

# **INSTRUCTION TO SERVICE**

ITS: 60823	October 2, 2023	
SECTION:	290-ELECTRICAL SCHEMATICS	
WRITTEN BY:	Ilan Kizner	
SUBJECT:	Rework - OVHD charge cable rework to prevent water intrusion	
ISSUE:	Low isolation faults present due to water entering the cable	
SUMMARY:	Rework OVHD, HV positive and negative cables and adding securements	

# **ITS-60823**

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WARNING: Only trained personnel shall supervise and perform High Voltage system testing, checkout and troubleshooting. Two personnel (one called the Checker & the other called Monitor/Recorder) shall perform Checkout Procedures, together, to ensure safety of themselves, others nearby & for the protection of vehicle & property. Refresher training shall be provided to these personnel on a regular basis and when new systems are to be checked by them.

- 1. Turn the master run switch to the off position and wait 5 minutes before proceeding.
- 2. Turn the 12/24V battery disconnect and HV Interlock switch to the "OFF" position.
- 3. Lock and tag the electrical system of the bus out and retain the key. See Figure 1.
- 4. Use commercially available lockout equipment and tags being sure to follow local regulations.
- 5. Install a Lockout/Tagout Steering wheel cover as require.

*NOTE:* Refer to the Lockout/Tagout Procedure in section 1 of your Preventive Maintenance Manual or section 9 of your Service manual for additional information.

*NOTE:* Use commercially available lock out equipment and tags being sure to follow any local laws or workplace procedures.

*NOTE:* Refer to New Flyer High Voltage Safety Guidelines and Procedures Document 532295 (Appendix A) when completing installation or service work on high voltage power cables.



Figure 1: Lockout tagout location reference.



- 6. Locate the DC RL SW POS and DC RAIL NEG TO DC RL SW NEG cables and disconnect the quick disconnect connectors from the overhead charge rail box. See Figure 2.
- 7. Remove the cable ring terminal mounting hardware on each cable and set aside for re-installation. See Figure 2.
- 8. Remove any clamps and hardware securing the cables in place and set aside for re-installation.
- Using a hard plastic bristles cleaning brush (sourced locally) along with contact cleaner P/N 1034975 remove any signs of corrosion from the Amphenol quick disconnect cable connectors and the OVHD charge box mating connector.
- *NOTE:* Use NFI approved respirator with organic vapor cartridges, and nitrile rubber gloves.

*NOTE:* If cleaning process does not remove the corrosion from the cable or the mating connectors, replace the parts through the regular warranty procedure.

- Remove Clamps &

   Mounting Hardware.

   Negative

   Remove Call

   Remove Clamps &

   Mounting Hardware.
- *NOTE:* The following sections applies for both positive and negative cables.

Figure 2 - OVHD HV POS and HV NEG cables location reference.



10. After removing the corrosion from the two HV cables, place them on a work bench or suitable work surface. Install supplied O-Ring P/N – 1036285 as shown. See Figure 3.



Figure 3 - O-Ring installation location reference.

- 11. Locate the ring terminal on each cable and remove 756938 loom end cap 31.5mm and the heat shrink. Clean ring terminal and cable sheathing with alcohol 134336 and a dry lent free cloth. See Figure 4.
- 12. Apply several coats of Scotchkote 1035894 on the portion where heat shrink was removed until void is full. Allow applied Scotchkote to dry. See Figure 4.



Figure 1 - Scotchkote applied on lug and cable location reference.



13. Apply heat shrink 251215 to the cable lug ends and over the cable sheathing. See Figure 5.



Figure 2 – Cable lug and sheathing heat shrink location reference.

14. Re-Install loom and apply heat shrink 028412, over the loom and the lug heat shrink. See Figure 6.



Figure 3 – Heat shrink applied over loom and lug heat shrink location reference.

15. Re-Install the loom end cap 756938 on top of the ring terminal and the loom. See Figure 7.



Figure 4 - Cable loom end cap installation location reference.



- 16. Using the DC rail cable support bracket 1038376 as a template mark the hole locations shown below. See Figure 8.
- 17. Drill the mounting hole locations using a drill and 25/64 drill bit. See Figure 8.





Figure 8 – DC rail cable support bracket drill location reference.



**NEW FLYER**. 18. Install inserts 736408 using an insert tool in the locations shown below. See Figure 9.



Figure 9 – Bracket insert location reference.



- 19. Secure DC rail cable support bracket 1038376 using 6 bolts 20B04010 and 6 washers 50W04000. See Figure 9.
- 20. Install clamps 752906 (two per cable) as shown in figure 11. Secure each clamp using 2 x 20B04036 bolts, 2 x 50W04000 washer and 2 x 72N04000 nylon nuts.
- *NOTE:* Torque clamp and bracket screws to 4-5 FT-LB.
- 21. Re-connect the cable quick disconnect connectors to their respective connection points.
- 22. Re-connect the cable ring terminals to their respective connection points on the charge rail. Torque cable lug hardware to 15 ft-lbs.
- 23. Re-install the cable clamps removed to complete the rework and torque to 6 ft-lbs.
- 24. Re-connect the plugs to the receptacles.
- 25. Ensure all tools and debris are removed from the work area and return the bus to service condition.



Figure 10 – Bracket and POS and negative HV cable securements



LABOUR ESTIMATE				
	Operation	Number of Technician(s)	Hours	Labor Time T X HR
1	Rework cables and adding securements	2	5	5

PARTS REQUIRED					
			Qty.		
Item	Part Number	Description	per Coach	Units	Notes
1	20B04010	BOLT HEX. 1/4-20 x 0.625	6	EA	
2	20B04036	BOLT-HEX 1/4-20 X 2.25 SS	4	EA	
3	50W04000	WASHER-FLAT 1/4 NOM	14	EA	
4	72N04000	NUT-NYLON LOCK SST 1/4-20	4	EA	
5	736408	INSERT-PEM 1/4" AELS8-420-165BS	5	EA	
6	752879	PLATE-CLAMP COVER GR 4	2	EA	
7	752906	CLAMP-SINGLE 1.24	4	EA	
8	1038376	BRACKET-DC RAIL CABLE SUPPORT	1	EA	
9	251215	TUBE-HEAT SHRINK 1.0" BK	6	IN	
10	028412	TUBE-HEAT SHRINK 1.7" BK	1	EA	
11	1036285	O-Ring P/N	2	EA	
12	1034975	CONTACT CLEANER	0.010	EA	
13	134336	ISOPROPYO ALCOHOL	0.010	EA	Source locally
14	1035894	3M SCOTCHKOTE ELECTRICAL COATING FD	0.001	EA	



# <u>Appendix A – NFIL Spec 532295 - High</u> <u>Voltage Safety Guidelines & Procedures for</u> <u>New Flyer Battery Bus</u>

The following provides general guidelines in relation to safety and best practices when completing installation or servicing work on any New Flyer battery bus vehicle platform.

This document is not meant to supersede the actual released installation and assembly drawings and where conflicts arise, the released engineering drawings take precedence.



# Introduction

The utmost concern, while working with High Voltage (HV) systems, is the safety of yourself, other personnel and the potential of damage to property. To minimize these risks, it is crucial to be properly trained and always maintain a very alert, questioning and disciplined attitude without fail. As soon as your guard is lowered, then the potential of an accident is probable that can hurt or kill yourself or someone else and possibly damage property.

#### What is High Voltage (HV)?

Any form of voltage that is greater than 50 volts if the person's skin at the electrical contact points is not compromised and not wet.

# **Equipment Required**



The following equipment shall be required:

Digital Multimeter (DMM), 1000 volt Category II, 600 volt Category IV, 10Megohm impedance or greater with insulated case or rubber holster

Clamp-on current probe, 1000 volt Category II, 600 volt Category IV High Pot Tester (Hi-Pot)

Phase rotation meter

Personal Protection Equipment (PPE) appropriate for 700volt DC & 230 volt AC with Class 00 or higher HV gloves with compatible leather over gloves. Appropriate safety glasses as well as the face shield. The PPE shall also meet the required Arc Flash & Arc Blast requirements. Before use, inspect the PPE in accordance with this guideline.

Adequate lighting

HV insulated mat

Two fused HV clip leads 10 inches long

Safety barricade with warning lights & "Danger High Voltage" signs

Belt tool pouch (use only to carry small components up/down a ladder)

Torque Screwdriver set

Imperial torque nut driver set

Metric torque nut driver set

Imperial 1/4" torque drive socket set

Imperial 3/8" torque drive socket set

Insulated rescue hook

ABC Fire extinguisher, 5 lb minimum, at the activity areas

Spare HV and low voltage fuses

# Equipment Calibration

All test equipment must be within their calibration interval and recorded such with the respective serial numbers. These records must be available to the Checker.

# **Personnel Requirement**

Only trained personnel shall supervise and perform High Voltage system testing, checkout and troubleshooting. Two personnel (one called the Checker & the other called Monitor/Recorder) shall perform Checkout Procedures, together, to ensure safety of themselves, others nearby & for the protection of vehicle & property. Refresher training shall be provided to these personnel on a regular basis and when new systems are to be checked by them. The training of the personnel shall consist of:

HV & low voltage basics, intermediate & advanced electricity		
HV & low voltage electrical systems of the vehicle		
Shop safety practices & procedures		
First aide including CPR & the use of the shop defibrillator		
How to release a victim that can't let go HV		
Quickest method of shutting down HV		
Fire fighting and emergency procedures		



HV & arcflash safety
Organized & tidy placement of equipment & tools allowing for unrestricted
movement
Operation of Hi-pot
Operation of Phase Rotation Meter

To ensure effectiveness of training, exams of the trained material shall be required with a high passing mark of at least 80% and a retraining of the missed 20 % on a one to one basis.

# **Checker Function**

(Caution: The Checker must not have any health conditions that can be exacerbated when startled and must not have any electronic implants.)

#### Vehicle Inspection

It is necessary that the vehicle to be checked out, first be visually inspected of all systems, workmanship and with special attention to ensuring there is no HV cable or equipment damage or chafing.

# High Voltage Checkout Preparation

- (1) The scope of the work must be accurately defined such as a Checkout Procedure that requires systematic steps with sign offs. Before a Checkout is performed, the Supervisor, Checker and Monitor/Recorder must conduct a briefing of what shall transpire, identify potential hazards, resist pressures of "is it done yet?", anticipate problems and question possible events. If an unexpected electrical hazard or fault occurs, during any time of the Checkout, it must be immediately reported to the supervisor. After the Checkout is completed the same group should review the results and processes and make proposed modifications to the procedures if required.
- (2) Install Safety barricade with warning lights & signs indicating "Danger High Voltage" around the vehicle perimeter and ensure no personnel are within the fenced perimeter during the checkout procedure.
- (3) It shall always be the goal to check the systems as much as possible with all HV power OFF and Locked Out/Tagged Out and proven as de-energized by voltage measurement using the DMM. The functionality of the DMM must be proved before and after the verification of no HV present. Then, if possible, the HV systems should be challenged by trying to energize them while checking that no HV appears.
- (4) When it is necessary to perform tests of HV systems with the power ON, then the Working Live procedure must be followed.
- (5) The test personnel shall always rehearse the actions required in case of any possible accident scenarios.
- (6) Before beginning the Checkout Procedure, the test personnel shall remove all their jewelry (including pierced ones), watches and any electrically conductive objects on them.

# **PPE Requirements**

The PPE voltage class, Arc Flash and Arc Blast rating shall be compatible with the voltage and Arc Flash capability of the systems being tested. Appropriate leather glove protectors shall be worn over the HV rubber gloves.



# **PPE Care & Testing**

Rubber insulated PPE shall be periodically cleaned and tested in accordance with 29 CFR 1910.137 and the appropriate ANSI/ASTM standards. HV gloves, sleeves and mats shall be tested every 6 months. PPE apparel shall be cleaned and maintained in accordance with the manufacturer's instructions. A record of the PPE testing shall be maintained and available to the users.

#### **PPE Inspection**

Inspect PPE equipment, before use, for any degradation or damage and ensure that the HV gloves have been tested every 6 months. Also perform an air pressure test on the HV gloves before and after each use. If during PPE use a potential damaging incident occurred to the PPE, stop further testing and inspect the PPE. If at any time the PPE is defective, reject it, and obtain an accepted one.

#### **PPE Storage**

PPE apparel should be stored lying flat, undistorted, right-side out and not folded in protective containers. The HV mats can be rolled with an inside diameter greater than 2 inches.

Rubber HV gloves should be stored in cool, dark, dry, and free from damaging chemicals or vapors. The glove cuffs should face downwards, without folding, in the appropriate glove bag and hung vertically.

#### Insulated Tools

Insulated tools should be visually inspected for insulation damage before and after each session of use.

#### Lockout/Tagout Procedure

The Lockout/Tagout procedure should be followed that is specified in the respective Checkout procedure. When removing the lock and tag:

- (1) The locks and tags shall be removed by the installer of them or under her/his supervision.
- (2) If the installer of the locks and tags is not available, then her/his supervisor:
  - (a) Ensures that the installer of the locks and tags in not in the facility
  - (b) Contacts the installer to inform her/him that the locks and tags will be removed
  - (c) Reminds the installer of the lock and tag removal when she/he resumes work

# Stored Energy

Personnel must always remember the characteristics of stored energy devices such as capacitors and batteries and when energy is available from.

#### Working Live

To maximize safety, it is always important to perform the maximum amount of HV checkout in the de-energized state.

When it is necessary to work with HV equipment while energized or to verify whether HV is present, the utmost care and safety procedures must be utilized including:

- (1) Wearing appropriate PPE with protector gloves over top of the HV rubber gloves
- (2) Ensure all personnel, except the Checker and Monitor/Recorder, are clear of the vehicle
- (3) Kneeling or standing on HV insulated mat

# **Energizing & De-energizing Procedure**

It is critical that before any HV system is energized that a visual check be performed to ensure that all possible HV compartments are closed and there is no debris, tools or test equipment lying on HV terminations. If there is a certain sequence of energizing and de-energizing the HV system, then all personnel involved must be trained in this sequence. (**CAUTION:** Never try to connect or disconnect circuit components such as cables, fuses, connectors, etc while there is current flowing in the circuit.)



Electrical injuries should be immediately reported to the first aide personnel and the supervisor. Other than electrostatic shocks, even non-injurious electrical shocks should be reported to the supervisor. These should be immediately investigated and documented to determine the cause and prevent the occurrence in the future.

# Appendix B – NFIL PPE Categories





PPE CATEGORIES					
CATEGORY 0	CATEGORY 1	CATEGORY 2			
1.2 cal/cm2	4 cal/cm2	8 cal/cm2			
Arc Rated Clothing:					
Untreated cotton long sleeve shirt and pants	AR long sleeve shirt and pants or AR coverall	AR long sleeve shirt and pants or AR coverall			
	AR flash suit hood or AR face shield	AR flash suit hood or AR face shield and AR balaclava			
	AR jacket, parka, rainwear or hard hat liner (as needed)	AR jacket, parka, rainwear or hard hat liner (as needed)			
Other Equipment:					
Hard hat	Hard hat	Hard hat			
Safety glasses	Safety glasses or goggles	Safety glasses or goggles			
Hearing protection	Hearing protection (with inserts)	Hearing protection (with inserts)			
	Heavy duty leather gloves	Heavy duty leather gloves			