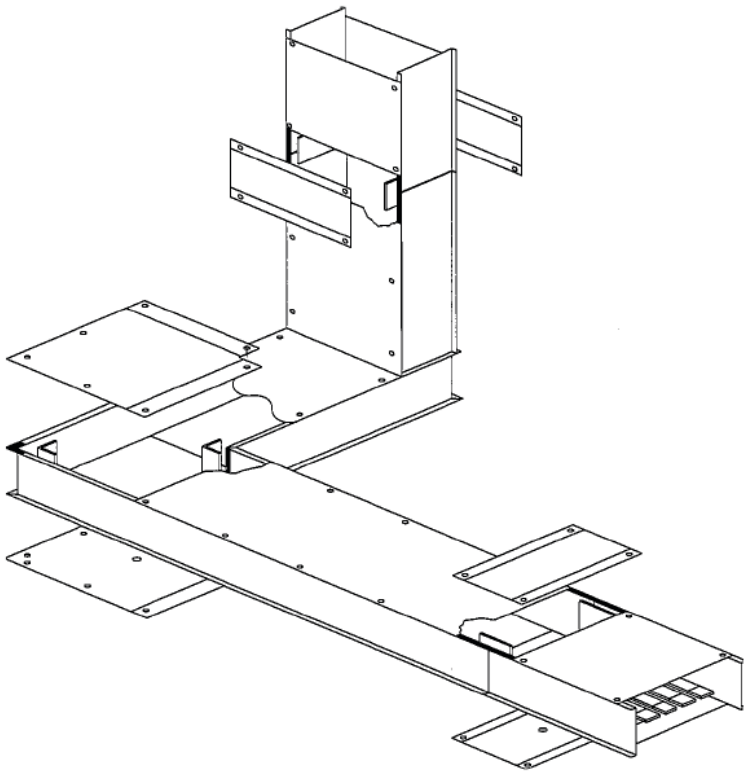
NSB product, storage, installation, and maintenance

Manufactured on/after October 1, 2023



Powering Business Worldwide

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Contents

Contents, continued

Introduction

The content of this manual is the property of Eaton and is considered proprietary and confidential. Any use, duplication, or disclosure of the contents requires prior written authorization.

All aspects of installation, operation, and maintenance of Eaton's metal-enclosed bus system must be thoroughly understood and performed under the supervision of qualified personnel.

Responsible personnel should establish procedures which insure the safety of personnel and equipment. Specific safety-related procedures are not covered by this manual. Please refer to all installation drawings, other equipment manufacturer's specifications, appropriate ANSI, IEEE®, NFPA® and NEMA® requirements and your own company's safety rules.

Information contained in this manual is to be used in conjunction with installation drawings provided for each system. Installation drawings typically include the drawings listed below which establish ratings and identify specific project requirements, which may vary from standard product features described in this manual.

Operation notice

Eaton bus systems are designed to be operated at the ratings specified. Operating the bus at ratings other than those specified may shorten the service life of the system and increase maintenance requirements. We recommend consulting the factory regarding any abnormal operation either above or below the ratings specified. Operation at ratings other than specified may void warranty.

Installation drawings

Bus duct layout

Plan and elevation views of duct routing. This drawing also lists and identifies all assemblies provided by the factory. Typical cross-sectional view of duct, providing ratings, housing size, weight per foot, material descriptions, and bus duct structural support locations.

Equipment terminations

Details of the bus and enclosure connection to the equipment.

Ship loose Bill of Materials

Lists and identifies all parts required for field assemblies.

NOTICE

THE RATINGS AND FEATURES LISTED BELOW HAVE NOT BEEN EVALUATED OR CERTIFIED BY UL AND WILL NOT BEAR A UL LABEL. VOLTAGE RATINGS OF 25 KV OR ABOVE, HEATERS INSTALLED IN ELBOW ASSEMBLIES, HAZARDOUS AREA HEATER SYSTEMS, INDOOR VENTILATED ENCLOSURES, STEEL ENCLOSURES, INTERNAL GROUND BUS, AND TAPE INSULATION.

Product description

Ratings

Each Eaton system is designed to meet the voltage, amperage, and fault level requirements specified on the drawing(s) provided.

Conductors

Copper or aluminum is sized in accordance with the specified ratings to operate within IEEE C37.23 temperature rise limitations.

Conductor joints

Contact surfaces are prepared and plated to satisfy the specific application. Refer to our equipment termination drawings and shipping split assembly illustrations for specific hardware requirements.

Insulation

Factory insulation is not required on 600 V conductors but is optional; refer to the layout drawing for details. The 5–38 kV conductors are insulated with 130 °C epoxy coating.

Bus support insulators

Eaton bus support insulators are furnished to suit the electrical and mechanical requirements specified for each installation. Molded glass polyester is standard for systems rated up to 15,000 V. Porcelain is optional for 5 kV and 15 kV. Porcelain is standard for 34,000 V systems.

Enclosure

Painted, non-magnetic aluminum enclosures eliminate hysteresis losses. Due to its inherent high conductivity, it also minimizes induced I^2R losses.

Eaton's high conductivity aluminum enclosures also shield external steel members from undesirable magnetic heating.

Outdoor installations

- Top and sides are not ventilated
- Screened breather/drains are provided along enclosure bottom to prevent accumulation of moisture
- All exposed hardware is stainless steel
- Gaskets are concealed to prevent deterioration
- Electric space heaters are provided to prevent the formation of internal condensation

Indoor installations

- Non-ventilated or ventilated enclosures may be provided as specified
- All hardware is plated steel

Expansion

Provisions for the bus and enclosure expansion are furnished as required by the configuration and lengths of each system.

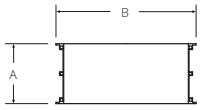
Grounding

The entire length of the enclosure must be properly grounded. Mating surfaces of the ground bonds are unpainted to ensure continuity. External or internal pads are provided for connection to the station ground. When specified, a separate ground bus attaching to the equipment ground may be provided as an option.

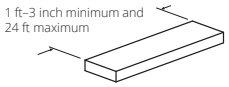
Structural supports

Our indoor structures will be painted to match the enclosure; outdoor structures are galvanized. Refer to illustration drawings and bus duct layout drawing for the suggested support locations and source of supply.

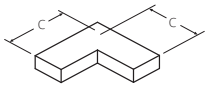
Assemblies and specifications



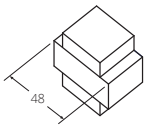
Cross section



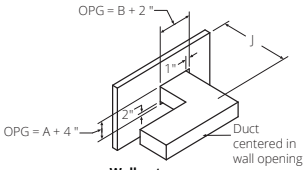
Straight



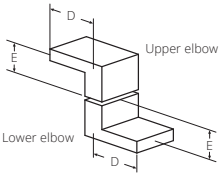
Horizontal elbow



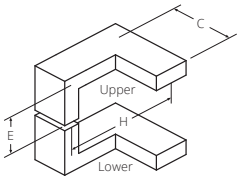
Phase transposition



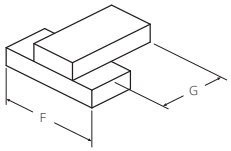
Wall entrance



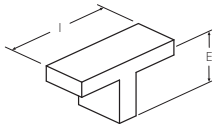
Vertical Elbows



Transition



Horizontal tee



Vertical tee

Voltage and material	Ampere rating ①	Wt/ft lb ②	Dimensions (inches) ②										Resistance microhms per phase per foot ③	Watt loss per three-phase foot ③	Reactance microhms per foot	Impedance microhms per foot ③	Capacitance microfarads per 1000 feet
			A	B	C	D	E	F	G	H	I	J					
600 Copper	1200	29	8	21	22	11.38	15	48	22	18.25	28	17	10.76	46	44.29	45.58	0.022
	1600	33	8	21	22	11.38	15	48	22	18.25	28	17	8.50	65	43.46	44.28	0.023
	2000	47	10	21	22	12.38	16	48	22	19.25	30	17	5.79	70	37.05	37.50	0.024
	2500	54	14	21	22	14.38	18	48	22	21.25	34	17	4.71	88	29.23	29.61	0.024
	3200	75	14	27	25	14.38	18	60	25	24.25	34	20	3.91	120	31.84	32.08	0.028
	4000	111	14	36	30	14.38	18	60	30	28.75	34	25	3.47	166	41.93	42.07	0.030
	5000	131	24	42	33	19.38	23	60	33	36.75	44	28	2.78	209	42.54	42.63	0.023
	6000	147	28	42	33	21.38	25	60	33	38.75	48	28	2.41	260	24.76	24.88	0.035
600 Aluminum	1200	21	8	21	22	11.38	15	48	22	18.25	28	17	13.41	58	43.46	45.48	0.023
	1600	26	10	21	22	12.38	16	48	22	19.25	30	17	8.76	67	37.05	38.07	0.024
	2000	32	14	21	22	14.38	18	48	22	21.25	34	17	6.16	74	28.79	29.44	0.025
	2500	37	14	27	25	14.38	18	60	25	24.25	34	20	5.61	105	31.84	32.33	0.028
	3000	47	14	27	25	14.38	18	60	25	24.25	34	20	4.10	126	41.93	42.13	0.029
5000 and 15,000 Copper	1200	34	14	27	25	14.38	18	60	25	24.25	34	20	15.09	65	56.50	58.48	0.015
	1600	41	14	27	25	14.38	18	60	25	24.25	34	20	8.50	65	54.37	55.03	0.016
	2000	55	14	30	27	14.38	18	60	27	25.75	34	22	5.79	70	51.20	51.53	0.019
	2500	64	14	36	30	14.38	18	60	30	28.75	34	25	4.71	88	48.76	48.98	0.024
	3000	85	14	36	30	14.38	18	60	30	28.75	34	25	4.03	109	42.88	43.07	0.030
	4000	125	14	36	30	14.38	18	60	30	28.75	34	25	3.47	166	41.93	42.07	0.030
	5000	143	24	42	33	19.38	23	60	33	36.75	44	28	2.78	209	42.54	42.63	0.023
	6000	162	28	42	33	21.38	25	60	33	38.75	48	28	2.41	260	24.76	24.88	0.034
5000 and 15,000 Aluminum	1200	30	14	27	25	14.38	18	60	25	24.25	34	20	13.41	58	54.37	56.00	0.016
	1600	34	14	30	27	14.38	18	60	27	25.75	34	22	8.76	67	51.20	51.95	0.019
	2000	41	14	36	30	14.38	18	60	30	28.75	34	25	6.16	74	48.32	48.71	0.024
	2500	44	14	30	27	14.38	18	60	27	25.75	34	22	5.68	107	42.52	42.89	0.025
	3000	55	14	36	30	14.38	18	60	30	28.75	34	25	4.32	117	41.93	42.15	0.030
38,000 Copper	600	84	24	51	37	24.00	23	84	37	45.88	48	33	15.44	17	76.79	78.50	0.011
	1200	84	24	51	37	24.00	23	84	37	45.88	48	33	15.44	67	76.79	78.50	0.011
	1600	89	24	51	37	24.00	23	84	37	45.88	48	33	10.76	83	68.89	69.73	0.012
	2000	93	24	51	37	24.00	23	84	37	45.88	48	33	8.37	100	62.93	63.48	0.014
	2500	111	24	51	37	24.00	23	84	37	45.88	48	33	4.68	88	53.83	54.03	0.017
	3000	120	24	51	37	24.00	23	84	37	45.88	48	33	3.99	108	53.39	53.54	0.017
38,000 Aluminum	600	78	24	51	37	24.00	23	84	37	45.88	48	33	25.46	27	76.97	81.07	0.011
	1200	79	24	51	37	24.00	23	84	37	45.88	48	33	17.23	74	68.89	71.01	0.012
	1600	81	24	51	37	24.00	23	84	37	45.88	48	33	13.41	58	68.06	69.36	0.013
	2000	82	24	51	37	24.00	23	84	37	45.88	48	33	11.33	136	62.28	63.30	0.014

① Ampere ratings are based upon a maximun conductor rise of 65 °C in a 40 °C ambient in compliance with the temperature limits of ANSI / IEEE C37.23.
② Weights and dimensions are for standard three-phase totally enclosed non-ventilated aluminum enclosures.
③ Resistance, watt loss, and impedance values are calculated using a maximum conductor temperature rise of 65 °C and a normal 20 °C ambient.

Frequently asked questions

When contacting the factory for service, how should I identify the project?

Use the factory order number found on the front cover.

There are taping instructions in the instruction manual. Do I need to wrap a bus joint if there is a bus boot provided for it?

No, taping instructions are provided for instances when a bus boot is not furnished.

Where exactly should the gasket be installed on outdoor shipping splits?

The gasket should be applied to the ground tie plate (**item G page 11 of the instruction manual**) so that when bolted to the bus duct side channel, the gasket will cover the seam where the pieces of side channel come together. The gasket should extend at least ¼ inch beyond the edge of the ground tie plate. Refer to **page 12** of the instruction manual for vertical joiner cap installation.

How do I find the parts that I need to connect at an equipment termination?

You must refer to your Ship Loose Bill of Material. A copy of the Ship Loose Bill of Material is packaged in the crate of loose parts and is referenced on the layout drawing.

How should the bolt be configured on a bus joint?

The standard bolt configuration is one flat washer on the bolt head side of the bus joint, one flat washer, and one split lock washer on the nut side of the bus joint. If Belleville washers are required, the configuration is one flat washer on the bolt head side of the bus joint, one flat washer, and one Belleville washer on the nut side of the bus joint. Refer to the instruction manual for bolt torque specifications.

When connecting two assemblies together, should the sides bolt up tight or should there be a gap?

The bus duct enclosures are designed with a ¼-inch adjustment gap at straight shipping splits. This gap may be increased or decreased to accommodate specific site variations. If the ¼-inch gap is not placed at the shipping splits, the bus duct run may end up short. See figures on **page 9, page 10, and page 11**.

When testing the heaters, the resistance is lower than expected. Is the heater bad?

The refractory material used in the heaters may absorb moisture during transit, storage, or when subject to humid environments that will reduce the cold insulation resistance (low megohm). It is recommended that heaters with less than 1 megohm resistance be dried out before applying full power. The heaters can be baked for several hours at 300 °F or the heater power can be cycled at 10- to 15-minute periods at low voltage until megohm values are normal. Sheath temperature should not exceed 350 °F. Once the moisture is removed, the heaters will operate normally.

Receiving, handling, and storage

Shipping and crating

Standard crating is suited for shipment via common carrier, motor freight, and indoor storage. Crates may be marked to indicate special handling and/or storage procedures. Each crate will be marked with job number, customer purchase order number, special markings, shipping address, description, and weight (see the sample crate marking below). A Ship Loose Bill of Material will be supplied with each job, which will show all assemblies, assembly kits, and accessories. Ship Loose Bill of Material examples are shown on **page 6**.

Sample crate markings

Job No:	
P.O. No:	
Ship To:	
Descripton:	
Weight:	

Lifting

Sling the bus package with lifting slings and a spreader bar so the weight is distributed equally as shown on **page 7**.

⚠ CAUTION

DO NOT STACK ANY OF THE SHIPPING CRATES AS DAMAGE MAY OCCUR.

Long-term indoor storage

The storage area must be clean, dry, and climate controlled to prevent condensation and corrosion. The equipment should be protected from flooding and contamination.

Note: Equipment should be subjected to a power frequency withstand test (see test section) prior to storage exceeding three months. Eaton recommends periodic inspection of the equipment to ensure that the storage methods are adequate.

Temporary outdoor storage

Place timbers between the package and the ground. The package should be covered with tarpaulin immediately after unloading. The area must be well drained to prevent flood damage. Weatherproof coverings that will minimize condensation must be supplied.

Damages

Any evidence of damage must be reported, and a claim filed with the carrier. Contact Eaton to initiate corrective action.

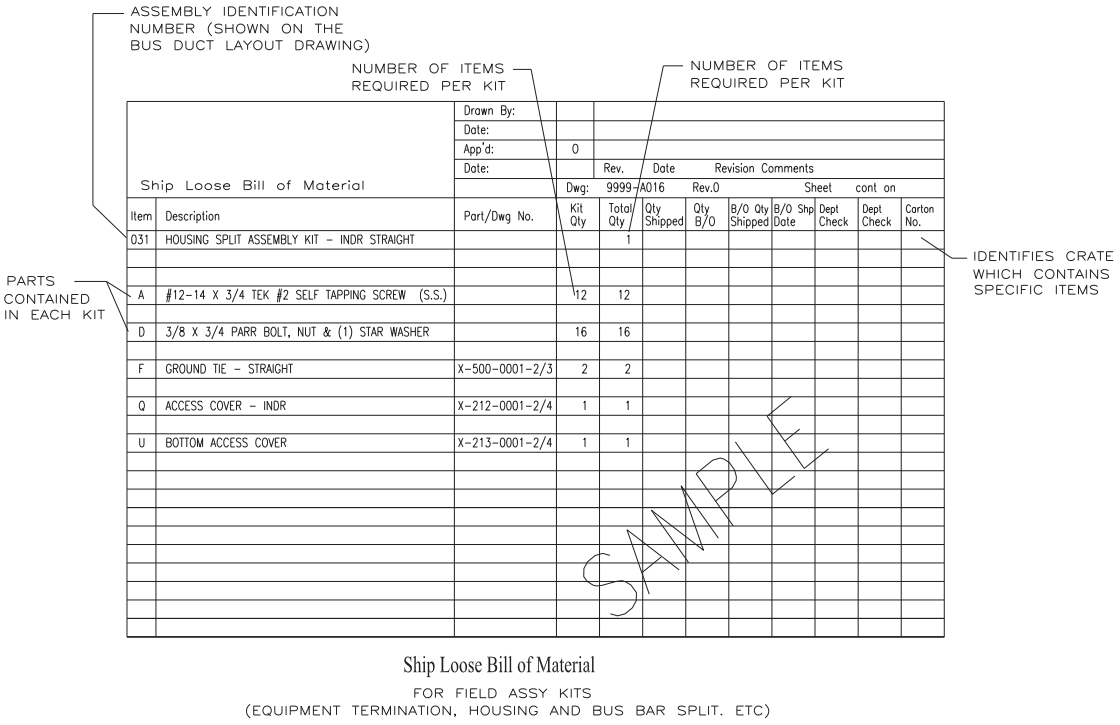
Shortages

Verify that all shipping manifest items have been received. Report any shortages to the manufacturer upon receipt of shipment. Failure to report shortages upon receipt may result in additional costs for replacements. Eaton accepts no responsibility for lost or stolen materials.

Installation and shipping fixtures

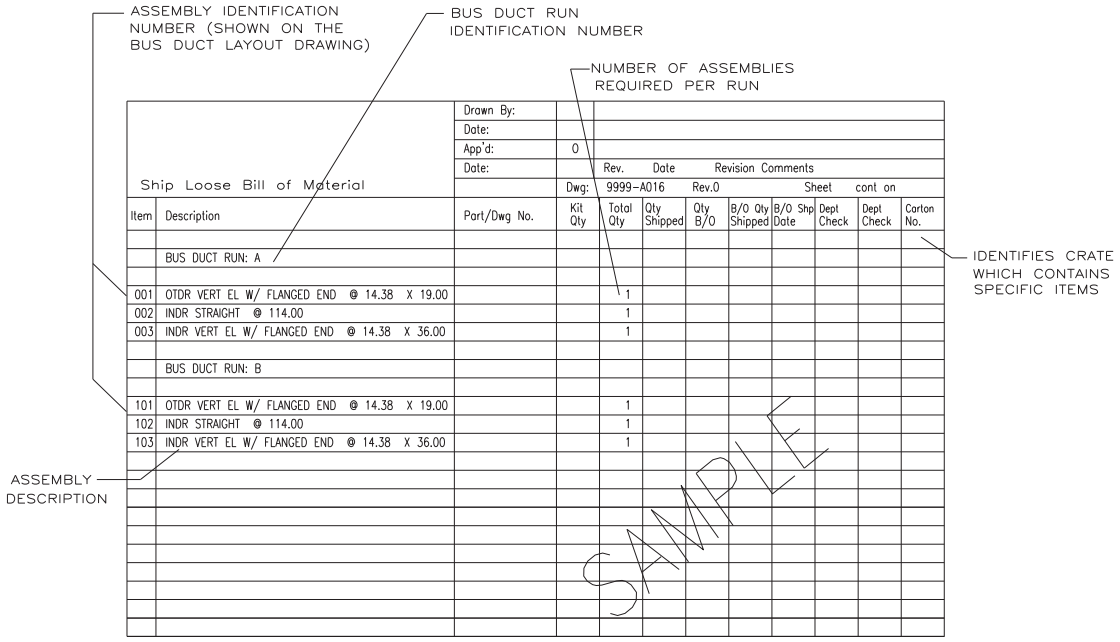
Ship Loose Bill of Material examples

Figure 4. Ship Loose Bill of Material examples



Ship Loose Bill of Material

FOR FIELD ASSY KITS
(EQUIPMENT TERMINATION, HOUSING AND BUS BAR SPLIT. ETC)

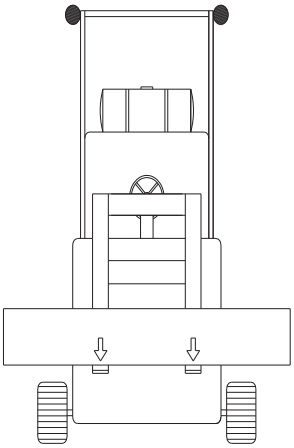


Ship Loose Bill of Material

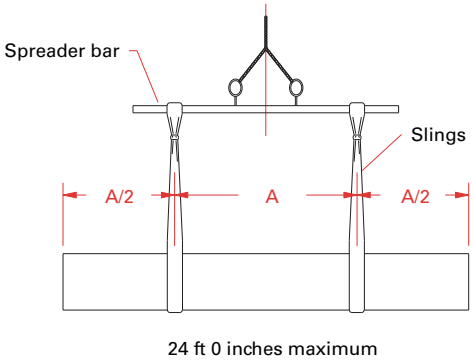
FOR BUS DUCT SECTIONS AND ACCESSORIES

Equipment handling instructions

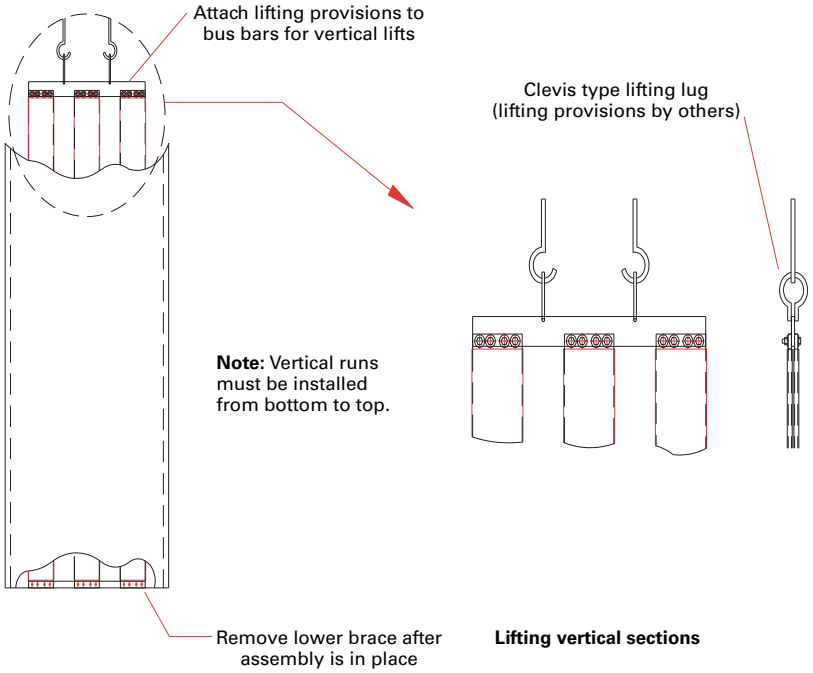
Figure 5. Equipment handling illustration



Fork lift



Sling
(Sling bus section so weight is distributed equally)



Lifting vertical sections

Drawings

Installation drawings described in the introduction of the manual are essential to identify and assemble the bus system.

⚠ WARNING

INSTALLATION SHOULD NOT BE ATTEMPTED WITHOUT A COMPLETE UNDERSTANDING OF THE INFORMATION PROVIDED BY THE DRAWINGS.

Identification

Each assembly is marked with the corresponding item and shipping split orientation numbers, which appear on the bus duct layout drawing(s). Packages containing miscellaneous loose parts required to assemble shipping splits and equipment terminations are identified using this same method.

Lifting individual assemblies

Care must be taken to avoid damaging the enclosure and finish when lifting and handling the equipment. Forklifts and slings are most commonly used for this purpose. Typical illustrations are provided on **page 7**.

Shipping fixtures

Some assemblies require fixtures to prevent bus movement or damage during handling and installation. Fixtures must be removed after the assembly has been positioned and properly secured.

Contamination

Steps must be taken to avoid entry of dirt and contaminates during installation.

Prior to testing or operation of system:

- Remove all foreign objects and tools from enclosure
- Consult Eaton concerning contaminated insulation system
- Mask breathers and louvers when applying touch-up paint or using solvents on or near the enclosure
- Operate heaters to eliminate moisture from interior components
- Ensure duct is clean using denatured alcohol only (interior only)

Assembly

All assemblies should be in place and the bus duct properly positioned at the equipment terminals **before** housing and conductor hardware are torqued to the proper levels and insulation is applied to the bus bar joints.

Note: Bus duct enclosures are designed based on a ¼-inch adjustment gap between side members. This gap may be increased or decreased to accommodate specific site variations.

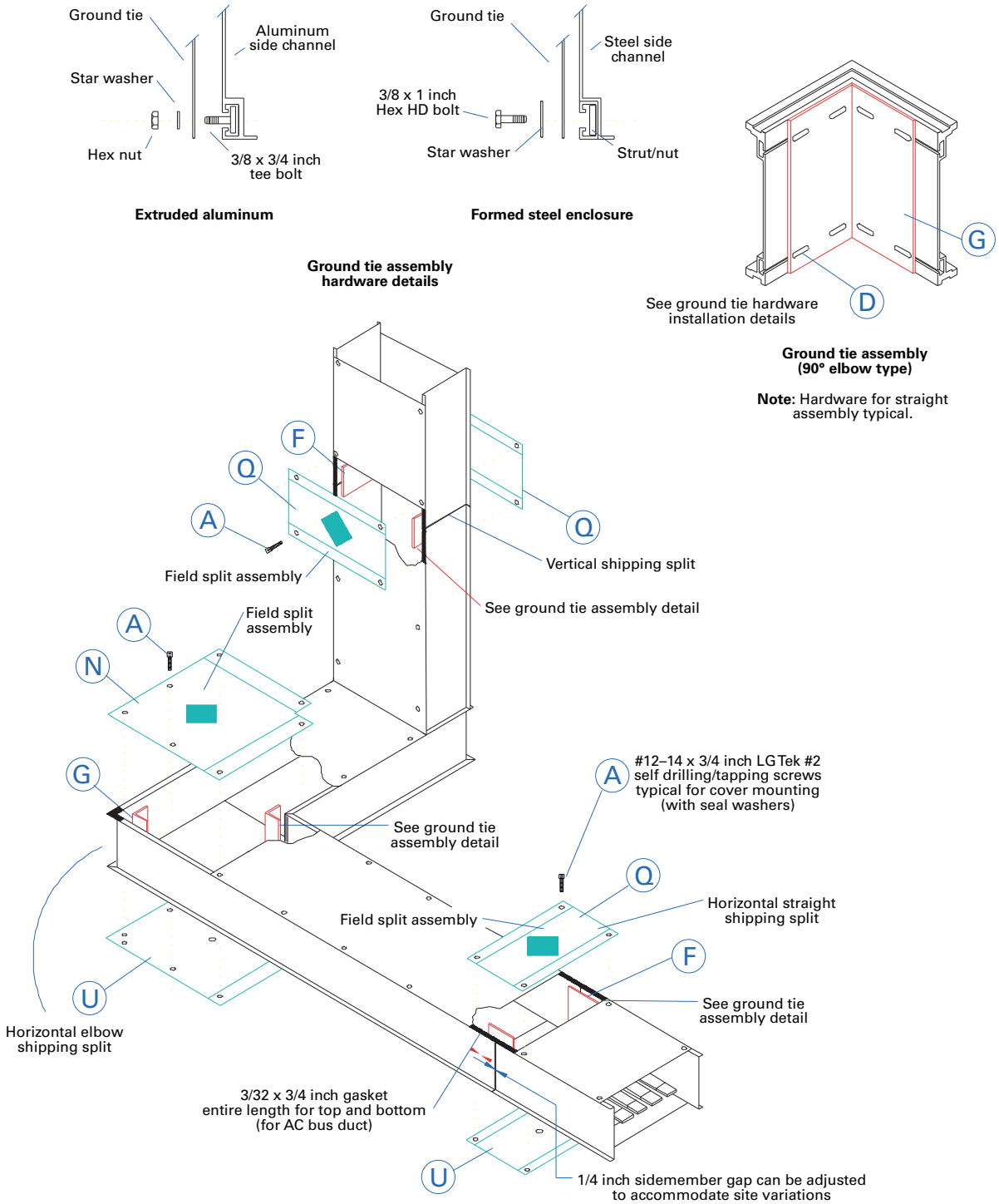
Modifications

Any alterations or field modifications made to the Eaton bus duct systems that deviate from the installation drawings or this manual require written authorization by Eaton before work is performed. Failure to obtain written approval will result in voiding of the equipment warranty.

Installation illustrations

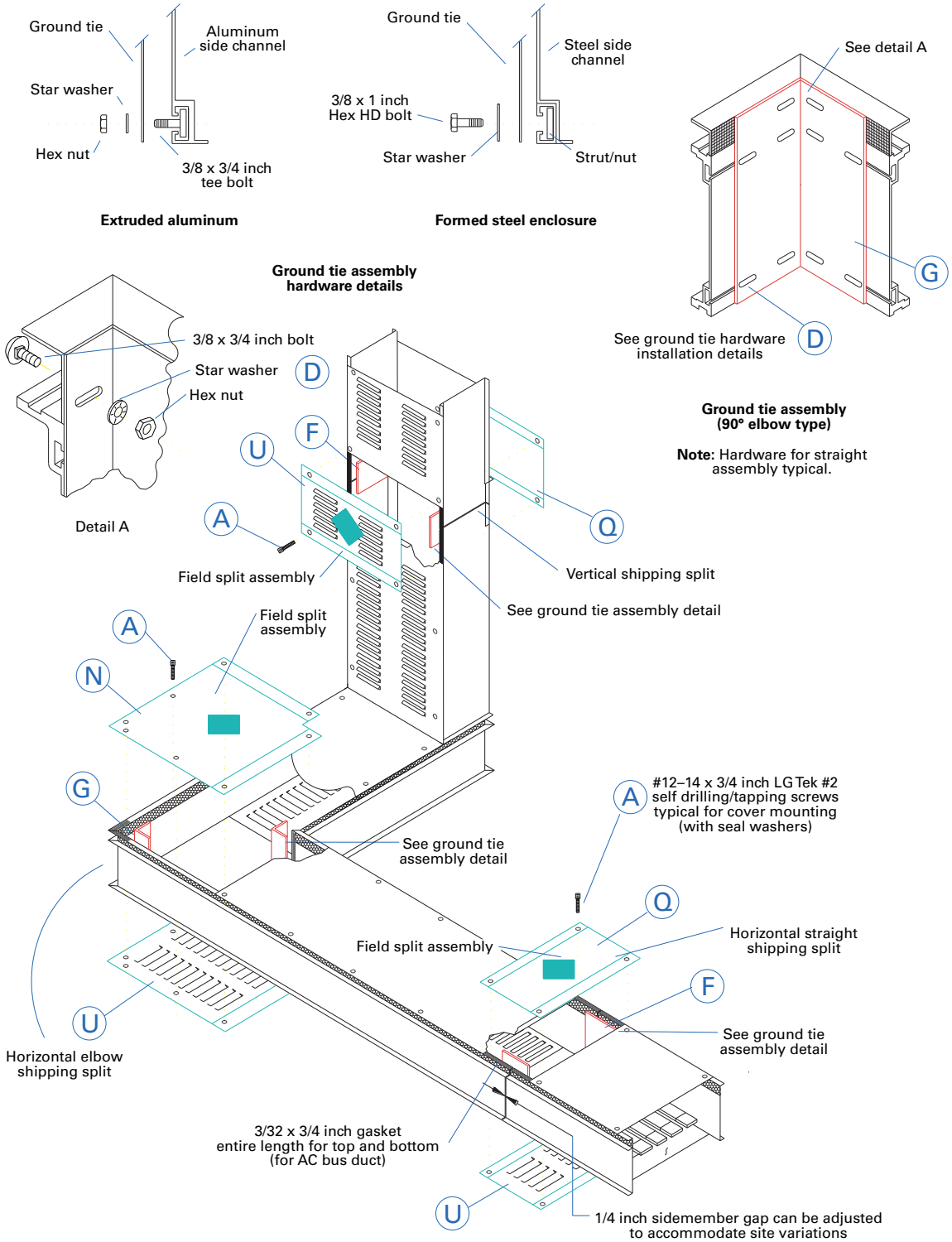
Indoor non-vented enclosure assembly instructions

Figure 6. Indoor non-vented enclosure assembly illustration



Indoor vented enclosure assembly instructions

Figure 7. Indoor vented enclosure assembly illustration



Outdoor non-vented enclosure assembly instructions

Figure 8. Outdoor non-vented enclosure assembly illustration

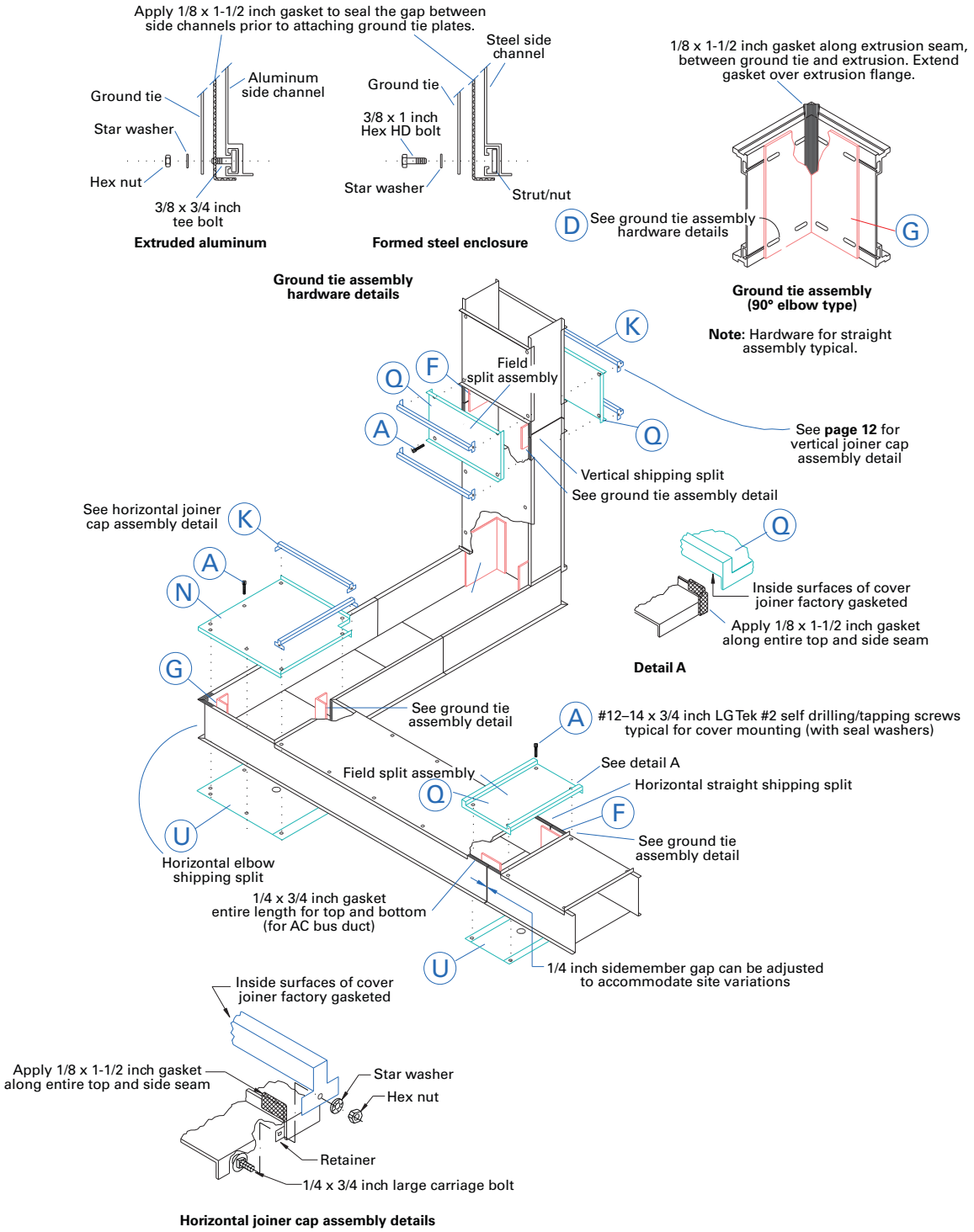
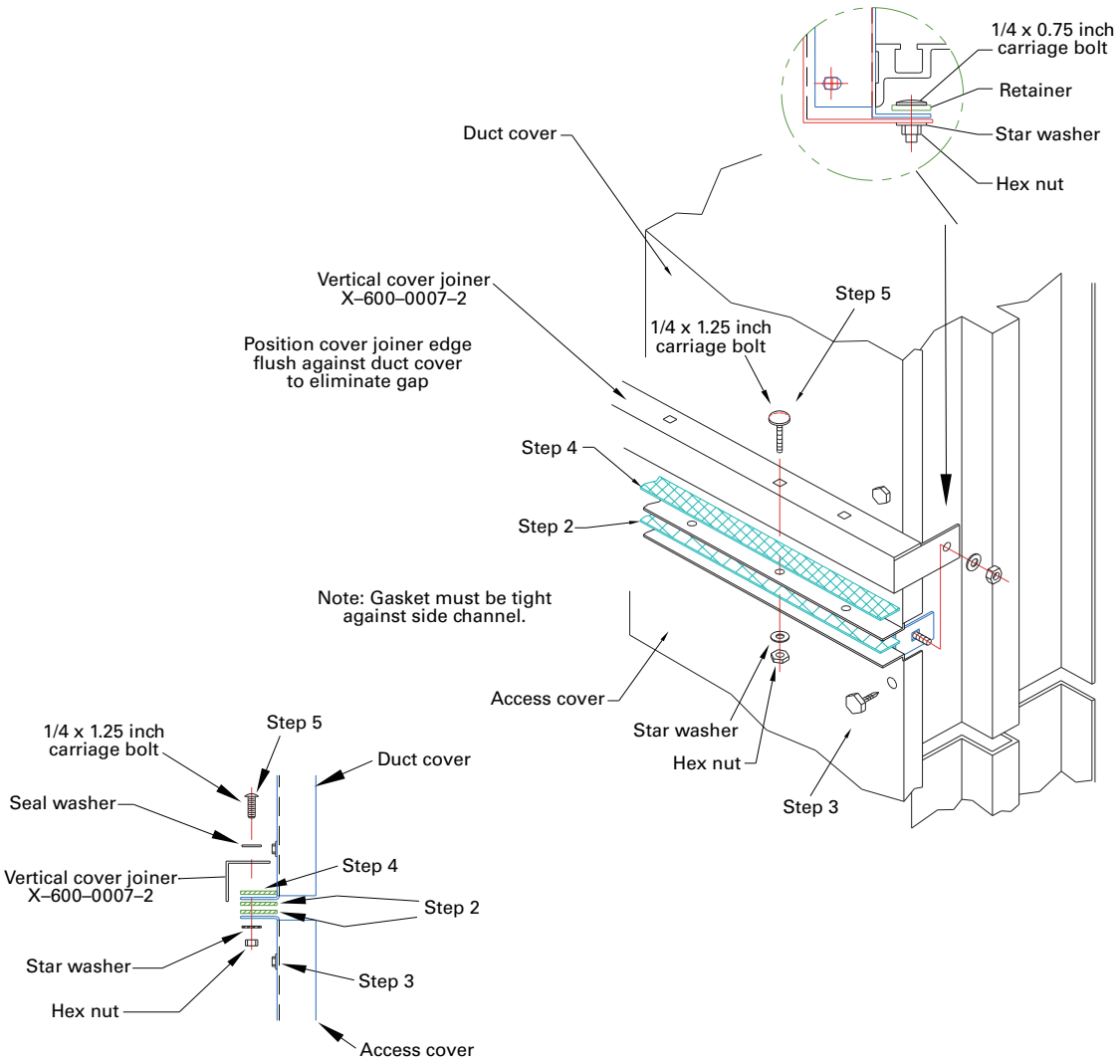


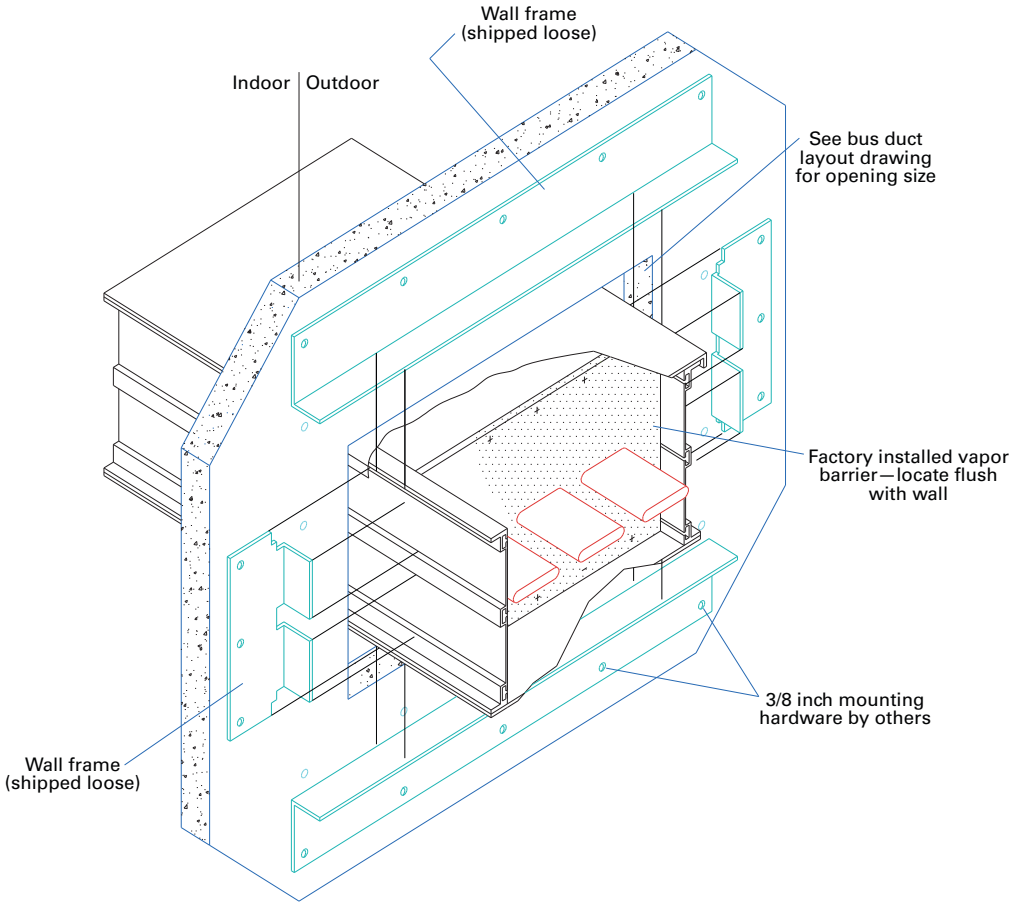
Figure 9. Vertical joiner cap assembly detail



1. Place the access cover in the center of the opening to determine the size of the gaps between the covers.
2. Apply 1/8 x 1-1/2 inch gasket on the lips of the covers as required to ensure compression of the gasket when carriage bolts are tightened. Make sure the gasket will rest firmly against the bus side channel when the access cover is installed to ensure the seal is water tight.
3. Install the access cover.
4. Apply one strip of 1/8 x 1-1/2 inch gasket to the lip where the vertical joiner cap will attach.
5. Bolt on the vertical joiner cap with the hardware supplied. Tighten carriage bolts in joiner cap until they are tight and the gasket is compressed.

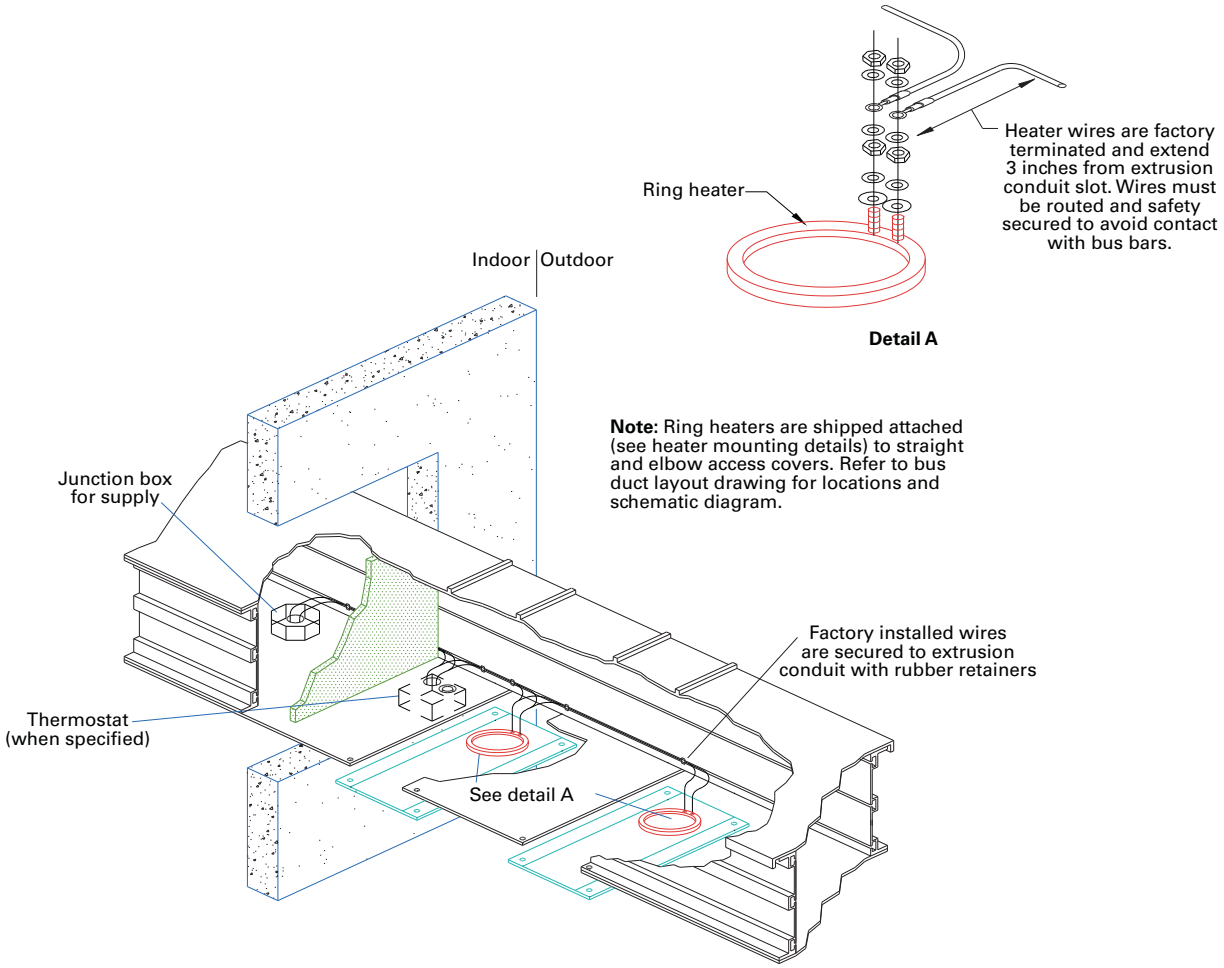
Wall entrance assembly instructions

Figure 10. Wall entrance assembly illustration



Installation note: Flash and caulk to fill in voids during installation.

Figure 11. Standard heater system assembly illustration



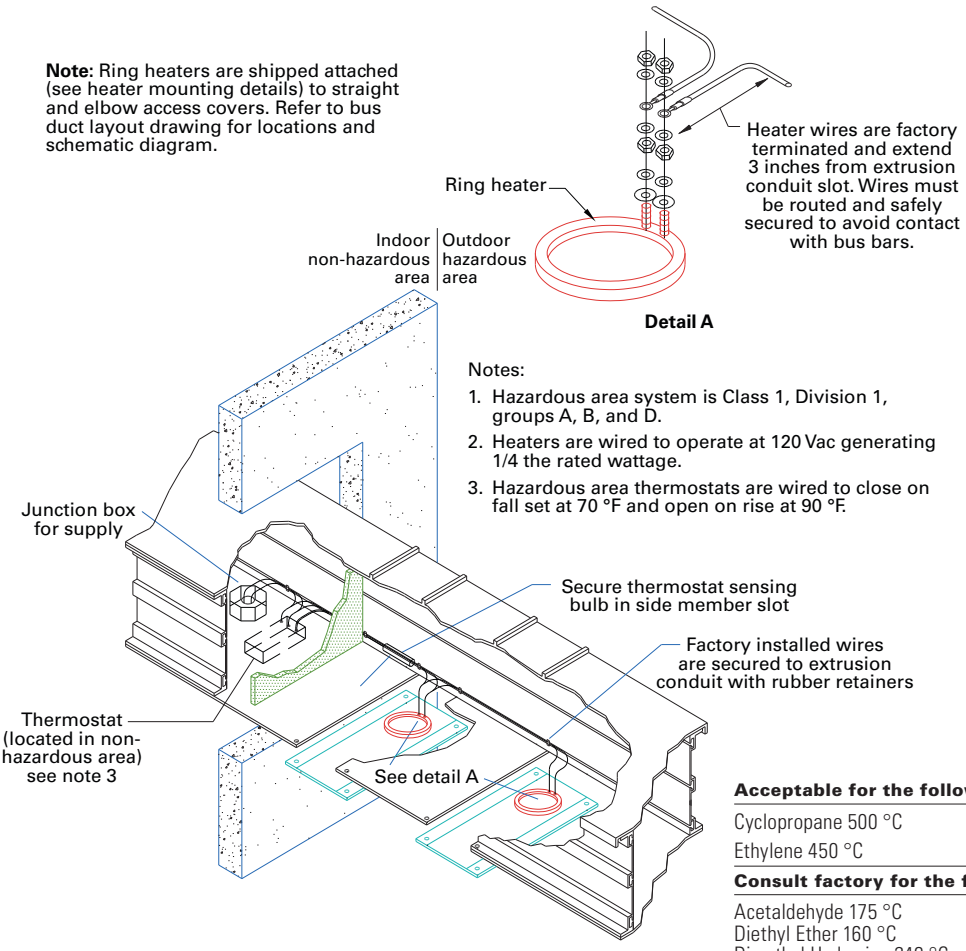
Part description

Part	Description
STD thermo	Thermodisc 202877 max. load 25 A preset to close at 95 °F and open at 110 °F
Outdoor junction box	Appleton JIC-2 or equal
Indoor junction box	1-1/2 x 4 x 4
Wire retainer	Akron gasket 3/16 x 5/8 x 5/8 inches neoprene
Lugs	T&B T10—10R or equal
Terminal block TRW 2-150	Newark 29F731, Magnum TB100-02TA or equal
Wire	#12 shielded unless otherwise specified
Heater element	Refer to project layout drawing for heater ratings and circuit loadings

Heater description and classification

Description	Circuit loading	Classification
For ducts 13–27 inches wide outside dimension Chromalox A-40 HT rated 240 V / 500 W	Operating at 110 V supply 105 W / 0.95 A Operating at 120 V supply 125 W / 1.04 A	Class 1, Division 1, Groups C and D T1 (450 °C) and T2 (300 °C)
For ducts 30–51 inches wide outside dimension Chromalox A-70 HT rated 240 V / 750 W	Operating at 110 V supply 158 W / 1.43 A Operating at 120 V supply 188 W / 1.56 A	Class 1, Division 1, Groups C and D T1 (450 °C)

Figure 12. Hazardous area—heater system assembly illustration



Part description

Part	Description
Hazardous area thermo	Grainger #4E047 max. load 16 A
Outdoor junction box	Appleton JIC-2 or equal
Indoor junction box	1-1/2 x 4 x 4
Wire retainer	Akron gasket 3/16 x 5/8 x 5/8 inches neoprene
Lugs	T&B T10—10R or equal
Terminal block TRW 2-150	Magnum TB100-02TA or equal
Wire	#12 shielded unless otherwise specified
Heater element	Refer to project layout drawing for heater ratings and circuit loadings

Acceptable for the following Group C gases

Cyclopropane 500 °C
Ethylene 450 °C

Consult factory for the following Group C gases

Acetaldehyde 175 °C
Diethyl Ether 160 °C
Dimethyl Hydrazine 249 °C

Acceptable for the following Group D gases

Acetone 465 °C
Amonia 651 °C
Benzene 560 °C
Butane 405 °C
Gasoline 100 Octane 456 °C
Vinyl Acetate 427 °C
Vinyl Chloride 472 °C
Xylenes 530 °C
Methane 482 °C
Ethyl Acetate 427 °C
Isobutyl Acetate 421 °C
Methyl 516 °C
Propane 450 °C
Ethylene Dichloride 413 °C
Ethane 515 °C

Consult factory for the following Group D gases

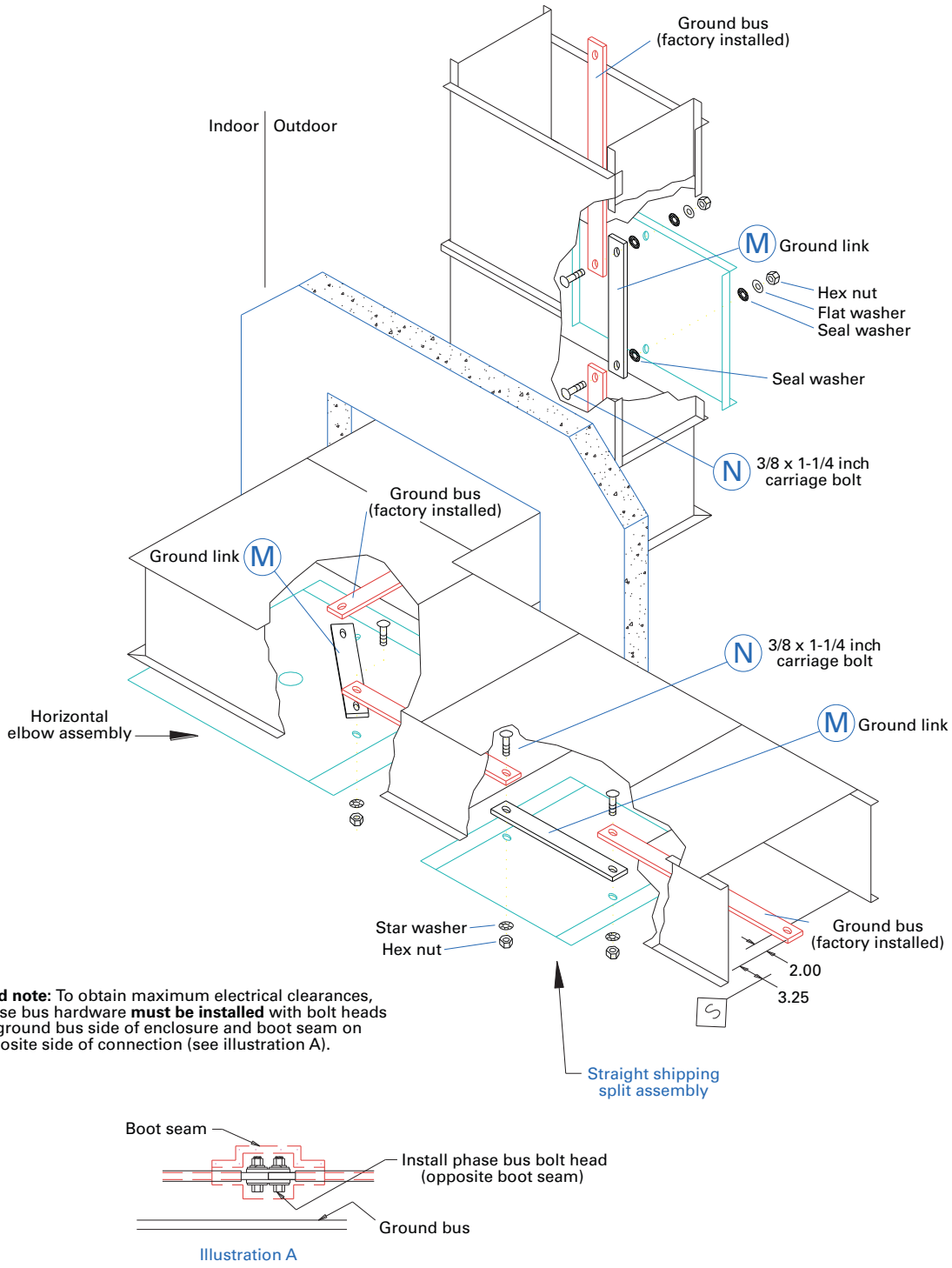
Gasoline 56–60 Octane 280 °C
Alcohols 300–480 °C
Hexane 225 °C
Heptanes 280 °C
Octanes 220 °C
Pentanes 260 °C
Isoprene 220 °C

Heater description and classification

Description	Circuit loading	Classification
For ducts 13–27 inches wide outside dimension Chromalox A-40 HT rated 240 V / 500 W	Operating at 110 V supply 105 W / 0.95 A Operating at 120 V supply 125 W / 1.04 A	Class 1, Division 1, Groups C and D T1 (450 °C) and T2 (300 °C)
For ducts 30–51 inches wide outside dimension Chromalox A-70 HT rated 240 V / 750 W	Operating at 110 V supply 158 W / 1.43 A Operating at 120 V supply 188 W / 1.56 A	Class 1, Division 1, Groups C and D T1 (450 °C)

Ground system assembly instructions

Figure 13. Ground system assembly illustration

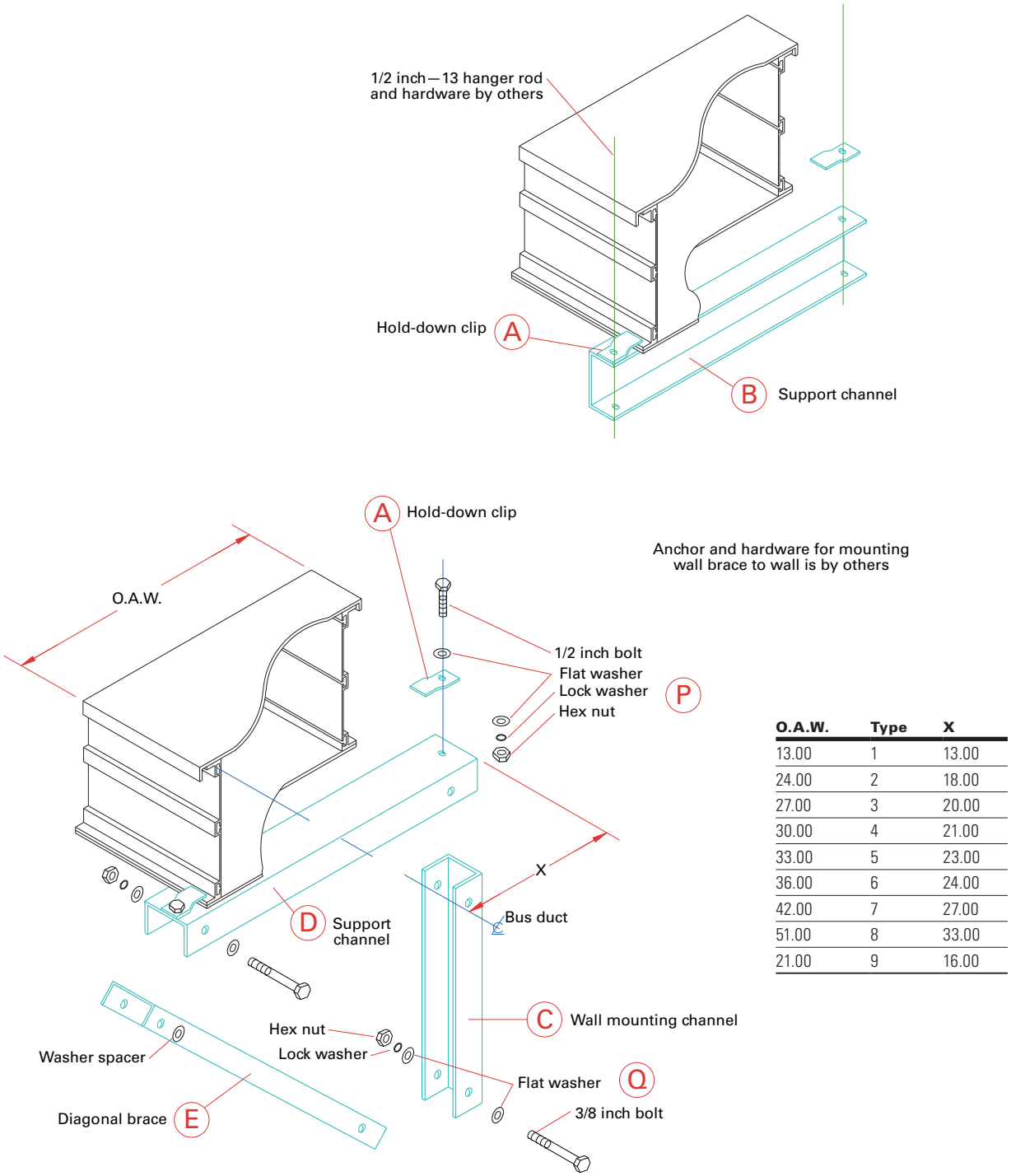


Field note: To obtain maximum electrical clearances, phase bus hardware **must be installed** with bolt heads on ground bus side of enclosure and boot seam on opposite side of connection (see illustration A).

Illustration A

Hanger and wall brace support assembly instructions

Figure 14. Hanger and wall brace support assembly illustration

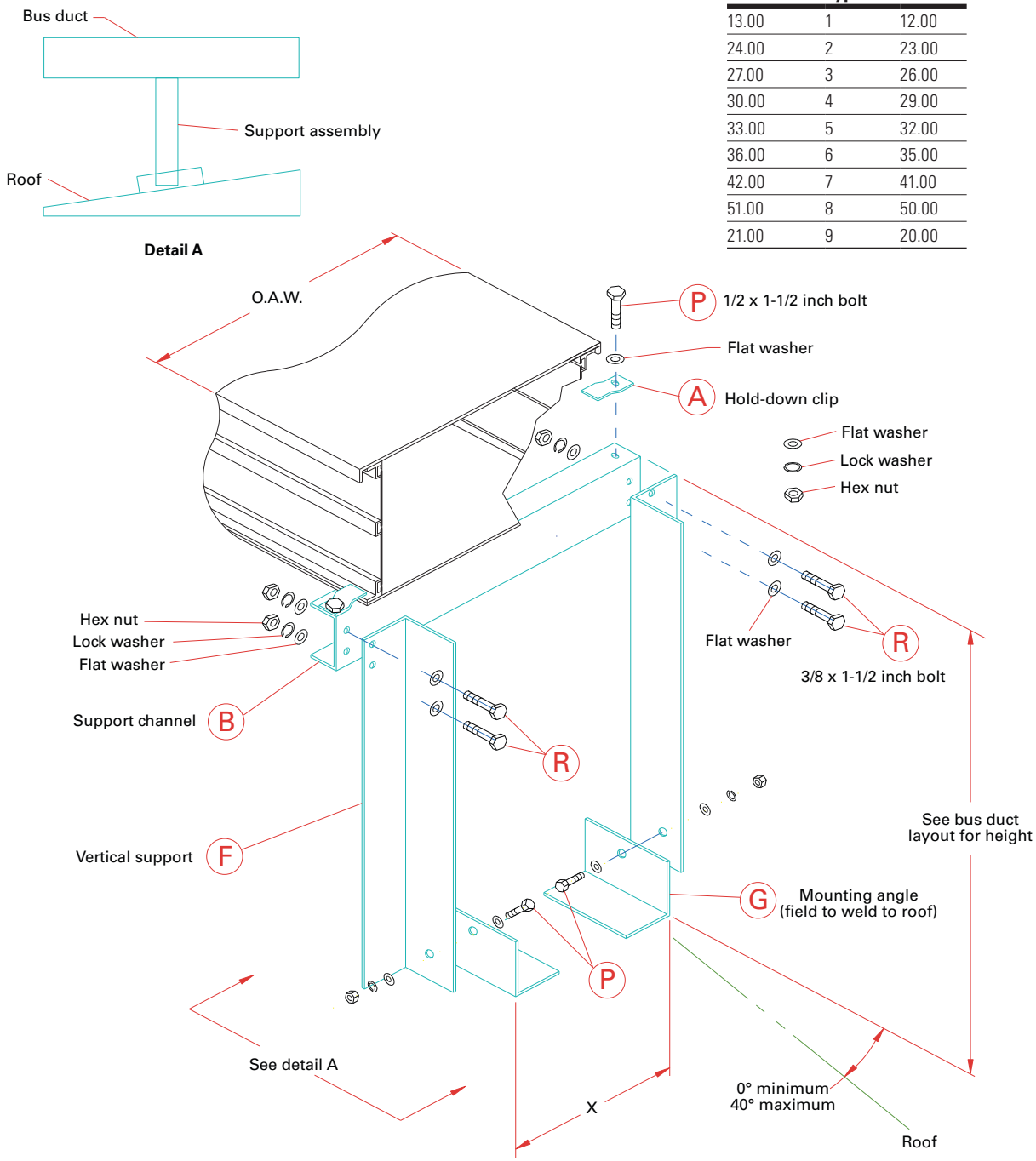


O.A.W.	Type	X
13.00	1	13.00
24.00	2	18.00
27.00	3	20.00
30.00	4	21.00
33.00	5	23.00
36.00	6	24.00
42.00	7	27.00
51.00	8	33.00
21.00	9	16.00

Roof support—style I assembly instructions

Figure 15. Roof support—style I (duct running with slope) assembly illustration

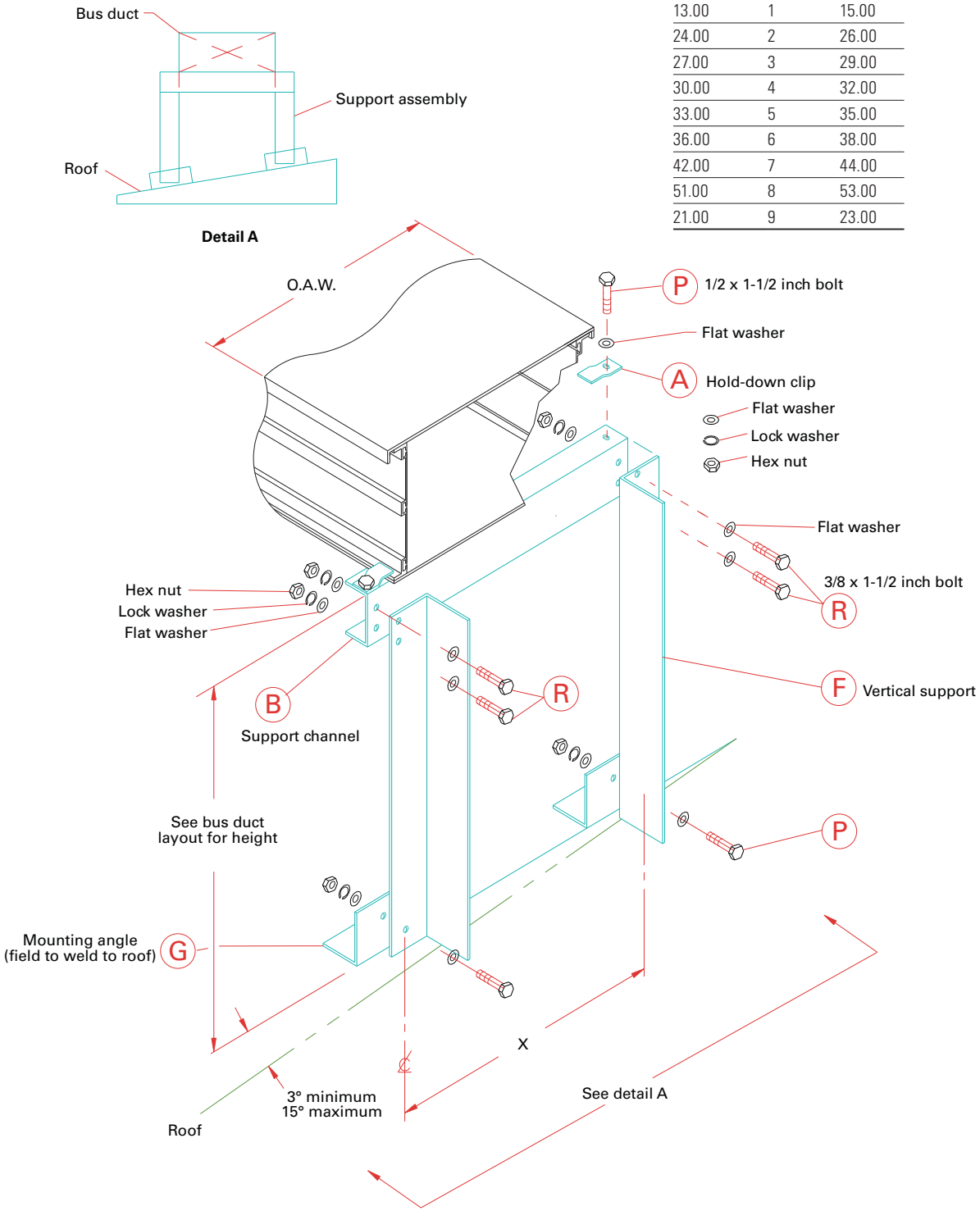
O.A.W.	Type	X
13.00	1	12.00
24.00	2	23.00
27.00	3	26.00
30.00	4	29.00
33.00	5	32.00
36.00	6	35.00
42.00	7	41.00
51.00	8	50.00
21.00	9	20.00



Roof support—style II assembly instructions

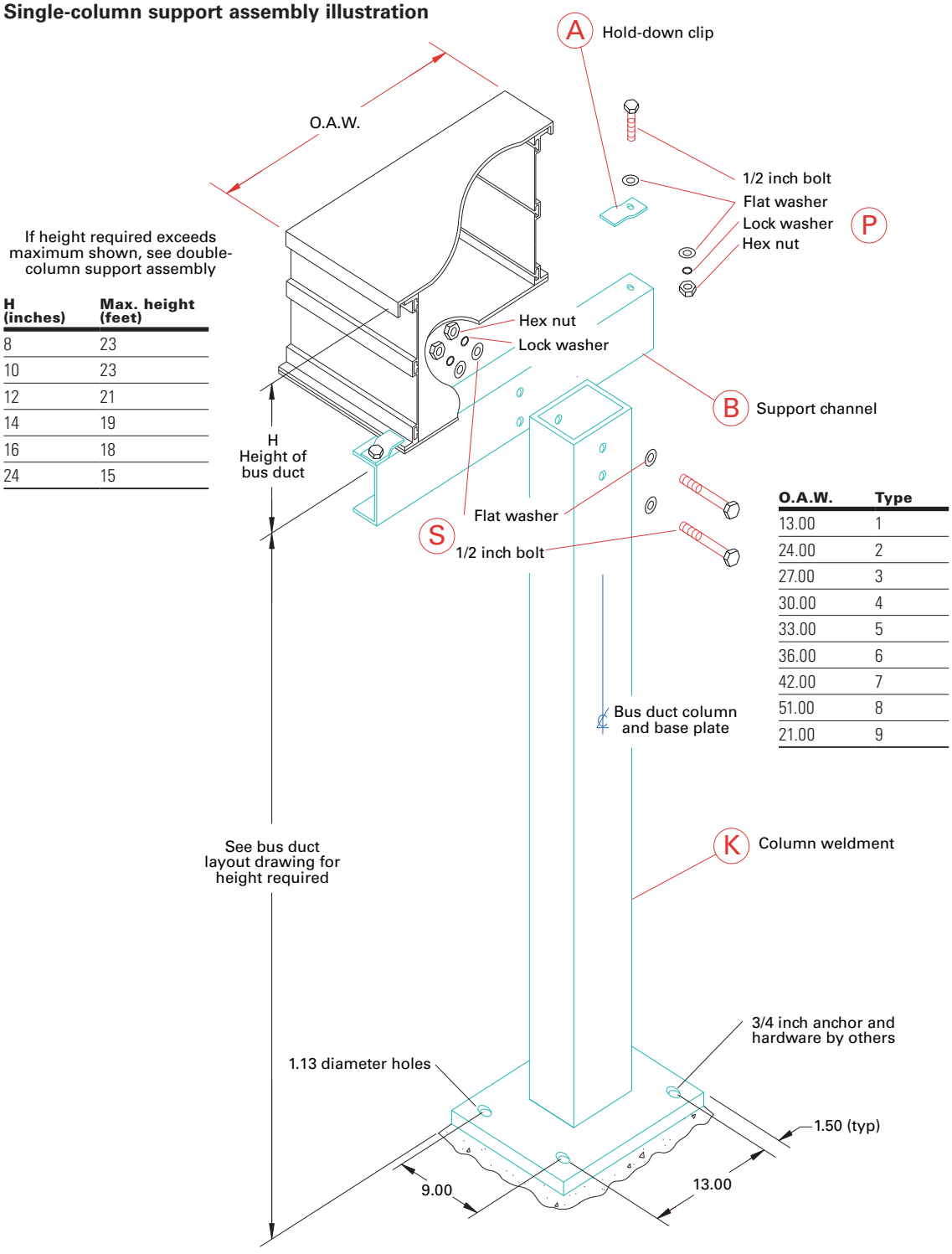
Figure 16. Roof support—style II (duct running perpendicular with slope) assembly illustration

O.A.W.	Type	X
13.00	1	15.00
24.00	2	26.00
27.00	3	29.00
30.00	4	32.00
33.00	5	35.00
36.00	6	38.00
42.00	7	44.00
51.00	8	53.00
21.00	9	23.00



Single-column support assembly instructions

Figure 17. Single-column support assembly illustration



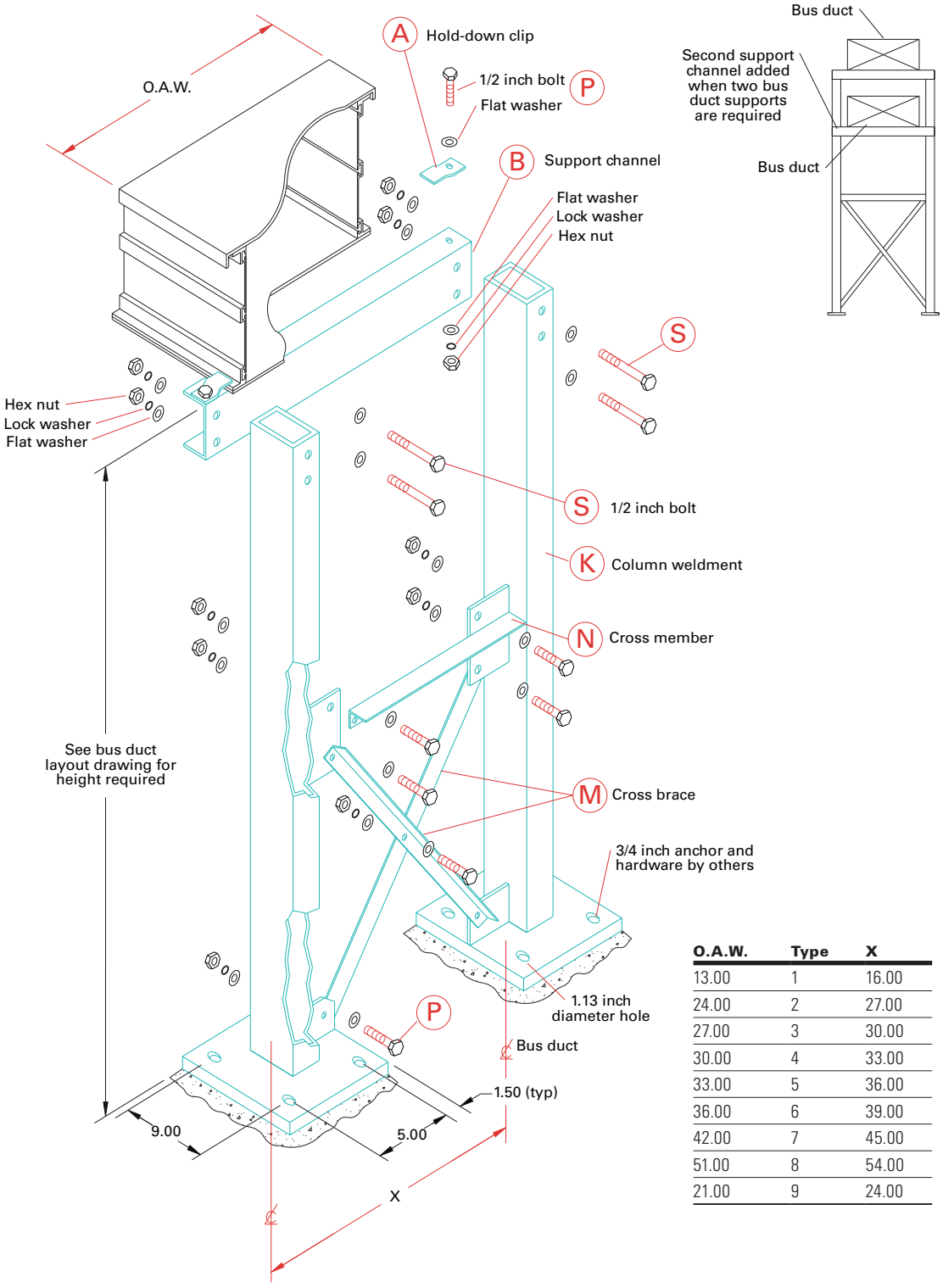
If height required exceeds maximum shown, see double-column support assembly

H (inches)	Max. height (feet)
8	23
10	23
12	21
14	19
16	18
24	15

O.A.W.	Type
13.00	1
24.00	2
27.00	3
30.00	4
33.00	5
36.00	6
42.00	7
51.00	8
21.00	9

Double-column support assembly instructions

Figure 18. Double-column support assembly illustration



O.A.W.	Type	X
13.00	1	16.00
24.00	2	27.00
27.00	3	30.00
30.00	4	33.00
33.00	5	36.00
36.00	6	39.00
42.00	7	45.00
51.00	8	54.00
21.00	9	24.00

Bus joint assembly/torque requirements

Alignment

To fully utilize the enclosure and bus alignment provided at each shipping split and equipment connections, do not tighten or insulate connections until the entire system has been installed and properly aligned with equipment terminals.

Contact surfaces

Prior to assembly of a bus joint, inspect contact surfaces for evidence of contamination. The factory applies a small amount of NO-OX electrical grease on the ends of the conductors prior to packaging. This must be wiped clean before assembling the joint or termination connections. Consult the factory for methods to remove contamination. Care must be taken to ensure that bus plating is not removed or damaged during any cleaning process. Consult factory if plating repair is required.

⚠ CAUTION

APPLICATION OF CLEANING AGENTS MAY RESULT IN DAMAGE TO INSULATING MATERIALS AND, FOR THIS REASON, SHOULD NOT BE USED FOR CLEANING OF ASSEMBLY OR BUS JOINTS.

Typical bus joint

The illustrations shown on the following pages may not represent actual configurations furnished. Refer to specific details shown on the bus duct layout and termination drawings provided for hardware and splice plate descriptions.

Copper bus joints

Copper bus joints will be assembled with split type lock washers. Use the following torque values corresponding to the material furnished. After the hardware has been installed and tightened, re-check torque to ensure that loads have been evenly distributed.

	Torque (in-lb)	Torque (ft-lb) for each hardware size			
Material	**5/16**	**3/8**	**1/2**	**5/8**	**3/4**
Grade 5 plated steel	215–240	25–30	50–55	110–115	200–205
Stainless steel	165–180	20–25	40–45	90–95	130–135
Silicon bronze	140–150	15–20	30–35	40–45	—

Aluminum bus joints

Aluminum bus joints are to be tightened to ensure that the Belleville washer has been flattened. DO NOT loosen bolt after the Belleville washer has reached the flat condition.

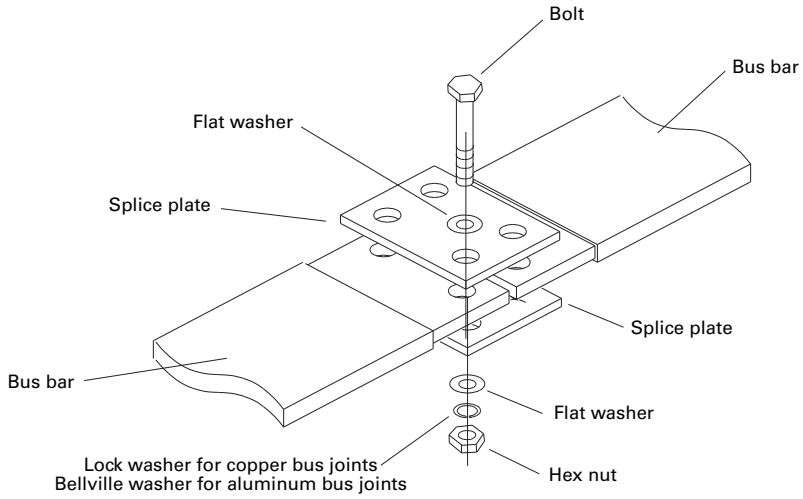
⚠ CAUTION

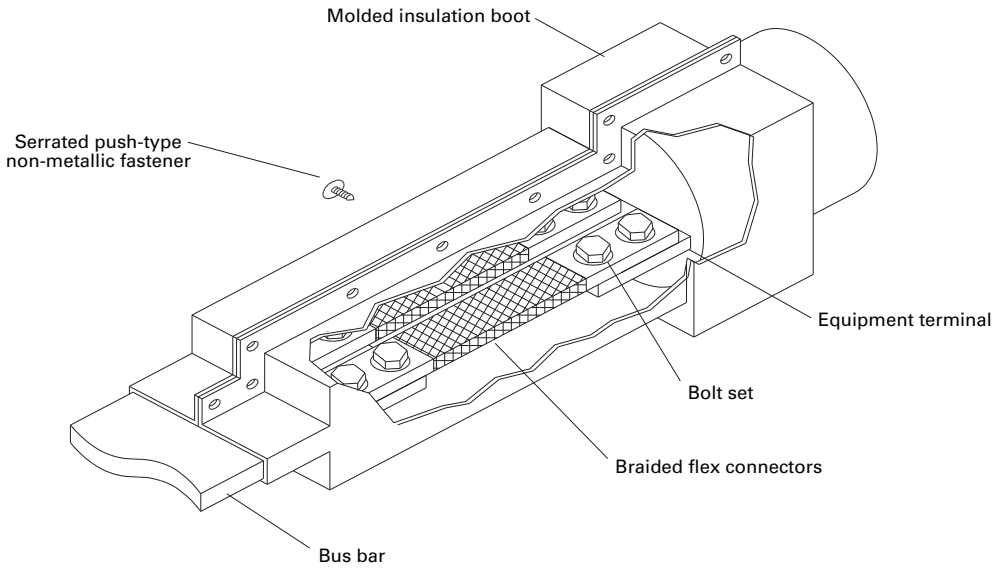
IT IS IMPORTANT TO ENSURE EQUAL SURFACE DISTRIBUTION AND BUS PUNCHED HOLE PATTERN CONCEALMENT OF SPLICE PLATES TO AVOID CREATING HOT SPOTS AND/OR A POINT OF ARC.

Insulating instructions

Bus boot joint assembly/boot installation

Figure 19. Boot installation





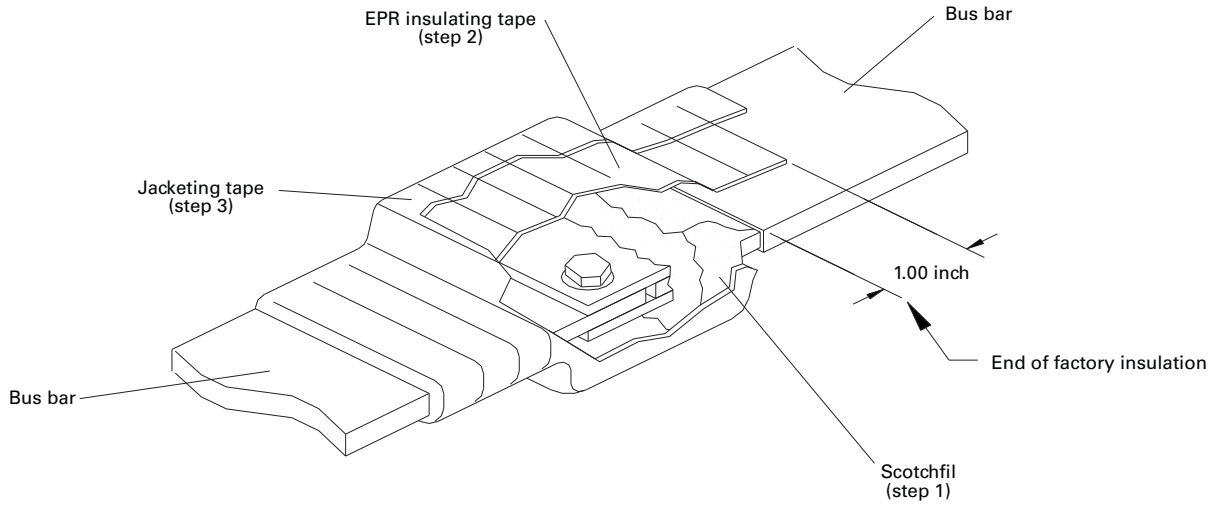
Insulation boots are supplied at all shipping splits for bus duct. Insulating tapes are not required on a joint that has a boot supplied. Insulation boots are secured around the bus joint using serrated push-type nonmetallic fasteners. **DO NOT substitute with metallic fasteners or tie-wrap type devices that may contain metallic materials. Boots should be installed to obtain the maximum electrical clearances.**

Taping low-voltage 5 kV bus joints

Taping instructions for low-voltage 5 kV bus joints (required only when boots are not provided)

1. Apply one half-lapped layer of 1½-inch 3M™ Scotchfil™ electrical insulation putty (or approved equal brand) over bare conductor and hardware to cover and smooth out the surface. Blend contour into factory-insulated surfaces.
2. Wrap joint with one half-lapped layer of 1½-inch 3M brand #130C EPR insulating tape, stretching to approximately two-thirds of its original width. Overlap the factory-applied insulation approximately 1 inch.
3. Wrap one half-lapped layer of 3M brand #35 jacketing tape over the joint, completely covering the EPR insulating tape.

Figure 20. Taping instructions for low-voltage 5 kV bus joints illustration

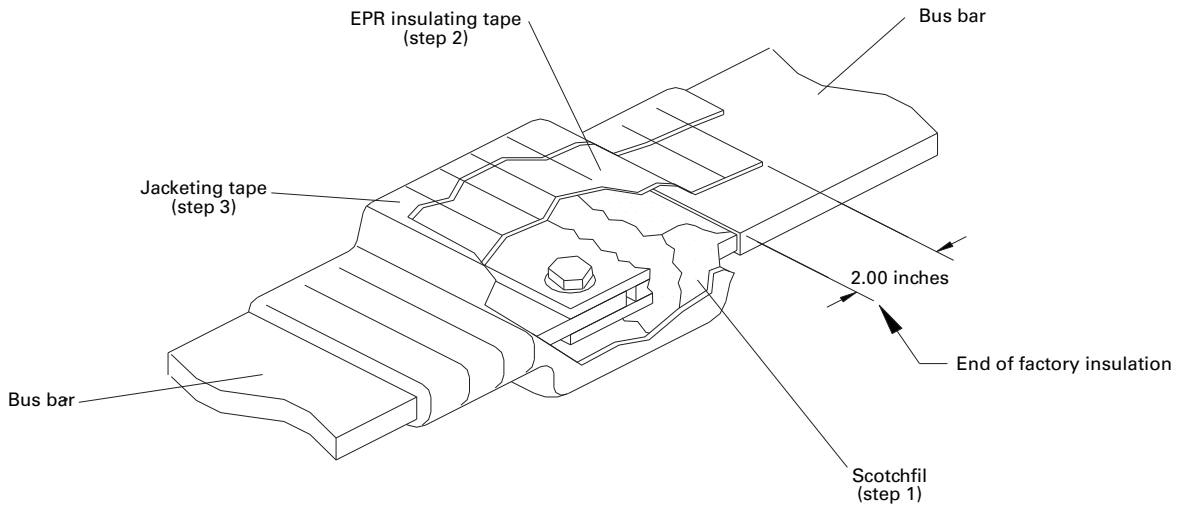


Taping 8.25–15.5 kV bus joints

15,000 V taping instructions (required only when boots are not provided)

1. Apply one half-lapped layer of 1½-inch 3M Scotchfil electrical insulation putty (or approved equal brand) over bare conductor and hardware to cover and smooth out the surface. Blend contour into factory-insulated surfaces.
2. Wrap joint with one half-lapped layer of 1½-inch 3M brand #130C EPR insulating tape, stretching to approximately two-thirds of its original width. Overlap the factory-applied insulation approximately 2 inches.
3. Wrap one half-lapped layer of 3M brand #35 jacketing tape over the joint, completely covering the EPR insulating tape.

Figure 21. 15,000 V taping illustration



Taping 38 kV bus joints

Taping insulating instructions for 38 kV bus joints (required only when boots are not provided)

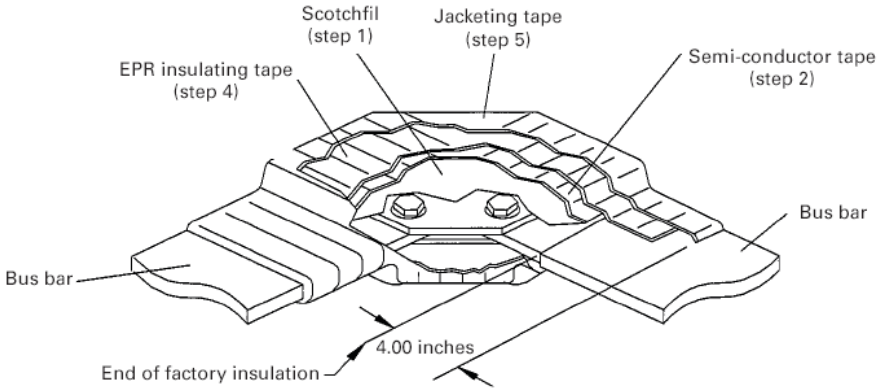
1. Fill voids between hardware and corners around splice plates with 3M Scotchfil brand electrical insulation putty and then wrap the bus joint area with the putty. Material should be lightly stretched and half-lapped. This material should stop between 3/4 and 1 inch away from the factory-applied insulation.
2. Apply one continuous half-lapped layer of Scotch® 13 (3/4 inch wide) semi-conductor tape to the entire joint. This tape must contact the bus surface and be extended to meet the end of the factory-applied insulation. **Do not overlap insulation. Do no cut tape into short lengths.**
3. Clean surface for insulation in joint area (minimum 4 inches from the end of insulation) with approved agent.
4. Apply five half-lapped layers of #130C EPR insulating tape with adhesive side down. Extend first layer 4 inches onto the factory-applied insulation and taper back toward joint one-half lap with each consecutive layer.

⚠ CAUTION

EPR TAPE MUST BE STRETCHED SUFFICIENTLY (ABOUT TWO-THIRDS OF WIDTH) TO AVOID ANY FOLDS OR GAPS. APPLY ENOUGH 3M #130C 1½-INCH WIDE EPR TAPE TO THE END OF THE INSULATION TO CREATE A SMOOTH TRANSITION FROM CONDUCTOR TO FACTORY-APPLIED INSULATION.

5. Apply one half-lapped layer Scotch 35 tape, completely jacketing the EPR layer. Extend slightly past EPR tape onto the factory-applied insulation.

Figure 22. Taping instructions for 38 kV bus joints illustration



Taping 38 kV studs and flexible connectors

Taping instructions for stud connectors (required only when boots are not provided)

1. Apply 3M Scotchfil electrical insulation putty between bolts and over bolts to eliminate sharp edges. Material may be cut into short lengths to build thickness.
2. Apply one continuous half-lapped layer of Scotch 13 semiconductor tape. This tape is brought down onto metal top of porcelain bushings. **Do not cut this tape into short lengths.**
3. Follow steps 4 and 5 on **page 26**. EPR tape should not extend beyond the top shed of porcelain insulator.

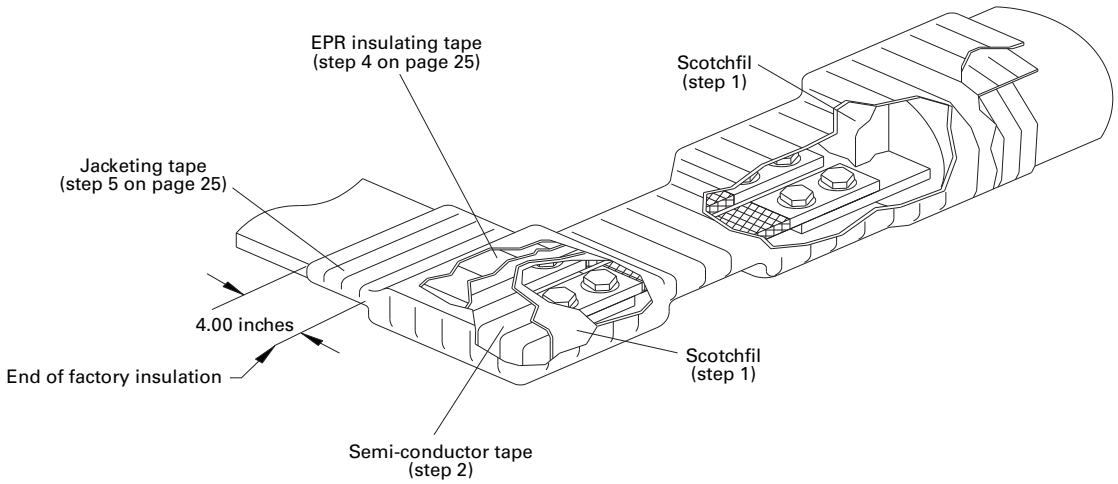
Taping instructions for flexible connectors

1. Follow the Stud Connector Taping steps above for areas where taping flexible connector attaches to the bus bar.
2. Apply five half-lapped layers of EPR tape (adhesive side down) over the entire connection. Extend first layer 4 inches beyond factory-applied insulation. Each consecutive half-lapped layer should stop short of the preceding layer by one-half lap.

> **⚠ CAUTION**
>
> **EPR TAPE MUST BE STRETCHED SUFFICIENTLY (APPROXIMATELY TWO-THIRDS OF ITS ORIGINAL WIDTH TO AVOID ANY FOLDS OR GAPS).**

3. Cover entire braid and joint area with one half-lapped layer of Scotch 35 tape. Care should be exercised to stretch the tape slightly to avoid folds and gaps.

Figure 23. 38 kV flexible connector/stud connector taping illustration



Testing

Bus insulation

Check bus and field-applied insulation from phase-to-phase using a 1000 V megger.

Control wiring

Secondary wiring such as heater circuits are subjected to an over potential test to ground at the factory. A 500 V megger test is recommended to check field terminal connections.

Power frequency withstand

⚠ CAUTION

INSULATION AND BUS SUPPORTS MUST BE FREE OF CONTAMINANTS AND MOISTURE DURING TESTING. OPERATE HEATERS PRIOR TO TESTING TO ENSURE THAT MOISTURE IS NOT PRESENT. BUS DUCT MUST BE DISCONNECTED FROM ASSOCIATED EQUIPMENT, TRANSFORMERS, POTENTIAL TRANSFORMERS, ETC. PRIOR TO WITHSTAND TEST.

In accordance with IEEE C37.23, a one-minute dry power frequency withstand field test can be performed at 75% of the factory test levels. Test voltage is applied phase-to-phase and phase-to-ground at the test levels provided in the following tables.

Table 1. Non-segregated and segregated phase 60 Hz system test levels

Maximum operating voltage	Factory test level	Field test levels	
kV rms	kV rms	kV rms	kV DC
1.058	3.0	2.25	3.18
4.76	19.0	14.25	20.2
8.25	36.0	27.0	38.2
15.00	36.0	27.0	38.2
15.50	50.0	37.5	53.0
27.00	60.0	45.0	63.6
38.00	80.0	60.0	—

DC test levels

DC field test levels are provided for reference only for those using DC testing equipment. Values are believed to be appropriate approximate equivalents to the DC levels listed.

Table 2. DC bus duct systems

Maximum operating voltage	Factory test level	Field test levels	
	kV rms	kV rms	kV DC
300	2.2	1.65	2.33
325	2.2	1.65	2.33
800	3.7	2.78	3.93
1200	4.8	3.60	5.10
1600	5.4	4.05	5.70
3200	8.8	6.60	9.30

Maintenance

Operation

The entire system must be completely assembled and insulated in accordance with the installation drawings provided.

Operation notice

Our bus systems are designed to be operated at the ratings specified. Operating the bus at ratings other than those specified may shorten the service life of the system and increase maintenance requirements. Eaton recommends consulting the factory regarding any abnormal operation either above or below the ratings specified. **Operation at ratings other than specified may void warranty.**

⚠ CAUTION

DO NOT ATTEMPT TO ENERGIZE INCORRECTLY ASSEMBLED, DAMAGED, OR CONTAMINATED SYSTEMS. PRIOR TO OPERATION, DAMAGED COMPONENTS MUST BE REPAIRED AND CONTAMINATES REMOVED (CONSULT INSTALLATION SECTION).

Necessary precautions should be taken to avoid using bus duct as a walkway or as a means of support for other equipment.

Maintenance

Due to possible variations in site conditions, responsibility for establishing a routine maintenance schedule cannot be assumed by Eaton. Top and/or bottom covers are removable for maintenance and inspection. Please check with other manufacturers of the equipment used along with the bus duct as well as the work conditions at your site to determine the appropriate maintenance schedule to be followed.

⚠ CAUTION

SYSTEM MUST BE DE-ENERGIZED TO ENSURE PERSONNEL SAFETY DURING INSPECTION AND MAINTENANCE.

Recommendations

1. A routine inspection to detect deterioration, contamination (see installation section), or damage of all components.
2. Heater circuits and elements should be tested to ensure they are operational.
3. Breathers should be cleaned as required.
4. Years of experience have proven that properly assembled conductor connections do not require routine maintenance when operated under normal conditions.

   NOTICE

   SYSTEMS SUBJECTED TO SEVERE OPERATING CONDITIONS THAT GENERATE EXCESSIVE LOCALIZED HEATING AT CONNECTIONS SUCH AS PERIODIC OVERLOADING OR SYSTEM FAULTS SHOULD BE CHECKED AND RE-TORQUED AS REQUIRED.

5. Installations operated at amperage loads below rated current should be inspected more often.

Heaters, indicators, and monitors

Heaters and monitoring systems

Metal-enclosed bus systems intended for outdoors are equipped with a heater system to prevent the formation of condensation within the enclosure. Failure to prevent condensation promotes corrosion, shortening the life of the system. It is also known as a common cause of insulation breakdown leading to system failures. For this reason, the heaters and heater monitor systems are essential to the system's operation. Proper maintenance of the heater system is vital.

Heaters

- The bus system is equipped with heaters attached to straight and elbow access covers (refer to bus duct layout drawing for locations and schematic diagrams)
- The heaters are operated at half voltage, limiting the surface temperature and prolonging the element life
- Heater wires are factory terminated and extend the required length from side channel conduit slot; **the wires must be routed and safely secured to avoid contact with bus bars and maintain adequate electrical clearances**.

Heater indicators (optional equipment)

- The heater indicators detect the loss of individual heater elements. Each heater is equipped with a current transformer and an LED indication light that is mounted on the heater access panel, external to the enclosure.
- During normal operations, the indicator lamp will be illuminated
- If a failure occurs to a heater element or there is a loss of power, the lamp associated with that heater will **not** illuminate
- Before attaching access cover to extrusion, connect heater wires directly to terminal block
- After bus duct installation, test the heater indicator lamps. Temporarily bypass the thermostat or adjust the thermostat below ambient temperature to energize heaters; lamps will illuminate if working properly. Return thermostats to proper configuration before beginning normal operations

Figure 24. Heater indicator assembly

Heater monitor unit (optional equipment) instructions

⚠ CAUTION

FOR SAFETY AND PROPER OPERATION, READ AND FOLLOW INSTRUCTIONS BEFORE INSTALLATION. BEFORE WIRING POWER SUPPLY, ALWAYS DISCONNECT POWER SOURCE.

Figure 25. Monitor box (outside view)

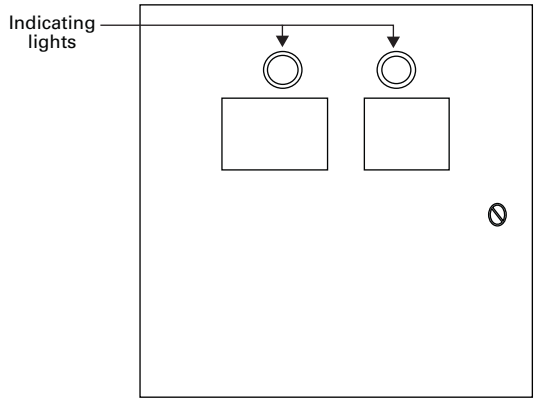
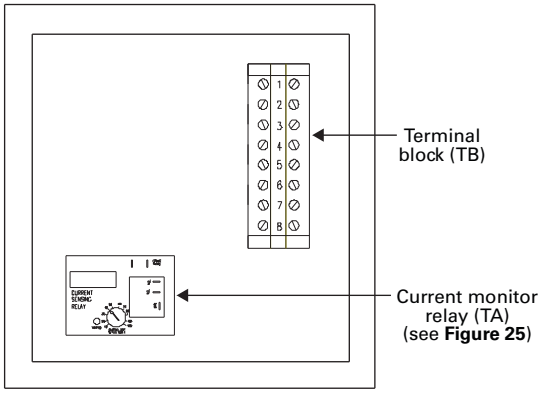


Figure 26. Monitor box (inside view)



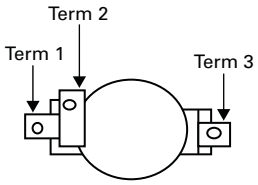
Installation

NOTICE

WIRING MUST BE A MINIMUM OF #10 AWG.

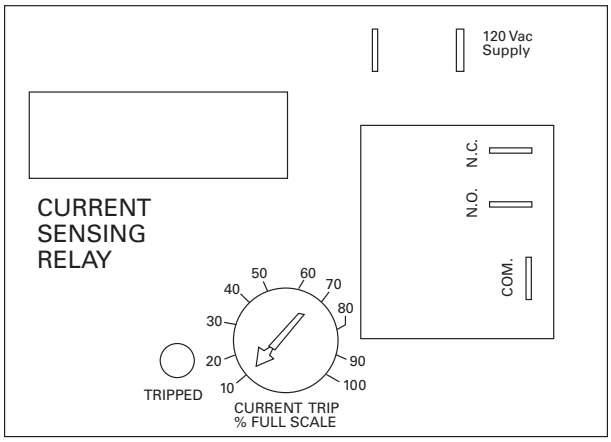
1. Inspect monitor unit for any shipment damage.
2. The heater monitor unit current range is 1.5 A to 15 A. The current sensing relay is to be set using 95% of the operating current of the heater circuit. **Currents exceeding 15 A rating require multiple monitors.**
3. Connect 120 Vac source to the monitor unit by attaching the HOT to TBI and NEUTRAL to TB2.
4. Terminate remote heater wires HOT to TB3 and NEUTRAL to TB4.
5. The remote thermostat (**Figure 27**) has three terminals. Connect Term 1 (HOT) to TBI at the terminal block. The thermostat Term 2 (closes "on temperature low") terminates on TB5 (heater load). The third terminal Term 3 (opens "on temperature low") terminates to TB6 (indication light).

Figure 27. Remote thermostat



Calibration

Figure 28. Current sensing relay



Operation

The operation of the indicator lights illuminates when all circuits are working properly. If a lamp is **not** illuminated, an abnormal condition has occurred. The condition is due to a power failure or an inoperative heater.

⚠ WARNING

ALL SERVICING SHOULD BE DONE BY QUALIFIED PERSONNEL.

⚠ WARNING

DO NOT USE OUTDOORS. THIS UNIT IS TO BE USED INDOORS OUT OF WET OR HAZARDOUS CONDITIONS.

⚠ WARNING

THE UNIT SHOULD BE MOUNTED IN A LOCATION AND HEIGHT WHERE IT WILL NOT READILY BE SUBJECT TO TAMPERING BY UNAUTHORIZED PERSONNEL.

⚠ WARNING

DO NOT USE THIS UNIT FOR OTHER THAN ITS INTENDED USE.

The current range for the monitor box is 1.5 A to 15 A. The current is monitored with an adjustable current sensing relay. The adjustable current sensing dial is marked with the percentage of the maximum rated amperage of the relay. The circuit's total current should be calculated to determine which operating range will fit your needs. See the following formula and example:

Io = *operating current (total circuit amps)* / **Vo** = *operating voltage (120 Vac)* / **Pr** = *heater rated power (W)*

Vr = *heater rated voltage (AC)* / **Is** = *system current (amps)* / **Hn** = *total number of heaters*

Io= [((VoVo)/(VrVr))Pr]Hn/Vo Is =0.95 (Io)
(Set relay to the nearest percentage below system current value)

Example: The system operating voltage is 120 Vac, with 10–250 W, 240 V rated heaters.

Io= [((120 x 120)/(240 x 240)) x 250 W)] x 10/120

Io = (62.5 x 10)/120 Vac Io = 5.21 Is = 0.95 x 5.21 A Is = 4.95 A

The example's circuit current is 4.95 A. 4.95 A is 16.5% of 30 A.
The dial should be set between 10 and 15 on the relay.

Table 3. Quick reference chart

150 W heater		250 W heater		500 W heater		750 W heater	
Quantity of heaters	**Dial setting**	**Quantity of heaters**	**Dial setting**	**Quantity of heaters**	**Dial setting**	**Quantity of heaters**	**Dial setting**
10–14	10	6–8	10	3–4	10	2	10
15–19	15	9–12	15	5	15	3	15
20–24	20	13–15	20	6–7	20	4	20
25–29	25	16–18	25	8	25	5	25
30–34	30	19–22	30	9–10	30	6	30
35–39	35	23–25	35	11	35	7	35
40–44	40	26–28	40	12–13	40	8	40
45–50	45	29–31	45	14–15	45	9–10	45

Spare parts list

Normal operation will not result in replacement of parts. We recommend miscellaneous items (i.e., hardware, gasket, or insulation) be available during maintenance activity. A list of common spare parts is provided below. For correct replacement part numbers and pricing, contact Eaton.

For prompt assistance, please reference the factory order number provided on the cover of this manual.

The factory will not assume responsibility for the use of substitute replacement parts without its written authorization. **Substitute replacement parts used without prior written authorization from Eaton will void all warranties.**

Aluminum extrusions
Access covers
Extrusion weather seal
Joiner cap
Housing hardware-indoor/outdoor
Enclosure hardware-indoor/outdoor
Housing gasket
Enclosure/flange gasket
Parallelogram bolts
Screened breather
Fire stops
Bus supports—thru porcelain
Bus supports—three-phase
Porcelain supports
Heaters
Thermostat
Thermostat—expansion proof
Heater wire

Cinch connector TRW 2–150
Junction box—indoor
Junction box—outdoor
Electrical insulation putty
EPR tape
Jacketing tape—red/brown at 38 kV
Shipping split boots
Termination boots
Boot hardware
Expansion joint bellows
Flexible connectors
Strain insulator
Ground pads
Stand-off insulators
1/2–13 concrete anchors
Power-strut hardware sets
Heater indicator
Heater monitor

For more information regarding Eaton non-segregated phase bus and installation and/or maintenance, contact the local Eaton sales office or call EatonCare (877-ETN-CARE or 877-386-2273).

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
Publication No. MN017001EN / Z28115
October 2023

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