Cutler-Hammer

Non-Segregated Phase Bus Duct

Technical Data TD01702001E

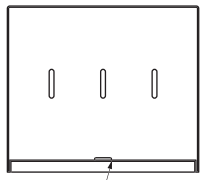
Effective July 2005
Supersedes TD01702001E
pages 1 – 24,
dated July 2003

Metal-Enclosed Non-Segregated Phase Bus Runs

Contents

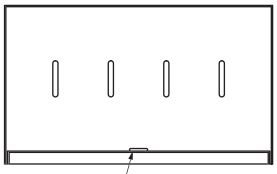
Straight Section

Downward Elbow



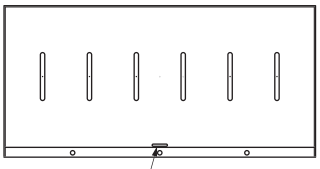
Optional
Ground Bus

3-Phase, 3-Wire
1200 – 3200 Amperes
600 V 5 kV – 15 kV



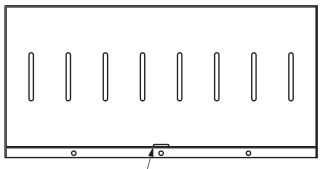
Optional
Ground Bus

3-Phase, 4-Wire
1200 – 3200 Amperes
600 V 5 kV – 15 kV



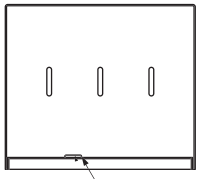
Optional
Ground Bus

3-Phase, 3-Wire
4000 – 5000 Amperes
600 V 5 kV – 15 kV



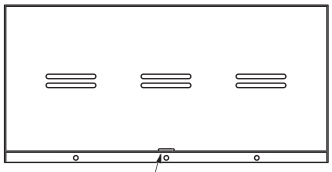
Optional
Ground Bus

3-Phase, 4-Wire
4000 – 5000 Amperes
600 V 5 kV – 15 kV



Optional
Ground Bus

3-Phase, 3-Wire
1200 – 2000 Amperes
27 kV



Optional
Ground Bus

3-Phase, 3-Wire
1200 – 2000 Amperes
38 kV

FIGURE 1. SYSTEM CONFIGURATIONS

General Description

Eaton's Cutler-Hammer® non-segregated phase bus runs are designed for use on circuits whose importance requires greater reliability than power cables provide. Typical of such applications are the connections from transformers to switchgear assemblies in unit substations, connections from switchgear assemblies to rotating apparatus, and tie connections between switchgear assemblies.

Non-segregated phase bus is an assembly of bus conductors with associated connections, joints and insulating supports confined within a metal enclosure without interphase barriers. The conductors are adequately separated and insulated from each other and grounded by insulating bus supports. Each conductor for 2400 volt service and above is insulated with a fluidized bed epoxy coating throughout which reduces the possibility of corona and electrical tracking.

Standards

The metal-enclosed non-segregated phase bus runs are designed for 600 V, 5 kV, 15 kV, 27 kV and 38 kV service in accordance with ANSI C37.23. Available ratings are shown in **Table 1**.

Temperature Rise

The bus will be capable of carrying rated current continuously without exceeding a conductor temperature rise of 65°C above an outside ambient temperature of 40°C, as required by ANSI Standard C37.23.

Test

The design of non-segregated bus runs has been tested per ANSI C37.23. Certification of momentary current testing, impulse testing, and heat rise are available upon request.

Seismic Application

Bus run assemblies are designed to meet Uniform Building Code® (UBC) and California Building Code Title 24 for Seismic Zones 4.3.2a.2b.1. and 0. Completed guidelines for proper supports are provided on each seismic specified order.

Short Circuit Force Withstand Ability

The metal-enclosed non-segregated phase bus runs are designed to withstand electrical and mechanical forces generated by momentary (10 cycle) and short-time (2 second) short circuit currents in accordance with the latest ANSI/IEEE Standard C37.23. For 600 V application, 4-cycle momentary current withstand rating up to 158 kA peak (98.8 kA rms asymmetrical) is also available.

Refer to **Table 1** for available short circuit ratings.

Third Party Certification

Certain bus ratings can be supplied with CSA® listing. Refer to **Tables 1** – **4** for availability of CSA listing.

TABLE 1. AVAILABLE NON-SEGREGATED BUS RATINGS PER ANSI/IEEE STANDARD C37.23-1987 ①

RATED MAXIMUM VOLTAGE KV RMS	RATED POWER FREQUENCY HZ	POWER FREQUENCY WITHSTAND 1 MIN. DRY, KV RMS	IMPULSE WITHSTAND (1.2 X 50 MICROSEC) KV PEAK	RATED CONTINUOUS CURRENT AMPERES	RATED SHORT-TIME SHORT CIRCUIT WITHSTAND CURRENT (KA RMS SYMMETRICAL)		RATED MOMENTARY SHORT CIRCUIT WITHSTAND CURRENT	
							10 CYCLE	
					2 SEC.	1 SEC. ②	KA PEAK	KA RMS ASYM.
0.635	60	2.2	10	1200 2000 3000 3200 4000 5000	49	69	132	78
0.635	60	2.2	10	1200 2000 3000 3200	63	89	170	100.8
4.76	60	19	60	1200 2000 3000 3200 4000 5000	49	—	132	78
4.76	60	19	60	1200 2000 3000 3200	63	—	170	100.8
8.25	60	36	95	1200 2000 3000 3200 4000 5000	41	—	111	66
8.25	60	36	95	1200 2000 3000 3200	63	—	170	100.8
15	60	36	95	1200 2000 3000 3200 4000 5000	48	—	130	77
15	60	36	95	1200 2000 3000 3200	63	—	170	100.8
27	60	60	125	1200 2000	40	—	108	64
38	60	80	170	1200 2000 3000 3200 4000 5000	40	—	104	64

① Refer to **Tables 2**, **3** and **4** for available CSA and UL® listings.

② This is a value calculated from 2 second short-circuit current withstand rating based on relationship I^2t = constant.

Dimensional Data

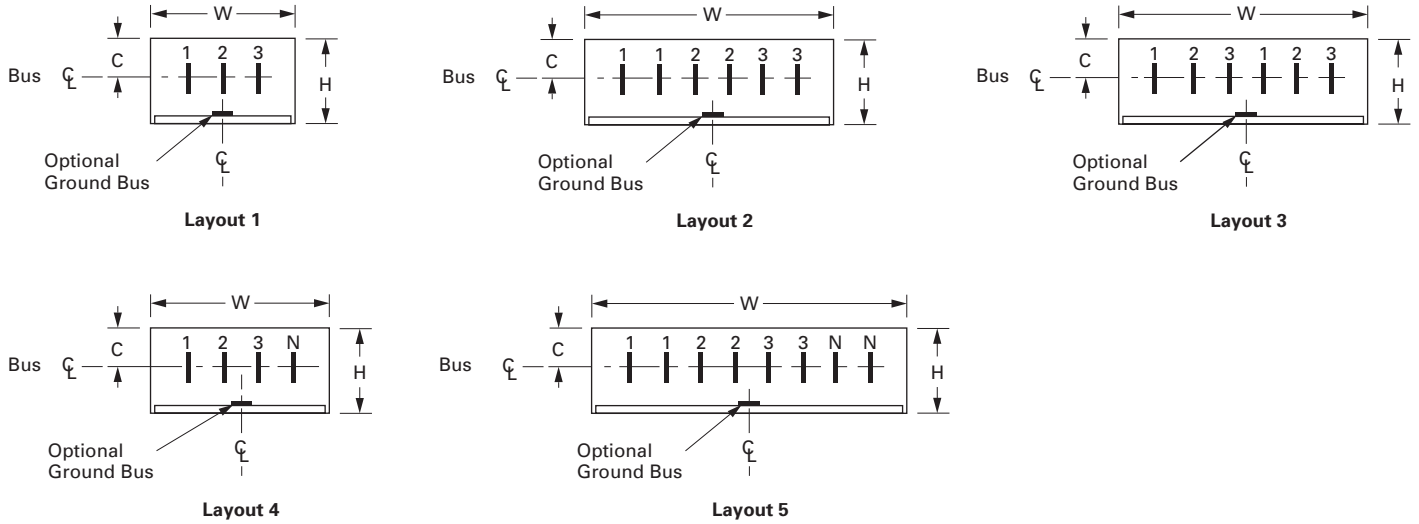
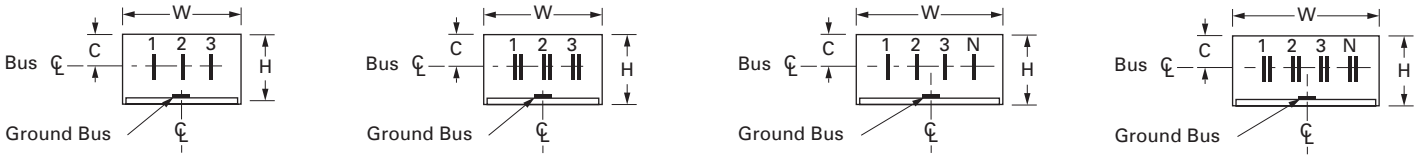


FIGURE 2. DIMENSIONAL DATA FOR 635 V/5 KV/15 KV NON-SEGREGATED PHASE BUS — STANDARD CONFIGURATIONS

TABLE 2. DIMENSIONAL DATA FOR 635 V/5 KV/15 KV BUS RATED UP TO 132 KA PEAK MOMENTARY, 49 KA RMS SYMMETRICAL 2 SECOND

WIRE TYPE	RATED MAXIMUM VOLTAGE KV ①	RATED CONT-INUOUS CURRENT AMPERES	LAYOUT NO.	ENCLOSURE MATERIAL		ENCLOSURE SIZE (INCHES)			# OF BARS PH AND SIZE, CU (INCHES) ①	PH-PH BUS SPACING (INCHES)	INSULATING SUPPORTS			OPTIONAL GROUND BUS, CU (INCHES)	APPROX. AVERAGE WEIGHT PER FOOT (LBS.) ③	LISTING	
				STD.	OPT.	W	H	C			STD.	OPT. ②				CSA	UL
3	0.635/5/15	1200	1	Aluminum	—	20.00	17.38	8.13	(1) 0.50 x 3	5.38	④	⑤	⑥	0.25 x 2	38	Yes	No
3	0.635/5/15	2000	1	Aluminum	—	20.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 2	47	Yes	No
3	0.635/5/15	3000	1	Aluminum	—	20.00	17.38	8.13	(1) 0.50 x 8	5.38	④	⑤	⑥	0.25 x 2	68	Yes	No
3	0.635/5/15	3200	1	Aluminum	—	20.00	17.38	8.13	(1) 0.50 x 8	5.38	④	—	—	0.25 x 2	77	Yes	No
3	0.635/5/15	4000	2	Aluminum	—	35.75	17.38	8.13	(2) 0.50 x 6	5.38	④	⑤	⑥	0.25 x 2	101	Yes	No
3	0.635/5/15	5000	2	Aluminum	—	35.75	17.38	8.13	(2) 0.50 x 8	5.38	④	⑤	⑥	0.25 x 2	101	No	No
3	0.635/5/15	5000	3	Aluminum	—	35.75	17.38	8.13	(2) 0.50 x 6	5.38	④	⑤	⑥	0.25 x 2	101	No	No
3	0.635/5/15	1200	1	—	Steel	20.00	17.38	8.13	(1) 0.50 x 3	5.38	④	⑤	⑥	0.25 x 2	58	No	No
3	0.635/5/15	2000	1	—	Steel	20.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 2	67	No	No
3	0.635/5/15	3000	2	—	Steel	20.00	17.38	8.13	(2) 0.50 x 4	5.38	④	⑤	⑥	0.25 x 2	106	No	No
3	0.635	3200	2	—	Steel	20.00	17.38	8.13	(2) 0.50 x 6	5.38	④	—	—	0.25 x 2	130	No	No
3	0.635/5/15	4000	2	—	Steel	35.75	17.38	8.13	(2) 0.50 x 8	5.38	④	⑤	⑥	0.25 x 2	154	No	No
3	0.635/5/15	5000	3	—	Steel	35.75	17.38	8.13	(2) 0.50 x 8	5.38	④	⑤	⑥	0.25 x 2	154	No	No
4	0.635/5/15	1200	4	Aluminum	—	26.00	17.38	8.13	(1) 0.50 x 3	5.38	④	⑤	⑥	0.25 x 2	48	No	No
4	0.635/5/15	2000	4	Aluminum	—	26.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 2	60	No	No
4	0.635/5/15	3000	4	Aluminum	—	26.00	17.38	8.13	(1) 0.50 x 8	5.38	④	⑤	⑥	0.25 x 2	88	No	No
4	0.635/5/15	3200	4	Aluminum	—	26.00	17.38	8.13	(1) 0.50 x 8	5.38	④	—	—	0.25 x 2	88	No	No
4	0.635	4000	5	Aluminum	—	35.75	17.38	8.13	(2) 0.50 x 6	4.00	④	—	—	0.25 x 2	127	No	No
4	0.635/5/15	1200	4	—	Steel	26.00	17.38	8.13	(1) 0.50 x 3	5.38	④	⑤	⑥	0.25 x 2	72	No	No
4	0.635/5/15	2000	4	—	Steel	26.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 2	84	No	No
4	0.635	3000	5	—	Steel	35.75	17.38	8.13	(2) 0.50 x 4	4.00	④	—	—	0.25 x 2	124	No	No
4	0.635	3200	5	—	Steel	35.75	17.38	8.13	(2) 0.50 x 6	4.00	④	—	—	0.25 x 2	156	No	No
4	0.635	4000	5	—	Steel	35.75	17.38	8.13	(2) 0.50 x 8	4.00	④	—	—	0.25 x 2	188	No	No
4	5/15	3000	—	—	Steel	NA	NA	—	—	—	—	—	—	—	—	—	—
4	5/15	4000	—	—	Steel	NA	NA	—	—	—	—	—	—	—	—	—	—

① All bus bars for applications above 600 V are fully insulated with fluidized epoxy coating for the rated maximum voltage. All bus bars for applications at 600 V or below are bare. Epoxy coating at 600 V and below is available as an option.
② Check with Eaton for availability.
③ Add 3 lbs. to the weights shown when using poly/porcelain or epoxy insulating supports in place of glass polyester.
④ Glass polyester.
⑤ Polyester/porcelain.
⑥ Epoxy.



Layout 6 **Layout 7** **Layout 8** **Layout 9**

FIGURE 3. DIMENSIONAL DATA FOR 635 V/5 KV/15 KV NON-SEGREGATED PHASE BUS — 63 KA CONFIGURATIONS

TABLE 3. DIMENSIONAL DATA FOR 635 V/5 KV/15 KV BUS RATED UP TO 170 KA MOMENTARY, 63 KA RMS SYMMETRICAL 2 SECOND

WIRE TYPE	RATED MAXIMUM VOLTAGE KV ①	RATED CONT-INUOUS CURRENT AMPERES	LAYOUT NO.	ENCLOSURE MATERIAL		ENCLOSURE SIZE (INCHES)			# OF BARS PH AND SIZE, CU (INCHES) ①	PH-PH BUS SPACING (INCHES)	INSULATING SUPPORTS			OPTIONAL GROUND BUS, CU (INCHES)	APPROX. AVERAGE WEIGHT PER FOOT (LBS.) ③	LISTING	
				STD.	OPT.	W	H	C			STD.	OPT. ②				CSA	UL
3	0.635/5/15	1200	6	Aluminum	—	20.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	48	Yes	No
3	0.635/5/15	2000	6	Aluminum	—	20.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	48	Yes	No
3	0.635/5/15	3000	7	Aluminum	—	20.00	17.38	8.13	(2) 0.38 x 6	5.38	④	—	⑥	0.25 x 3	78	Yes	No
3	0.635/5/15	3200	7	Aluminum	—	20.00	17.38	8.13	(2) 0.38 x 6	5.38	④	—	—	0.25 x 3	78	No	No
3	0.635/5/15	1200	6	—	Steel	20.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	68	No	No
3	0.635/5/15	2000	6	—	Steel	20.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	68	No	No
4	0.635/5/15	1200	8	Aluminum	—	26.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	61	No	No
4	0.635/5/15	2000	8	Aluminum	—	26.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	61	No	No
4	0.635/5/15	3000	9	Aluminum	—	26.00	17.38	8.13	(2) 0.38 x 6	5.38	④	—	⑥	0.25 x 3	101	No	No
4	0.635/5/15	3200	9	Aluminum	—	26.00	17.38	8.13	(2) 0.38 x 6	5.38	④	—	—	0.25 x 3	101	No	No
4	0.635/5/15	1200	8	—	Steel	26.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	85	No	No
4	0.635/5/15	2000	8	—	Steel	26.00	17.38	8.13	(1) 0.38 x 6	5.38	④	⑤	⑥	0.25 x 3	85	No	No

① All bus bars for applications above 600 V are fully insulated with fluidized epoxy coating for the rated maximum voltage. All bus bars for applications at 600 V or below are bare. Epoxy coating at 600 V and below is available as an option.
② Check with Eaton for availability.
③ Add 3 lbs. to the weights shown when using poly/porcelain or epoxy insulating supports in place of glass polyester.
④ Glass polyester.
⑤ Polyester/porcelain.
⑥ Epoxy.

Dimensional Data (Continued)

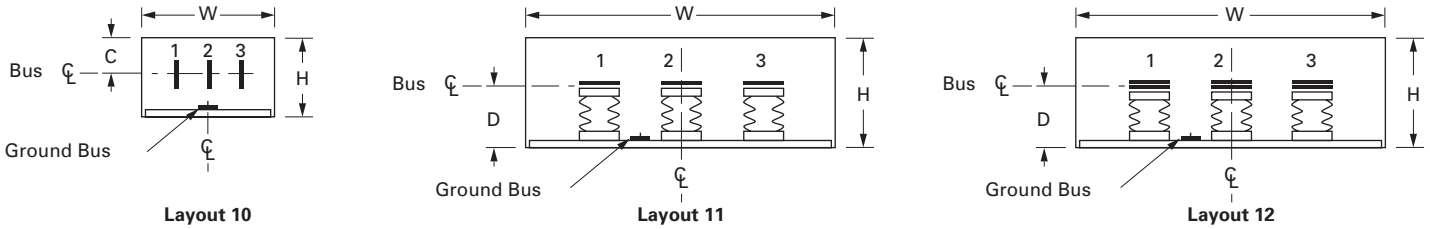


FIGURE 4. DIMENSIONAL DATA FOR 27 KV/38 KV NON-SEGREGATED PHASE BUS — STANDARD CONFIGURATIONS

TABLE 4. DIMENSIONAL DATA FOR 27 KV BUS RATED UP TO 108 KA PEAK MOMENTARY, 40 KA RMS SYMMETRICAL 2 SECOND

WIRE TYPE	RATED MAXIMUM VOLTAGE KV ①	RATED CONT-INUOUS CURRENT AMPERES	LAYOUT NO.	ENCLOSURE MATERIAL		ENCLOSURE SIZE (INCHES)			# OF BARS PH AND SIZE, CU (INCHES) ①	PH-PH BUS SPACING (INCHES)	INSULATING SUPPORTS			OPTIONAL GROUND BUS, CU (INCHES)	APPROX. AVERAGE WEIGHT PER FOOT (LBS.) ③	LISTING	
				STD.	OPT.	W	H	C			STD.	OPT. ②				CSA	UL
3	27	1200	10	Aluminum	—	30.00	21.00	9.88	(1) 0.25 x 4	7.00	④	⑤	⑥	0.25 x 2	37	Yes	No
3	27	2000	10	Aluminum	—	30.00	21.00	9.88	(1) 0.50 x 4	7.00	④	⑤	⑥	0.25 x 2	49	Yes	No
3	27	1200	10	—	Steel	30.00	21.00	9.88	(1) 0.25 x 4	7.00	④	⑤	⑥	0.25 x 2	37	Yes	No
3	27	2000	10	—	Steel	30.00	21.00	9.88	(1) 0.50 x 4	7.00	④	⑤	⑥	0.25 x 2	49	Yes	No

① All bus bars for applications above 600 V are fully insulated with fluidized epoxy coating for the rated maximum voltage.
② Check with Eaton for availability.
③ Add 3 lbs. to the weights shown when using poly/porcelain or epoxy insulating supports in place of glass polyester.
④ Glass polyester.
⑤ Polyester/porcelain.
⑥ Epoxy.

TABLE 5. DIMENSIONAL DATA FOR 38 KV BUS RATED UP TO 104 KA PEAK MOMENTARY, 40 KA RMS SYMMETRICAL 2 SECOND

WIRE TYPE	RATED MAXIMUM VOLTAGE KV ①	RATED CONT-INUOUS CURRENT AMPERES	LAYOUT NO.	ENCLOSURE MATERIAL		ENCLOSURE SIZE (INCHES)			# OF BARS PH AND SIZE, CU (INCHES) ①	PH-PH BUS SPACING (INCHES)	INSULATING SUPPORTS			OPTIONAL GROUND BUS, CU (INCHES)	APPROX. AVERAGE WEIGHT PER FOOT (LBS.) ③	LISTING	
				STD.	OPT.	W	H	C			STD.	OPT. ②				CSA	UL
3	38	1200	11	Aluminum	—	40.25	21.50	10.23	(1) 0.25 x 4	10.50	Epoxy	—	—	0.25 x 2	61	Yes	No
	38	2000	12	Aluminum	—	40.25	21.50	10.64	(1) 0.38 x 4	10.50	Epoxy	—	—	0.25 x 2	89	Yes	No
3	38	1200	11	—	Steel	40.25	21.50	10.23	(1) 0.25 x 4	10.50	Epoxy	—	—	0.25 x 2	88	No	No
	38	2000	12	—	Steel	40.25	21.50	10.64	(1) 0.38 x 4	10.50	Epoxy	—	—	0.25 x 2	116	No	No

⑦ All bus bars for applications above 600 V are fully insulated with fluidized epoxy coating for the rated maximum voltage.

Product Description

Collar

Collars (see **Figure 5**) are U-shaped metal pieces used for enclosure-to-enclosure connections.

Splice Joint

Conductors are silver plated for maximum conductivity (tin plating is optional). Bus runs rated 3200 amperes (aluminum enclosure) or 2000 amperes (steel enclosure) and below use one conductor per phase, while the higher ratings use two conductors per phase. Adjacent sections are electrically bonded together by means of plated copper splice plates to provide electrical continuity. All splice joints (see **Figure 6**) should be torqued 50 ft/lbs.

Boot Connection

Bus joints are insulated with a flame-retardant PVC boot, easily removable for joint inspection (see **Figure 7**).

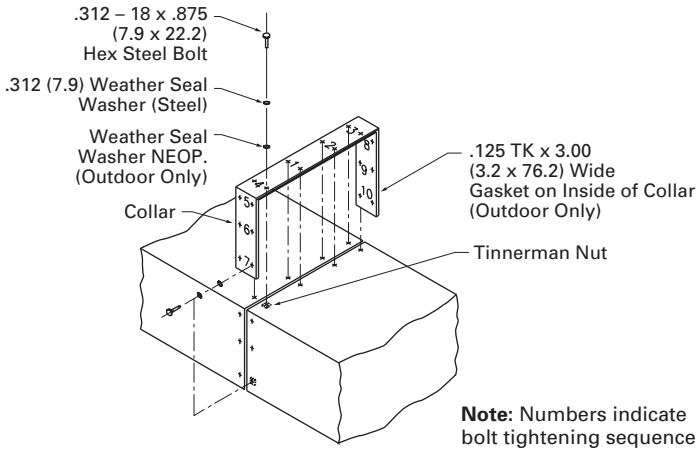


FIGURE 5. ENCLOSURE SECTION JOINT COLLAR

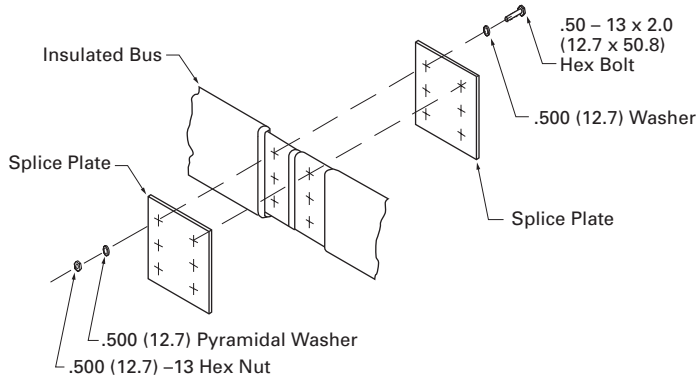


FIGURE 6. TYPICAL SPLICE PLATE CONNECTION

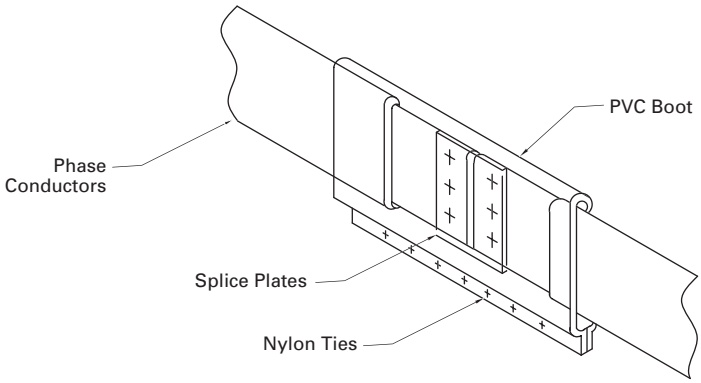


FIGURE 7. BOOT ASSEMBLY (FOR INSULATED BUS ONLY)

Construction

Enclosures are fabricated from 11-gauge aluminum, and are welded for maximum rigidity (see **Figure 8**). Removable covers are secured with bolts for ease of access when making joints and subsequent and periodic inspection. (Steel housings are also available.)

Enclosures are painted with baked-on epoxy powder coat paint system resulting in a very durable finish with uniform thickness and gloss. This cosmetically pleasing finish minimizes the risk of problems in harsh environments. The standard color is ANSI-61 light gray. Special paint colors are available upon request.

Flexible joints are supplied in all straight bus runs at approximately 50 feet (15.2 m) intervals to allow for the expected expansion when the conductors are energized and are carrying rated current.

A variety of terminations is available to accommodate most termination requirements. Bus runs can be terminated with flexible shunts, potheads, porcelain bushings, or conductor stub ends for connections to riser bars in switchgear assemblies.

Phase Conductors

All conductors are 98% conductivity copper bars. Bus joints are made by solidly bolting the bus bars together with splice plates on each side (see **Figure 9**). All joint surfaces are silver-plated or tin-plated to ensure maximum conductivity through the joint. After bolting, each standard joint is covered by a preformed, flame-retardant insulating boot, providing full insulation for bus conductors (5 kV and above). These boots are easily removable for inspection of the joints at any future time. The copper bus bars are mounted on supports of track-resistant, flame-retardant glass polyester. If boots are not available for connection, taping the joint will be required.

For flex connectors, finish connections with insulating tape (furnished). The following procedures should be followed for taping joints.

1. Clean area of dirt and foreign matter as specified under cleaning procedures.
2. Apply at least 1/8-inch (3.2 mm) of filler over the sharp edges of the conductor, splice plates, hardware or flex connectors. Smooth out and blend the contour so that tape may be easily applied.
3. Apply 3-inch insulating tape, lapping and layering (1 layer up to 5 kV) (2 layers for 5 kV to 15 kV) Tape must overlap pre-insulation by 1.50 inches (38.1 mm). Should a tape roll expire, start a new roll by overlapping any previous end by 1/2-turn.

Ground Conductor (Optional)

For all ratings except 170 kA peak rated bus, a separate, continuous .25 x 2 inch (6.4 x 50.8 mm) bare copper ground bus, bolted, and running along the entire length is available. For 170 kA peak rated bus runs, a continuous .25 x 3 inch (6.4 x 76.2 mm) bare copper ground bus running along the entire length is provided when required.

In the 170 kA peak rated bus, ground pads are welded at each end of the enclosure. Copper ground links are provided (regardless of provisions of ground bus) to ensure a continuous ground path throughout the run.

Neutral Conductor (Optional)

Fully rated, isolated and insulated neutral conductor can be provided when specified.

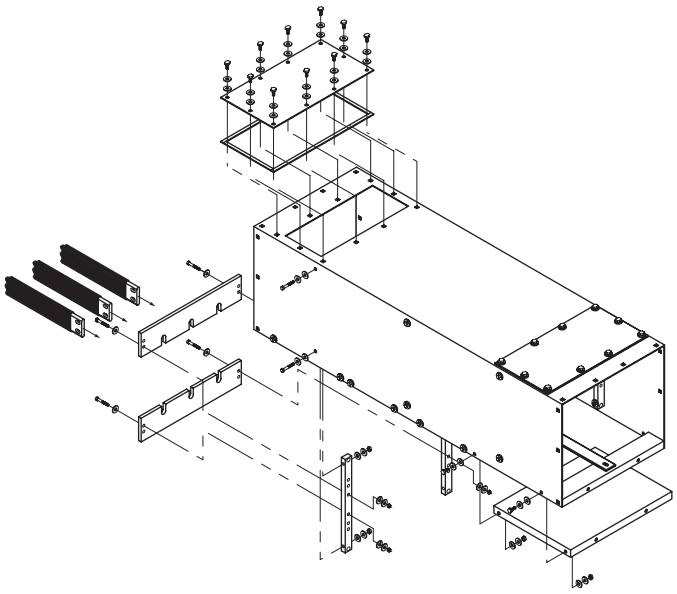


FIGURE 8. HOUSING ASSEMBLY

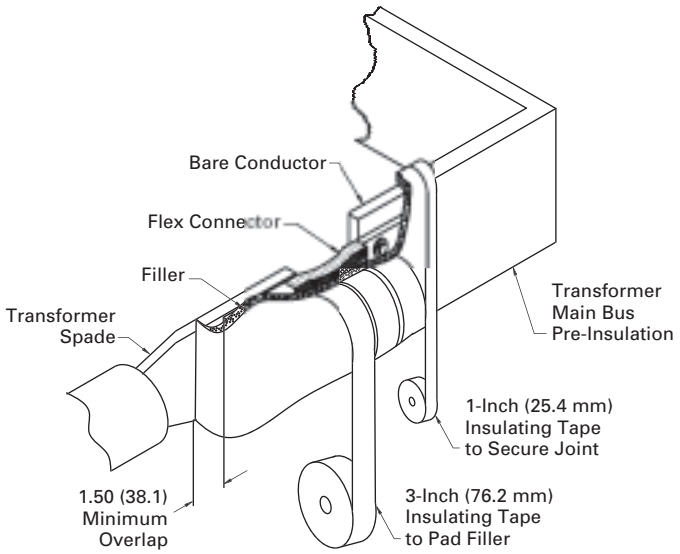


FIGURE 9. TAPING INSTRUCTIONS

Non-Segregated Phase Feeder Bus

Straight sections of feeder bus can be supplied in any length, at 1/8-inch (3.2 mm) increments, from a 14-inch (355.6 mm) minimum to an 8-foot (2 m) maximum. **Figure 10** illustrates the configuration of feeder bus and the conductor's locations. Collars are used for all horizontal enclosure-to-enclosure connections.

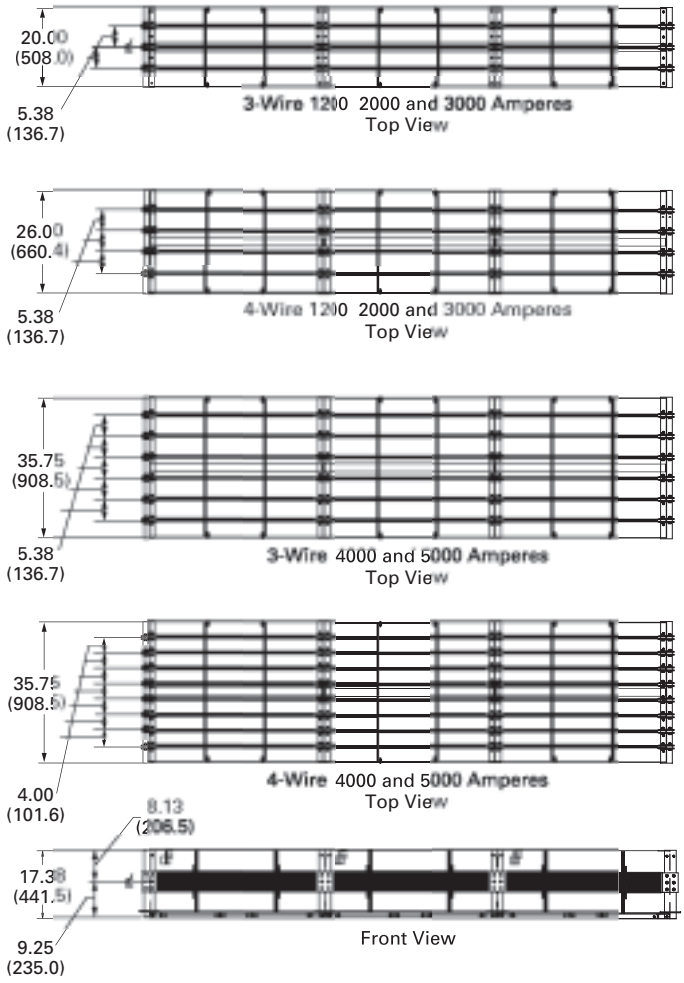


FIGURE 10. NON-SEGREGATED PHASE FEEDER BUS

Vertical Feeder

Vertical feeder enclosures (see **Figure 11**) are designed in standard lengths of 24 inches (609.6 mm) through 56 inches (1422.4 mm) in 1-inch (25.4 mm) increments. All vertical enclosures are supplied with external (turned-out) flanges for enclosure-to-enclosure connections.

Dust-Proof Construction

Both vertical and horizontal sections of feeder bus can be supplied with dust-proof construction in any length, at 1/8-inch (3.18 mm) increments, from 14 inches (355.6 mm) to an 8-foot (2.4 m) maximum. **Figure 10** illustrated the configuration of feeder bus and the conductor's locations. Removable gasket flat covers are secured with bolts for ease of access when making joints and subsequent and periodic inspection. External and internal flanges are used for all dust-proof enclosure-to-enclosure connections.

Space Heaters

Space Heaters are provided on outdoor bus duct runs for use with customer-supplied 120 or 240 Vac power supply at 250 watts for both. Consult the factory for additional heater ratings. Heaters come pre-wired using #14 shielded pair cable with a terminal block ready to accept customer-supplied power. The heaters are continuously energized or may be thermostat controlled. There is one heater provided every 8 ft. (2.4 m) as standard.

Fittings

There is a fitting to meet every application need: flanges, elbows, offsets, tees, cable tap boxes, transformer connections and expansion joints.

These fittings, along with standard and minimum dimensions, are described on the following pages.

The relationship of fittings to straight lengths (forward, rearward, upward and downward) is illustrated in **Figure 12**.

When making field measurements and layouts, it should be remembered that the dimensions are given from the centerline of the non-segregated bus bar, not the center line of the housing. **Figures 11** and **12** show the differences in center line in relationship to the housing.

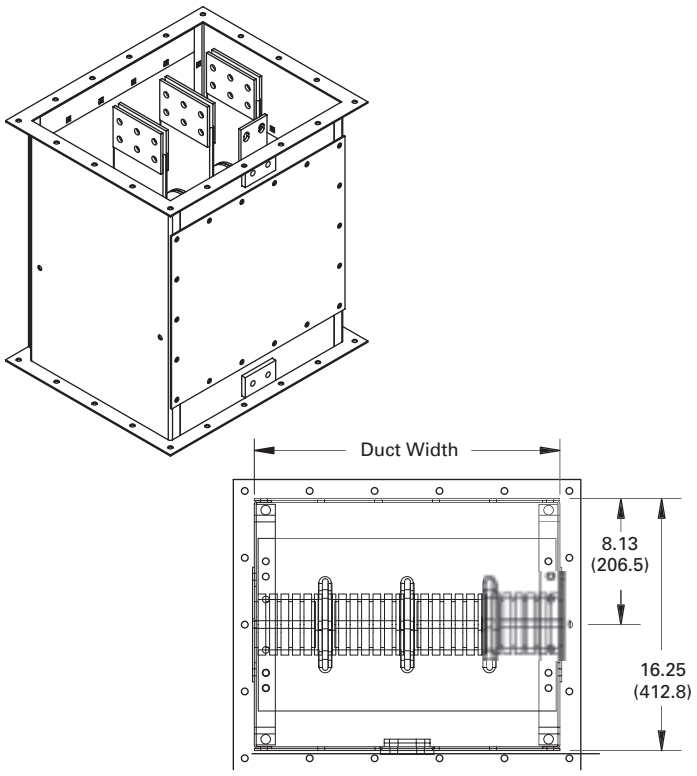


FIGURE 11. VERTICAL FEEDER

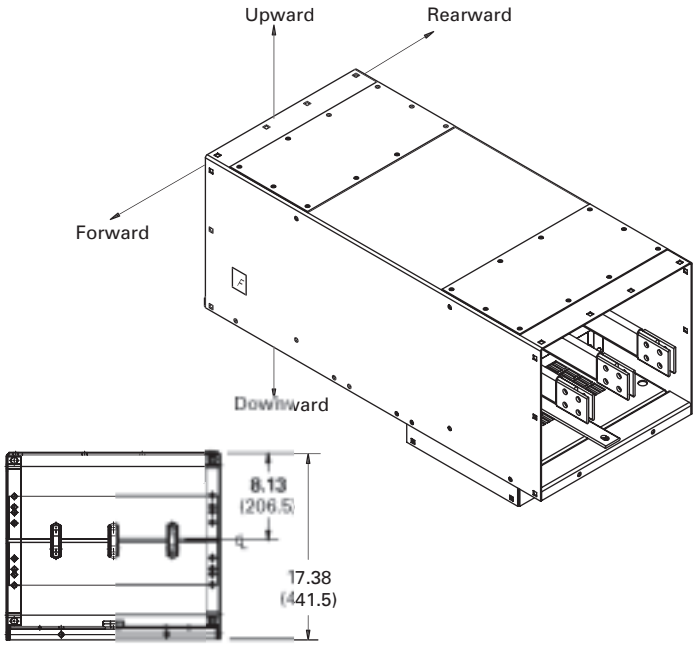


FIGURE 12. FEEDER

Traditional Elbows

Elbows are used to make 90-degree changes in the direction of bus runs. The four types that are available are forward, rearward, upward and downward.

TABLE 6. ELBOW DIMENSIONS

			DIMENSIONS IN INCHES (MM)							
			UPWARD		DOWNWARD		REARWARD		FORWARD	
AMPERES	WIRE TYPE	ENCLOSURE MATERIAL	A	B	A	B	A	B	A	B
1200	3	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)
2000	3	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)
3000	3	Aluminum	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)
3000	3	Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)
3200	3	Aluminum	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)	21.00 (533.4)
3200	3	Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)
4000	3	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)
5000	3	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)
1200	4	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)
2000	4	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)
3000	4	Aluminum	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)
3000	4	Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)
3200	4	Aluminum	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)	24.00 (609.6)
3200	4	Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)
4000	4	Aluminum/Steel	17.00 (431.8)	19.25 (489.0)	18.00 (457.2)	19.25 (489.0)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)	29.00 (736.6)

Note: All dimensions are to the centerline of the non-segregated bus bar.

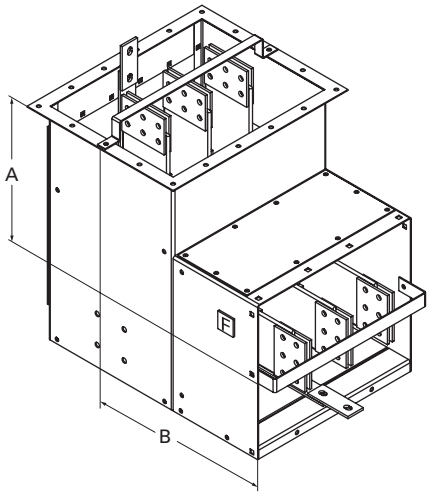


FIGURE 13. UPWARD ELBOW

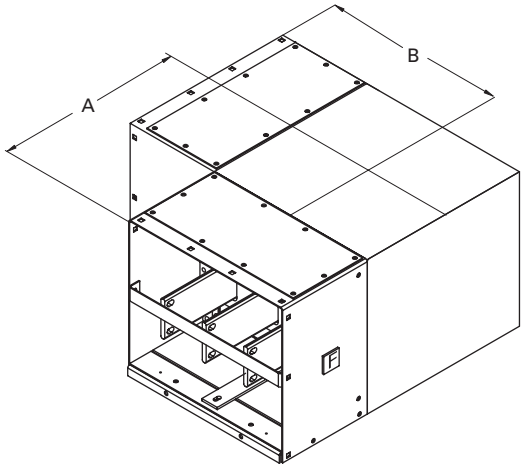


FIGURE 15. REARWARD ELBOW

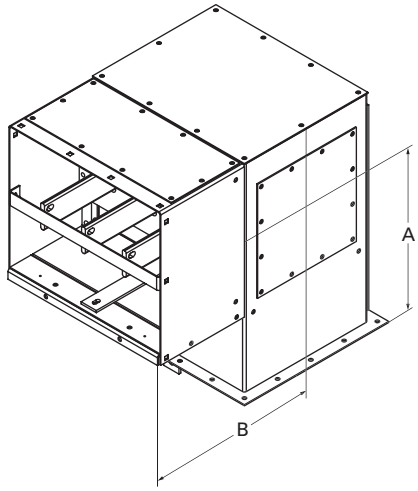


FIGURE 14. DOWNWARD ELBOW

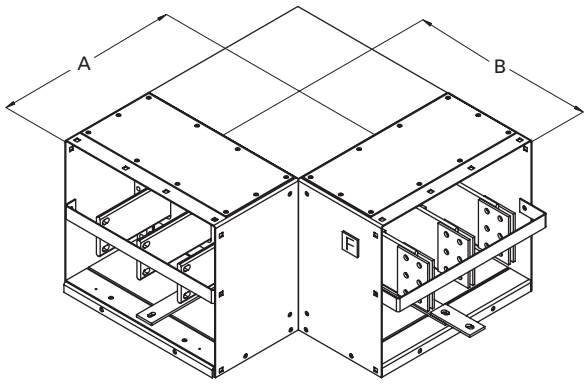


FIGURE 16. FORWARD ELBOW

Offsets

An offset is used to avoid obstacles and to conform to building structure. It is two elbows fabricated into a single fitting for use where space restrictions prohibit the use of a standard 90-degree elbow. The minimum lengths are listed in **Table 7**.

TABLE 7. OFFSET DIMENSIONS

			DIMENSIONS IN INCHES (MM)			
			UPWARD	DOWNWARD	REARWARD	FORWARD
AMPERES	WIRE TYPE	ENCLOSURE MATERIAL	A	A	A	A
1200	3	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)
2000	3	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)
3000	3	Aluminum	19.25 (489.0)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)
3000	3	Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)
3200	3	Aluminum	19.25 (489.0)	19.25 (489.0)	21.00 (533.4)	21.00 (533.4)
3200	3	Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)
4000	3	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)
5000	3	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)
1200	4	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)
2000	4	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)
3000	4	Aluminum	19.25 (489.0)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)
3000	4	Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)
3200	4	Aluminum	19.25 (489.0)	19.25 (489.0)	24.00 (609.6)	24.00 (609.6)
3200	4	Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)
4000	4	Aluminum/Steel	19.25 (489.0)	19.25 (489.0)	28.87 (733.3)	28.87 (733.3)

Note: All dimensions are to the centerline of the non-segregated bus bar.

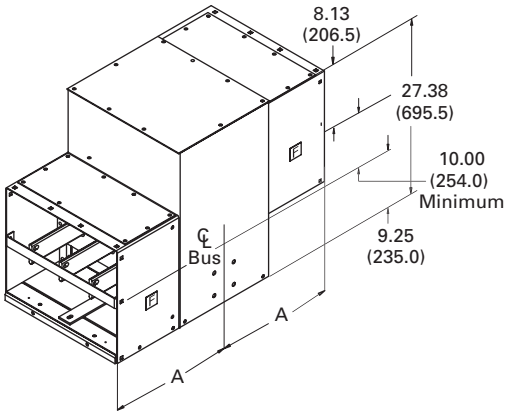


FIGURE 17. UPWARD OFFSET

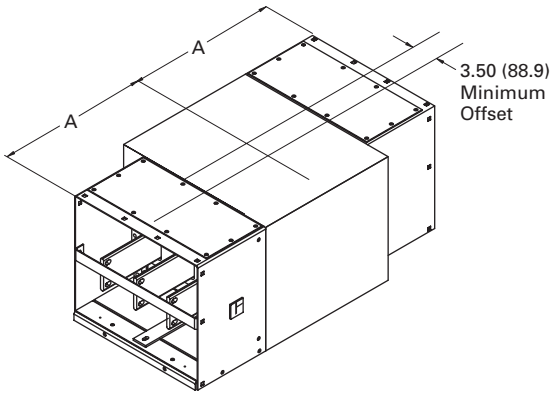


FIGURE 18. DOWNWARD OFFSET

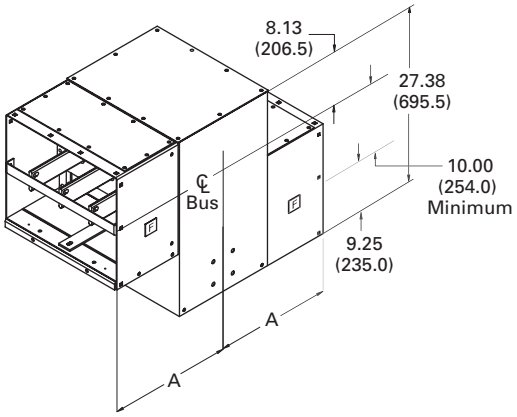


FIGURE 19. REARWARD OFFSET

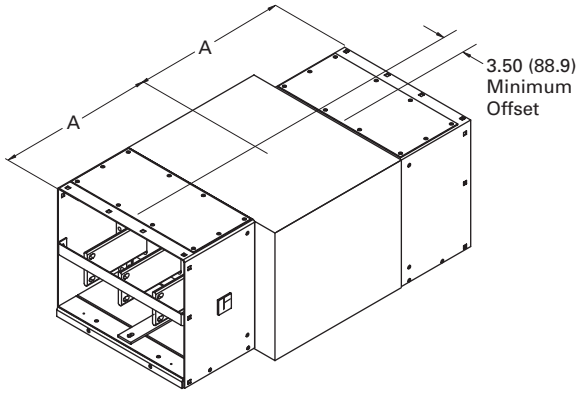


FIGURE 20. FORWARD OFFSET

Tees

Tees are used to branch-off a bus run. The four types available are forward, rearward, upward and downward.

Note: All dimensions are to the centerline of the non-segregated bus bar.

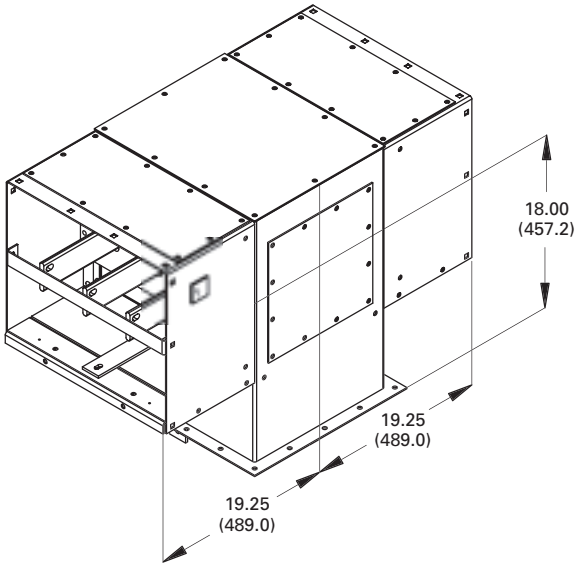


FIGURE 21. DOWNWARD

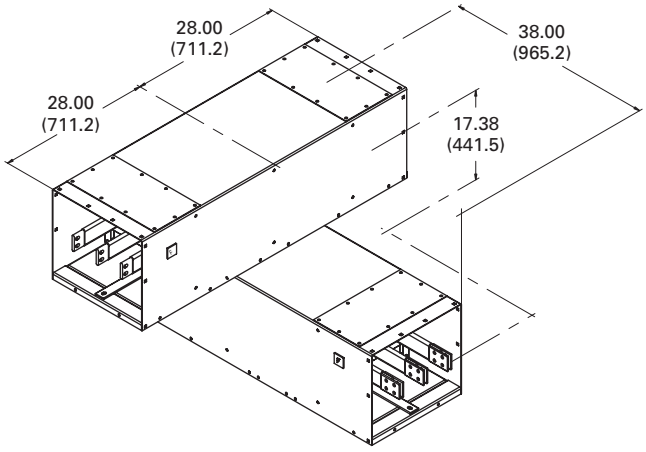


FIGURE 23. FORWARD

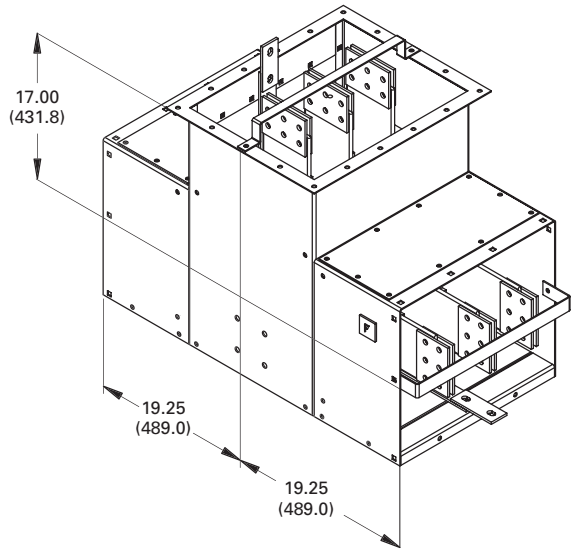


FIGURE 22. UPWARD

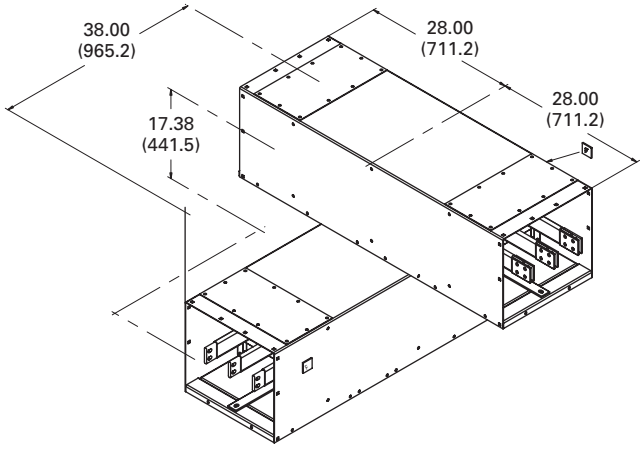


FIGURE 24. REARWARD

Switchgear Flanges

Switchgear termination enclosures connect non-segregated phase bus to medium voltage switchgear, medium voltage motor control centers, and low voltage switchgear, switchboards or motor control centers. Each enclosure is designed to coordinate with opening, drilling and bus extension detail supplied on the switchgear equipment by the switchgear supplier. Standard switchgear termination enclosures include external (turned out) flange for connections to switchgear equipment for medium voltage applications, and internal (turned in) flange for low voltage applications. All flanges will match switchgear roof sheet coordinations.

TABLE 8. FLANGE

DIMENSIONS IN INCHES (MM)

			49 KA	63 KA
AMPERES	**TYPE**	**ENCLOSURE**	**A**	**A**
1200	3-Wire	Aluminum/Steel	7.13 (181.1)	7.13 (181.1)
2000	3-Wire	Aluminum/Steel	7.13 (181.1)	7.13 (181.1)
3000	3-Wire	Aluminum	8.13 (206.5)	7.13 (181.1)
3000	3-Wire	Steel	7.13 (181.1)	—
3200	3-Wire	Aluminum	8.13 (206.5)	7.13 (181.1)
3200	3-Wire	Steel	7.13 (181.1)	—
4000	3-Wire	Aluminum	7.13 (181.1)	—
4000	3-Wire	Steel	8.13 (206.5)	—
5000	3-Wire	Aluminum	7.13 (181.1)	—
5000	3-Wire	Steel	8.13 (206.5)	—
1200	4-Wire	Aluminum/Steel	7.13 (181.1)	7.13 (181.1)
2000	4-Wire	Aluminum/Steel	7.13 (181.1)	7.13 (181.1)
3000	4-Wire	Aluminum	8.13 (206.5)	7.13 (181.1)
3000	4-Wire	Steel	7.13 (181.1)	—
3200	4-Wire	Aluminum	8.13 (206.5)	7.13 (181.1)
3200	4-Wire	Steel	7.13 (181.1)	—
4000	4-Wire	Aluminum	7.13 (181.1)	—
4000	4-Wire	Steel	8.13 (206.5)	—

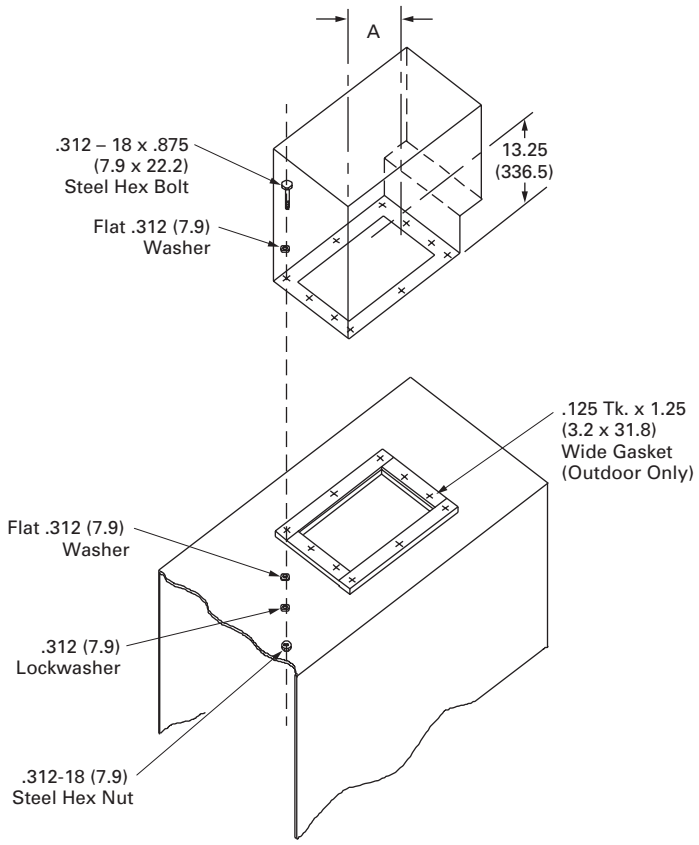


FIGURE 25. LOW VOLTAGE SWITCHGEAR FLANGE (INTERNAL FLANGE)

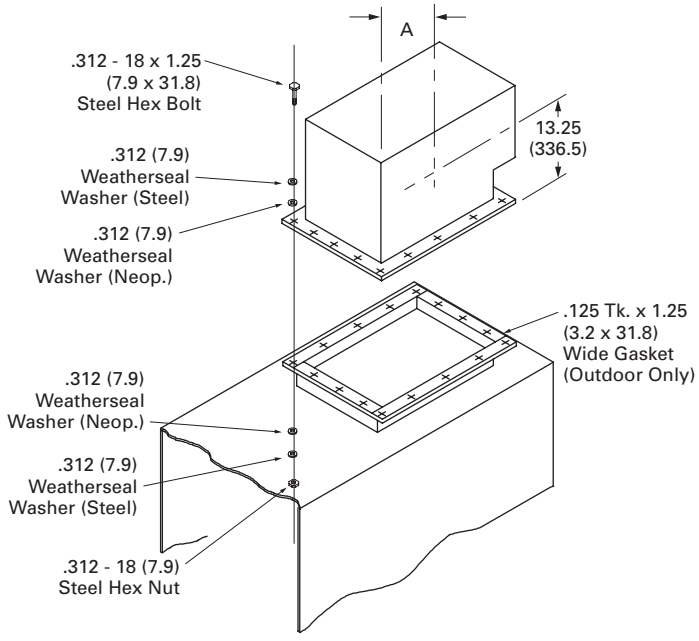


FIGURE 26. MEDIUM VOLTAGE SWITCHGEAR FLANGE (EXTERNAL FLANGE)

End Cable Tap Box

End cable tap boxes (see **Figure 27**) are applied to feed a run of bus duct with cable and conduit. The enclosure is designed to accommodate specified size and number of cables per phase. Conductors are separated and provided with the required number of cable lugs per phase, and necessary space for cable termination. The enclosure is provided with removable access covers as necessary for access to power cable terminations.

Phase Transposition

Phase transposition is normally provided within the switchgear equipment. However, when required, it can be provided within the bus run system to align phasing of terminal equipment at two ends.

All dimensions are to the centerline of the non-segregated bus bar.

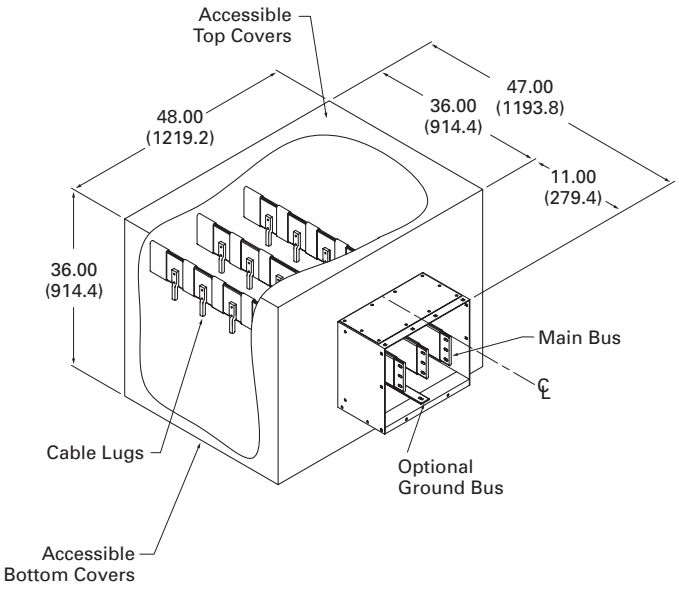


FIGURE 27. END CABLE TAP BOX

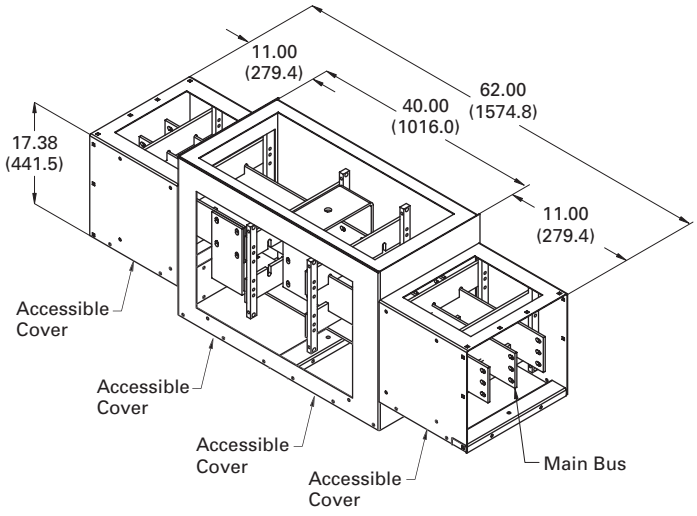


FIGURE 28. PHASE TRANSPOSITION

Expansion Joints

An expansion joint is a special bus and housing fitting provided in long runs to accommodate thermal expansion of bus conductors with respect to steel or aluminum housing, when carrying rated continuous current. The fitting consists of two pieces of housing, each with one flange end. The flanged ends are separated by a 1-inch (25.4 mm) gap. A sealing ring assembly is then installed over the bolted flanges (see **Page 16**). Flexible copper braids of required ampacity connect bus conductors within the expansion fitting. An expansion joint is normally provided for every 50 feet (15 m) of straight run. However, within those 50 feet (15 m), if the bus run contains elbows or flexible termination, such as transformer throat, the expansion joint may be omitted.

The enclosure is bolted together for shipping but the four bolts should be removed after installation.

Bushing Box Termination

This is used to connect bus duct to an outside source such as a power station or when the customer wants to connect cable that is located outdoors.

The enclosure is designed to accommodate bushing sizes of 1200 – 3000 amperes with voltages up to a maximum of 15 kV (see **Figure 30**).

The conductors are separated and provided with flex connectors on the internal portion. The enclosure will be furnished with heaters and removable access covers for maintenance.

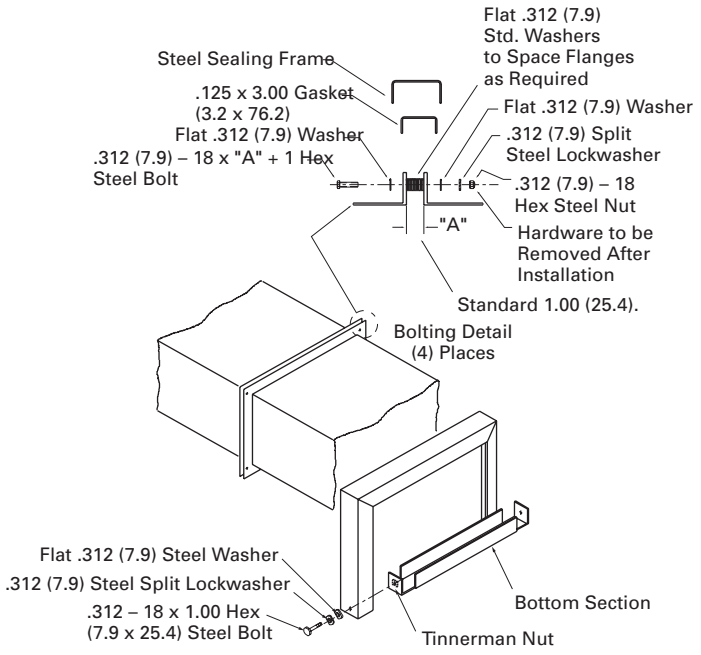


FIGURE 29. EXPANSION JOINT

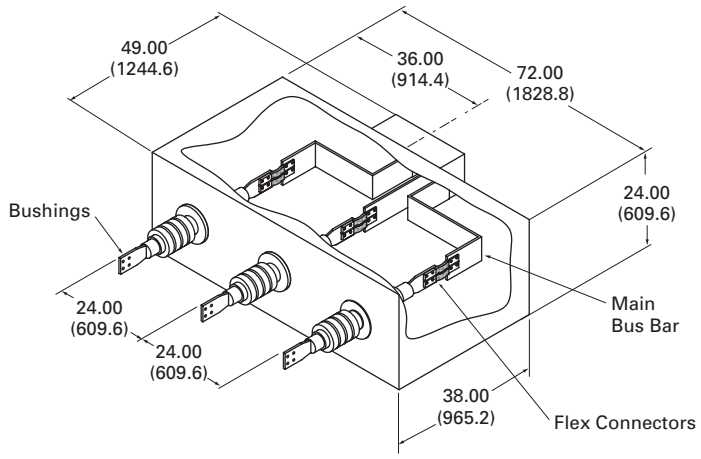


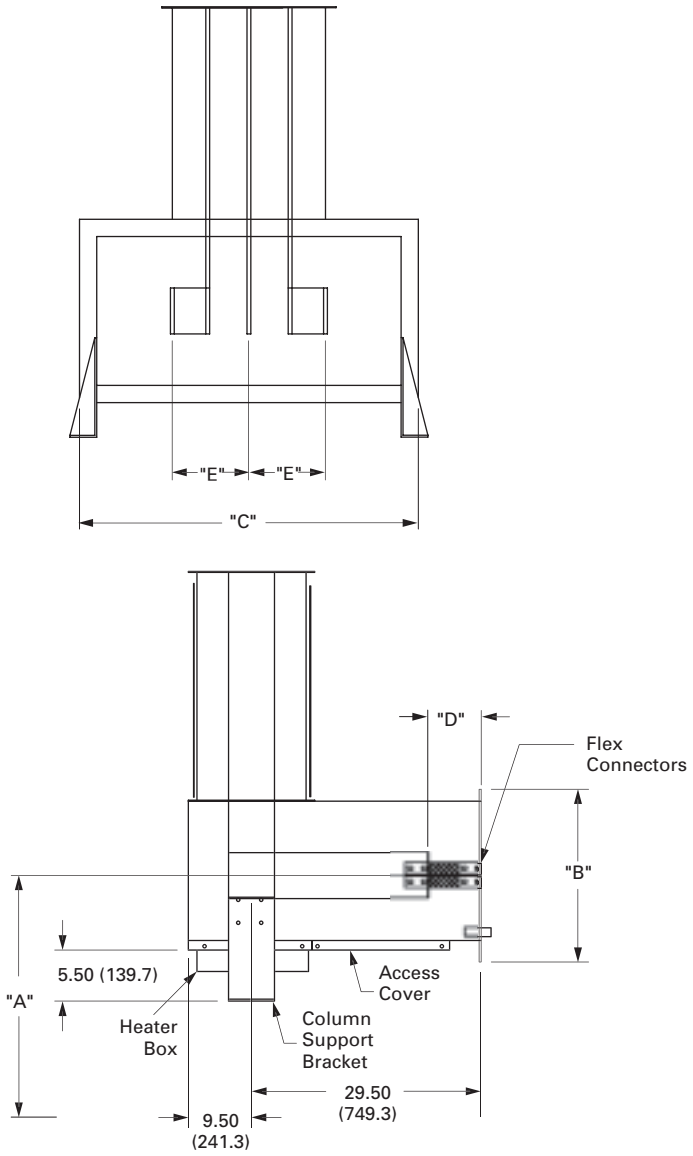
FIGURE 30. BUSHING BOX

Transformer Termination

This is a special enclosure designed to match the transformer throat. It includes a matching flange and required number of flexible copper braids for connections to transformer bushing terminal pads. The transformer termination enclosure flange is provided with or without drilling as required for a given transformer. A sealing ring kit is included for field installation around the flange connection (see **Figure 31**).

Sealing Ring

A sealing ring kit is provided for placement around enclosure-to-enclosure flange connections in an expansion fitting, and for placement around bus run flange and transformer or generator flange interface (see **Figure 32**). The sealing ring provides a weatherproof seal around such joints. The kit consists of three pieces: a U-shaped metal piece fabricated by welding together three members, a separate bottom piece, and a U-shaped gasket. The sealing ring kit is installed in the field by the customer. First, the U-shaped gasket is placed upside down around flange-to-flange interface. Then the U-shaped metal piece is placed over the gasket bolted to the bottom piece to provide a weatherproof seal around the enclosure.



A = Floor to Centerline of Transformer Flange
B = Flange Height
C = Flange Width
D = Pending Location of Transformer Spade
E = Dimensions Between Transformer Spades

FIGURE 31. TRANSFORMER TERMINATION

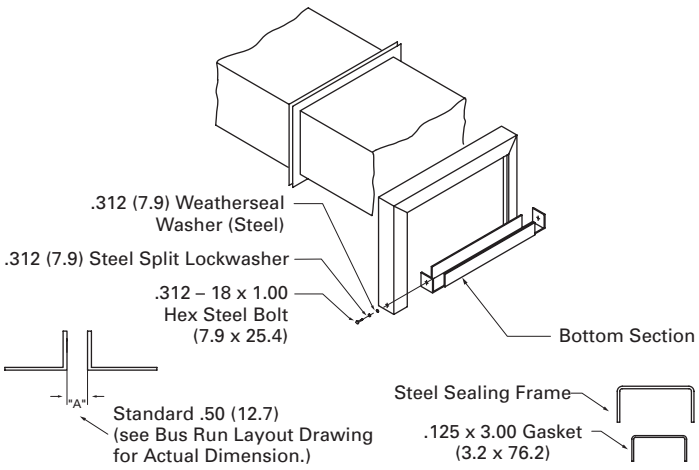


FIGURE 32. SEALING RING

Vapor Barriers

Vapor barriers are two pieces of .75-inch (19.1 mm) thick glass polyester that are sealed with silicone sealant. The vapor barrier is used to seal construction openings and penetrations through floor slabs, walls and other building partitions and assembles against the passage of moisture.

Fire Barriers

Fire barriers consist of desired fire-rated barrier sandwiched between two vapor barriers. Used to seal construction openings and penetrations through floor slabs, walls and other fire-rated building partitions and assemblies against the passage of flame, noxious gas, smoke and water. Restore fire- rated construction to original integrity.

TABLE 9. SUGGESTED GUIDE FOR DESIGNING MINIMUM PENETRATION THICKNESS FOR DESIGNATED FIRE RATINGS — IN INCHES (MM)

	FIRE RATING		
DESCRIPTION	1-HOUR FIRE TEST	2-HOUR FIRE TEST	3-HOUR FIRE TEST
Thickness of Dow Corning RTV Foam	4.00 (101.6)	8.00 (203.2)	12.00 (304.8)

Note: Data extracted from results of several large scale E-I 19-76 fire test of different Dow Corning silicone RTV foam penetration seal systems in both floor and wall test structures.

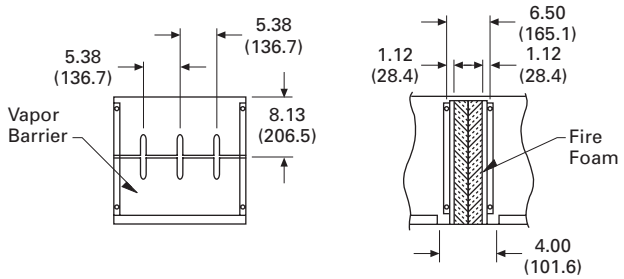


FIGURE 33. 1-HOUR FIRE BARRIER

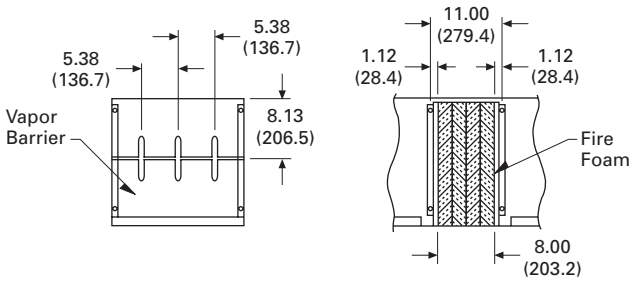


FIGURE 34. 2-HOUR FIRE BARRIER

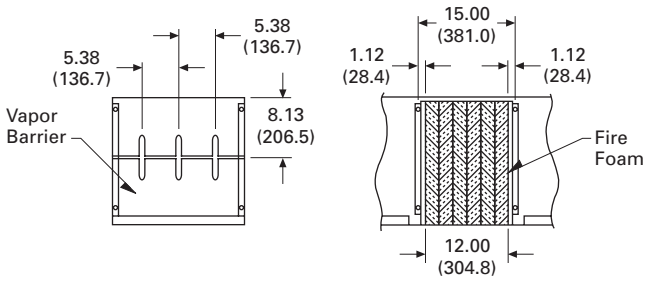


FIGURE 35. 3-HOUR FIRE BARRIER

Column Supports

Outdoor bus runs are normally supported by a single structural column with a crossbeam, which is bolted to brackets provided on the bus housing. Special conditions may require a different design. The customer furnishes the columns, beams and foundation hardware for the support columns. Only the brackets are included with the bus run. Column supports should be placed every 8 to 10 feet, at transformer throats and at trasitions where the run turns vertical for more than three feet.

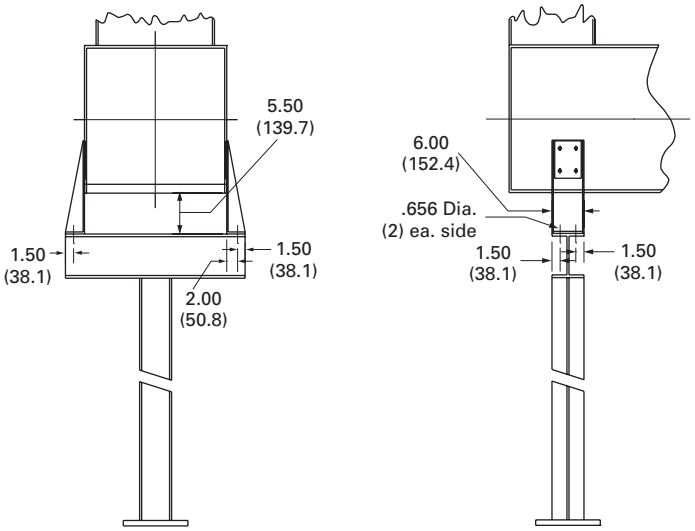


FIGURE 36. COLUMN SUPPORT AT TRANSFORMER

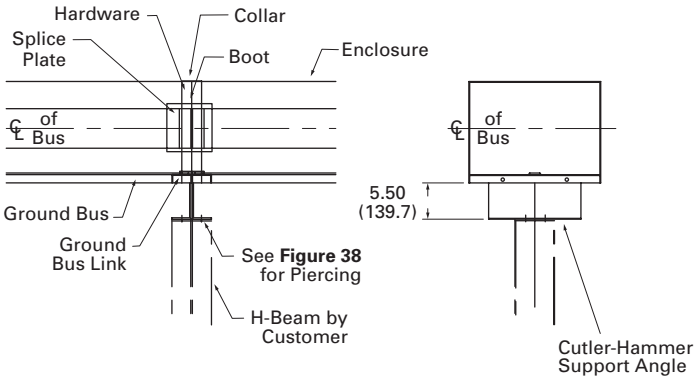


FIGURE 37. COLUMN SUPPORT AT JOINT

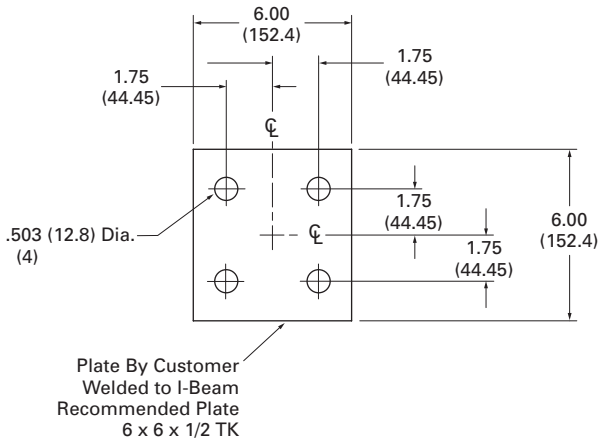


FIGURE 38. BEAM DRILLING

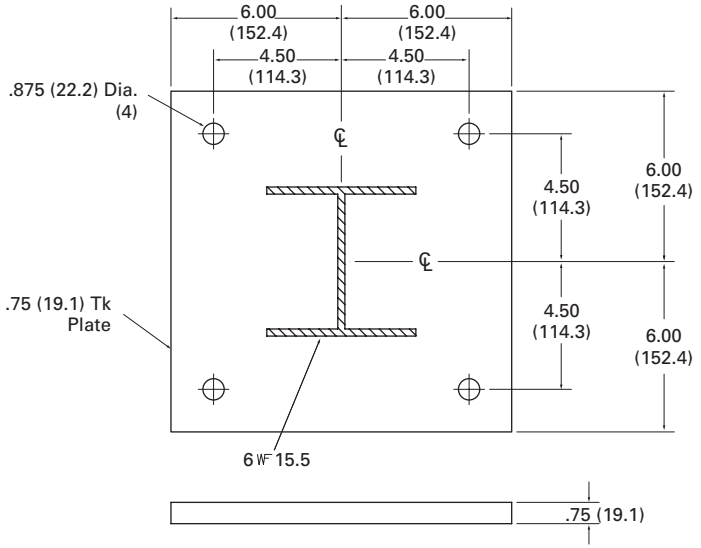


FIGURE 39. BASE PLATE DETAIL

Horizontal Hanger

The indoor bus run is attached to existing building structure through the use of 5/8-inch (15.9) diameter hanger rod assembly (see **Figure 40**). Exact placement to be determined by installer.

Hanger rods and associated support material to be supplied by the customer or contractor.

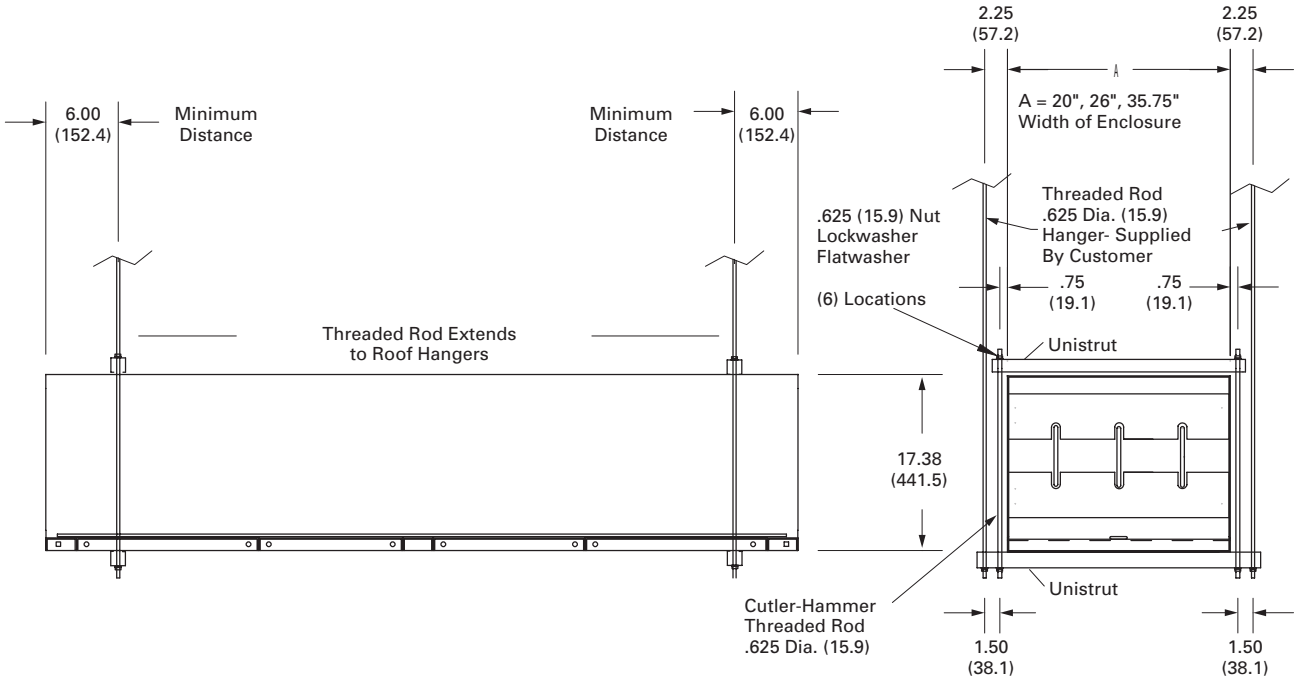


FIGURE 40. HORIZONTAL HANGER ASSEMBLY

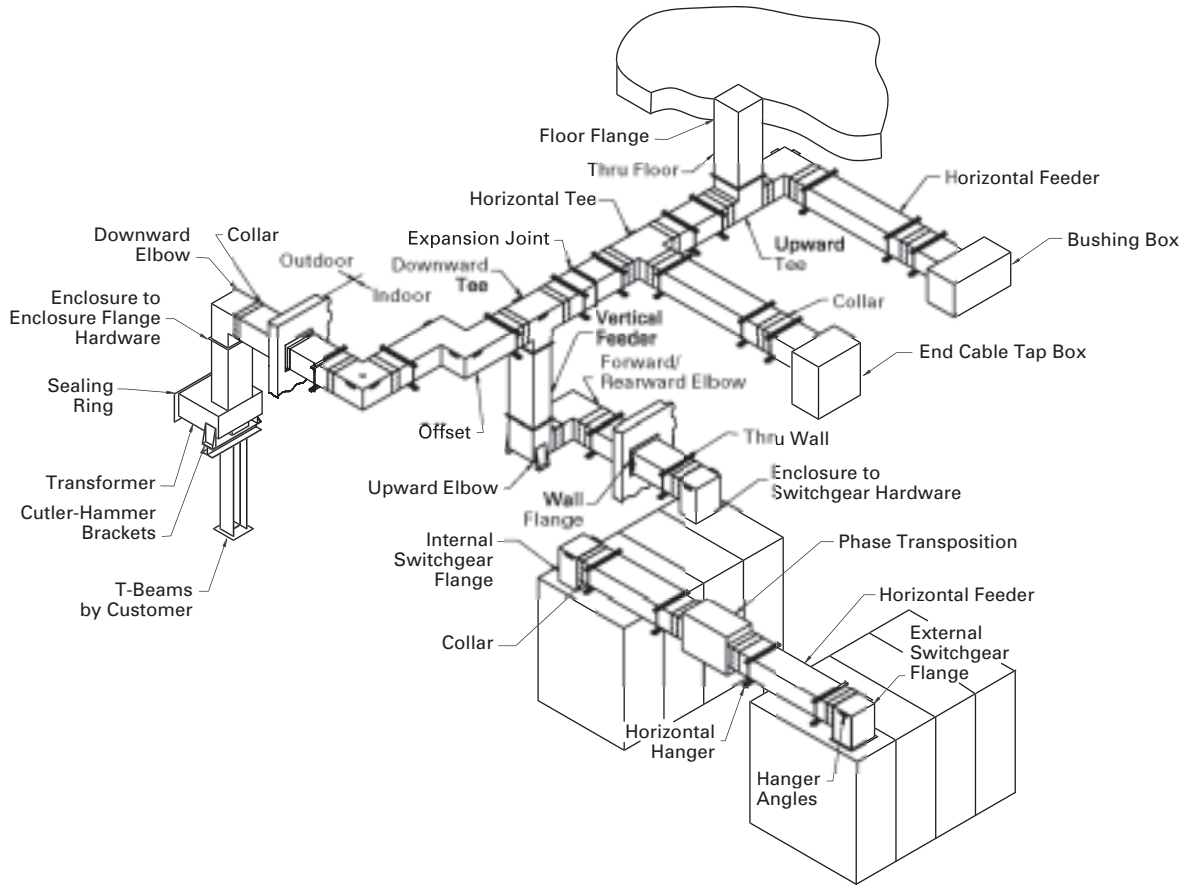


FIGURE 41. TYPICAL BUS DUCT COMPONENTS

Wall/Floor Flange

Wall/floor flange fittings are provided when a bus run passes through a wall or floor. The wall/floor flange assembly is a sliding design. It consists of a U-shaped piece fabricated with two lips. The assembly is installed in the wall opening by the purchaser. The bus run is installed through the wall/floor flange assembly by sliding through it.

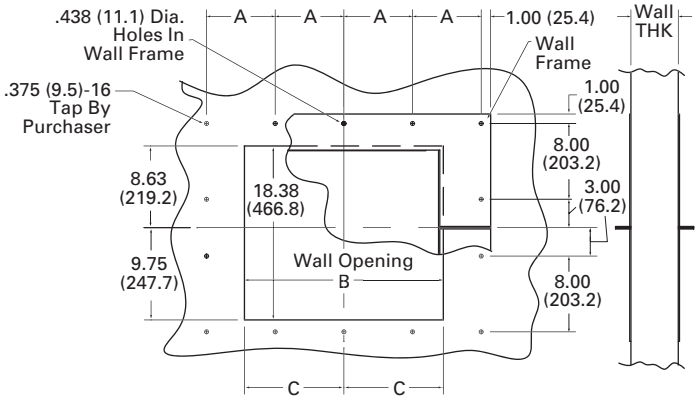


FIGURE 42. WALL OPENING

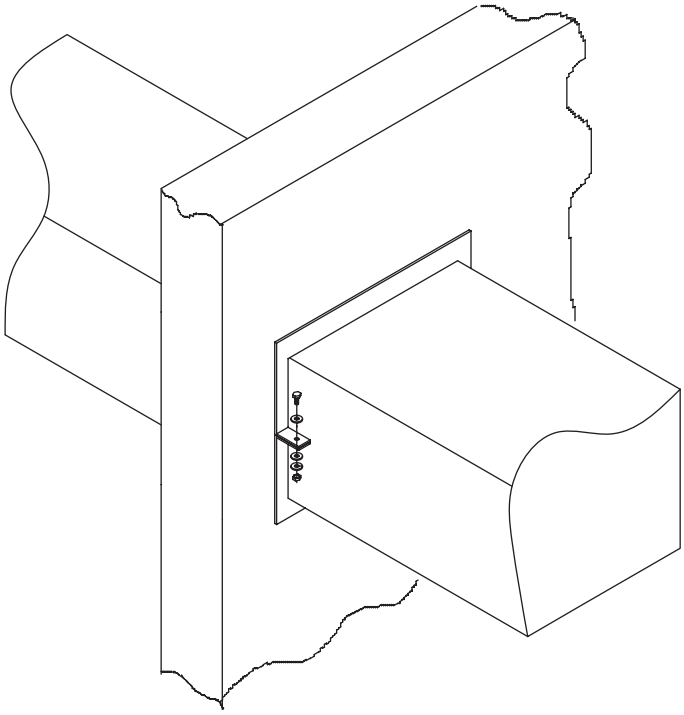


FIGURE 43. WALL FLANGE

TABLE 10. WALL OPENING DIMENSIONS IN INCHES (MM)

ENCLOSURE WIDTH	A	B	C
20.00 (508.0)	7.25 (184.2)	21.00 (533.4)	10.50 (266.7)
26.00 (660.4)	7.25 (184.2)	27.00 (685.8)	13.50 (342.9)
35.75 (908.1)	8.00 (203.2)	36.75 (933.5)	18.38 (466.9)

Installation Diagrams

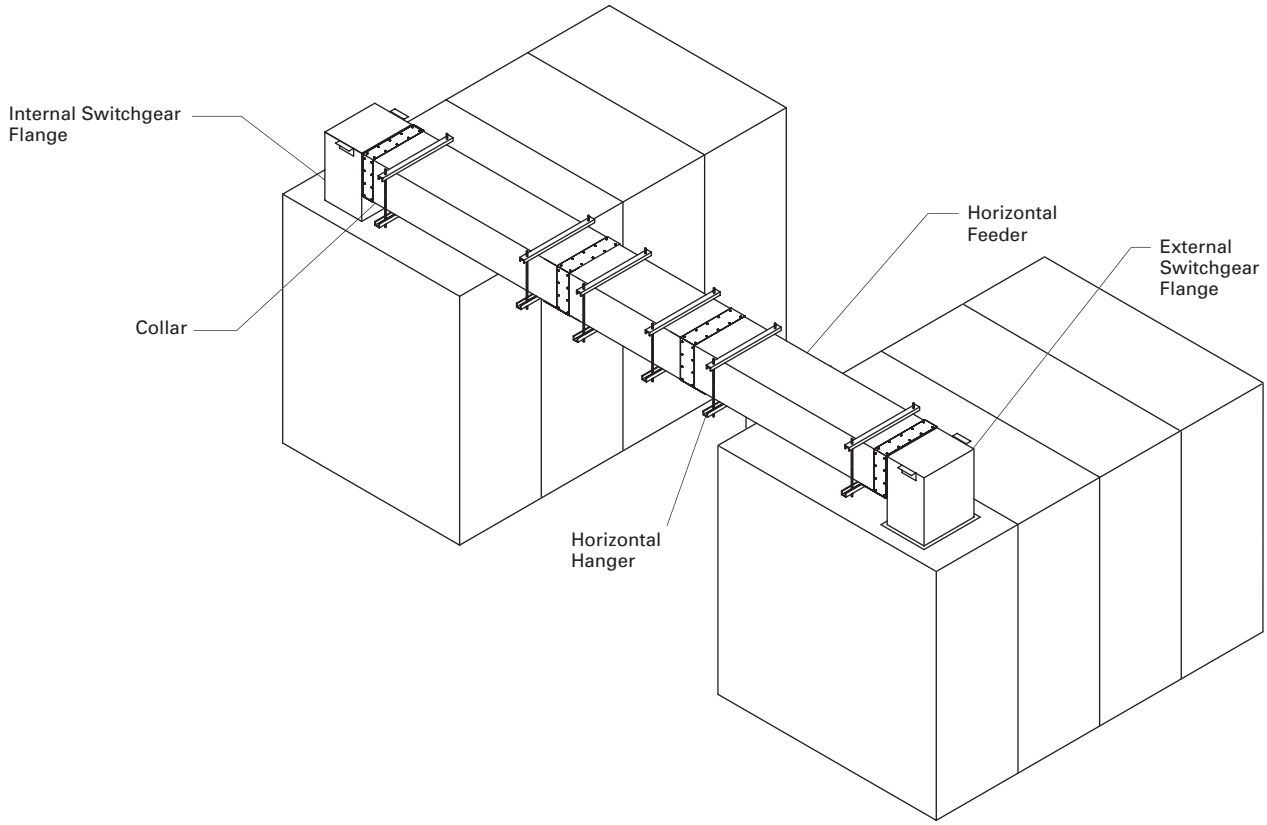


FIGURE 44. TYPICAL BUS RUN (SWITCHGEAR-TO-SWITCHGEAR)

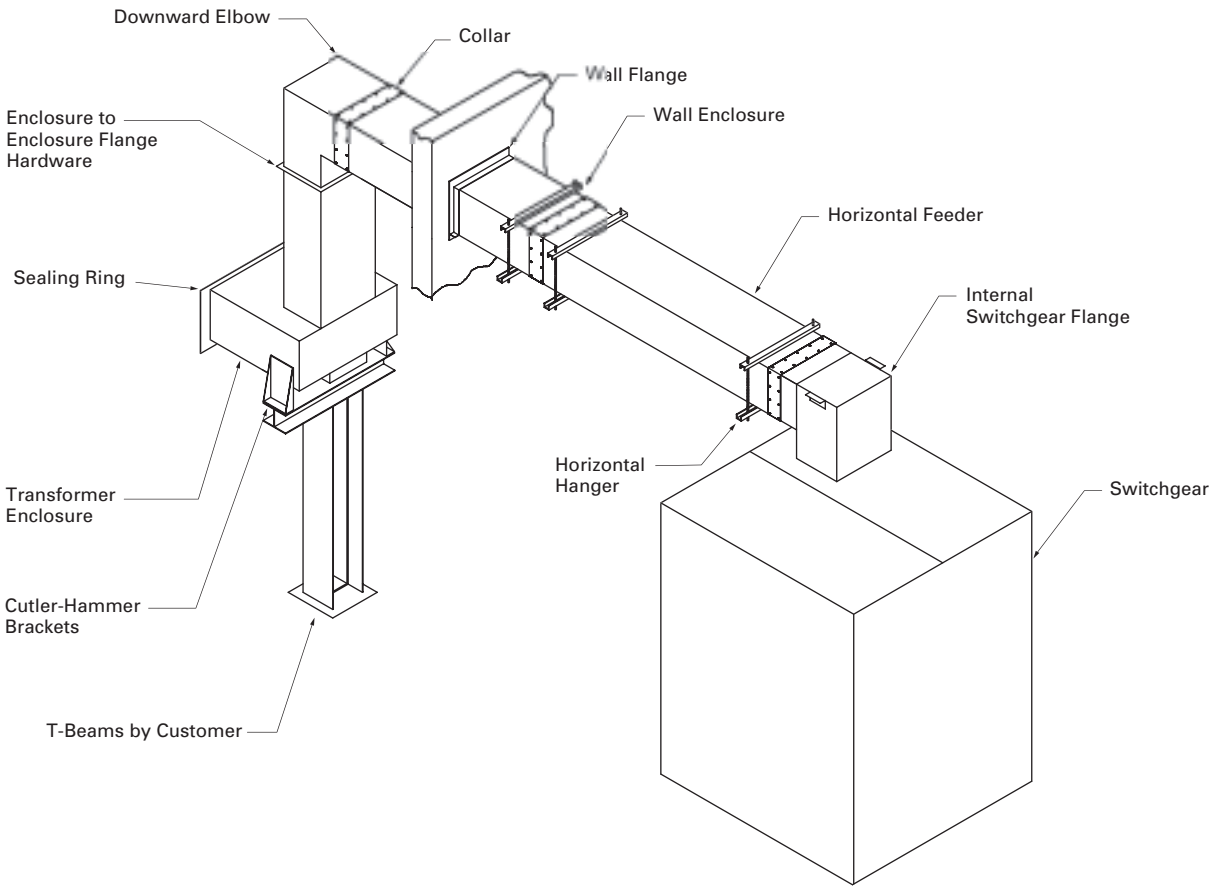


FIGURE 45. TYPICAL BUS RUN (SWITCHGEAR-TO-TRANSFORMER)

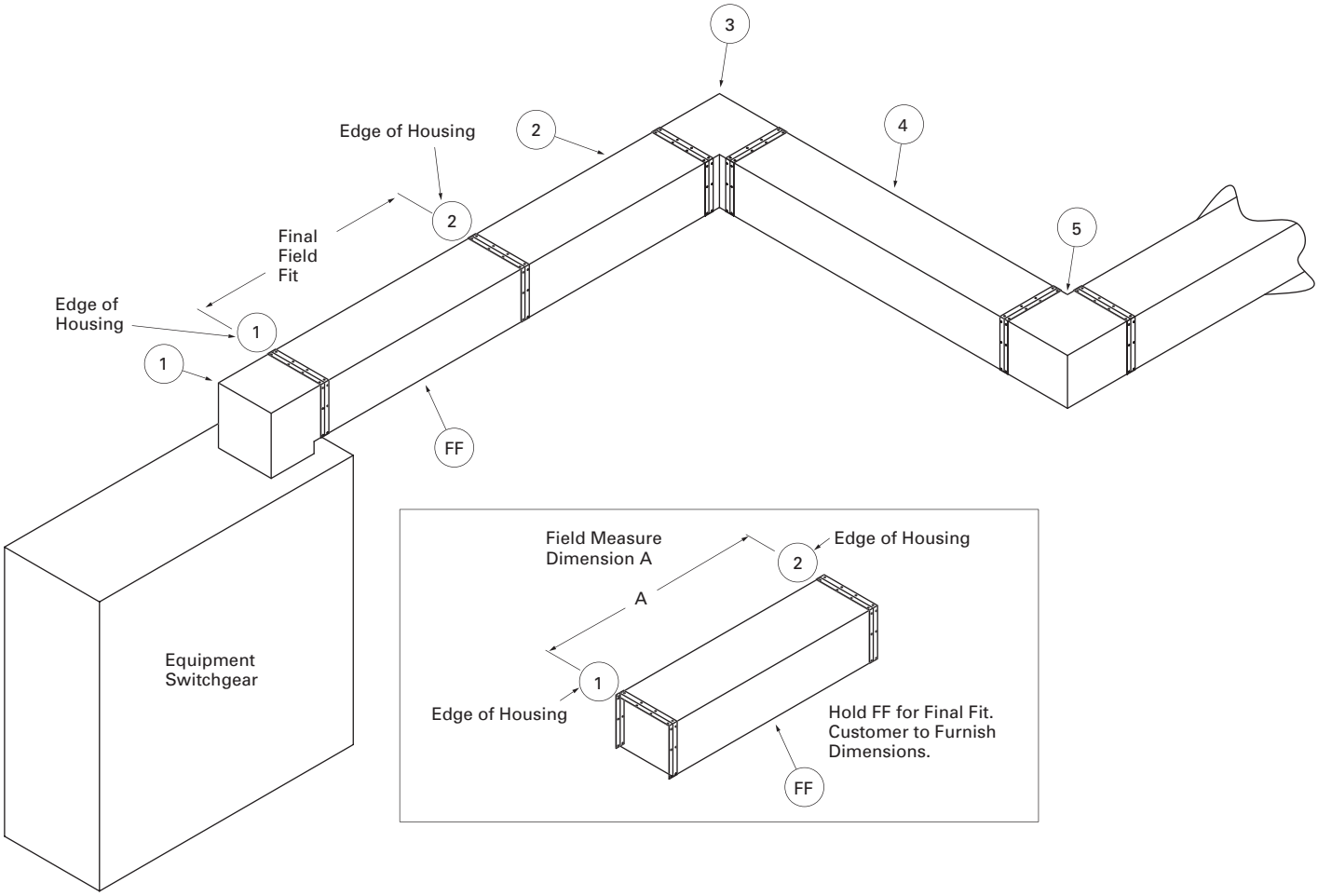


FIGURE 46. FINAL FIELD FIT

Field Fit

A field fit section of bus is typically an elbow or a short length of feeder that is intentionally left out of a run for later shipment. It is most often a mutually agreed upon section between the customer and the plant. The purpose of the program is to effectively manage the dimensional uncertainties that may be involved in a bus layout.

The example shown in **Figure 46** identifies the field fit piece as a straight length.

Upon release of the order, this item is kept on hold for field measurement. The contractor installs the bus duct and is then able to obtain an exact dimension for the final field fit piece. The measurement should be made from edge of the housing "1" to the edge of the housing "2."

The contractor can fax the dimensions directly to the factory on the Final Field Fit Fax Release form, which is packed with the original shipment.

The field fit section will ship within 5 to 10 working days from the receipt of the release fax. This program has been successful for many years and it provides assurance of an exact fit the first time. It allows bus duct to be released when certain dimensions are not yet determined. It also eliminates the costly delays that can occur when sections have to be remade and shipped due to last minute job site changes. In turn, this allows installations to begin early and projects can be completed on time.

Final Field Fit Program

Fax Release!

Fax Direct to Greenwood factory.

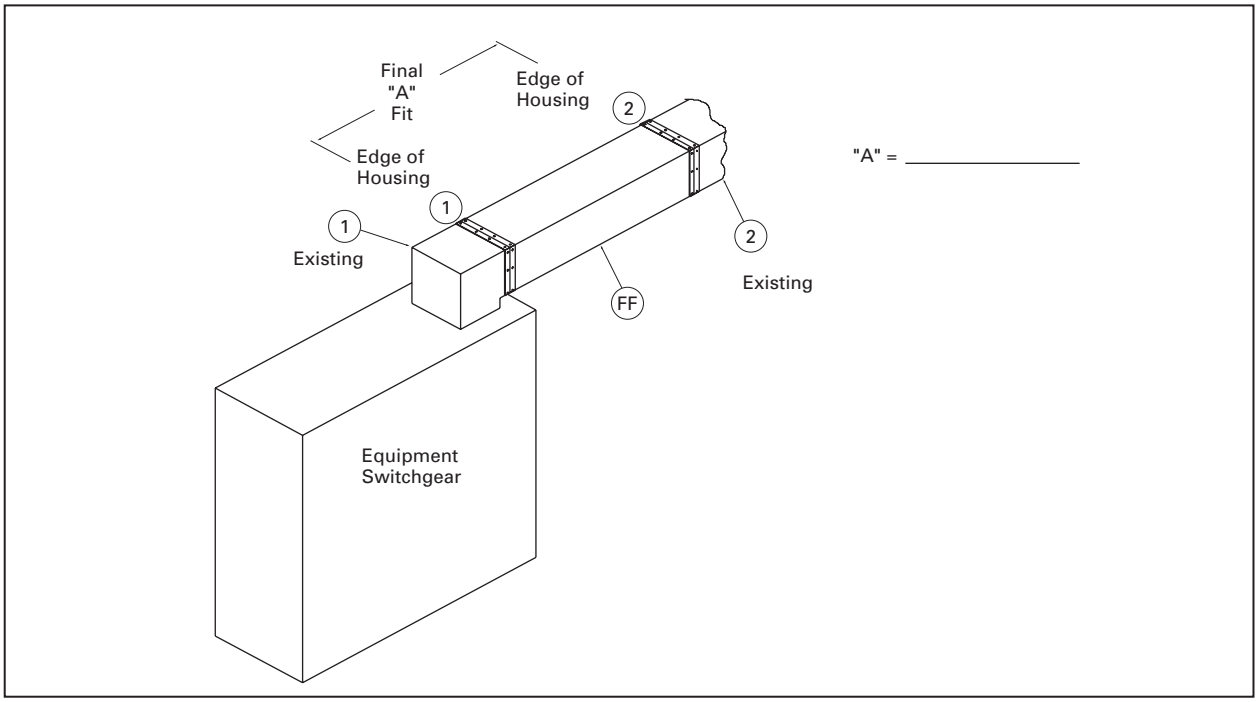
Ref. Drawing:

G.O.#: Item #:

Phone #:: **864-942-6310** Fax #: **864-942-6339**

Customer to provide dimensions indicated by letters on field fit section of busway.

"A" Dimension = _____ (25" min.)



Name: _____

Company: _____

Phone #: _____ Fax #: _____

Date: _____

List other field fit items released at this time:_____

Requested Ship Date: _____

Standard ship lead time is 5 to 10 working days from receipt of complete information.

FIGURE 47. FINAL FIELD FIT FAX

Specifications

Part 1 – General

1.01 Scope

A. The contractor shall furnish and install the bus duct system including all necessary fittings, hangers and accessories as specified herein and as shown on the contract drawings.

1.02 References

A. The non-segregated bus duct and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, CSA, NEMA® and IEC.

1.03 Submittals Review/Approval

A. The following information shall be submitted to the engineer:

1. Master drawing index.
2. Isometric / 2D drawing of each bus duct run.
3. Bus ratings including:
   a. Short-circuit rating
   b. Voltage
   c. Continuous current
4. Major component ratings including:
   a. Voltage
   b. Continuous current
   c. Interrupting ratings
   d. Cable terminal sizes

1.04 Submittals for Information

A. When requested by the Engineer the following product information shall be submitted:

1. Descriptive bulletins.
2. Product sheets.

1.05 Submittals for Close-out

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Section 1.04.
2. Installation information.
3. Seismic certification and equipment anchorage details.

1.06 Qualifications

A. All components shall be of the same manufacturer as the bus duct.

B. For the equipment specified herein, the manufacturer shall be ISO® 9000, 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a period of 10 years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The bus duct and related accessories shall be suitable for and certified to meet all applicable seismic requirements of the Uniform Building Code and the California Building Code Title 24 for zone 4.32a.2b.1. and 0 application.

1.07 Delivery, Storage and Handling

A. Equipment shall be handled and stored in accordance with the manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.08 Operation and Maintenance Manuals

A. Ten copies of the equipment operation and maintenance manuals shall be provided.

B. Operation and maintenance manuals shall include the following information:

1. Instruction books or leaflets.
2. Recommended renewal parts list.
3. Drawings and information required by Section 1.06.

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