)		
	A	B	C
DB-25	26 <sup>5</sup> / <sub>32</sub>	27 <sup>7</sup> / <sub>32</sub>	19 <sup>23</sup> / <sub>32</sub>
DB-50	33 <sup>9</sup> / <sub>32</sub>	29 <sup>31</sup> / <sub>32</sub>	21 <sup>31</sup> / <sub>32</sub>

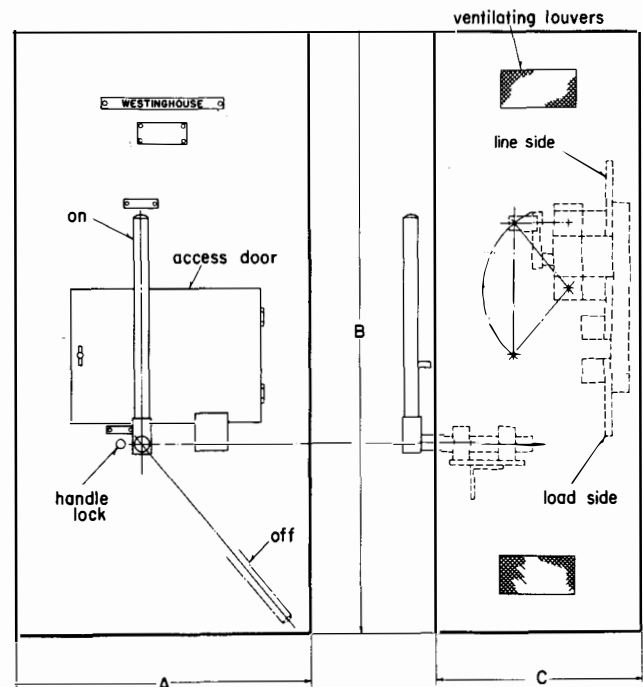
① For DB-75 and DB-100 breaker dimensions refer to Westinghouse.

## pressure type switch

Used primarily for service entrance applications, these switches are available in capacities ranging from 1200 to 5000 amperes for 3-wire or 4-wire service, 600 volts maximum. They have bolted high pressure contacts and are used in conjunction with high interrupting capacity fuses to obtain I.C. of 100,000 amperes. The operating mechanism is so arranged that the first turn closes the blades and a continuing motion of the handle tightens the contact bolts at the hinge and jaw, thus actually bolting the blades and contacts together. They may be obtained in either a wall-mounted or a floor-mounted, free-

standing enclosure. The switch enclosure is complete with internal bussing, duct entrance and exit stubs and external operating handle. Bus duct line and load connections may be located in the upper and lower sides, top of cubicle, and the upper and lower portions of the rear cover when the cubicle is free-standing. Provisions can be made for built-in current transformers and any other modifications which may be required.

ampere rating of switch	voltage	dimensions (in inches)			
		A	B	C	
				minimum	maximum
1200	240	31	63	17	24
	600	41	65		
1600	240	33	65	18	28
	600	41			
2000	240	36	65	18	28
	600	41			
2500	240	37	68	23	36
	600	47			
3000	240	44	71	26	42
	600	47			
4000	240	47	72	28	45
	600	54			
5000	240	51	73	28	45
	600	56			





**fittings****transformer tap openings**

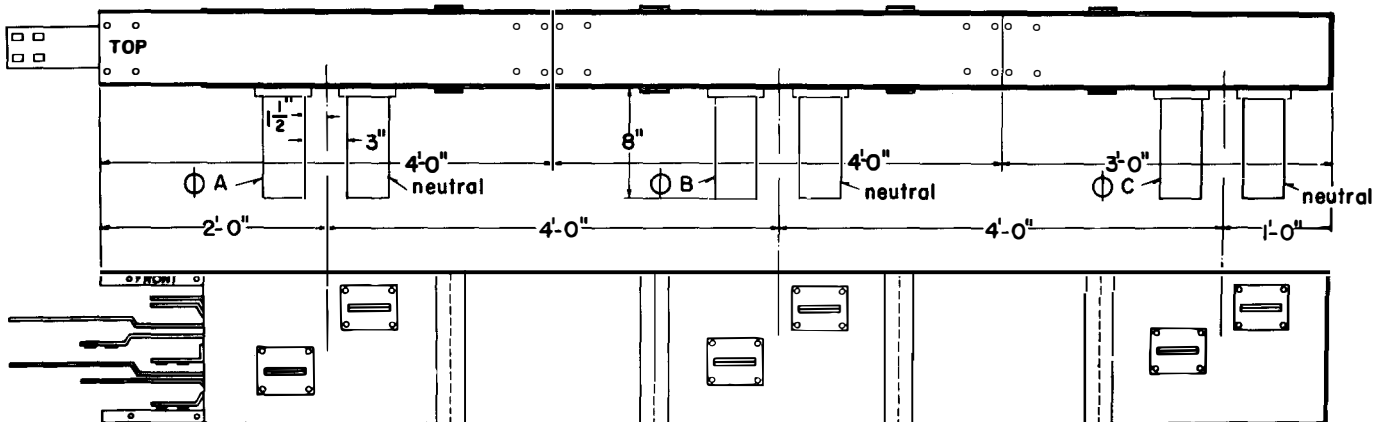
The drawings below show the most common type of transformer tap openings for weatherproof duct. They are also typical of those used on plug-in and low impedance duct for indoor use. Bus bar extensions extend through the duct housing and connection to the transformer is made by cable in a drip loop. The bus extensions do not include drilling or lugs unless specified on the order.

As explained below, **full-size neutral** should be furnished in that portion of a bus duct run extending over three single phase transformers when connected in Wye for either 120/208 volts a-c or 277/480 volts a-c.

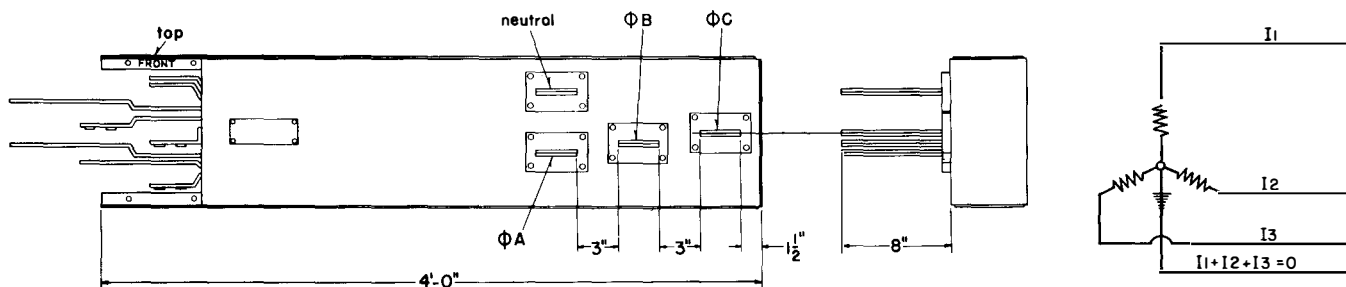
Many, when considering an application of this type, visualize the transformer connection as shown in Figure A. With this type of connection, in the event

the load was balanced equally on all three phases, the resultant neutral current would be zero. It would appear that a half-size neutral in this portion of the bus duct run would be adequate for any unbalance which might normally occur. In actual practice, the physical set-up of a transformer bank in a bus duct run as described above looks like Figure B. The resultant current in the bus bar between transformers T-2 and T-3 is the vectoral sum of  $I_1 + I_2$ , which is the full line current of any single transformer. The current in the neutral bar between transformers T-1 and T-2 is, of course, full line current of transformer T-1. Therefore, for the portion of the bus duct included between transformers T-1 and T-3 it is necessary to provide a **full-size neutral**. The neutral can then be reduced to half size for the balance of the run.

For three single  $\emptyset$  transformers connected in Y or  $\Delta$



for one three  $\emptyset$  transformer with taps staggered



for one three  $\emptyset$  transformer with taps in line

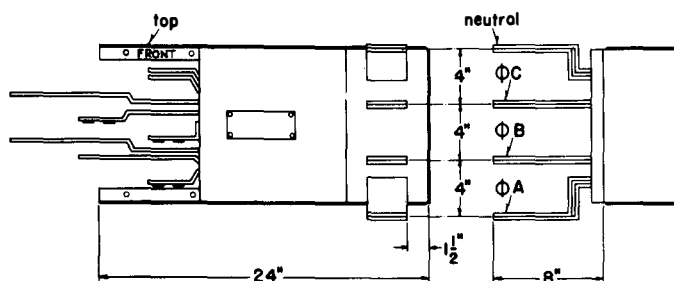


figure A

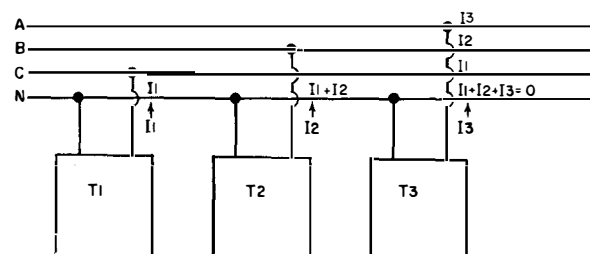


figure B

## weatherhead

A weatherhead or weatherproof cable tap box is used to feed a run of bus duct from a transformer located outdoors. Connections are made through holes in the ebony asbestos bottom plate. Lugs are furnished in the number and size shown in the accompanying table.

ampere rating	no. & size bus bars ① per Ø	no. of lugs per Ø ②	dimensions (in inches)					
			A		B		C	
			FN	1/2 N	3W & 4W 1/2 N & FN	4W 1/2 N	4W FN	3W & 4W 1/2 N & FN
600	2-1/4 x 1	1	1	19 1/2	14	15	17 1/4	6 1/2
800	2-1/4 x 1 1/2	2	1	19 1/2	14	15	17 1/4	7
1000	2-1/4 x 2	2	1	19 1/2	14	15	17 1/4	7 1/2
1300	2-1/4 x 3	3	2	19 1/2	14	15	17 1/4	8 1/2
1600	2-1/4 x 4	3	2	19 1/2	14	15	17 1/4	9 1/2
2000	2-1/4 x 5	4	2	24	14	15	17 1/4	10 1/2
2250	2-1/4 x 6	4	2	24	14	15	17 1/4	11 1/2
2640	4-1/4 x 4	5	3	19 1/2	20 1/4	20 1/4	23 1/2	9 1/2
3300	4-1/4 x 5	6	3	19 1/2	20 1/4	20 1/4	23 1/2	10 1/2

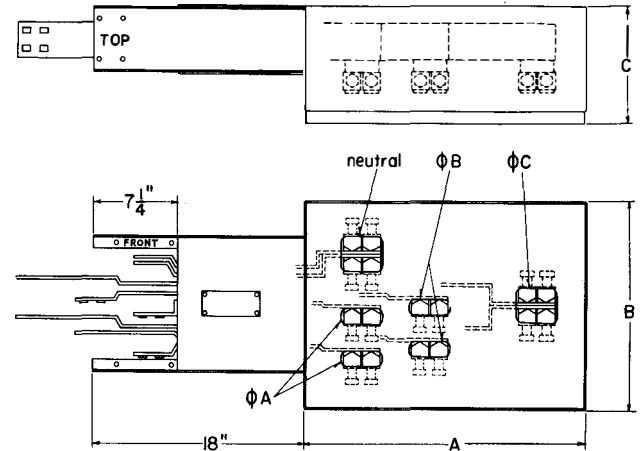
① copper bus bars

② 4/0 to 500 MCM

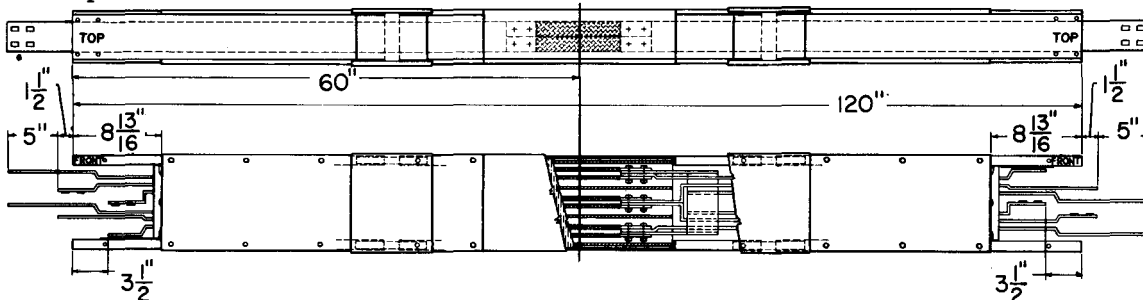
## expansion sections

Expansion sections accommodate the expansion and contraction of bus bars with respect to the enclosure. They are necessary in long, straight runs to compensate for the difference in the coefficient of expansion of steel and copper or aluminum. They are ten foot sections of duct in which the steel housings contain sliding telescopic joints to allow movement of the housings. Inside the telescopic joints lengths of rigid bus bars are replaced by flexible braid surrounded with ebony asbestos. An expansion section should be installed in the

center of any horizontal run of 150 feet or more of copper or of 100 feet or more of aluminum duct. If such a run has an end closer at one end, so that the bus bars are free to move, the expansion section may be omitted. When duct is installed in a vertical position, as in tall commercial buildings, expansion sections should be used at every 50 feet of vertical rise. Also, they *must* be used wherever a run of duct crosses an expansion joint in the building. The use of expansion sections should be engineered for individual installations.



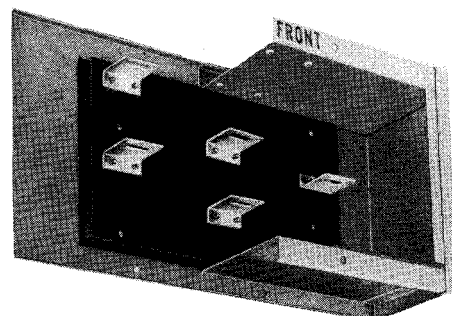
center of any horizontal run of 150 feet or more of copper or of 100 feet or more of aluminum duct. If such a run has an end closer at one end, so that the bus bars are free to move, the expansion section may be omitted. When duct is installed in a vertical position, as in tall commercial buildings, expansion sections should be used at every 50 feet of vertical rise. Also, they *must* be used wherever a run of duct crosses an expansion joint in the building. The use of expansion sections should be engineered for individual installations.



## end closers

The end closer is a fitting which terminates the bus way and closes the open end of a run. When ordering end closers for 4-wire duct, be sure to specify on which end of the duct the unit is to be used. Facing the "FRONT" of a run with the "TOP" marking up, a left end closer would be used on the left end of the run; and a right end closer would be used on the right end of the run. For the 3-phase duct the end closers are interchangeable from right to left. End closers for the right end of the duct come complete with splice plates and access covers. Those for the left end are not so equipped since the splice plates

and access covers come with the left end of the duct sections.





## fittings

### adapter cubicles

In many instances, it is economical to reduce the ampere rating of the duct as the load drops off. In this case, whenever the rating is reduced more than two-thirds of the rating of the overcurrent protection next back on the line or the length of the reduced run is over 50 feet an overcurrent protective device must be used to meet NEC requirements.

Adapter cubicles are available with either a circuit

#### circuit breaker adapter cubicles

Overall length of circuit breaker cubicles using the type M or L breaker, with maximum bus duct rating of 800 to 1000 amperes respectively, is 60 inches. Facing the "FRONT" of a right cubicle with the marking "TOP" up, the larger size duct is on the left end or the line side and the smaller size duct is on the right end or load side of the cubicle. Viewing the "FRONT" of a left cubicle with the marking "TOP" up, the larger size duct is on the right end or the line side of the cubicle, while the smaller size duct is on the left end or load side.

#### safety switch adapter cubicles

This is a heavy-duty safety switch built into a section of duct. It assures continued performance and safety under the most severe type of application. This switch is available in continuous ratings of 600, 800 and 1200 amperes for adapting from a larger to smaller rating of low impedance duct.

Facing the "FRONT" of a right fused switch cubicle with the marking "TOP" up, the larger size duct is on the left end or line side of the cubicle, with the smaller size duct on the right end or load side.

When viewing the "FRONT" of a left fused switch cubicle with the marking "TOP" up, the larger size duct is on the right end or the line side, while the smaller duct is on the left end or load side. Operating handle is on the bottom.

### reducers

Reducers are used to reduce the capacity of bus duct without overcurrent protective devices. They are built into a 36-inch section of duct. For A and B dimensions, see page 27.

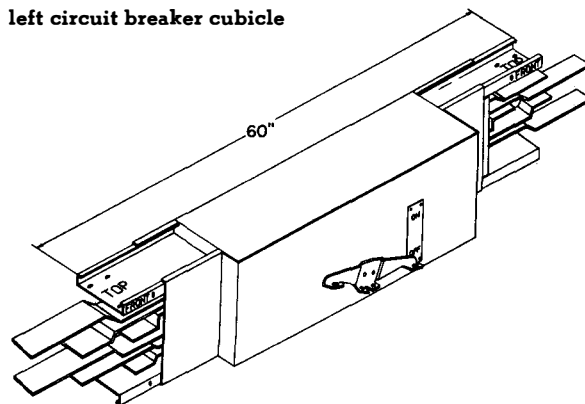
No overcurrent protection is required where bus duct is reduced in size provided the length of the smaller duct does not extend more than 50 feet and has a current rating at least  $\frac{1}{3}$  that of the breaker next back on the line.

**left reducer:** If, when facing the "FRONT" of a bus duct run with marking "TOP" up, one desires to reduce the capacity of the run at its left end, a left reducer is used. Viewing the "FRONT" of a left reducer the larger size bus bars are on the right and the smaller size bars on the left.

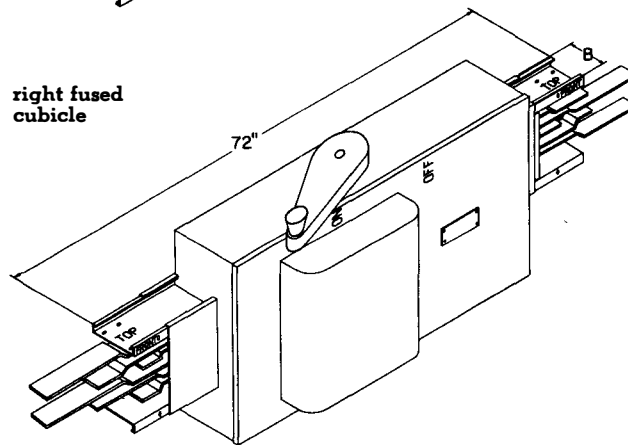
**right reducer:** A right reducer is used to reduce the capacity of the run at its right end when viewing the "FRONT" of a bus duct run with marking "TOP" up. Facing the "FRONT" of a right reducer the bus bars are reduced from left to right.

breaker or heavy duty fused safety switch to furnish overcurrent protection and serve as a disconnecting means. Reduction in bus capacity is made within the cubicle. The line side of the cubicle is connected to the large rating of duct and the load side to the reduced rating of duct. These cubicles may also be used when adapting from low impedance to plug-in bus duct.

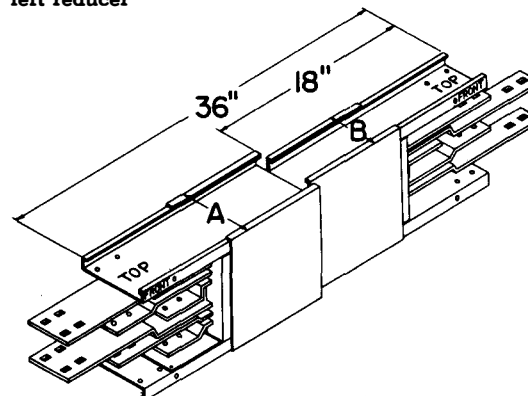
left circuit breaker cubicle



right fused cubicle



left reducer



## hangers for low impedance duct

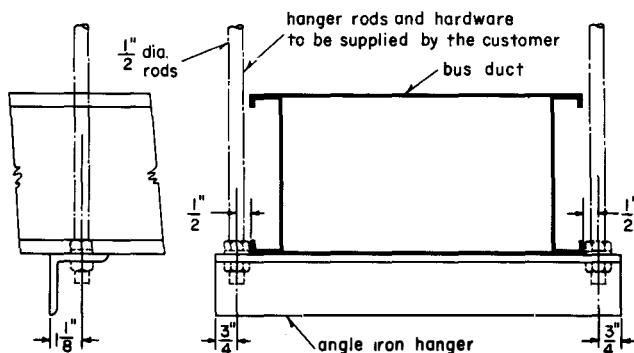
### cantilever and "C" type

Low impedance duct is supplied equipped with one hanger for every five feet of duct. Cantilever hanger or "C" type hangers can be used on ventilated indoor and outdoor or totally enclosed indoor duct up to and including the bar sizes shown in the accompanying table. "C" type hangers can be used on 3-phase, 4-wire half neutral systems but cannot be used on full neutral systems. However, the cantilever hanger can be used on either half or full neutral systems. (See plug-in Section, page 66.) Both may be used on indoor duct when bus bars do not exceed the sizes listed below.

no. and size bus bars (in inches)	system	type of bus bar
2- $\frac{1}{4}$ x 4	3 & 4-wire	copper
2- $\frac{1}{4}$ x 6	3 & 4-wire	aluminum

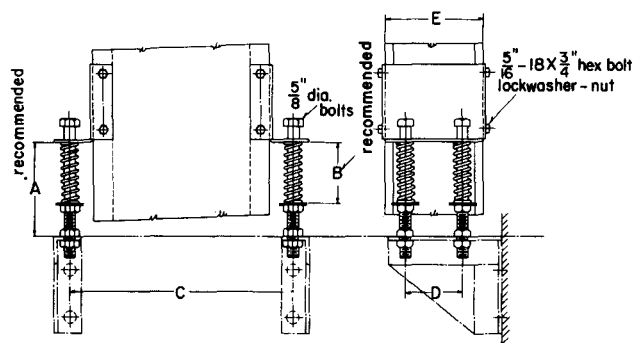
### angle-iron hangers

For all sizes above those listed for cantilever or "C" type, an angle-iron hanger with two supporting rods is used. The angle-iron hanger is  $\frac{1}{4}$ -inch thick and each leg is two inches. Although the drawing shows bus duct mounted flatwise, it may be mounted edgewise. Angle-irons come with bus duct but the customer furnishes hanger rods and hardware.

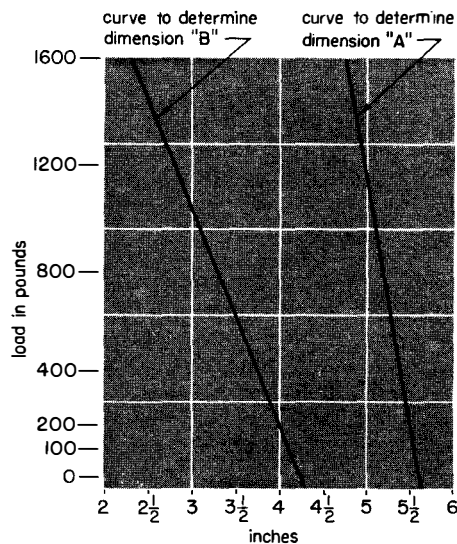


### hanger for vertical mounting

This unique hanger equalizes the weight of vertically mounted duct among all supports. A vertical hanger should be used for every ten feet of duct. However, if floors are not over 12 feet apart one hanger per floor may be used. Although the tables and drawings apply to low-impedance duct, this hanger may be used with plug-in duct.



deflection diagram



no. of bars per/phase	system	dimensions (in inches)		
		C	E	D
2	3-wire	12 $\frac{3}{16}$	3 $\frac{3}{8}$	1 $\frac{7}{8}$
2	4-wire, $\frac{1}{2}$ neutral	13 $\frac{3}{16}$	3 $\frac{7}{8}$	1 $\frac{15}{16}$
2	4-wire, full neutral	13 $\frac{15}{16}$	4 $\frac{3}{8}$	2 $\frac{3}{16}$
4	3-wire	20 $\frac{3}{32}$	4 $\frac{7}{8}$	2 $\frac{1}{16}$
4	4-wire, $\frac{1}{2}$ neutral	20 $\frac{3}{32}$	5 $\frac{3}{8}$	3 $\frac{3}{16}$
4	4-wire, full neutral	24 $\frac{9}{32}$	6 $\frac{3}{8}$	4 $\frac{3}{16}$
			7 $\frac{3}{8}$	5 $\frac{3}{16}$
			8 $\frac{3}{8}$	6 $\frac{3}{16}$



## typical specifications for low impedance bus duct

### general

The bus duct shall be of the { totally enclosed type  
ventilated }  
with two or more { aluminum  
copper } conductors per phase supported in a sheet steel housing. The complete installation shall be coordinated throughout, rigid in construction, of uniform size, and neat and symmetrical in appearance. As many sections as possible shall be ten-foot lengths. Special sections and/or fittings shall be provided only where necessary to suit the installation. Access openings to the bolted joints of conductors shall be provided on two opposite sides of the duct. Conductor joints shall be made in such a manner that no increase of enclosure size is required at the splice between adjoining sections. One Hanger shall be provided for every 5'-0" of horizontally-mounted duct; however, the duct shall be suitable for being supported on 10'-0" support spacing.

For vertically-mounted duct, one adjustable vertical hanger shall be provided per 12'-0" of riser or per span between floors. The bus duct shall be listed by Underwriters' Laboratories including mounting in either the horizontal or vertical position. The bus duct shall be as manufactured by Westinghouse or approved equal.

### enclosure

The duct housing, which shall be made from 16-gauge steel or heavier, according to Underwriters' standards, shall be of the 4-channel interlocking type of construction. It shall be bonderized both inside and outside and given one coat of gray, baked-on enamel. At least two sides of the ventilated duct shall have perforations stamped out. Two removable access covers shall be provided at each splice to insure ease of inspection of bus bar joints and to facilitate the bolting-on of current take-off devices. Two splice plates shall also be provided at each splice to insure a strong, positive, mechanical connection being made between the housings of adjoining sections.

### conductors

The conductors for aluminum shall be fabricated from high-strength, 55% minimum conductivity, extruded aluminum bus bars. Bars shall be of the rectangular type with edges having rounded corners. All aluminum bus bars shall be plated electrolytically with a minimum thickness of .0002" of silver where the lap joint is made. Except for the portion required for the lap joint, the bus bars shall be insulated their entire length with varnished cambric tape of not less than .036" total thickness or other approved

insulating sheath. Bars shall be provided with threaded steel inserts at one end and slotted holes at the other for ease in making splices. Offsets in each bar shall be provided near its extremities to permit the making of neat lap splices. Joints shall be made with not less than two bolts which shall be of heat-treated, cadmium-plated steel and with a tensile strength of 100,000 lbs. per sq. inch.

The conductors for copper shall be fabricated from the best grade, 98% conductivity, pure copper bus bars. Bars shall be of the rectangular type with full, rounded edges. All copper bus bars shall be silver-plated where the lap joint is made. Except for the portion required for the lap joint, the bus bars shall be insulated their entire length with varnished cambric tape of not less than .036" total thickness or other approved insulating sheath. Bars shall be provided with threaded steel inserts at one end and slotted holes at the other for ease in making splices. Offsets in each bar shall be provided near its extremities to permit the making of neat lap splices. Joints shall be made with not less than two bolts which shall be of heat-treated cadmium-plated steel and with a tensile strength of 100,000 lbs. per sq. inch.

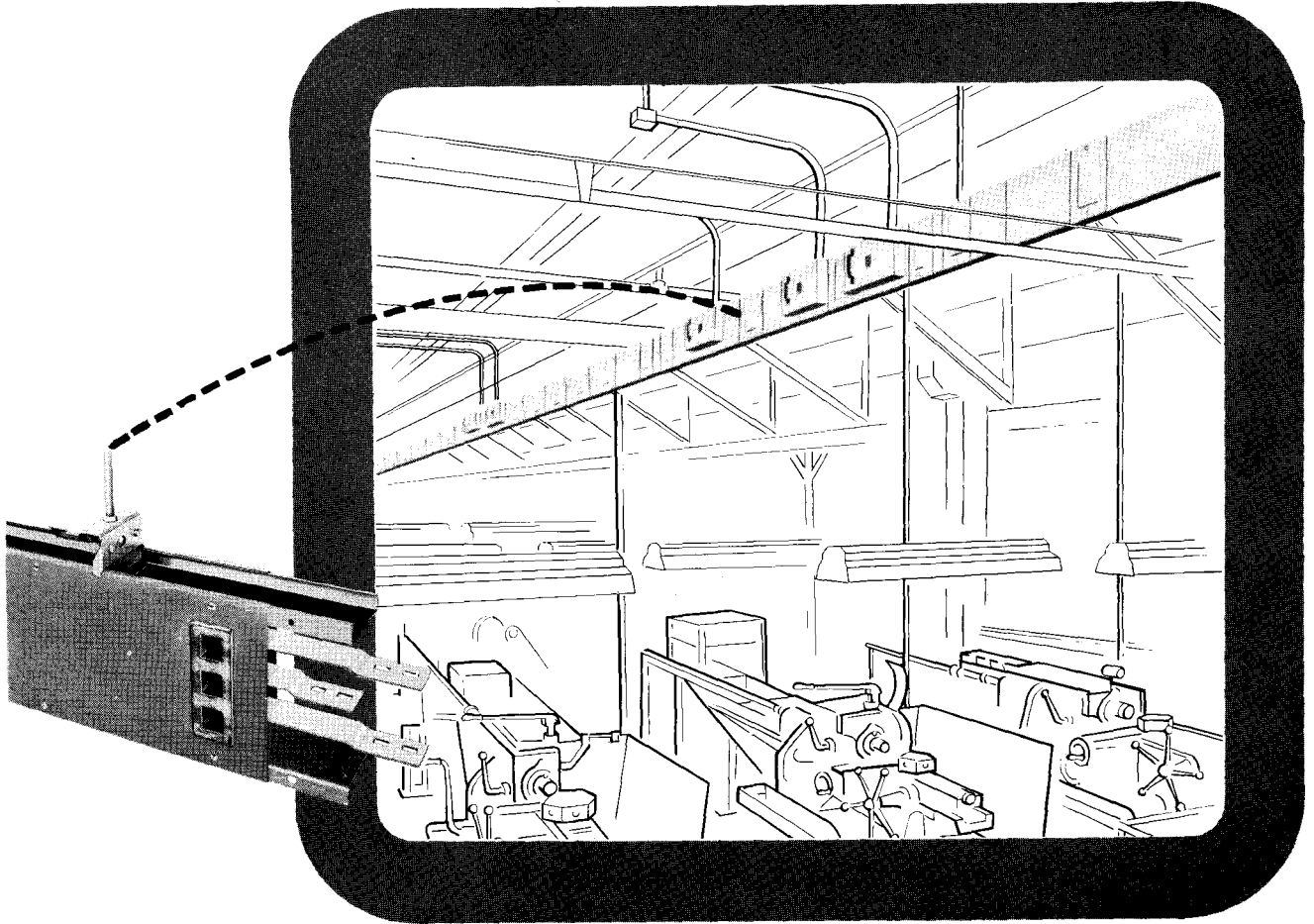
### bus bar assembly

The bus bars shall be assembled on  $\frac{3}{4}$ " centers in such a manner that their flat sides shall be adjacent. In order to reduce reactance, bars of opposite polarity shall be interlaced to provide a repeating phase sequence. Four-wire systems shall have all neutral conductors assembled entirely to one side of the phase bars assembly. The bus bar assembly shall withstand short circuit stresses in accordance with Nema short circuit ratings for busways. Consequently, bus bar supports shall be located on not greater than  $17\frac{1}{2}$ " centers for 2 bars per phase duct and not greater than 21" when more than 2 bars per phase are used. Bus bar supports shall be of the clamp type, not integral with the housing, nor dependent upon the housing for either action or strength. Bus bar joints shall be so arranged that no additional insulation need be applied at installation on joints of opposite polarity.

### operating characteristics

The bus duct shall be so designed and tested that, at rating, no part shall exceed 55°C rise; nor shall the current density exceed 1200 amps per sq. inch. Moreover, impedance characteristics of the duct shall be such that, at rating, the line-to-line voltage drop will not exceed 3 volts in 100 feet for any system power factor. The bus duct shall withstand for one minute without breakdown the application of 2200 volts of 60 cycle alternating potential between conductors and between conductors and enclosure.

*straight lengths, fittings, plug-in  
protective devices, hangers*

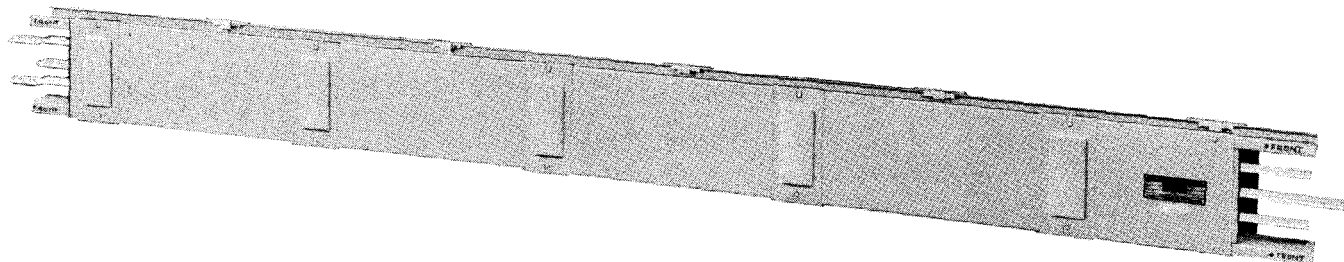


**in this section:**

<b>description</b>	<b>page</b>	<b>description</b>	<b>page</b>
<b>straight lengths (10 ft. sections)</b>		<b>plug-in protective devices</b>	
3-wire .....	45	circuit breaker plug-ins .....	60
2 and 4-wire .....	45	safety switch plug-in, type TAP .....	62
duct joint and bus slots .....	46	cover operated switch plug-in, type COP .....	63
<b>fittings</b>		combination Linestarter plug-ins .....	64
flange sections .....	47	straight length plug-ins .....	64
elbows .....	48	tap box plug-in .....	65
offsets .....	50	ground detector and neutralizer plug-in .....	65
tees .....	51	load center plug-in units .....	65
crossovers .....	53	transformer plug-in units .....	65
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adapter cubicles .....	55	<b>hangers for plug-in duct</b>	
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## general information



### application

Plug-in bus duct consists of bus bars supported in air by Rosite insulators and enclosed in a steel housing. It is far superior to other types of power distribution systems where frequent tap-off locations are necessary . . . places such as manufacturing areas with heavy concentrations of electrical machinery and lighting.

This is because the Rosite insulators also serve as plug-in receptacles. They are spaced at 11½ inch intervals, staggered so that adjacent receptacles fall on opposite sides of the duct. Therefore, power can be taken off close to its utilization point no matter where it is needed.

### construction

Plug-in bus duct is furnished with either copper or aluminum bus bars. The maximum ratings are 1500 amps for copper and 1000 amps for aluminum. Two and 3-conductor duct is designed for 600 volts maximum and three-phase, 4-wire duct for 120/208 volts. The latter is also available for 277/480-volt systems.

Housing is manufactured of 16-gauge steel with channel construction on all four sides. These channels are interlocked to provide an extremely rigid housing which assures proper mating of bus bars with those of the adjacent sections. Top, bottom, and rear

channels are spot-welded together while the front channel is fastened with Phillips-head, self-tapping screws.

### assembly

Assembled sections of duct are plainly marked TOP and FRONT to ease installation. Facing the "FRONT" of the duct with the marking "TOP" upward, bus bars at the left end of a section are offset downward and those at the right end are straight. *When assembling the system, "TOP" and "FRONT" markings of adjacent sections must match.*

Front and back channels are identical and measure 9½ inches. This dimension remains constant for all sizes of duct from the 225-ampere to the 1500-ampere rating in 2-wire; 3-wire; and 3-phase, 4-wire duct. Width of the duct varies with the size of bus bars and the dimensions for available ratings in both copper and aluminum are tabulated on the following page.

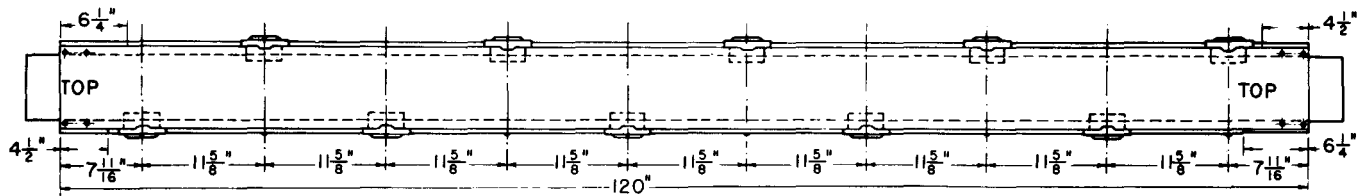
### standards

All Westinghouse plug-in duct in ratings from 225 amperes up to and including 1000 amperes is listed by Underwriters' and CSA approved. Sections used for vertical installation are so marked. Plug-in duct is manufactured in accordance with NEMA standards for bus duct short circuit withstanding strength which is 15,000 amperes for 225 ampere duct and 25,000 amperes for 400, 600, 800 and 1000 ampere duct.

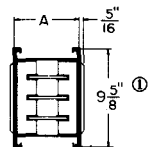
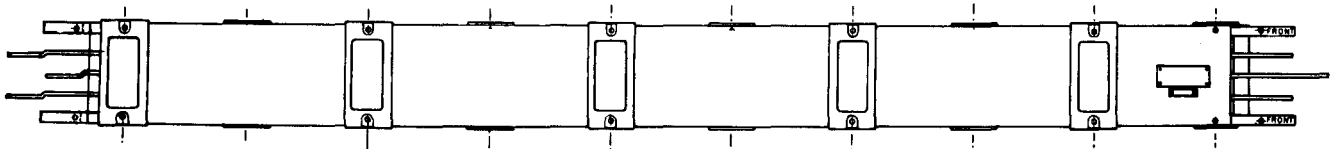
*straight lengths, fittings, plug-in  
protective devices, hangers*

## straight lengths

top view—ten foot section—all straight lengths



## 3-wire duct



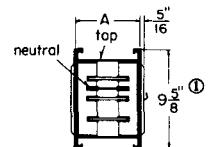
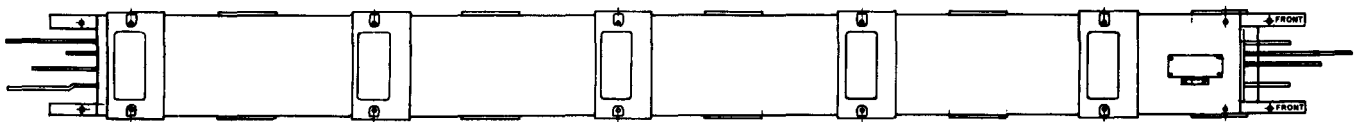
## 2-wire and 4-wire duct

All dimensions and construction features of plug-in duct are applicable to 2 and 4-wire duct as well as 3-wire. Four-wire duct has either a half or full-size neutral bus bar inserted between the top and middle bus bars. In addition, an opening to accept the neutral stab is located at the right-hand side of the plug-in insulator. In order to cover this opening when not in use, an outlet cover slightly wider than that for 2-wire and 3-wire duct is employed. To accommodate the neutral in 3-phase, 4-wire bus duct, the offset in the bus bars differs from the 2- and 3-wire duct as indicated in the following drawing.

For 3-phase, 4-wire plug-in bus duct systems serving a combination power and lighting load, a half-size neutral is normally sufficient. However, when the load is completely lighting or a major portion of the total, a full-size neutral is recommended.

The 2-wire duct is, in all respects, identical with the 3-conductor, except that the middle bus bar is omitted.

Straight lengths of duct are available in lengths from 2 through 10 feet in increments of one foot.



## channel and bus bar dimensions plug-in duct: 2-wire, 3-wire, and 3-phase, 4-wire

rating of duct (in amperes)	bus bar size (in inches)		neutral bar (in inches)		housing dimension "A" (in inches)	
	copper	aluminum	copper <sup>②</sup>	aluminum	copper	aluminum
					(centerline)	(centerline)
225	1/8 x 7/8	1/4 x 7/8	1/8 x 7/8	1/4 x 7/8	3 3/8	1 11/16
400	1/4 x 1 1/2	1/4 x 2	1/8 x 1 1/2	1/4 x 2	3 3/8	1 13/16
600	1/4 x 2	1/4 x 4	1/8 x 2	1/4 x 4	4 3/8	2 3/8
800	1/4 x 3	1/4 x 5	1/8 x 3	1/4 x 5	5 3/8	2 11/16
1000	1/4 x 4	1/4 x 6	1/8 x 4	1/4 x 6	6 3/8	3 3/8
1250	1/4 x 5		1/8 x 5		7 3/8	3 11/16
1500	1/4 x 6		1/8 x 6		8 3/8	4 3/8

② full-size neutral can be supplied on request. ① centerline dimension 4 13/16"



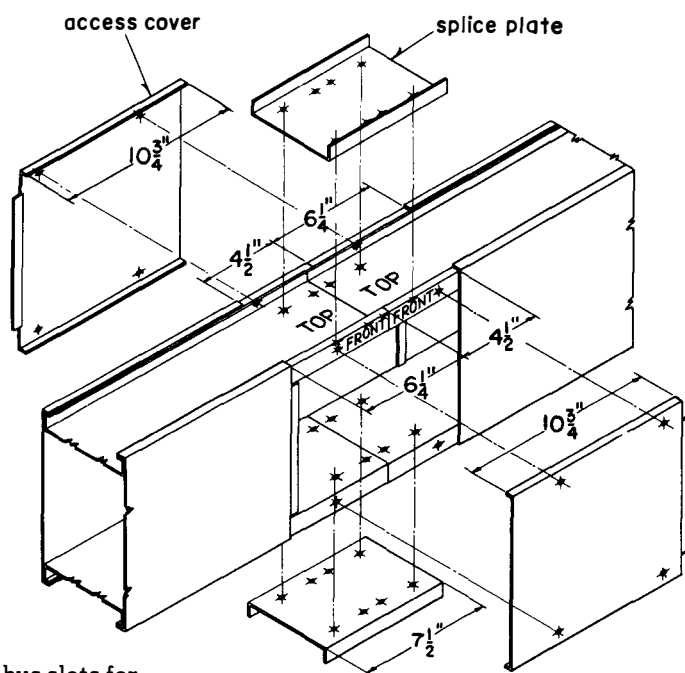
## straight lengths

### duct joint and bus slots

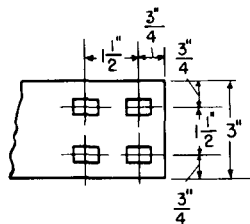
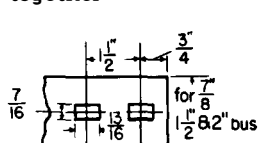
To facilitate installation and inspection of bus duct, an opening  $10\frac{3}{4}$  inches wide is provided in the front and rear channels at each splice. This affords ample room for bolting of bus bars. After they are bolted, an access cover  $9\frac{5}{8}$  inches by  $10\frac{3}{4}$  inches covers this opening and is held in place by Sems fasteners.

Bus bars on the left of each section are offset slightly so that proper electrical clearances are maintained and bars of mating sections are in the same relative plane. In joining bus bars of any two sections, heat-treated, cadmium-plated bolts having a tensile strength of 100,000 pounds per square inch are used.

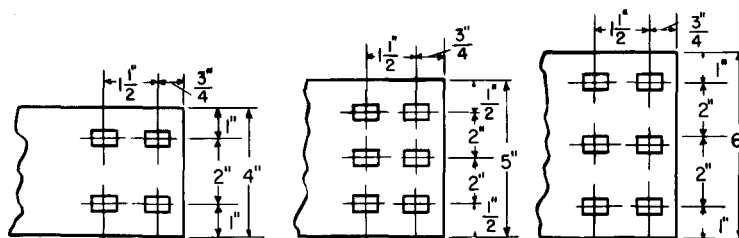
typical plug-in duct joint



bus slots for bolting bus bars together



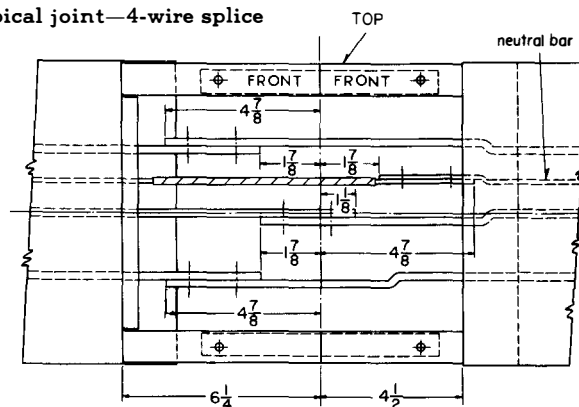
note: all slotted holes  $\frac{7}{16} \times \frac{13}{16}$   
except  $\frac{7}{8}$  bus, it has  $\frac{11}{32} \times \frac{11}{16}$  holes



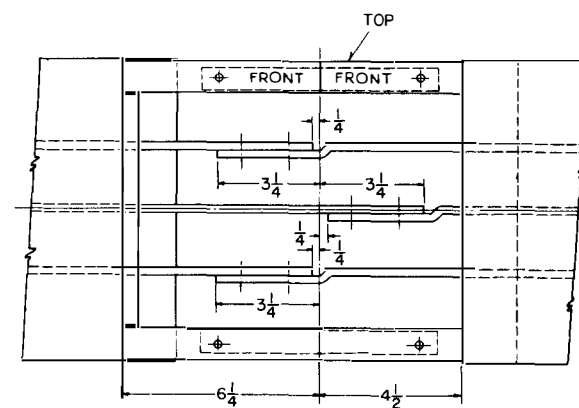
Rectangular slots in the bus bars simplify installation since they do not have to match perfectly when inserting bolts. The same slots are furnished in extensions for flange sections. Since they are silver-plated, a non-oxidizing contact surface is assured between the two joining ends of the bus bars.

Heavy 14-gauge steel splice plates telescope inside the top and bottom channels. They are attached by means of Sems fasteners—cadmium plated bolts with shakeproof washers permanently attached.

typical joint—4-wire splice



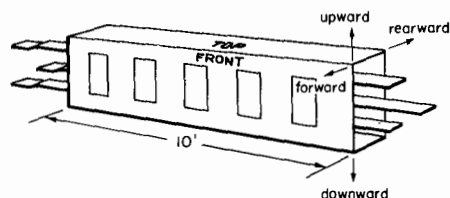
typical joint—3-wire splice



*straight lengths, fittings, plug-in  
protective devices, hangers*

## fittings

key to relationship of fittings to straight lengths



There are ten basic fittings available to meet every construction or application need. These include:

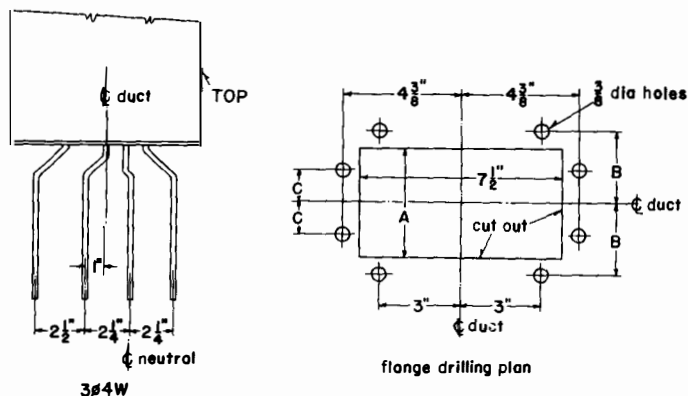
## flange sections

When the bus duct system connects to switchgear structure or a pullbox, it is necessary to provide means for mechanical and electrical connection of the busway to the other apparatus. For such applications a flange for joining the duct housing to the steel pullbox or switchgear is used and specially fabricated bus bars are furnished. For proper coordination between bus duct and switchgear, detailed drawings must accompany the order.

When bus duct extends out of switchgear, opening and flange drillings must be provided by the switch-

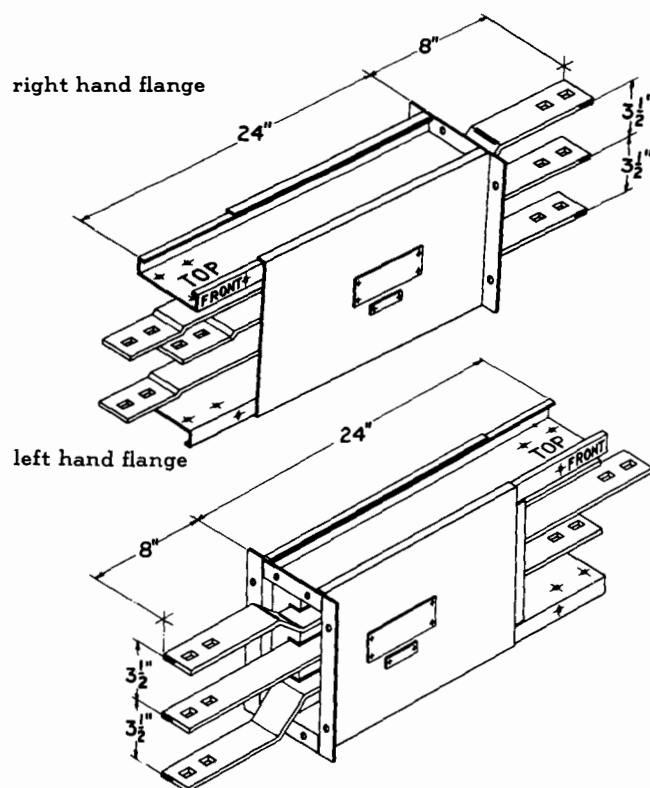
gear builder. In this case, the cutout dimensions and drilling plan shown must be followed. Standard bus extensions are 8 inches long. For 3-wire duct the middle bar is straight with the two outside bars flared to 3½ inches on center from the middle bar. They cannot be spread to more than 7½ inches overall.

Flange and bus extensions are fabricated for either right or left connections to the duct system. The two sections are similar except for the straight and offset bus bars which are necessary to connect them to the system.



amp rating copper	amp rating aluminum	busbar size (in inches)	dimensions (in inches)		
			A	B	C
225	225*	1/8 x 3/8	3 1/4	2 1/4	5/8
400		1/4 x 1 1/2	3 3/4	2 1/2	7/8
600	400	1/4 x 2	4 1/4	2 3/4	1 1/8
800		1/4 x 3	5 1/4	3 1/4	1 5/8
1000	600	1/4 x 4	6 1/4	3 3/4	2 1/8
1250	800	1/4 x 5	7 1/4	4 1/4	2 5/8
1500	1000	1/4 x 6	8 1/4	4 3/4	3 1/8

\* 225 amp rating in aluminum uses 1/4 x 3/8" bar.





## fittings

### forward and rearward elbows

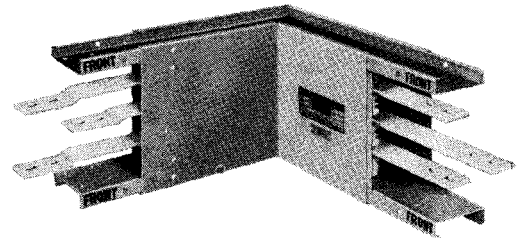
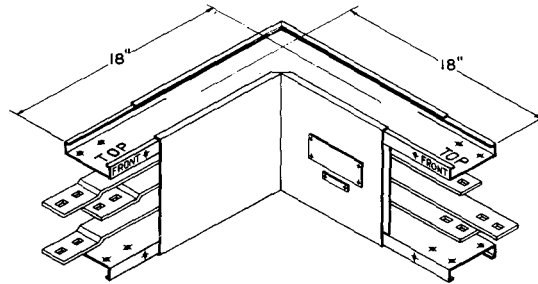
When bus duct is hung in the conventional edgewise mounting position with the marking "TOP" up and "FRONT" toward the viewer, the bus bars are flat, one over the other. If the duct run is to be extended forward, a forward elbow must be used. The marking "FRONT" on this elbow is always on the inside of the right angle. When using the elbow at the right end of the run, the straight bus in the elbow extends forward. When used at the left end of the run, the offset bus extends forward.

If bus duct is mounted in the conventional edgewise position and it is desired to extend the busway rearward, a rearward elbow is used. The marking "FRONT" on the elbow falls on the outer side of the right angle. When used on the right end of a run of duct, the leg with the straight bus extends rearward. On the left end of a run, the leg with the offset bus extends rearward.

#### forward elbow

minimum leg dimensions  
2-wire, 3-wire, and 3-phase,  
4-wire duct

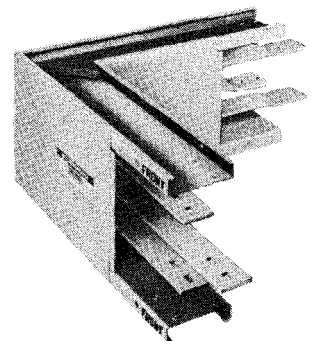
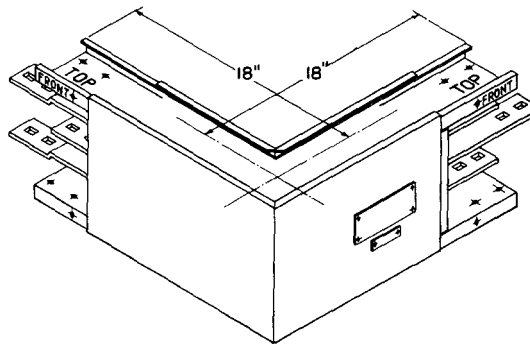
bus bar size (in inches)	left leg (in inches)	right leg (in inches)
$\frac{1}{8} \times \frac{3}{8}$	11	14
$\frac{1}{4} \times \frac{3}{8}$	11	14
$\frac{1}{4} \times 1\frac{1}{2}$	11	14
$\frac{1}{4} \times 2$	11	14
$\frac{1}{4} \times 3$	11½	14½
$\frac{1}{4} \times 4$	12	15
$\frac{1}{4} \times 5$	12½	15½
$\frac{1}{4} \times 6$	13	16



#### rearward elbow

minimum leg dimensions  
2-wire, 3-wire, and 3-phase,  
4-wire duct

bus bar size (in inches)	left leg (in inches)	right leg (in inches)
$\frac{1}{8} \times \frac{3}{8}$	14	11
$\frac{1}{4} \times \frac{3}{8}$	14	11
$\frac{1}{4} \times 1\frac{1}{2}$	14	11
$\frac{1}{4} \times 2$	14	11
$\frac{1}{4} \times 3$	14½	11½
$\frac{1}{4} \times 4$	15	12
$\frac{1}{4} \times 5$	15½	12½
$\frac{1}{4} \times 6$	16	13



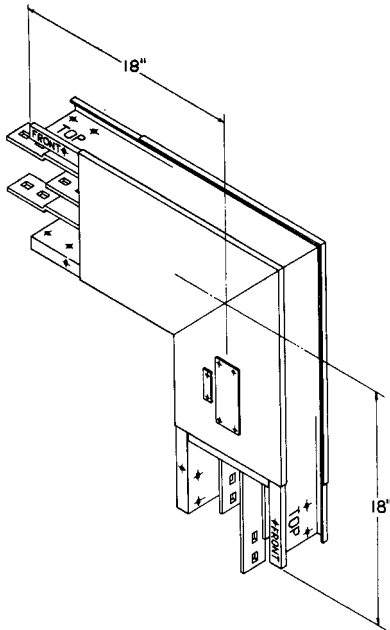
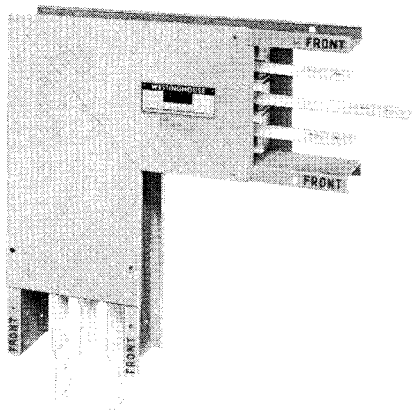
straight lengths, fittings, plug-in  
protective devices, hangers

upward and downward elbows

If bus duct is hung in the conventional edgewise manner with the marking "TOP" up, an upward elbow is used to direct the busway upward. The marking "TOP" on the elbow will always be on the inside of the right angle and when used on the right end of a run, the leg with the straight bus extends upward. When used on the left end of a run, the leg with the offset bus extends upward.

A downward elbow is used to direct the busway downward when it is hung in the conventional manner. The marking "TOP" on the duct will always be on the outer side of the right angle. The leg with the straight bus extends downward when used on the right end of a run of duct and the leg with the offset bus extends downward when used on the left end.

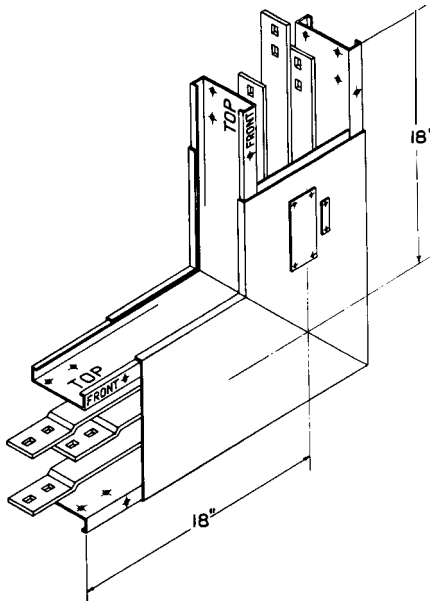
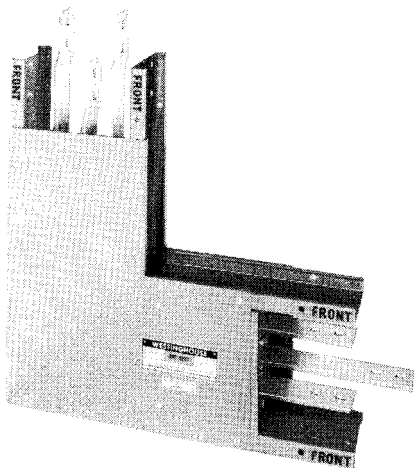
downward elbow



minimum leg dimensions  
2-wire, 3-wire, and 3-phase,  
4-wire duct

bus bar size (in inches)	left leg (in inches)	right leg (in inches)
1/8 x 1/8	16 1/2	16 1/2
1/4 x 1/8	16 1/2	16 1/2
1/4 x 1 1/2	16 1/2	16 1/2
1/4 x 2	13 3/4	13 3/4
1/4 x 3	13 3/4	13 3/4
1/4 x 4	13 3/4	13 3/4
1/4 x 5	13 3/4	13 3/4
1/4 x 6	13 3/4	13 3/4

upward elbow



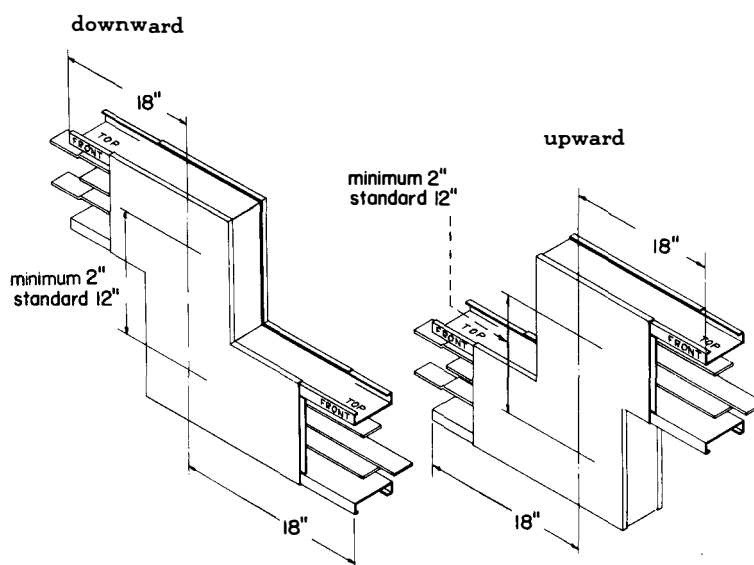
**fittings****offsets**

Offsets are used to avoid obstacles and to conform with building structure. Essentially, an offset is composed of two elbows fabricated into one unit. They are also used to lower or raise the level of a bus duct

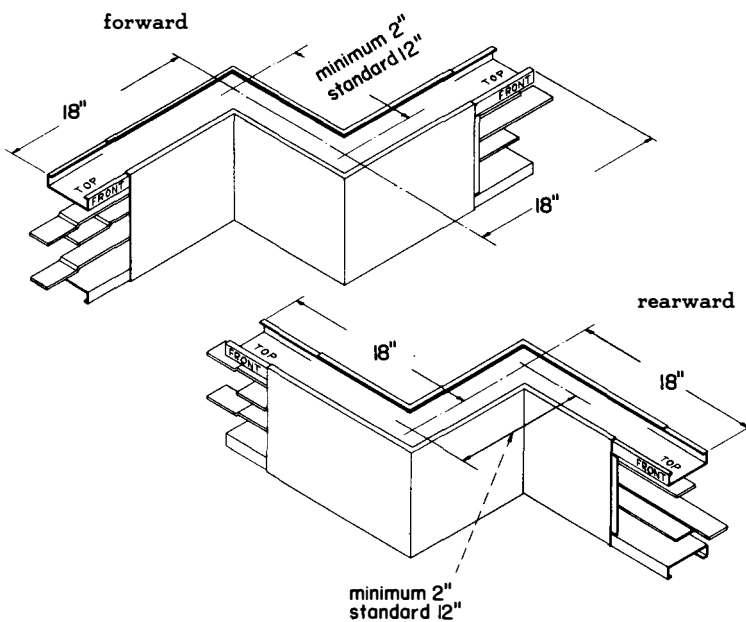
when it is impossible to use elbows because of space restrictions. Installation is simplified because offsets bolt onto other sections of duct in the same manner as standard lengths.

**upward and downward offset****minimum leg dimensions****2-wire, 3-wire, and 3-phase, 4-wire duct**

bus bar size (in inches)	left leg (in inches)	right leg (in inches)
$\frac{1}{8} \times \frac{3}{8}$	16½	16½
$\frac{1}{4} \times \frac{3}{8}$	16½	16½
$\frac{1}{4} \times 1\frac{1}{2}$	16½	16½
$\frac{1}{4} \times 2$	13¾	13¾
$\frac{1}{4} \times 3$	13¾	13¾
$\frac{1}{4} \times 4$	13¾	13¾
$\frac{1}{4} \times 5$	13¾	13¾
$\frac{1}{4} \times 6$	13¾	13¾

**forward and rearward offset****minimum leg dimensions****2-wire, 3-wire, and 3-phase, 4-wire duct**

bus bar size (in inches)	left leg (in inches)	right leg (in inches)
$\frac{1}{8} \times \frac{3}{8}$	14	14
$\frac{1}{4} \times \frac{3}{8}$	14	14
$\frac{1}{4} \times 1\frac{1}{2}$	14	14
$\frac{1}{4} \times 2$	14	14
$\frac{1}{4} \times 3$	14½	14½
$\frac{1}{4} \times 4$	15	15
$\frac{1}{4} \times 5$	15½	15½
$\frac{1}{4} \times 6$	16	16



## tees

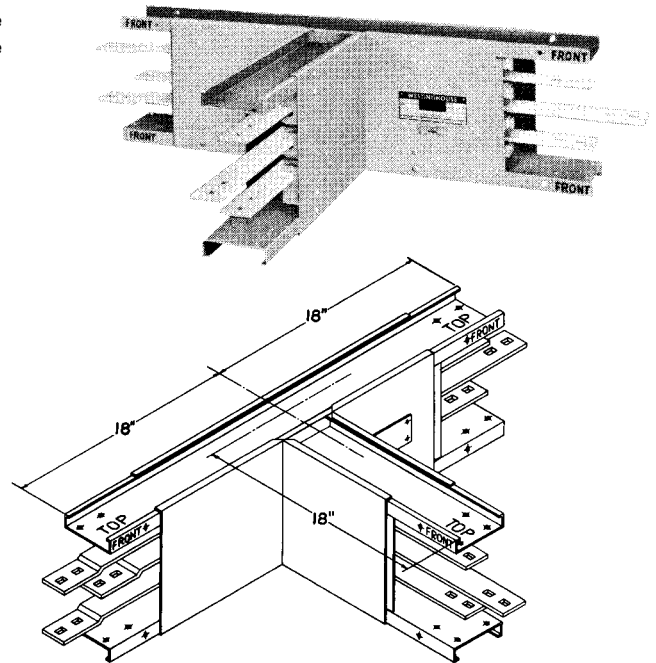
A tee is a busway fitting suitable for connection in three directions. There are four types of tees available; forward, rearward, upward, and downward.

Legs of all standard tees are 18 inches long, measured from the center line of the duct to the end of the top or bottom channels.

**forward tee** Facing the "FRONT" of a forward tee with the marking "TOP" upward, an 18-in. leg extends forward from the center of a 3-ft. section of duct. This leg has straight bus bars.

**minimum leg dimensions**  
2-wire, 3-wire, and 3-phase,  
4-wire duct

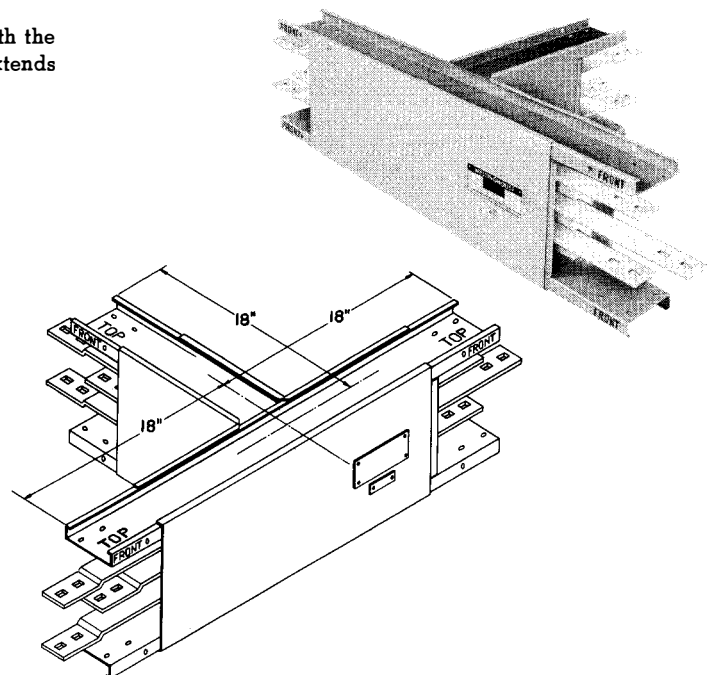
bus bar size (in inches)	left leg (in inches)	middle leg (in inches)	right leg (in inches)
1/8 x 3/8	11	14	14
1/4 x 3/8	11	14	14
1/4 x 1 1/2	11	14	14
1/4 x 2	11	14	14
1/4 x 3	11 1/2	14 1/2	14 1/2
1/4 x 4	12	15	15
1/4 x 5	12 1/2	15 1/2	15 1/2
1/4 x 6	13	16	16



**rearward tee** Facing the "FRONT" of a rearward tee with the marking "TOP" upward, an 18-in. leg with offset bus bars extends rearward from the center of a 3-ft. section of duct.

**minimum leg dimensions**  
2-wire, 3-wire, and 3-phase,  
4-wire duct

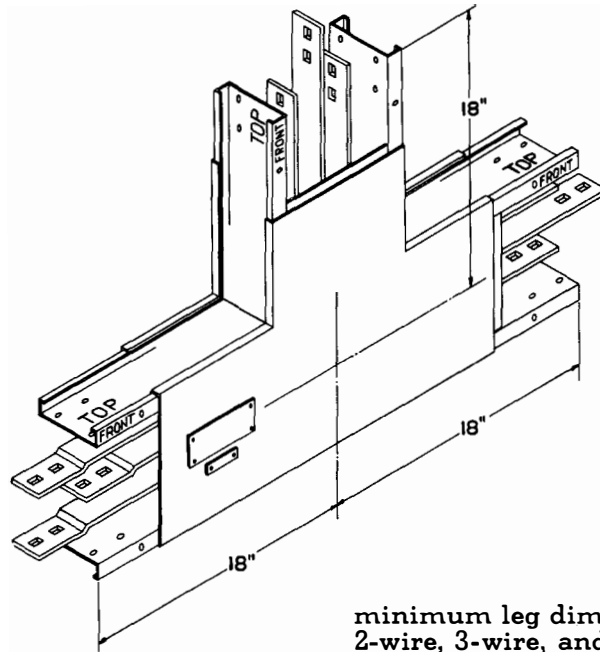
bus bar size (in inches)	left leg (in inches)	middle leg (in inches)	right leg (in inches)
1/8 x 3/8	11	11	14
1/4 x 3/8	11	11	14
1/4 x 1 1/2	11	11	14
1/4 x 2	11	11	14
1/4 x 3	11 1/2	11 1/2	14 1/2
1/4 x 4	12	12	15
1/4 x 5	12 1/2	12 1/2	15 1/2
1/4 x 6	13	13	16





tees cont'd

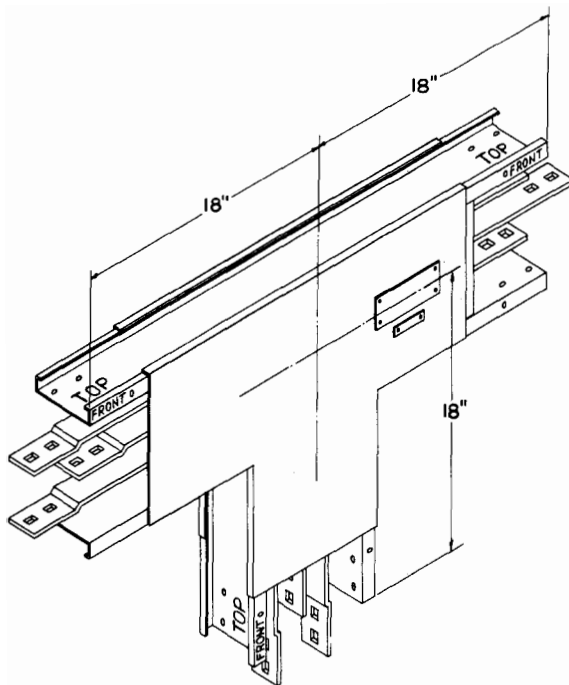
**upward tee** With the "TOP" marking upward, the upward tee has an 18-in. leg extending upward from the center of a 3-ft. section. This leg has straight bus bars.



minimum leg dimensions  
2-wire, 3-wire, and 3-phase, 4-wire duct

bus bar size (in inches)	left, middle and right leg (in inches)
$\frac{1}{8} \times \frac{7}{8}$	14
$\frac{1}{4} \times \frac{7}{8}$	14
$\frac{1}{4} \times 1 \frac{1}{2}$	14
$\frac{1}{4} \times 2$	14
$\frac{1}{4} \times 3$	14
$\frac{1}{4} \times 4$	15
$\frac{1}{4} \times 5$	16
$\frac{1}{4} \times 6$	18

**downward tee** With the "TOP" marking upward, the downward tee has an 18-in. leg with offset bus bars extending downward from the center of a 3-ft. section of duct.



## **crossovers**

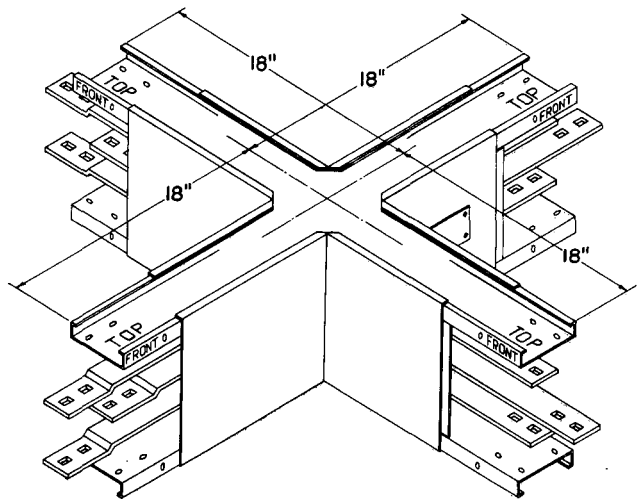
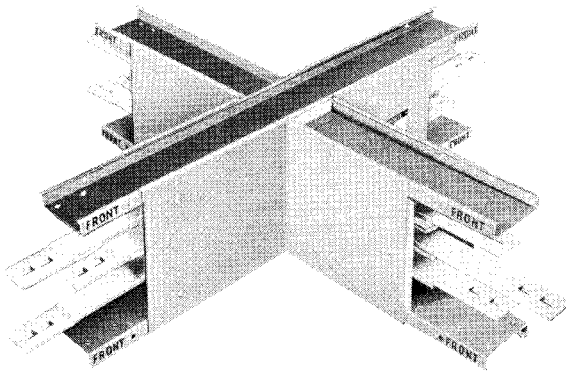
Crossovers are needed where two runs of duct cross each other in the same plane. Since bus duct can be installed in only two positions, only two types of

crossover are needed. Two adjacent legs have straight bus bars, the other two have offset.

### **forward - rearward**

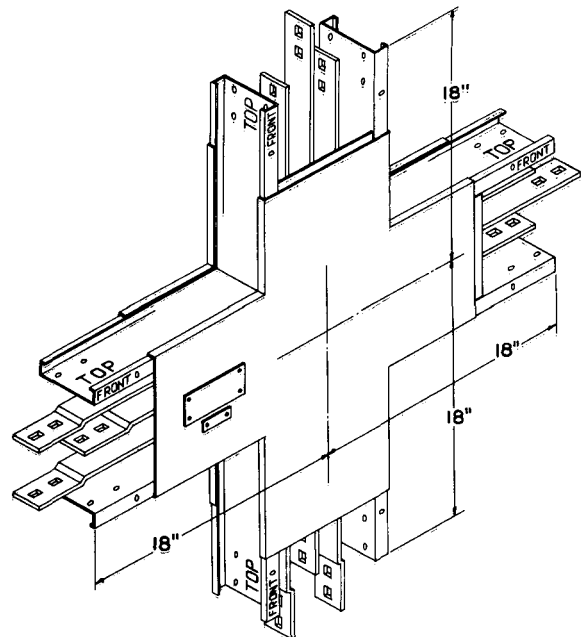
When two runs of duct must cross each other so that the sides marked "TOP" are to be in the same plane, a forward-rearward crossover is used. It has two 18-inch legs extending at right

angles from the center of a three foot section of duct, one leg extending forward and one rearward.



### **upward - downward**

When two runs of duct must cross each other so that the sides marked "FRONT" are to be in the same plane an upward-downward crossover is used. It also has two 18-inch legs extending at right angles from the center of a three foot section, one extending upward and one downward.







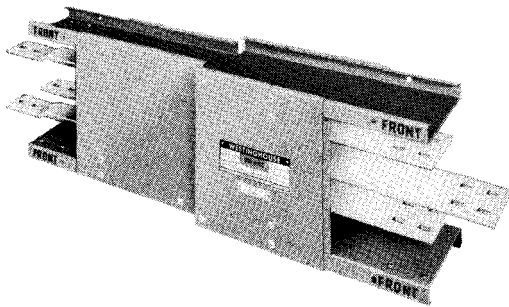
## fittings

### reducers

Reducers are used to reduce the capacity of bus duct without overcurrent protective devices. They are built into a 30-inch section of duct with the straight and offset bus bars the same as in straight sections of duct.

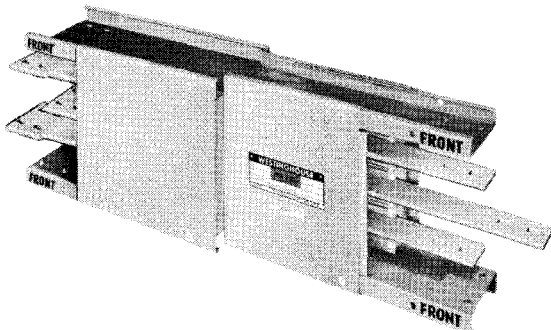
#### left reducer

To reduce the capacity of a run at its left end when facing the "FRONT" with marking "TOP" up a left reducer is used. Looking at the "FRONT" of a left reducer, the larger size bus bars are on the right and the smaller size bars on the left.

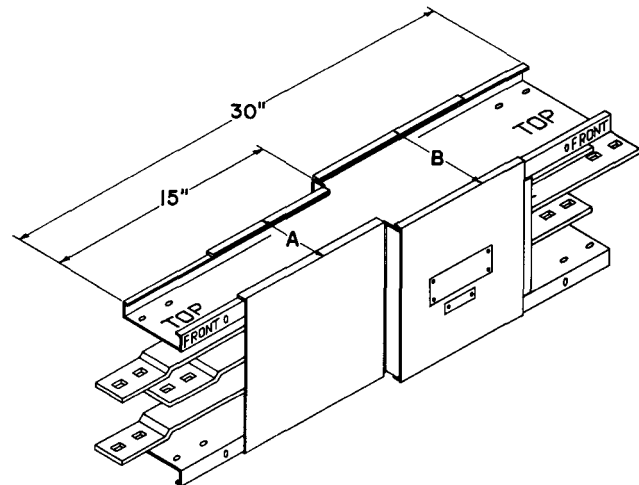


#### right reducer

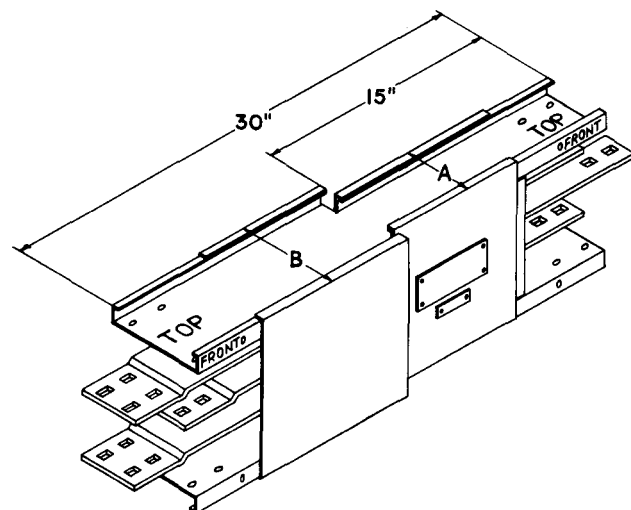
For reducing the capacity of a run at its right end, when facing the "FRONT" with marking "TOP" up a right reducer is used. Viewing the "FRONT" of a right reducer, the bus bars are reduced from left to right.



No overcurrent protection is required where bus duct is reduced in size, provided the length of the smaller duct does not extend more than 50 feet and has a current rating of at least  $\frac{1}{3}$  of the breaker next back on the line. (See NEC section 3649.)



reduction		dimensions (in inches)			
from (amperes)	to (amperes)	copper		aluminum	
		A	B	A	B
400	225	3 7/8	3 3/8	4 3/8	3 3/8
600	400	4 3/8	3 3/8	6 3/8	4 3/8
600	225	4 3/8	3 3/8	6 3/8	3 3/8
800	600	5 3/8	4 3/8	7 3/8	6 3/8
800	400	5 3/8	3 3/8	7 3/8	4 3/8
1000	800	6 3/8	5 3/8	8 3/8	7 3/8
1000	600	6 3/8	4 3/8	8 3/8	6 3/8
1000	400	6 3/8	3 3/8	8 3/8	4 3/8
1250	1000	7 3/8	6 3/8		
1250	800	7 3/8	5 3/8		
1250	600	7 3/8	4 3/8		
1250	400	7 3/8	3 3/8		
1500	1250	8 3/8	7 3/8		
1500	1000	8 3/8	6 3/8		
1500	800	8 3/8	5 3/8		
1500	600	8 3/8	4 3/8		



## adapter cubicles

In many instances, it is economical to reduce the ampere rating of the duct as the load drops off. In these cases, whenever the rating is reduced more than two-thirds of the rating of the overcurrent protection next back on the line or the length of the reduced run is over 50 feet, an overcurrent protective device must be used to meet N.E.C. requirements.

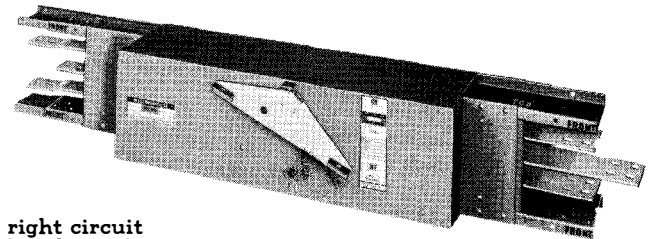
These adapter cubicles are available with either a

circuit breaker or Type HD fused safety switch to furnish overcurrent protection and serve as a disconnecting means. Reduction in bus capacity is made within the cubicle. The line side of the cubicle is connected to the large rating duct and the load side to the reduced rating duct. Adapter cubicles connect to bus duct like any other section of duct.

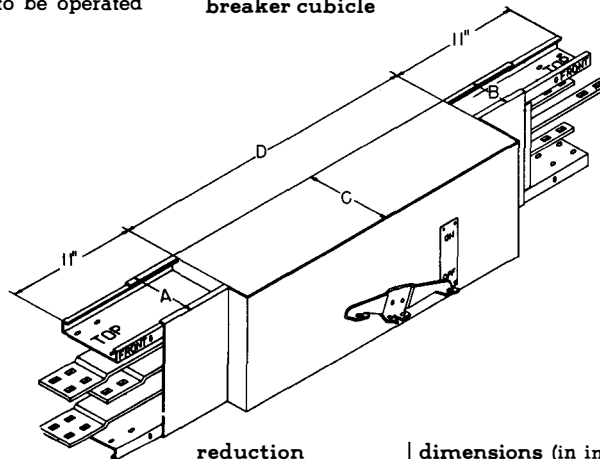
## circuit breaker adapter cubicles

When the reduced run does not exceed 800 amperes in capacity, Type M, L, KL, or J circuit breakers are ideally suited for the overcurrent protective device. Circuit breaker cubicles are compact, for their housing is no wider than duct and just slightly deeper. Overall length of the cubicles housing Type M or L breakers is 54 inches; for Type KL or J breakers it is 48 inches. Unique handle construction permits the breaker to be operated from the floor by either hookstick or chain.

left circuit  
breaker cubicle



right circuit  
breaker cubicle



## circuit breaker adapter cubicle 2 and 3-wire

type breakers	dimensions (in inches)	
	C	D
J	7 1/4 *	26
KL	7 1/4 *	26
L	9 1/2	32
M	9 1/2	32

\* This dimension 9 1/4" for 1/4 x 5" and 1/4 x 6" bus bars.

**right circuit breaker cubicle** When facing the "FRONT" of a right cubicle with the marking "TOP" upward, the larger size duct is on the left end or line side of the cubicle and the smaller size on the right end or load side of the cubicle.

**left circuit breaker cubicle** From the "FRONT" of a left cubicle with the marking "TOP" upward, the larger size duct is on the right end or line side of the cubicle, and the smaller size on the left end or load side of the cubicle.

reduction		dimensions (in inches)			
from (amperes)	to (amperes)	copper		aluminum	
		A	B	A	B
225	225	3 3/8	3 3/8	3 3/8	3 3/8
400	225	3 3/8	3 3/8	4 3/8	3 3/8
400	400	3 3/8	3 3/8	4 3/8	4 3/8
600	225	4 3/8	3 3/8	6 3/8	3 3/8
600	400	4 3/8	3 3/8	6 3/8	4 3/8
600	600	4 3/8	4 3/8	6 3/8	6 3/8
800	225	5 3/8	3 3/8	7 3/8	3 3/8
800	400	5 3/8	3 3/8	7 3/8	4 3/8
800	600	5 3/8	4 3/8	7 3/8	6 3/8
800	800	5 3/8	5 3/8	7 3/8	7 3/8
1000	225	6 3/8	3 3/8	8 3/8	3 3/8
1000	400	6 3/8	3 3/8	8 3/8	4 3/8
1000	600	6 3/8	4 3/8	8 3/8	6 3/8
1000	800	6 3/8	5 3/8	8 3/8	7 3/8
1250	225	7 3/8	3 3/8		
1250	400	7 3/8	3 3/8		
1250	600	7 3/8	4 3/8		
1250	800	7 3/8	5 3/8		
1500	225	8 3/8	3 3/8		
1500	400	8 3/8	3 3/8		
1500	600	8 3/8	4 3/8		
1500	800	8 3/8	5 3/8		



## fittings

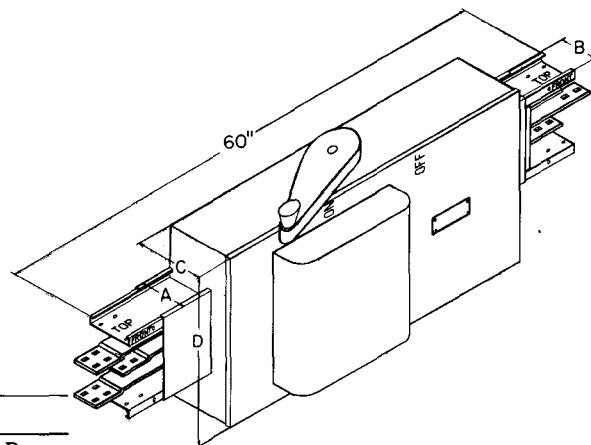
adapter cubicles *cont'd*

## safety switch adapter cubicles

Fused safety switch cubicles consist of a Type HD safety switch built into a 5-foot section of duct. This switch assures continued performance and safety under the

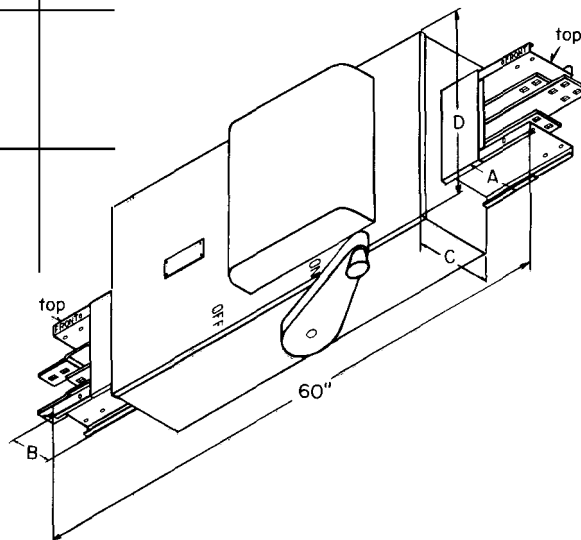
more severe type of application. It is available in continuous ratings of 400, 600, 800, and 1200 amperes.

**right fused switch cubicle** Facing the "FRONT" of a right fused switch cubicle with the marking "TOP" upward, the larger size duct is on the left end or line side of the cubicle and smaller size duct on the right end or load side. The operating handle is on the "TOP" side.



reduction		switch size (amperes)	dimensions (in inches)							
from (amperes)	to (amperes)		copper				aluminum			
			A	B	C	D	A	B	C	D
225	225	400	3⅜	3⅜	8½	20½	3⅜	3⅜	8½	20½
400	225	400	3⅜	3⅜	8½	20½	4⅜	3⅜	8½	20½
400	400	400	3⅜	3⅜	8½	20½	4⅜	4⅜	8½	20½
600	225	400	4⅜	3⅜	8½	20½	6⅜	3⅜	8½	20½
600	400	400	4⅜	3⅜	8½	20½	6⅜	4⅜	8½	20½
600	600	600	4⅜	4⅜	8⅝	23½	6⅜	6⅜	8⅝	23½
800	225	400	5⅝	3⅜	8½	20½	7⅜	3⅜	8½	20½
800	400	400	5⅝	3⅜	8½	20½	7⅜	4⅜	8½	20½
800	600	600	5⅝	4⅜	8⅝	23½	7⅜	6⅜	8⅝	23½
800	800	800	5⅝	5⅝	9¼	35¼	7⅜	7⅜	9¼	35¼
1000	225	400	6⅝	3⅜	8½	20½	8⅝	3⅜	9½	20½
1000	400	400	6⅝	3⅜	8½	20½	8⅝	4⅜	9½	20½
1000	600	600	6⅝	4⅜	9¼	23½	8⅝	6⅜	9½	23½
1000	800	800	6⅝	5⅝	9¼	35¼	8⅝	7⅜	9¼	35¼
1000	1000	1200	6⅝	6⅝	9¼	40¼	8⅝	8⅝	9¼	40¼
1250	225	400	7⅝	3⅜	8½	20½				
1250	400	400	7⅝	3⅜	8½	20½				
1250	600	600	7⅝	4⅜	8⅝	23½				
1250	800	800	7⅝	5⅝	9¼	35¼				
1250	1000	1200	7⅝	6⅝	9¼	40¼				
1500	225	400	8⅝	3⅜	9½	20½				
1500	400	400	8⅝	3⅜	9½	20½				
1500	600	600	8⅝	4⅜	9½	23½				
1500	800	800	8⅝	5⅝	9¼	35¼				
1500	1000	1200	8⅝	6⅝	9¼	40¼				

**left fused switch cubicle** The larger size duct is on the right end or line side of the cubicle and smaller size duct on the left end or load side when facing the "FRONT" of a left fused switch cubicle with the marking "TOP" upward. The operating handle is on the bottom of the cubicle.



## expansion section

An expansion section is a busway section which accommodates the expansion and contraction of the bus bars with respect to the enclosure. They are necessary only in long, straight runs to compensate for the difference in the coefficient of expansion\* for steel and copper or aluminum.

They consist of a 10-foot section of duct in which the steel housing contains a sliding telescopic joint to allow movement of the housings. A length of rigid bus bars inside the telescope joint is replaced by flexible braid completely surrounded by ebony asbestos.

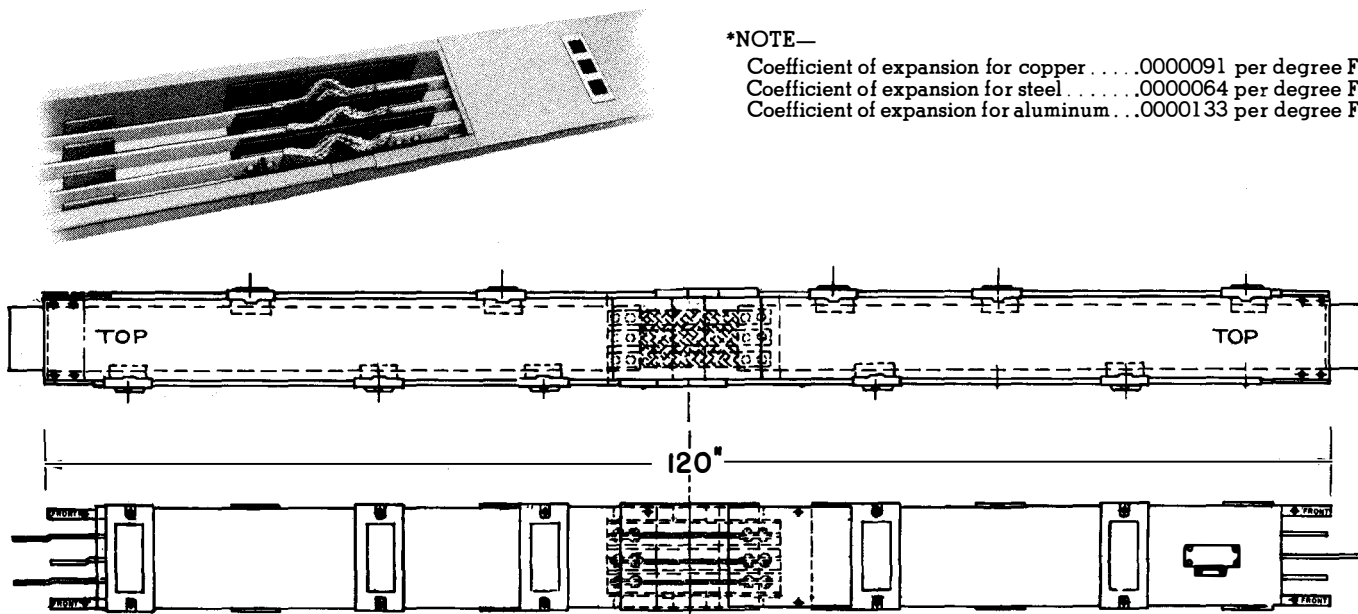
There should be an expansion section installed in the center of any run of 150 feet or more of copper duct, 100 feet or more of aluminum. This is especially true if the bus bars are anchored at each end of the run, such as an elbow. If a 150-foot run of copper duct or a 100-foot run of aluminum duct has an end closer at one end so that the bus bars are free to move, it may be omitted. Also if runs of the above length are fed in the center so that the bus bars are free to move in either direction, an expansion section is unnecessary. They must be used wherever a run of duct crosses an expansion joint in the building. The use of expansion joints should be engineered for individual installations.

### \*NOTE—

Coefficient of expansion for copper . . . . .0000091 per degree F.

Coefficient of expansion for steel . . . . .0000064 per degree F.

Coefficient of expansion for aluminum . . .0000133 per degree F.



## transposition section

On long runs of plug-in duct, especially where the load is concentrated at the end of the run, the voltage sometimes becomes unbalanced between phase bars. This is due to unequal impedances in the three bars of the duct.

To correct such a situation, the use of two transposition sections in the run is recommended. These transposition sections are built into a 10-foot section of duct and are otherwise identical to a standard 10-foot length.

The use of transposition sections is best described by the following quote from the A.I.E.E. publication

"Electrical Power Distribution for Industrial Plants."

"If the load end voltages are badly unbalanced, due to unequal impedances in the three legs of the busway, this condition can be minimized by the use of two transpositions. For a load concentrated at the end of the run, the transpositions should be placed at the  $\frac{1}{3}$  and  $\frac{2}{3}$  points in the run. For an evenly distributed loading, the transpositions would be placed at the 20 percent and 40 percent points. Transpositions are generally not necessary except in the long runs. Transpositions are never required in the low impedance feeder busways of the interlaced or paired-phase designs."

 **fittings****cable tap boxes**

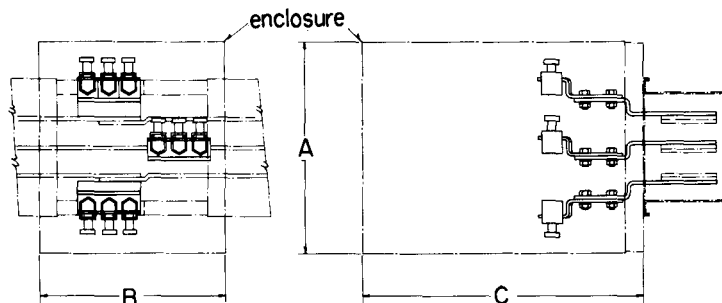
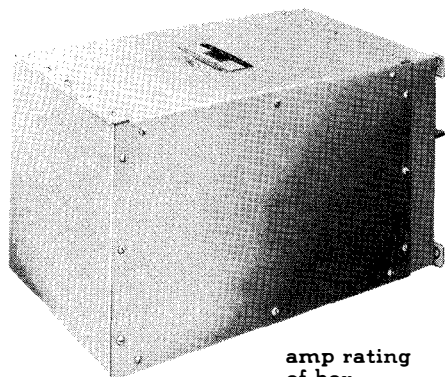
Cable tap boxes are used where a run of duct is fed by cable or where equipment served by the duct is connected without overcurrent protection. There are two types of cable tap boxes, the end cable tap box which bolts onto the end of the duct, and the center cable tap box which bolts onto the joint between any two sections of duct.

Solderless lugs are furnished with each tap box. Since it is easier for electrical contractors to work with 500 MCM cable and smaller, and it is more economical to use multiple cables for large capacities per phase, multiple lugs are furnished in the numbers shown in the following tables.

**center cable tap boxes front or rear mounted**

The front mounted center cable tap box bolts to the "FRONT" of duct where any two sections join. The tap box covers the access opening. Bus bars in the tap box have slotted holes for bolting onto the bus bars of the duct. Thus, tap boxes can be used on any rating of plug-in duct. Universal clamps are used to hold the box on the duct. Sides of the box are remov-

able, permitting easy access to the solderless lugs. The rear mounted cable tap box is identical to the front mounted box except for the bus work which is made to bolt on the rear side of the splice. Both front and rear mounted tap boxes may also be bolted onto the ends of a run when used in conjunction with a special end closer.



amp rating of box	lugs per phase bar		lugs per neutral bar		dimensions (in inches)		
	copper	aluminum	copper	aluminum	A	B	C
225	1-4/0	1-4/0	1-4/0	1-4/0	11 1/2	12 1/8	20 1/8
400	2-4/0	2-350 MCM	1-4/0	1-350 MCM			
600	2-500 MCM	2-500 MCM	2-4/0	2-350 MCM	14 7/8	13 1/4	20 1/8
800	3-350 MCM	3-350 MCM	3-4/0	3-350 MCM	20	14	24
1000	3-500 MCM	3-500 MCM	3-4/0	3-350 MCM			
1250	4-500 MCM		4-4/0				
1500	5-500 MCM		5-4/0				

**end cable tap boxes right or left**

End cable tap boxes have a short section of duct attached to them so that they can be bolted onto the end of duct like another section. Bus bars extending into the tap box are flared to allow clearance when the lugs are in place. The front cover is removable and the back of the box is flush with the rear side of the duct.

Left and right end cable tap boxes are identical except for the short section of duct attached to the

boxes. These sections are so constructed that facing the "FRONT" of the bus duct run with the marking "TOP" upward, the left end box bolts onto the left end of the duct run and the right end box bolts onto the right end. Left end boxes have straight bus bars to match the offset bars in the left end of duct while the right end box has offset bars to match the straight bars in the right end. There are end cable tap boxes to match every plug-in duct rating and the multiple lugs furnished are shown in the following table:

# plug-in duct

application  
data

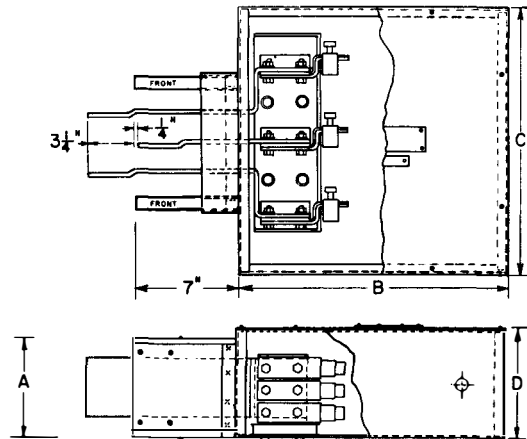
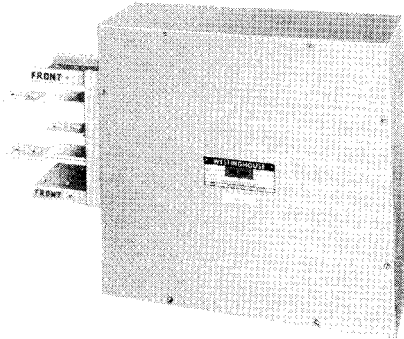
**30-660**

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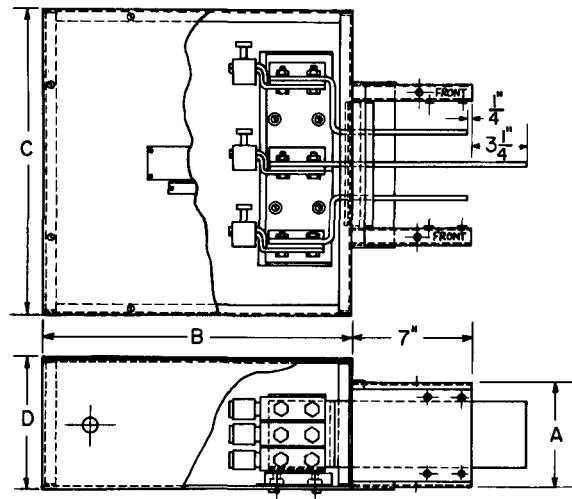
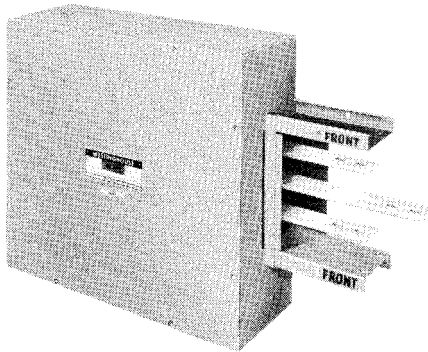
*straight lengths, fittings, plug-in  
protective devices, hangers*

## end cable tap boxes right or left cont'd

right



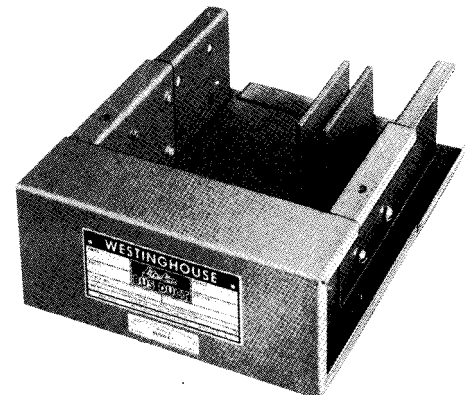
left



amp rating of box	lugs per phase bar		lugs per neutral bar		dimensions (in inches)							
	copper	aluminum	copper	aluminum	A		B		C		D	
					copper	alum.	copper	alum.	copper	alum. 3W 4W	copper	alum.
225	1-4/0	1-4/0	1-4/0	1-4/0	3 3/8	3 3/8	17 1/8	21 1/8	16 1/8	18 20	5 1/8	5 1/8
400	2-4/0	2-350 MCM	1-4/0	1-350 MCM	3 3/8	4 3/8	17 1/8	21 1/8	16 1/8	18 20	5 1/8	5 1/8
600	2-500 MCM	2-500 MCM	2-4/0	2-350 MCM	4 3/8	6 3/8	20 1/8	21 1/8	18 1/8	18 20	7 1/8	9 1/8
800	3-350 MCM	3-350 MCM	3-4/0	3-350 MCM	5 3/8	7 3/8	20 1/8	21 1/8	18 1/8	18 20	7 1/8	9 1/8
1000	3-500 MCM	3-500 MCM	3-4/0	3-350 MCM	6 3/8	8 3/8	21 1/8	21 1/8	18 1/8	18 20	7 1/8	9 1/8
1250	4-500 MCM		4-4/0		7 3/8		21 1/8		18 1/8		9 3/8	
1500	5-500 MCM		5-4/0		8 3/8		21 1/8		18 1/8		9 3/8	

## end closers

An end closer is a fitting which terminates the busway run and closes the end. It comes complete with two splice plates and two access covers and is designed to be used on either end of duct. A micarta barrier is provided to maintain isolation of neutral bar on 4-wire duct. The effective length of an end closer is 7" and the depth is the same as the rating of duct involved.





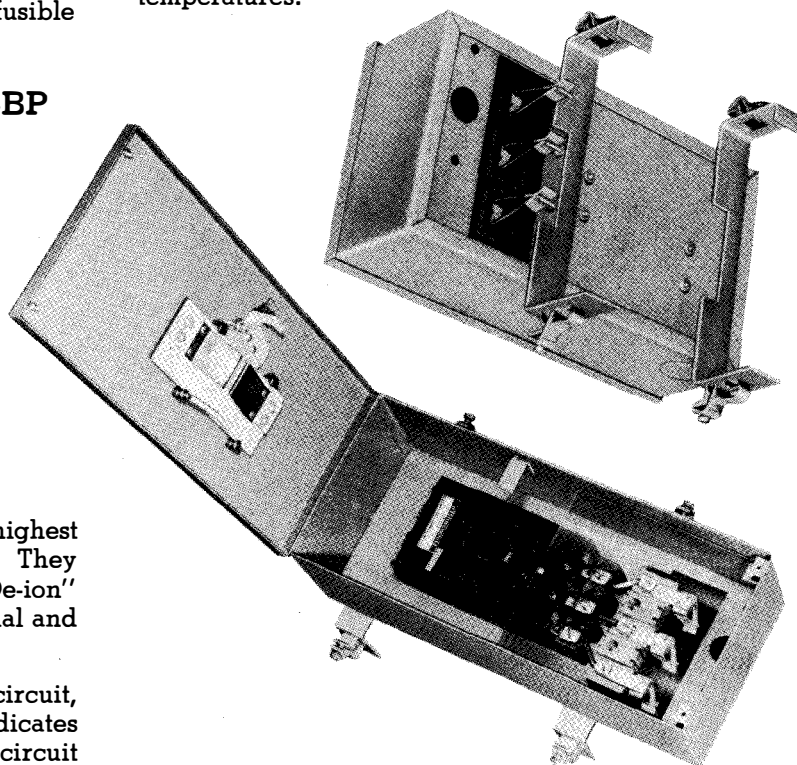
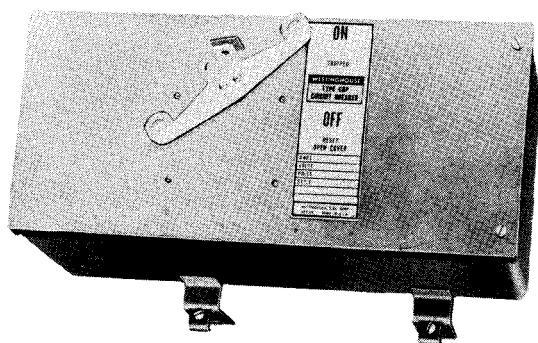
## plug-in protective devices

A primary advantage of plug-in bus duct is that power can be taken off close to its utilization point. To accomplish this, easily installed plug-in devices are available which plug-in through the Rosite insulators onto the bare bus bars of the duct. These devices provide overcurrent protection to the conductors and also serve as a disconnecting means.

Three types of overload protective units are available: the AB circuit breaker (type CBP), the type HD safety switch (type TAP), and the cover-operated fusible

switch (type COP). These units are equipped with insulated plug-in stabs in two sizes. The smaller size stabs are made of phosphor bronze and used on all ratings up to and including 100 ampere. Larger size stabs are made of Cupaloy® copper alloy and used on all 200 and 400 ampere fused and circuit breaker units. Use of these materials makes possible the elimination of reinforcing springs, while maintaining better contact pressure through a wider range of temperatures.

### circuit breaker plug-in type CBP



The AB De-ion® circuit breakers provide the highest type of automatic branch circuit protection. They incorporate the exclusive Westinghouse "De-ion" principle of arc quenching and combine thermal and magnetic overload protection on all ratings.

In the event of a dangerous overload or short circuit, the breaker opens the circuit and the handle indicates this by moving to the "TRIPPED" position. The circuit is restored, after the fault is cleared, simply by moving the handle to the "RESET" position and then back to "ON."

The slam-proof cover is locked into place as soon as it is closed and cannot be opened until the operating handle is pulled to the "OPEN COVER" beyond the "OFF" position. The operating handle can be locked in either "OFF" or "ON" position and is constructed so that the unit can be hookstick, chain, or hand operated. In case of an emergency, a means has been provided for an authorized person to open the cover with the breaker in the "ON" position. All CBP enclosures with plug-in stabs are designed so that, if necessary, a neutral stab assembly can be added in the field.

Type E, F, J, K, and KL breaker plug-ins are furnished with plug-in stabs, and Type L and M<sup>①</sup> breaker plug-

ins are built with copper extensions that bolt onto the bus bars between any two sections of duct.

The 4-pole solid neutral type E and F plug-ins through 50 ampere rating have lugs designed to accommodate a full-size neutral conductor. However, in all other ratings of type E and F plug-ins and all other circuit breaker plug-ins, when a full-size neutral stab and lug is required, it must be specified in the order write-up.

The same enclosure is used for 2-pole, 3-pole, and 3-phase, 4-wire applications. Dimensions are given in table no. 7.

Normally, all 2-pole units plug into the two outside bars of the duct and combinations other than this should be specified in the order write-up.

① For complete information on breaker types refer to Section 29-000.

## circuit breaker plug-in type CBP cont'd

**E breaker plug-in**, 100 amp, 240 volts a-c, non-interchangeable trip. Available in 15, 20, 30, 40, 50, 70, 90 and 100 ampere trip ratings, the Type E plug-in is the standard unit for 240 volt, 2 and 3 pole, and 3-phase, 4-wire systems up to 100 amperes. Connections between the plug-in stabs and the line side of the breaker are made with heavy solid wire.

**F breaker plug-in**, 100 amp, 600 volts a-c, non-interchangeable trip. Type F breaker plug-in is used up to and including 100 amperes, 600 volts, and is available with 15, 20, 30, 40, 50, 70, 90 and 100 ampere trip ratings. Connections between the line side of the breaker and the plug-in stabs are made with heavy solid wire.

**J breaker plug-in**, 225 amp, 600 volts a-c, non-interchangeable trip. When a larger breaker is needed the Type J breaker plug-in is used to and including 225 amperes, 600 volts. It is available with 70, 90, 100, 125, 150, 200 and 225 ampere trip ratings. Plug-in stabs are connected directly to the line terminals of the breaker.

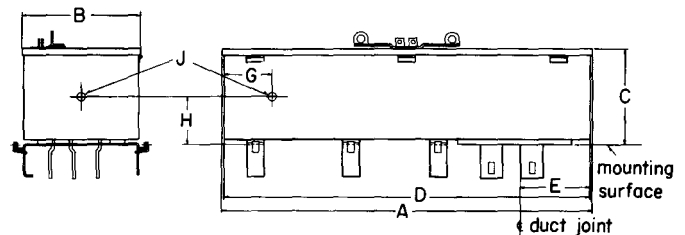
**K breaker plug-in**, 225 amp, 600 volts a-c, interchangeable trip. Wherever a larger breaker with an interchangeable trip is needed, the K breaker plug-in is used up to and including 225 ampere, 600 volts. It is available with 70, 90, 100, 125, 150, 175, 200 and 225 ampere trip ratings. The plug-in stabs are connected directly to the line terminals of the breaker.

**KL breaker plug-in**, 400 amp, 600 volts a-c, interchangeable trip. These units provide a maximum of 400 ampere, 600 volt protection in minimum space. The KL breaker plug-in has an interchangeable trip with ratings of 125, 150, 175, 200, 225, 250, 300, 350 and 400 amperes.

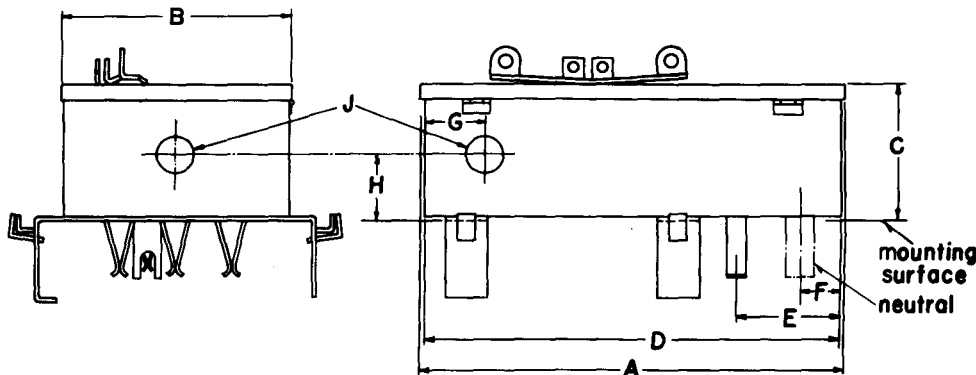
**L breaker bolt-on**, 600 amp, 600 volts a-c, interchangeable trip. When the load requires larger units than the type KL breaker will accommodate, the L breaker bolt-on with an interchangeable trip is available up to and including 600 amperes, 600 volts. Trip ratings available are 125, 150, 175, 200, 225, 250, 275, 300, 325, 350, 400, 450, 500, 550 and 600 amperes. These units are also designed to be bolted on to any size plug-in duct between any two sections. *It is absolutely necessary to specify front or rear mounting on the order write-up.*

**M breaker bolt-on**, 800 amp, 600 volts a-c, interchangeable trip. The M breaker bolt-on is used up to 800 amperes, 600 volts, and is available with interchangeable trip of 700 and 800 ampere rating. These units are built to be bolted on between any two sections of duct. *It is necessary to specify front or rear mounting on the order write-up.*

L and M breaker enclosure



E, F, J, K and KL breaker cubicle. (E, F and K enclosures have end hinged covers.)



circuit breaker	dimensions (in inches)									net weights		
	A	B	C	D	E	F	G	H	J	2P	3P	3PH 4W
type E	15 <sup>1</sup> / <sub>2</sub>	8 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>6</sub>	15 <sup>5</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	¾-1-1 <sup>1</sup> / <sub>4</sub>	17	18 <sup>1</sup> / <sub>2</sub>	19
type F	18 <sup>2</sup> / <sub>2</sub>	10 <sup>1</sup> / <sub>2</sub>	6 <sup>5</sup> / <sub>8</sub>	18 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	¾-1-1 <sup>1</sup> / <sub>4</sub>	20	22	23
type J	18 <sup>2</sup> / <sub>2</sub>	10 <sup>1</sup> / <sub>2</sub>	6 <sup>5</sup> / <sub>8</sub>	18 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	2	2 <sup>1</sup> / <sub>8</sub>	2-2 <sup>1</sup> / <sub>2</sub>	41	49	50
type K	26 <sup>1</sup> / <sub>2</sub>	10 <sup>3</sup> / <sub>8</sub>	6 <sup>2</sup> / <sub>2</sub>	26 <sup>3</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>8</sub>	2-2 <sup>1</sup> / <sub>2</sub>	47	56	59
type KL	26 <sup>1</sup> / <sub>8</sub>	10 <sup>2</sup> / <sub>2</sub>	6 <sup>3</sup> / <sub>2</sub>	26 <sup>2</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	.....	.....	.....	57	63	67
type L	42 <sup>1</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>2</sub>	8 <sup>5</sup> / <sub>8</sub>	41 <sup>2</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>2</sub>	.....	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>8</sub>	½	96	105	131
type M	42 <sup>1</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>2</sub>	8 <sup>5</sup> / <sub>8</sub>	41 <sup>2</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>2</sub>	.....	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>8</sub>	½	98	107	133





## plug-in protective devices

### safety switch plug-in type TAP

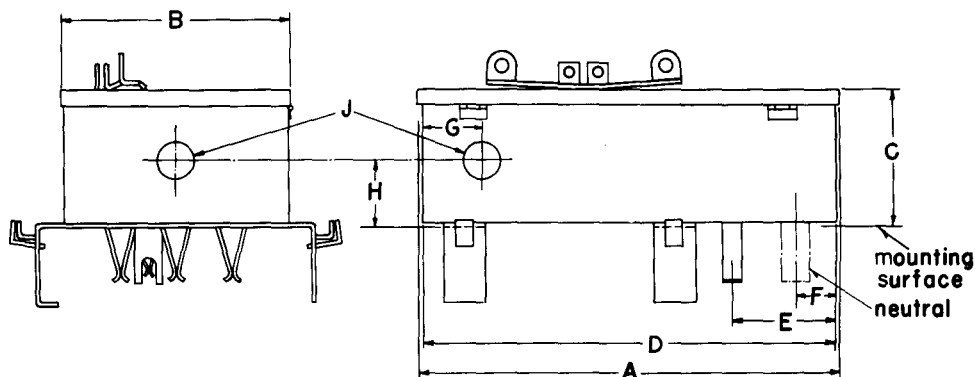
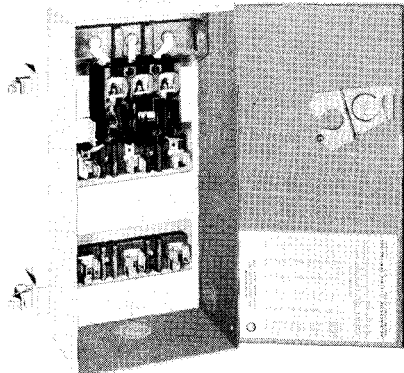
For use on motor circuits and heavy-duty industrial circuits, type TAP fusible plug-in is available in 30, 60, 100, 200, 400 and 600 ampere ratings in 2-pole, 3-pole, and 3-phase, 4-wire types for 240 and 600 volt circuits.

The 30, 60, 100 and 200 ampere units utilize the visible blade De-ion Switch. These units have a front-operated device similar to the circuit breaker plug-in and can be hookstick, chain or hand operated. Cover is interlocked to prevent opening while the switch is "ON." A second interlock is provided to prevent accidental closing of switch when cover is open. All 30 and 60 ampere units are so designed that a neutral

stab assembly can be added in the field, if necessary. Four-pole solid neutral units in the 60 and 30 ampere ratings have proper lugs to accommodate a full-size neutral conductor. **However, in all other ratings, a full-size neutral stab and lug must be specified in the order write-up, if needed.**

Four hundred and 600 ampere rating units are type HD safety switches modified to mount on plug-in duct. The 400 ampere device is furnished with plug-in stabs but the 600 ampere units are bolted to the duct at a splice between sections. **Specify whether the 600 ampere unit is front or rear mounted.** The covers of these units are interlocked to prevent opening when the switch is "ON" and the operating handle has to be pulled beyond the "OFF" position to open the cover.

Front operated 30, 60, 100 and 200 amp type TAP safety switch plug-in

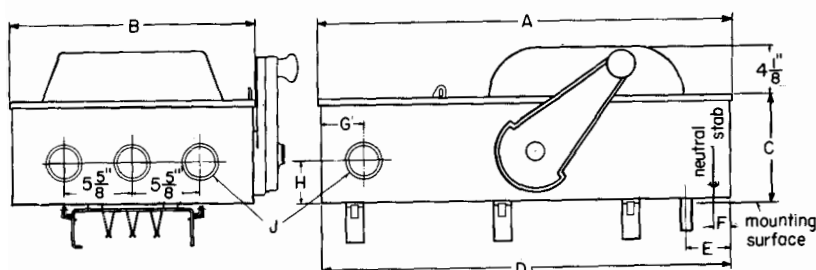


ampere rating	voltage	poles	horsepower rating		dimensions (in inches)									net weight
			N.E.C. stand.	time delay	A	B	C	D	E*	F	G	H	J	
30	240	2 & 3	3	7½	18 ¼	8 <sup>21</sup> / <sub>32</sub>	5 <sup>3</sup> / <sub>16</sub>	18	3 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>16</sub>	¾-1-1 ¼	16 lbs.
	120/208	3Ø 4W	3	7½										17 lbs.
	600	2 & 3	7½	20										17 lbs.
	277/480	3Ø 4W	5	15										18 lbs.
60	240	2 & 3	7½	15	18 ¼	8 <sup>21</sup> / <sub>32</sub>	5 <sup>3</sup> / <sub>16</sub>	18	3 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>16</sub>	¾-1-1 ¼	17 lbs.
	120/208	3Ø 4W	7½	15										18 lbs.
	600	2 & 3	20	50										18 lbs.
	277/480	3Ø 4W	15	30										19 lbs.
100	240	2 & 3	15	30	19 <sup>1</sup> / <sub>16</sub>	8 <sup>21</sup> / <sub>32</sub>	5 <sup>3</sup> / <sub>8</sub>	18 <sup>13</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>32</sub>	1 ½	1 <sup>1</sup> / <sub>8</sub>	¾-1-1 ¼	22 lbs.
	120/208	3Ø 4W	15	30	21 <sup>1</sup> / <sub>16</sub>			20 <sup>13</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>16</sub>					23 lbs.
	600	2 & 3	30	50	21 <sup>1</sup> / <sub>16</sub>			20 <sup>13</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>8</sub>					23 lbs.
	277/480	3Ø 4W	25	50	22 <sup>3</sup> / <sub>4</sub>			22 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>16</sub>					1 <sup>1</sup> / <sub>32</sub>
200	240	2 & 3	30	50	20 <sup>3</sup> / <sub>8</sub>	13 <sup>7</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>32</sub>	20 <sup>3</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>32</sub>	2 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>16</sub>	2-2 ½-3	44 lbs.
	120/208	3Ø 4W	30	50	22 <sup>1</sup> / <sub>16</sub>			21 <sup>7</sup> / <sub>32</sub>	3 <sup>3</sup> / <sub>16</sub>					46 lbs.
	600	2 & 3	50		22 <sup>7</sup> / <sub>8</sub>			22 <sup>1</sup> / <sub>32</sub>	1 <sup>7</sup> / <sub>8</sub>					46 lbs.
	277/480	3Ø 4W	50		24 <sup>1</sup> / <sub>16</sub>			24 <sup>3</sup> / <sub>32</sub>	3 <sup>3</sup> / <sub>32</sub>					1 <sup>1</sup> / <sub>32</sub>
400	240	2			39 <sup>7</sup> / <sub>8</sub>	17 <sup>7</sup> / <sub>32</sub>	8 <sup>7</sup> / <sub>8</sub>	39	3 <sup>21</sup> / <sub>32</sub>	1 <sup>3</sup> / <sub>8</sub>	3 ½	8 <sup>7</sup> / <sub>8</sub>	2 ½-3	86 lbs.
	240	3			39 <sup>7</sup> / <sub>8</sub>	20 <sup>13</sup> / <sub>32</sub>		39	3 <sup>21</sup> / <sub>32</sub>					102 lbs.
	120/208	3Ø 4W			39 <sup>7</sup> / <sub>8</sub>	20 <sup>13</sup> / <sub>32</sub>		39	3 <sup>21</sup> / <sub>32</sub>					115 lbs.
	600	3			42 <sup>11</sup> / <sub>16</sub>	20 <sup>13</sup> / <sub>32</sub>		42 ¼	3 <sup>21</sup> / <sub>32</sub>					130 lbs.
600	277/480	3Ø 4W			42 <sup>1</sup> / <sub>16</sub>	20 <sup>13</sup> / <sub>32</sub>		42 ¼	3 <sup>21</sup> / <sub>32</sub>	1 <sup>3</sup> / <sub>8</sub>				144 lbs.
	240	3			52 <sup>1</sup> / <sub>16</sub>	23 <sup>21</sup> / <sub>32</sub>	9 ¼	51 <sup>5</sup> / <sub>8</sub>	6 <sup>1</sup> / <sub>16</sub>					
	120/208	3Ø 4W			52 <sup>1</sup> / <sub>16</sub>			51 <sup>5</sup> / <sub>8</sub>						
	600	3			55 <sup>1</sup> / <sub>16</sub>			54 <sup>5</sup> / <sub>8</sub>						
	277/480	3Ø 4W			55 <sup>1</sup> / <sub>16</sub>			54 <sup>5</sup> / <sub>8</sub>						

\* centerline of duct joint for 600 amp switch.

## safety switch plug-in type TAP cont'd

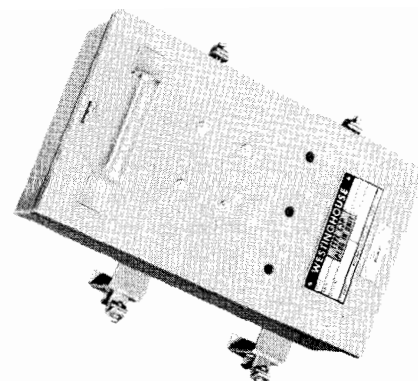
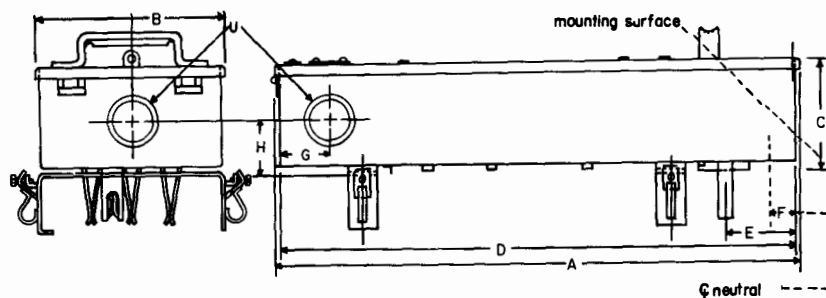
side operated 400 and 600 amp type TAP safety switch plug-in  
(for dimensions see table on preceding page).



## cover-operated switch plug-in type COP

Cover-operated fusible take-off devices are available in 30, 60, 100 and 200 ampere ratings in 2-pole, 3-pole, and 3-phase, 4-wire types for 240 and 600-volt a-c circuits. Switch blades are mounted on cover so switch and cover are always opened together. These units are horsepower-rated up to and including the 100 ampere device. All 30 and 60 ampere units

are so designed that a neutral stab assembly can be added in the field, if necessary. On 4-pole solid neutral devices, the 30 and 60 ampere ratings have proper lugs to accommodate a full-size neutral conductor. *However, on the 100 and 200 ampere devices, a full-size neutral stab and lug, if needed, must be specified on the order write-up.*

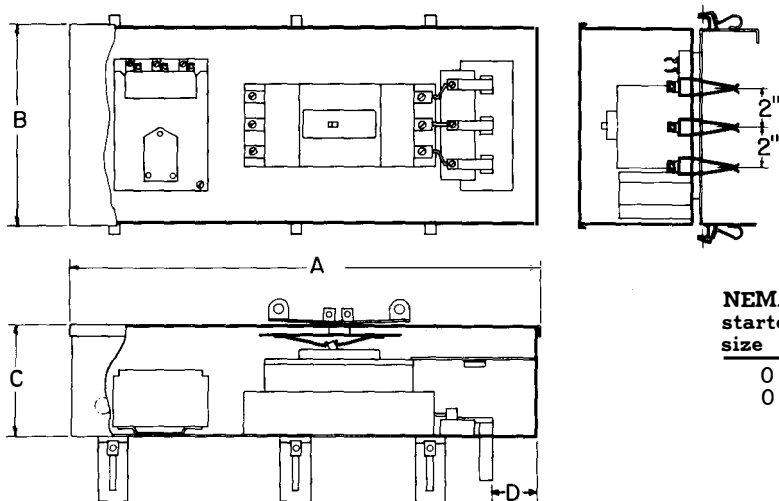


ampere rating	voltage	poles	dimensions (in inches)									net weight
			A	B	C	D	E	F	G	H	U	
30 & 60	240	2 & 3	16 1/2	8 1/2	4 1/4	15 1/4	3 3/8	1 1/2	1 1/4	1 1/2	3/4-1-1 1/4	14 lbs.
	120/280	3 Ø 4W						1 1/2				15 lbs.
	600	2 & 3						1 1/2				14 lbs.
	277/480	3 Ø 4W						1 1/2				15 lbs.
100	240	2 & 3	16 3/4	8	4 1/8	16 1/8	3 3/8	1 1/2	1 1/2	1 5/8	3/4-1-1 1/4	21 lbs.
	120/208	3 Ø 4W	16 3/4			16 1/8		1 1/2				22 lbs.
	600	2 & 3	18 3/4			18 1/8		1 1/2				22 lbs.
	277/480	3 Ø 4W	18 3/4			18 1/8		1 1/2				23 lbs.
200	240	2 & 3	26 1/2	9 1/8	5 1/8	26 3/4	3 3/8	1 1/2	2 1/8	2 1/2	2-2 1/2	41 lbs.
	120/208	3 Ø 4W	26 1/2			26 3/4	3 3/8	1 1/2				42 lbs.
	600	2 & 3	26 1/2			26 3/4	2 1/2	1 1/2				42 lbs.
	277/480	3 Ø 4W	27 1/2			27 3/8	3 3/8	1 1/2				43 lbs.

**plug-in protective devices****combination Linestarter® plug-ins**

For motor circuits the ultimate in motor overload and branch conductor protection is furnished by combination Linestarter plug-ins. The unit consists of a Linestarter for motor overload protection and a circuit breaker or a De-ion Switch with fuses for protection of the conductors. Additional safety for operating personnel can be obtained by using a step-down control transformer to provide a low-voltage control

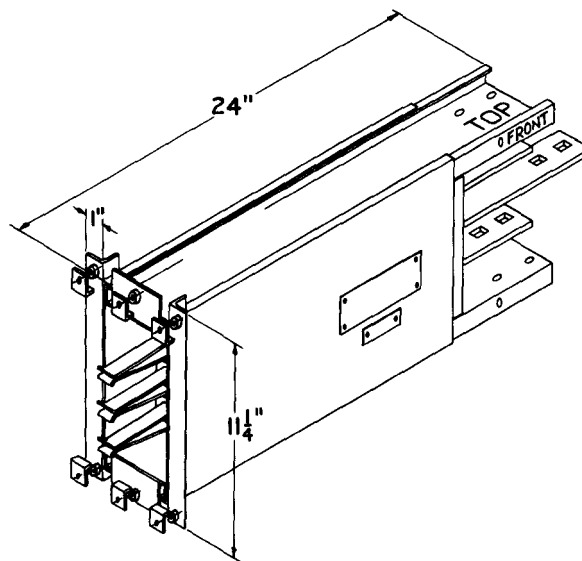
circuit. These units are available for motors up to 100 horsepower, 440 volts, which use a size 4 starter and type J breaker. A remote control pushbutton can be located at any convenient place. *When ordering a combination plug-in Linestarter, include all information necessary for any other combination starter.*



NEMA starter size	poles	dimensions (in inches)			
		A	B	C	D
0 & 1	3P	23	10 $\frac{1}{2}$	5 $\frac{5}{8}$	3 $\frac{1}{16}$
0 & 1	3 $\phi$ 4W	23 $\frac{3}{4}$	10 $\frac{1}{2}$	5 $\frac{5}{8}$	3 $\frac{1}{16}$
2	3P	23 $\frac{1}{2}$	13 $\frac{1}{2}$	5 $\frac{5}{8}$	3 $\frac{1}{16}$
2	3 $\phi$ 4W	24 $\frac{1}{2}$	13 $\frac{1}{2}$	5 $\frac{5}{8}$	3 $\frac{1}{16}$
3	3P	25 $\frac{1}{2}$	16 $\frac{1}{2}$	6 $\frac{3}{4}$	3 $\frac{1}{16}$
3	3 $\phi$ 4W	27 $\frac{1}{2}$	16 $\frac{1}{2}$	7 $\frac{1}{2}$	3 $\frac{1}{16}$
4	3P	34 $\frac{1}{2}$	20 $\frac{1}{2}$	6 $\frac{3}{4}$	3 $\frac{1}{16}$

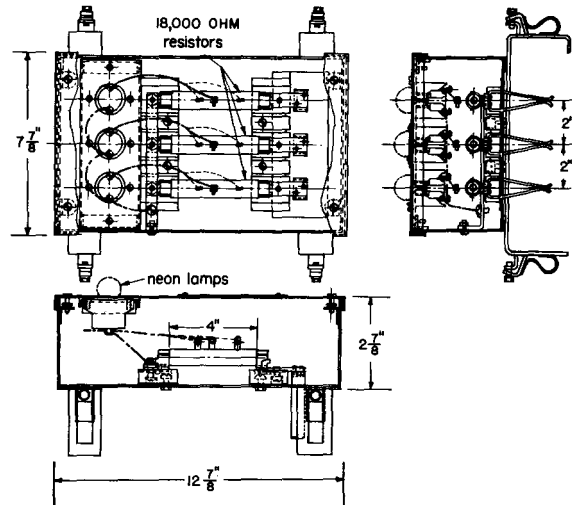
**straight length plug-in**

To provide additional branch circuits from a run of plug-in bus duct, a 2-foot straight length with stabs on one end can be used. These stabs make it possible to locate the branch run anywhere along the run of plug-in duct. This unit is available in 225 and 400 amp ratings only, for 2 and 3-pole duct.



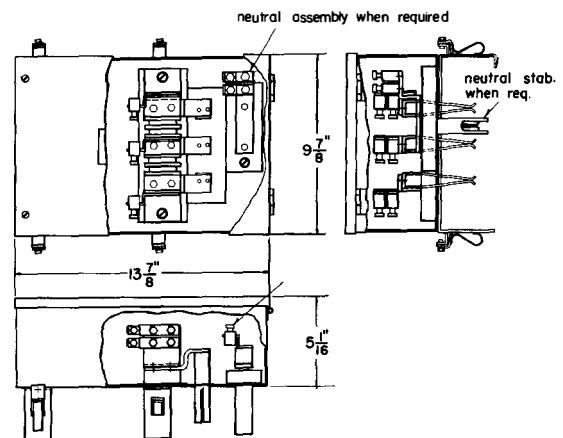
## ground detector and neutralizer plug-in

In rare cases, bus bars in a bus duct system pick up static electricity. In order to discharge this potential, a neutralizer plug is available which also serves as a ground detector. The unit has an 18,000 ohm resistor connected between the bus bars and the ground. Static electricity is discharged through this resistor. A neon lamp is placed in series with the bus bar and part of the resistor and burns continuously. If there is a ground anywhere on the system which is of lower resistance than the path through the lamp, the lamp will go out, indicating that there is a short in the system. *When ordering specify system voltage —240, 480, or 575.*



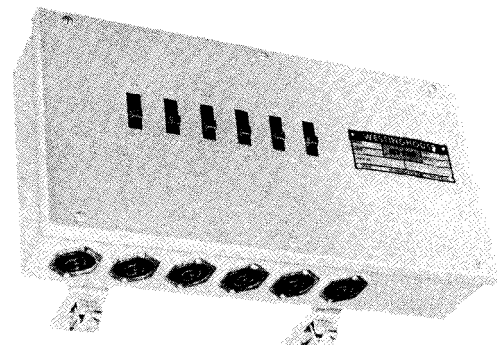
## tap box plug-in

Flexibility is extended by using a tap box plug-in for cable connection. They are available in ratings of 100, 225 and 400 amperes.



## load center plug-in unit

Shown here are 6 single-pole E frames. These units are also available in combinations of 1, 2 and 3-pole units up to a total of 12 poles, or a maximum total current of 400 amperes. Each unit is completely wired at the factory making it unnecessary to open the enclosure to put them in service. Convenient Twist-lock receptacle simplifies power take-off. Units are available with or without twist-lock receptacle.



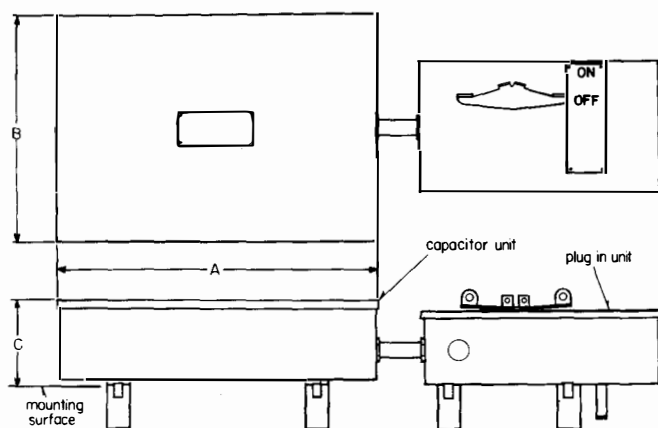
## transformer plug-in units

Whenever power for small loads is needed at a lower voltage than that of the bus duct system, they are conveniently served by the use of a transformer plug-

in unit. The transformer and plug-in device is built into one unit, reducing voltage from 480, 440 to 240, 220 or 120/208 etc.

**plug-in protective devices****capacitor plug-in units**

When bus duct systems serve an inductive load, it is sometimes necessary and economical to use capacitors for improving the power factor. On large installations it may be best to bank capacitors, however on individual units they are built into one enclosure in capacities of 5 and 7½ KVAR, 230-volt, and 5, 10 and 15 KVAR, 460 and 575-volt. For overcurrent protection either type CBP, type TAP, or type COP plug-in devices may be used.

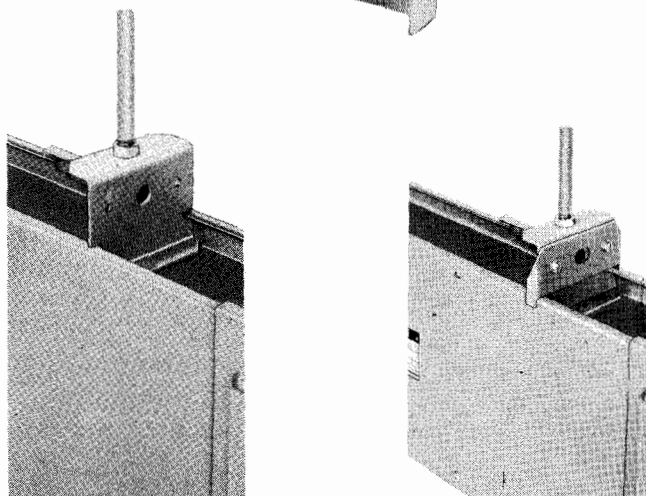
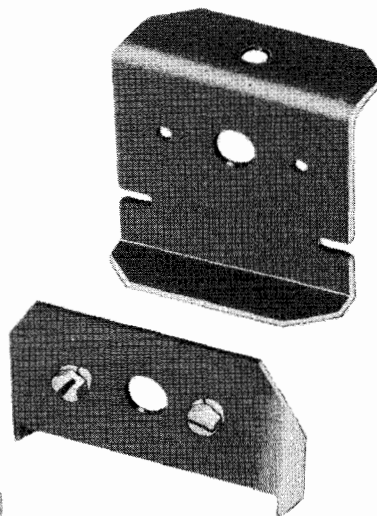


KVAR	voltage	dimensions (in inches)		
		A	B	C
5.0	240	24 ¾	14 ½	5 ⅞
7.5	240	24 ¾	14 ½	6 ⅞
5.0	460, 575	24 ¾	14 ½	5 ⅞
10.0	460, 575	24 ¾	14 ½	5 ⅞
15.0	460	24 ¾	14 ½	6 ⅞
15.0	575	24 ¾	14 ½	5 ⅞

**hangers for plug-in duct****cantilever hangers**

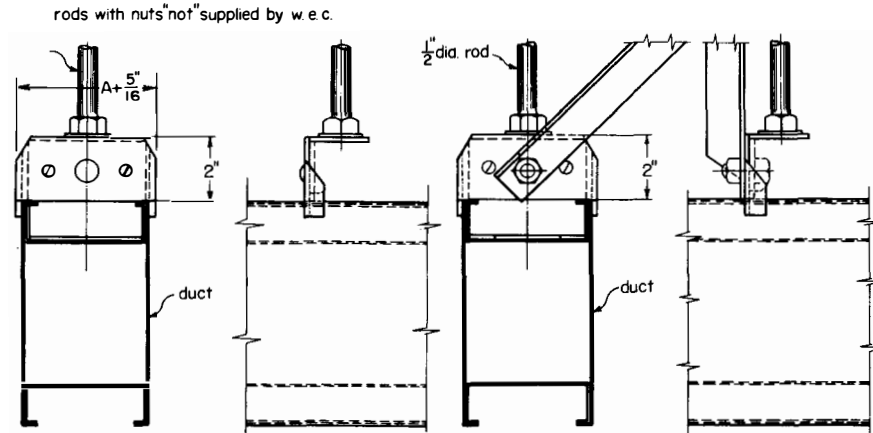
The cantilever type hanger can be used to support 225 to 1500 ampere plug-in duct. The most popular hanger in the industry by far, it is easy to install, saves material, and contributes to neat appearance. Drop rods, with "Z" shaped plates on them, can be suspended before duct is ready for installation. Then the duct is raised to the proper place, the "Z" shaped plate twisted onto the duct, and the flat plate bolted to the "Z" shaped piece. Installation is completed by tightening a nut on the drop rod. (See illustrated step-by-step assembly of cantilever hanger below.)

One hanger is furnished with every 5 feet of duct, *but drop rods and nuts are not supplied by Westinghouse.* If the installation requires long drop rods, it may be necessary to place braces at occasional intervals to prevent sideways. *When ordering, specify what size duct the hangers are to carry.*



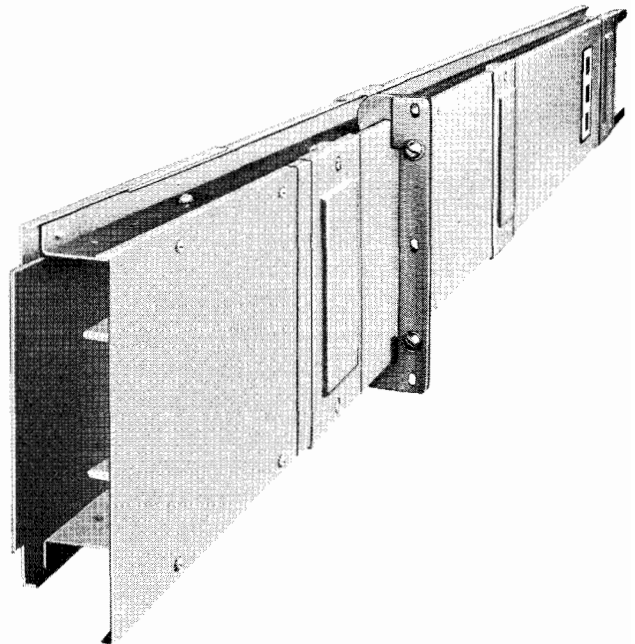
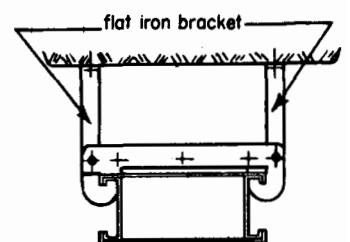
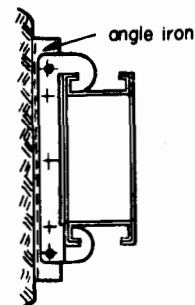
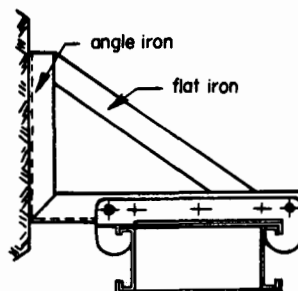
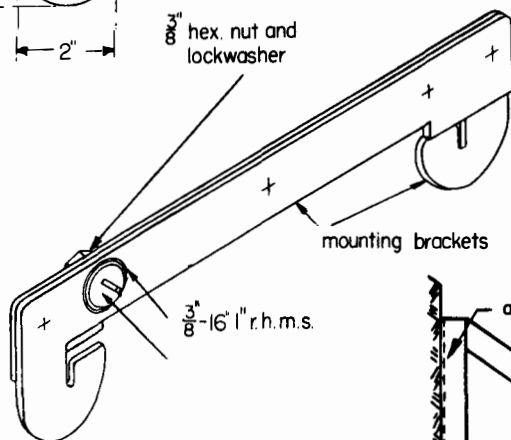
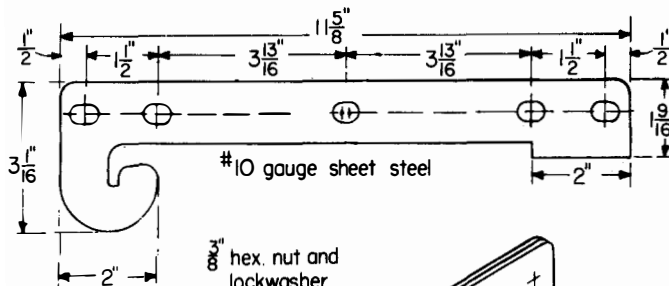
straight lengths, fittings, plug-in  
protective devices, hangers

## cantilever hangers cont'd



## "C" type hangers

If duct is to be mounted flatwise or close to a wall, "C" type hangers can be used. These consist of a 2-piece mounting bracket which fits on either the "FRONT" or "REAR" side of the duct. The same bracket fits all sizes of plug-in duct from 225 to 1500 amperes and one hanger is furnished for every 5-feet of duct.





## typical specifications for plug-in bus duct

### general

The bus duct shall consist of {aluminum  
copper bus conductors  
totally enclosed by and supported in a sheet steel housing. The complete installation shall be coordinated throughout, rigid in construction, of uniform size, and neat and symmetrical in appearance. As many sections as possible shall be ten-foot lengths. Special sections and/or fittings shall be provided only where necessary to suit the installation. Access openings to the bolted joints of conductors shall be provided in two opposite sides of the housing. Conductor joints shall be made in such a manner that no increase of enclosure size is required at the splice between adjoining sections. One hanger shall be provided for every 5' 0" of horizontally mounted duct; however, the duct shall be suitable for being supported on 10' 0" support spacing. For vertically mounted duct, one adjustable vertical hanger shall be provided per 15' 0" of riser or per span between floors. The bus duct shall be approved by Underwriters' Laboratories including approval for mounting in the horizontal or vertical position. The bus duct shall be as manufactured by Westinghouse or approved equal.

### enclosure

The duct housing, which shall be made from 16-gauge steel, shall be of the four-channel interlocking type of construction. It shall be bonderized both inside and outside and given one coat of gray, baked-on enamel. Except for fittings, at least one plug-in opening per foot shall be provided in the housing of standard sections. Spring retained, sliding-plate type outlet covers shall be provided to cover each plug-in opening in the housing. Two removable access covers shall be provided at each splice to insure ease of inspection of bus bar joints and to facilitate the bolting-on of current take-off devices. Two splice plates shall also be provided at each splice to insure a strong, positive, mechanical connection being made between the housing of adjoining sections.

### conductors

The conductors shall be fabricated from the best grade 98% conductivity pure copper bus bars. Bars shall be of the rectangular type having full round edges. Bars shall be silver-plated at their ends where lap joints are to be made.

(Alternate: The conductors shall be fabricated from high strength, 55% minimum conductivity, extruded aluminum bus bars. Bars shall be of the rectangular type with edges having rounded corners. The entire length of the bars shall be plated electrolytically with a minimum thickness of .0002" of silver.)

Bus bars shall be offset at one end for ease in making neat lap splices. However, to further simplify installation, bars shall be pierced on both lap ends with rectangular slots. Joints shall be made with not less than two bolts which shall be of heat-treated, cadmium-plated steel and of a tensile strength of 100,000 lbs. per square inch.

### supports

Bus bars shall be firmly supported by insulators of cold-molded Rosite, spaced equally, on alternate sides of the duct, and on not greater than 12" centers. Insulators shall be of the type through which it is possible to insert the stabs of a plug-in device in order to fully isolate stabs as well as to afford extra protection in the event of stresses due to a fault. Insulator construction shall be such that the only requirement for the securing of the insulator to the housing is an extension of a portion of insulator through either the front or back cover of housing.

### plug-in devices

Plug-in devices shall be of the circuit breaker type, fusible (De-ion switch, visible blade), load-break type or fusible (cover-operated) non-load break type. Plug-in units shall be equipped with safety interlocks and insulated stabs so that live parts are not readily exposed to personnel. A universal clamping device shall be used to securely fasten both plug-in units and bolt-on units to the duct. The plug-in units shall be interchangeable without alteration or modification on all ratings of plug-in duct. Plug-in units shall also be equipped with operating mechanisms that will permit easy operation from the floor by means of hookstick or chain. Plug-in units shall bear the label of Underwriters' Laboratories, Inc.

### operating characteristics

The current carrying capacity of bus duct and plug-in units shall be according to NEMA Standards. Likewise, the bus duct structure shall withstand short circuit stresses in accordance with NEMA short circuit ratings for busways.

### engineering and test data

The data, tables and formulas on the following pages will be found useful in correctly applying bus duct, and in selecting power take-off devices.

#### short circuit current

The table at the right lists the greatest symmetrical three-phase, short-circuit current on the secondary side of transformers of 3 percent reactance, based on sustained primary voltage regardless of the amount of power on the primary side. These current values have been calculated from the formula:

$$I = \frac{KVA \times 1000 \times 100}{E \times 1.73 \times X}$$

where KVA = rating of 3-phase transformer or transformer bank

E = secondary voltage of transformer or bank

X = reactance of transformer or bank

To obtain proper current values for transformers having different reactance, multiply the current values by the ratio:

$$\frac{3}{\% \text{ reactance of transformer}}$$

#### transformer short-circuit current

KVA rating of 3Ø transformers	secondary volts			
	120	240	480	600
secondary short-circuit current in amps				
10	1,605	803	401	321
15	2,408	1,204	602	482
25	4,014	2,007	1,004	803
37.5	6,021	3,010	1,505	1,204
50	8,028	4,014	2,007	1,606
75	12,040	6,021	3,010	2,408
100	16,060	8,028	4,014	3,211
150	24,080	12,040	6,021	4,817
200	32,120	16,060	8,028	6,422
300	48,170	24,080	12,040	9,634
450		36,130	18,060	14,450
600		48,170	24,080	19,270
750		60,210	30,110	24,090
1,000			40,140	32,110
1,200			48,170	38,450
1,500			60,210	48,170
2,000			80,280	64,230
2,500				80,280

#### formulas for determining amperes, horsepower, kilowatts and kilovolt-amperes

to find:	direct current	alternating current		
		single-phase	two-phase, 4-wire ①	three-phase
amperes when horsepower is known	$\frac{HP \times 746}{E \times \% \text{ Eff.}}$	$\frac{HP \times 746}{E \times \% \text{ Eff.} \times PF}$	$\frac{HP \times 746}{2 \times E \times \% \text{ Eff.} \times PF}$	$\frac{HP \times 746}{1.73 \times E \times \% \text{ Eff.} \times PF}$
amperes when kilowatts are known	$\frac{KW \times 1000}{E}$	$\frac{KW \times 1000}{E \times PF}$	$\frac{KW \times 1000}{2 \times E \times PF}$	$\frac{KW \times 1000}{1.73 \times E \times PF}$
amperes when KVA is known	.....	$\frac{KVA \times 1000}{E}$	$\frac{KVA \times 1000}{2 \times E}$	$\frac{KVA \times 1000}{1.73 \times E}$
kilowatts	$\frac{I \times E}{1000}$	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 2 \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$
KVA	.....	$\frac{I \times E}{1000}$	$\frac{I \times E \times 2}{1000}$	$\frac{I \times E \times 1.73}{1000}$
horsepower (output)	$\frac{I \times E \times \% \text{ Eff.}}{746}$	$\frac{I \times E \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times 2 \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times 1.73 \times \% \text{ Eff.} \times PF}{746}$

where I = amperes  
PF = power factor  
KVA = kilovolt-amperes

E = volts  
KW = kilowatts  
HP = horsepower

% Eff. = percent efficiency

① for 3-wire, 2-phase circuits the current in the common conductor is 1.41 times that in either of the two other conductors.





## resistance welding application

Electrical resistance welding is a means of joining two or more metals together by the use of heat and pressure. The heat is generated by an electric current flowing across the intended joint location and the pressure is applied by the two electrodes which carry the current, using hydraulic, mechanical, or other means. High amperage current passes between the electrodes and through the metals to be joined, producing an intense, localized heat. This causes the contact areas at the point of pressure to become plastic, thus forming the weld.

The bus duct distribution system for a resistance welder installation must meet two requirements. First, it must provide sufficient current carrying capacity to avoid overheating the duct. Secondly, it must not allow the permissible voltage drop to be exceeded. Due to the intermittent character of resistance welder loads the voltage drop requirement is the most difficult to meet. It will usually be found that if a bus duct size is chosen which will satisfy this requirement, it will also have sufficient current carrying capacity. However, this cannot be taken for granted and both requirements must be carefully determined by separate calculations.

The operation of resistance welders may be considered as either constant or varying. Constant operation means that the actual primary current during weld and the duty cycle are known and do not vary. In varying operation the duty cycle and type and thickness of material being welded will not be constant, thus reasonable assumptions must be made for these varying quantities.

### current carrying capacity requirement

To determine the current carrying capacity required it is necessary to convert the intermittent welder loads to an equivalent continuous load or effective KVA. If the during weld KVA demand and the duty cycle for a welder are known, the effective KVA can be obtained by multiplying the during weld KVA demand by the square root of the duty cycle. The duty cycle, as defined by the NEC, is the ratio of the actual current flow time during welding of a production item to the total time required to set up, weld and remove the piece.

The multipliers for various duty cycles are listed in the following table:

duty cycle (%)	50	40	30	25	20	15	10	7.5	5.0 or less
multiplier	.71	.63	.55	.50	.45	.39	.32	.27	.22

If the during weld KVA demand is unknown, it can be assumed to be 70% of the secondary short circuit KVA. If both the during weld KVA and the duty cycle are unknown, the effective KVA can be assumed to be 70% of the nameplate KVA rating for seam and automatic welders and 50% of the nameplate KVA rating for manually operated welders other than seam. Nameplate KVA rating is defined as the maximum load that can be imposed on the welding machine transformer at a 50% duty cycle.

It has been found by actual measurements that the total effective KVA of a group of welders is equal to the effective KVA of the largest welder plus 60% of the sum of the effective KVA of the remaining welders.

Once the effective KVA has been determined the current carrying requirement can be easily calculated as follows:

#### single phase distribution systems

$$\text{current carrying requirement} = \frac{\text{total effective KVA} \times 1000}{\text{system voltage}}$$

#### three phase distribution systems

$$\text{current carrying requirement} = \frac{\text{total effective KVA} \times 1000}{\text{system voltage} \times \sqrt{3}}$$

### voltage drop requirements

To assure consistently good welds the voltage drop in a distribution system should be limited to 10%. In some instances this may be excessive, therefore specific permissible voltage drop information should be obtained whenever possible. The 10% value includes voltage drop in the primary distribution system, the distribution transformers, and the secondary distribution system.

The voltage drop in the primary distribution system can be obtained from the power company provided the maximum KVA demand and the power factor of the largest welder is furnished them.

The voltage drop in the distribution transformer can be found from the formula:

$$\text{voltage drop (\%)} = \frac{\text{during weld KVA} \times \text{transformer impedance (\%)}}{\text{transformer KVA rating}}$$

Voltage drop curves for Westinghouse bus duct can be used as a basis for determining the voltage drop in the secondary distribution system. It is general practice to permit 2% voltage drop in the primary distribution system, 5% in the distribution transformer, and the remaining 3% in the secondary distribution system.

Voltage drop can be determined in the same way as for conventional circuits based on the current as calculated from the during weld KVA. If the during weld KVA is unknown, it can be assumed to be approximately 4 times the nameplate KVA rating for large projection or butt welders and  $2\frac{1}{2}$  times the nameplate KVA rating for other types. Large welders are sometimes interlocked to prevent excessive voltage drop caused by the possibility of simultaneous firing. In such cases it is necessary to consider only the largest of the interlocked welders in calculating voltage drop.

### example

It is desired to determine the minimum size bus duct that will meet current carrying and voltage drop requirements for an industrial plant with 440 volt, 3 phase, 3 wire service. The bus duct is to supply the following group of welders which are balanced on the phases and evenly distributed along a 200 foot feeder run: 1—300 KVA butt, 1—175 KVA butt, 1—150 KVA seam, 4—100 KVA spot, 5—50 KVA spot, 10—5 KVA spot. The welders are manually operated and the 300 and 175 KVA welders are interlocked to prevent their firing simultaneously. Power factor of the welders is given as 40% and permissible voltage drop in the feeder duct is 3%. Specific information regarding during weld KVA and duty cycles is not available.

#### current carrying requirement calculations

effective KVA of largest welder  $300 \times 50\% = 150 \text{ KV}$

effective KVA of seam welder  $150 \times 70\% = 105 \text{ KVA}$

effective KVA of remaining welders  $700 \times 50\% = 350 \text{ KVA}$   
excluding the interlocked 175 KVA welder

total effective KVA  $150 + (105 + 350) \times 60\% = 423 \text{ KVA}$

equivalent continuous current  $\frac{423 \text{ KVA} \times 1000}{440 \times \sqrt{3}} = 555 \text{ amp}$

thus 600 amp low impedance bus duct will meet the current carrying requirement.

#### voltage drop requirement calculations

Total nameplate KVA of butt welders—300 KVA excluding the interlocked 175 KVA welder

total nameplate KVA of remaining welders—850 KVA

during weld KVA of butt welders  $4 \times 300 = 1200 \text{ KVA}$

during weld KVA of remaining welders  $2\frac{1}{2} \times 850 = 2125 \text{ KVA}$   
KVA 3325 KVA

three phase during weld current  $\frac{3325 \text{ KVA} \times 1000}{440 \times \sqrt{3}} = 4370 \text{ amp}$

At 40% power factor the voltage drop per 100 feet of 600 ampere low impedance bus duct carrying rated load is 2.7 volts. Since the load is distributed, use half this value, or 1.35.

voltage drop for feeder system is  $1.35 \times \frac{4370}{600} \times \frac{200 \text{ feet}}{100 \text{ feet}} = 19.6 \text{ volts}$

percent voltage drop is  $\frac{19.6}{440}$  or 4.5%

This exceeds the permissible voltage drop of 3%, and it will be necessary to go to a larger size bus duct. 800 ampere low impedance duct would have a voltage drop of 3.3%. Because of the conservative nature of the assumptions made, this would be the logical choice.

### conclusion

Since it is difficult to obtain specific information concerning the operation of welders (particularly in new installations) and to determine accurately the possibilities for simultaneous firing of the welders, exact solutions to problems of distribution systems for resistance welders are not possible.

In the example it was stated that the load was balanced and distributed. In actuality, it is extremely difficult to balance the load, and distribution may be far from uniform. In the case of unevenly distributed loads it may be necessary to compute the voltage drop for each welder individually and use the sum of the results. By obtaining as much information as possible concerning a proposed installation, by tabulating this information in logical sequence, and by using good judgment in the making of reasonable and conservative assumptions where missing data is concerned, a bus duct distribution system can be chosen in a size necessary to serve the load adequately at lowest possible cost.

### test data • short circuit stresses

#### plug-in bus duct

With higher concentrations of power in industrial plants becoming more commonplace, the subject of short-circuit stresses in plug-in bus duct is becoming more important.

A study of short-circuit stresses on plug-in duct was made on groups of two 10-ft. sections bolted together, making a 20-ft. run. Two types of fault conditions were used—the bolted fault and the arcing fault.

#### tests on bolted faults

A fault equal to a bolted fault seldom happens in actual practice, but tests using bolted faults give a better understanding of what takes place, especially since in the laboratory, a bolted fault can be more easily controlled than an arcing fault. By using a 20-ft. run or two 10-ft. sections bolted together, the splice was tested as well as the 10-ft. unit. Current was fed into the three copper conductors at one end of the duct while the copper conductors at the other end were shorted out by a bolted connection.

The results were determined by varying the duration of time-fixed values of current which flowed through the conductors. The time was controlled by the use of a Westinghouse DA-50 Breaker in the circuit. The current was increased in steps of 5000 rms amperes, and two tests for each current value were run. In the first test, the current was allowed to remain on for two cycles and in the second test, for twenty cycles. From these and previous tests, it was determined that the damage, so far as the bending of the copper conductors and the breaking of insulators was concerned, occurred in the first one-half cycle that the current was on.

Fault currents were increased in steps of 5000 rms amperes until 25,000 rms amperes was reached and still none of the standard Westinghouse Rosite plug-in insulators was broken. An identical test was run with a still higher quality insulator and the

**engineering and test data****test data • short circuit stresses cont'd**

current was increased in steps of 5000 rms amperes until it reached 40,000 rms amperes without breaking the insulators.

All the values of short-circuit current are average 3-phase rms values calculated in accordance with the American Standards publication, Methods for Determining the RMS Value of Sinusoidal Current Wave and a Normal Frequency Recovery Voltage C 37.5—1945.

The stress set up in the duct due to short-circuit currents, which tend to bend the bus bars and break insulators, can be computed by the formula:

$$\text{stress in pounds per foot} = \frac{37.2 \times I^2 \times 10^{-7}}{D}$$

- $I$  = Short-circuit current in rms amperes  
 $D$  = Distance between center line of conductors in inches.  
 (2 in. = the distance between center line of conductors in Westinghouse plug-in duct.)

From this formula it will be seen that the stress under heavy short-circuit current is tremendous. For example, the force tending to pull the bars apart when the short circuit is 50,000 rms amperes is 4650 pounds per foot.

**3-phase arcing fault**

An arcing fault is more apt to occur on bus duct installations than a solid fault, represented by a bolted connection. Anything that will cause an arc to strike between the conductors of the duct may start an arcing fault. The ionized gas caused by the arc serves as a conductor, and the arc will be sustained as long as sufficient voltage is maintained.

An arcing fault of the same current value as a bolted fault will produce the same mechanical damage to the duct, such as the bending of the bars and the breaking of insulators. In addition to this, there is the arc, which due to its high temperature, has its own destructive effect. An arc will always travel away from the source of supply and at a very high speed which varies in proportion to the current magnitude.

Westinghouse plug-in duct uses the half insulator spaced twelve inches on centers and placed on alternate sides of the duct housing, thus allowing the arc to travel freely without causing noticeable damage. The plug-in stabs, which are inserted through the insulator, are completely surrounded with a good quantity of Rosite material which prevents them from burning and protects them from the forces of the short-circuit stress.

In the arcing fault test, as in the bolted fault test, the current was increased in steps of 5000 rms amperes until destruction took place. Tests have been run using full insulators in an attempt to stop the arc. The arc cannot be stopped unless a gastight barrier is used, and then, if an arc could be confined between two such barriers, the gas pressure would build up to the point where the enclosure would be forced apart. The ionized gas will leak through the full insulator and, as long as voltage is maintained on the circuit, a new arc will strike and continue to travel away from the source of supply. The damaging thing is that, wherever the arc hesitates, it burns the copper bars and housing surround-

ing them. In Westinghouse plug-in duct, the arc is free to travel and does the least amount of damage.

The data taken from one of these tests is as follows:

bolted fault—DA-50 breaker

rms amperes first one-half cycle at 450 volts—	
max. phase.....	29,400
a-c component.....	20,800
average 3-phase.....	26,600
peak amperes first cycle max. phase.....	52,300

test results—The DA-50 breaker removed the fault within two cycles. The Westinghouse duct showed no damage.

Tests show that Westinghouse plug-in duct, using standard Rosite insulators will take the stresses of 25,000 rms amperes short circuit without any damage to copper bars or insulators on all ratings of duct except the 225-ampere rating, using  $\frac{1}{8}$  in. by  $\frac{7}{8}$  in. copper bars. This  $\frac{1}{8}$  in. by  $\frac{7}{8}$  in. bar will bend between insulators when subjected to stresses from currents over 18,000 rms amperes.

Should it be necessary to use a plug-in duct that has to take higher short-circuit stresses than those of 25,000 rms amperes, then the Westinghouse duct using special insulator should be used. It is identical in shape and size to the Rosite insulator but has the added strength that will allow the duct to take the stresses of 40,000 rms amperes without damage.

Should Westinghouse plug-in duct be subjected to stresses that will bend the copper bar, it does not necessarily mean that the duct is out of service because the bars are held firmly in place at the point where the plug-in stabs are inserted, thus eliminating any interference with the current take-off devices. The insulators are held in place by a portion extending through the front and back covers of the duct. If stresses in excess of those delivered by 25,000 rms amperes or 40,000 rms amperes are applied causing the insulator to crack and the copper bars to bend, the duct can usually remain in service until an opportune time for repairs.

**low-impedance bus duct**

Low-impedance bus duct is made with the bus bars on much closer centers than in plug-in duct. Because of this close spacing, it is necessary to insulate the full length of the bars. Since the bars are fully insulated, there is no path over which an arc can travel; therefore, the only forces which the duct must withstand are short-circuit stresses. A duct can be built to withstand the stresses of most any high short-circuit current by placing the supports closer together.

From the formula given under "tests on bolted faults", it is evident that the forces working on bars that are close together are much greater than those on the ones that are farther apart.

From actual tests similar to those run on plug-in duct, except for higher values of current, it was determined what spacing of supports is necessary to keep the copper bars from bending.

Westinghouse standard low-impedance duct will take the stresses in accordance with NEMA standards. By moving the supports closer together, the duct can be made to stand the stresses of 100,000 rms amperes.

## NEMA standards • short circuit ratings

"The short-circuit ratings shall be 15000, 25000, 50000, 75000, and 100000 rms total amperes.

The short-circuit ratings for plug-in and low-impedance busways shall be as follows:

### plug-in busway

ampere rating	short-circuit rating
225	15000
400	25000
600	25000
800	25000
1000	25000

### low-impedance busway

ampere rating	short-circuit rating
600	25000
800	25000
1000	50000
1350	50000
1600	50000
2000	75000
2500	75000
3000	75000
4000	100000

"Short-circuit rating values are based on available amperes at the line end of the busway as determined in par. B of BU1-3.11 and are also the values used for  $I^2t$  in formulas in par. 3 of BU1-3.12."

## breaker interrupting ratings

### type AB breakers

type	voltage	ratings based on Underwriters' standards	ratings based on NEMA test procedure ①			
			interrupting ratings amps (a-c or d-c)	interrupting ratings amps a-c		
				240 volts or less	241 to 480 volts	481 to 600 volts
E	240 v a-c 2, 125/250 v d-c 3-pole 120 v a-c 1 pole 120 v d-c	5,000	7,500	.....	.....	5,000
	277 v a-c	10,000 a-c only	.....	10,000 (277 v)	.....	.....
F	600 v a-c 250 v d-c	10,000	20,000	15,000	15,000	10,000
G	600 v a-c 250 v d-c	10,000	20,000	15,000	15,000	10,000
J	600 v a-c 250 v d-c	10,000	25,000	20,000	15,000	10,000
K	600 v a-c 250 v d-c	10,000	30,000	25,000	25,000	10,000
KL	600 v a-c 250 v d-c	10,000	40,000	30,000	25,000	20,000
L	600 v a-c 250 v d-c	10,000	50,000	35,000	25,000	20,000
M	600 v a-c 250 v d-c	10,000	50,000	35,000	25,000	20,000

① Westinghouse AB breakers, in addition to passing Underwriters' Laboratories, Inc. tests are also given an interrupting rating based on NEMA test procedure. (NEMA test procedure differs from Underwriters' in that NEMA procedure omits the single-pole, short-circuit tests for multi-pole breakers, but calls instead for test on a multi-pole basis. Also NEMA a-c test circuits have the following power factors: 45-50% at 10,000 amperes or below, 25-30% at 10,000 amperes to 20,000 amperes, and 15-20% above 20,000 amperes.)

### type DB breakers

type	voltage		inter-rupting rating ④
	a-c ②	d-c ③	amperes
DB-15	600-481	250 & below	15000
	480-241	.....	25000
	240 & below	.....	30000
DB-25	600-481	250 & below	25000
	480-241	.....	35000
	240 & below	.....	50000
DB-50	600-481	250 & below	50000
	480-241	.....	60000
	240 & below	.....	75000
DB-75	600-481	250 & below	75000
	480-241	.....	75000
	240 & below	.....	100000
DB-100	600-481	250 & below	100000
	480-241	.....	100000
	240 & below	.....	150000

③ The table applies for frequencies 50 to 60 cps. For frequencies less than 50 cps use the ratings for the 481-600 volt range.

② For 2 or 3 pole breakers for applications on d-c systems over 250 volts, the type DA is available, refer to the nearest Westinghouse district office.

④ On a-c systems, the interrupting rating is the average rms asymmetrical current. On the d-c systems, it is the maximum current that any one pole of the breaker can satisfactorily interrupt.



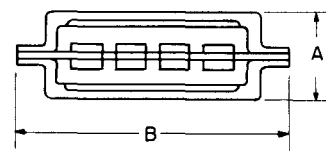
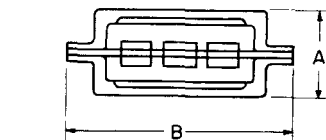
## engineering and test data

## tables of standard bus duct outline dimensions and weights

## Life-Line Busway • Uni-Bus

## copper

ampere rating	phase bus size	dimension B and weights						1/2 neutral bus size	full neutral bus size	dim. A
		3-W	lbs./ft.	4-W 1/2 neut.	lbs./ft.	4-W full neut.	lbs./ft.			
225	1—11 x 1	7 3/4	5.8	9 1/4	7.2	9 1/4	7.2	1—11 x 1	1—11 x 1	3 1/8
400	2—11 x 1	7 3/4	7.1	9 1/4	8.5	9 1/4	8.5	2—11 x 1	2—11 x 1	3 1/8
600	2—5/2 x 1	7 3/4	8.2	9 1/4	9.4	9 1/4	9.8	2—5/2 x 1	2—5/2 x 1	3 1/8
800	2—1/4 x 1	7 3/4	10.5	9 1/4	11.6	9 1/4	12.4	2—1/4 x 1	2—1/4 x 1	3 1/8
1000	2—3/8 x 1	7 3/4	15.0	9 1/4	17.0	9 1/4	19.0	2—3/8 x 1	2—3/8 x 1	3 1/8



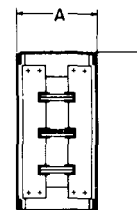
## aluminum

ampere rating	phase bus size	3-W	lbs./ft.	4-W 1/2 neut.	lbs./ft.	4-W full neut.	lbs./ft.	1/2 neutral bus size	full neutral bus size	dim. A
225	1—5/32 x 1	7 3/4	5.1	9 1/4	6.2	9 1/4	6.2	1—5/32 x 1	1—5/32 x 1	3 1/8
400	2—5/32 x 1	7 3/4	5.8	9 1/4	6.8	9 1/4	6.8	2—5/32 x 1	2—5/32 x 1	3 1/8
600	2—1/4 x 1	7 3/4	6.5	9 1/4	7.5	9 1/4	7.7	2—1/4 x 1	2—1/4 x 1	3 1/8
800	2—3/8 x 1	7 3/4	9.0	9 1/4	10.0	9 1/4	11.0	2—3/8 x 1	2—3/8 x 1	3 1/8

## conventional weatherproof bus duct

## copper

ampere rating	bus size	dimension B and weights						1/2 neutral bus size	full neut. bus size	dim. A
		3-W	lbs./ft.	4-W 1/2 neut.	lbs./ft.	4-W full neut.	lbs./ft.			
400	1/4 x 1 1/2	14 7/32	22	17 15/32	26	17 15/32	27	1/8 x 1 1/2	1/4 x 1 1/2	5 19/32
600	1/4 x 2	14 7/32	24	17 15/32	28	17 15/32	29	1/8 x 2	1/4 x 2	6 3/32
800	1/4 x 3	14 7/32	28	17 15/32	32	17 15/32	33	1/8 x 3	1/4 x 3	7 3/32
1000	1/4 x 4	14 7/32	32	17 15/32	36	17 15/32	38	1/8 x 4	1/4 x 4	8 3/32
1250	1/4 x 5	14 7/32	35	17 15/32	41	17 15/32	43	1/8 x 5	1/4 x 5	9 3/32
1500	1/4 x 6	14 7/32	39	17 15/32	45	17 15/32	48	1/8 x 6	1/4 x 6	10 3/32



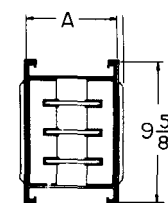
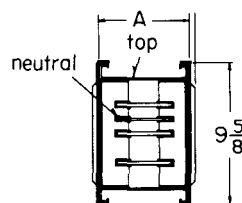
## aluminum

ampere rating	bus size	3-W	lbs./ft.	4-W 1/2 neut.	lbs./ft.	4-W full neut.	lbs./ft.	1/2 neutral bus size	full neut. bus size	dim. A
400	1/4 x 2	14 7/32	20	.....	..	17 15/32	24	.....	1/4 x 1	6 3/32
600	1/4 x 4	14 7/32	24	.....	..	17 15/32	27	.....	1/4 x 4	8 3/32
800	1/4 x 5	14 7/32	25	.....	..	17 15/32	30	.....	1/4 x 5	9 3/32
1000	1/4 x 6	14 7/32	27	.....	..	17 15/32	32	.....	1/4 x 6	10 3/32

## plug-in bus duct

## copper

ampere rating	bus size	lbs./ft.	1/2 neutral bus size	lbs./ft.	full neutral bus size	lbs./ft.	dim. A
225	1/8 x 3/8	12	1/8 x 3/8	12	1/8 x 3/8	12	3 3/8
325	1/4 x 1	13	1/8 x 1	14	1/4 x 1	15	3 3/8
400	1/4 x 1 1/2	15	1/8 x 1 1/2	16	1/4 x 1 1/2	17	3 3/8
600	1/4 x 2	17	1/8 x 2	18	1/4 x 2	19	4 3/8
800	1/4 x 3	20	1/8 x 3	22	1/4 x 3	23	5 3/8
1000	1/4 x 4	24	1/8 x 4	26	1/4 x 4	28	6 3/8
1250	1/4 x 5	28	1/8 x 5	30	1/4 x 5	32	7 3/8
1500	1/4 x 6	31	1/8 x 6	34	1/4 x 6	37	8 3/8



## aluminum

ampere rating	bus size	lbs./ft.	1/2 neutral bus size	lbs./ft.	full neutral bus size	lbs./ft.	dim. A
225	1/4 x 3/8	11	.....	..	1/4 x 3/8	12	3 3/8
325	1/4 x 1 1/2	12	.....	..	1/4 x 1 1/2	13	3 3/8
400	1/4 x 2	13	.....	..	1/4 x 2	14	4 3/8
600	1/4 x 4	16	.....	..	1/4 x 4	17	6 3/8
800	1/4 x 5	18	.....	..	1/4 x 5	19	7 3/8
1000	1/4 x 6	19	.....	..	1/4 x 6	21	8 3/8

### indoor low impedance bus duct

ventilated or totally enclosed

#### copper

amp rating	phase bus size	dimension B and weights						1/2 neut. bus size	full neut. bus size	dim. A
		3-W	lbs./ft. (1)	4-W 1/2 neut.	lbs./ft. (1)	4-W full neut.	lbs./ft. (1)			
600	2-1/4 x 1	9 5/8	13	10 5/8	15	11 3/8	16	1-1/4 x 1	2-1/4 x 1	3 3/8
800	2-1/4 x 1 1/2	9 5/8	17	10 5/8	19	11 3/8	21	1-1/4 x 1 1/2	2-1/4 x 1 1/2	3 3/8
1000	2-1/4 x 2	9 5/8	21	10 5/8	23	11 3/8	25	1-1/4 x 2	2-1/4 x 2	4 3/8
1350	2-1/4 x 2 1/2	9 5/8	24	10 5/8	27	11 3/8	30	1-1/4 x 2 1/2	2-1/4 x 2 1/2	4 3/8
1600	2-1/4 x 3	9 5/8	27	10 5/8	30	11 3/8	32	1-1/4 x 3	2-1/4 x 3	5 3/8
2000	2-1/4 x 4	9 5/8	34	10 5/8	39	11 3/8	43	1-1/4 x 4	2-1/4 x 4	6 3/8
2500	2-1/4 x 5	9 5/8	41	10 5/8	47	11 3/8	53	1-1/4 x 5	2-1/4 x 5	7 3/8
3000	2-1/4 x 6	9 5/8	48	10 5/8	57	11 3/8	63	1-1/4 x 6	2-1/4 x 6	8 3/8
4000	4-1/4 x 4	18 1/2	66	18 1/2	74	21 3/4	82	2-1/4 x 4	4-1/4 x 4	6 1/2
5000	4-1/4 x 5	18 1/2	79	18 1/2	90	21 3/4	101	2-1/4 x 5	4-1/4 x 5	7 1/2
5600	4-1/4 x 6	18 1/2	93	18 1/2	105	21 3/4	117	2-1/4 x 6	4-1/4 x 6	8 1/2

#### aluminum

amp rating	phase bus size	dimension B and weights						1/2 neut. bus size	full neut. bus size	dim. A
		3-W	lbs./ft. (1)	4-W 1/2 neut.	lbs./ft. (1)	4-W full neut.	lbs./ft. (1)			
600	2-1/4 x 1	9 5/8	11	10 5/8	12	11 3/8	13	1-1/4 x 1	2-1/4 x 1	3 3/8
800	2-1/4 x 1 1/2	9 5/8	13	10 5/8	14	11 3/8	15	1-1/4 x 1 1/2	2-1/4 x 1 1/2	3 3/8
1000	2-1/4 x 2	9 5/8	14	10 5/8	15	11 3/8	16	1-1/4 x 2	2-1/4 x 2	4 3/8
1350	2-1/4 x 2 1/2	9 5/8	15	10 5/8	16	11 3/8	17	1-1/4 x 2 1/2	2-1/4 x 2 1/2	4 3/8
1600	2-1/4 x 3	9 5/8	17	10 5/8	19	11 3/8	21	1-1/4 x 3	2-1/4 x 3	5 3/8
2000	2-1/4 x 4	9 5/8	20	10 5/8	23	11 3/8	25	1-1/4 x 4	2-1/4 x 4	6 3/8
2500	2-1/4 x 5	9 5/8	23	10 5/8	28	11 3/8	30	1-1/4 x 5	2-1/4 x 5	7 3/8
3000	2-1/4 x 6	9 5/8	28	10 5/8	35	11 3/8	37	1-1/4 x 6	2-1/4 x 6	8 3/8
4000	4-1/4 x 4	18 1/2	28	18 1/2	29	21 3/4	31	2-1/4 x 4	4-1/4 x 4	5 1/2
5000	4-1/4 x 5	18 1/2	32	18 1/2	35	21 3/4	37	2-1/4 x 5	4-1/4 x 5	6 1/2
5600	4-1/4 x 6	18 1/2	43	18 1/2	46	21 3/4	50	2-1/4 x 6	4-1/4 x 6	8 1/2

① Weights are for ventilated duct only. For weights of totally enclosed duct, add 2 lbs. per ft. to weights of ventilated duct with the same bar size.

### outdoor low impedance bus duct

ventilated or totally enclosed

bus bars insulated with polyvinyl chloride tubing (suitable for caustic and acid conditions) • not gasketed • with drain holes and molded supports

#### copper

amp rating		phase bus size	dimension B and weights								1/2 neut. bus size	full neut. bus size	dim. A	
vent.	solid		3-W	lbs./ft.		4-W 1/2 neut.	lbs./ft.		4-W full neut.	lbs./ft.				
				vent.	solid		vent.	solid		vent.				solid
600	600	2-1/4 x 1	9%	13	15	10%	17	17	11%	18	18	1-1/4 x 1	2-1/4 x 1	3%
800	800	2-1/4 x 1 1/2	9%	17	18	10%	19	20	11%	21	22	1-1/4 x 1 1/2	2-1/4 x 1 1/2	3%
1000	1000	2-1/4 x 2	9%	21	22	10%	23	24	11%	25	26	1-1/4 x 2	2-1/4 x 2	4%
1350	.....	2-1/4 x 2 1/2	9%	24	25	10%	27	28	11%	30	31	1-1/4 x 2 1/2	2-1/4 x 2 1/2	4%
1600	1300	2-1/4 x 3	9%	27	29	10%	30	32	11%	32	34	1-1/4 x 3	2-1/4 x 3	5%
2000	1600	2-1/4 x 4	9%	34	36	10%	39	41	11%	43	44	1-1/4 x 4	2-1/4 x 4	6%
.....	①2000	2-1/4 x 5	9%	41	43	10%	48	49	11%	53	55	1-1/4 x 5	2-1/4 x 5	7%
.....	②2250	2-1/4 x 6	9%	48	49	10%	57	58	11%	63	62	1-1/4 x 6	2-1/4 x 6	8%

#### aluminum

amp rating	phase bus size	3-W	lbs./ft.		4-W 1/2 neut.	lbs./ft.		4-W full neut.	lbs./ft.		1/2 neut. bus size	full neut. bus size	dim. A
			vent.	solid		vent.	solid		vent.	solid			
600	2-1/4 x 1	9 5/8	11	12	10 5/8	12	13	11 3/8	13	14	1-1/4 x 1	2-1/4 x 1	3 3/8
800	2-1/4 x 1 1/2	9 5/8	13	14	10 5/8	14	15	11 3/8	15	16	1-1/4 x 1 1/2	2-1/4 x 1 1/2	3 3/8
1000	2-1/4 x 2	9 5/8	14	15	10 5/8	15	16	11 3/8	16	17	1-1/4 x 2	2-1/4 x 2	4 3/8
1350	2-1/4 x 2 1/2	9 5/8	15	16	10 5/8	16	18	11 3/8	17	19	1-1/4 x 2 1/2	2-1/4 x 2 1/2	4 3/8
1600	2-1/4 x 3	9 5/8	17	19	10 5/8	19	21	11 3/8	21	23	1-1/4 x 3	2-1/4 x 3	5 3/8
2000	2-1/4 x 4	9 5/8	20	22	10 5/8	23	25	11 3/8	25	27	1-1/4 x 4	2-1/4 x 4	6 3/8
2500	2-1/4 x 5	9 5/8	23	25	10 5/8	27	29	11 3/8	29	31	1-1/4 x 5	2-1/4 x 5	7 3/8
3000	2-1/4 x 6	9 5/8	28	30	10 5/8	35	37	11 3/8	37	39	1-1/4 x 6	2-1/4 x 6	8 3/8

① 2160 A. edgewise & 3000 A flatwise  
② 2600 A. edgewise & 3600 A flatwise

### weatherproof low impedance bus duct

totally enclosed

insulated with conventional taped bars • access covers gasketed • wood block supports

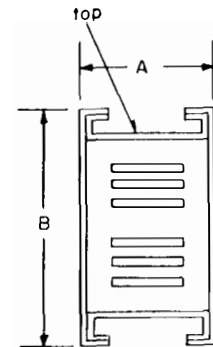
#### copper

amp rating	phase bus size	dimension B and weights						1/2 neut. bus size	full neut. bus size	dim. A
		3-W	lbs./ft.	4-W 1/2 neut.	lbs./ft.	4-W full neut.	lbs./ft.			
600	2-1/4 x 1	9 1/2	18	10 1/2	20	11 1/2	22	1-1/4 x 1	2-1/4 x 1	3 1/2
800	2-1/4 x 1 1/2	9 1/2	22	10 1/2	24	11 1/2	26	1-1/4 x 1 1/2	2-1/4 x 1 1/2	4 1/2
1000	2-1/4 x 2	9 1/2	26	10 1/2	29	11 1/2	32	1-1/4 x 2	2-1/4 x 2	4 1/2
1300	2-1/4 x 3	9 1/2	33	10 1/2	37	11 1/2	41	1-1/4 x 3	2-1/4 x 3	5 1/2
1600	2-1/4 x 4	9 1/2	40	10 1/2	46	11 1/2	51	1-1/4 x 4	2-1/4 x 4	6 1/2
2000	2-1/4 x 5	9 1/2	48	10 1/2	54	11 1/2	60	1-1/4 x 5	2-1/4 x 5	7 1/2
2250	2-1/4 x 6	9 1/2	55	10 1/2	62	11 1/2	69	1-1/4 x 6	2-1/4 x 6	8 1/2
2640	4-1/4 x 4	18 1/2	73	18 1/2	81	21 1/2	91	2-1/4 x 4	4-1/4 x 4	6 1/2
3300	4-1/4 x 5	18 1/2	87	18 1/2	97	21 1/2	110	2-1/4 x 5	4-1/4 x 5	7 1/2
4000	4-1/4 x 6	18 1/2	101	18 1/2	113	21 1/2	127	2-1/4 x 6	4-1/4 x 6	8 1/2

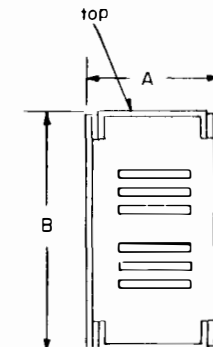
#### aluminum

amp rating	phase bus size	3-W	lbs./ft.		4-W 1/2 neut.	lbs./ft.		4-W full neut.	lbs./ft.		1/2 neut. bus size	full neut. bus size	dim. A
			vent.	solid		vent.	solid		vent.	solid			
600	2-1/4 x 1	9 1/2	16	17	10 1/2	17	18	11 1/2	18	19	1-1/4 x 1	2-1/4 x 1	3 1/2
800	2-1/4 x 1 1/2	9 1/2	18	19	10 1/2	20	21	11 1/2	21	22	1-1/4 x 1 1/2	2-1/4 x 1 1/2	4 1/2
1000	2-1/4 x 2	9 1/2	21	22	10 1/2	22	24	11 1/2	24	25	1-1/4 x 2	2-1/4 x 2	4 1/2
1350	2-1/4 x 2 1/2	9 1/2	27	28	10 1/2	30	32	11 1/2	32	34	1-1/4 x 2 1/2	2-1/4 x 2 1/2	5 1/2
1600	2-1/4 x 3	9 1/2	30	31	10 1/2	33	36	11 1/2	36	38	1-1/4 x 3	2-1/4 x 3	5 1/2
2000	2-1/4 x 4	9 1/2	39	40	10 1/2	42	46	11 1/2	46	49	1-1/4 x 4	2-1/4 x 4	6 1/2
2500	2-1/4 x 5	9 1/2	51	52	10 1/2	54	60	11 1/2	60	63	1-1/4 x 5	2-1/4 x 5	7 1/2

indoor and outdoor  
low impedance duct



weatherproof low  
impedance duct

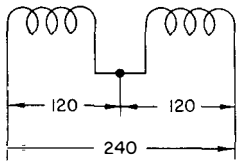




## engineering and test data

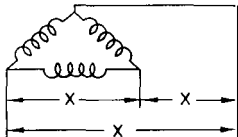
**typical applications of bus duct**

The following schematic diagrams show typical systems for which bus duct is used. Westinghouse manufactures a complete line of bus duct for all systems. Consult your nearest Westinghouse representative for assistance in selecting the best system for your particular application.

**lighting**

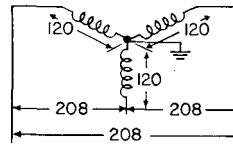
single phase 3 wire  
120/240 volt

This system is used to serve lighting circuits and small single phase power equipment. Where the load consists of 50% or more of electric discharge lamp ballasts the neutral conductor shall be the same size as the phase conductors. (NEC 22038)

**power**

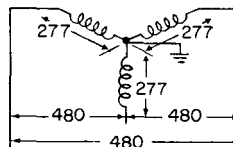
three phase 3 wire  
240 or 480 or 600 volt delta  
X = 240 or 480 or 600 volt

Any of these systems offer efficient three phase power connections. The voltage is selected for the individual requirements.

**lighting and power**

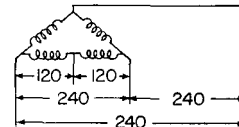
three phase 4 wire  
120/208 volt wye

This system is used for commercial and industrial lighting and power applications where a large percentage of the load is 120 volt single phase. Three phase 208 volt power is also available for motor loads. Most network systems utilize this system.



three phase 4 wire  
277 / 480 volt wye

This system is used primarily for industrial combination lighting and power applications where the prime concern is the three phase powers. Here 480 volt is selected as being a highly efficient utilization voltage. The 277 volt single phase voltage can be used either at this rating or reduced through transformers to 120/240 volt single phase.

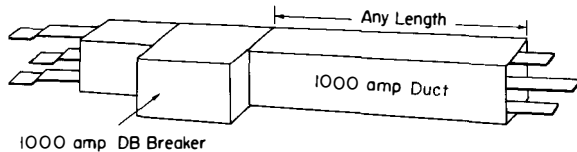


three phase 4 wire delta  
120/240 volt single phase 3 wire  
240 three phase 3 wire

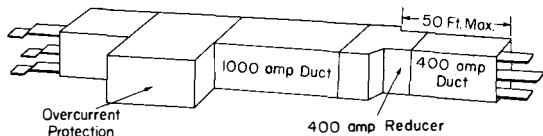
This system is used for applications requiring only a small percentage of three phase power. Caution must be exercised in installation to determine correct phasing.

**NEC bus duct overcurrent protection requirements**

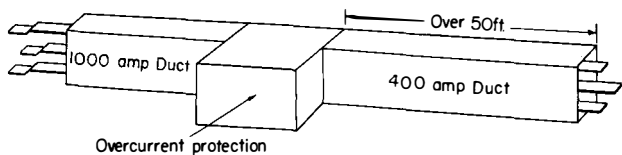
(For conditions under which bus duct may be used see NEC section 3642.)



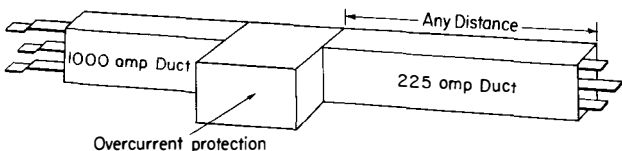
If overcurrent protection has the same rating as the bus duct the run can be of any length.



No overcurrent protection is required where bus duct is reduced in size provided the length of the smaller bus duct does not extend more than 50 feet and has a current rating of at least  $\frac{1}{3}$  of the breaker next back on the line. See NEC section 3649.



If smaller bus duct is extended over 50 feet overcurrent protection must be provided at the point of reduction.



If at a point of reduction, the smaller bus duct has a rating of less than  $\frac{1}{3}$  that of the overcurrent protective device next back in the line, then overcurrent protection must be installed at the point of reduction regardless of the length of the run.

*UNI-BUS, low impedance, plug-in,  
conventional weatherproof*

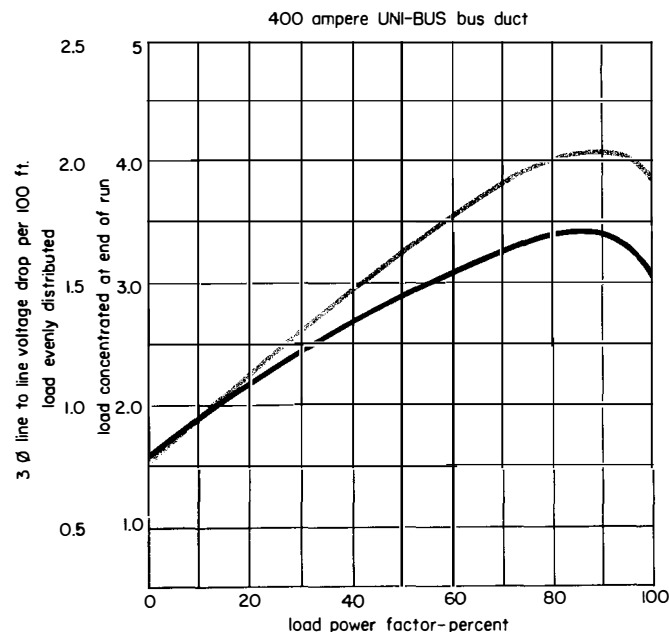
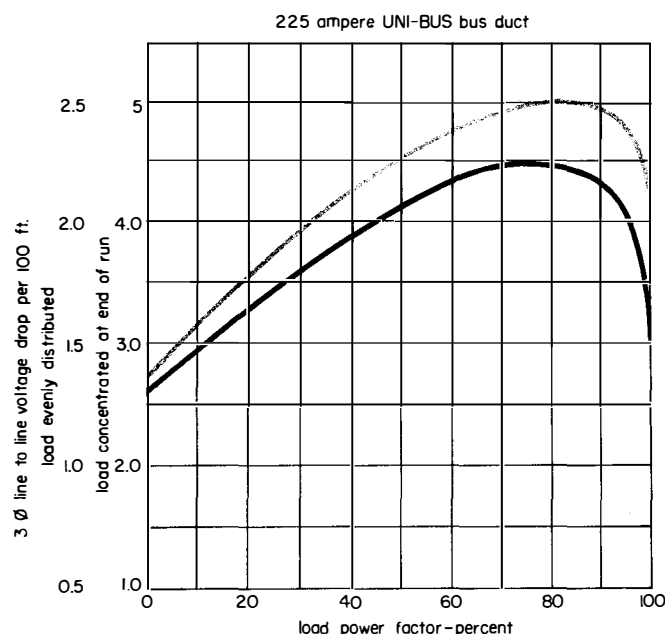
**voltage drop curves**

**Life-Line Busway • Uni-Bus**

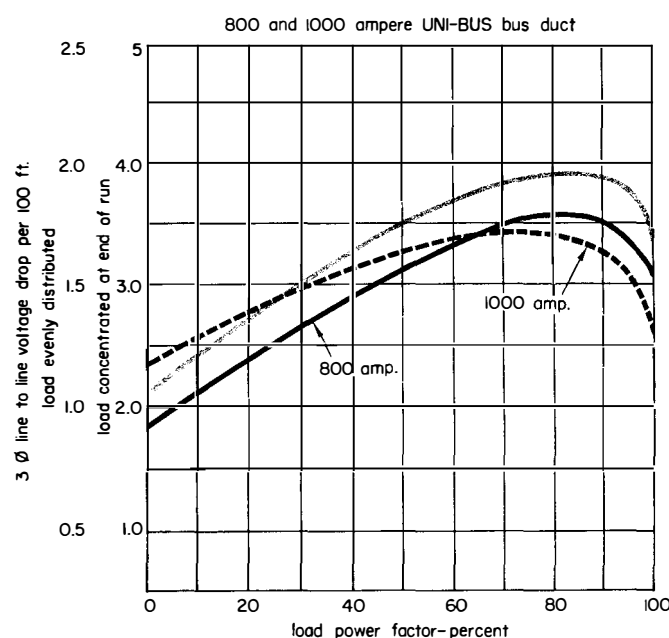
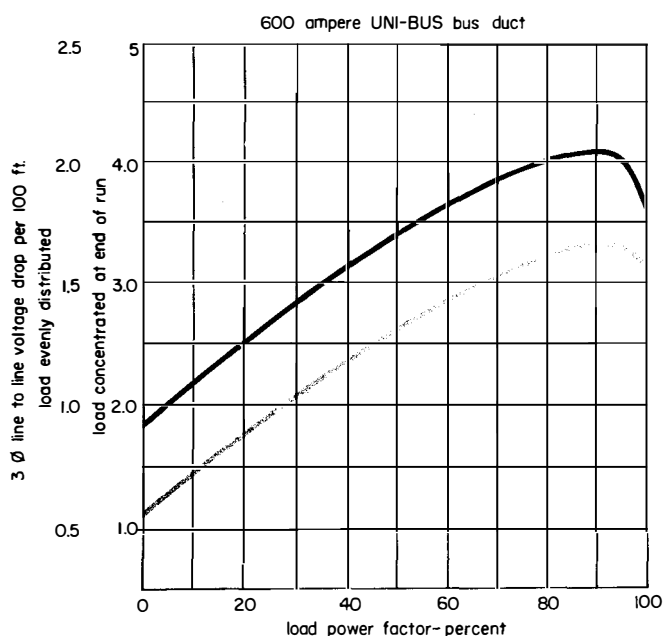
The voltage drop curves for Life-Line Busway shown below are plotted from readings taken in actual tests and are based on the bus bar sizes shown at the right.

— blue curves indicate aluminum bus bars in all cases.

ampere rating	bus bar size	
	copper	aluminum
225	1—.110 x 1	1—.156 x 1
400	2—.110 x 1	2—.156 x 1
600	2—.156 x 1	2—.250 x 1
800	2—.250 x 1	2—.375 x 1
1000	2—.375 x 1	.....



blue curves indicate aluminum bus bars in all cases.



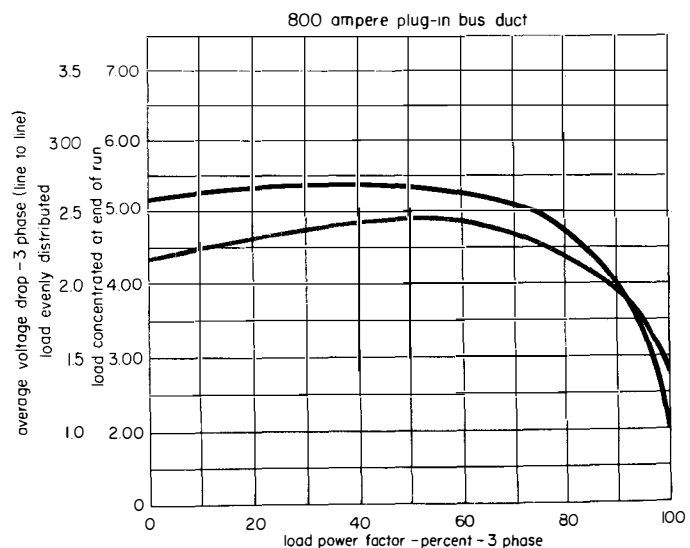
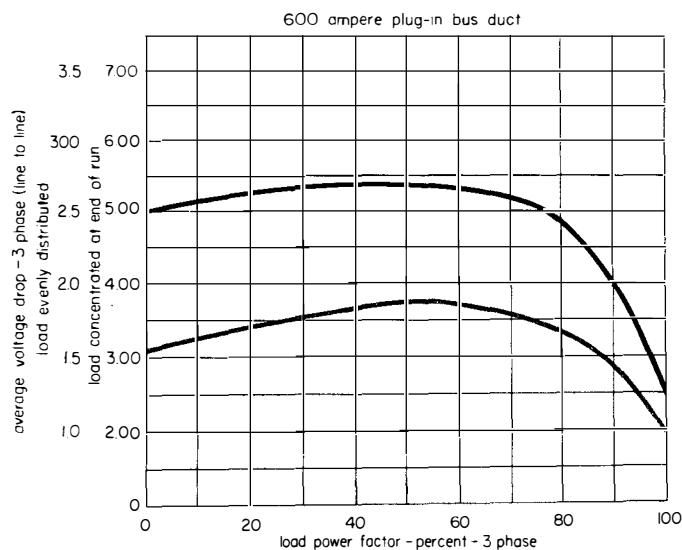
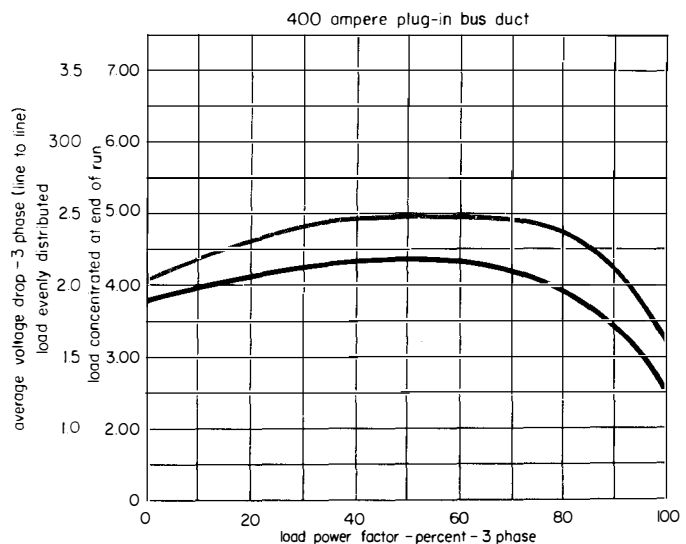
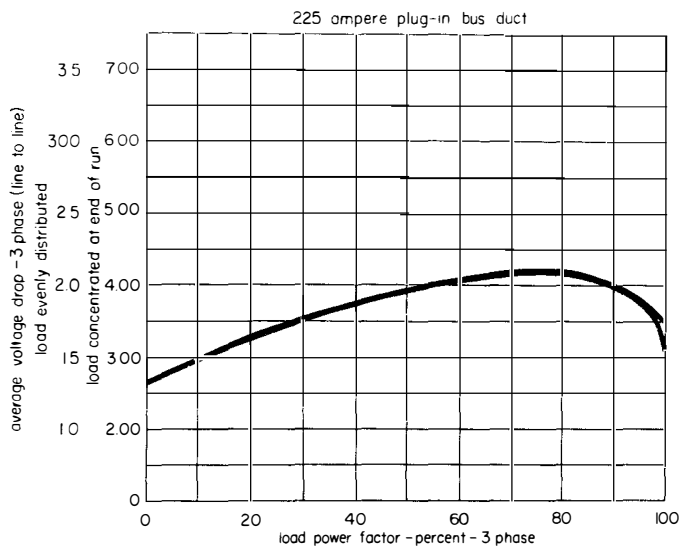


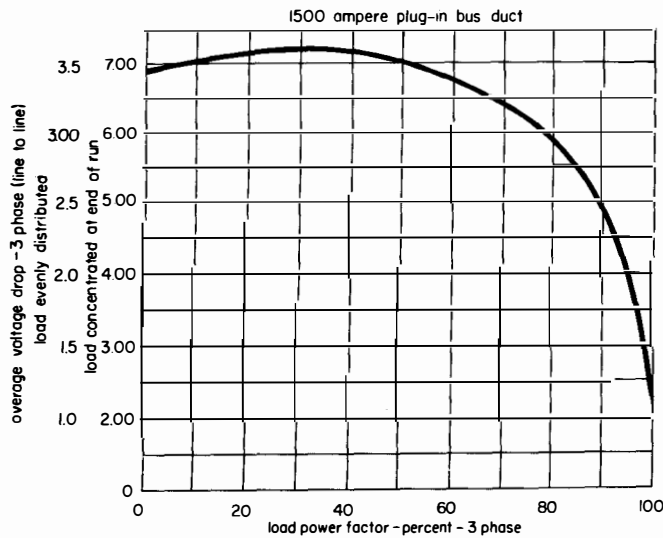
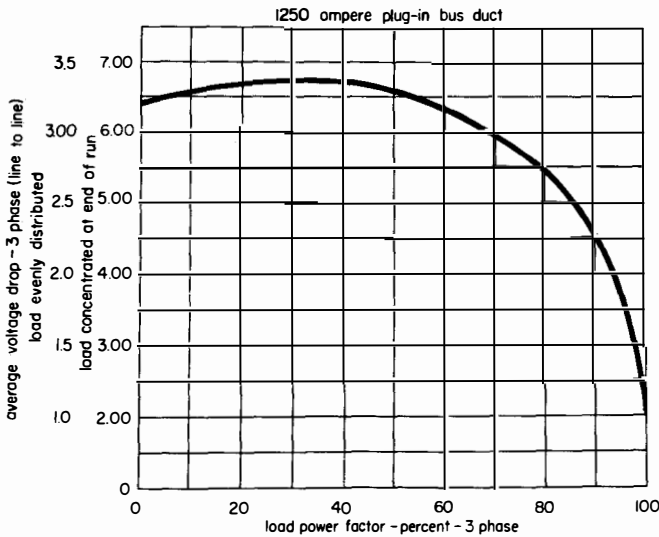
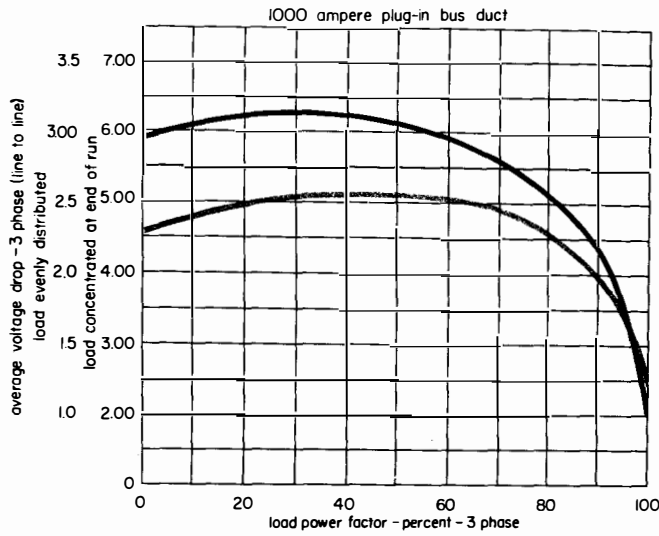
**engineering and test data****voltage drop curves    plug-in bus duct**

These graphs give the average line-to-line voltage drop per 100 feet for various sizes of plug-in bus duct at varying power factor. The curves are plotted from readings taken in actual tests, and are applicable to line voltage above 100 volts. Voltage drop at values above or below full load current are proportional to the values shown. For example, voltage drop at one-half load will be one-half the values shown on the curves. The curves are based on the bus bar sizes shown in the table at the right.

— blue curves indicate aluminum bus bars in all cases.

ampere rating	bus bar size	
	copper	aluminum
225	$\frac{1}{8} \times \frac{7}{8}$	$\frac{1}{4} \times \frac{7}{8}$
400	$\frac{1}{4} \times 1\frac{1}{2}$	$\frac{1}{4} \times 2$
600	$\frac{1}{4} \times 2$	$\frac{1}{4} \times 4$
800	$\frac{1}{4} \times 3$	$\frac{1}{4} \times 5$
1000	$\frac{1}{4} \times 4$	$\frac{1}{4} \times 6$
1250	$\frac{1}{4} \times 5$	.....
1500	$\frac{1}{4} \times 6$	.....

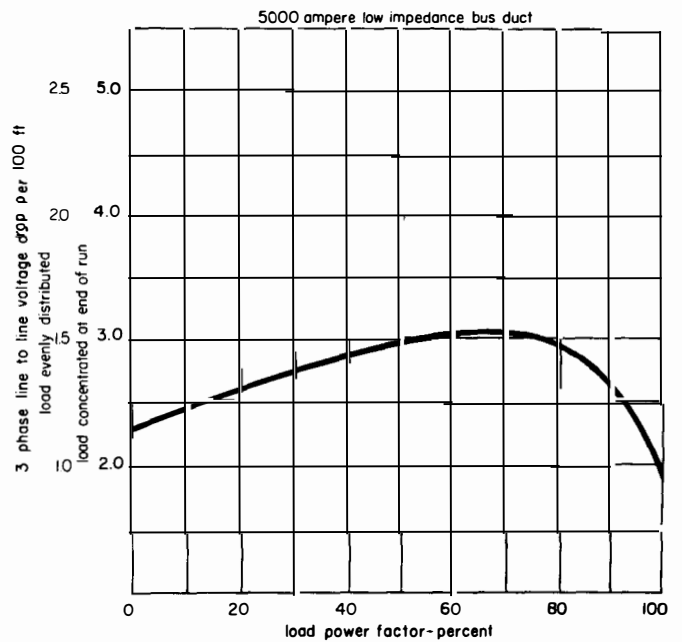
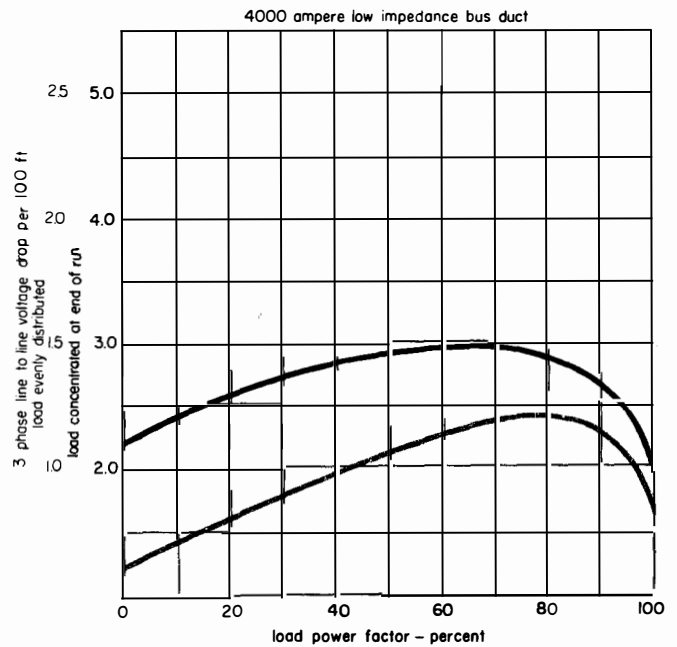




### voltage drop curves low impedance bus duct

Multiply three phase values by 1.15 to obtain voltage drop on single phase systems. Curves are based on bus bar sizes shown.

ampere rating	bus bar no. and size	
	copper	aluminum
600	2-1/4 x 1	2-1/4 x 1 1/2
800	2-1/4 x 1 1/2	2-1/4 x 2
1000	2-1/4 x 2	2-1/4 x 2 1/2
1350	2-1/4 x 2 1/2	2-1/4 x 3
1600	2-1/4 x 3	2-1/4 x 4
2000	2-1/4 x 4	2-1/4 x 6
2500	2-1/4 x 5	4-1/4 x 3
3000	2-1/4 x 6	4-1/4 x 4
4000	4-1/4 x 4	4-1/4 x 6
5000	4-1/4 x 5	.....



blue curve indicates aluminum bus bars in all cases.



**engineering and test data**

**voltage drop curves • low impedance bus duct**

blue curves indicate aluminum bus bars in all cases.

