INSTRUCTION TO SERVICE

ITS: 61111	08/12/2024
SECTION:	260-Battery Compartment
SUBJECT:	R&R rear mount and roof mount ESS assemblies
ISSUE:	ESS is missing internal ground strap kit and the Pre-Charge resistor need to be upgraded.
SUMMARY:	R&R the rear mount and roof mount ESS assemblies to install the ground strap kit and upgrade the pre-charge resistor.

ITS-61111

Ref. NHTSA Recall No.	Ref. Transport Canada Recall No.
Not Applicable	Not Applicable

THIS ITS DOCUMENT SHOULD BE RETAINED AND REFERRED TO FOR FUTURE MAINTENANCE UNTIL THE NEW FLYER PARTS AND/OR SERVICE MANUAL IS UPDATED TO REFLECT WORK DONE AS A RESULT OF THIS DOCUMENT. ENSURE THAT THIS DOCUMENT IS AVAILABLE FOR PARTS AND MAINTENANCE STAFF GOING FORWARD.

Warning

•Exposure to high voltages from a large modules or packs can cause shock, burns or even death.
•The high voltage components in a large module or pack can only be serviced by technicians with special high voltage training.
• Follow all necessary precautions before working on them.
• Always assume voltage is present on high voltage cables until you have verified voltage has been removed.

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
Firefighting and emergency procedures
HV & arc flash safety
Organized & tidy placement of equipment & tools allowing for
unrestricted movement
Operation of Hi-pot

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 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

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.

PROCEDURE:

Section 1 – Initial Prep Work

1. Set the park brake and chock the wheels.
2. Turn the main battery disconnect and HV interlock switch to the “OFF” position.

⚠ **WARNING:** ***The work detailed in this ITS involves working near exposed High Voltage (HV) compartments, even after the bus has been locked out and tagged out. It is recommended that the service personnel be trained in NFI HV safety practices, such as those included in NFIL Spec 532295 - High Voltage Safety Guidelines & Procedures for New Flyer Battery Bus.***

3. Perform the Lock Out Tag Out and De-Energizing procedures found in the Electrical System Section of the New Flyer Service Manual. Reference Figure 1 below.

⚠ **WARNING:** ***ENSURE MSD DUMMY PLUGS AND ARC FLASH GLOVES ARE AVAILABLE PRIOR TO STARTING ANY HV DISASSEMBLY***

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

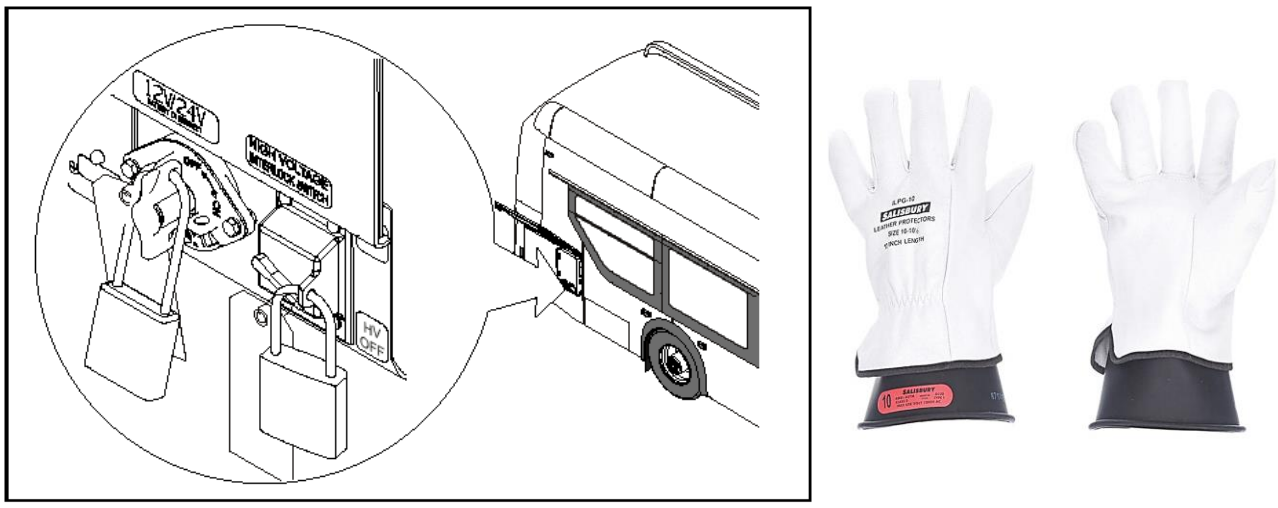


Figure 1: HV and LV Disconnect Switch Location and Arc Flash Glove Reference

Section 2 – Rear ESS Assembly Removal.

4. Open the rear ESS access door to gain access to the rear ESS area.
5. Open streetside and curbside upper side corner panels. Remove the gas springs supporting the ESS access door on the bus side and raise the access door in the up position. Tyrap the door to the bracket inside the streetside and curbside side upper corner panels.
6. From top of the bus on the curbside corner, remove the access panel to gain access to the coolant line to the roof ESS battery packs. Clamp off the supply and return rubber elbows using coolant hose clamp tools. See figure 2.

☞ **NOTE:** ***By clamping off these coolant hoses will minimize draining coolant from the ESS circuit.***

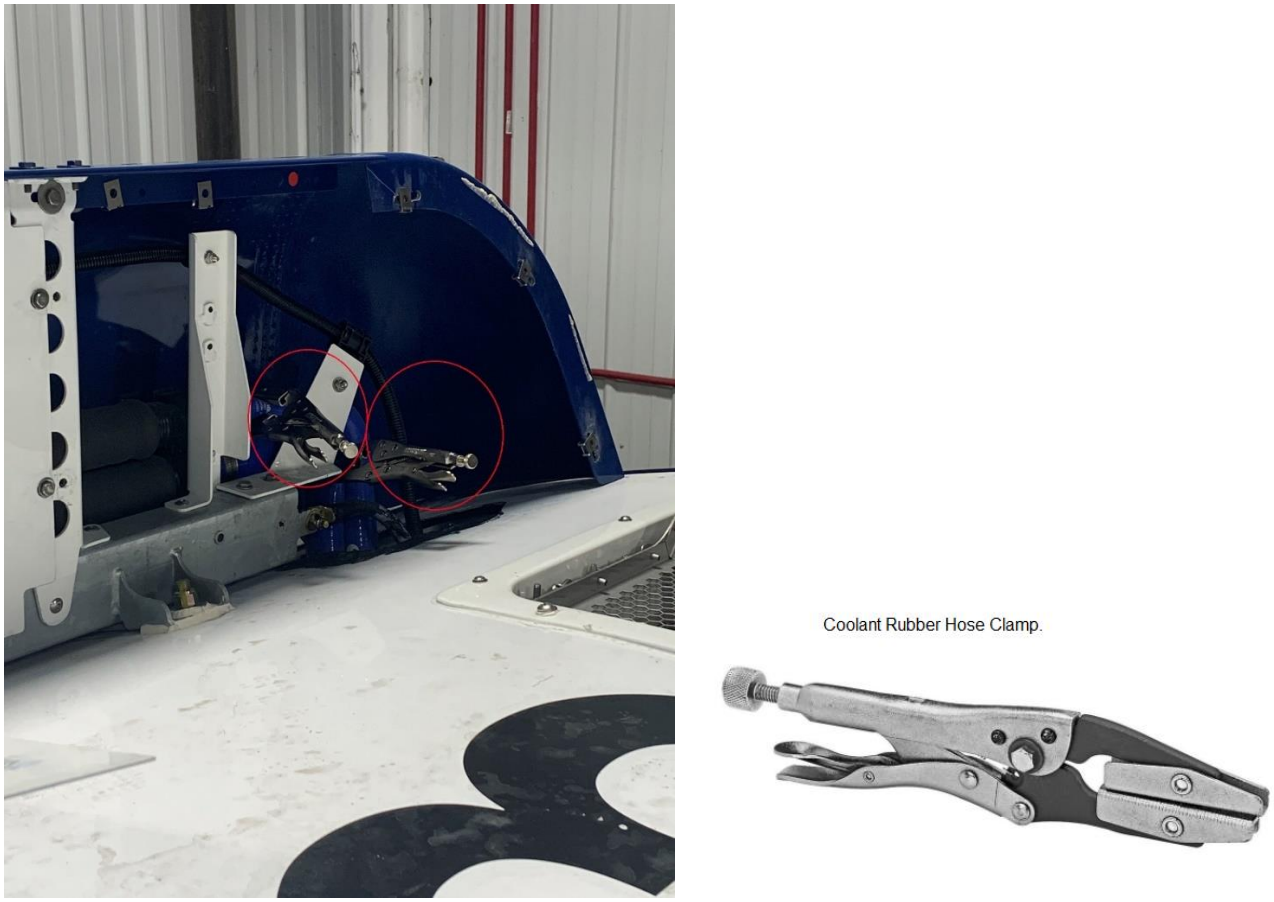


Figure 2: Roof ESS coolant lines cut-off location reference.

7. Support the rear bumper with forklift, remove the four retaining bolts, and remove the rear bumper. Save all mounting hardware for reuse later.

8. Remove the lower corner pillars (including turn signals and brake lights) and brackets. Save hardware for reuse. Reference figure 3 below.

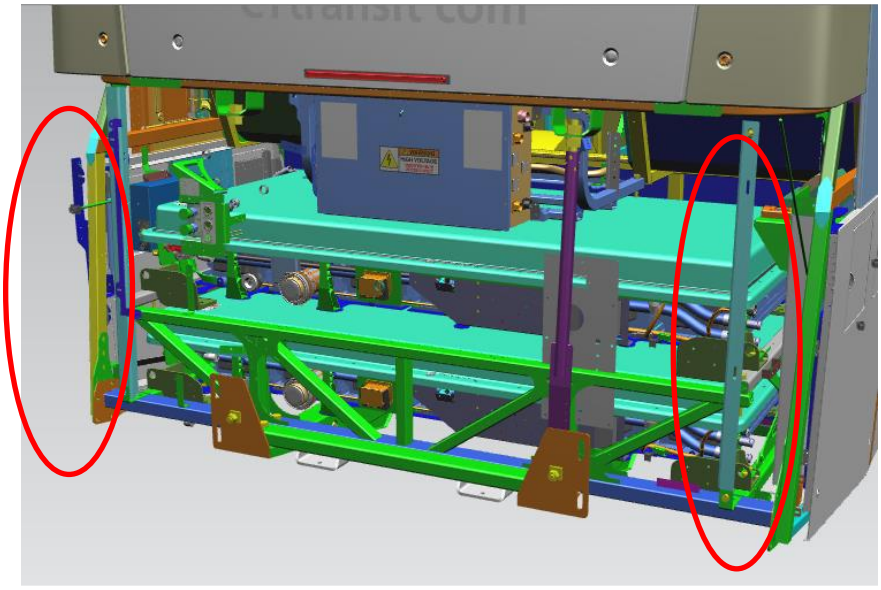


Figure 3: Lower Corner Pillars and Rear Door Removed

9. From streetside rear corner, disconnect ESS grounding strap to bus frame. Reference figure 4 below.

Figure 4: ESS ground strap to bus frame location reference.

10. Disconnect HV cables from both ESS packs. Make notes of the positive and negative connections. See figure 5 below.

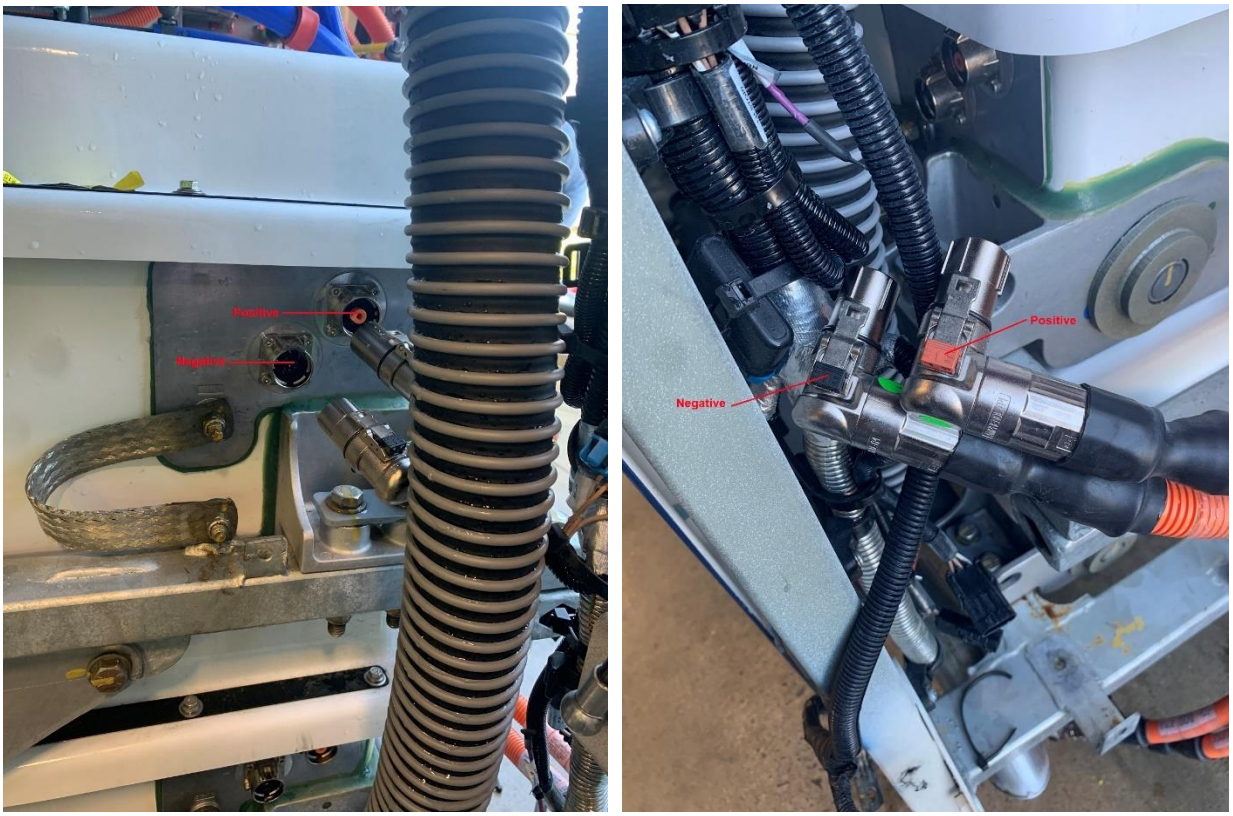


Figure 5: HV cable connections reference.

11. From the curbside rear of the bus, place a 5 gal. bucket under the ¼ turn drain vent valve. Open the vent valve to drain the coolant out of the rear ESS packs.
12. Remove the clear BTMS vent line from the ESS frame.

13. Disconnect and secure the low voltage harness connected to both ESS packs. Disconnect the supply and return coolant lines from both ESS packs. See figure 6.

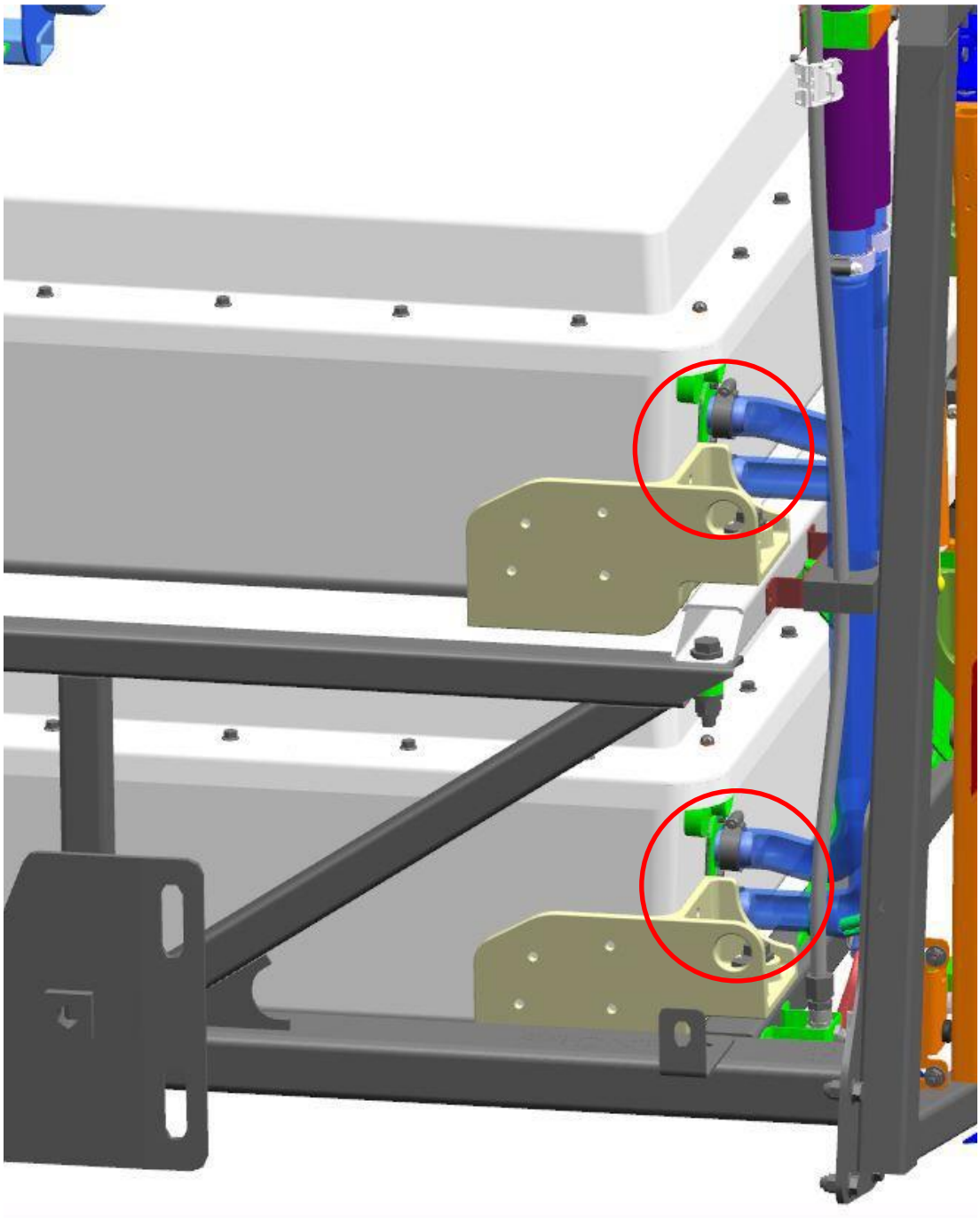


Figure 6: Low voltage and coolant line connections reference.

14. Remove the hardware between the bumper beam and side structure. See Figure 7.
15. Remove the street side and curbside struts as follows: See Figure 7.

a. Loosen the jam nut and remove the 1” upper nut on the strut.
b. Remove the ¾” lock nut, bolt, and washers that attach the lower end of the strut to the main frame rail bracket.
c. Remove the strut itself.

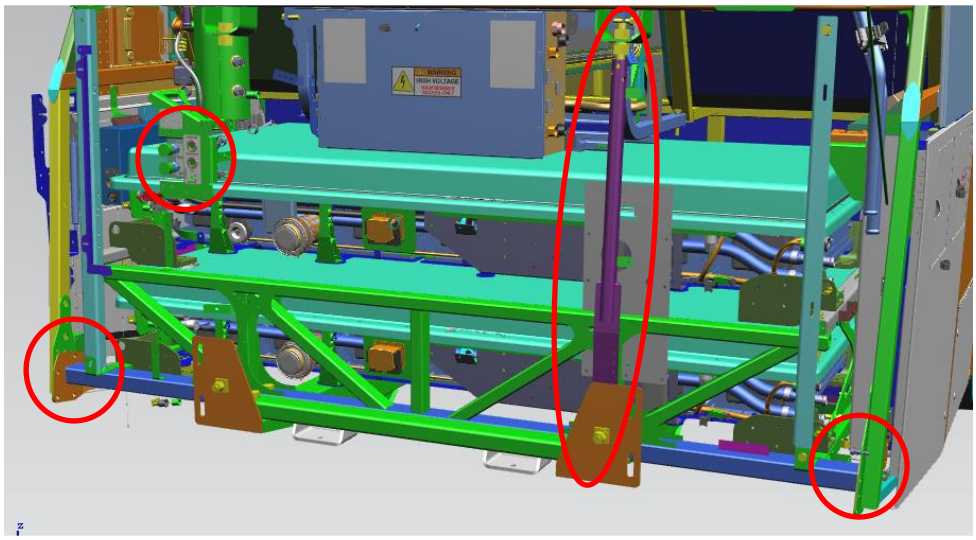


Figure 7: Rear Struts and Side Structure Hardware Removal

16. Using big tyraps, secure both struts along with, HV cables, and AC drain hoses above the ESS packs. See figure 8.

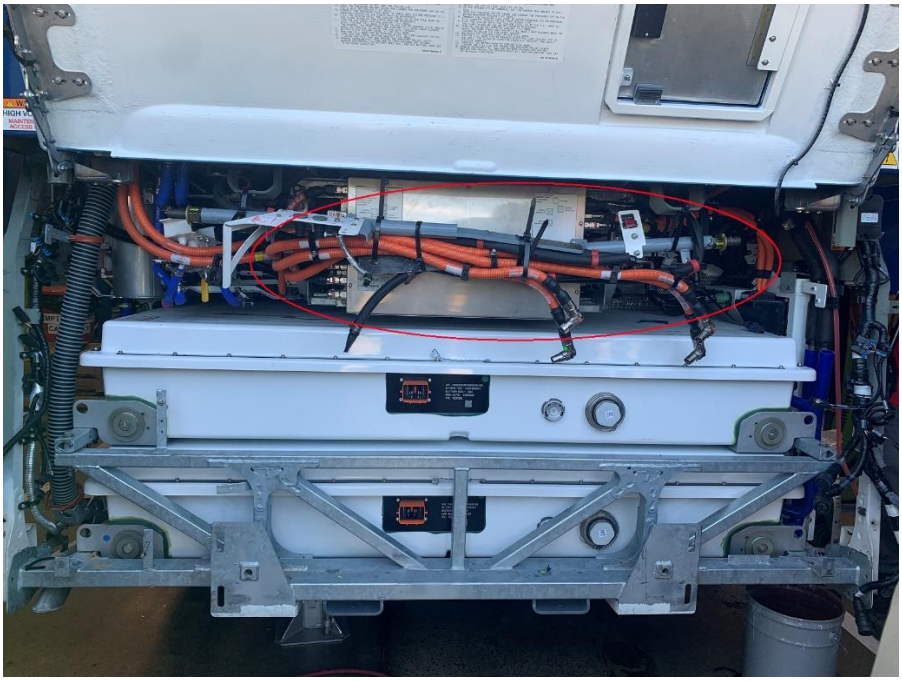


Figure 8: Struts, HV cables and AC drain hoses securement reference.

17. Support the rear frame members with jack stands as seen in figure 9 below.

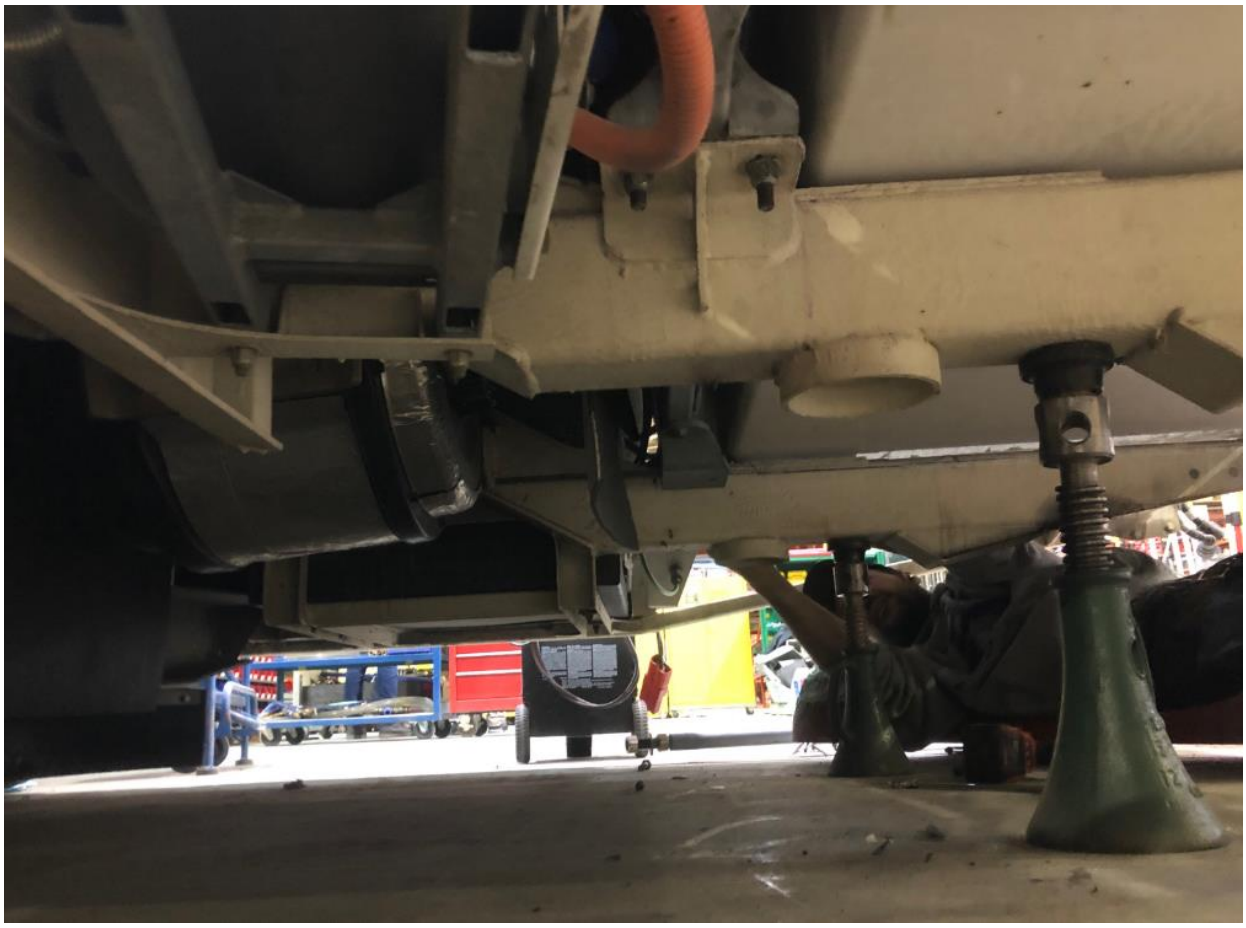


Figure 9: ESS frame member jack stands reference.

18. Remove the hardware securing the ESS rack on the front and rear chassis. Should be 2 sets on each side. Reference figure 10 below for details.

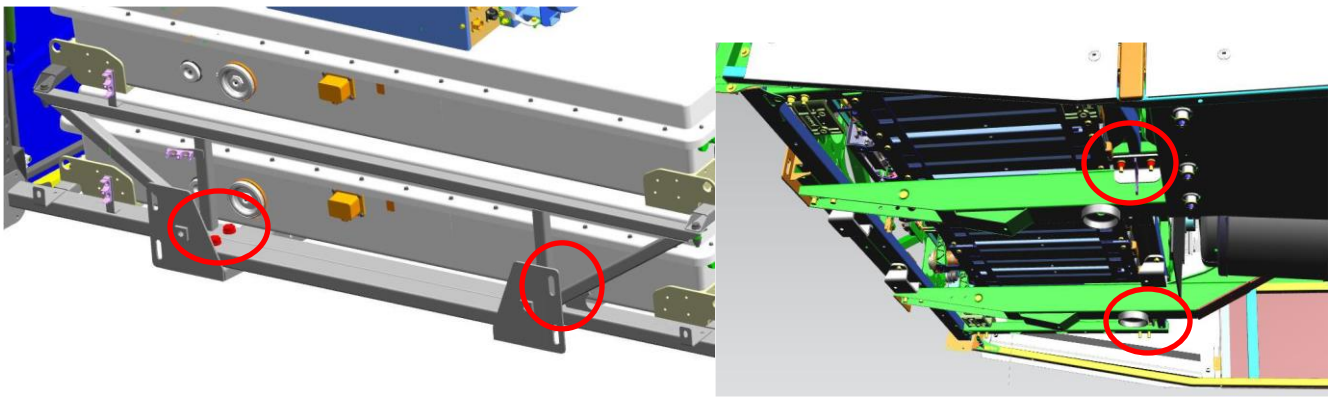


Figure 10: ESS pack assembly mounting hardware location reference.

19. Support ESS packs with forklift and remove ESS packs assembly from the bus. See figure 11.

☞ **NOTE:** Before removal of the ESS, ensure no harnesses, cables, ground straps, or coolant hoses are connected. Use a spotter to ensure the forks are captured within the pockets on the ESS frame and not resting on the composite ESS enclosure. A c-clamp will ensure that the frame does not slide on the forks.

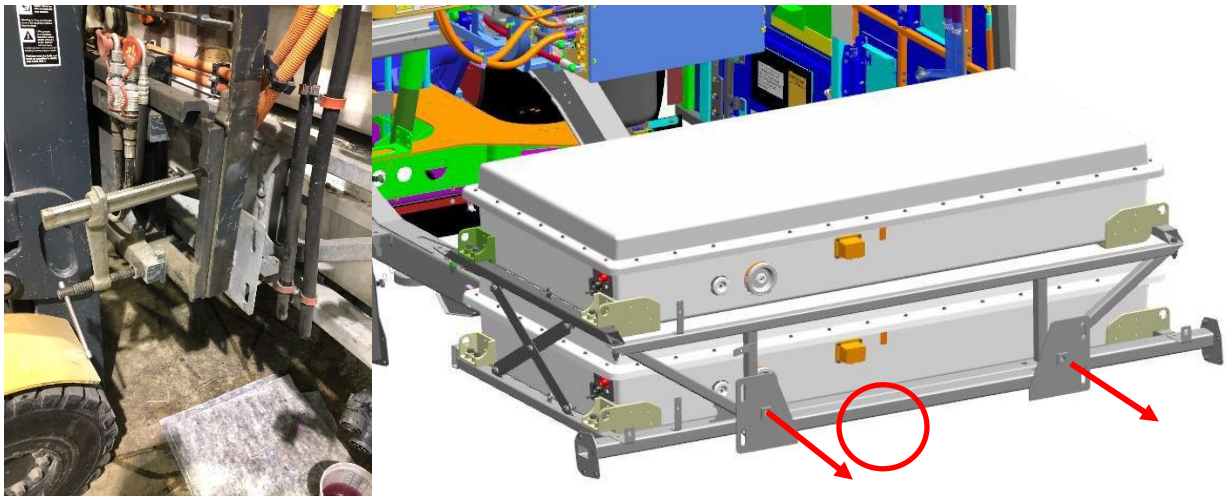


Figure 11: Rear ESS pack assembly removed from the bus reference.

20. Move the ESS battery packs to a clear and open workspace. Place block of wood under the ESS battery pack assembly on each side and two in the middle for support. See figure 12.

Figure 12: ESS battery packs wooden block under the assembly reference.

Section 3: Rear ESS Hoisting and Separating Instructions.

21. Remove fasteners securing the upper ESS packs to the frame (four fasteners on each side). See figure 13.

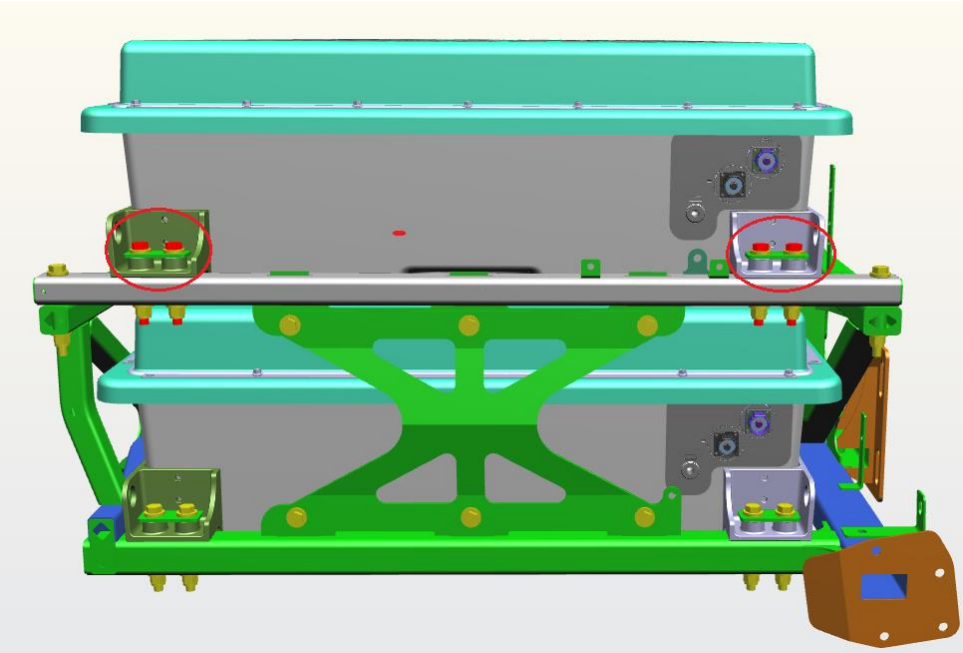


Figure 13: Upper ESS mounting hardware location reference (4 Places Each Side).

22. Use a forklift with appropriate hoist boom and straps (one in each corner), lift the upper ESS pack from the frame assembly. Reference figure 14 below for proper rigging.

Figure 14: Rigging for lifting upper ESS battery pack.

23. Carefully move the upper ESS battery pack to a appropriate work station.

NOTE: At this point, sufficient space to work has been obtained for the supplier to rework the ESS battery packs. Supplier rework documents available upon request.

24. Once the upper ESS battery pack rework is complete, reinstall the upper battery pack back into the ESS rack assembly. Secure battery pack using existing hardware (four fasteners on each side). Torque hardware to 69 ft-lbs.

NOTE: ESS battery pack assembly pressure test procedure should be performed prior to reinstall into the bus. See Appendix-A below for pressure test procedure reference.

NOTE: During reassembling, replace any nylock nuts that may be damaged during removal.

Section 4: Reinstall rear ESS assembly into the bus.

25. Using a forklift, reinstall the ESS battery rack assembly inside the vehicle and align the mounting holes to the vehicle structure. Secure the ESS battery rack assembly using existing hardware. Torque the 1/2” hardware to 69 ft-lbs. (94 Nm). Torque 3/4” hardware to 245 ft-lbs. (339 Nm). Apply yellow paint torque marks. Reference figure 15.

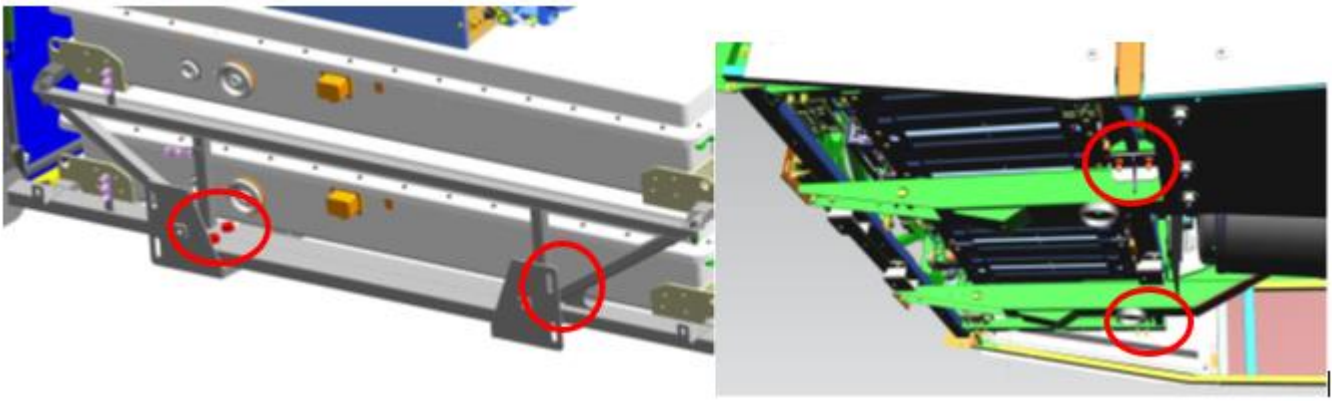


Figure 15: ESS Battery pack assembly securement hardware reference.

26. Reconnect the low voltage harnesses to the upper and lower ESS battery packs. Use zip ties (NF PN: 5962614) to secure harnesses.

27. Reconnect the coolant lines to the upper and lower ESS battery packs. Secure the coolant hoses using existing clamps. Torque clamps to 80 in-lbs. (9 Nm).

☞ **NOTE:** ***The orientation of clamps may vary to maximize clearance and access.***

28. Reconnect the high voltage cables, and grounding strap to the bus frame. Torque ground strap hardware to 22 ft-lbs.

29. Secure corner pillar brackets to pillars using existing 3/8 in. hardware on each side of bracket (3 each per side). Torque hardware to 28 ft-lbs. (38 Nm). Reference figure 16.

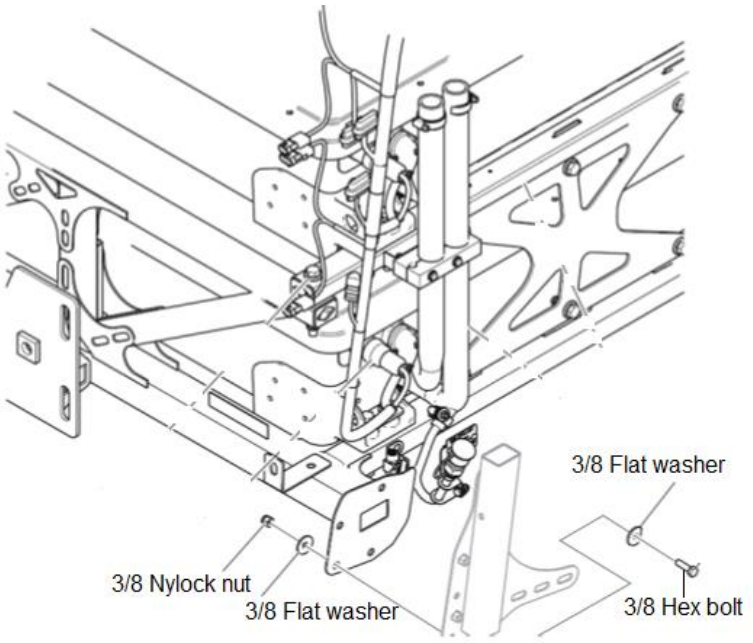


Figure 16: Secure corner pillar brackets to pillars reference.

30. Reinstall curbside and streetside lower pillar mounting brackets. Secure using existing ½ inch bolt, flat washer and nylock nut. Torque hardware to 69 ft-lbs. See figure 17.

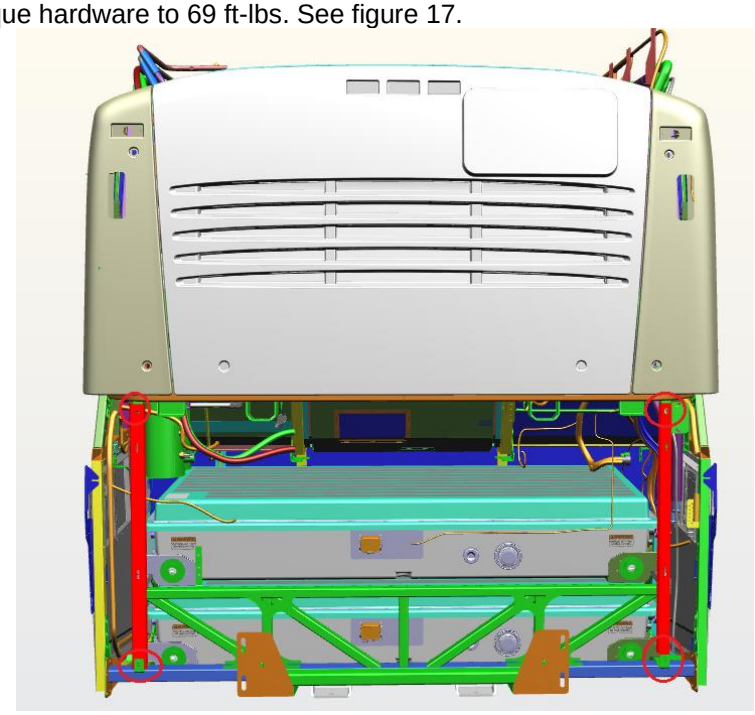


Figure 17: Curbside and streetside lower pillar mounting bracket location reference.

31. Reinstall curbside and streetside tail light corner pillar and secure using existing hardware.
32. Support strut Installation – Reference figure 18:

    a. Thread a 1” nut on the upper end of the strut until it’s nearly bottomed out.

b. Install the threaded end of strut into upper mounting bracket and loosely install the upper nut.

c. Align hole in lower end of strut with hole in main frame rail mounting bracket and secure strut to frame rail bracket with 3/4" bolt, washers, and lock nut.

d. Apply Never-Seize to bolt threads and torque lock nut to 250 ft-lb. (339 Nm).

e. Ensure lower 1" nut is backed off, then tighten upper 1" nut until contact is made with upper mounting bracket.

f. Measure the distance between the lower frame rail and upper vehicle structure.

g. Continue to tighten upper nut until the 44.84" (+/- 0.50) dimension is achieved, and then tighten an additional two turns.

h. Apply Never-Seize to threaded area of strut and tighten lower 1" jam nut to 426 ft-lb. (578 Nm).

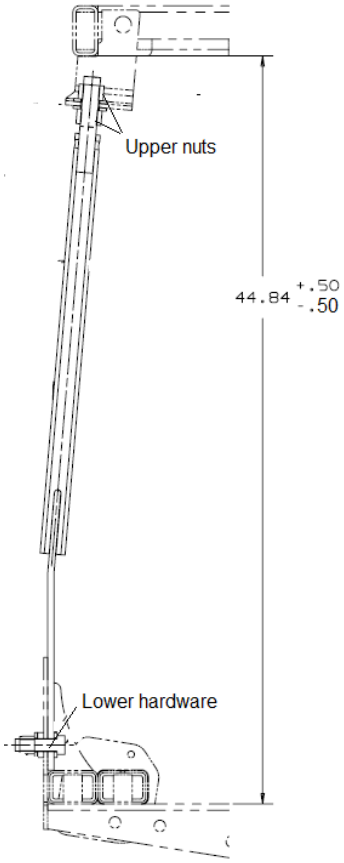


Figure 18: Strut Tensioning

33. Reinstall rear bumper – retorque rear bumper hardware to 106 ft.-lbs. Apply 1-2 drops Loctite (NF PN: 081034) to the hardware threads. Additional instruction available within the Service Manual if panel gaps require adjustment.

Section 5: Rework roof mount ESS assembly.

NOTE: Ensure steps 3 are completed before moving to the next steps. Gain access to the rooftop ESS enclosures. Ensure that appropriate fall protection, and appropriate safety procedures are followed.

34. Remove streetside and curbside, side screens in the ESS area as needed. See figure 19 and 20.

NOTE: May by necessary to remove charger rail assemble on the 40-foot buses only to be able to remove the ESS lid. See figure 19.

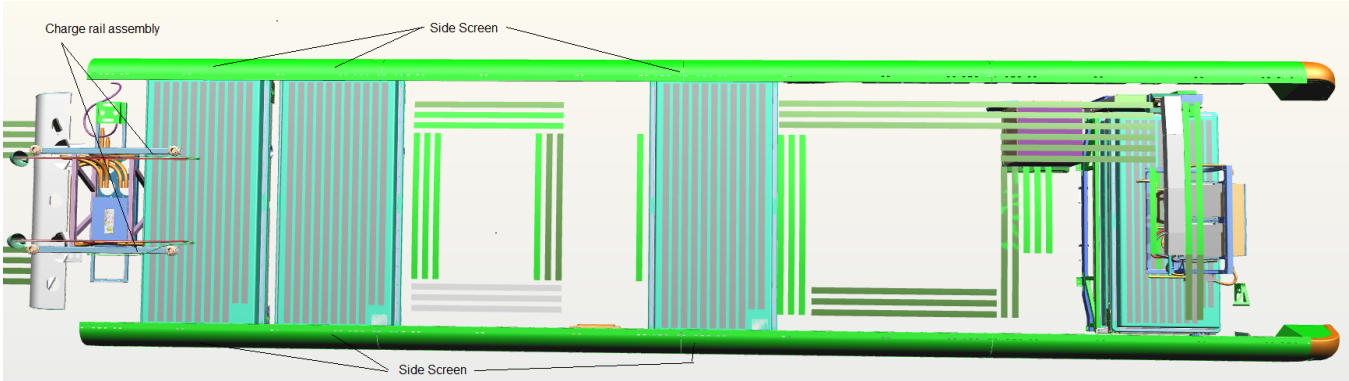


Figure 19: Typical 40-foot bus roof ESS location reference.

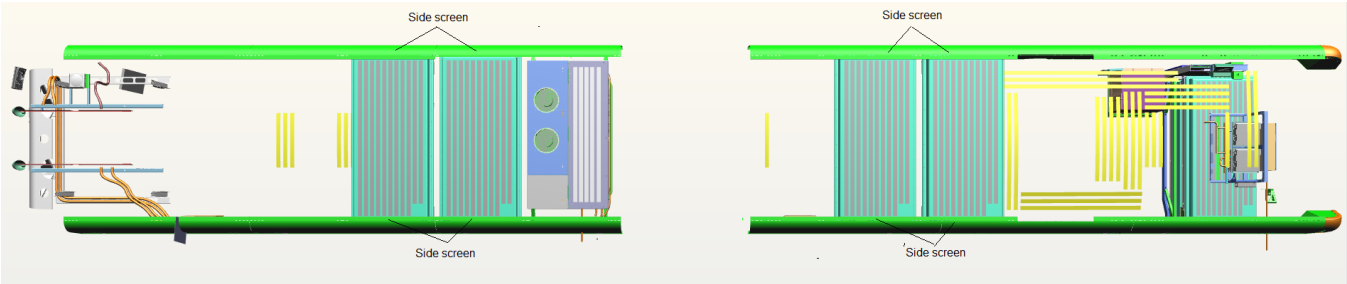


Figure 20: Typical 60-foot bus roof ESS location reference.

35. To locate the roof structure tubes, measure approximately 18.0 inches from inside edge of the side structure tube. Install 4 each Air-Shims under the ESS unit approximately 3 inches from the edge of the bottom of the tub to the edge of the air-shim. Centering the Air-Shims with the roof structure tubes. Do not inflate. See figure 21.

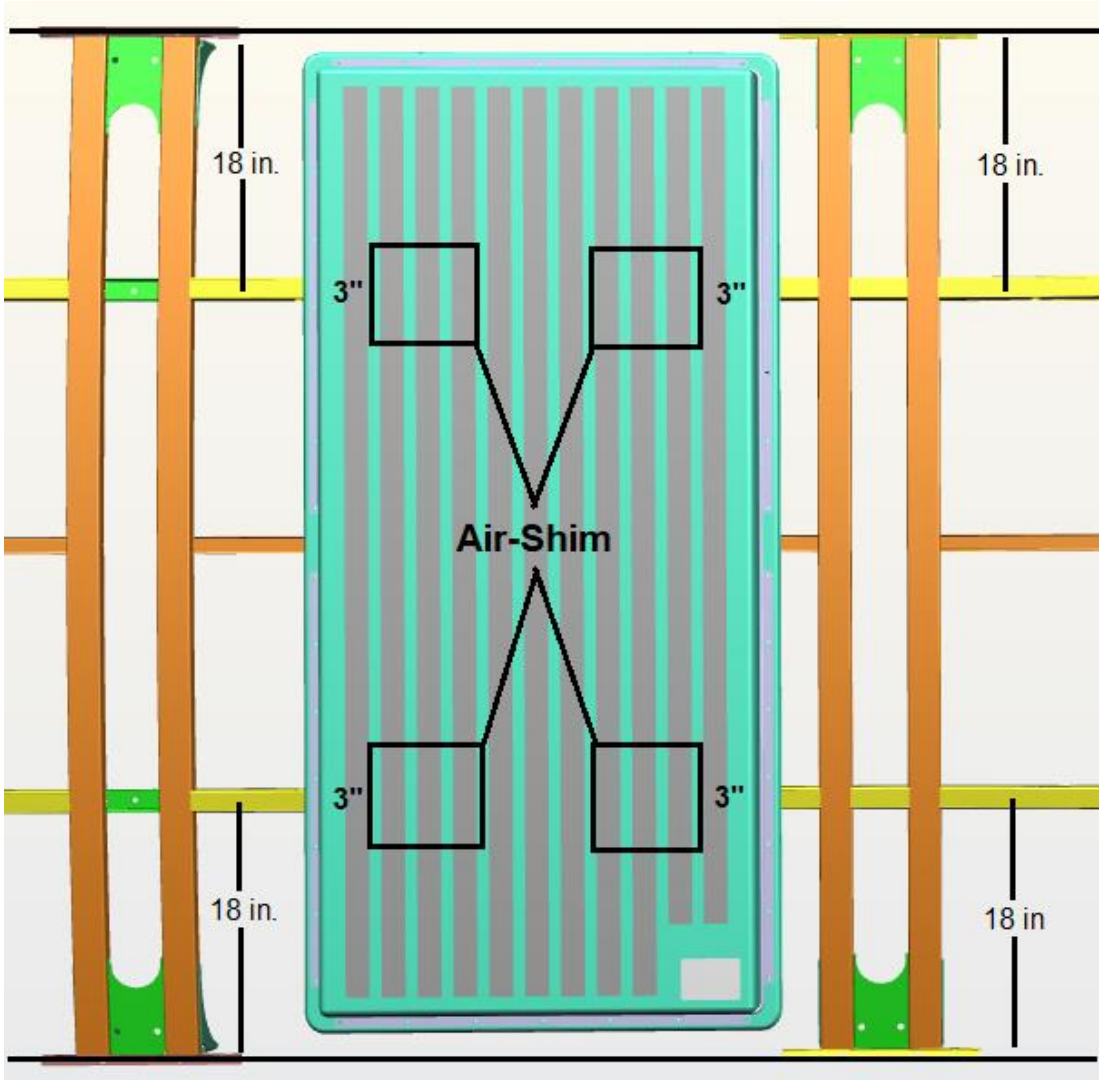


Figure 21: Air-Shim location reference.

36. To add additional support, remove the light track vinyl covers under each ESS units. See figure 22.

NOTE: Depending on design of the light panel assembly, some vinyl covers may be vented or solid.

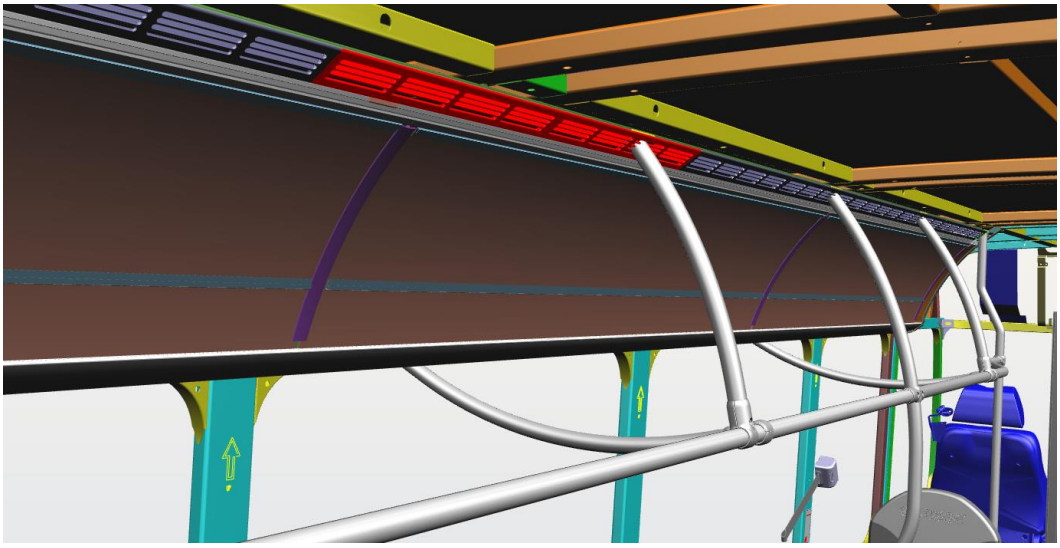


Figure 22: Light track vinyl cover location reference.

37. As close as possible, install wood block (1” thick X 3.5”W X 10”L) into the light track and support rod under each Air-Shim. Place cardboard on the floor to prevent damaging floor material. See Figure 23.

NOTE: To assist in finding air-shim location from inside the bus, place a string from on top of the ESS/Air-Shim area and hang the string off the side of the bus. From inside the bus, you should be able to see the hanging string for Air-Shim location reference.

NOTE: The block of wood must be a true 1 inch thick to fit snug into the light track.

Figure 23: Wood block and support rod location reference.

38. Inflate the Air-Shims until the Air-Shims fit tight against the bottom of the ESS tub.

Note: Over inflating the Air-Shims could cause damage to the roof panel and ESS fiberglass tub.

NOTE: At this point, supplier to rework the ESS battery packs. Supplier rework documents available upon request.

Once the ESS assembly rework is complete, remove the Air-Shims, support rods and wood blocks. Reinstall light track vinyl covers.

39. Perform ESS enclosure assembly pressure test. See appendix A below for pressure test procedure reference.
40. Once the ESS pressure test is complete, remove the upper rear corner coolant clamps. Reinstall access panel using existing hardware.
41. Refill and deairate ESS coolant system according to NF Service Manual.
42. Reinstall streetside and curbside, side screens securing using the existing hardware. Apply 1-2 drops of Loctite (NF PN: 081034) to the threads of the hardware. Torque hardware to 50 in. lbs.

NOTE: Replace any nylock nuts that may be damaged during removal.

43. Turn the main battery disconnect and HV interlock switch to the “ON” position. Turn the ignition switch in the on position.

    a. If issues are found, perform Low Voltage Checkout. See Appendix B.
    b. If issues are found, perform High Voltage Checkout. See Appendix C.

NOTE: Address all issues before proceeding to next step.

44. Perform two sessions DC Plug-in Charger Checkout. See Appendix D.
45. Perform two sessions OVHD Charging (if applicable). See Appendix E.

NOTE: Address all issues before proceeding to the next step.

46. Perform EV Drive Mode Validation checkout and road test the bus for 20-30 miles. See appendix F.
47. After road test complete, check ESS coolant level.
48. Inspect ESS mounting hardware torque marks. Retorque hardware if torque marks been disturbed.
49. Secure all access panels and return bus back into service.

Appendix A - ESS Enclosure Assembly Pressure Test procedure.

DESCRIPTION: JUICEBOX BATTERY ASSEMBLY PRESSURE TEST

APPLICATION: This procedure only applies to Juicebox Battery (ESS) assemblies.

PURPOSE: To provide a method for checking the sealing of the Juicebox battery to prevent water & air ingress to inside of the pack for all Juicebox battery enclosures.

This procedure is designed to:

1. Pressure test the Juicebox ESS pack before installing on the bus and installing the desiccant filter (which absorbs humidity) to detect and correct leaks and defects.
2. Prevent damage related to water ingression (including humid air) to system components after production build or major service.

PROCEDURE: The procedure outlined in this document does not supersede or replace IP qualification of the Juicebox battery assembly. This is a supplementary procedure to ensure the Juicebox battery pack is free from leaks and will hold pressure for optimal system performance.

This pressure test is to be performed by Production on each Juicebox battery pack after sealing & closing of the lid. The results of the test are to be recorded as indicated in this document. A completed copy of this procedure is to be included with the other coach run-off documentation for future reference.

TABLE OF CONTENTS

American Battery Solutions	New Flyer
20000060-AF	1037293
20000060-AG	1037316

This procedure is to be loaded to the Juicebox bench assembly.

This test is to be completed after closing of the lid to allow for diagnosing air leaks.

2. SPECIAL EQUIPMENT LIST

2.1 ESS Sealing Accessories

EQUIPMENT DESCRIPTION	QTY	P/N or REFERENCE
LV Cap for 9 Pin Connector	1	NF P/N 182470 (Vendor P/N HDC16-9)
LV Connector for 20 Pin Connector & 20 Blanking Plugs	1	NF P/N 707430 & QTY 20 P/N 8110650
POS HV Connector with Blanking Tube	1	P/N 869619
NEG HV Connector with Blanking Tube	1	P/N - 869677
MSD with No Fuse	1	P/N - 869751

See SECTION C - ESS Sealing Accessories for details.

2.2 Test Equipment

EQUIPMENT DESCRIPTION	QTY	P/N or REFERENCE
Leak Test Kit Port Assembly (includes Milwaukee Shop-Vac & Battery)	1	P/N 6493641

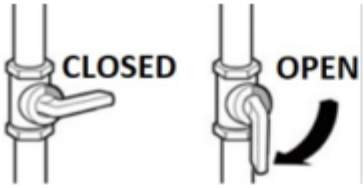
See SECTION A – Equipment Installation for details.

3. SETUP & TEST

It is recommended that this procedure is completed while the Juicebox assembly is complete but has not been installed on the bus to allow for diagnosing leaks.

3.1 SAFETY WARNINGS

1. Read and/or understand safety procedure in full before use
2. Do not leave unattended when connected to shop air or vacuum
3. MAX 1.5 PSI do not exceed pressure or vacuum
4. Ball Valve operation:



3.2 TEST SETUP

1. Zero pressure gauge on the Leak Test Port Assembly.
2. Install ESS sealing accessories per SECTION C - ESS Sealing Accessories.
3. Remove the desiccator cap from the Juicebox assembly and install the Leak Test Port Assembly
4. Connect the Blower Port on the Milwaukee Shop-Vac to the Leak Test Port Assembly. Ports are labeled on the Milwaukee shop vac and can be seen in SECTION A – Equipment Installation.
5. Close the ¼ Turn valve located on the Leak Test Port Assembly.

3.3 TEST Procedure

1. With the ¼ turn valve in the closed position, turn on the Milwaukee Shop-Vac.
2. While watching the gauge, slowly open the ¼ turn valve on the leak test assembly to achieve +0.70 psi pressure. Close the valve once the +0.7 psi pressure is achieved.
3. Shut off the Milwaukee Shop-Vac.
4. Allow the system to stabilize for ~1-2 minutes.
5. Record the stabilization pressure.

a. Minimum stabilization pressure is +0.60 psi. Repeat steps 1-4 or proceed to **FAILED TEST DIAGNOSIS** section if this cannot be achieved.

6. Set a timer for 5 minutes
7. Record the pressure at 1 minute intervals and at the end of the timer:

Time:	Pressure: (Psi)
0:00	
1:00	
2:00	
3:00	
4:00	
5:00	

a. If the pressure at the end of the test changes less than 0.1 psi, the test is considered a **PASS**.

b. If the pressure at any point during the test is > 0.1 psi of the stabilized pressure, proceed to the **FAILED TEST DIAGNOSIS** section.

8. If the test is considered a **PASS**:

a. Record final results in SECTION B - Data Entry Table.

b. Relieve internal pressure by disconnecting the shop-vac & opening the 1/4 turn valve.

c. Remove the test equipment, sealing accessories, & return the assembly to the as-found condition.

3.4 FAILED TEST DIAGNOSIS

If the pressure at any point during the test is > 0.1 psi of the stabilized pressure or a desired stabilization pressure cannot be reached.

1. Diagnose the location of the leak.

    i. Standard leak detection methods include Snoop and soap / water.

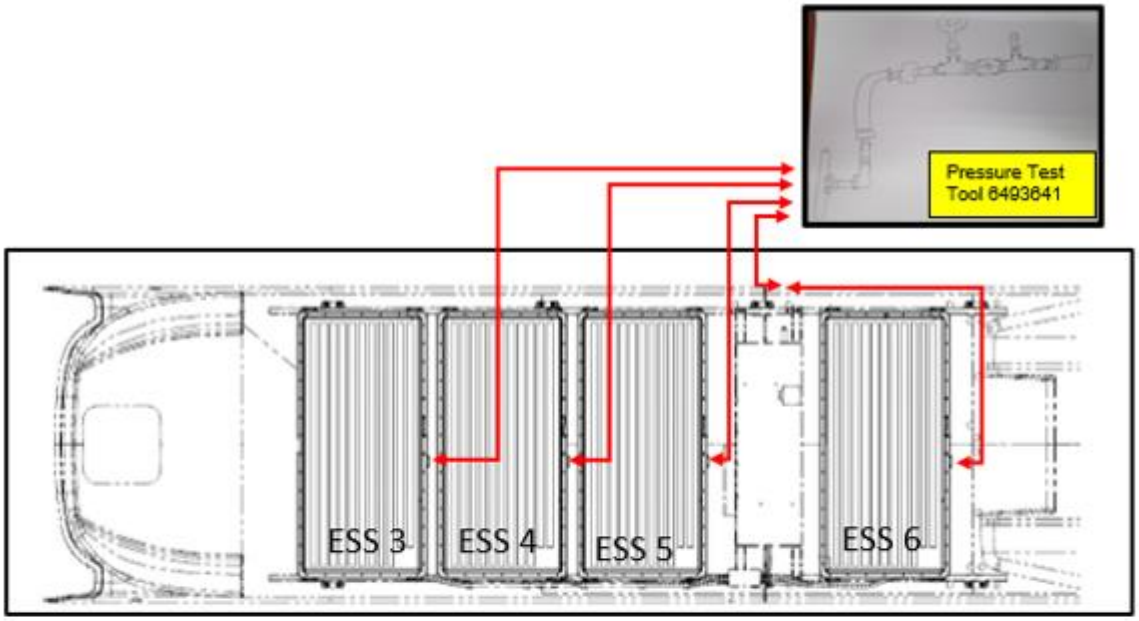
    With the lid closed and sealed, there should be no exposed high voltage.

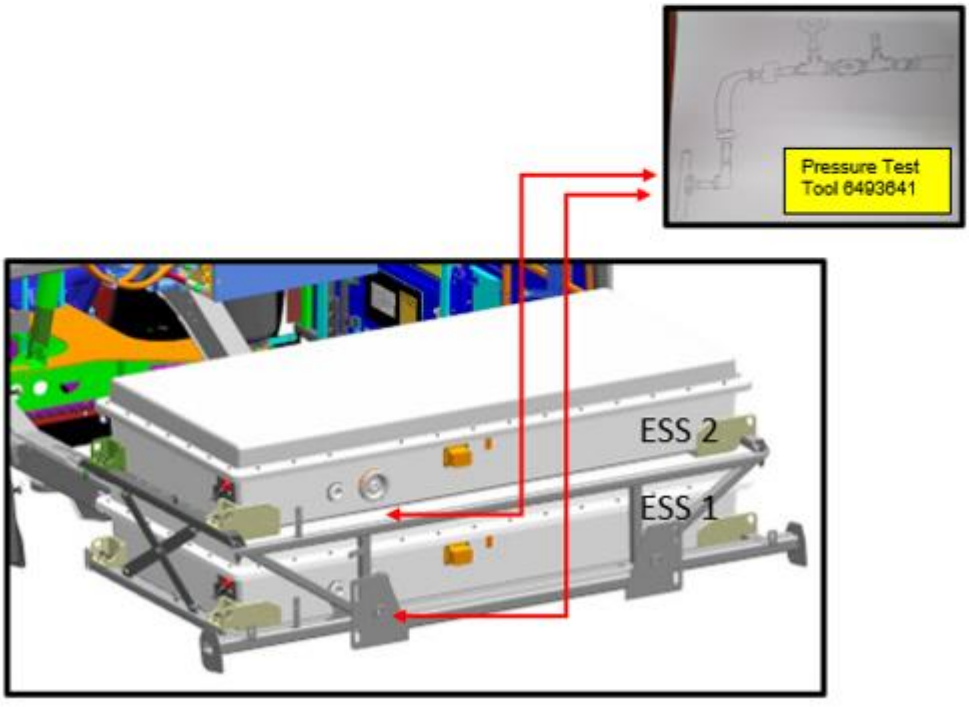
    HIGH VOLTAGE SAFETY GUIDELINES & PROCEDURES P/N 532295 MUST BE FOLLOWED WHEN CHECKING FOR LEAKS NEAR HIGH VOLTAGE CONNECTIONS.

    Non-contact (visual and audible) methods for leak detection are preferred near high voltage connections.

2. Resolve the leak path and re-test by following Section 3.3.

SECTION A – Equipment Installation





See P/N 6493641 for components included in leak test kit which includes the Milwaukee Shop-VAC & Milwaukee Battery.

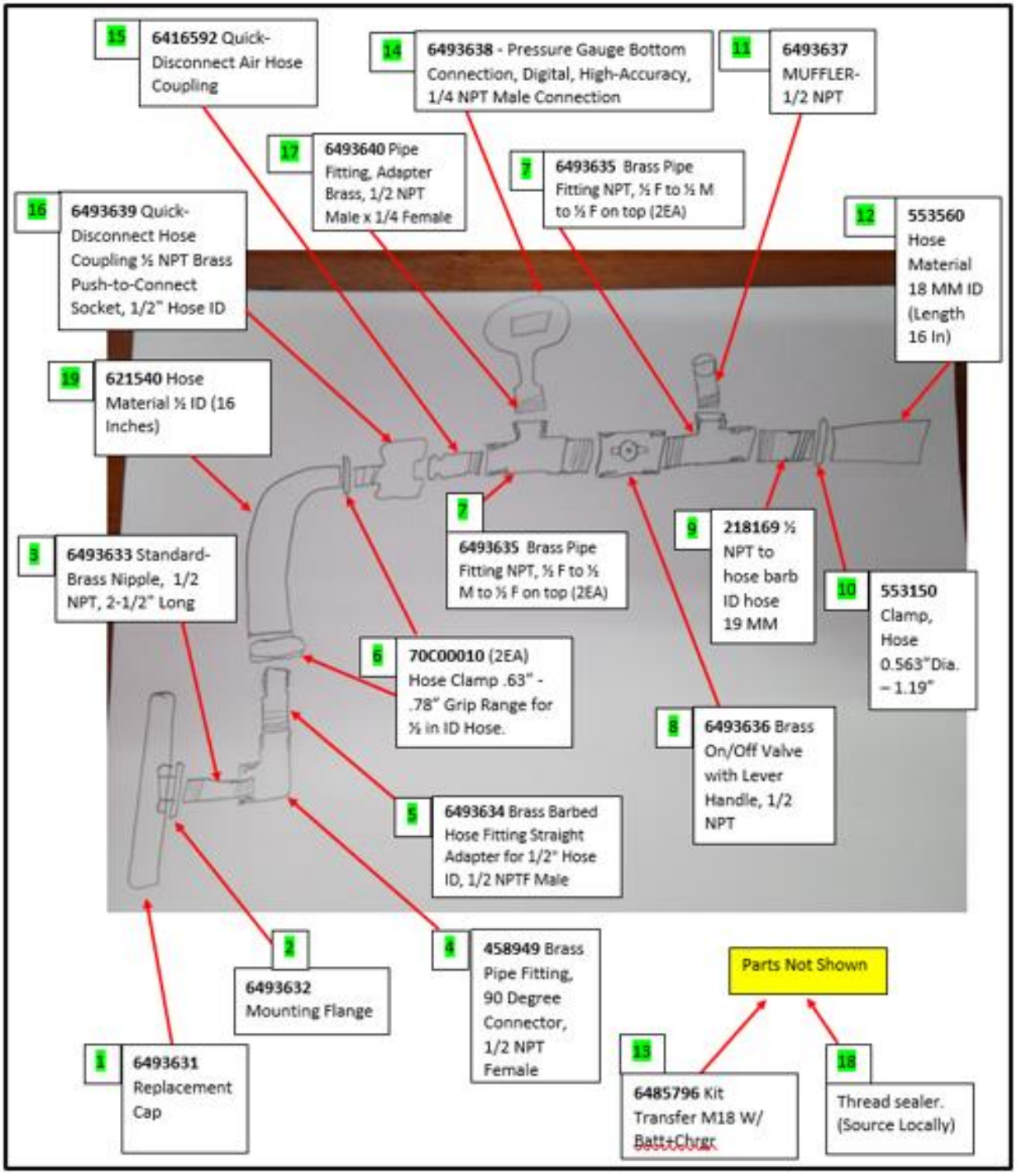


Figure 1 Leak Test Port Assembly

Figure 2 Milwaukee Shop VAC

SECTION B - Max Pressure for Leak Test Port Kit

Note: Illustration is for reference only. New pressure test tools may be constructed different to improve accessibility.

Figure 3 - Max Vacuum Pressure Capable with Tool (-0.89 PSI)

Figure 4 - Max Positive Pressure Capable with Tool (1.13 PSI)

SECTION C- ESS Sealing Accessories

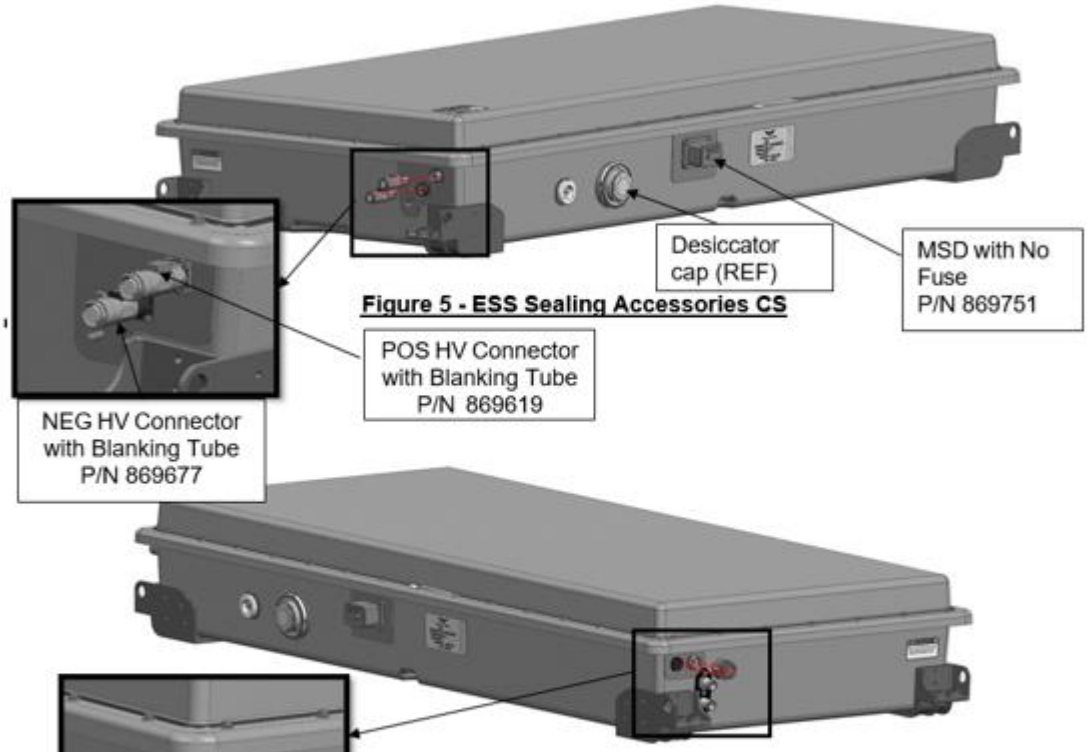


Figure 5 - ESS Sealing Accessories CS

Figure 6 - ESS Sealing Accessories SS

Appendix B: XE Battery Low Voltage System Checkout Procedure.

Caution: There are 2 parts to this checkout: PRE-EV MODE and POST-EV MODE. During Pre-EV Mode checkouts, ensure the MSDs are disconnected and capped. Post-EV Mode checkouts need all HV components to be professionally installed.

TOOLS REQUIRED:

Item No.	Item	Description	Checked	Remarks
1)	Laptop and Software	Laptop PC with Siemens recommended applications installed (Siadis Expert, Vector CANalyzer, Vansco software, Vector Indigo)		
2)	CAN Interface	• Peak PCAN-USB • CANalyzer software and database installed on laptop • Nexiq • Vector VN1630/CANcaseXL		
3)	Diagnostic Cable	As required to interface to Primary and Secondary vehicle networks and Battery diagnostic ports		
4)	DMM	Digital Multimeter		
5)	Power Supply	Power connection for laptop, extension cords or dc/ac inverter		
6)	Drawing Package	Electrical drawings for coach and propulsion system		
7)	Procedure Document	Refer to P/N 880804 for software installation		

PRE-EV MODE CHECKS

BEFORE GETTING STARTED (LV Connections):

Item No.	Item	Description	Checked	Remarks
1)	Siemens DICO (if applicable)	Main communication interface connector		
2)	Drive Motor Inverter #1	X1 LV Connections		
		X2 LV Connections		
3)	Drive Motor Inverter #2 (if applicable)	X1 LV Connections		
		X2 LV Connections		
3)	Drive Motor Inverter #3 (if applicable)	X1 LV Connections		
		X2 LV Connections		
3)	Aux Inverter #1	X31 LV Connections LV +/- Connections		
4)	Aux Inverter #2	X31 LV Connections LV +/- Connections		
5)	Aux Inverter #3 (if applicable)	X31 LV Connections LV +/- Connections		
6)	IMD (CAN based – if applicable)	X1 PWR/GND and CAN Connections		
7)	IMD (PWM based – if applicable)	X1 PWR/GND and PWM Connections		
8)	ESS Battery Packs (validate LV for each string, TOTAL# varies by implementation)	ESS# Connections (where # corresponds to a given bank in the implementation)		
		X10 LV Connection		
		X11 LV Connections		
9)	CM0711 Controller	C1 LV Connection		
10)	PVSG/Repeater	J1 LV Connection		
11)	Battery Manager	J1 LV Connection J2 LV Connection		
12)	DC charging receptacle at low voltage fuse box (Low Voltage)	LV connection to back of fuse box		
13)	Coolant Pumps (motors/inverters, HVAC)	XCCCAN Communication LV Connections		
		PWR Connections		
		GND Connections		
14)	Throttle Assembly	XAPS Connection		
		XIVS Connection		
15)	Electric Coolant Heater (If applicable)	XHTR LV Connection		
16)	Dual Electric Coolant Heater (If applicable)	XHTR LV Connection Heater 1		
		XHTR LV Connection Heater 2		
17)	Diesel Aux Heater (If applicable)	X1, X2, X3 and X4 LV Connections		
		D1 LV Connection		
18)	2 Fan Motor/Inverter Fans (Front/Rear – if applicable)	C01 LV Connection		
		C02 LV Connection		
		C03 LV Connection		

		C04 LV Connection		
		C05 LV Connection		
19)	4 Fan Motor/Inverter Fans (Front/Rear – applicable)	C3 LV Connection		
20)	Shift Selector	LV Connection to shifter		
21)	BTMS (Low Voltage)	XBTMS1 PWR/GND Connections		
		XBTMSCAN Communication Connections		
22)	HVAC System	PWR Connection		
		XCCCAN Communication LV Connection		
		XDISPLAY LV Connection		
		XCC1 LV Connection		
23)	Power Steering	PWR Connections		
		CTRL LV Connection		
		XCAN1 LV Connection (for Berendsen)		
		XALARM LV Connection (for Parker)		
23)	12/24V	Check the 12/24V system. Confirm solid resting voltage around 12.5V & 25V respectively		
24)	Ignition Ready	OEM is confident bus is ready for master run		
25)	Air Lines	Air lines connected and governor pressure switch connected		

INITIAL LOW VOLTAGE COMMUNICATION SYSTEM CHECKOUTS:

Item No.	Item	Description	Checked	Pass/Fail
1)	SAE_CAN (Primary Vehicle CAN) **NOTE:** Ensure this is validated on BOTH SIDES of CAN Repeater)	Using meter, check that the SAE_CAN is properly terminated and has proper active voltages on CAN H,L A. With all system power off. Check termination resistance with a multimeter, should read 60 Ohms. Check across both Vehicle diagnostic ports (both rear panel and SDS enclosure) pins C & D, and Propulsion diagnostic port pins C&D. B. With Master Run and Ignition ON measure SAE_CAN High on pin C to ground. Should be between 2.5-3.5V. C. With Master Run and Ignition ON measure SAE_CAN Low on pin D to ground. Should be between 1.5-2.5V.		
2)	DCAN	Using meter, check that the DCAN is properly terminated and has proper active voltages on CAN H,L A. With all system power off. Check termination resistance with a multimeter, should read 60 Ohms. Check across Siemens diagnostic ports (rear panel) pins C & D. B. With Master Run and Ignition ON measure DCAN High on pin H to ground. Should be between 2.5-3.5V.		

		C. With Master Run and Ignition ON measure DCAN Low on pin J to ground. Should be between 1.5-2.5V.		
3)	VEH_CAN (Secondary Vehicle CAN)	Using meter, check that the VEH_CAN is properly terminated and has proper active voltages on CAN H,L A. With all system power off. Check termination resistance with a multimeter, should read 60 Ohms. Check across Vehicle diagnostic ports (both rear panel and SDS enclosure) pins H & J. B. With Master Run and Ignition ON measure VEH_CAN High on pin H relative to ground. Should be between 2.5-3.5V. C. With Master Run and Ignition ON measure VEH_CAN Low on pin J relative to ground. Should be between 1.5-2.5V.		
4)	BATT_CAN	Using meter, check that the BATT_CAN is properly terminated and has proper active voltages on CAN H,L. A. With all system power off. Check termination resistance with a multimeter, should read 60 Ohms. Check across EBUS rear diagnostic port pins H & J. B. With Master Run and Ignition ON measure ESS_BATT_CAN High on pin H relative to ground. Should be between 2.5-3.5V.		

		C. With Master Run and Ignition ON measure ESS_BATT_CAN Low on pin J relative to ground. Should be between 1.5-2.5V.		
5)	PROP_CAN	Using meter, check that the PROP_CAN is properly terminated and has proper active voltages on CAN H,L A. With all system power off. Check termination resistance with a multimeter, should read 60 Ohms. Check across Propulsion diagnostic port (rear panel) pins H & J. Check across EBUS diagnostic port (rear panel) pins C & D. B. With Master Run and Ignition ON measure PROP CAN High on pin H to ground. Should be between 2.5-3.5V. C. With Master Run and Ignition ON measure PROP CAN Low on pin J to ground. Should be between 1.5-2.5V.		
6)	AUX_INV_CAN	Using meter, check that the AUX_INV_CAN is properly terminated and has proper active voltages on CAN H,L A. With all system power off. Check termination resistance with a multimeter, should read 60 Ohms. Check across Siemens diagnostic port (rear panel) pins H & J. B. With Master Run and Ignition ON measure DCAN High on pin H to ground. Should be between 2.5-3.5V. C. With Master Run and Ignition ON measure DCAN Low on pin J to ground. Should be between 1.5-2.5V.		

THERMAL SYSTEM CHECKS.

Item No.	Item (Command)	Description	Checked	Pass/Fail
1)	MTR_LO_CLNT_TMR	Motor/Inverter Coolant Reservoir Level OK = 0, NOT OK = 1		
2)	BTMS_CLNT_ST_FLG	ESS Coolant Reservoir Level Non-zero percentage (%) value		
3)	HVAC_LO_CLNT_FLG	HVAC Coolant Reservoir Level OK = 0, NOT OK = 1		
4)	RR_MTR_INV_FAN_SPD_PCT	Override motor/inverter cooler fans to 20, 50 and 100% (Should hear response)		
5)	ESS_CELL_TEMP_MIN	Confirm reasonable cell temperature maintained relative to ambient when system is operating		
6)	ESS_CELL TEMP_MAX	Confirm reasonable cell temperature maintained relative to ambient when system is operating		

PEM MOTOR PAIRING CHECK

Item No.	Item	Description	Checked	Remarks
1)	ENSURE PEM MOTOR IS PAIRED WITH THE ELFA INVERTER	REFER TO DOCUMENT P/N 880804		

VEHICLE/SIEMENS/BMU COMMUNICATION CHECKOUT:

VEHICLE TO/FROM SIEMENS

Item No.	Item (Command)	Description	Checked	Pass/Fail
1)	ACC_PED_POS	Accelerator Pedal Position (Release - 0%, Middle 30-70%, Full 92%-100%).		
2)	BRK_PEDAL_POS	Brake Pedal Position (Release - 0%, Middle 30-70%, Full 92-100%).		
3)	ACC_PDL_SW	Accelerator Pedal Switch (Released = 0, Depressed = 1).		
4)	BRK_PEDAL_SW	Brake Pedal Switch (service brake) (Released = 0, Depressed = 1)		
5)	ELFA_CONT_CMD_FLG	ELFA Contactor Command State Machine (Open = 0, Pre-Charge = 0.5, Close = 1, Emergency Power Off = 2, N/A = 3)		
6)	EV_MD_SEL_SIG	ELFA3 Operation mode (OFF = 1, ON = 1, DISCHARGE MODE = 128)		
7)	MTR_COOLING_SYS_ST	Inverter Cooling System (OFF = 0, ON = 1)		

8)	ELFA_CONT_CMD_MSG_PRES_TEST_FLG	Confirm that ELFA system messages are being received.		
9)	STOP_SYSTEM_IND	Stop System Inactive = 0, Stop System Active = 1		
10)	CHECK_SYSTEM_IND	Check System Inactive = 0, Check System Active = 1		
11)	IMD_ISO_KOHM_FLG	Confirm reasonable isolation measurement over 500KΩ is being received		
12)	KEY_START_ACK_IND	Acknowledgement that key start request was received (FALSE = 0, TRUE = 1)		
13)	PROCEDURE-ESS BATT INSTL & CHK (298-155U)	Ensure all steps were completed and fully passed before proceeding		

VEHICLE TO BMU

Item No.	Item (Command)	Description	Checked	Pass/Fail
1)	EVCU_ESS_DISCHARGE_SATURATE	Discharge current limit should be non-zero value		
2)	EVCU_ESS_CHARGE_SATURATE	Charge current limit should be a negative non-zero value		

BMU TO VEHICLE/SIEMENS.

Item No.	Item (Command)	Description	Checked	Pass/Fail
1)	BMU_MAIN_CONT_FDBK_FLG	HV Contactor Status (OPEN = 0; CLOSE = 1)		

POST EV MODE COMMUNICATION CHECKS

VEHICLE/SIEMENS/BMU COMMUNICATION CHECKOUT:

VEHICLE TO/FROM SIEMENS.

Item No.	Item (Command)	Description	Checked	Pass/Fail
1)	EV_MODE_ON_IND	System Ready Lamp (EV-Mode Indicator)		
2)	SHIFT_SEL_REQ_GEAR	Drive = 252, Neutral = 125, Reverse = 223		
3)	DNR_ST_FLG	Drive = 1, Neutral = 2, Reverse = 4		
4)	ELFA_EAMS_MODE_FDBK_FLG	Inverter Status (OFF = 0, Motor Running in Forward Direction = 1)		
5)	PARK_BRK_SW	Park Brake (Released = 0, Active = 1)		
6)	HALT_BRK_SW	Bus Interlock (Released = 0, Active = 1)		
7)	EVCU_EAMC_EMDAG1_FREQ_REQ	Inverter 3-Phase AC Power Frequency Command (OFF = 0%, ON = 100%)		
8)	EVCU_EAMC_EMDAG2_FREQ_REQ	Inverter 3-Phase AC Power Frequency Command (OFF = 0%, ON = 71% to 100%)		
9)	ELFA_EAMS_INSTANCE_FDBK_FLG	Inverter #1 Select (Instance = 0) Inverter #2 Select (Instance = 1)		
10)	MAX_VEHICLE_SPD_LIM	Max vehicle speed limit should be a non-zero value; the value should be SR-specific		
11)	MAX_VEHICLE_SPD_RAMP	Max acceleration ramp – 5kph/s		
12)	MAX_TRACT_PWR_LIM	Max power supplied ELFA3 (100% - normal operation; 0 – charging/derated		
13)	MAX_REGEN_PWR_LIM	Max power regen ELFA3 (100% - normal operation)		

Appendix C: XE Battery High Voltage System Checkout Procedure.

							PASS	FAIL	Comments/Notes
							✓/NR		
Note	This checkout is applicable to XE coaches with ABS ESS pack enclosure. Checkout will be conducted according to the number of packs installed in the vehicle and number of charge receptacles. If used for non-XE60 then treat any XE60 checks as NR								
1 Materials 2 Equipment preparation 3 Checker and Recorder Roles 4 Vehicle preparation						5 General procedures 6 Continuity test 7 Restoration			
1	**Materials Required**								
1	.01		**Equipment:**						
1	.02			Digital Multimeter (DMM), 1000 volt Category III, 600 volt Category IV, 10MΩ impedance or greater with insulated case or rubber holstered					
1	.03			10kΩ 3W 800V Discharge tool					
1	.04			Wire jumper with alligator clips					
1	.05			Quick connect Receptacles, 2positive (PN 804120_A) & 2negative (PN 822453_A)					
1	.06			NF High Voltage Safety Guidelines PN 532295					
1	.07			High potential leakage test procedure PN 885581 (as needed)					
1	.08			Electrical Schematic 290-001C/U					
1	.09			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 requirements. Before use, inspect the PPE in accordance with the High Voltage Safety Guidelines					
1	.10			Adequate lighting					
1	.11			ABC Fire Extinguisher, 5 lbs. minimum					
1	.12		**Insulated Tools:**						
1	.13			Imperial torque nut driver set					
1	.14			Metric torque nut driver set					
1	.15			Insulated rescue hook					
2	**Equipment preparation**								
2	.01		**Ensure Digital Multimeter (DMM) accurately measures DC & AC voltages & resistance & has test leads and battery in good condition**						
3	**Checkout Personnel**								
3	.01		Two trained personnel (one called Checker & the other called Monitor/Recorder) shall perform this Checkout Procedure, together, to ensure safety of themselves, others nearby & for the protection of vehicle & property						
3	.02		**Checkout personnel function:**						
3	.03		**Checker: (Caution:** the Checker must not have any health conditions that can be exacerbated when startled and must not have any electronic implants)						
3	.04				Directed by the Monitor/Recorder				
3	.05				Performs all preparations & checks				
3	.06				Wears PPE as specified by this Checkout Procedure				
3	.07				Performs all restorations				
3	.08		**Monitor/Recorder:**						
3	.09				Directs the Checker sequentially per this Checkout Procedure				
3	.10				Ensures Checker wears PPE as specified by this Checkout Procedure				
3	.11				Does not wear PPE				
3	.12				Never contacts electrically conductive objects in/on the vehicle				
3	.13				Ensures Checker follows all safety procedures				
3	.14				Maintains a minimum distance of 6 feet from the Checker				
3	.15				Retains the Insulated Rescue Hook & is ready to rescue the Checker				
3	.16				Ready to apply first aide, CPR &/or defibrillator to Checker if required				
3	.17				Records the progression of this procedure immediately a task is done				

						PASS	FAIL	Comments/Notes
					✓/NR			
Note		This checkout is applicable to XE coaches with ABS ESS pack enclosure. Checkout will be conducted according to the number of packs installed in the vehicle and number of charge receptacles. If used for non-XE60 then treat any XE60 checks as NR						
3	.18				Performs all calculations			
3	.19				Ensures repairs are performed at appropriate times			
3	.20				Ensures repairs are checked as valid			
3	.21			Checkout personnel shall be trained in:				
3	.22				HV & low voltage basics, intermediate & advanced electricity			
3	.23				HV & low voltage electrical systems of the vehicle			
3	.24				Shop safety practices & procedures			
3	.25				First aide including CPR & the use of the shop defibrillator			
3	.26				How to release a victim that can't let go HV			
3	.27				Firefighting and emergency procedures			
3	.28				Quickest method of shutting down HV			
3	.29				HV & arcflash safety			
3	.30				Organized & tidy placement of equipment & tools allowing for unrestricted movement			
4	Vehicle preparation							
4	.01	Remove all their jewelry (including pierced ones), watches and any electrically conductive objects from your body						
4	.02		Turn the 24/12 volt battery switch OFF, **lock/tag it & retain key**					
4	.03		Ensure there is no voltage on the 12 & 24 volt battery busbars					
4	.04	**Check ESS Manual Service Disconnects MSD**						
4	.05		Ensure that the MSD "Service Disconnect Fuse" is not installed in the Energy Storage System Pack 1. If instead, the service disconnect fuse is installed, then wearing PPE, follow the procedure # 4.06 and 4.07 below and remove the service disconnect fuse. Ensure that the ESS service disconnect fuse is stowed in a locked location to which you only have access. Skip to 4.08 if MSD is not installed					
4	.06		With PPE on, open **Rear HV Fuse Box** and using the DMM ensure there is no voltage between the HV positive (BAT +) & HV negative (BAT -) bus bars					
4	.07		Remove the ESS service disconnect fuse (**MSD**) and cover the MSD receptacle with relevant plastic cap					
4	.08		Repeat the procedure of 4.05 for rest of the Packs, to ensure that the "Service Disconnect Fuses" are removed					
5	General procedures							
5	.01	Use electrically insulated tools whenever opening & working within High Voltage enclosures & restoring						
5	.02	Throughout this procedure the High Voltage Safety Guidelines PN 532295 and Electrical Schematic 290-001C/U must be followed						
5	.03		All requested voltage measurements are DC unless otherwise indicated					
5	.04		Ensure HV cable shields terminated properly at glands					
5	.05		Ensure there is no HV cable insulation damage					
5	.06	**With PPE on, open Rear HV Fuse Box and using the DMM ensure there is no voltage between the HV positive & HV negative bus bars Ensure there is no short circuit between HV positive & HV negative bus bars, DMM reading must be ≥20kΩ, as well as no continuity between chassis and any bus bar, DMM reading must be ≥20MΩ**						
Note		If in sections 5.06, 5.07 & 5.08, the Voltmeter shows voltage ≥0.01V, discharge the residual voltage on the DC Link using 10kΩ tool : connect the resistor 10kΩ between positive and negative bus bars and wait for 30 seconds						
5	.07	**With PPE on, open Roof Rear HV Junction Box and using the DMM ensure there is no voltage between the HV positive & HV negative bus bars Ensure there is no short circuit between HV positive & HV negative bus bars, DMM reading must be ≥20kΩ, as well as no continuity between chassis and any bus bar, DMM reading must be ≥20MΩ**						

						PASS	FAIL	Comments/Notes
						✓/NR		
Note					This checkout is applicable to XE coaches with ABS ESS pack enclosure. Checkout will be conducted according to the number of packs installed in the vehicle and number of charge receptacles. If used for non-XE60 then treat any XE60 checks as NR			
5	.08				With PPE on, open Roof Front HV Fuse Box (if applicable) and using the DMM ensure there is no voltage between the HV positive & HV negative bus bars Ensure there is no short circuit between HV positive & HV negative bus bars, DMM reading must be ≥20kΩ, as well as no continuity between chassis and any bus bar, DMM reading must be ≥20MΩ			
5	.09				With PPE on, open HV Vehicle Fuse Box and using the DMM ensure there is no voltage between the HV positive & HV negative bus bars Ensure there is no short circuit between HV positive & HV negative bus bars, DMM reading must be ≥20kΩ, as well as no continuity between chassis and any bus bar, DMM reading must be ≥20MΩ			
5	.10				With PPE on, open DC Rail Switch Box and using the DMM ensure there is no voltage between the HV positive & HV negative bus bars Ensure there is no short circuit between HV positive & HV negative bus bars, DMM reading must be ≥20kΩ, as well as no continuity between chassis and any bus bar, DMM reading must be ≥20MΩ			
6	Continuity test							
					No PPE required for following portion of procedure			
Note					In case of long distance between testing points, use vehicle chassis as an extension conductor, connecting one end of cable to chassis by jumper, and connecting the DMM between chassis and second end of cable. **Disconnect jumper after each test**			
6	1.01				**Ensure there is continuity between Rear HV Fuse Box and Roof Rear HV Junction Box**			
6	1.02				Positive bus bar in the Rear HV Fuse Box and positive bus bar in the Roof Rear HV Junction Box			
6	1.03				Negative bus bar in the Rear HV Fuse Box and negative bus bar in the Roof Rear HV Junction Box			
6	2.01				**Ensure there is continuity between Roof Front HV Junction Box and Roof Rear HV Junction Box**			
6	2.02				Positive bus bar in the Roof Front HV Junction Box and positive bus bar in the Roof Rear HV Junction Box			
6	2.03				Negative bus bar in the Roof Front HV Junction Box and negative bus bar in the Roof Rear HV Junction Box			
6	3.01				**Check out power cables routing between Roof Front HV Junction Box and Center Axle Inverter Rack**			
6	3.02				Cable EP61HV1 has to be connected to positive bus bar of the Roof Front HV Junction Box			
6	3.03				Cable EP61HV2 has to be connected to negative bus bar of the Roof Front HV Junction Box			
6	3.04				Cable EP63HV1 has to be connected to positive bus bar of the Roof Front HV Junction Box			
6	3.05				Cable EP63HV2 has to be connected to negative bus bar of the Roof Front HV Junction Box			
6	3.06				Cable EP35HV1 has to be connected to positive bus bar of the Roof Front HV Junction Box			
6	3.07				Cable EP35HV2 has to be connected to negative bus bar of the Roof Front HV Junction Box			
6	4.01				**Ensure there is continuity between DC Rail Switch Box and Roof Front HV Junction Box**			
6	4.02				Positive bus bar in the DC Rail Switch Box and positive bus bar in the Roof Front HV Fuse Box			
6	4.03				Negative bus bar in the DC Rail Switch Box and negative bus bar in the Roof Front HV Fuse Box			
		Between Rear HV Fuse Box and Equipment						
6	5.01	Open back cover of the Spheros heaters						
6	5.02				**Ensure there is continuity between the:**			
6	5.03				Contactor GXL14, downstream terminal in the Rear HV Fuse Box and the HV positive input terminal of the Spheros heater1			

					PASS	FAIL	Comments/Notes
					✓/NR		
Note				**This checkout is applicable to XE coaches with ABS ESS pack enclosure. Checkout will be conducted according to the number of packs installed in the vehicle and number of charge receptacles. If used for non-XE60 then treat any XE60 checks as NR**			
6	5.04			Contactor GXL14, downstream terminal in the Rear HV Fuse Box and the HV positive input terminal of the Spheros heater2			
6	5.05			Negative bus bar in the Rear HV Fuse Box and the HV negative input terminal of the Spheros heater1			
6	5.06			Negative bus bar in the Rear HV Fuse Box and the HV negative input terminal of the Spheros heater2			
6	6.01		**Ensure there is NO continuity between HV Positive and Negative input terminals of CCS charging interface at curb side**				
6			**Ensure there is continuity between the:**				
6	6.02			Positive Contactor GV240, upstream terminal in the Rear HV Fuse Box and the HV positive input terminal of the charging interface at curb side			
6	6.03			Negative Contactor GV240, upstream terminal in the Rear HV Fuse Box and the HV negative input terminal of the charging interface at curb side			
6	6.04		**Ensure there is NO continuity between HV Positive and Negative input terminals of CCS charging interface at street side**				
6			**Ensure there is continuity between the:**				
6	6.05			Positive Contactor GV240, upstream terminal in the Rear HV Fuse Box and the HV positive input terminal of the charging interface at street side			
6	6.07			Negative Contactor GV240, upstream terminal in the Rear HV Fuse Box and the HV negative input terminal of the charging interface at street side			
6	7.01	Open Traction Motor access hatch near the rear seat					
6	7.02		**Visually inspect PEM motor cables:**				
6	7.03			Cable EP10HV1 has to be connected to U1 terminal of the PEM motor Cable EP10HV2 has to be connected to V1 terminal of the PEM motor Cable EP10HV3 has to be connected to W1 terminal of the PEM motor Cable EP10HV4 has to be connected to U2 terminal of the PEM motor Cable EP10HV5 has to be connected to V2 terminal of the PEM motor Cable EP10HV6 has to be connected to W2 terminal of the PEM motor			
6	8.01		**Open TK Interface behind TK Panel above the backseat and visually inspect TK cables:**				
6	8.02			Cable CC18HV1 has to be connected to L1 terminal Cable CC18HV2 has to be connected to L2 terminal Cable CC18HV3 has to be connected to L3 terminal			
6	9.01		**Open Front HVAC Interface and visually inspect TK cables:**				
6	9.02			Cable CC19HV1 has to be connected to L1 terminal Cable CC19HV2 has to be connected to L2 terminal Cable CC19HV3 has to be connected to L3 terminal			
6	10.01	Lift the bus up					
Note		**Lifting operation must be performed by certified personnel**					
6	10.02	Open Air Compressor Junction Box					
6	10.03		**Visually inspect air compressor cables:**				
6	10.04			Cable EP26HV1 has to be connected to L1 terminal Cable EP26HV2 has to be connected to L2 terminal Cable EP26HV3 has to be connected to L3 terminal			
6	11.01		**Visually inspect ZF motors cables:**				
6	11.02	**Street side**		Cable EP11HV1 has to be connected to U terminal Cable EP11HV2 has to be connected to V terminal Cable EP11HV3 has to be connected to W terminal			
6	11.03	**Curb side**		Cable EP13HV1 has to be connected to U terminal Cable EP13HV2 has to be connected to V terminal Cable EP13HV3 has to be connected to W terminal			
6	11.04	Lower the bus back to the floor					
		Between ESS and Equipment					
Note		Use quick connect Receptacles positive & negative to safely and reliably access the core of HV cables					
6	12.01	Disconnect the power connectors of the ESS pack1 and pack2					
6	12.02		**Ensure there is continuity between the:**				
6	12.03			Pack1 positive connector housing and vehicle chassis			

					PASS	FAIL	Comments/Notes
				✓/NR			
Note				**This checkout is applicable to XE coaches with ABS ESS pack enclosure. Checkout will be conducted according to the number of packs installed in the vehicle and number of charge receptacles. If used for non-XE60 then treat any XE60 checks as NR**			
6	12.04			Pack1 positive connector housing and all the rest 3 connectors housing (pack1 and pack2)			
Note				**The reading values should not be greater 1Ω and must be stable on connectors**			
6	12.05			Pack1 positive connector core and pack2 positive connector core			
6	12.06			Pack1 negative connector core and pack2 negative connector core			
6	12.07			Disconnect the power connectors of the ESS pack3, pack4, pack5 and pack6			
6	12.08			**Ensure there is continuity between the:**			
6	12.09			Pack5 positive connector housing and vehicle chassis			
6	12.10			Pack5 positive connector housing and all the rest 7 connectors housing (pack3, pack4, pack5 and pack6)			
6	12.11			Pack5 positive connector core and packs 3, 4, 6 positive connectors core			
6	12.12			Pack5 negative connector core and packs 3, 4, 6 negative connectors core			
6	12.13			Inspect torque marks on set screws within all 90° Amphenol connectors			
6	13.01			Disconnect the power connector of the BTMS unit			
6	13.02			**Ensure there is continuity between the:**			
6	13.03			Positive bus bar in the Roof Junction Box and the HV positive input terminal of the BTMS unit			
6	13.04			Negative bus bar in the Roof Junction Box and the HV negative input terminal of the BTMS unit			
6	14.01			**Ensure there is continuity between applicable Roof HV FB and DC Rail Switch**			
6	14.02			Positive bus bar in the Roof HV Fuse Box and the terminal of Positive Contactor GX16 in the DC rail Switch Box			
6	14.03			Negative bus bar in the Roof HV Fuse Box and the terminal of Negative contactor GX16 in the DC rail Switch Box			
6	15.01			**Ensure there is continuity between DC Charging Rails and DC rail Switch Box**			
6	15.02			Positive bus bar of the DC Rail and the terminal of Positive Contactor GX16 in the DC rail Switch Box			
6	15.03			Negative bus bar of the DC Rail and the terminal of Negative Contactor GX16 in the DC rail Switch Box			
6	16.01			**Ensure there is no continuity between HV positive & HV negative bus bars of DC Rails, as well as no continuity between chassis and any bus bar**			
7	**Restoration**						
7	1.00	**HV Connections**					
7	1.01			**Re-connect all HV cables, using insulated tools, & re-install all respective covers (Before connecting the cables, do not touch the cable terminations until a check is made to ensure there is no voltage between any of these cables & with respect to vehicle chassis)**			
7	1.02			**Reverse Sections 4.06 & 4.07 to re-install the MSD "Service Disconnect Fuse" for each pack, using all appropriate PPE**			
7	1.03			**CAUTION:** While connecting these HV cables in each equipment continuously monitor, with the DMM connected, for the inadvertent appearance of HV. If HV appears, suit up with PPE and troubleshoot why the HV appeared & resolve			
7	2.00	**Lockout/Tag Outs**					
7	2.01			Remove the Lockout/Tag Out from the 24/12 V battery switch			

Appendix D: Checkout – DC PLUGIN CHARGER.

Tools required: Digital multimeter with 1000 V class III rating or higher, (2) Laptop with the latest Vansco PLC program for the bus being tested, and a (3) NEXIQ.

1.0 Preliminary Preparations.

Safety is the highest priority of our activities. It is especially important to ensure that safety procedures be diligently followed when working on high voltage systems. This helps to prevent injury to personnel and damage to property. Below are the preliminary preparation steps:

1. Turn off all breakers supplying power to the plugin charging system. Apply a tag and lock-out in this position.
2. Turn off the AC mains power switch on the plugin charger.
3. Dress up fully with personal protective equipment (PPE) and ensure someone is near you with an insulated safety hook.
4. Open the charger panels to gain access to the interior wiring of the plugin charger.
5. Using a functionally proven multimeter, ensure that there is no AC voltage present between the three-phase inputs to the isolation transformer. Check all combinations.

Note: If no AC voltage is present, a typical multimeter will display an extremely low voltage, less than 0.1 volts. This is caused by the multimeter reading electrical noise due to its high input impedance.

6. Using the multimeter, ensure that there is no DC voltage present between the outputs of the DC rectifier.

Note: If no DC voltage is present, a typical multimeter will display an extremely low voltage, less than 0.1 volts. Again, this is caused by the multimeter reading. electrical noise due to its high input impedance.

7. Once it is established that there is no voltage present in the plugin charger, the PPE can be removed if the tag and lock-out is maintained at the power transfer switch. Also, for added protection, maintain the plugin charger disconnect switch in the OFF position. The standby person with the insulated safety hook is no longer needed.

2.0 Low Voltage Functional Checks.

1. Verify all low voltage wiring.

3.0 Vehicle Preliminary Checks.

1. With no high voltage applied ensure that ALL the high voltage wiring of the DC plugin charging system in the vehicle is in accordance with the drawings.
2. Check the continuity of the high voltage wiring of the DC plugin charging system in the vehicle.

4.0 High Voltage Applied Tests.

1. Ensure that the DC plugin charger power switch is in the OFF position.
2. Refasten the panels on the DC plugin charger.
3. Install a Caution High Voltage Fence and signs around the vehicle and DC plugin. charger.
4. Warn all staff nearby of the oncoming high voltage tests.
5. One person should observe the operation within proximity of the insulated. safety hook.

6. Coordinate with the shop supervisor as to when the breakers supplying the power to the DC plugin charging system can be turned on. Arrange a time to remove the lock-out from the breaker and switch it to the ON position.
7. Apply a tag and lock-out in this position.
8. Turn the DC plugin charger power switch to the ON position.
9. Complete the checklist below.

		Receptacle 1		Receptacle 2 (if applicable)		
	Item	**PASS**	**FAIL**	**PASS**	**FAIL**	**Comments/Notes**
01	Verify that the latest PLC Program is downloaded on the bus. Record this in the comments.					
02	Verify that the vehicle communicates with the onboard charging modules in the charge controller panel. Turn on the MRS, enter diagnostic mode, and check if **F4-1 EVCC_HB_FLG** is active. This will confirm that charge controller panel modules are ON and communicating.					
03	Verify that plug detection works. Turn off the Door Master Switch to temporarily disable charging, then plug the charger into receptacle 1 and verify that **F4-13 EVCC_PLUG_DET_FLG** becomes active. Verify that F4-13 goes inactive when the plug is removed.					
04	DO NOT PERFORM THIS TEST IF TEST 03 FAILED. Turn the Door Master switch back on and verify that the bus cannot drive away when the charger is plugged in. Plug the charger into the receptacle. Ensure that **F4-13 EVCC_PLUG_DET_FLG**, **F14-16 TRACTION_INHIBIT_FLAG**, and **O9-10 IL_BRK_MV** are active before attempting this. Ensure that there is extra slack in the charge cable and have someone watching the cable while testing this. IF THE BUS MOVES WITH THE PLUG CONNECTED, STOP IMMEDIATELY TO AVOID ANY DAMAGE.					

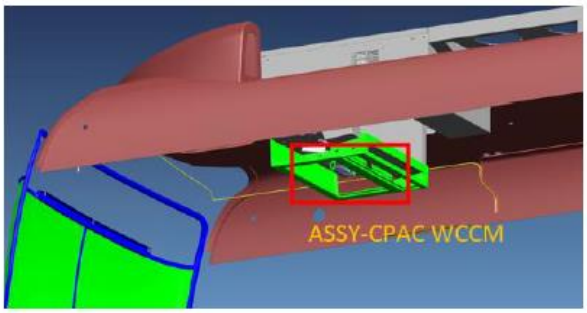
05	Test the auto-start feature when **PLC is asleep**. Turn the MRS to OFF and turn off the Battery Disconnect switch in the rear of the bus. Ensure that the park brake is engaged and hazard switch is off. Turn on the Battery Disconnect switch and after 30 seconds plug the charger into the receptacle. The indicator should flash blue and after a 1-minute duration, the receptacle should lock and the vehicle will prepare for charging. At this point the indicator should turn solid blue confirming that the receptacle is locked. This will take about 20 seconds. The vehicle should automatically enter EV mode when it is ready to charge. Confirm that "EV Mode" and "Charge Mode" are displayed on the dash. Let the bus charge for 5 minutes and then cancel the charging process by activating the charge stop switch (located next to the charging port) and disconnect the charger. Confirm that EV mode is no longer displayed on the dash.					
06	Repeat item 6 but without turning the battery disconnect to OFF on the following scenarios: • **MRS to OFF** position with PLC awake • **MRS to DAY/NIGHT RUN** position • **EV Mode**					
07	With the bus asleep, connect the charger to the receptacle, allow it to charge for about a minute and stop the charging session by (1) disabling door master switch (2) disabling park brake, and (3) shifting bus out of neutral (if the propulsion system allows it).					
08	Start a charging session from sleep and allow the vehicle to charge for 2 minutes, then cancel charging from the charge station. Disconnect the charger from the receptacle. Observe if the vehicle powers off and goes to sleep within 15 mins.					
09	Drain the vehicle's SoC down to 5% and complete a full charge cycle. While charging, observe how the green indicator on the receptacle changes blink speed as the SoC increases. Record the total charge time.					

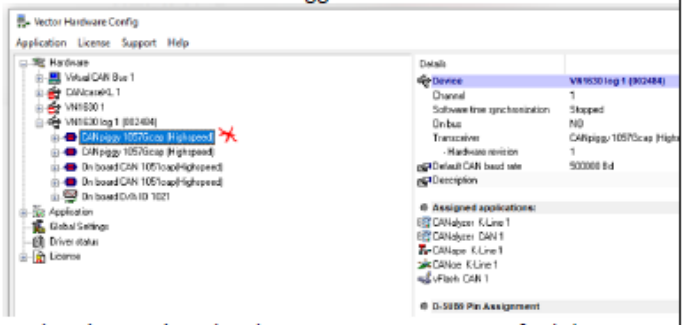
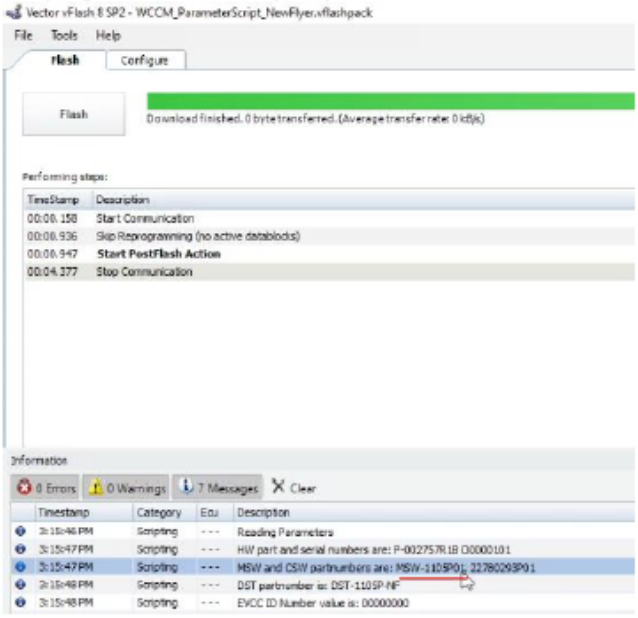
NOTE: If a second plugin receptacle is available, repeat items 1 through 11. Discharge battery below 50% before starting.

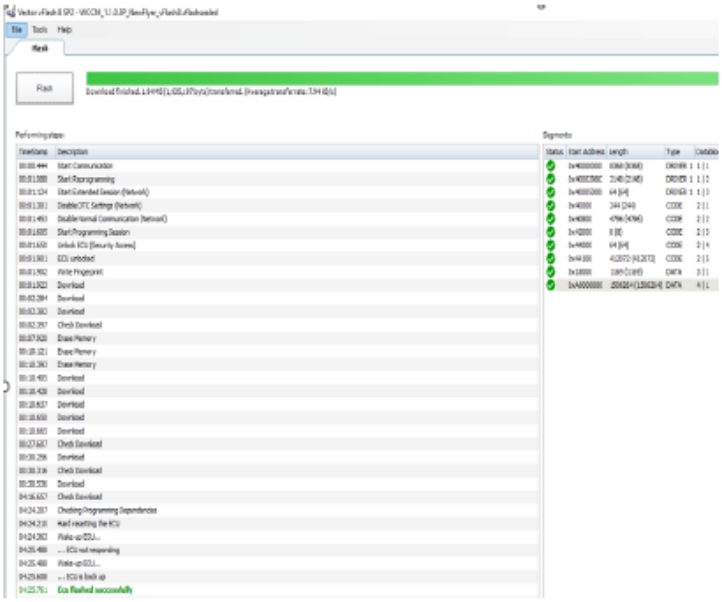
Appendix E: Checkout – Overhead Charging, NG CPAC.

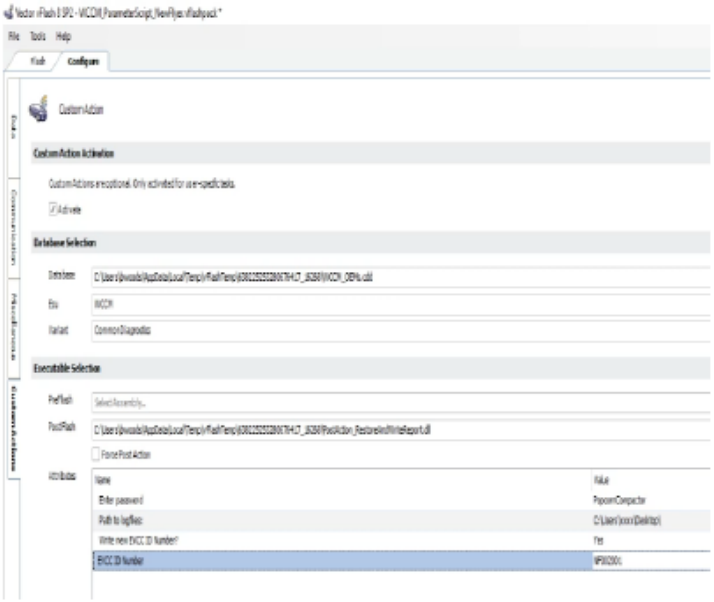
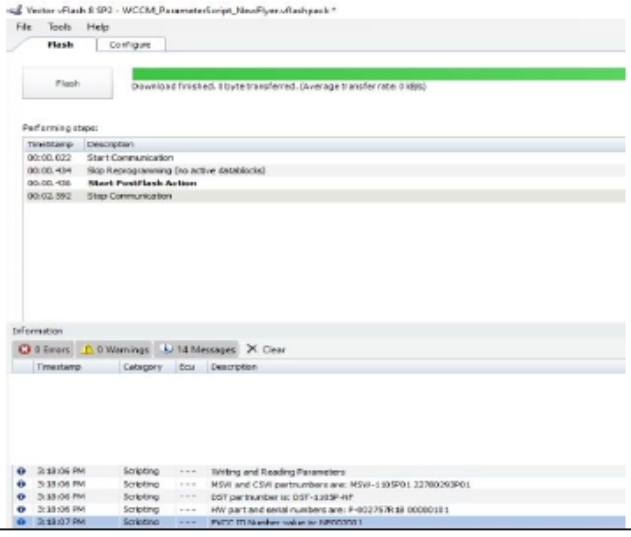
Requirements: (1) Laptop with the latest Vansco program for the bus under test and Vector vFlash software installed, (2) NEXIQ, (3) CAN logger with vFlash license (see 1021946 for additional info on vFlash), (4) bus driver.

Important Note: This checkout applies to New Flyer XE buses that use the CPAC **next-gen** (NG) WCCM controller as the **electric vehicle charge controller** (EVCC) for the SAE J3105 overhead charging option. This checkout must be completed before the bus leaves the plant. For interoperability testing with new charger OEMs, consult the **Infrastructure Solutions** (IS) team for their more detailed interoperability checkout. It is recommended to have the bus below 30% SOC as several charge sessions will be required. **Items 08 and onward require a driver to position the bus under the charger and deplete the SOC, as necessary.**

Item		Pass	Fail	Notes
Items 01 – 07 should be performed inside so personnel can access the roof of the bus.				
01	Confirm the bus under test has all the latest software installed before proceeding with this checkout.			Key software to confirm: □ IP Config 290-2U □ Vansco PLC 290-3U □ PVSG 290-12U □ HV battery 290-645U □ HV battery 290-652U □ CM0711 290-656U □ ELFA3 motor 219-322U □ ELFA3 inverter 219-323U
Items 02-05 are completed at the WCCM panel. The MRS must be set to Day Run with the hazards on.				
02	Open the WCCM panel. This is located under the blower fan on XE35/40s and front HVAC unit on XE60s. While inside CPAC WCCM panel, confirm the antenna cable is connected to the WCCM and that both green connectors are properly plugged into the WCCM. With the bus in Day Run or Night Run you should see lights inside the WCCM if you look at the openings around the connectors. 			

Item		Pass	Fail	Notes
03	**Confirming the WCCM software matches 290-254U.** a. Put the MRS in Day Run with the hazards on. b. Connect a CAN logger that contains a vFlash license to the *WCCM FLASH DIAG* port (ch 1) on the WCCM panel. c. Connect the USB cable of the CAN logger to a laptop with vFlash installed. Open vFlash. Click *Tools – Vector Hardware Configuration*. The example below used a VN1630. Right click on the first item under the logger and select vFlash – CAN1.  d. Under Electrical_archive\CPAC WCCM Programs, find the correct folder based on 290-254U. Open *WCCM_ParameterScript_NewFlyer.vflashpack* in vFlash to check parameters. Hit flash. This pulls the parameters from the WCCM. Open the *Information* window and confirm that MSW number matches the "PROGRAM TO LOAD" on 290-254U. **If the program matches, skip step 04.** 			

Item		Pass	Fail	Notes
04	**Flashing the WCCM Program - Only perform this step if the program on the WCCM does not match the BOM as determined in step 03.** The logger must remain connected to the WCCM FLASH DIAG port pins c,d and laptop with the MRS in Day Run and hazards on. In vFlash, open the "PROGRAM TO LOAD" file indicated in 290-254U located in the Electrical_archive\CPAC WCCM Programs. Click Flash. This may take up to 5 min. DO NOT INTERRUPT OR POWER OFF THE BUS OR WCCM DURING THIS TIME.  Repeat step 03 to confirm that the WCCM now has the correct software.			

Item		Pass	Fail	Notes
05	**Updating WCCM EVCCID - This step must be performed after flashing the WCCM program since flashing the WCCM program will reset the EVCCID to 00000000.** a. In vFlash, open *WCCM_ParameterScript_NewFlyer.vflashpack*. Go to the Configure tab and then CustomActions. b. The password is PopcornCompactor and you must set Write new EVCCID ID number to yes. Set the EVCCID to NF###### where ###### is the fleet number of the bus. E.g., fleet number is 2001, the EVCCID should be set to NF002001.  c. Go to the Flash tab and click Flash to write the EVCCID. d. Open the *Information* window to confirm the EVCCID has been set. 			

Item		Pass	Fail	Notes
06	With the MRS in Day Run or Night Run, ensure that the green LED light on the outside of the DC Rail Switch is active. This requires access to the roof of the bus. If the light is "OFF", ensure the proximity switch under the lid is being activated. Check the low voltage wiring if necessary.			
07	On the roof, confirm that the antenna cable is connected to the WLAN antenna on one end and the pothead on the other end. Ensure the antenna cable terminations were done properly.			
08	Connect a CAN logger to the 9-pin "OVHD CHG DIAG" port near the WCCM. Configure the logger to 250 kbps on ch 1 and 250 kbps on ch 2. Ch 1 captures primary vehicle CAN and ch 2 captures CAN between Node 21 CAN 2 and the DC RAIL SW. **Verify the logger is logging properly**. Leave the logger connected throughout the entire checkout in case detailed troubleshooting is required.			
09	Connect a laptop to the bus using a NEXIQ. Open the latest Vansco PLC software for the bus and enter diagnostic mode with the bus in Day Run. Navigate to the ES-EP OVHD CHARGING page and *confirm* ***F21-133 DC_RAIL_SW_LO_CUR_OPENS*** and ***F21-134 DC_RAIL_SW_HI_CUR_OPENS*** are both equal to 0. If they are not equal to 0, go to Tools-Logs, and clear the log files to reset them to 0. Confirm F21-133 and F21-134 are 0.			
10	Enter EV mode and with the bus not under the charger, force ***F14-16 CM0711_TRACTION_INHIBIT_FLG*** active and confirm that the bus cannot move when the accelerator is pressed. This confirms the drive system will be disabled while charging. Unforce F14-16 before proceeding to the next step.			
11	With the bus in EV mode and not under the charger, under the ES-EP OVHD CHARGING page in Vansco, force ***F4-24 PANTO_DN_FLG*** active and confirm that kneeling/unkneeling the bus is disabled. This confirms kneeling will be disabled when the pantograph is contacting the bus. Unforce F4-24 before proceeding to the next step.			
Items 12 and onward should be performed at the charger.				
12	Align and park the bus under the overhead charger. Under the ES-EP OVHD CHARGING page in Vansco, confirm that ***F4-2 WLAN_CONN_ESTD_FLG*** is active. This confirms the bus is connected to the charger's access point. **F21-136 OVHD_WIFI_STRENGTH_DBM** gives the signal strength of the access point measured at the WCCM. A session will not be possible if the strength is lower than -75 dBm.			

Do not proceed until items 01 – 12 have passed.				
Items		**Pass**	**Fail**	**Notes**
13	Ensure the bus is in EV mode, fully kneeled (**kneeling is not a necessity, but we want to test the maximum vertical extension of the pantograph**), in neutral, and the park brake is set. Turn ON the Charge Enable switch to execute the charge session. Under the ES-EP OVHD CHARGING page in Vansco, confirm that ***F4-23 V2G_COMM_ESTD_FLG*** is active. This indicates that the bus is communicating with the charger. Visually verify that the pantograph contacts the roof rails and that the "CHARGE MODE" indicator appears on the dash within 1 min. Charge until the SOC increases by 2% and then turn OFF the Charge Enable switch to cancel the session. The pantograph should go to the fully stowed position. **Perform three times without errors.**			
14	Start an overhead charge session. Charge until the SOC increases by 2% and then release the park brake to cancel the session. The pantograph should go to the fully stowed position. **Perform once without any errors.** Turn off the Charge Enable switch before proceeding to the next step.			
15	Start an overhead charge session. Charge until the SOC increases by 2% and then turn OFF the master-run switch to cancel the session. The pantograph should go to the fully stowed position. **Perform once without any errors.** Turn off the Charge Enable switch before proceeding to the next step.			
16	Start an overhead charge session. Charge until the SOC increases by 2%. Initiate a charger side emergency shutdown by pushing the red eStop button on the overhead charger. Charging should stop, the pantograph should retract and the "CHARGE SYSTEM FAIL" indicator should appear on the dash. The Charge Enable switch can be turned OFF. The "CHARGE SYSTEM FAIL" indicator may or may not vanish. This is normal behavior since communications with the charger can be lost when the eStop button is pressed so the bus may not receive confirmation that the pantograph is up causing the "CHARGE SYSTEM FAIL" indicator to remain displayed. If the pantograph up signal is not received, the bus will remain immobilized indefinitely as a safety precaution. To reset the bus, turn off the master-run switch for at least 2 min and then turn off the battery disconnect switch at the rear of the bus. Leave the battery disconnect switch off for 1 min and then turn it back on. The bus should be able to drive once it enters EV mode. **Perform once.**			

Item		Pass	Fail	Notes
17	Start an overhead charge session. Charge until the SOC increases by 2%. Under the ES-EP OVHD CHARGING page in Vansco, force ***F4-10 EV_EMESTDN_OVHD_FLG*** active to simulate a vehicle initiated emergency shutdown. Charging should stop and the "CHARGE SYSTEM FAIL" indicator should appear on the dash. Unforce F4-10. The indicator will vanish once the pantograph is fully stowed and the Charge Enable switch is turned OFF. **Perform once.**			
18	Loop the bus around the charger for each attempt. Charge until the SOC increases by 2% and then turn OFF the Charge Enable switch to cancel the session. **Repeat three times total without any errors.**			
19	Perform a full uninterrupted overhead charge session (initial SoC ≤ 30%). Allow the session to stop on its own without intervening. The pantograph should raise automatically once the top of charge threshold is reached. "CHARGE DONE" will remain on the dash with the drive system disabled until the Charge Enable switch is turned OFF. The top of charge threshold may vary by customer, battery supplier, or whether high-power batteries (usually 91%) or high-energy batteries (usually 87%) are installed. To confirm the threshold, go to the ES-EP OVHD CHARGING page in Vansco. The threshold is set in ***F4-5 OVHD_CHG_REQ***.			

Appendix F: XE Battery Bus EV Drive Mode Validation Checkouts.

Caution: Do not attempt Final Drive Check until all electrical checks & fluid fills are complete!

DO NOT ATTEMPT DRIVE UNLESS TRACTION BATTERY SOC IS ABOVE 30%.

Item No.	Item	Description	Checked	Remarks
1)	Ignition	Turn on master run switch		
2)	Battery Bus Start	Press start button, confirm key-start acknowledge from vehicle immediately following button press (Green indicator should light on instrument cluster LCD screen and will extinguish approximately 5 seconds later)		
3)	System Ready	Confirm vehicle successfully enters EV-Mode (Green indicator should light on instrument cluster LCD screen within a minutes or less of start button activation with no check/stop system fault. Indicator will extinguish approximately 20 seconds after initial activation)		
4)	Battery SOC	Confirm that battery SOC gauge on instrument cluster LCD screen is reading a value of 30% or greater		
5)	Cooling pumps	Confirm that battery and motor/inverter cooling package pumps are running		
6)	Cooling fans	Confirm that battery and motor/inverter rooftop cooling fans are running		
7)	Air System Cutout	Auxiliary system should build up pressure and cutout at ~125psi (8-9 bar)		
8)	Power Steering	Power steering should be functioning. Work out bubbles by turning from lock to lock		
9)	Select Drive	Release park brake, depress service brake and select drive. Allow vehicle to creep forward (may need to gently tap accelerator before this happens)		
10)	Select Neutral	Release park brake, depress service brake and select neutral. Vehicle should stop moving		
11)	Select Reverse	Release park brake, depress service brake and select Reverse. Allow vehicle to creep backwards		
12)	Initial Drive Test	Drive bus 0-to-55-to-0 [mph]. Bus should reach this top speed in a smooth efficient manner		
13)	Drive Mileage Accumulation	Accumulate at least 100 miles (or one full battery discharge) of fault free driving through a variety of CBD and arterial drive simulations.		
14)	Climate Control	Check that climate control system is operating as expected with appropriate cycling of HVAC unit compressors and blower fans.		
15)	Electric Heating Operation	Engage driver's defroster in heat mode and validate that climate control coolant pump is operating and that sufficient heat is generated in driver's area		
16)	Speedometer	Speedometer is indicating proper vehicle speed and odometer is accumulating normal mileage		
17)	Energy Consumption	Confirm that SOC gauge on instrument cluster LCD screen is decreasing at a reasonable rate relative to drive mileage accumulation, confirm that amber warning indicator illuminates on LCD screen when SOC value is 20% or less, confirm reasonable energy consumption numbers after full battery discharge. Expected discharge should be between 2-3 kWh/mile on XE35/40 & 3-4 kWh/mile on XE60.		
18)	Regenerative Braking	Verify that regenerative braking is applied when throttle is released while driving in a smooth efficient manner		
19)	Electric Aux Heater Operation (If applicable)	Activate electric aux heater (either in cold weather or through control forcing in Vansco) and verify that unit is operating and maintaining defroster heat		
20)	Diesel Aux Heater Operation (If applicable)	Activate diesel aux heater (either in cold weather or through control forcing in Vansco) and verify that unit is operating and maintaining defroster heat		
21)	Diesel Aux Heater Fuel Sender (If applicable)	Fuel level on instrument cluster LCD screen should read reasonable value		
22)	HVIL Switch	With the vehicle in EV mode, set the High-Voltage Interlock switch at the rear fuse box to "HV OFF" Ensure that the vehicle exits EV mode.		

LABOUR				
	Operation	Number of Technician(s)	Hours	Labor Time T X HR
1	Install the ground strap kit and upgrade the pre-charge resistor in the rear mount, ESS and roof mount, ESS.	4	8.0	24.00

PARTS					
Item	Part Number	Description	Qty. per Coach	Units	Notes
1	5928660	NEVER-SEIZE	0.010	EA	
2	081034	LOCTITE 243	0.010	EA	
3	5962614	Zip Ties	30	EA	

SPECIAL TOOLS					
Item	Part Number	Description	Qty.	Units	Notes
1	N/A	COOLANT RECOVERY AND FILL TOOL	1	EA	Source Local
3	N/A	3200LBS VERTICAL RATED STRAPS	2	EA	Source Local
4	N/A	FORKLIFT	1	EA	Source Local
5	N/A	HV-INSOLATED TOOLS	1	EA	Source Local
6	N/A	TORQUE WRENCH /Max 200 ft lbs. 3/8 drive	1	EA	Source Local
7	N/A	YELLOW PAINT TORQUE MARKER	1	EA	Source Local
8	6493641	ESS Pressure Testing Kit	1	EA	
9	182470	Cap	1	EA	
10	707430	Kit-14CCT TWR HDP 20	1	EA	
11	8110650	Plug Seal	20	EA	
12	869619	Assy-Amphnl strt-positive blanking	1	EA	
13	869677	Assy-Amphnl strt-negative blanking	1	EA	
14	869751	Plug MNL service disconnect blank	1	EA	
15	6485763	JB Removal Beam	1	EA	
16	6485514	Forklift Adaptor Boom	1	EA	
17	N/A	Digital Multimeter (DC & AC voltage)	1	EA	Source Local
18	N/A	Laptop with Vansco program w/Nexiq.	1	EA	Source Local
19	N/A	Air-Shim rated up to 500 lbs.	4	EA	4 per ESS unit
20	N/A	Heavy Duty Quick Support Rod	4	EA	4 per ESS unit
21	N/A	Wood Blocks 1” thick X 3.5”W X 10”L	4	EA	4 per ESS unit
22	N/A	1 ½ Crows Foot	1	EA	Source Local
23	N/A	1 ½ Ratchet Wrench	1	EA	Source Local

24	N/A	1 1/8 Wrench	1	EA	Source Local
25	N/A	1 1/8 Deep wall socket. ½ and 3/8 drive	1	EA	Source Local
26	N/A	15/16 Wrench ratchet	2	EA	Source Local
27	N/A	¾ Wrench	1	EA	Source Local
28	N/A	¾ Deep wall socket 3/8 drive	1	EA	Source Local
29	N/A	3/8 drive deep wall sockets 9/16, ½, 7/16, 5/16, 10mm	1	EA	Source Local
30	N/A	9/16, ½, 7/16, 5/16, 10mm Wrenches	1	EA	Source Local
31	N/A	Torque wrench / Max 500 ft-lbs. / ¾ drive	1	EA	Source Local
32	N/A	Coolant crimp clamps	3	EA	Source Local
33	N/A	3/8 drive extension 6 inch and 12 inches	1	EA	Source Local
34	N/A	5-gal bucket	1	EA	Source Local