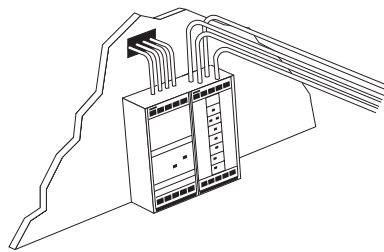
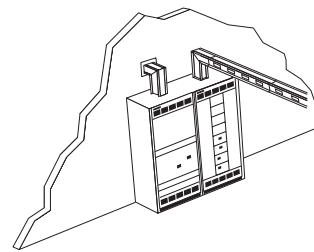


Cable/Conduit Conversion

Busway can be used in many applications where cable and conduit are more commonly used. The question arises, "Why use busway instead of conventional cable and conduit?"



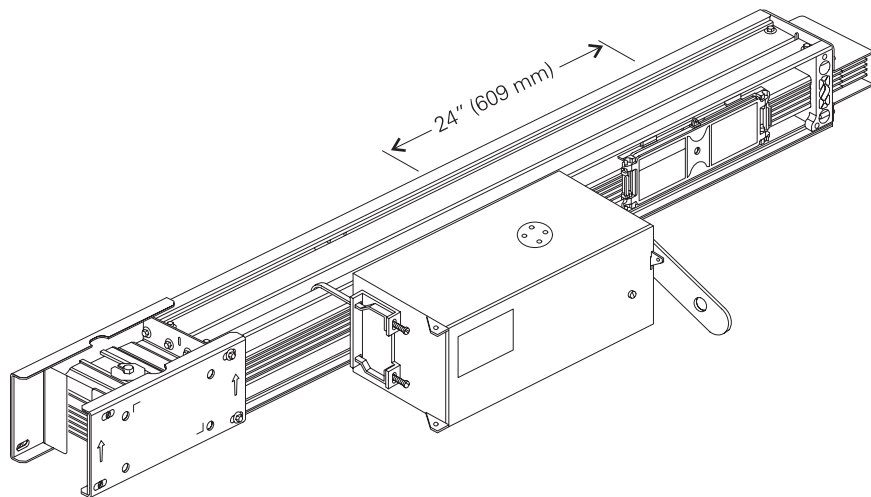
Conduit



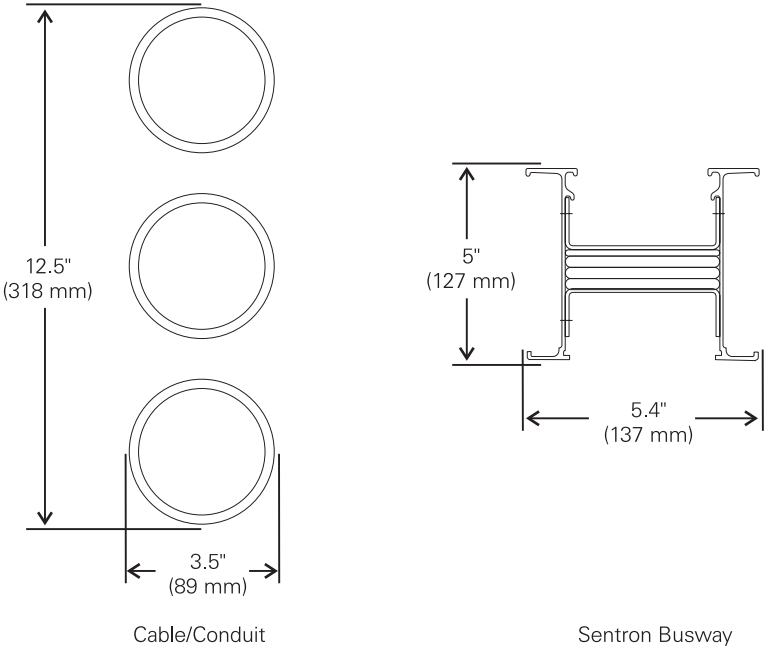
Busway

Benefits of Busway

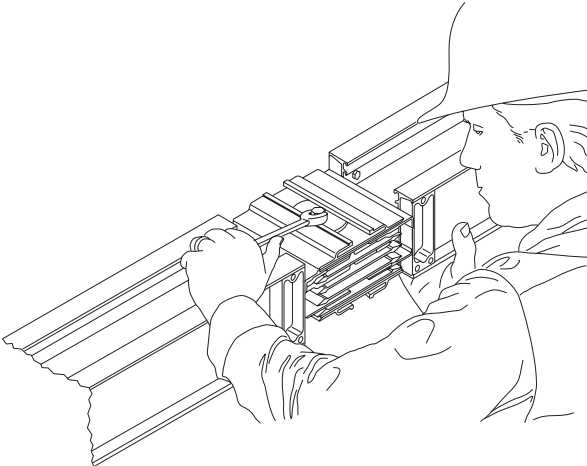
There are several reasons why busway may be a better choice over cable and conduit. Busway provides greater flexibility by allowing equipment to be connected anywhere along the run on 24" centers. Equipment can be easily disconnected and moved to a new location without major rewiring.



Busway has a smaller cross section. This means less installation space is required. Sentron™ busway with aluminum bus bars rated at 1000 amperes, for example, occupies a much smaller space than a comparable cable and conduit installation. The smaller cross section also means that busway is lighter in weight, by as much as half, which means less loading on the building.

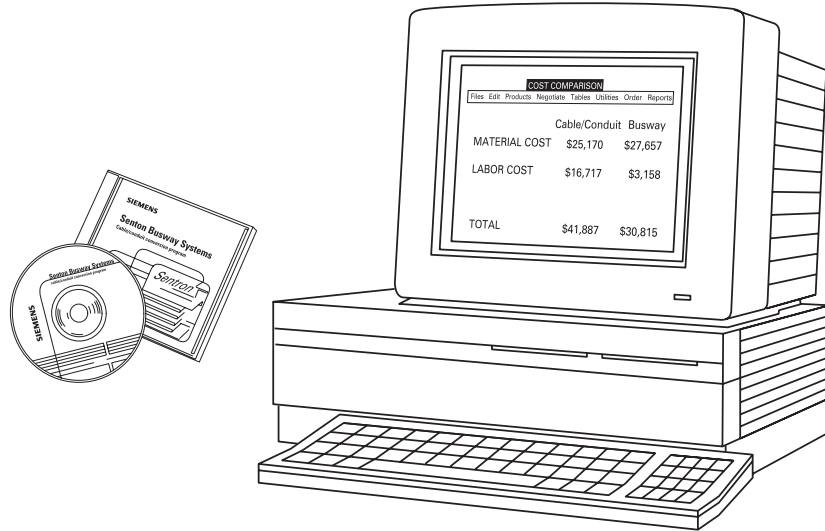


The installed cost of busway is typically less than cable and conduit. Busway is easier to install. Sections are simply hung and joined together using readily available hardware. Total installed costs associated with using Sentron busway over cable and conduit typically results in 20 - 30% lower installed cost.



Sentron Busway Estimating Program

A software program, available from Siemens, compares the total installed price of cable and conduit to Sentron busway.



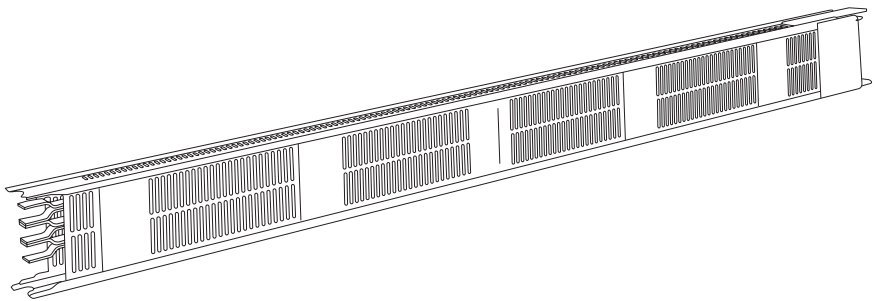
Comparison Example

The following table shows one example of the cost savings of busway over cable and conduit. The job calls for a 500 foot run of 1350 amperes. A hypothetical labor rate of \$37.15 an hour is used. It will take an estimated 455 hours to install the cable and conduit. It will take an estimated 134 hours to install Sentron busway. The total savings, by using Sentron busway, is \$12,693.

Material	Material Cost	Installation Labor	Total Installed Cost
Cable/ Conduit	\$73,977	\$16,925 (455 hrs. @ \$37.15/hr)	\$90,902.24
Sentron Busway	\$73,212	\$4,996 (134 hrs. @ \$37.15/hr)	\$78,208.89
Savings with Sentron			\$12,693

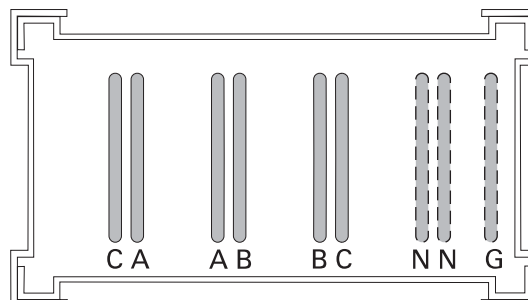
XL-U Busway

XL-U[®] is available in both feeder and plug-in busway with ratings of 225 to 5000 amperes with aluminum bus bars or 225 to 6500 amperes with copper bus bars. Maximum voltage is 600 volts. XL-U feeder busway is available in either indoor or outdoor ventilated types. XL-U plug-in busway is indoor only and ventilated. XL-U is available in 3Ø3W and 3Ø4W.



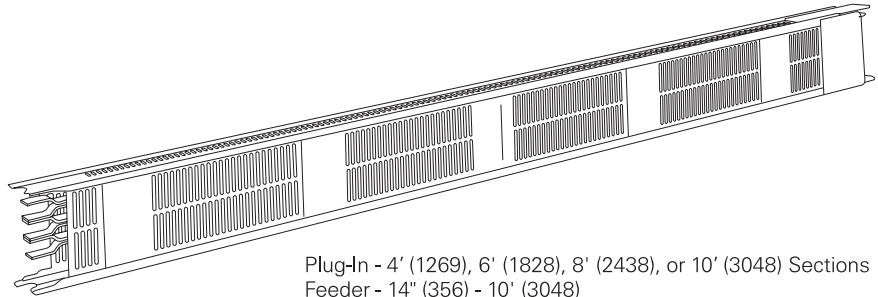
Paired Phases

XL-U is available with a paired-phase bus bar scheme. Bus bars are grouped in pairs so that AC current in each pair is nearly equal in magnitude and opposite in direction. Two bus bars per phase are used. Phase C is paired with phase A, phase A is paired with phase B, and phase B is paired with phase C. The result is a minimized magnetic field. Current is balanced and temperature rise is kept to a minimum. Voltage drop is reduced. XL-U busway can be used on any application within its current rating but it is usually used for long runs where end-of-run voltage is critical. Due to its paired-phase design, XL-U busway is known throughout the industry as the best product available for welder loads.



Sections and Components

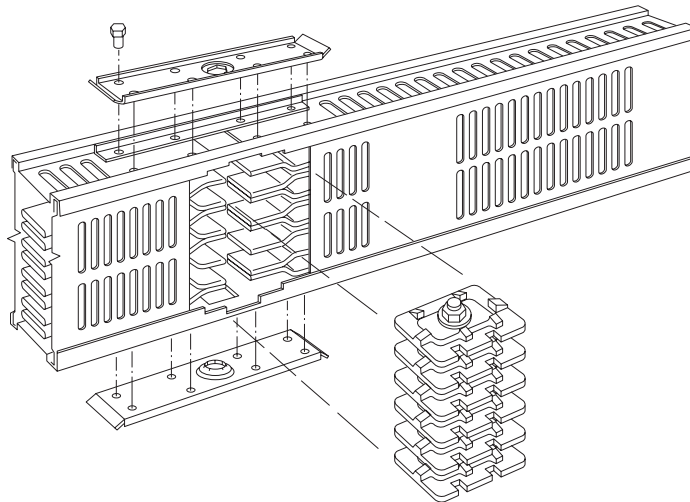
XL-U feeder busway sections can be supplied in any length from 14" (356 mm) to 10' (3048 mm). XL-U Plug-in busway is available in 4' (1269 mm), 6' (1828 mm), 8' (2438 mm), and 10' (3048 mm) sections. Elbows, tees, crosses, end closers, wall flanges, tap boxes, flanged end connections, switchboard connections, bus plugs, reducers, and hangers are available.



Plug-In - 4' (1269), 6' (1828), 8' (2438), or 10' (3048) Sections
Feeder - 14" (356) - 10' (3048)

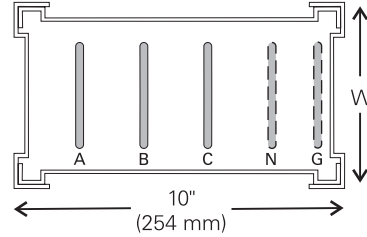
Joint Stack

XL-U busway uses a joint stack, similar to the Sentron™ busway, to connect sections together. The joint stack bolt is secured with a recommended 35 ft. lbs. of torque.



One Bar Per Phase

XL-U busway is available from 225 to 6500 amperes. The number of bus bars and the dimensions depends on the maximum current rating. XL-U busway can be mounted vertically or horizontally, either edgewise or flatwise. The cross sections illustrated below are shown edgewise mounted. The "W" dimension varies with the current rating. There are two maximum current ratings for XL-U, UL and standard rating. XL-U busway is available in a one-bar-per-phase configuration for the maximum current ratings shown in the following table.

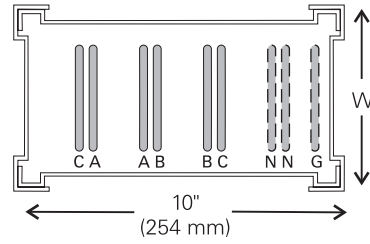


W	Bus Bars			Copper Ampere Rating					
	Number of Conductors			Vent. Bars on Edge		Vent. Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
4.5" (114 mm)	1	1	1	225	225	225	225	225	225
4.5" (114 mm)	1	1	1	400	400	400	400	400	400
4.5" (114 mm)	1	1	1	600	600	600	600	600	600
				Aluminum Ampere Rating					
4.5" (114 mm)	1	1	1	225	225	225	225	225	225
4.5" (114 mm)	1	1	1	400	400	400	400	400	400
5.5" (140 mm)	1	1	1	600	600	600	600	600	600

Ground Bus Capacity - 100%

Two Bars Per Phase

XL-U busway is available in a two-bar-per-phase, paired-phase configuration for the maximum current ratings shown in the following table.

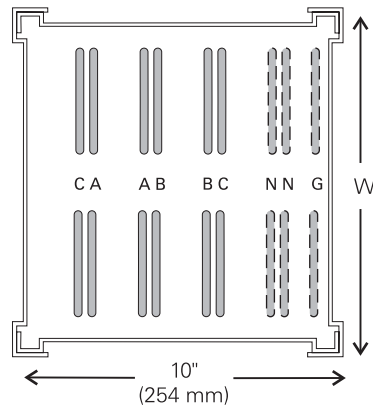


W	Bus Bars			Copper Ampere Rating					
	Number of Conductors			Vent. Bars on Edge		Vent. Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
4.5" (114 mm)	2	2	1	800	800	800	800		
4.5" (114 mm)	2	2	1	1200	1200	1000	1000	800	800
4.5" (114 mm)	2	2	1	1450	1350	1200	1200	1000	1000
5.5" (140 mm)	2	2	1	1700	1600	1350	1350	1100	
5.5" (140 mm)	2	2	1	2000	2000	1600	1600	1250	1200
				Aluminum Ampere Rating					
4.5" (114 mm)	2	2	1	800	800	800	800		
4.5" (114 mm)	2	2	1	1000	1000	900		800	800
5.5" (140 mm)	2	2	1	1250	1200	1000	1000	900	
5.5" (140 mm)	2	2	1	1400	1350	1200	1200	1000	1000

Ground Bus Capacity - 50%

Four Bars Per Phase

At higher current ratings bus bars are doubled up. Four bars per phase are used in the current ratings shown in the following table. Note that paired-phasing is still used.

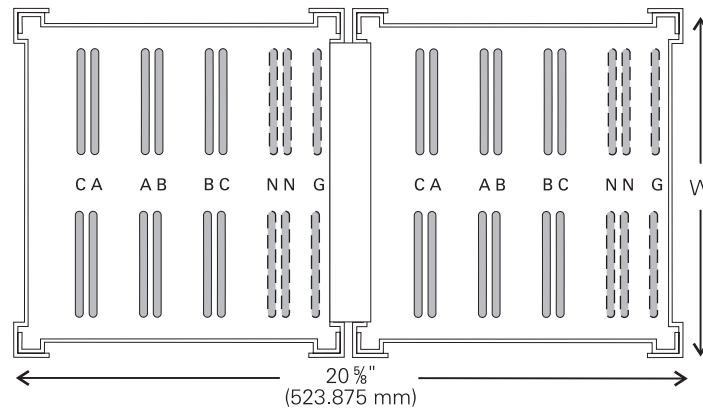


W	Bus Bars			Copper Ampere Rating					
	Number of Conductors			Vent. Bars on Edge		Vent. Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
7.5" (191 mm)	4	4	2	2300		2000		1400	1350
7.5" (191 mm)	4	4	2	2700	2500	2300	2000	1600	1600
9.5" (241 mm)	4	4	2	3000	3000	2500	2500	1900	
9.5" (241 mm)	4	4	2	3500	3500	2800	2800	2100	2000
				Aluminum Ampere Rating					
7.5" (191 mm)	4	4	2	1700	1600	1500	1350		
7.5" (191 mm)	4	4	2	2000	2000	1700	1600	1200	1200
9.5" (241 mm)	4	4	2	2300		1900		1400	1350
9.5" (241 mm)	4	4	2	2500	2500	2100	2000	1600	1600

Ground Bus Capacity - 50%

Eight Bars Per Phase

To accommodate even higher current levels eight bars per phase are used.



W	Bus Bars			Copper Ampere Rating					
	Number of Conductors			Vent. Bars on Edge		Vent. Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
7.5" (191 mm)	8	8	4	4400	4000	4000	4000	2700	2500
7.5" (191 mm)	8	8	4	5200	5000	4600	4500	3200	3000
9.5" (241 mm)	8	8	4	6000	6000	5000	5000	3700	3500
9.5" (241 mm)	8	8	4	6500	6500	5700	5500	4100	4000
				Aluminum Ampere Rating					
7.5" (191 mm)	8	8	4	3300	3000	3000	3000	2000	2000
7.5" (191 mm)	8	8	4	3900	3500	3500	3500	2500	2500
9.5" (241 mm)	8	8	4	4500	4000	3900		2750	
9.5" (241 mm)	8	8	4	5000	5000	4200	4000	3100	3000

Ground Bus Capacity - 50%

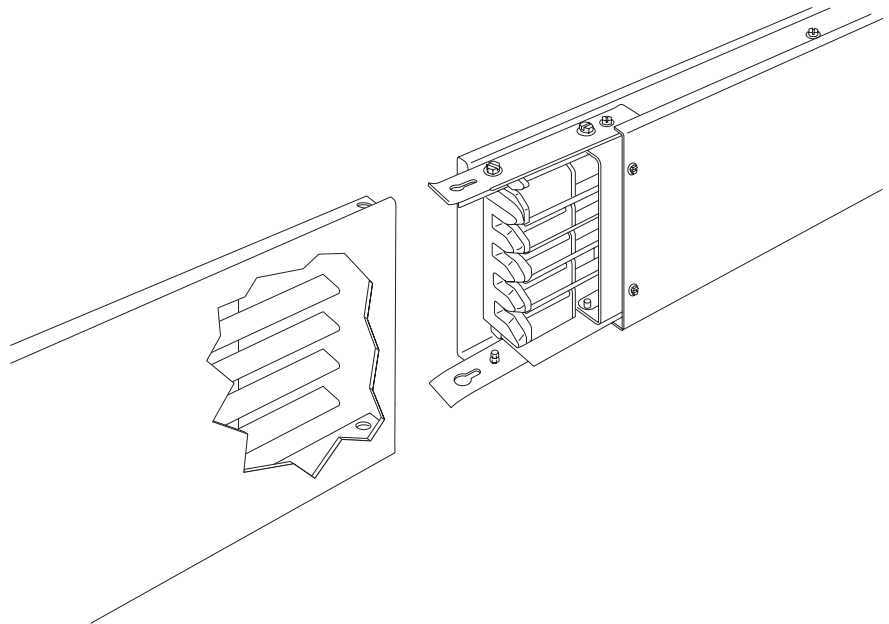
Components

The following components are available for XL-U busway:

- Hangers
- End closers
- Flanged ends
- Plug-in and center cable tap boxes
- Elbows
- Offsets
- Tees
- Crosses
- Reducers and expansion sections
- Bus plugs (circuit breaker, fusible)

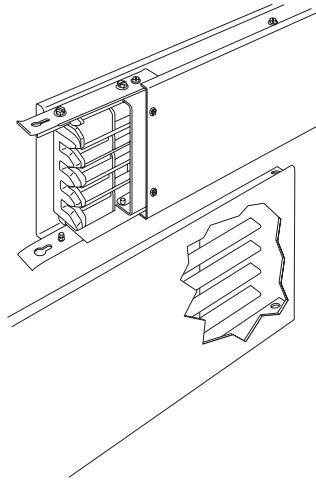
XJ-L Busway

When an application needs a horizontal run of plug-in busway with a current rating that does not exceed 200 amperes, Siemens XJ-L™ would be a good choice. XJ-L busway is available with 100 or 200 ampere capacities, three-phase, three-wire (3Ø3W), 600 VAC or three-phase, four-wire (3Ø4W), 600 VAC. The neutral bus bar in the 3Ø4W type is rated for 100%. XJ-L busway is available in 2' (610 mm), 5' (1524 mm), and 10' (3048 mm) lengths. There are up to 12 plug-ins per 10' (3048 mm) length. Plug-ins are located in alternate positions from side-to-side.

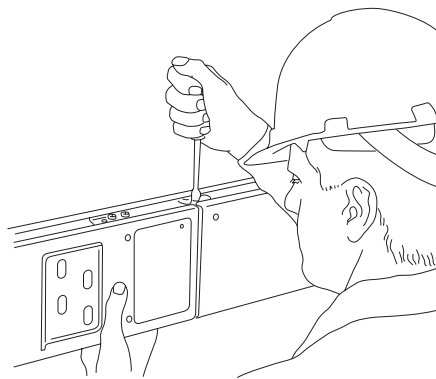


Installation

All XJ-L busway sections mate together end-to-end with overlapping joints which are held in place by integral spring pressure clips.



The sections are bolted together with captive screws.



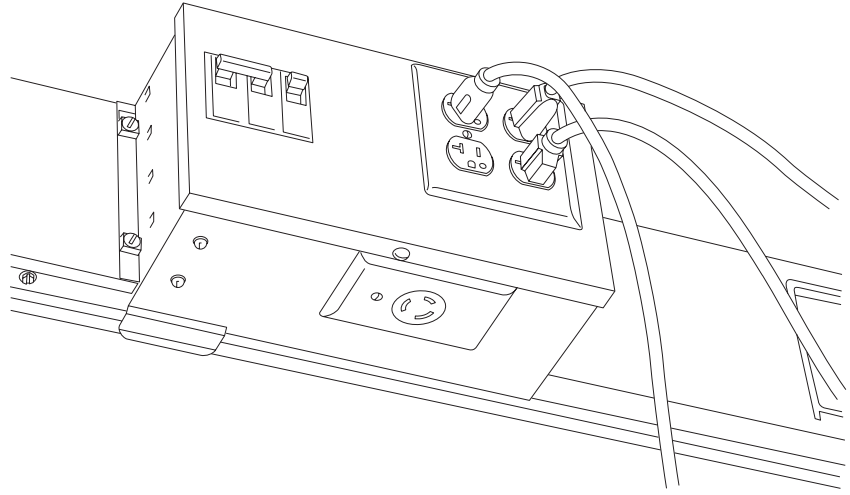
Components

The following components are available for XJ-L busway:

- Hangers
- End closers
- Flanged ends
- Plug-in and center cable tap boxes
- Elbows
- Tees
- Bus plugs (circuit breaker, fusible)

XQ-R bus plug

XQ-R bus plugs serve both 120 and 240 VAC needs. This is useful for computer applications, laboratory/test facilities, schools, hospitals, and machine shops.

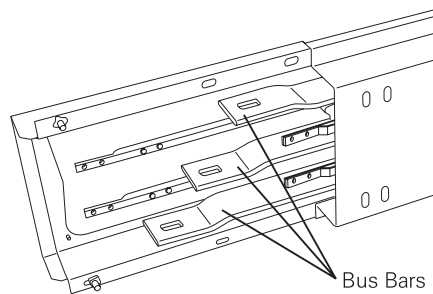


Review 6

1. The installed cost of busway is typically _____ than cable and conduit.
 - a. more
 - b. less
2. The maximum current rating available with XL-U busway with aluminum bus bars is _____ amperes.
3. _____ is a unique feature of XL-U busway that results in a magnetic field cancellation.
4. To accommodate levels of current in the 3000 to 5000 ampere range, using aluminum XL-U busway, _____ bars per phase are used.
5. XJ-L is available in either _____ ampere or _____ ampere capacities.
6. The _____ is a bus plug available for XJ-L busway which provides 120 and 240 VAC.

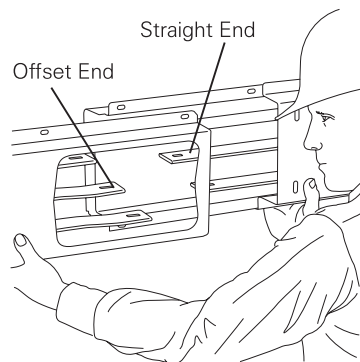
BD Busway

The BD™ busway is a general purpose power distribution busway of the plug-in design. BD busway is well established in the industry and has proven to be a dependable system. BD busway was first introduced in 1932, and with the exception of minor upgrades in materials, the basic design has remained unchanged. This means older systems can be expanded with today's BD busway components.

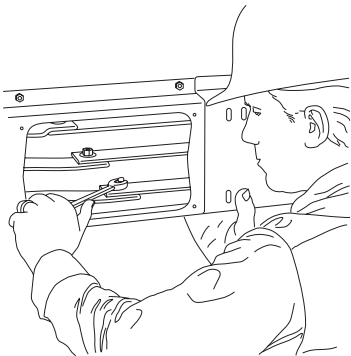


Installation

The bus bars of one end of a section are offset and the other end is straight. To connect two sections together match an offset end with a straight end. When ordering new BD busway to expand an existing system it is important to note if the new connection will be to an existing offset or straight end.



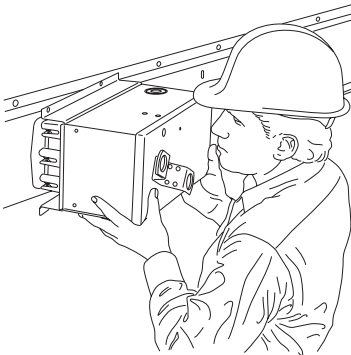
Bus bars are bolted together with a recommended 25 ft. lbs. of torque.



Plug-Ins

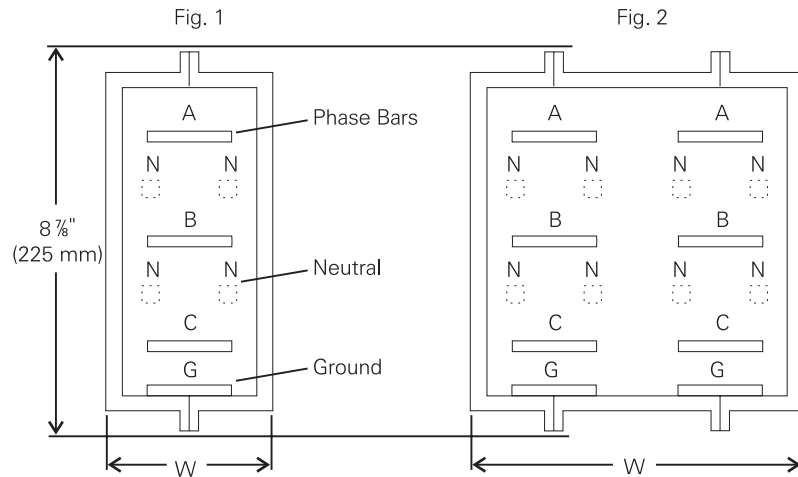
Each 10' (3048 mm) section has ten bus plug receptacles, spaced alternately on each side (five on each side) of the busway section. Circuit breaker plugs are available in sizes from 100 to 800 amperes for voltages of 600 VAC or less. Fusible Vacu-Break[®] switch plugs are available in sizes of 30 to 600 amperes, 3-pole, 600 VAC or less, or 4-pole solid neutral, 240 or 480 VAC.

Capacitor and transformer bus plugs are also available. Capacitor bus plugs are used to reduce inductive heating and improving power factor. Transformer bus plugs furnish single-phase 120 or 240 VAC for lighting, small motors, or portable tools. Transformer plugs are also available with or without two-pole AC magnetic contactors for plugging in on three-phase 240 or 480 VAC.



Ratings and Dimensions

BD busway comes in 10' (3048 mm) lengths in current ratings from 225 to 1600 amperes. The number of bus bars per phase is determined by the current rating. A section of 225 amperes aluminum busway, for example, would have one bar per phase. A section of 1000 ampere aluminum busway would have two bus bars per phase. The following busway cross section diagram and table reflect ampere ratings and dimensions of BD busway.



3Ø3W			3Ø4W - 100% Neutral		
Ampere Rating	Fig #	Width (W)	Ampere Rating	Fig #	Width (W)
Aluminum					
225	1	4 1/16" (103 mm)	225	1	4 1/16" (103 mm)
400	1	4 1/16" (103 mm)	400	1	4 1/16" (103 mm)
600	1	6 1/16" (154 mm)	600	1	6 1/16" (154 mm)
800	1	6 1/16" (154 mm)	800	1	8 1/8" (206 mm)
1000	2	12 1/8" (308 mm)	1000	2	12 1/8" (308 mm)
1200	2	12 1/8" (308 mm)	1200	2	12 1/8" (308 mm)
Copper					
225	1	4 1/16" (103 mm)	225	1	4 1/16" (103 mm)
400	1	4 1/16" (103 mm)	400	1	4 1/16" (103 mm)
600	1	4 1/16" (103 mm)	600	1	4 1/16" (103 mm)
800	1	6 1/16" (154 mm)	800	1	8 1/8" (206 mm)
1000	1	6 1/16" (154 mm)	1000	1	8 1/8" (206 mm)
1350	2	12 1/8" (308 mm)			
1600	2	12 1/8" (308 mm)			

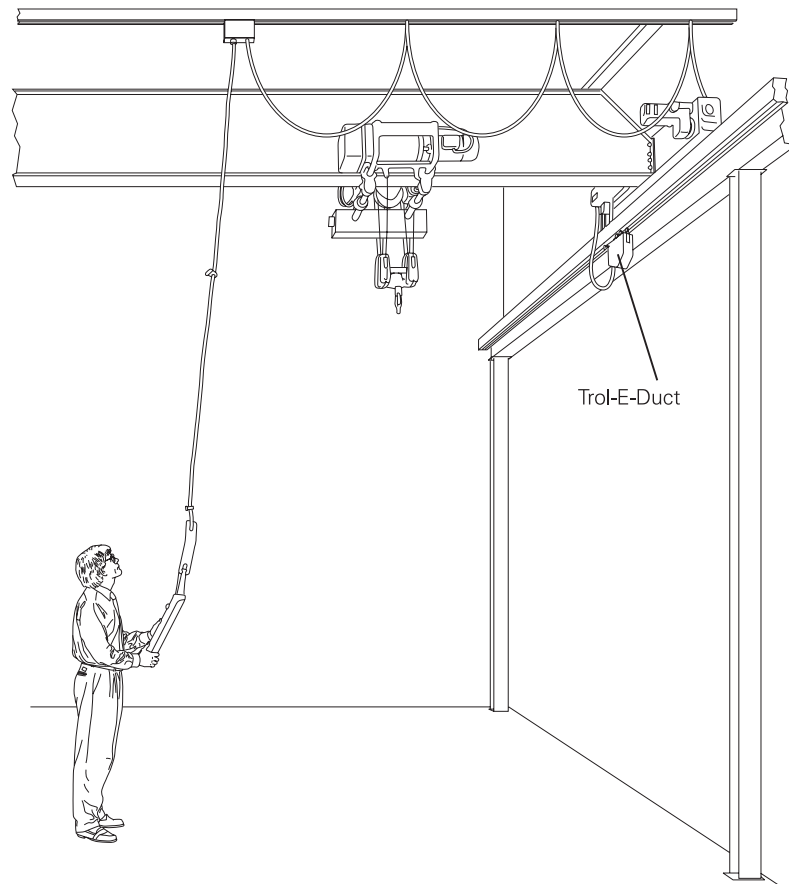
Components

The following components are available for BD busway:

- Hangers
- End closers
- Flanged ends
- Plug-in and center cable tap boxes
- Elbows
- Tees
- Crosses
- Bus plugs (circuit breaker, fusible)

Trol-E-Duct

Trol-E-Duct™ is part of the Siemens busway family. This busway is designed to provide power to indoor moving equipment, such as cranes, conveyors, hoists, mobile tools, and similar moving equipment.



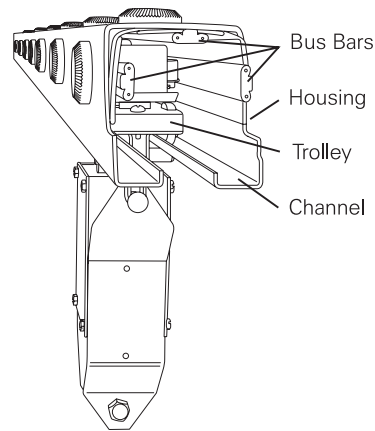
Ratings

Trol-E-Duct is available in the following ratings:

Indoor
1Ø2W, 1Ø3W, 3Ø3W, 3Ø4W
100 to 800 amperes
600 VAC

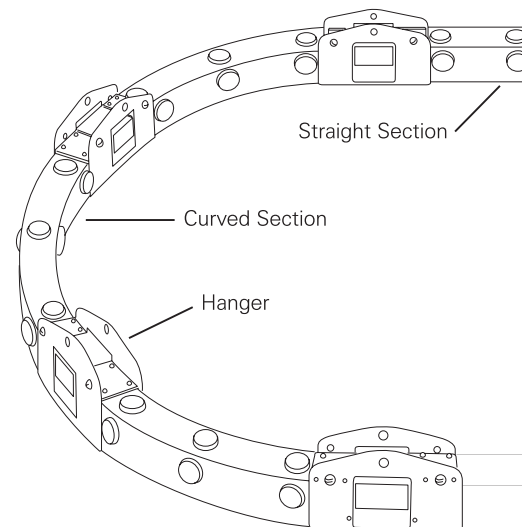
Construction

Bus bars inside a housing provide power to a trolley. Brushes, mounted on the trolley, make contact with the bus bars. The trolley can be moved along an internal channel that is part of the housing. A section of the bus bar can be removed and replaced with a spacer that can be as small as $\frac{1}{4}$ " (6.35 mm) or as large as 1' (305 mm). It may be desirable to have a system that is powered only at specific locations. In these cases less expensive busless casings can be used throughout the unpowered sections.



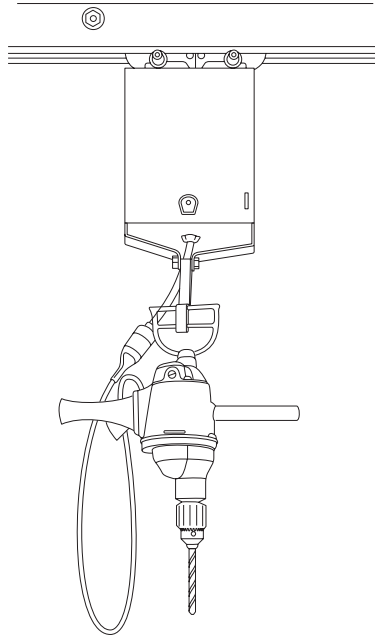
Sections

Trol-E-Duct sections can be straight or curved. Curved sections are available only for 100 ampere busway. Curved sections can either be horizontal (shown) or vertical (not shown). Curved sections join with straight sections to create a continuous Trol-E-Duct system that matches any structural pattern. Curved sections are available for any radius of two feet or greater.

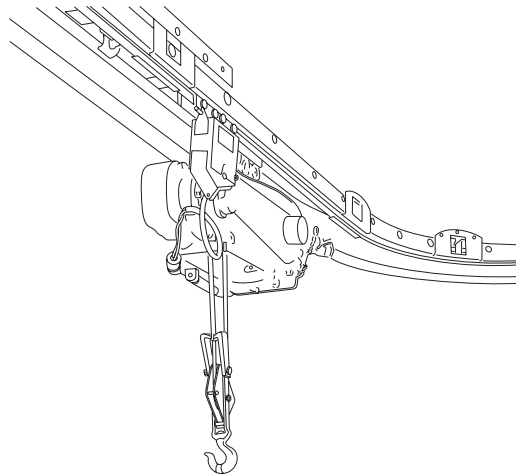


Trolleys

Several types of trolleys are available for Trol-E-Duct. There are two types of tool hanger trolleys. Types TPTH and TBTH. Both types of tool hangers should not be used on a curved section with a radius of less than 5'. Type TPTH has provision for wiring a tool to the trolley. Type TBTH also has space for starters, receptacles and fuses.



Several other types of trolleys are available for a wide variety of applications. In the following example a hoist is wired to a trolley. The hoist moves along a monorail that runs parallel to a Trol-E-Duct system.



Standard Trolleys	Standard trolleys are recommended for applications where the load current is less than 30 amperes, trolley speed is less than 5 m.p.h., and the curve radius is 5' (1524 mm) or larger.
Heavy-Duty Trolleys	Heavy duty trolleys are used where the load current is less than 60 amperes, trolley speed is less than 5 m.p.h., and the curve radius is 5' (1524 mm) or larger. By adding an additional pigtail between the brush and the wire grip the trolley can be rated as high as 90 amperes.
Roller-Type Trolleys	Roller-type trolleys are used on lighter duty applications. The load current is less than 20 amperes and the trolley speed does not exceed 2.5 m.p.h. Roller-type trolleys will negotiate a 5' (1524 mm) radius curve.
Curved-Type Trolleys	Curved-type trolleys will negotiate a curve with a 3' (914 mm) radius or greater, speeds up to 5 m.p.h., and loads as high as 60 amperes.
Button-Type Trolleys	Button-type trolleys will negotiate a curve with a 5' (1524 mm) radius or greater, speeds up to 5 m.p.h., and loads as high as 60 amperes. Extra wheels on this trolley make it well suited for carrying a heavy weight.
Transfer Trolley	The transfer trolley is rated at 30 amperes and is suited for applications where the trolley must jump a gap in duct. Flared ends are used on the bus duct when the trolley must jump. The trolley can jump a separation as great as 3/8" (9.5 mm) with sections misaligned as much as 3/8" (9.5 mm). It will negotiate a curve with a radius of 2' (610 mm) or greater.
Nylon Brush Trolley	Nylon brush trolleys have brushes which are used to remove abrasive material, such as metallic or cement dust, from the bus bars.
Abrasive Trolley	Abrasive trolleys are designed to clean and remove corrosive buildup from bus bars in harsh atmospheres.

Review 7

1. BD busway was first introduced in _____ .
2. When ordering new BD busway to expand an existing system it is important to note if the new connection will be to an existing _____ or straight end.
3. Fusible Vacu-Break switches are available in sizes of _____ to _____ amperes for BD busway.
4. _____ is a type of busway that is designed to provide power to moving equipment such as cranes or hoists.
5. Standard Trol-E-Duct trolleys can handle a curve radius of _____ feet or larger.

Review Answers

- Review 1** 1) distribution system; 2) feeder; 3) Busway; 4) busway; 5) feeder, plug-in; 6) Feeder, plug-in.
- Review 2** 1) two, three; 2) 47,000; 3) 66, 54; 4) 368; 5) 200,000; 6) 10,000, 200,000.
- Review 3** 1) 4,000, 5,000; 2) a. feeder, b. plug-in; 3) 4', 6', 8'; 4) 2; 5) 0.125, 1' 4.5", 10'.
- Review 4** 1) C; 2) F; 3) A; 4) B; 5) E; 6) H; 7) G; 8) D.
- Review 5** 1) closed; 2) *Sentron Busway Systems Selection and Application Guide*; 3) 24, 24; 4) 5; 5) a.
- Review 6** 1) b; 2) 5000; 3) Paired phases; 4) eight; 5) 100, 200; 6) XQ-R.
- Review 7** 1) 1932; 2) offset; 3) 30, 600; 4) Trol-E-Duct; 5) 5.

Final Exam

The final exam is intended to be a learning tool. The book may be used during the exam. A tear-out answer sheet is provided. A grade of 70% or better is passing. Upon successful completion of the test a certificate will be issued.

Questions

1. The two types of busway are _____ .
 - a. feeder and service entrance
 - b. feeder and plug-in
 - c. plug-in and service entrance
 - d. indoor and outdoor

2. It typically takes _____ man-hours to install a busway system than cable and conduit.
 - a. about the same
 - b. more
 - c. fewer
 - d. twice as many

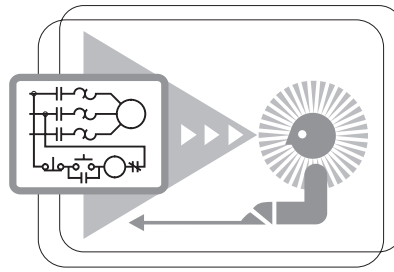
3. According to NEMA publication number BU 1.1-2000, the short-circuit rating of plug-in busway with a maximum continuous current rating of 1000 amperes should be at least _____ amperes.
 - a. 10,000
 - b. 14,000
 - c. 22,000
 - d. 42,000

4. According to IEC 529, a plug-in outlet that is said to be "finger safe" has an IEC code of IP _____ .
 - a. 2X
 - b. 40
 - c. 43
 - d. 54

5. General guidelines which discuss the safe application of busway are covered in the *NEC*[®] Article _____ .
 - a. 368
 - b. 445
 - c. 365
 - d. 450

13. A minimum distance of _____ from the wall to a joint where the new section of busway begins is required when Sentron busway passes through a wall.
- a. 4" (102 mm)
 - b. 7" (127 mm)
 - c. 6" (152 mm)
 - d. 10" (254 mm)
14. The dimensions of a Sentron right elbow, with aluminum bus bars, rated for 1000 amperes is _____ .
- a. 10" x 10"
 - b. 12" x 12"
 - c. 18" x 18"
 - d. 24" x 24"
15. The paired-phase bus bar scheme is used with _____ busway.
- a. Sentron
 - b. XJ-L
 - c. XL-U
 - d. BD
16. The maximum current rating of XL-U busway with copper bus bars is _____ amperes.
- a. 3000
 - b. 4000
 - c. 5000
 - d. 6500
17. The maximum current rating of XJ-L busway is _____ amperes.
- a. 100
 - b. 5000
 - c. 200
 - d. 6000
18. The type of Siemens busway that was first introduced in 1932 is _____ busway.
- a. Sentron
 - b. XJ-L
 - c. XL-U
 - d. BD
19. _____ is the type of Trol-E-Duct tool box hanger that provides space for starters, receptacles and fuses.
- a. TBTH
 - b. TPTH
 - c. Transfer trolley
 - d. Button-type trolley
20. Curved Trol-E-Duct sections are available for _____ .
- a. any radius of 2' (610 mm) or greater
 - b. a 2' (610 mm) radius only
 - c. any radius of 5' (1524 mm) or greater
 - d. a 5' radius only (1524 mm)

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