



**ELECTRICAL BUS SYSTEMS
O & M MANUAL
FOR
RECEIVING, STORAGE,
INSTALLATION,
&
PREVENTIVE MAINTENANCE
ON
SEGREGATED AND NON-SEGREGATED PHASE
BAR BUS EQUIPMENT**

Electrical Bus Systems

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Revision History		
Number	Comment	Date
	Original version	9/25/2005
1	Updated torque requirements, reformatted manual	4/4/2014
2	Updated Section 3 Equipment Storage	4/8/2014
3	Updated Section 3 Equipment Storage & document formatting	5/19/2014

FOREWORD

Introduction

The following pages contain information and illustrations that have been collected for the purpose of assisting construction, better understanding our products, how they are to be received, stored and maintained.

Since all AZZ Bus Systems products are designed per customer specifications there is no intent to define a specific project but rather to explain in general as many given applications as possible for concept only. Exact applications should be confirmed with engineering drawings for specific orders involved.

Safety

Before installation begins or before any bus or equipment is connected to the generator, switchgear, transformers, etc., all primary and secondary power must be de-energized and all equipment grounded. All personnel involved in the installation should first be instructed on safety procedures set forth by the contractor or responsible party for installation.

General

It is the intent of AZZ Bus Systems to sell a complete and coordinated bus system. The engineers design all parts of the job from terminal to terminal. Customer consideration is required in the determination of what and how much is to be supplied. When the order is shipped the Bill of Materials is a complete list of all necessary parts to satisfy the contract. The installation crew should be able to use the Bill of Materials as a supplemental guide.

If there are any questions concerning Bar Bus equipment, please call the following number and ask for the Project Manager:

AZZ BUS SYSTEMS
120 AZTEC DRIVE
RICHLAND, MISSISSIPPI 39218
(601) 939-9191 (Phone)
(601) 932-2513 (Fax)

If needed, a AZZ Bus Systems Field Service Representative can be scheduled for travel to your facility. Please make arrangements by calling the following number and ask for the Bus Systems Installation Service Department:

AZZ BUS SYSTEMS
120 AZTEC DRIVE
RICHLAND, MISSISSIPPI 39218
(601) 939-9191 (Phone)
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RECEIVING AND STORAGE

1. On Site Inspection

NOTE: AZZ Bus Systems will not be responsible for shortages or damage if not notified within thirty (30) days after receipt of the shipment.

Receiving Inspection:

1. Receiving starts when the items arrive at a storage facility or construction site before unloading or unpacking from shipping vehicle.
2. Preliminary visual inspection or examination shall be performed prior to unloading to determine if any damage occurred during shipping.
3. If any damage occurred during shipment contact factory immediately.

Bill of Materials:

The Bill of Materials supplied with the project should be used for incoming inspection and will show the following:

- a. Item number
- b. Reference drawing description number
- c. Bar Bus section (number and/or letter)
- d. P. O. number
- e. Quantities and description of all associated materials for the stated run

How Bar Bus sections will be marked:

All Bar Bus sections will be marked as shown on the Bill of Material (i.e. 3A/3B). These end markings correspond to the housing splice and bus end numbers found on the layout drawings. See layout drawings for specific section marking instructions.

Crate Markings:

Crate Markings will include the following information:

- a. Destination
- b. Return Address
- c. Crate number
- d. Purchase Order number
- e. Handling instructions
- f. Weights and Dimensions
- g. Special instructions (if applicable)Unloading of Equipment

2. Unloading Equipment

CAUTION: All equipment must be unloaded carefully. Under no circumstances should a shipping crate be dropped or otherwise subjected to abuse during handling.

Preferred Method:

The preferred method of unloading Bar Bus, associated equipment and crates from the trailer is with a crane by placing slings under the crate. Spreaders and other protective means should be used to keep the cables or slings from damaging equipment and crates.

Using a Loading Dock:

If a crane is unavailable equipment may be unloaded from the truck by means of a loading dock. The dock must be at the same level as the trailer bed. The crates can then be safely pulled off the trailer.

Using a Fork Lift:

If a dock is unavailable and a forklift is used for unloading, a means of supporting the crate/equipment as it is pulled from the carrier must be employed. (i.e. forks on lift must span width of crate). Forks should lift on crate only not on the equipment. In most cases forks should be a minimum of 8 feet. This is to prevent the crate or equipment from falling and causing damage to the contents.

NOTE: Do not remove or disassemble any crating, supporting blocks, banding or sealing materials prior to removal from storage. If equipment is not to be stored, then crating may be disassembled to allow equipment to be moved to its installation point. However, no internal blocking supports or sealing materials should be removed until equipment is at its installation point. If any disassembly of crates or equipment is required for unloading or storage, consult AZZ Bus Systems factory. Once the equipment is unloaded, it should be stored in accordance with Section 3 "Equipment Storage", (shown below).

3. Equipment Storage

Protection From Environmental Exposure:

All equipment requires protection from exposure to salt spray, rain, dust, dirt, physical damage and other contaminants. All equipment should be stored within a fire resistant, tear resistant, weather tight, and well-ventilated building or equivalent enclosure. If outdoor storage is required, it should be temporary and protected as described above.

Protection From Vandalism and Flooding:

Precautions shall be taken against vandalism. The area should be located and constructed so that it will not be subject to flooding; the floor shall be paved or equal, and well

drained. Items shall be placed on pallets above water levels or shoring to permit air circulation.

Control of equipment in storage:

1. Inspections shall be performed and documented on a periodic basis to assure that the integrity of the item and its container is being maintained. If storage of equipment is greater than 6 months, the inspections shall be performed bi-monthly. The characteristics verified during inspections shall include items such as:
 - a. Identification and marking of all equipment and crates
 - b. Protective covers and seals both temporary (shipping purposes) and permanent
 - c. Coatings and plated surfaces
 - d. Physical damage
 - e. Cleanliness

Structural Steel:

1. All galvanized structural steel (supports or supporting structures) materials may be stored outdoors in an area marked and designated for storage, which is well-drained, preferably gravel covered or paved and reasonably removed from the actual construction traffic area so that possibility of damage from construction equipment is minimized. Items shall be stored on pallets, shoring or equivalent to allow for air circulation and to avoid trapping water.
2. Structural steel that has been coated by means other than hot dipped galvanizing process must remain covered (by means of tarp or equivalent covering) during storage to prevent rust or corrosion. Painted surfaces must be maintained.

Care of Equipment:

1. All equipment should be maintained as received from the factory. If any items listed under Section 3 "Equipment Storage" (on page 8 of this document) require maintenance, consult factory before proceeding with any maintenance.

Removal of Equipment from Storage:

1. Only items which have been inspected and are considered acceptable for installation or use in accordance with storage control procedures shall be removed from storage for installation or use.

INSTALLATION

1. **Bill of Materials:**

The Bill of Material is very important for organizing the installation of the bus system. The following instructions will help use it correctly.

- a. The Bill of Material provides each customer with the following:
 1. Item
 2. Total number of units
 3. Number of units
 4. Description of parts
 5. Associated part and reference drawing numbers
- b. The item number references the drawing number where information may be found concerning details of the item.
- c. All parts and equipment can be identified from the Bill of Materials by the item number. Each part or piece of equipment will be identified by a Bill of Material tag or item number stamp.
- d. All steel supports will have the item number written on each piece.
- e. Only pull the parts or equipment, which you plan to install at the time. Items pulled in advance may get misplaced or lost. Small items may be difficult to identify if tag is removed or lost.

2. **Applicable Drawings:**

- a. Drawings should be reviewed and any questions answered before installation begins.
- b. The installation contractor should understand the working relationship between the Bill of Materials and drawings before installation begins.

3. **Steel Supports:**

- a. Steel supports are generally the first item that should be erected for the Bar Bus system.
- b. Dimensions given on the drawings should be verified while erecting the steel.
- c. All steel should be plum, level and at the right elevation.

4. Erecting Bus Sections:

- a. All slings should be nylon or equivalent, to prevent damage to the bus enclosure. Metal straps or chains should never be used as a alternative method of lifting.
- b. The bus should be lifted by overhead means, it is permissible to lift indoor bus using a duct lift.
- c. To avoid damage, spreader bars should be used along with nylon slings to distribute the weight of the bus.
- d. Installation of bus sections should begin from a fixed location such as transformer, generator, etc. and worked to the center portion of each run of bus if possible. All bolted connections, whether internal or external, should remain loose fit to allow for final adjustment. Final rigid connections and torquing of bolted connections should be done after all bus sections have been set in place and all fixed locations have been verified to fit correctly.
- e. After setting a bus section in the proper location make sure it is level, plum and at the correct elevation.
- f. Periodic checks should be made using the dimensions on installation drawings to assure the bus length does not grow or shrink due to adjustment that may have been made at each splice location.
- g. Refer to splice detail drawings for instructions on setting all splices.
- h. If Duct System is rigidly connected to the steel support by design where no adjustment can be made once supporting members are in place, the support members should also remain loose fit until final fit up is made.

5. Bolted Connections:

- a. No termination should be bolted until all bus has been assembled and required testing is complete.
- b. All material to complete the termination assembly will be shown on the Bill of Materials and shown on the detail drawings per application.
- c. Do not use steel wool, sandpaper or any abrasive on the silver or tin plated contact areas.

WARNING: Cleaning solvents should never be used on or around bus insulation at any time.

6. Tightening Bolts:

- a. If substitutions are necessary on hardware other than what is specified in the Bill of Materials, contact AZZ Bus Systems Engineering Department.
- b. Avoid over tightening or under tightening of bolts on conductor bolted connections. Either case will cause an inferior joint and may result in over heating at the joint.

7. Standard Fastening Procedure for Conductor Applications:

This procedure applies to all conductor fasteners. The following areas include but are not limited to: Conductor Splices, Conductor Flexible Joints, Conductor Rigid Joints, Insulator mounting, Insulator brackets, Spacers, Adapter Bars, Flexible Connectors of any type and/or any fastening means by which fasteners tie to or pass directly through a Bus Duct Conductor(s).

Typical applications are shown in Figures 1~11.

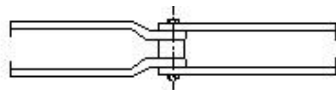


FIG. 1
BAR TO BAR SPLICE

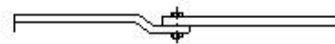


FIG. 2
BAR TO BAR SPLICE

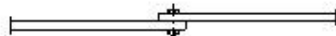


FIG. 3
BAR TO BAR SPLICE

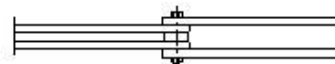


FIG. 4
BAR TO BAR SPLICE

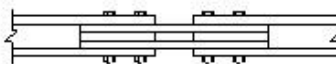


FIG. 5
BAR TO BAR SPLICE PLATE



FIG. 6
BAR TO BAR FLEX

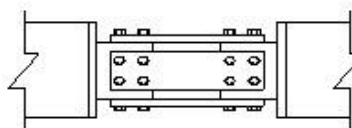


FIG. 7
TUBE STUD SPLICE PLATE

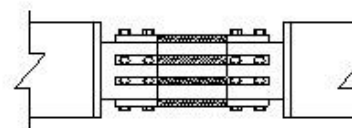


FIG. 8
TUBE STUD FLEX



FIG. 9
TUBE TO TUBE SPLICE PLATE

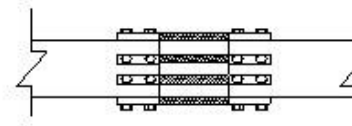


FIG. 10
TUBE TO TUBE FLEX



FIG. 11
CABLE TERMINATION

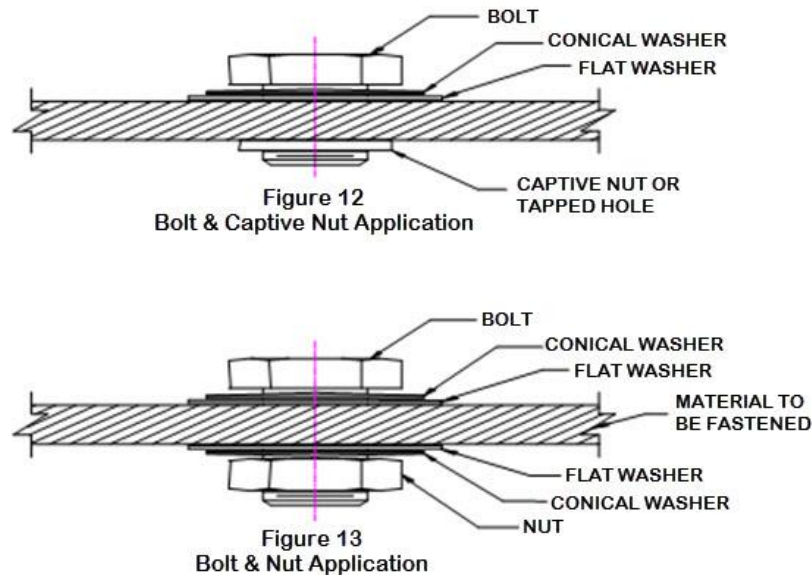
8. Conical Washers:

All fasteners shall be installed as shown in Figures 12 & 13 below. Refer to detail drawing or bill of material for hardware type and quantity.

See Figure 12, if the application is for use with a captive nut or tapped hole. A conical washer and flat washer should be placed between the bolt head and the material to be fastened.

See Figure 13, if the application is for use with a through bolt. A conical washer and flat washer should be placed between the bolt head and the material to be fastened & between the nut and material to be fastened.

Note that each application shows the conical washer should be installed so the bolt and nut will cause the conical washer to compress against the material to be fastened.



Figures 12 & 13

9. Torque Values:

Conical washers provided by AZZ Bus Systems are preset from the factory and should be set with a torque wrench to the appropriate value shown in the table below.

The various conductor and other connection conductors should be either copper or aluminum. In either case, the contact surfaces will be silver surfaced or equivalent. Do not use non-plated copper or aluminum bars/conductors, except as ground bus. All field assembled joints in primary conductors, regardless of material, should be made as described below.

Wipe contact surfaces with a clean, soft, dry, lint free cloth to remove dirt and grease. Do not use any abrasives such as sandpaper, emery cloth, or steel wool for this purpose. Avoid handling of the contact surfaces after cleaning.

After all the hardware has been installed the bolts should be tightened to the correct torque per the below chart.

Bolt Size	304 Stainless Steel	316 Stainless Steel
1/4"	6	7
3/8"	20	21
1/2"	43	45
5/8"	63	65

Recommended Torque Values – Unified (ft-lbs.)

10. Torque Marking:

Torque marks shall be made by use of a red paint stick marker.

Torque marks shall be placed across end of bolt, across top of nut, down side of nut, across washer and extend onto bolted material surface (see figure below).



Torque Marking Detail

Applications shown in Figure 12 procedure will be typical but mark shall cross bolt head.

All bolts that have been confirmed to the proper torque are to be torque marked immediately by the person who torqued the assembly.

If fasteners that have been previously torqued marked are loosened, all previous torque marks must be removed. Tightening and marking procedures must be reapplied to the entire joint. Bolts and nuts must be loosened completely and re-tightened.

Maintenance of fasteners is by visually checking the torque marks. If the mark is aligned, the fastener remains at the proper setting to provide a good joint.

Be very cautious checking torque marks. If there is any doubt, re-tighten and mark entire joint.

11. Flexible Bellows:

a. Factory Installed:

Before installation, remove bellows retainer tabs located on the interior or exterior of the bellows assembly. These tabs are only used to prevent movement during shipment.

b. Field Installed:

The surface to which flexible bellows are to be attached must first be cleaned with a suitable non-flammable cleaning agent to ensure that they are oil free, clean and dry.

After surface is clean install the bellows per bellows detail drawings.

All bellows that are installed outdoors must have a bead of Silicone Sealant applied underneath the bellows mounting surface to ensure no moisture can get inside the bus system.

Indoor bellows do not require the use of sealant.

12. Equipment Grounds:

All bus enclosure grounds will be located at the termination point. If your system incorporates an internal or external ground these connections will be found at all enclosure splices.

13. Touch Up Painting Instructions:

a. Special Notes

All painting shall be done under cover.

All painting shall be done by qualified personnel in strict accordance with the specific written instructions supplied by the manufacturer, and in accordance with this procedure.

All material must be mixed in strict accordance with the manufacturer's printed instructions.

b. Prepare Surface

Clean welds by wire brushing. Grind excess weld metal and weld spatter if required.

Clean surface by removing all oil, grease and other contaminants in accordance with Steel Structures Painting Council (SSPC-1 Solvent Cleaning).

Ensure all bus sections, boxes, and cubicles are prepped to ensure no over spray will gain entrance.

c. Apply Paint

Painting shall be done within four (4) hours of surface preparation or before any rust contamination occurs on the surface.

Paints shall be applied by spray.

Paints shall be evenly applied and the finish shall be completely free of runs, drips, sags, dirt and other defects.

Each coat shall be completely dry before the next coat is applied.

Any areas marred or otherwise damaged shall be re-prepared and repainted as necessary. (For areas where a small amount of the paint may have been rubbed off, touch-up with spray cans is allowed).

d. Conform to Specifications

The following paint materials and thickness ranges are specified.

Finish Coat

Dawn Gray Enamel (ANSI-61) at 1.2 mils (min) DFT (Dry Film Thickness).

Sky Gray Enamel (ANSI-70) at 1.2 mils (min) DFT.

Blue Gray Enamel (ANSI-24) at 1.2 mils (min) DFT.

Hi-Temp Flat Black is applied in one complete coat (no mil thickness is specified).

Flat Black Enamel at 1.2 (min) DFT.

Other colors are available as required.

Thinning Finish Coat

F75 Series shall be reduced as needed with Hi-Flash Naphtha 100, Naphtha or Xylene Dependent upon environmental conditions. 20% reduction typical. From 1 pint – 1 quart per gallon.

NOTE: Temp 70 degrees F Hi-Flash Naphtha 100.

Temp 50 degrees F Naphtha or Xylene. (Xylene will give a better flow and leveling)

Thinning 450c Hi-Temp Black – Reduce as needed with Xylene. 1 pint to 1 quart Xylene to 1 gallon FCN045DC Hi-Temp Black (20% reduction is typical).

Thinning Specifications

Check viscosity with a No. 2 Signature ZAHN cups.

F75 series finish coats 25 – 30 seconds.

SWFC Flame Control No. 450 degrees C Flat Black 30 – 40 seconds.

14. Final Inspection:

Before bus is energized the following items should be checked:

- a. All splices are completed.
- b. Terminations are completed.
- c. Covers are installed.
- d. Heaters are connected and operating (if the bus system employs this design).
- e. Bus is secured to supports.
- f. Bus and equipment is correct.
- g. Hi-Pot testing must be accomplished.

15. Field Testing:

AZZ Bus Systems recommends the use of AC Test Equipment for field-testing. All required field tests shall be performed in accordance with ANSI/IEEE C37.23-2003 Standard, Section 6.4, Field-Tests. The actual test values recommended for the field acceptance test are presented below:

<u>VOLTAGE</u> (KV-RMS)		POWER FREQUENCY <u>WITHSTAND</u> DRY-1 MINUTE	<u>D.C. WITHSTAND</u> DRY
<u>NOM.</u>	<u>MAX</u>	<u>KV</u>	<u>KV</u>
.6	.635	.65	2.32
4.16	4.76	14.25	20.25
13.8	15.0	27.00	37.50
14.4	15.5	37.50	52.50
23.0	25.8	45.00	--
34.5	38.0	60.00	--
39.0	72.5	120.00	--

PREVENTIVE MAINTENANCE

1. Bus Enclosure:

a. Moisture or condensation check:

This problem may occur during cool times of the year when humidity levels are high.

1. If moisture is present consult factory for instructions concerning removal.
2. Excessive moisture may mean a leak has developed in the enclosure. If this situation occurs consult the factory.

b. Dust, dirt and foreign material check:

The bus system is designed to prevent dirt, foreign objects and/or pests from entering the enclosure.

1. If a small amount of dust is noticed on the internal surfaces of the bus system, no service will be required. If a large amount of dust appears on internal components of the bus system it must be removed. Consult factory for recommended cleaning procedure for your bus system.
2. If dirt, foreign material or pests are noticed in the bus system consult factory for cleaning procedure.

2. Conductor Joints

a. Bolted Joints:

1. All bolted connections should be checked for torque at every outage.

2. Refer to Standard Fastening Procedure in the Installation section of this manual for maintenance of Conductor related fasteners.
3. If boots are present and removed for any reason, they should be inspected for damage before re-installing. If damage is found, please contact factory for replacement.

3. Potential Transformers

Potential transformers require no maintenance but should be inspected.

- a. If your bus system design employs the use of potential transformers they can be located per Installation Layout Drawings.
- b. Maintenance on the Bar Bus System is minimal. It is recommended that maintenance be performed at every scheduled shut down or at approximately (18) eighteen-month intervals.
- c. If dust or dirt is found all dust should be removed from the potential transformer.
- d. Check all connections and mounting hardware that may have worked loose.
- e. Any other problem with the potential transformers should be directed to AZZ Bus Systems Engineering Department.

4. Seal-Off Plates:

Maintenance in not required, but should be inspected for the following:

- a. If your bus system design employs the use of seal-off plates they can be located per Installation Layout Drawings.
- b. Inspect all seal-off bushings for cracks and dust. Remove dust if needed. If seal-off bushing is cracked it will need to be replaced.
- c. Check R.T.V. silicone to make sure the seal-off plate is still sealed. If the seal-off plate seal has been broken, reapply silicone.
- d. Check all internal mounting hardware for tightness.
- e. Any other problems with seal-off plates need to be directed to AZZ Bus Systems Engineering Department.

5. Current Transformers:

Maintenance in not required, but should be inspected for the following:

- a. Inspect current transformers for dust.

- b. Clean all dust as needed.
- c. Inspect all wiring to make sure connections are secure.
- d. Contact AZZ Bus Systems Engineering Department with any problems.

6. Flexible Bellows:

- a. If your bus system employs the use of bellows they will be located throughout the system. Refer to the Installation Layout Drawing for location of bellows.
- b. Check the silicone around each bellow to ensure the seal is watertight.
- c. For assistance in maintaining bellows reference bellows installation drawing.

7. Equipment Grounds:

All equipment grounds should be checked for loose connections and oxidation at terminals.

8. Surge Arresters:

Maintenance is not required, but should be inspected for the following:

- a. If your bus system design employs the use of surge arresters, they can be located per Installation Layout drawings.
- b. After locating the surge arresters, check for dust and remove dust as needed.
- c. Contact AZZ Bus Systems Engineering Department for any other problems with surge arresters.

9. Surge Capacitors:

Maintenance is not required, but should be inspected for the following:

- a. If your bus system design employs the use of surge capacitors they can be located per Installation Layout Drawings.
- b. After locating surge capacitors, inspect for dust and remove as needed.
- c. Contact AZZ Bus Systems Engineering Department for any other problems with surge capacitors.

10. Switches:

Should require no maintenance, but should be inspected for the following:

- a. Remove access covers and inspect switches for dust and dirt.

- b. Remove dust as needed from switches (See Section 1.b. "Dust, dirt and foreign material check" on Page 18 under PREVENTIVE MAINTENANCE, Bus Enclosures).
- c. Check all plated surfaces for corrosion.
- d. Check all mounting hardware for tightness.
- e. Contact AZZ Bus Systems Engineering Department with any other problems.

11. Gaskets:

- a. All gasket and sealing washers should be replaced when covers are removed for any reason.
- b. Remove old gasket before applying the new.

12. Hardware:

All hardware used in AZZ Bus Systems are for specific design conditions. Please contact the factory before changing any hardware.

13. External Insulators and Supports:

- a. All support insulators should be cleaned where needed.
- b. All support insulators should be checked for cracking. All cracked insulators must be replaced.
- c. All hardware in the support steel should be checked for tightness.