



INSTRUCTION TO SERVICE

ITS: 58912

SECTION:	Electrical
WRITTEN BY:	Daniel Tice
SUBJECT:	DC Charge Rail Box Cable Replacement

ITS-58912

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Only trained personnel shall supervise and perform the High Voltage system testing, servicing and troubleshooting contained in this procedure. Two personnel (one called the Checker and the other called Monitor/Recorder) shall perform troubleshooting and servicing procedures, together, to ensure the safety of themselves, others nearby and for the protection of vehicle and property.

PROCEDURE:

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. Install a Lockout/Tagout Steering wheel cover as required.

☞ **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.

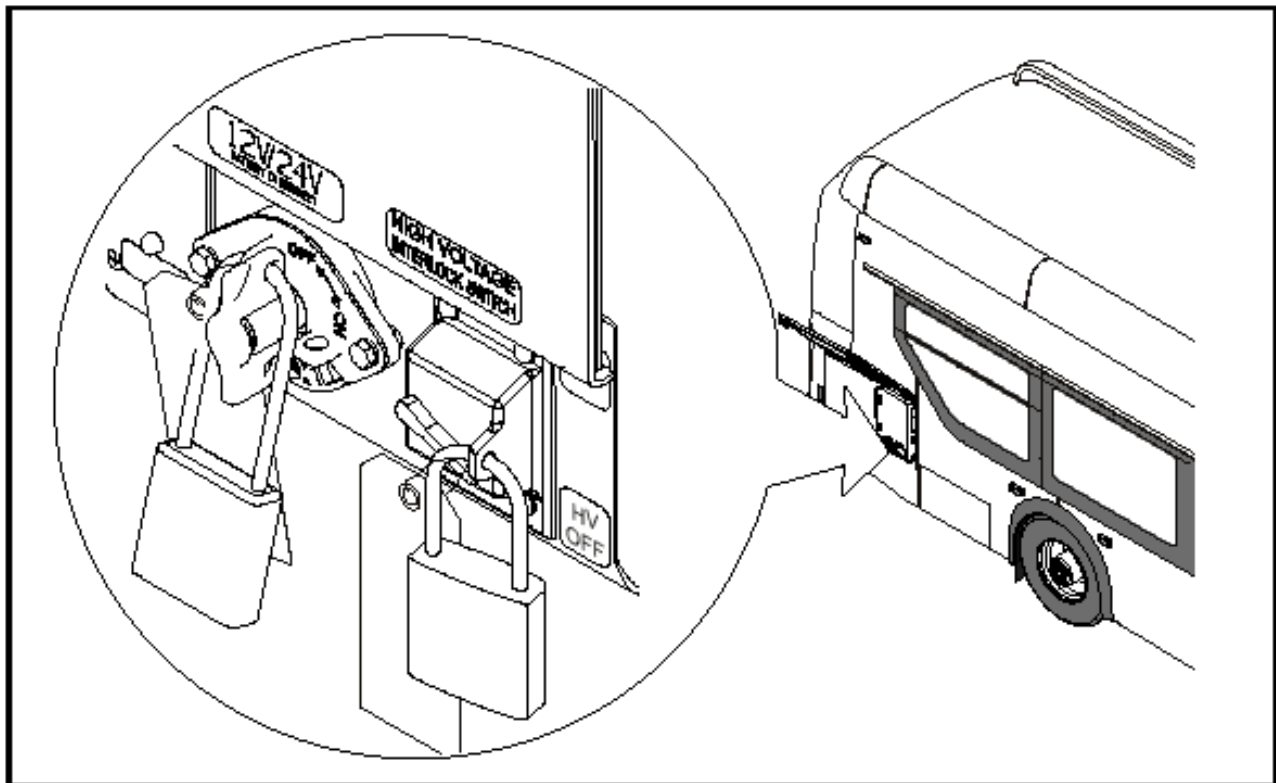


Figure 1: Lockout Tagout location reference.



⚠ Caution: Appropriate High Voltage PPE is required. Please refer to the safety section 1 of your New Flyer Preventive Maintenance Manual or Service Manual for more information. (See Appendix B)

⚠ Caution: No communication from observers with the H/V Tech and Checker while work is being performed. If required all work must stop until communication has been completed.

5. Identify the location of the Charge Rail Contactor Box that will require work. See Figure 2.

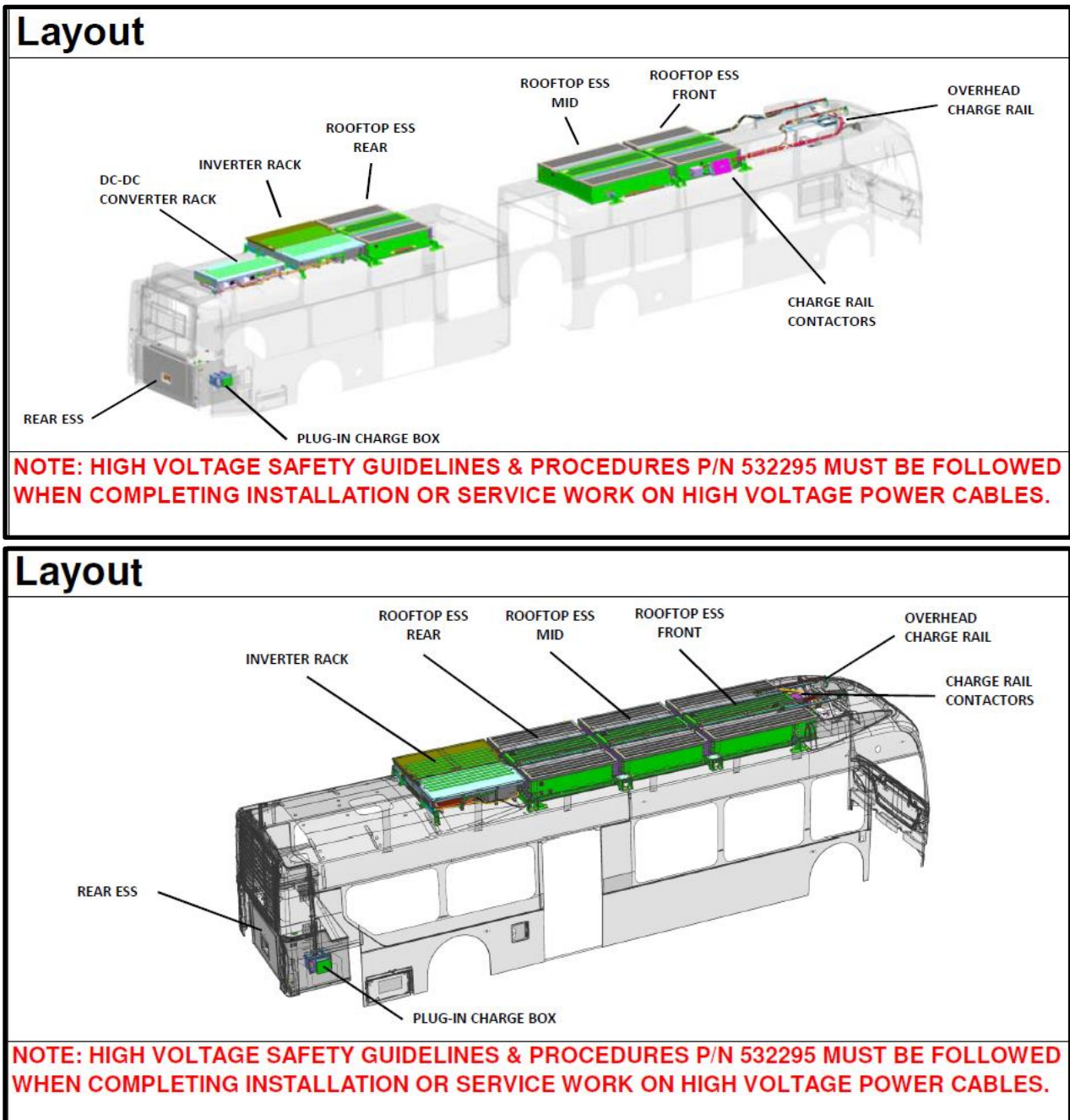


Figure 2: Battery pack string location reference.



6. Ensure the bus is not charging and gain access to the DC charge rail box where the work is required. Ensure the appropriate fall protection PPE is used and appropriate safety procedures are followed.
 - ☞ **Caution: Wear High Voltage PPE. Refer to your PM or Service Manual for PPE requirements.**
 - ☞ **Caution: No communication from observers with the H/V Tech and Checker while work is being performed. If required all work must stop until communication has been completed.**
7. Review the scope of work to be completed with the Monitor/Recorder.
8. Review/Rehearse the actions required in case of any possible accident scenarios.
9. Determine and organize the required tools neatly before work begins.
10. Remove the DC charge rail box lid and set aside for reinstallation.
11. Confirm there is NO voltage before work begins.
12. Remove the appropriate clamps and hardware to remove the cables from the box and charge rail(s).
13. Refer to the table below for the appropriate cables for your application.

SR	Property	Original	Original	Original	Original	Original	New	New	New	New	New
1682	Chicago, IL	761334	761325	761230	NA	NA	841338	841370	841390	NA	NA
2144	New Flyer Demo Bus	683594	683589	683588	NA	NA	683591 _B	683589 _B	683588 _B	NA	NA
2143	New Flyer Demo Bus	804214	804211	804087	NA	NA	841468	841477	841479	NA	NA
2165	New York City Transit Authority (New York)	685380	680858	680857	NA	NA	850470	850469	850468	NA	NA
2145	New Flyer Demo Bus	692352	692357,	NA	NA	NA	841607	841618	NA	NA	NA
2211	TRI County Metro Trans District of Oregon	724044	723967	723908	723134	NA	724044	723967	723908	723134	NA
2297	Utah Transit Authority (Salt Lake City, UT)	740677	740678	740679	NA	NA	850556	850557	850558	NA	NA
2313	UNIVERSITY OF UTAH (SALT LAKE CITY, UT)	740677	740678	740679	NA	NA	850556	850557	850558	NA	NA
2315	METROPOLITAN COUNCIL (MINNEAPOLIS, MN)	756037	756036,	756035	NA	NA	840244	840229	840257	NA	NA
2212	MBTA (Boston, MA)	756037	756036,	756035	NA	NA	840244	840229	840257	NA	NA
2318	FORT WORTH TRANSPORTATION AUTHORITY (FORT WORTH, TX)	692352	692357,	NA	NA	NA	841607	841618	NA	NA	NA
2182	Tran slink (Vancouver)	724044	723967	723908	723134	719675	841711	841742	841788	842547	NA
2213	Los Angeles County, CA (LACMTA)	771410	771411	771435	771436	829896	839727	839726	839728	839718	839710
2352	ROARING FORK TRANSPORTATION AUTHORITY (ASPEN, CO)	791605	791604	791603	NA	NA	837783	839301	839647	NA	NA

SR	Property	Original	Original	Original	Original	Original	New	New	New	New	New
2363	NEW YORK CITY TRANSIT AUTHORITY	756037	756036,	756035	NA	NA	840244	840229	840257	NA	NA
2319	SOCIETE DE TRANSPORT (MONTREAL)	791605	791604	791603	NA	NA	837783	839301	839647	NA	NA
2382	Toronto Transit Commission (Toronto, ON)	791605	791604	791603	NA	NA	837783	839301	839647	NA	NA
2403	Demo Test Bus	791605	791604	791603	NA	NA	Juice Box	Juice Box	Juice Box	NA	NA
2374	Port Authority of Allegheny County	791605	791604	791603	NA	NA	837783	839301	839647	NA	NA
2475	ST. Louis Metro	771410	771411	771435	771436	829896	839727	839726	839728	839718	839710

14. Connect the cables to the Charge rail box using the quick disconnect fittings or using the appropriate lug and gland nuts based on your application. Torque based on your application. See Figure 3.
15. Install the remaining end on the charge rail and torque. See Figure 3.

NOTE: Torque all the cable nuts, gland nuts and lug connection nuts. See Figure 3.

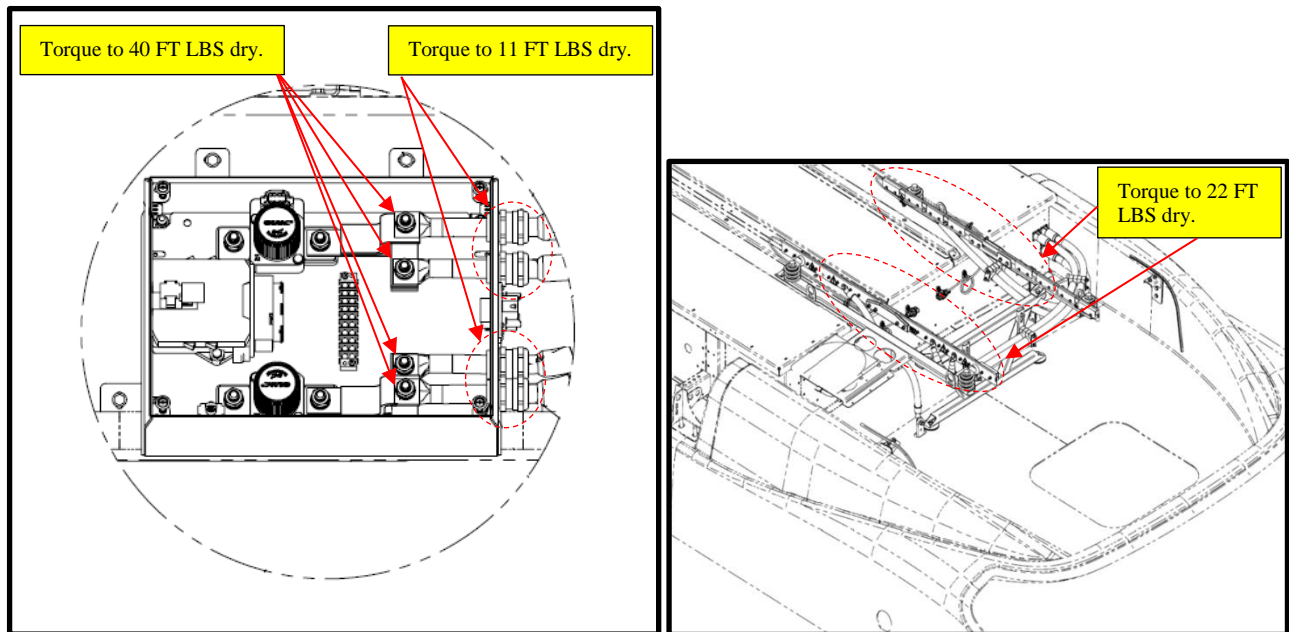


Figure 3: DC charge rail box connection location reference.



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16. Install charge rail ground cable ends to the appropriate locations on the charge rail and bus. Apply one or two drops of Loctite NF PN-081034. See Figure 4.

☞ **NOTE: Torque the ground connection to 17 FT LBS Wet.** See Figure 4.

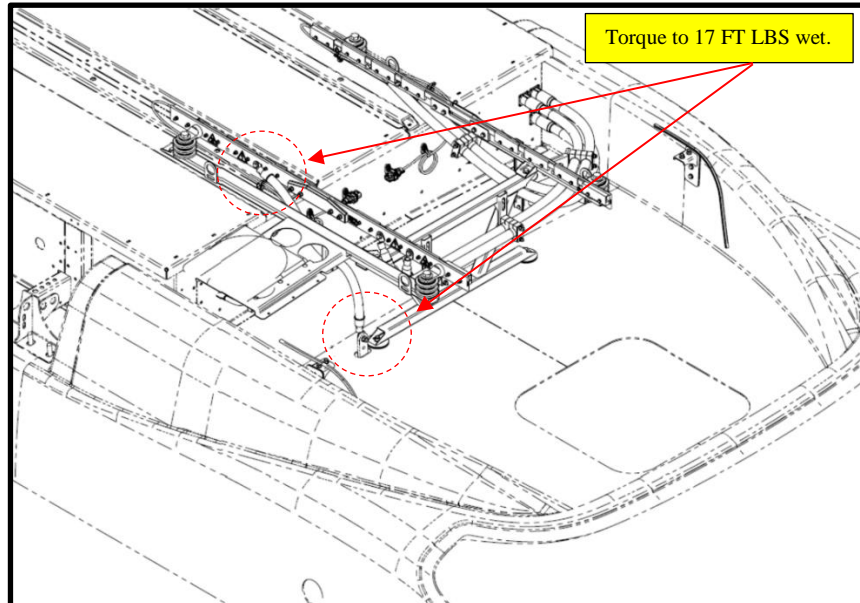


Figure 4: DC charge ground connection location reference.

17. Reinstall any clamps removed when connecting the new cables. Torque the clamp hardware based on your application. See Figure 5.

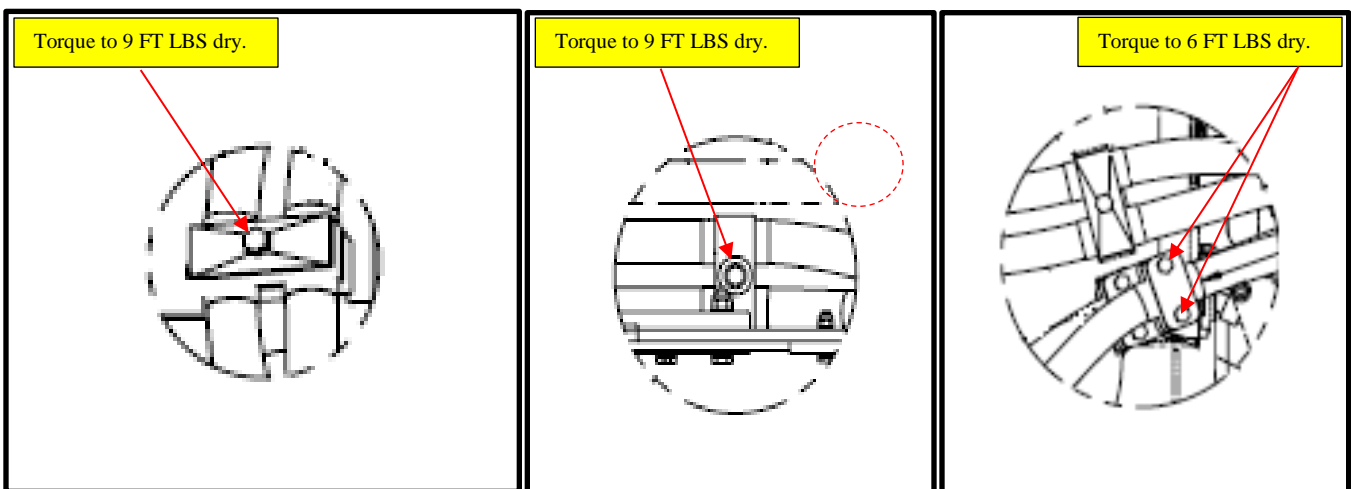


Figure 5: Clamp torque location reference.

18. Confirm that all connections are reconnected, torqued properly.
19. Ensure that all tools and debris are clear from the work area.
20. Turn the 12/24 Volt battery disconnect switch to the "ON" position. See Figure 6.
21. Turn the high voltage interlock to the "ON" position. See Figure 6.
22. Remove the lock out tag out equipment.
23. Return the bus to service.

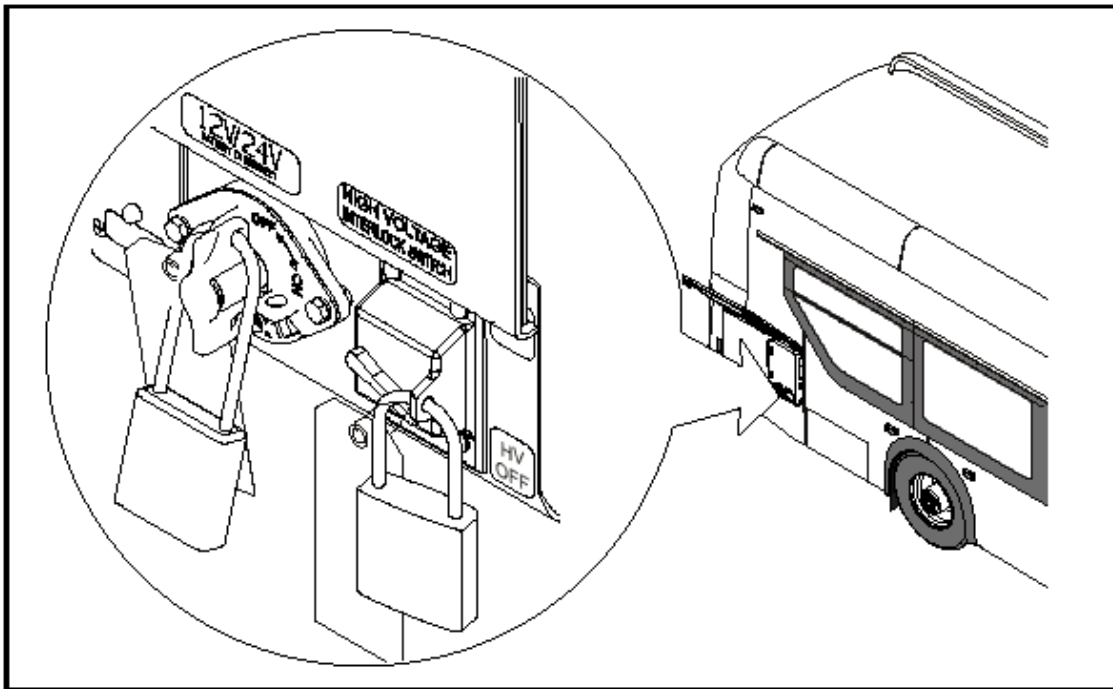
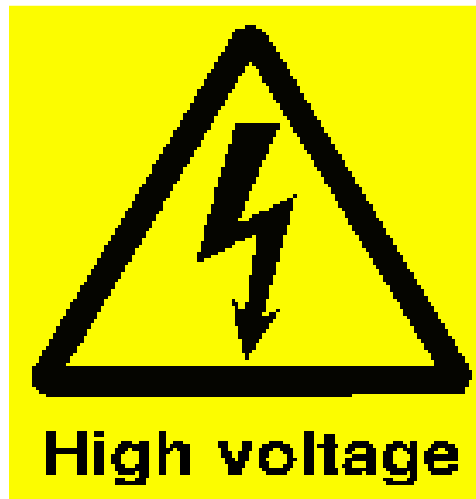


FIGURE 6: LOCKOUT TAGOUT LOCATION REFERENCE.

Appendix A – NFIL Spec 532295 - High Voltage Safety Guidelines & Procedures for New Flyer Battery Bus

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 III, 600 volt Category IV, 10Megohm impedance or greater with insulated case or rubber holster
Clamp-on current probe, 1000 volt Category III, 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:



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HV & low voltage basics, intermediate & advanced electricity
HV & low voltage electrical systems of the vehicle
Shop safety practices & procedures
First aid 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.)

Directed by the Monitor/Recorder
Performs all preparations & checks
Wears PPE as specified by the Checkout Procedure
Performs all restorations

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.



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- (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 is 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

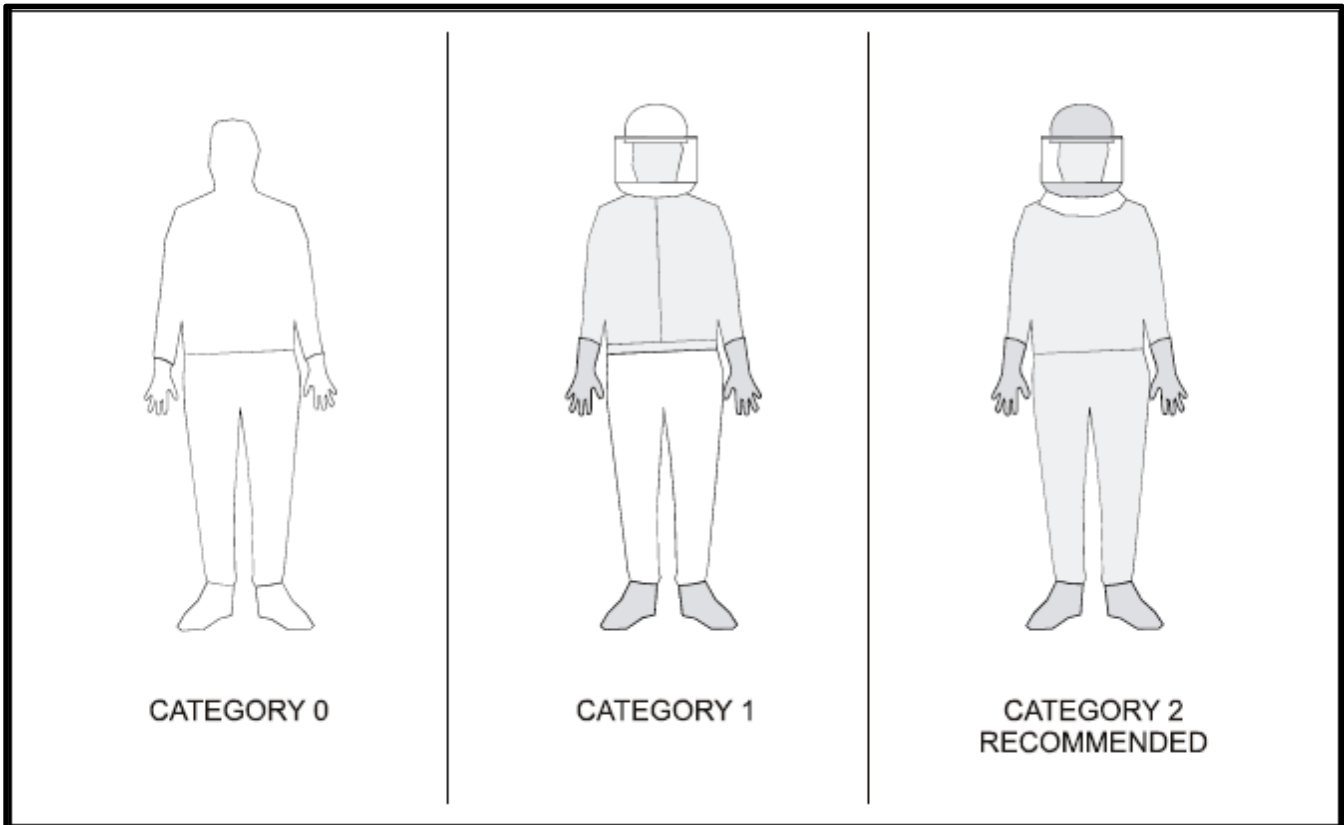
Energizing & De-energizing Procedure

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

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/cm ²	4 cal/cm ²	8 cal/cm ²
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



PPE CATEGORIES		
CATEGORY 0	CATEGORY 1	CATEGORY 2
1.2 cal/cm2	4 cal/cm2	8 cal/cm2
	Leather footwear (as needed)	Leather footwear (as needed)
High Voltage Gloves rated Class 0 (0 to 1000 VAC/1500 VDC)	High Voltage Gloves rated Class 0 (0 to 1000 VAC/1500 VDC)	High Voltage Gloves rated Class 0 (0 to 1000 VAC/1500 VDC)

LABOUR ESTIMATE				
Item	Operation	Men	Hours	Labor Time M X HR
1	Replace the HV DC Charge Rail Box Cables and Ground Cable	2	2	4.0

PARTS REQUIRED					
Item	Part Number	Description	Qty. per Coach	Units	Notes
NA	NA	NA	NA	NA	NA

NOTES
All required cables have been ordered under the RI by work orders.