

# ***SERVICE MANUAL BULLETIN***

This Service Manual Bulletin is prepared by the Publications Department of New Flyer Industries Canada ULC. Refer to details below.

## **SMB-187**

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<b>APPLICABILITY</b>					
<b>VEHICLE LENGTH</b>	<input type="checkbox"/> 30ft.	<input type="checkbox"/> 35ft.	<input type="checkbox"/> 40ft.	<input type="checkbox"/> 60ft.	<input checked="" type="checkbox"/> <b>ALL</b>
<b>VEHICLE TYPE</b>	<input checked="" type="checkbox"/> <b>Xcelsior®</b>	<input type="checkbox"/> <b>MiDi®</b>	<input type="checkbox"/> <b>Invero®</b>	<input type="checkbox"/> <b>ALL</b>	
	<input type="checkbox"/> <b>Low Floor</b>	<input type="checkbox"/> <b>High Floor</b>			
<b>FUEL TYPE</b>	<input type="checkbox"/> <b>Diesel</b>	<input checked="" type="checkbox"/> <b>Diesel/Electric</b>	<input type="checkbox"/> <b>CNG</b>	<input type="checkbox"/> <b>LNG</b>	<input type="checkbox"/> <b>ALL</b>
	<input checked="" type="checkbox"/> <b>Fuel Cell</b>	<input checked="" type="checkbox"/> <b>Trolley/Electric</b>	<input checked="" type="checkbox"/> <b>Battery/Electric</b>		
<b>SUBJECT</b>	<b>High Voltage Safety</b>				
<b>SECTION TITLE</b>	<b>4 - ELECTRIC DRIVE SYSTEM</b>				
<b>DETAILS</b>	<p><b>This bulletin stresses the need for safety when performing maintenance on the High Voltage System on your New Flyer vehicle.</b></p> <p><b>This information supersedes any prior information on this subject already provided in your New Flyer Service Manuals. Make this Service Bulletin available to service personnel to inform them of changed information.</b></p>				

## 1. SAFETY



During component removal or installation, ensure that the vehicle is de-energized. Set the Master Run switch to the STOP-SYSTEM position and the Batter Disconnect switch to the OFF position. On vehicles equipped with a High Voltage Interlock switch, ensure it is in the High Voltage (HV) OFF position. Lock and tag the switch and retain the key. Failure to follow this procedure may result in personal injury or component damage.

### 1.1. High Voltage Safety



The Electric Drive System uses hazardous High Voltage (HV) electrical energy. There is a risk of electric shock. Only trained service personnel should access components of the High Voltage Equipment. Failure to observe all HV electrical safety precautions may result in personal injury and/or death.

The highest concerns are for the safety of service personnel working on the vehicle and others in the vicinity, and in minimizing the potential for damage to property.

Death, serious injury, and significant material damage will result if these safety rules are not followed.

### 1.2. General Safety Guidelines & Practices

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

#### 1.2.1. Definitions

##### 1.2.1.1. High Voltage (HV)

Any form of voltage that is greater than 50 volts.

#### 1.2.1.2. Stored Energy

Potential energy stored in electrochemical or electrostatic devices such as batteries or capacitors.

Personnel must always remember the characteristics of these stored energy devices and under what conditions they retain energy and pose an electrocution risk.

### 1.3. Equipment Requirements

The following equipment is required:

- Personal Protection Equipment (PPE) meeting Category 2 ratings for Arc Flash protection. Refer to 1.5. "PPE Requirements" on page 3 in this bulletin for more information on the category ratings
- Rubber Insulating Gloves meeting Class 0 ratings (0 to 1000 VAC/1500 VDC) for High Voltage protection
- Insulated rescue hook
- ABC fire extinguisher, 5 lb. minimum, at the activity areas
- Digital Multimeter (DMM), 1000 volt Category III, 600 volt Category IV, 10 Megohm impedance or greater with insulated case or rubber holster
- Clamp-on current probe, 1000 volt Category III, 600 volt Category IV
- High-Potential (Hi-Pot) dielectric strength tester
- Phase rotation meter
- Adequate lighting
- HV insulated mat
- Safety barricade with warning lights and "Danger High Voltage" signs
- Belt tool pouch (use only to carry small components up/down a ladder)
- Torque screwdriver set
- Spare HV and low voltage fuses
- Any other equipment required by applicable local and federal regulations

### 1.3.1. Equipment Calibration

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

### 1.3.2. Insulated Tools

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

## 1.4. Personnel Requirements

### 1.4.1. General

Only trained personnel shall supervise and perform High Voltage system testing, servicing and troubleshooting. Two personnel (one called the Checker and the other called Monitor/Recorder) shall perform troubleshooting and servicing procedures, together, to ensure safety of themselves, others nearby and for the protection of vehicle and property. Refresher training shall be provided to these personnel as required

### 1.4.2. Training Requirements

The training of personnel shall consist of:

- HV and low voltage basics, intermediate and advanced electricity
- HV and low voltage electrical systems of the vehicle
- Shop safety practices and procedures
- First aid including CPR and the use of the shop defibrillator
- How to release a victim that can't let go of HV
- Quickest method of shutting down HV
- Fire fighting and emergency procedures
- HV and arflash safety
- Organized and tidy placement of equipment and tools allowing for unrestricted movement

- Operation of High Potential (Hi-Pot) or dielectric strength test equipment
- 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.

## 1.5. PPE Requirements

### 1.5.1. General

PPE voltage class, Arc Flash rating shall be compatible with the voltage and arc flash capability of the systems being tested.

#### 1.5.1.1. Gloves

Gloves used for High Voltage protection are divided into 6 classes by maximum voltage rating. Class 0 (0 to 1000 VAC/1500 VDC) rated gloves are adequate for all New Flyer High Voltage applications.

 **NOTE:**

*Leather protector gloves should always be worn over rubber insulating gloves.*

#### 1.5.1.2. Arc Flash

PPE used in high voltage applications is divided into 5 categories by Minimum Arc ratings. Category 2 rated PPE is adequate for all New Flyer High Voltage applications. See "Fig. 1: PPE Categories" on page 4.

### 1.5.2. 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.

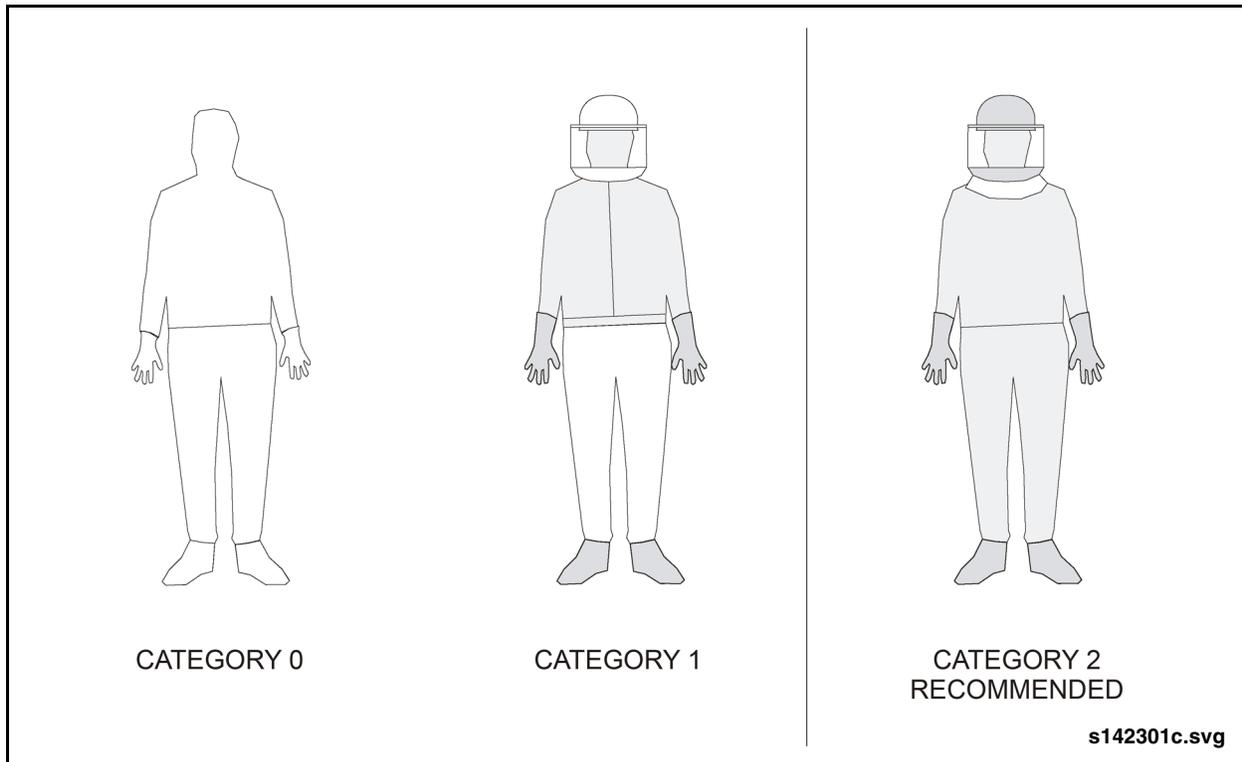


Fig. 1: PPE Categories

### 1.5.3. 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.

### 1.5.4. 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.

### 1.5.5. Electrical Injuries

Electrical injuries should be immediately reported to first aid personnel and the supervisor. Even non-injurious electrical shocks, originating from components in the HV system, should be reported to the supervisor. All incidents should be immediately investigated and documented to determine the cause and prevent the occurrence in the future.

<b>PPE CATEGORIES</b>		
<b>CATEGORY 0</b>	<b>CATEGORY 1</b>	<b>CATEGORY 2</b>
1.2 cal/cm2	4 cal/cm2	8 cal/cm2
<b>Arc Rated Clothing:</b>		
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)
<b>Other Equipment:</b>		
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
	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)

### 1.6. Service Preparation

- The scope of the work must be accurately defined such as a Servicing Procedure that requires systematic steps with sign-offs. Before servicing is performed, the Supervisor, Checker and Monitor/Recorder must conduct a briefing of what shall transpire, identify potential hazards and resist pressures to speed through a procedure, anticipate problems and question possible events. If an unexpected electrical hazard or fault occurs, during any service work, it must be immediately reported to the supervisor. After the work is completed the same group should review the results and processes and make proposed modifications to the procedures if required.
- Install Safety barricade with warning lights and signs indicating “Danger High Voltage” around the vehicle perimeter and ensure no personnel are within the fenced perimeter during the service procedure.
- 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 a Category III or better Digital Multimeter (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.
- When it is necessary to perform tests of HV systems with the power ON, then the Working Live procedure must be followed. Refer to 1.6.3. “Working Live” on page 6 in this bulletin for procedure.
- The test personnel shall always rehearse the actions required in case of any possible accident scenarios.
- Before beginning the Service procedure, the test personnel shall remove all their jewelry (including pierced ones), watches and any electrically conductive objects on them.

**1.6.1. Vehicle Inspection**

Prior to conducting any high voltage servicing, the vehicle must be visually inspected to ensure all systems are properly maintained, paying special attention to any evidence of fretting, chafing, or other damage to HV cables or equipment.

**1.6.2. Lockout/Tagout Procedure**

The Lockout/Tagout procedure should be followed as specified in the respective service procedure.

When removing the lock and tag:

1. The locks and tags shall be removed by the installer of the locks and tags or shall be removed 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.

**1.6.3. Working Live**

To maximize safety, it is always important to perform the maximum amount of HV service in the de-energized state. Component removal and installation must always be performed in a de-energized state. When it is necessary to test HV equipment while energized or to verify whether HV is present, the utmost care and safety procedures must be used including:

- Wearing appropriate PPE including protector gloves over top of the HV rubber gloves.
- Ensuring all personnel, other than the Checker and Monitor/Recorder, are clear of the vehicle.
- Standing on HV insulated mat.
- Covering any energized HV components not being immediately worked on with an HV insulated mat to limit exposure to live parts.