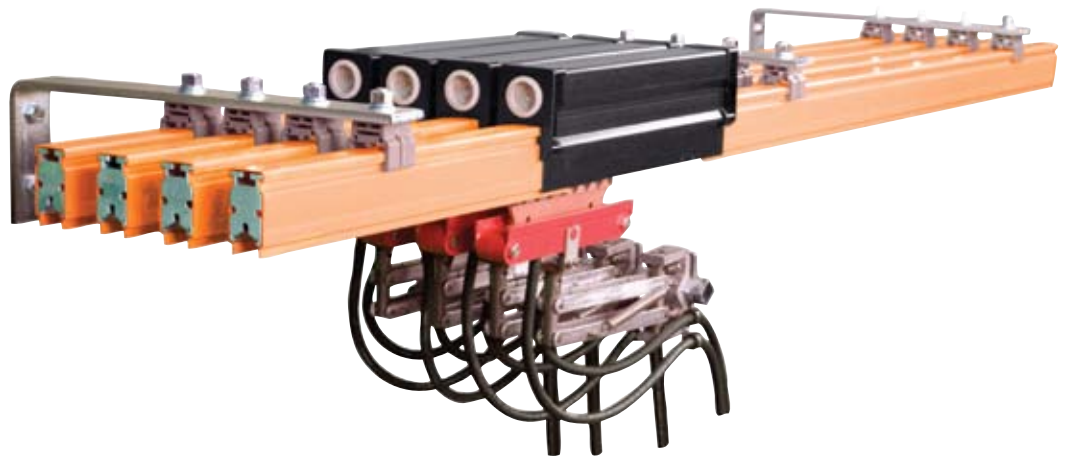


Hevi-Bar II Manual Conductor Bar Systems



CONDUCTIX INCORPORATED

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HEVI-BAR II FAMILIARIZATION

All personnel working on the conductor system should be familiar with the guide way, the components, and the components location on the guide way.

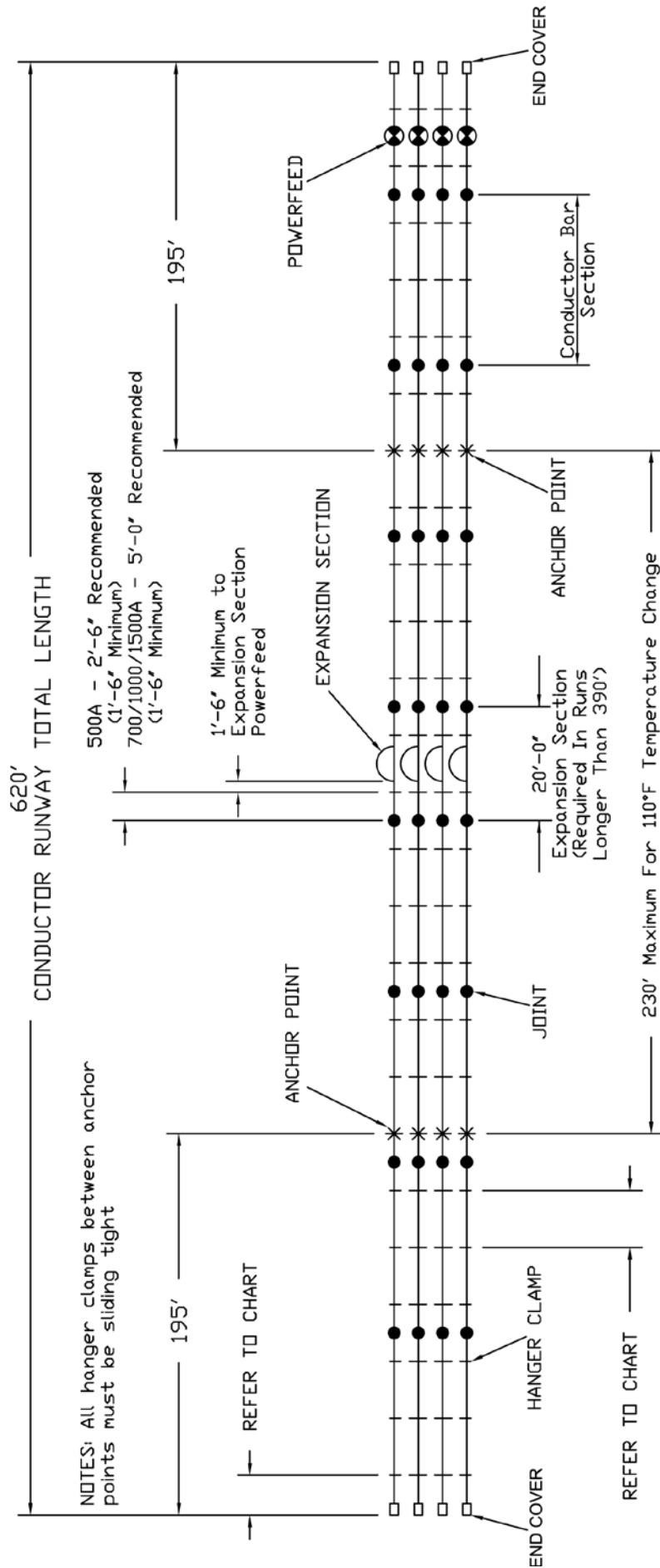
To avoid problems during installation, the installer's personnel must become familiar with the notes on the component drawings. The drawings serve to identify the components and include notes on installation with torque values for fasteners. In the event of a conflict or question over installation procedure between the manual and the drawings, the drawing shall take precedence.

Due to the nature of this product as an electric conductor, all connections are critical. Mating surfaces must be cleaned of dirt and debris and aluminum oxide must be removed. Aluminum when exposed to air, builds up an oxide on the surface. This oxide is high in resistance. If the oxide is not removed prior to assembling the components, such as a splice, the current flow through the conductor system will be inhibited. It is critical that the resistance remain low for proper system performance. To remove the oxide, a wire brush must be used to clean all aluminum surfaces. Immediately after the oxide is removed, (Aluma-Shield or No-Lox oxide inhibiting grease) must be applied to the surface then the components bolted together. The oxide inhibiting grease prevents oxide buildup and provides low-resistant connection.

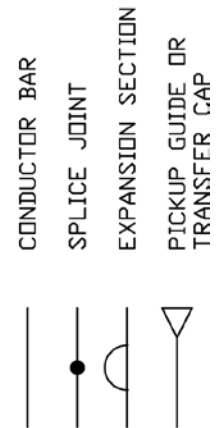
Hevi-Bar II can be used indoor, or outdoor with insulated hangers. The operating temperature range is -40°F to +230°F (up to +400°F with high-heat covers on 700A and 1000A Conductors Only).

TYPICAL 3-PHASE SYSTEM OVERVIEW

EXAMPLE OF 4 CONDUCTOR RUNWAY HEAVY BAR 2 (3 PHASE + 1 GROUND)



LEGEND:



HANGER SPACING CHART

SYSTEM	FIRST HANGER	MAX. HANGER SPACING
500 AMP	2'-6"	5'-0"
700 AMP	3'-9"	7'-6"
1000 AMP	5'-0"	10'-0"
1500 AMP	5'-0"	10'-0"

ENVIRONMENTAL CONSIDERATIONS

- Standard Cover (PVC) is suitable up to 160°F.
- Medium Heat Cover (Poly carbonate) is suitable up to 250°F.
- High Heat Cover (Glass Filled Polyester) is suitable up to 400°F.
- The following acidic or corrosive environments require the use of stainless steel hangers

Hydrochloric Acid
Hydrofluoric Acid
Sodium Hydrochloride
Ammonium chloride
Chlorine Bleach
Chloride Ions
Fluoride Ions

RECOMMENDED INSTALLATION TOOLS & EQUIPMENT

- A. Man lift or platform lift for access to the installation location (if required)
- B. A power drill, with drill bits ranging from 1/4" thru 3/4", depending on system.
- C. A hammer, to tap in anchor pins.
- D. Two torque wrenches, one for use on the ground, and one for the use at the runway level. 7/16" thru 3/4" sockets depending on system.
- E. Two wire brushes, ground and runway level.
- F. Linoleum knife.
- G. A measuring tape.
- H. Scotch Brite Pads (or equivalent) to clean mating surfaces of bar.
- I. Open end/box end combination 3/8", 7/16" and 1/2" wrenches.

GENERAL ASSEMBLY INSTRUCTIONS

WARNING: Always lock out/tag out all electrical power before starting work.

This manual provides detailed instructions in the general order of system installation.

System installation consists of 4 phases:

1. Identifying and organizing the materials
2. Installation of brackets along the runway
3. Pre-install assemblies on the ground
4. Installation of hangers and conductors and final assembly along the runway.

1. Identify and organize your materials. Check the pack list against the items received. Parts are labeled for your convenience. Review your specific installation layout drawing (if provided) or the typical layout diagram provided in this booklet to become familiar with the component location on the system. Note where the anchors, expansions, power feeds, and other assemblies will be located along the runway. Read through these instructions before starting work.

Do not remove shipping supports from expansion sections or power interrupting sections until they have been installed on the runway.

2. Install the brackets as shown in the “Support Brackets” section. Keep them as level and evenly spaced as possible. You may install the hangers on the brackets before or after they are mounted along the runway.

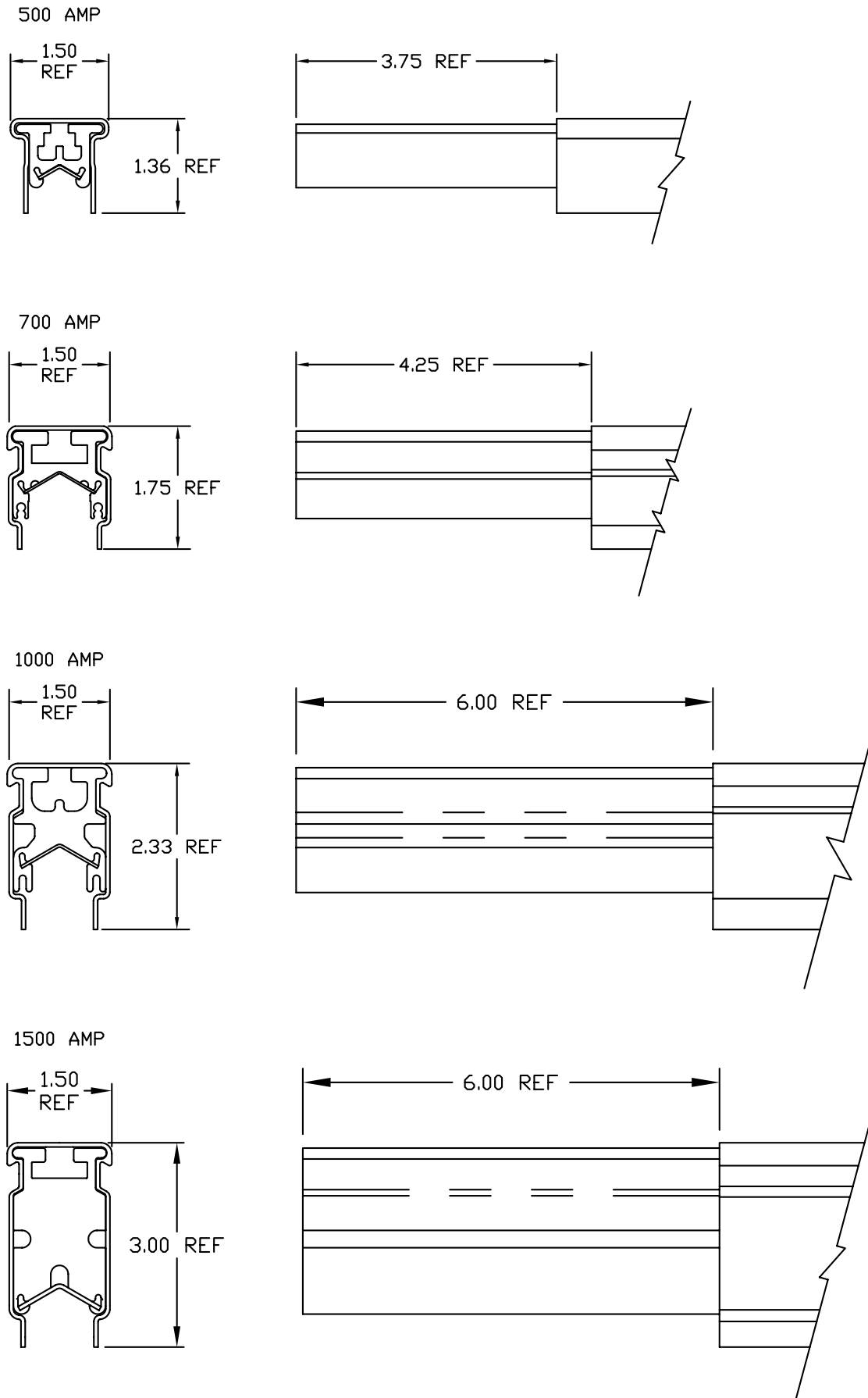
3. Assemble as much as possible on the ground - it's faster, easier, safer, and more convenient should you drop something.

- a. Install splices on one end of conductors and expansions.
- b. Install end caps on the end conductors, keeping them separated from the main runway conductors.
- c. Install isolation splices (if included) on the ends of the conductors in accordance with the installation layout drawing and the instructions found in the booklet.
- d. Install end covers (transfer caps) on the conductor ends (if included) per this booklet.

4. Final installation along the runway will most likely be accomplished from a lift or work platform.

- a. **Ensure the power is locked/tagged out!**
- b. Install the hangers, per this booklet.
- c. Roll adjacent conductors into the hangers as shown in the “Conductors” section of this booklet. Follow the steps for the specific hanger that is being used, either snap in or cross bolt.
- d. Conductix recommends the first accessible conductor being the ground conductor (if applicable).
- e. Move down the runway, install the next inboard conductor and join it to the corresponding conductor installed in step 4c. Install the splice cover. Keep the splice assemblies at least 18.0” from the hanger brackets to allow for conductor movement from expansion. Repeat for the remaining phases and ground conductors.
- f. When you get to where the expansion assemblies are to be installed, refer to the instructions found in the “Expansion Assemblies” section of this booklet. Be sure to divide the total expansion gap distance (from chart) between the two air gap locations in the expansion assembly. (If the total gap setting = 1.85”, each air gap will be .92”). Ensure the expansion assembly body is at least 18” from the nearest bracket.
- g. Proceed with system installation, ensuring anchors are positioned the correct distance from the expansions and that they are drilled and pinned in accordance with “Anchor Clamp” section of this booklet.
- h. If a conductor must be cut to a specific length, ensure that the cut end is properly de-burred. The conductor cover is always shorter than bar length. A detailed drawing of the bar with cover cut-back can be seen in Figure A-1.
- i. When you run the feed cable to the power feed assembly, ensure the cables have sufficient free length and are flexible enough to enable movement of the conductor due to expansion. Locating the power feed as close as possible to the anchors minimizes this concern. Do not support the weight of the feed cables with the conductors.
- j. Install power feeds on conductor bars per layout and the instructions in the “power feed assemblies” section of this booklet.

Figure A-1



SUPPORT BRACKETS

Locations: Support brackets may be web, flange, brace web, or lateral. A drawing of each bracket can be seen in Figure A-2. The brackets are located at a maximum distance of 5 feet on a 500A system, 7.5 feet on a 700A system, and 10.0 feet on a 1000-1500A system.

Tools needed: Drive torque Wrench with standard sockets
Welder (optional)

Support bracket installation:

- (a) For ease of installation pre-install hangers to brackets on the ground following the steps described in the Hanger Clamps section. When mounting web brackets, take special care in aligning the brackets at precisely the same height as to assure level travel of the system.
- (b) Web brackets may be mounted by bolting the bracket to the support structure or by welding in place. If it is intended to bolt the bracket in place follow steps "c" through "g" below. If the intent is to weld the bracket in place follow steps "h" through "i" below.
- (c) Drill two (2) $\Phi 0.531$ " holes that match the mounting pattern of the web bracket being used.
- (d) Use 1/2" Grade 2 or higher hardware to mount the web bracket and I-beam hole with the bolt head on the web bracket side.
- (e) Place 1/2" bolt with washer on through the web bracket and I-beam hole with the bolt head on the web bracket side.
- (f) Place a 1/2" flat washer, lock-washer, and then nut on the bolt and tighten to 40 ft-lbs. (52.8 N-m).
- (g) Repeat step "f" for all mounting holes on web bracket.
- (h) To weld the web bracket to the support structure simply position the web bracket and tack weld to the beam.
- (i) After ensuring that the bracket is mounted at the correct height and level, proceed to fillet weld the bracket to the support structure.

Figure A-2

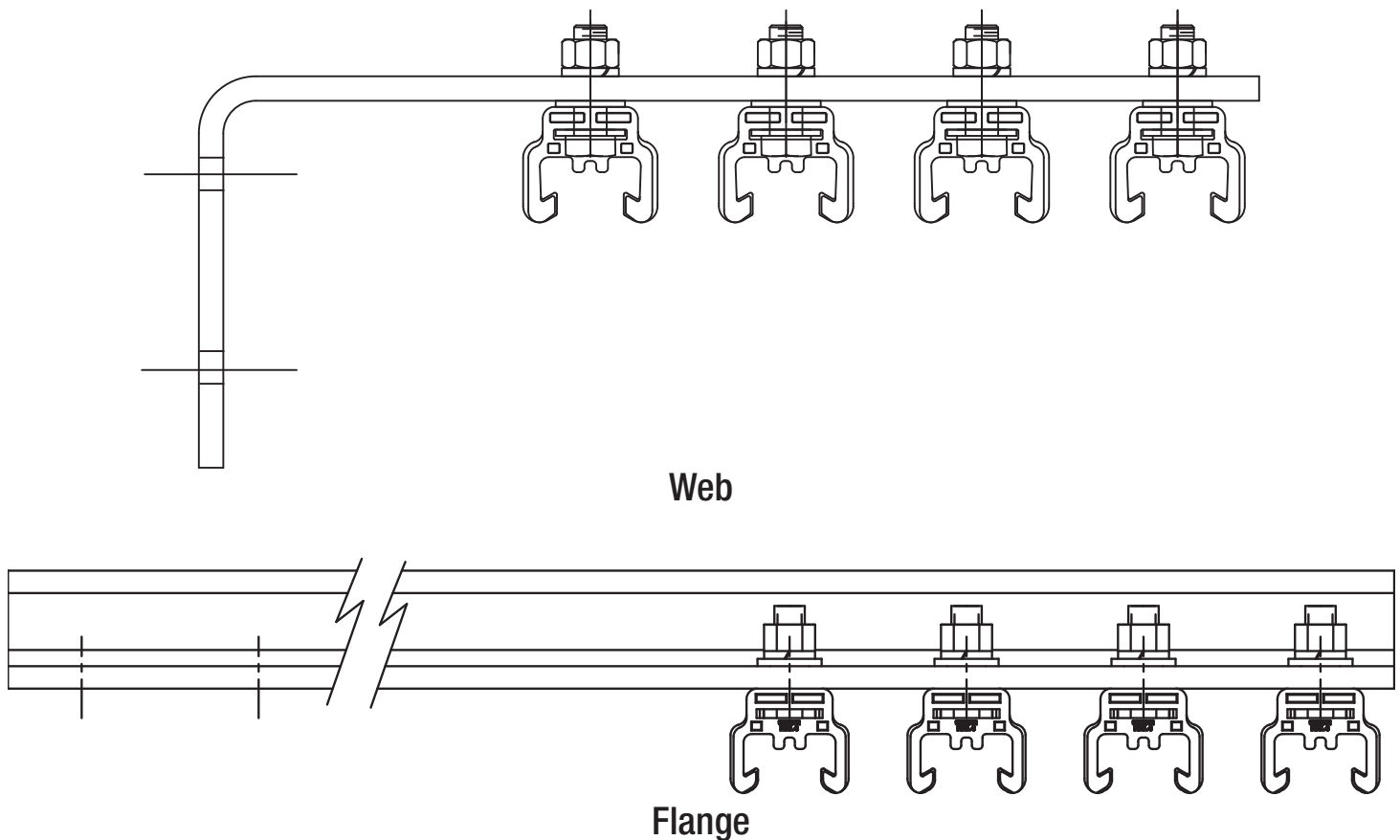
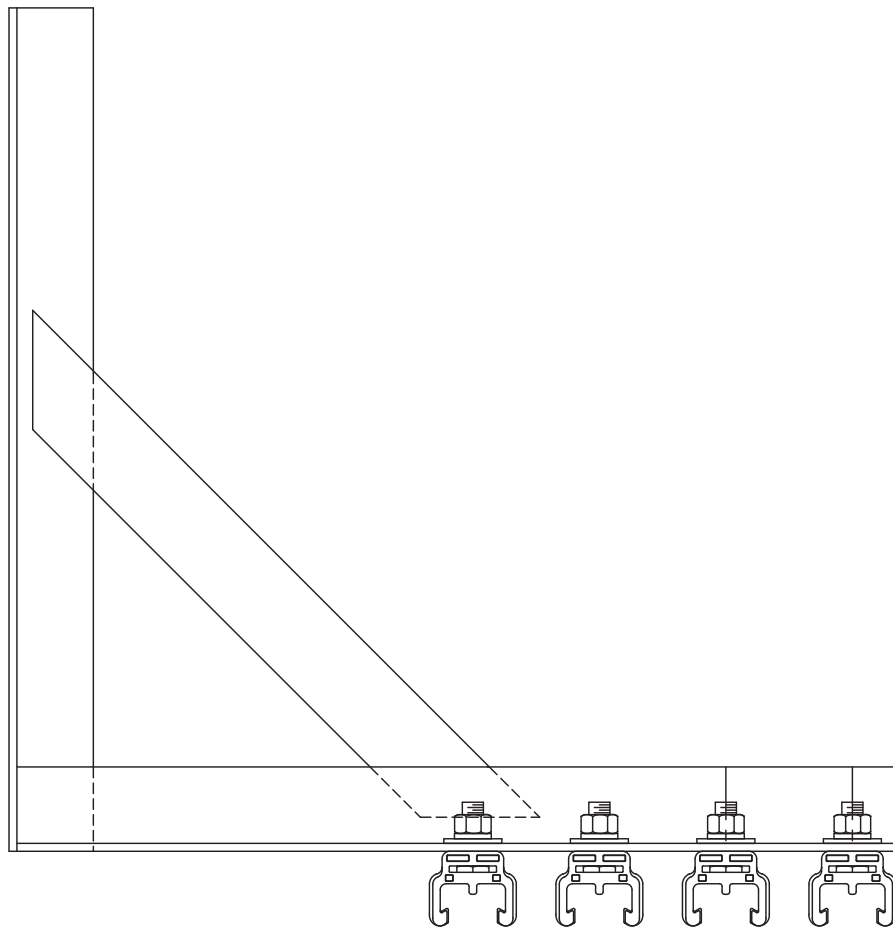
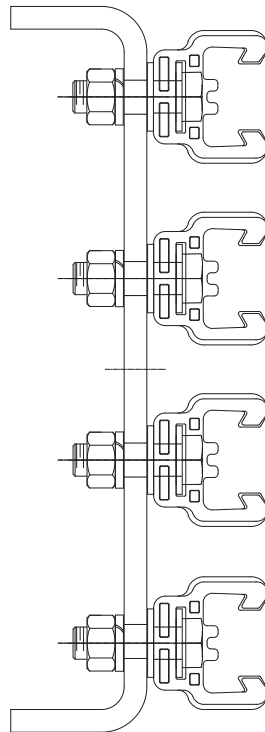


Figure A-2



Braced Web



Lateral

HANGER CLAMPS

Locations: Hanger clamps are located at a maximum of five 5 feet for 500A conductor bar, 7.5 feet for 700A conductor bar, and 10 feet for 1000 and 1500 A conductor bar.

Tools Needed: Drive torque wrench with standard sockets
Welder (when mounting hanger directly to structure or unable to use fasteners)

Hanger clamp kits include: Hanger clamp body, bolts, washers, and lock washers.

A reference drawing for both cross-bolt and snap-in hanger clamps can be seen in Figure A-3.

Hanger clamp installation:

- (a) Hanger clamps are most easily installed on brackets while on the ground, before the brackets are mounted to the runway.
- (b) Set the 1/2" hex-bolt head into the hole inside the top of the hanger clamp.
- (c) Place the bolt through the mounting hole on the bracket.
- (d) Attach a flat washer, lock washer, and nut and then tighten.
- (e) Weld or bolt brackets into place on the runway after checking to make sure that no splices will occur closer than 18 inches to a support bracket.

A drawing is shown below of the proper installation of each type of hanger clamp, snap-in or cross bolt, that is offered (conductor bar is shown only as a reference).

The distance from the bottom of the mounting surface of the bar is shown in chart C-1.

Figure A-3

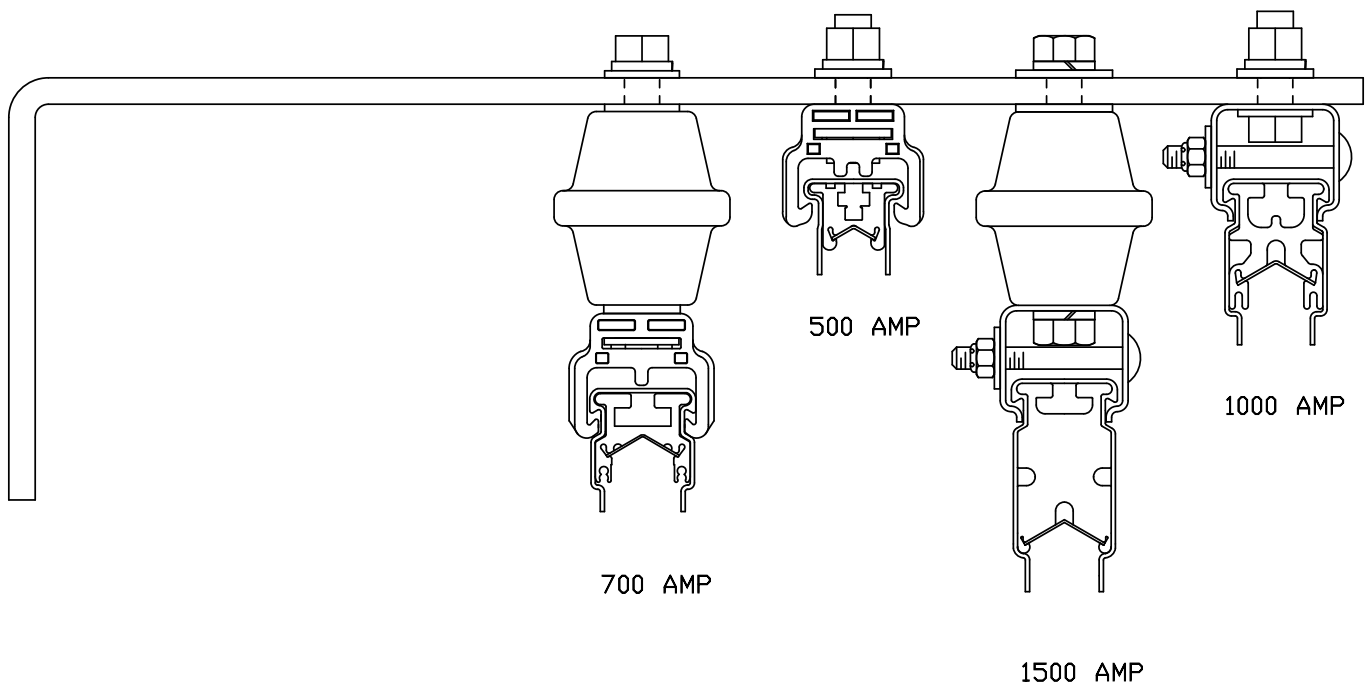


Chart C-1

System	Distance to Contact Surface
500 Amp	1.75"
700 Amp	1.75"
1000 Amp	2.25"
1500 Amp	3.13"

ANCHOR CLAMPS

Purpose and Function: Anchors control the expansion movement of the conductors. They fix or anchor the conductor to hangers at specified points along the runway. Failure to properly install and locate the anchors could result in system malfunction and/or damage to the system components.

Locations: The first anchor point is nominally placed no more than 195 ft. from the starting end, and succeeding anchor points will be made no more than 230 ft. (distances will vary depending upon total system length and number of expansion zones) These values are based on 100°F (61°C) max. temperature change. For a greater maximum temperature change please consult the factory.

Tools Needed: A power drill with a 0.247 inch or machinist "D" size drill bit
A hammer
RTV compound
1/4" Pin Punch

Available but not required

For 500A bar (for use with snap-in-hanger clamps only) use drill fixture, P/N 29855.

For 700/1000/1500A bar (for use with snap-in hanger clamps only) use drill fixture, P/N 30033.

Anchor clamp kits include: Anchor pins, hanger clamp body, bolts, washers, lock washers, and nuts

Anchor clamp installation:

- Mount hanger clamp portion or anchor clamp to web brackets using the same steps for mounting hanger clamps found in this manual.
- Drill two (2) 0.247" (size "D") holes through the conductor rail and cover. Drill these holes as straight as possible, parallel to the top of the rail. A detailed drawing of the pin placement can be seen in Figure A-4 for a snap-in anchor clamp, Figure A-5 for a 500A cross bolt anchor clamp, and Figure A-6 for a 700/1000/1500A cross bolt anchor clamp.
- User anchor pin punch, to insert the anchor pins through the conductor rail.
- If pins are not a forced fit, an RTV type compound must be used to insure pin is properly secure and cannot fall out.

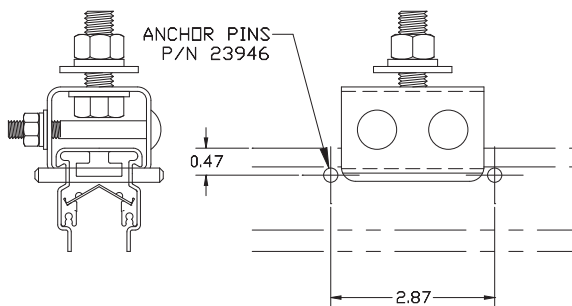


Figure A-4

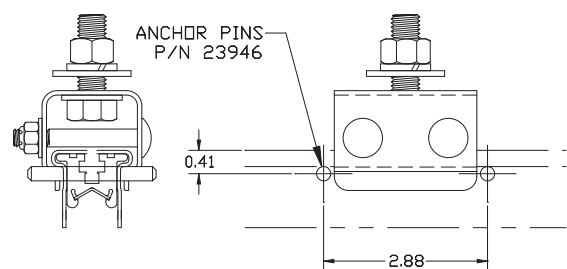


Figure A-5 500A

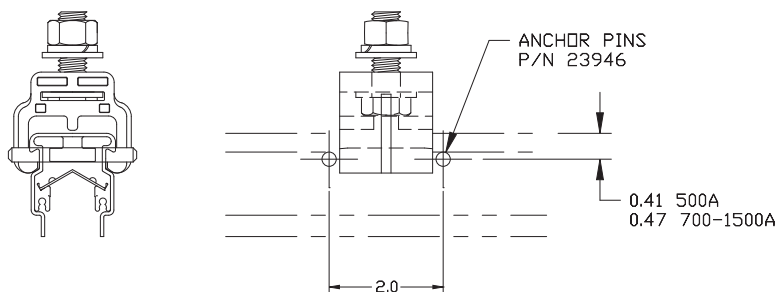


Figure A-6 700A-1500A

CONDUCTOR

Locations: Conductor bar spans the length of the entire system except where there are gaps in the span of the power interrupt sections and expansions.

Tools needed: Drive torque wrench with standard sockets
Scotch Brite Pads (or equivalent) to clean mating surfaces of bars.

Conductor Includes: Conductor bar with insulating cover

Conductor Installation:

Conductor bar is delivered from the factory with cover pre-installed. For information on installing cover over power feed connections, power interrupt sections, and splice assemblies, please see the respective sections in this manual.

After brackets with hanger clamps are in place, installation of the bar may begin. Start at one end of the runway and work toward the other end.

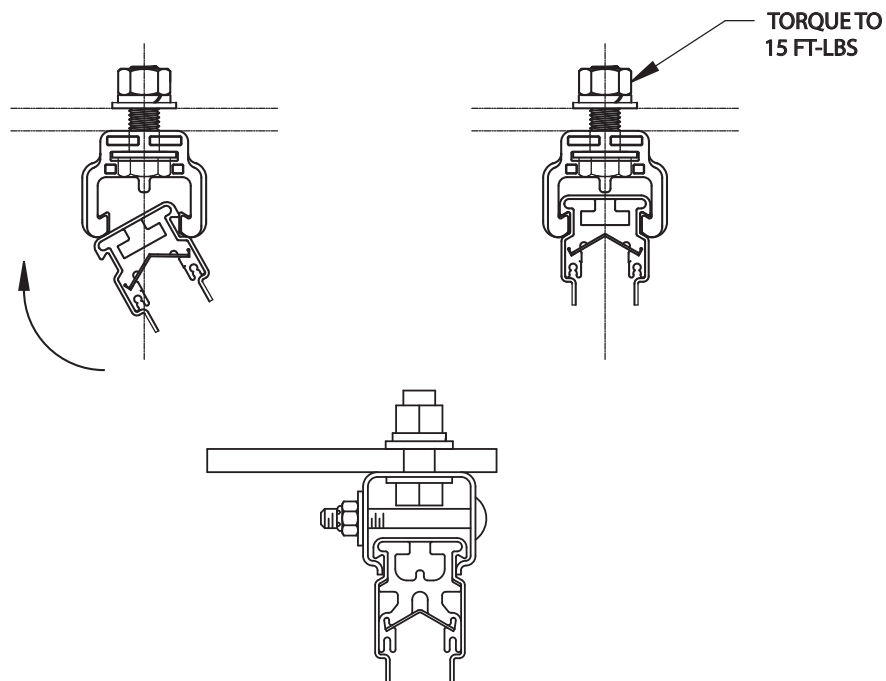
- (a) Clean the contact surfaces with a scotch brite pad or fine wire brush (see Chart C-2 for distance). Note - if conductor has DURA-COAT, the surface must have all the coating removed before joint compound can be applied. Apply electrical joint compound (15629) on cleaned contact surfaces.

Chart C-2

System	Distance application for end of bar
500 Amp	3.00"
700 Amp	4.00"
1000 Amp	5.25"
1500 Amp	5.25"

- (b) Slide three carriage bolt heads into the slot on the top of the bar, and put the splice plate over the bolts. Attach flat washer and nut, and tighten to 11 ft-lbs. torque. DO NOT OVER TORQUE! One half of the splice plate, exposing three bolt holes, should be extended off the end of the conductor bar.
- (c) With three people at runway level (insure safety of the installers and proper handling of the conductor), raise the first bar up to position. It is best to hoist 30ft. lengths with three ropes. Install the first section in the clamps nearest the web of the beam. One person should be handling the bar at each hanger clamp location.
- (d) One lip of the covered bar should be inserted into the clamp, and then the bar should be rotated until it snaps firmly into the other lip of the clamp. A detailed drawing of the this procedure can be seen in Figure A-7.

SNAP-IN HANGER CLAMP SHOWN FOR REFERENCE



Cross Bolt Installation

CONDUCTOR (continued)

- (e) Continue the same procedure for the second or third phase of adjacent conductor bars.
- (f) The 30 ft. length of bar is now suspended in three (3) clamps. It is recommended that you snug each bar to one clamp with duct tape or a nylon tie TEMPORARILY, so that as you splice on successive bars down the runway you will not jar the first bars from their proper position. Hang a brightly colored streamer from the tie so that you will be reminded to come back and remove it as soon as you have installed the first set of anchor pins.

The bar and clamps have now been “seated”. Tighten the nut on the top of each clamp to 15 ft-lbs. torque (snap-in hanger clamps only), DO NOT OVER TORQUE! Check clamps to see that they have not rotated and that they are still square with the bar.

SPLICE ASSEMBLY KITS

Locations: Splice assemblies are used to join 2 pieces of bar together. They provide an electrical and mechanical connection.

Tools needed: Drive torque wrench with standard sockets
Cable tie gun to tighten & cut cable ties
Scotch Brite Pages (or equivalent) to clean mating surfaces of bars
Electrical Joint Compound

Splice kits include: Aluminum splice bar, bolts, washers, nuts & insulating cover

An example of a completed splice assembly is shown below in Figure A-8.

Installation

- (a) You are now ready to install the second set of bars and make the first splice connection. If assembly has end caps slide end caps onto conductor bar far enough away to leave room to work.
- (b) Before splices can be assembled onto the conductor bar the mating surfaces of the conductor and splice need to be cleaned with Scotch Brite Pad (or equivalent). Note - if conductor has DURA-COAT, the surface must have all the coating removed before joint compound can be applied.
- (c) Apply joint compound to the top of the conductor bar end for approximately half of the splice length, and to the bottom of the splice plate. Apply joint compound to top surface of the second bar where splice plate will attach.
- (d) Slide three bolts into the slot in second bar, ease the bar downward slightly and slide the bar up to the next bar until bars butt together.
- (e) Maneuver the three bolts through the holes in the splice plate, attach flat washer and nut, and tighten to 6 ft-lbs torque for 500 amp bar, 11 ft-lbs. for 700-1500 amp. DO NOT OVER TORQUE
- (f) Snap overlap cover in place, centered over splice, slide end plugs (if assembly has end plugs) onto splice cover and install ty-wraps into holes through end plugs. Continue in the same manner until it is time to install the first anchors.

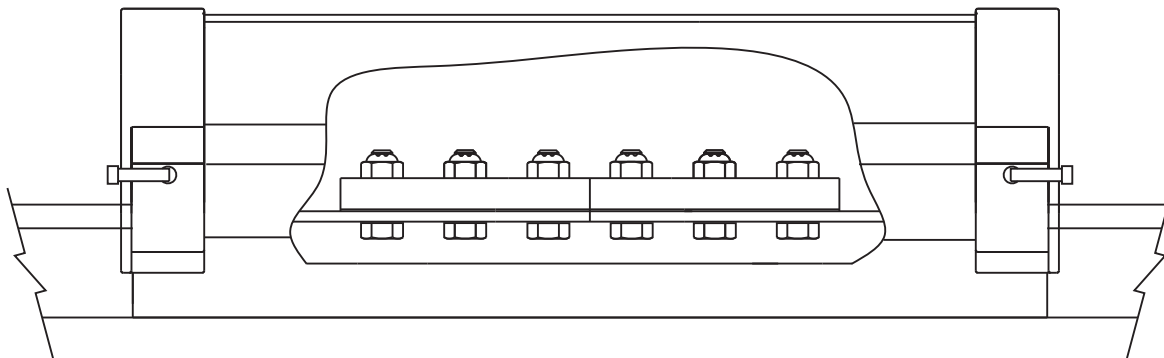


Figure A-8

EXPANSION SECTION KITS

Locations: Expansion assemblies can be placed in the span of any standard piece of bar. It is required that an expansion assembly be used if the span of the system exceeds 390 feet.

Tools needed: Drive torque wrench with standard sockets
Cable tie gun to tighten and cut cable ties
Scotch Brite Pads (or equivalent) to clean mating surfaces of bars
Electrical joint compound

Expansion assembly kits include: Conductor bar, conductor bar cover, slider assembly, overlap cover, end plugs, cable ties, EJC compound

A drawing of a 500A expansion assembly can be seen below in Figure A-9.

*** NOTE - DO NOT REMOVE ALL SHIPPING HARDWARE UNTIL READY TO SET THE GAP. THE HARDWARE WILL KEEP THE EXPANSION FROM GETTING DAMAGED DURING SHIPMENT.**

Installation:

- (a) Clean all surfaces to be joined with 3M Scotch Brite pads and apply electrical joint compound (15629) to all mating surfaces.
- (b) Use same procedures for joint compound and splice plates on expansion sections as with standard bar section.
- (c) Install expansion section into clamps using same procedures as with standard bar, but while using extra care as to not twist this section.
- (d) When conductor run has reached the next anchor point, adjust expansion gap per settings shown below. The standard temperature range is 0" to 110". For standard and medium heat consult table T-1, and consult table T-2 for high heat. After the gap has been set, anchor the conductor.

For other temperature ranges see installation drawings or consult factory for gap settings.

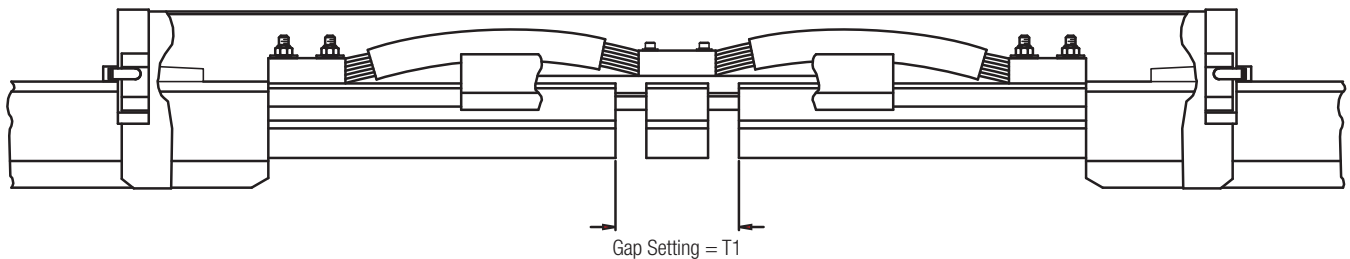


Figure A-9

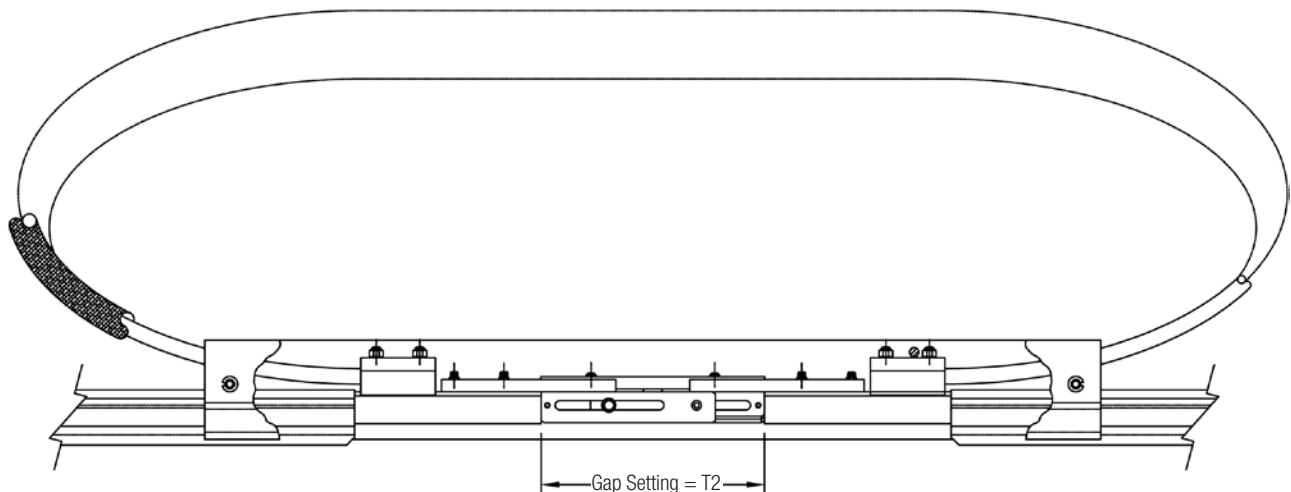


Figure A-10

EXPANSION SECTION KITS (continued)

Table T-1

Figure A-9

Gap Setting Inches (mm)	Temperature Chart °F (°C)
	Chart 1
2.00 (50.8)	120 (48.9)
2.16 (54.9)	115 (46.1)
2.33 (59.2)	110 (43.3)
2.50 (63.5)	105 (40.6)
2.66 (67.6)	100 (37.8)
2.83 (71.9)	95 (35.0)
3.00 (76.2)	90 (32.2)
3.16 (80.3)	85 (29.4)
3.33 (84.6)	80 (26.7)
3.50 (88.9)	75 (23.9)
3.66 (93.0)	70 (21.1)
3.83 (97.3)	65 (18.3)
4.00 (101.6)	60 (15.6)
4.16 (105.7)	55 (12.8)
4.33 (110.0)	50 (10.0)
4.50 (114.3)	45 (7.2)
4.66 (118.4)	40 (4.4)
4.83 (122.7)	35 (1.7)
5.00 (127.0)	30 (-1.1)
5.16 (131.1)	25 (-3.9)
5.33 (135.4)	20 (-6.7)
5.50 (139.7)	15 (-9.4)
5.66 (143.8)	10 (-12.2)
5.83 (148.1)	5 (-15.0)
6.00 (152.4)	0 (-17.8)

Table T-2

Figure A-10

Rail Temp °F (°C)	Gap Settings (inches) with Anchors Located at Intervals of:			
	230 ft.	170 ft.	140 ft.	80 ft.
300 (148)	-----	-----	-----	7.281
290 (143)	-----	-----	-----	7.406
280 (137)	-----	-----	-----	7.531
270 (132)	-----	-----	-----	7.656
260 (126)	-----	-----	-----	7.781
250 (121)	-----	-----	-----	7.906
240 (115)	-----	-----	-----	8.000
230 (110)	-----	-----	-----	8.125
220 (104)	-----	-----	-----	8.250
210 (98)	-----	-----	-----	8.375
200 (93)	-----	-----	-----	8.500
190 (87)	-----	-----	-----	8.625
180 (82)	-----	-----	7.094	8.719
170 (76)	-----	-----	7.313	8.844
160 (71)	-----	-----	7.531	8.969
150 (65)	-----	-----	7.750	9.094
140 (60)	-----	7.313	7.938	9.188
130 (54)	-----	7.594	8.156	9.313
120 (48)	-----	7.844	8.375	9.438
110 (43)	7.094	8.094	5.594	9.563
100 (37)	7.438	8.344	8.781	9.688
90 (32)	7.781	8.594	9.000	9.813
80 (26)	8.125	8.844	9.188	9.938
70 (21)	8.469	9.094	9.406	10.031
60 (15)	8.813	9.344	9.625	10.156
50 (10)	9.156	9.625	9.844	10.281
40 (4)	9.500	9.875	10.031	10.406
30 (-1)	9.844	10.094	10.250	10.531
20 (-6)	10.188	10.375	10.469	10.656
10 (-12)	10.531	10.625	10.656	10.750
0 (-17)	10.875	10.875	10.875	10.875
-4 (-20)	10.875	10.875	10.875	10.875

POWER FEED ASSEMBLY KITS

Locations: Power feed assemblies are typically installed in the center of a system, but can be placed anywhere along the system depending upon voltage drop, characteristics, and feed cable location. A minimum distance of 1-1/2 ft. to other components must be maintained. Cable sizes range from 2/0 thru 350 MCM for 500A and 2/0 thru 500 MCM for 700/100/1500A. Cable must be welding cable or as flexible as welding cable. Cable and lugs are to be supplied by customer.

Tools needed: Drive torque wrench with standard sockets
Cable tie gun to tighten & cut cable ties
Scotch Brite Pads (or equivalent) to clean mating surfaces of bars
Electrical Joint Compound

Power feed kits include: Power feed plate, bolts, washers, nuts, and insulating cover.

Cable and lug are to be supplied by the customer. The maximum allowable cable diameter can be seen below in Chart C-3.

500A Installation:

- (a) If assembly has end plugs (refer to drawing supplied with power feed kits), slide end plugs onto conductor bar far enough away to leave room to work.
- (b) Cut top of cover to length (shown on installation instructions sent with power feed kit) where power feed is to be installed.
- (c) If conductor is DURA-COATED, coating must be removed prior to assembly of power feed plate. Drill and deburr a 1/2" hole in the center of the slot in the top of the conductor. (do not drill past slot)
- (d) Drop bolts head first into hole and slide into position.
- (e) If assembly has end plugs, cut grommet to accept feeder cable (Φ 1.25" max.), install in end plug, and insert power cable through grommet.
- (f) Clean mating surfaces (bar, power feed plate and lug) with wire brush or Scotch Brite Pads and apply electrical joint compound to cleaned surfaces.
- (g) Assemble power feed plate and cable on top of conductor using hardware provided. If hardware is stainless steel apply anti-seize to end of bolts before assembly of nuts. Torque to 6 ft-lbs.
- (h) Snap cover (centered) over power feed cable assembly, slide end plugs (if assembly has end plugs) onto power feed cover and install ty-wraps into holes through end plugs and cover.

An example of a 500A power feed assembled can be seen on the following page in Figure A-11

700/1000/1500A Installation:

- (a) If assembly has end plugs (refer to drawing supplied with power feed kit), slide end plugs onto conductor bar far enough away to leave room to work.
- (b) Cut top of cover to length (shown on installation instructions sent with power feed kit) where power feed is to be installed.
- (c) If conductor is DURA-COATED, coating must be removed prior to assembly of power feed plate. Drill and deburr a 3/4" hole in the center of the slot in the top of the conductor. (do not drill past slot).
- (d) Drop carriage bolts into hole head first and slide into position.
- (e) If assembly has end plugs, cut grommet to accept feed cable (Φ 1.25" max.), install in end plug, and insert power cable through grommet.
- (f) Clean mating surfaces (bar, power feed plate, and lug) with wire brush or Scotch Brite Pads and apply electrical joint compound to cleaned surfaces.
- (g) Assemble power feed plate and cable on the top of conductor using hardware provided. If hardware is stainless steel apply anti-seize to end of bolts before assembly of nuts. Torque to 10-11 ft-lbs.
- (h) Snap cover (centered) over power feed cable assembly, slide end plugs (if assembly has end plugs) onto power feed cover and install ty-wraps into holes through end plugs and cover.

Figure A-11

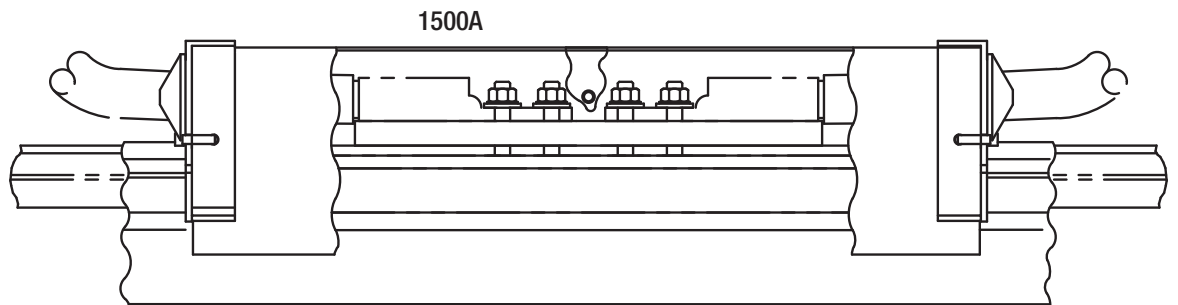
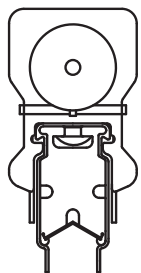
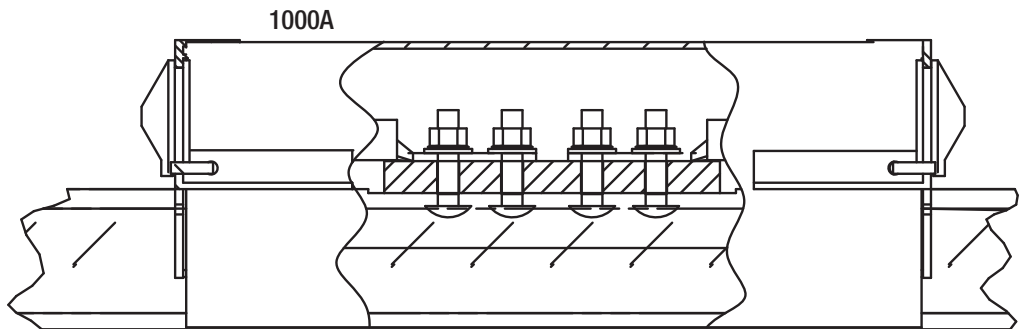
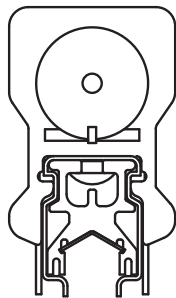
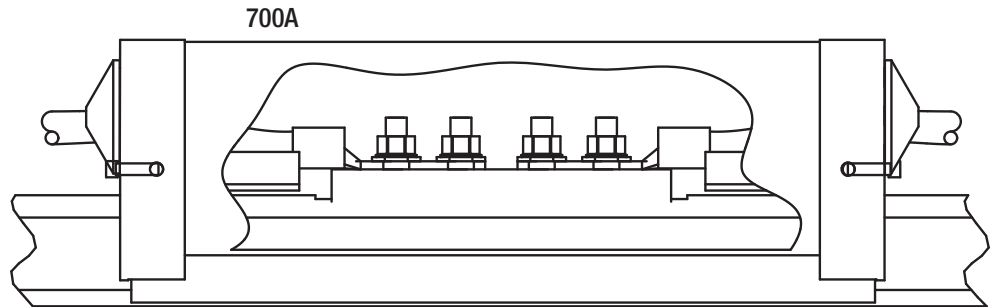
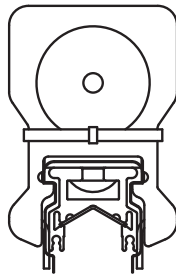
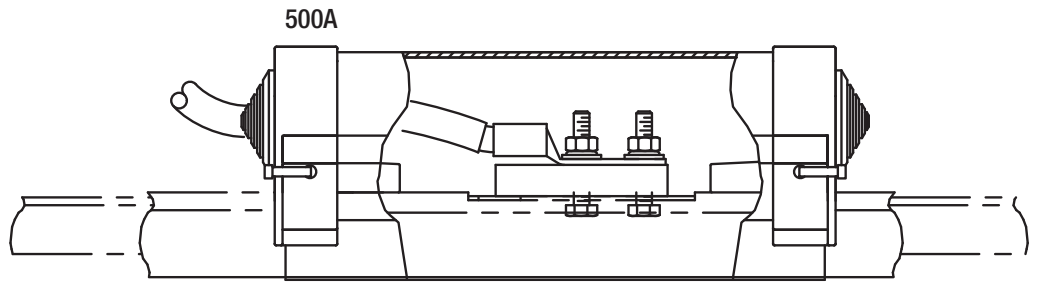
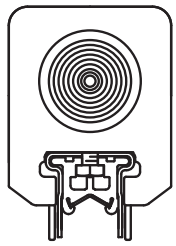


Chart C-3

Amperage	Max. Cable Size	Part #
500	350 MCM	37674
700	500 MCM	38117
1000	500 MCM	38184
1500	500 MCM	50227
500	350 MCM	32500
1000	500 MCM	31965
700	500 MCM	24594
1000	500 MCM	23530

POWER INTERRUPTING SECTION KITS

Locations: Power interrupting section kits are used so that a single power system may be broken into two separate power sections thus allowing one side to be shut off while the other is powered.

Tools needed: Drive torque wrench with standard sockets
Cable tie gun to tighten and cut cable ties
Scotch Brite Pads (or equivalent) to clean mating surfaces of bars
Electrical joint compound

Power interrupt assembly kits include: Conductor bar, conductor bar cover, disconnect section, overlap cover, end plugs, cable ties, EJC compound
A detailed drawing of a power interrupt section is shown below in Figure A-12. The assembly displayed has a double 1.00" air gap setting for power interruption.

Installation:

- Clean all surfaces to be joined with 3M Scotch Brite pads and apply electrical joint compound (15629) to mating surfaces.
- Use same procedures for joint compound and splice plates on expansion sections as with standard bar section.
- Install power interrupt section into clamps using same procedures as with standard bar, but while using extra care as to not twist this section.

A detailed schematic can be seen in Schematic S-1 below.

Note - The standard air gap for isolation is 1.0", it is recommended that a 2.0" air gap is used for outdoor and dusty / dirty environments.

Figure A-12

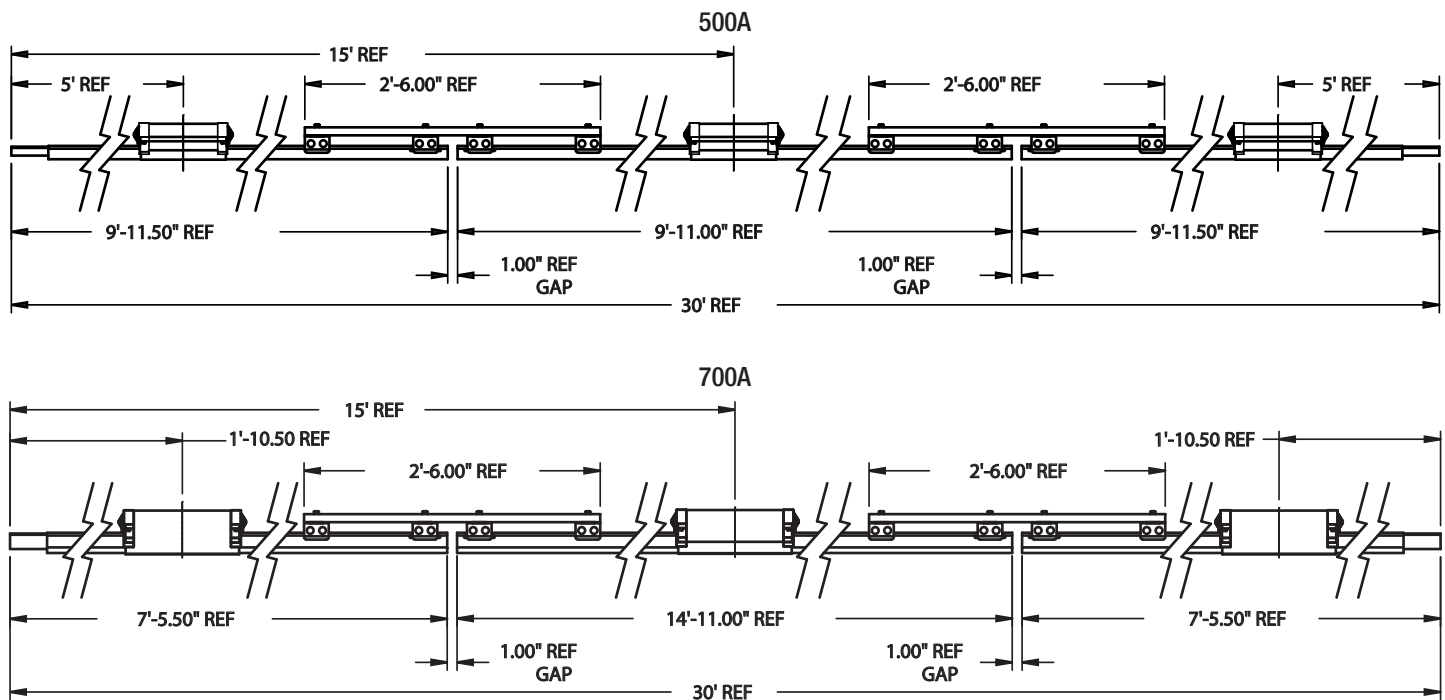
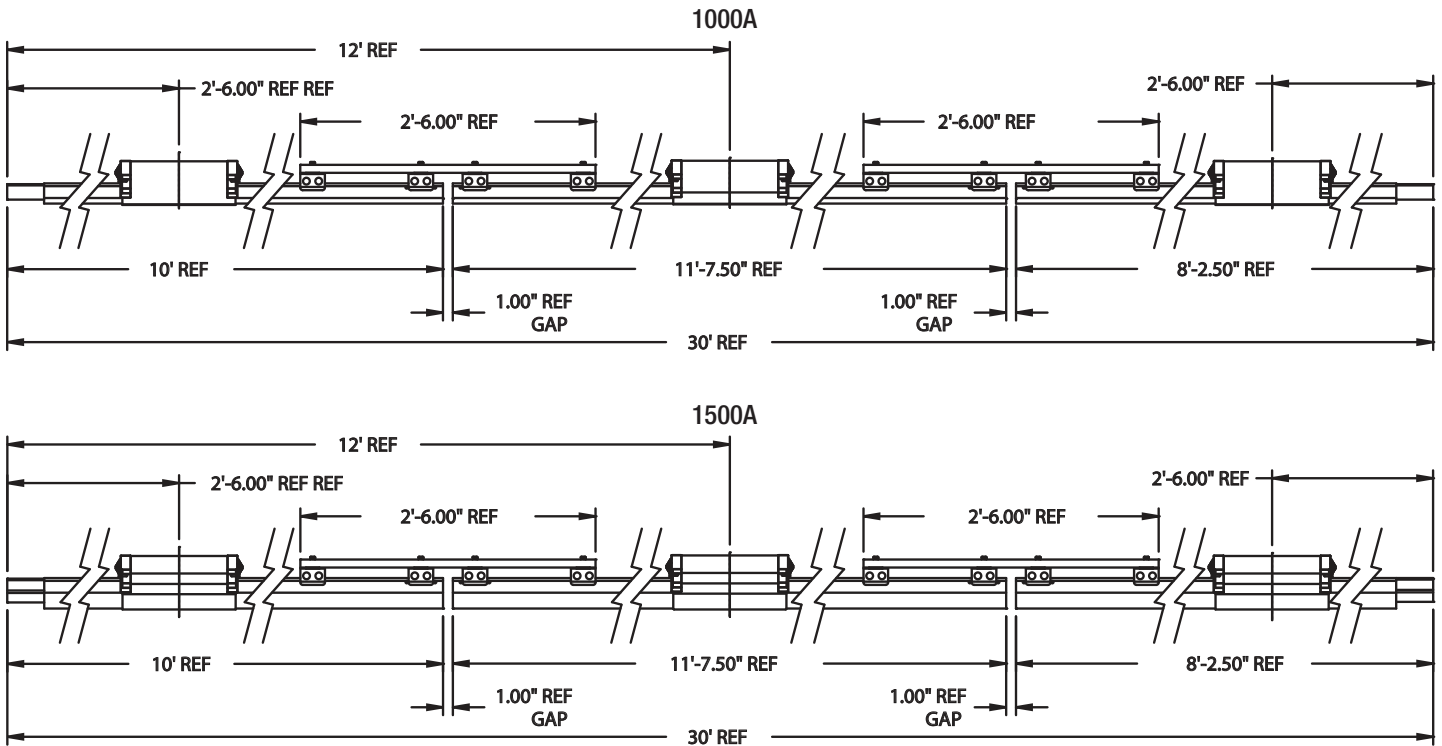
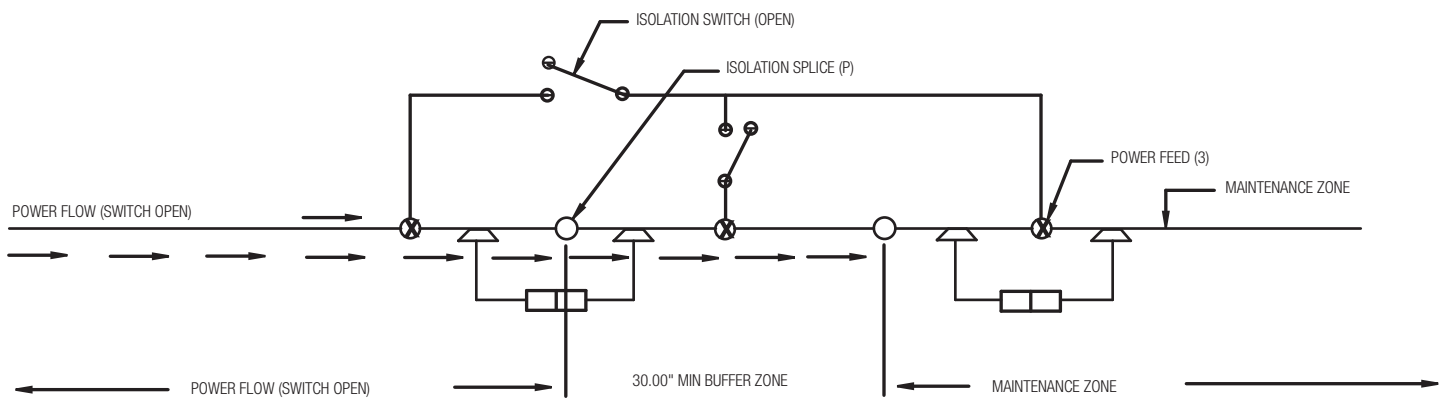


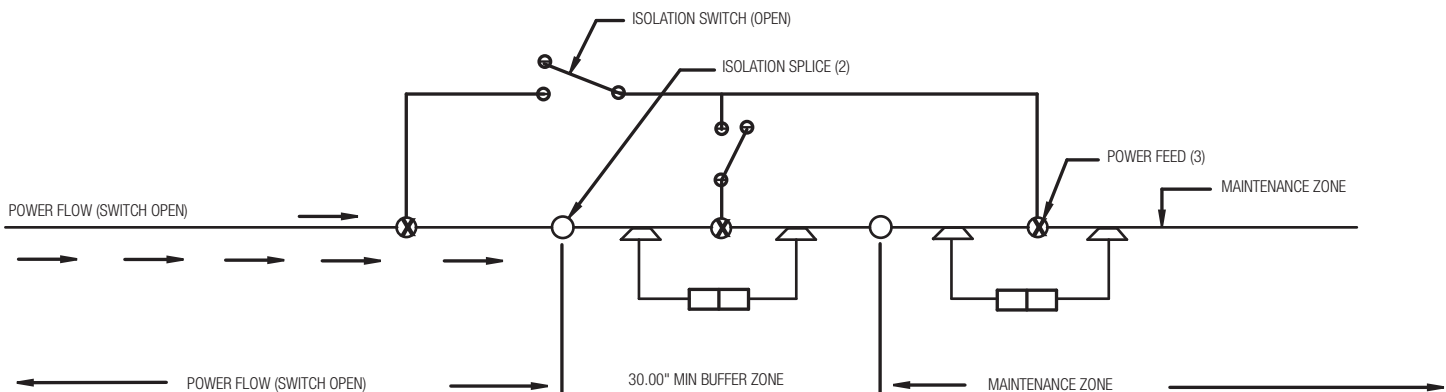
Figure A-12



Schematic S-1

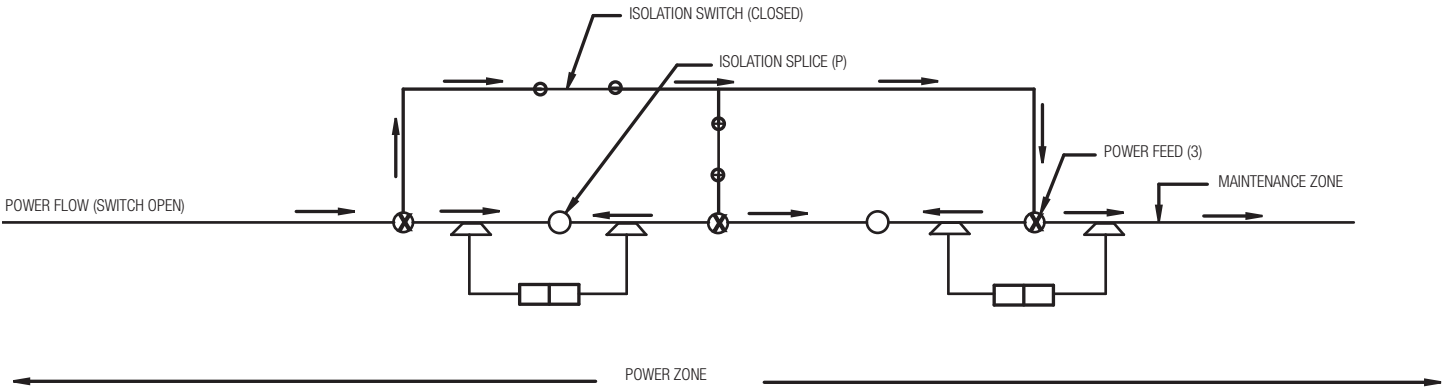


*BUFFER ZONE PREVENTS BRIDGING OF POWER TO THE MAINTENANCE ZONE.



POWER INTERRUPTING SECTION KITS (continued)

Schematic S-1



STRONG BACK ASSEMBLIES

Locations: Strong back Figure A-13 assemblies are used to protect and give extra support when needed for expansion gaps, isolation sections, and power interrupting sections.

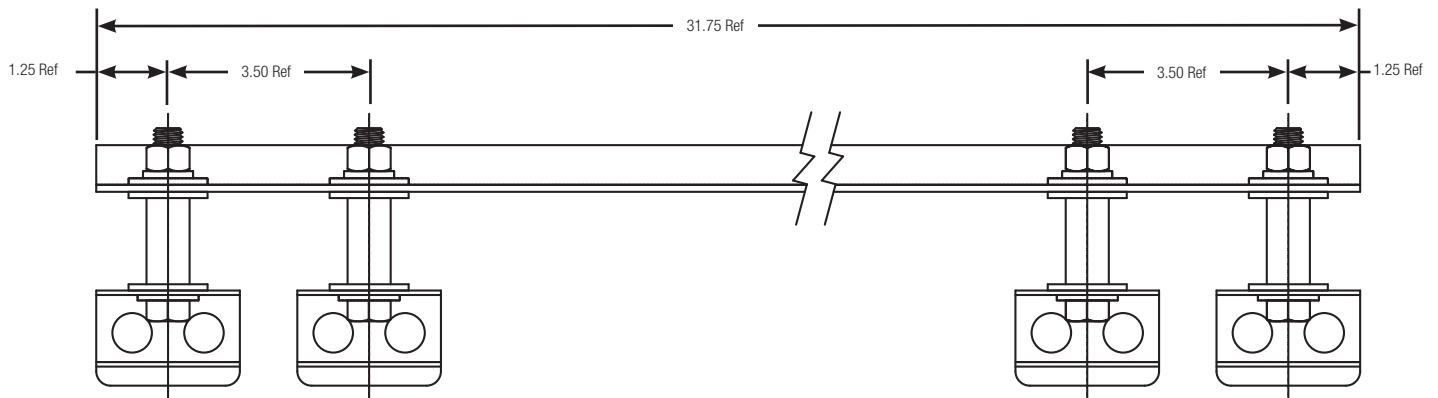
Tools needed: Drive torque wrench with standard sockets

Strong back assemblies include: Hanger clamps, channel for required length, and mounting hardware.

Installation: The strong back assembly is generally factory installed before shipment. The following must be checked prior to putting the system into use.

- (a) The top hanger mount must be checked for a max torque of 39 ft-lbs.
- (b) The cross bolts will be finger tight or max torque of 5 ft-lbs, depending on placement of strong back.

Figure A-13



COLLECTORS

Locations: Collectors run the length of the system traveling along the bar supplying power to the given machine. Collectors may be run single or tandem and may also be run as many as 4 wide.

Tools needed: Drive torque wrench with standard 3/8" socket
Open end/box end combination 3/8" wrench

Collector kits include: Collector assembly with all mounting hardware and pigtails.

Collector installation:

- (a) Mount the one (1) inch square bar so that the center line is six (6) inches from the contact surface of the bar. If using a collector with a shoe p/n 30516 or 50002 mount the one (1) inch square bar so that the center line is five and a half (5.5) from the contact surface of the bar. If there is any question to the mounting distance, please refer to the particular system layout drawing or consult the factory at (800) 452-0052.
- (b) Align the collectors on the square bar as shown in Figure A-14. The typical phase-to-phase mounting distance between collectors is three (3) inches. Please consult the specific layout drawing for exact values. Take special care as to align the collector arms so they run directly beneath the conductor bar. This will assure maximum shoe life and permit full articulation of the collector head.
- (c) Fasten the collector to the one (1) inch square bar by tightening the mounting nuts to 17-18 ft-lbs.
DO NOT OVER TORQUE!

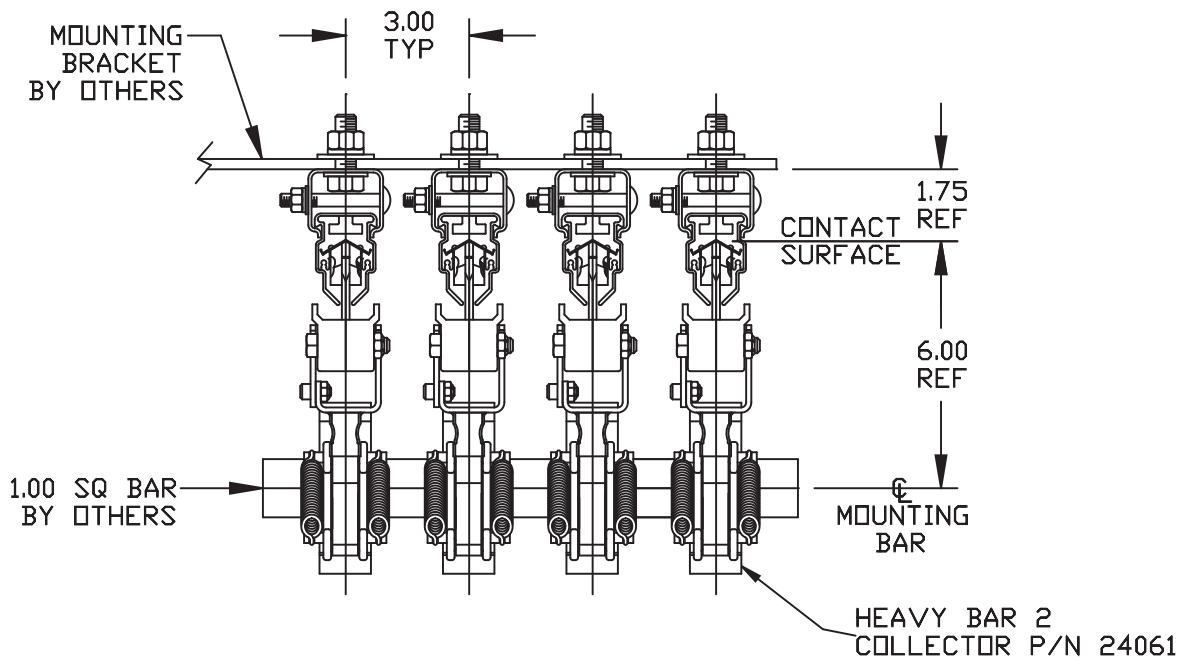
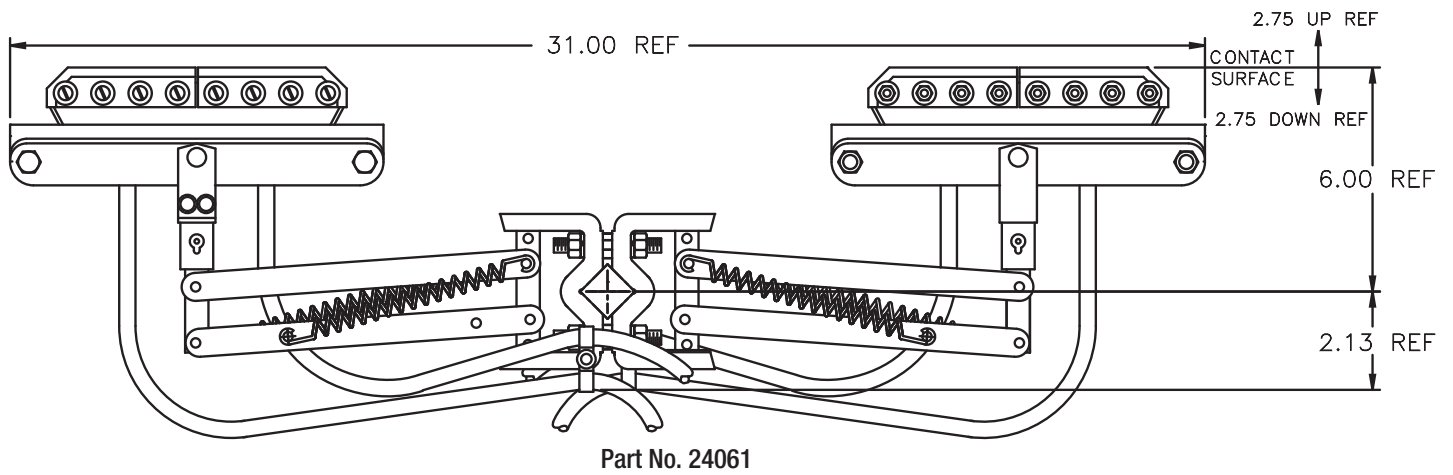
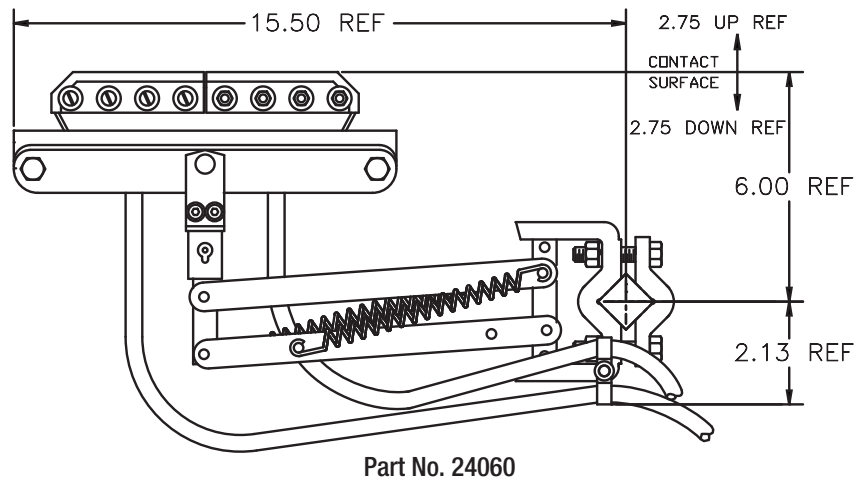
For special collectors, refer to specific layout.

For specific pigtail size please see Chart C-4 below.

Chart C-4

Collector Part No.	Pigtail Part No.	Pigtail Gauge
24060	13696	2 AWG
29818	13696	2 AWG
30136	13696	2 AWG
31831	13696	2 AWG
28760	28578	4 AWG
30579	28578	4 AWG
30848	28578	4 AWG
28893	28892	4 AWG
30770	31131	4 AWG
33301	31714	2 AWG
34457	34458	6 AWG
35804	35803	4 AWG
31631F	50128	2 AWG

Figure A-14



STANDARD HEAT END COVER KITS

500 Amp

Locations: End covers are used at runway ends to cover exposed conductor bar ends. The following covers are suitable up to medium heat applications up to 275°F (135°C)

Tools needed: 7/16" open end wrench
Torque wrench with 7/16" socket
Heat gun

End cover kits include: Heat shrink tubing, bolt, and nut

Installation:

- (a) With approximately 3.75" (95mm) bar exposed position 1/4" - 20UNC x 0.50" hex head bolt into top slot on bar approximately 3.13" (79mm) from end of bar.
- (b) Install 1/4" hex nut and tighten with a 7/16" open end wrench.
- (c) Torque nut with torque wrench to 4-5 ft-lbs.
- (d) Position heat shrink tubing over end of bar approximately 6.13" (156mm)
- (e) Using a heat gun shrink tubing over bar and cover.
- (f) While shrink tubing is warm, press and flatten the excess tubing starting approximately 0.75" (19mm) behind end of bar.
- (g) When tubing has cooled cutoff excess tubing, leaving approximately 0.75" (19mm) of flattened tubing.

700 Amp

Locations: End covers are used at runway ends to cover exposed conductor bar ends. The following covers are suitable up to medium heat applications up to 275°F (135°C)

Tools needed: 1/2" open end wrench
Torque wrench with 1/2" socket
Heat gun

End cover kits include: Heat shrink tubing, bolt, and nut

Installation:

- (a) With approximately 4.25" (108mm) bar exposed position 5/16" - 18UNC x 0.75" carriage head bolt into top slot on bar approximately 3.00" (76mm) from end of bar.
- (b) Install 5/16" hex nut and tighten with a 1/2" open end wrench.
- (c) Torque nut with torque wrench to 10-11 ft-lbs.
- (d) Position heat shrink tubing over end of bar approximately 8.25" (209mm)
- (e) Using a heat gun shrink tubing over bar and cover.
- (f) While shrink tubing is warm, press and flatten the excess tubing starting approximately 0.75" (19mm) behind end of bar.
- (g) When tubing has cooled cutoff excess tubing, leaving approximately 0.75" (19mm) of flattened tubing.

STANDARD HEAT END COVER KITS (continued)

1000/1500 Amp

Locations: End covers are used at runway ends to cover exposed conductor bar ends. The following covers are suitable up to medium heat applications up to 275°F (135°C)

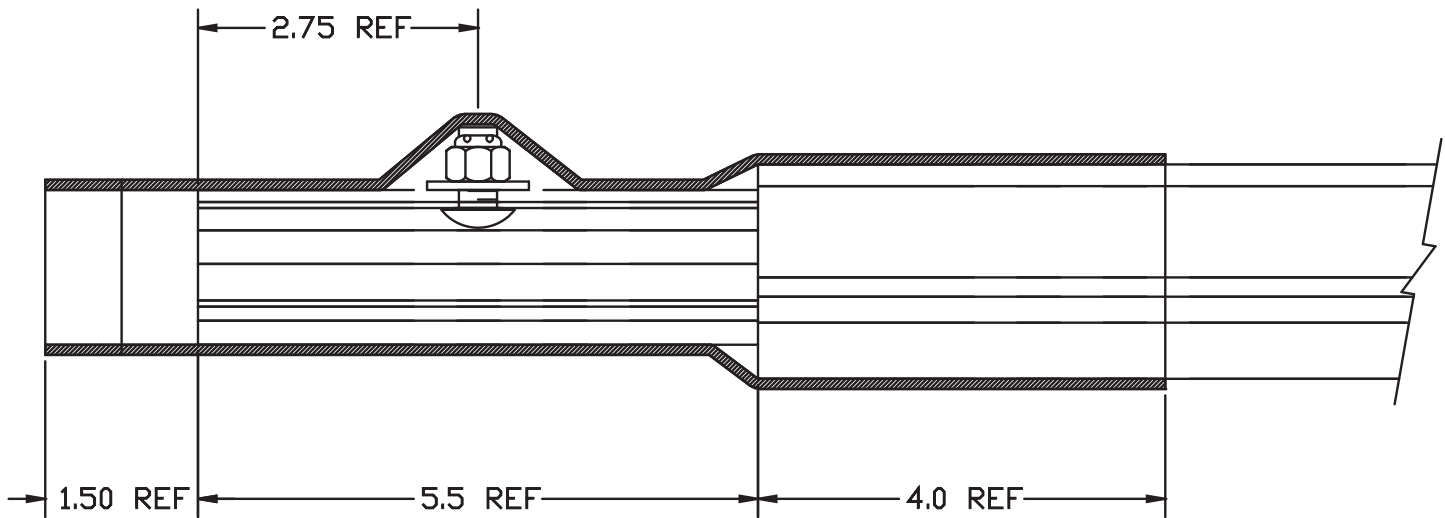
Tools needed: 1/2" open end wrench
Torque wrench with 1/2" socket
Heat gun

End cover kits include: Heat shrink tubing, bolt, and nut. A reference drawing of a standard heat end cover is shown in Figure A-15.

Installation:

- (a) With approximately 5.50" (140mm) bar exposed position 5/16" - 20UNC x 0.75" carriage head bolt into top slot on bar approximately 2.75" (70mm) from end of bar.
- (b) Install 1/4" hex nut and tighten with a 1/2" open end wrench.
- (c) Torque nut with torque wrench to 10-11 ft-lbs.
- (d) Position heat shrink tubing over end of bar approximately 9.50" (241mm)
- (e) Using a heat gun shrink tubing over bar and cover.
- (f) While shrink tubing is warm, press and flatten the excess tubing starting approximately 0.75" (19mm) behind end of bar.
- (g) When tubing has cooled cutoff excess tubing, leaving approximately 0.75" (19mm) of flattened tubing.

Figure A-15
(1500A Shown)



HIGH HEAT END COVER KITS

700 Amp

Locations: End covers are used at runway end to cover exposed conductor bar ends. The high heat end covers are suitable up to 400°F (204°C).

Tools needed: 1/2" open end wrench

End cover kits include: Insulating cover, insulating cover clamp, bolt, nut and washer

A reference drawing of a high heat end cover is shown in Figure A-16.

Installation:

- (a) With approximately 4.25" (108mm) bar exposed slide a 10.0" (254mm) conductor bar cover on conductor bar bare end. Leave excess cover hang over the edge of bar.
- (b) Slide the overlap cover over bar and cover. Make sure the outer ends of the cover and overlap are even.
- (c) Install hardware into clamp using one 5/16"-18UNC x 2.75" carriage bolt, 5/16" flat washer, and 5/16" flexloc hex nut.
- (d) Position clamp underneath bar approximately 8.0" (203mm) from end and tighten 5/16" flexloc nut with a 1/2" open end wrench until cover is firm.

1000 Amp

Locations: End covers are used at runway ends to cover exposed conductor bar ends. The high heat end covers are suitable up to 400°F (204°C).

Tools needed: 1/2" open end wrench
Torque wrench with 1/2" socket

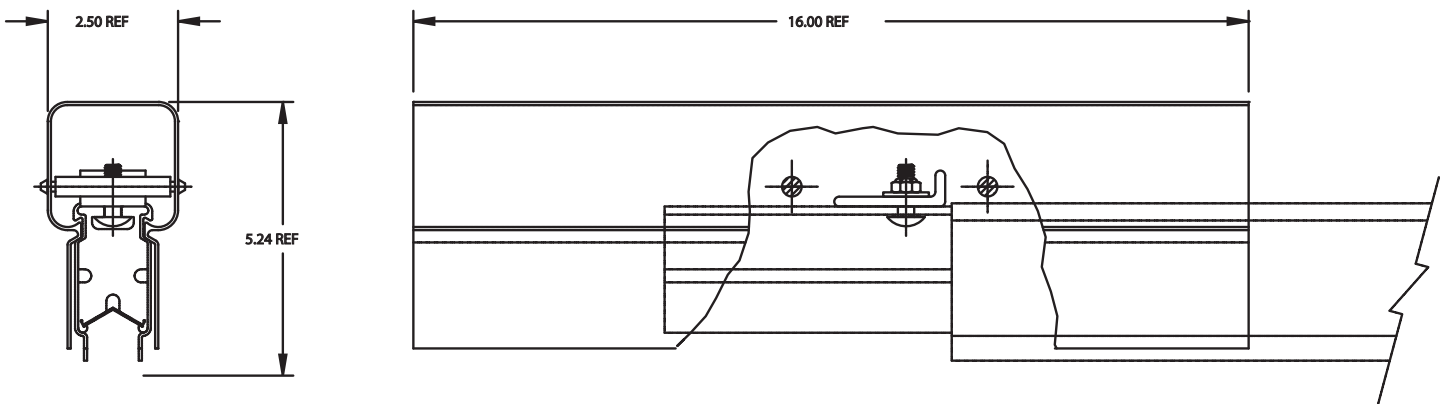
End cover kits include: Insulating cover, insulating cover clamp, bolt, nut, and washer

A reference drawing of a high heat cover is shown in Figure A-16

Installation:

- (a) With approximately 5.50" (140mm) bar exposed position 5/16"-20UNC x 1.0" carriage head bolt into top slot on bar approximately 4.5" (114mm) from end of bar.
- (b) Install "L" shape clamp on carriage bolt with leg upward and slide toward conductor bar cover.
- (c) Install 5/16" hex nut and tighten with a 1/2" wrench.
- (d) Torque nut with torque wrench to 10-11 ft-lbs.
- (e) Snap overlap cover assembly, with short end toward conductor bar, over conductor bar and cover with "L" shape clamp positioned between overlap cover pins.

Figure A-16



HEVI-BAR II MAINTENANCE INSTRUCTIONS

Inspection and Maintenance Background

Proper system performance and reliability require thorough periodic system maintenance. Each component of the system must be inspected, as a minimum annually. Many components require more frequent inspection and possibly maintenance. Bolt torque, cable connection integrity, insulating material integrity, and collector alignment and shoe wear are among the primary areas of concern.

WARNING: ALL POWER MUST BE DISCONNECTED FROM THE GUIDEWAY PRIOR TO PERFORMING ANY INSPECTION OR MAINTENANCE. PROPER LOCKOUT/TAG OUT PROCEDURES MUST BE FOLLOWED.

Should questions or concerns arise regarding the condition of the system or its components, call Conductix Corporation at (800) 521-4888.

Inspection and Maintenance Frequency

	Component	Frequency
1	Covers	Semi-annually
2	Hanger Clamps	Semi-annually
3	Conductor	Semi-annually
4	Splice	Semi-annually
5	Anchor	Semi-annually
6	Expansion	Semi-annually
7	Power feed	Semi-annually
8	End Cap	Semi-annually
9	Collector Assemblies	2 weeks after initial installation then Quarterly

Inspection and Maintenance of Covers

All covers (conductor and component overlap covers) shall be inspected semi-annually.

The integrity of the cover is critical. Damage to the cover in the form of cracks, splits, or holes requires replacement.

Inspect the visible outside surfaces of the conductor and overlap covers for signs of damage. Replace as necessary.

Inspection and Maintenance of Hanger Clamps

Check the hanger clamps to ensure there are no cracks or fractures in the molded plastic claps. Replace components as necessary.

Check bolt torque per drawing. This can be a random sampling of 2 hanger clamps between each set of anchors (distance between anchors is approximately 115" from the starting end succeeding anchor points at 230" max). If the hardware is not a minimum of 15 ft-lbs, all the hardware between those 2 anchors must be checked and/or properly torqued.

Inspection and Maintenance of Conductor

All conductors shall be inspected semi-annually.

Inspect the contact surfaces and open area inside the cover for any debris and abnormal wear in 150ft. intervals (every 5th conductor). This will give a good overall indication of the degree of debris accumulation throughout the system.

Inspection and Maintenance of Splice

Remove covers and check bolt torque. Hardware must be 11 ft-lbs.

If bolts are loose, remove the splice plate and check for signs of burning or arcing between the conductor and splice plate. Replace damaged components as required following the installation instructions. Apply conductive grease when reinstalling splices.

Check overlap covers and end caps for signs of damage. Replace as required.

HEVI-BAR II MAINTENANCE INSTRUCTIONS (continued)

Inspection and Maintenance of Anchor Clamps

Check the anchor clamps to ensure there are no cracks or fractures in the molded plastic clamps or damage to the stainless steel hangers. Replace components as necessary.

Check bolt torque per drawing. This can be a random sampling. If the hardware is not at a minimum of 30 ft-lbs. all the hardware must be checked and/or properly torqued.

If system is equipped with anchor pins, check to insure pins are not missing or broken. If pins are found missing, insert new anchor pins. If the pins are not a force fit, use RTV sealant to insure the pin is properly secured.

Inspection and Maintenance of Expansion

All expansions shall be inspected semi-annually.

Inspect the contact surfaces and open area inside the cover from any debris and abnormal wear. Verify there are no obstructions in the slots that will inhibit movement. Grab the block and determine if it is loose. Look for evidence of shoes hitting block. This could indicate that the block has come loose and will make shoes jump out of contact with conductor. The slider may have to be replaced.

Inspection and Maintenance of Power feed

Remove covers and check bolt torque to ensure it is properly torqued to 11 ft-lbs. If bolts are loose, remove the splice plate and check for signs of burning or arcing between the conductor and splice plate. Replace damaged components as required following the installation instructions. Apply conductive grease when reinstalling splices. Check overlap covers and end caps for signs of damage. Replace as required. Check to ensure the grommets are located securely in the end plugs. Check cables for abrasion or damage to the jackets. Replace as required.

Inspection and Maintenance of End Cap

Inspect the cover on the end cap for damage in the form of cracks, splits, or holes. Replace as necessary.

Inspection and Maintenance of Collector

Inspect quarterly for signs of cracks, wear, damage, dirt accumulation, or anything that would indicate an item or the assembly needs to be replaced. At a minimum, the inspection should include:

Collector arms - Inspect for cracks, deformation, or any other evidence of damage. Collector arm should be replaced at least every 5 years.

Mounting bracket and bolts - Collector mounting base is square on the vehicle and it is aligned with the conductor.

Tension spring - Spring is properly positioned on the pin in the base. Contact force and nominal distance between the mounting surface and contact surface. (Contact Conductix for force requirement). A "fish scale" may be used to check this. Hook the scale on the collector arm as close to the shoe-end of the collector. Pull the scale. The contact force is the force at which the arm begins moving away from the conductor. Replace if spring tension is not correct.

Spring Pins - Inspect for cracks, deformation, or any other evidence of damage. Verify all are in place.

Cables - Cable length between lug on shoe and cable clamp on arm is per the drawing. Cable routing to vehicle must allow free movement of collector throughout its complete range of motion. Check that cables are properly terminated to the vehicle (specification by others).

Shoe holder - Inspect for cracks, deformation, or any other evidence of damage.

All retaining rings and E-rings are securely in place.

Inspect the shoes weekly for wear and damage. Replace the shoes when the height, measured at any location along the shoe, is 3/8" or less.

If a broken shoe is found, inspect the system for the cause. Broken shoes usually result from:

Insufficient contact force causing the shoe to bounce excessively - Replace the spring as required.

Gaps at the splice joint. Loosen splice hardware and butt conductors. Tighten fasteners and torque to 11 ft-lbs.

Misalignment between adjacent conductors - Realign as required.

Misalignment between the vehicle and guideway pulling the collector beyond its maximum horizontal and/or vertical envelope - this usually happens around curves in the guideway or in locations where hanger clamps and/or mounting brackets are not properly aligned. Realign as necessary.

Inspect the shoes for uneven wear - Uneven wear can be an indication of insufficient contact force or bias on a shoe due to cable routing, incorrect location of the tension spring, or misalignment. Uneven shoe wear, if not corrected, can wear the side of aluminum resulting in the stainless steel contact surface coming loose. Both ends of the shoe must be checked for uneven wear.

HEVI-BAR II MAINTENANCE INSTRUCTIONS (continued)

Inspect the cables weekly for damage or abrasions. Ensure the electrical connections are solid and the bolted connections at the lugs are tight.

Collector Shoe Replacement

Due to a wide variety of applications and environmental conditions, no time frame is given for shoe replacement. It is recommended however that the customer do periodic inspections of the collector heads to check for shoe wear. If the contact surface of the shoe reaches the wear-line the shoe should be replaced immediately. The shoe should also be replaced immediately shows signs of overheating, is pitted, cracked or chipped. If the wear pattern on the shoe is more than 10 degrees off even, the shoe should be replaced and the collector mounting position should be re-evaluated. A minimum of 0.18" (3/16") to the nearest cover component (including overlap covers) should always be maintained.

Several conditions may lead to accelerated shoe wear. The most common conditions are:

(a) A loss of contact with the conductor surface creates an overheating situation which will cause pitting in the conductor surface. This pitting further reduces electrical contact, exacerbating the overheat condition and in turn, creates more pitting. Improper installation may prevent the collectors from maintaining adequate contact with the conductor contact surface along part or all of the complete length of the runway. This may be due to:

- a. Poor alignment of the conductor mounting brackets in the vertical and horizontal planes - In this case the collectors don't have enough travel to maintain good contact because the conductors don't stay within the optimal contact range of the collector.
- b. Improper location of the collector mounting bracket relative to the conductor (too close or too far away) - Too far away creates too little contact pressure and too close may cause the shoe to nose or drag on the end.
- c. Restricted movement of collector heads - it is essential that the collector pigtails (feed cables) to the shoes have adequate free loop to allow rotation of the collector head throughout the full range of motion. Too-short pigtails can prevent good shoe contact and cause loss of contact.
- d. Loosening of conductor joints - when too few expansion sections are used or when anchor clamps are loose, the conductor joints may separate. The gaps in the conductor contact surface caused by this separation can shave the shoes down and cause premature wear. If not detected in time, poor contact may result, creating overheating, pitting of the conductor etc.

(b) Contaminants in the environment may accumulate on the conductor contact surface. These contaminants need not be electrically insulating to cause problems; if they decrease the area of contact between the shoes and conductor, problems may arise with overheating, pitting, etc. Some contaminants may be abrasive, increasing the rate of wear on the shoes.

(c) Corrosive elements may create deposits on the collector's shoe and/or the conductor contact surface they decrease conductivity at the sliding contact surface. Under severely corrosive conditions, the copper graphite shoes may be corroded to the point where less than half of the shoe is remaining, decreasing the available contact surface area and causing overheating and pitting.

(d) infrequent maintenance of the collectors can lead to worn-out shoes, poor contact, pitting etc.

TROUBLESHOOTING

Problem	Possible Cause(s)	Possible Solution(s)
Overheating/Burning Conductor	Loose splice	Disassemble component, clean mating surfaces, apply EJC, and re-torque hardware replacing Belleville washers and nuts
	Loose power feed and/or lug(s)	
	Overloading	Check electrical loading by doing a load survey. Rectify if not according to system parameters.
Arcing/pitting on the stainless steel insert at the splice	Loose splice	Disassemble component, clean mating surfaces, apply EJC, and re-torque hardware replacing Belleville washers and nuts
	Misaligned conductors resulting in the copper shoe losing contact	Disassemble component, clean mating surfaces, apply EJC, realign conductors and re-torque hardware
Arcing/pitting on the stainless steel insert	Collector not making good contact with conductor	Check alignment of conductor with respect to vehicle. Adjust position of hanger clamp and/or hanger bracket. Verify contact force of collector is 8-12 lb. Replace tension spring on collector arm. Investigate stainless steel insert for debris and/or misaligned splice joints causing collector to bounce. Remove debris and/or align conductor in splice. Check vehicle's running surface for anything causing sudden lurch of the vehicle or excessive vibration. Adjust as necessary.
Arcing/pitting on the stainless steel insert at an isolation	Large voltage potential between both side of the isolation	Check for debris and/or misaligned isolation joint causing the collector to bounce. Remove debris and/or align conductors adjusting for a smooth transition of the collector shoe as required. Splice short pieces of conductor on either side of the isolation that can be easily replaced when worn out. Compare voltage drop from feed points on either side of the isolation. Adjust the location of the power feeds if possible.
Conductor binding/shaking in between hanger clamps	Hanger clamp not "squared" with the conductor	Loosen hardware on hanger clamp, make square with conductor and re-torque. Check for debris and/or cracks in cover impeding expansion and contraction of conductor. Remove debris with compressed air and/or water. Replace cover if necessary.
	Expansion gap set incorrectly	Measure expansion gap and adjust according to the gap setting chart
	Anchor clamp not tight	Check torque of the hardware on the anchor. Re-torque as required. Check anchor clamps and verify none are cracked or fractured. Replace as necessary.

TROUBLESHOOTING

Shoe Chipping on leading edge	Misaligned splice, power feed, and/or isolation	Check alignment of conductor joints at splice, power feed, and isolations by running a shoe across the joint by hand. Adjust alignment of conductors as required.
	Insufficient contact force of shoe on conductor resulting in the shoe “tipping” up on the bar and impacting the leading edge	Verify correct position of collector base to contact surface then measure the contact force of the shoe on the conductor with a spring scale. Contact force should be 8-12 lbs. Replace spring if necessary.
Excessive shoe wear (<4000 miles/shoe)	Misaligned splice, power feed, and/or isolation	Check alignment of conductor joints at splice, power feed and isolations by running a shoe across the joint by hand. Adjust alignment of conductors as required.
	Arcing/pitting on the stainless steel creating a rough surface	See “Arcing/pitting on the stainless steel insert” above.
Uneven shoe wear on leading edge vs. trailing edge	Insufficient contact force of shoe on conductor resulting in the shoe “tipping” up on the bar and impacting the leading edge.	Verify correct position of collector base to contact surface then measure the contact force of the shoe on the conductor with a spring scale. Contact force would be 8-12 lbs. Replace spring if necessary.
	Misaligned splice, power feed, and/or isolation impacting shoe in one direction	Check alignment of conductor joints at splice, power feed, and isolations by running a shoe across the joint by hand. Adjust alignment of conductors as required.
Uneven shoe wear on sides of shoe	Incorrect position of tension spring on collector	Position hook of spring in top slot of pin in base so spring is pulling the collector shoe into the conductor and “up” from the running surface (refer to collector drawing).

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