



Proterra On-Route Charge Station Maintenance Manual

Proterra Inc.
1 Whittle Court
Greenville, SC 29607
P/N ORCS-001 Rev 3.0
June 2014

This maintenance manual has been prepared to provide you with the information necessary to perform the necessary maintenance required to sustain this On-Route charge station. To ensure maximum On-Route Charge Station performance and reliability, you must read and thoroughly understand the contents of this manual and refer to the specific vendor manuals for complete information.

The specifications and information in this manual are the most current at the time of publication, and may be subject to change without notice. It is the responsibility of the transit agency to provide you with the necessary updates when special equipment or changes to standard equipment are implemented.

Copyright ©2014, Proterra Inc.

The accompanying product is protected by one or more U.S. and foreign patents and/or pending patent applications held by Proterra Inc.

All rights reserved. No part of this publication may be photocopied, reproduced, reprinted, transmitted, or distributed in any form, or by any means electronic, mechanical, recording, or otherwise, without prior written permission of Proterra Inc.

Table of Contents

Chapter 1 Introduction	1
Notes, Cautions, and Warnings	1-2
Terminology	1-3
System Overview	1-5
Proterra-Supplied Charge Station Components	1-6
System Operation	1-7
Chapter 2 Maintenance Schedule.....	9
Service Precautions	2-10
General Preventive Maintenance Schedules	2-10
Optional Annual Preventive Maintenance	2-17
Optional Annual Charge Station Inspection Service	2-18
Chapter 3 Maintenance Procedures.....	19
Service Precautions	3-19
Servicing the High-Voltage System	3-20
Servicing the Pneumatic System	3-25
Servicing the Air Compressor	3-25
Servicing the Air Lines	3-32
Inspecting Hardware	3-34
Servicing the Mechanical System	3-34
Lubricating the Charge Arm Assembly	3-35
Servicing the Sensors	3-45
Servicing the Charger	3-47
General Service	3-49
Chapter 4 Replacement Procedures	51
Replacing the Charge Head	4-52
Replacing the Charge Arm Assembly	4-64
Replacing the Main Cylinder	4-67
Removing the Main Cylinder	4-67

Installing the Main Cylinder	4-70
Replacing the Main Springs	4-73
Removing the Main Springs	4-73
Installing the Main Springs	4-75
Replacing the Boat Unit	4-77
Removing the Boat Unit	4-77
Installing the Boat Unit	4-80
Replacing the Ground Brush	4-83
Removing the Ground Brush	4-83
Installing the Ground Brush	4-86
Replacing the Pilot Brush	4-89
Chapter 5 Calibration Procedures.....	93
Control Box Pressure Regulator Values	5-94
Calibrating the Ultrasonic Sensor	5-95
Calibrating Charge Head Up/Down Travel Rate	5-98
Calibrating the Charge Arm Up/Down Position Sensors	5-100
Chapter 6 Troubleshooting	105
Overview	6-105
Docking and Charging Stages	6-105
Fault Codes and Causes	6-107
Fault Cause Troubleshooting	6-109
Arm Max Travel Issues	6-109
Arm Home Travel Issues	6-109
Air Pressure Sensor Issues	6-109
Ultrasonic Sensor Electrical Issues	6-110
Distribution Box High Voltage Contactor Issues	6-110
Brush Control Issues	6-111
Head Landing Issues	6-112
Head Over Temp Issues	6-113
Pilot Not Received Issue	6-113
Chargers Not Responding Issue	6-114
Trouble-Trees – Head Home	6-115
Trouble-Trees – Charge/Ground Brush Home	6-119

List of Figures

Figure 1-1: Proterra Battery-Electric Bus at On Route Charge Station	1
Figure 1-2: One-Stall and Two-Stall Transit On-Route Charge Site	5
Figure 3-1: High-Voltage Cables	21
Figure 3-2: Lugs	22
Figure 3-3: Contactors	22
Figure 3-4: Control Wiring	23
Figure 3-5: Charge Head Cables	23
Figure 3-6: HV Cable Cover and Lugs	24
Figure 3-7: Charge Head Control Wiring	24
Figure 3-8: Air Compressor Tank Safety Valve	25
Figure 3-9: Air Filter Element	26
Figure 3-10: Air Dryer Desiccant	27
Figure 3-11: Drain Valve	28
Figure 3-12: Air Compressor Pump Oil Dipstick	29
Figure 3-13: Compressor Pump Oil Draining	30
Figure 3-14: Lower Air Lines	32
Figure 3-15: Upper Air Lines	33
Figure 3-16: Charge Head “Roll” Pin Lubrication	35
Figure 3-17: Charge Head “Twist” Pin Lubrication	35
Figure 3-18: Charge Head to Charge Arm Pivot Pin Lubrication	36
Figure 3-19: Center Guide Rod Lower Pivot Pin Lubrication	36
Figure 3-20: Spring Return-to-Center Cable Lubrication	37

Figure 3-21: Air Cylinder Actuator Rod Lower Pivot Pin and Spring Cylinder Pivot Pin Lubrication	37
Figure 3-22: Spring Cylinder Rod Lubrication	38
Figure 3-23: Air Cylinder Actuator Rod Lubrication	38
Figure 3-24: Spring Cylinder Upper Pivot Pin Lubrication	38
Figure 3-25: Guide Rod Upper Pivot Pin Lubrication	39
Figure 3-26: Charge Arm Lower Pivot Pin Lubrication	39
Figure 3-27: Charge Arm Vertical Pivot Pin Lubrication	40
Figure 3-28: Charge Head in correct resting position.	41
Figure 3-29: Charge Brushes showing wear	43
Figure 3-30: Charge Head Fasteners	44
Figure 3-31: Charge Head Cotter Pins	44
Figure 3-32: Head Land Detent Sensor at 75 degrees	45
Figure 3-33: Bottom Surface of Ultrasonic Sensor	46
Figure 3-34: Filter Elements	48
Figure 3-35: Docking Control Box Thermostat	49
Figure 3-36: Docking Control Box Exhaust Fan Filter Element	49
Figure 3-37: Spring Assembly Bushing	50
Figure 4-1: High-Voltage Termination Cover Removal	52
Figure 4-2: High-Voltage Terminations	53
Figure 4-3: High-Voltage Cable and Ground Cable Grommets	53
Figure 4-4: Ground Brush Actuator Cover	54
Figure 4-5: Grounding Bracket Bolts	54
Figure 4-6: Ground Cable Lug Bolts	54

Figure 4-7: Ground Brush Actuator Air Line Connection	55
Figure 4-8: Guide Cable Nuts	55
Figure 4-9: Low-Voltage and Deutsch Connectors	56
Figure 4-10: Charge Head Air Connections	56
Figure 4-11: Cotter Pin Location on bottom of Pivot Pin	56
Figure 4-12: Retaining Pin C-Clip	57
Figure 4-13: “Twist” Motion Pivot Pin	57
Figure 4-14: “Roll” Movement Pivot Pin	58
Figure 4-15: “Twist” Motion Pivot Pin	59
Figure 4-16: Retaining Pin C-Clip	59
Figure 4-17: Cotter Pin Location on bottom of Pivot Pin	59
Figure 4-18: Charge Head Air Connections	60
Figure 4-19: Low-Voltage and Deutsch Connectors	60
Figure 4-20: Guide Cable Nuts	61
Figure 4-21: Ground Brush Actuator Air Line Connection	61
Figure 4-22: Ground Cable Lug Bolts	62
Figure 4-23: Grounding Bracket Bolts	62
Figure 4-24: Ground Brush Actuator Cover	62
Figure 4-25: High-Voltage Cable and Ground Cable Grommets	63
Figure 4-26: High-Voltage Terminations	63
Figure 4-27: High-Voltage Termination Cover Installation	63
Figure 4-28: Main Cylinder - Removing C-clips	67
Figure 4-29: Main Cylinder - Removing Clevis Pin on Lower End	68

Figure 4-30: Main Cylinder - Removing Cotter Pin	68
Figure 4-31: Main Cylinder - Installing Clevis Pin on Upper End	69
Figure 4-32: Main Cylinder - Installing 90-degree elbows	70
Figure 4-33: Main Cylinder - Installing Clevis Pin on Upper End	71
Figure 4-34: Main Cylinder - Installing Cotter Pin	71
Figure 4-35: Main Cylinder - Installing Clevis Pin on Lower End	72
Figure 4-36: Main Cylinder - Installing C-clip	72
Figure 4-37: Main Spring Removal (1 of 2)	73
Figure 4-38: Main Spring Removal (2 of 2)	74
Figure 4-39: Main Spring Installation (1 of 2)	75
Figure 4-40: Main Spring Installation (2 of 2)	76
Figure 4-41: Removing Long Screws on Boat Unit	77
Figure 4-42: Removing HV Lugs on Boat Unit	78
Figure 4-43: Removing Charge Head Screws	78
Figure 4-44: Actuation Brush Assembly - Disconnecting Harness Pigtail and Air Line Connection	79
Figure 4-45: Actuation Brush Assembly - Connecting Harness Pigtail and Air Line Connection	80
Figure 4-46: Installing Charge Head Screws	81
Figure 4-47: Installing HV Lugs on Boat Unit	82
Figure 4-48: Installing Long Screws on Boat Unit	82
Figure 4-49: Removing Ground Brush Assembly Cover	83
Figure 4-50: Ground Brush Cable Lug	84
Figure 4-51: Ground Brush Rocker	84

Figure 4-52: Removing Ground Brush Clevis Pin	85
Figure 4-53: Removing Ground Brush Standoff and Pivot Pin	85
Figure 4-54: Installing Ground Brush Pivot Pin	86
Figure 4-55: Securing Ground Brush Standoff and Pivot Pin	86
Figure 4-56: Installing Ground Brush Rocker	86
Figure 4-57: Installing Cotter Pin	87
Figure 4-58: Installing Ground Brush Cable Lug	87
Figure 4-59: Tightening Ground Brush Cable Lug	87
Figure 4-60: Installing Ground Brush Assembly Cover	88
Figure 4-61: Delrin Cover Over Pilot Brush	89
Figure 4-62: Pilot Brush Compression Spring	90
Figure 4-63: Pilot Brush Assembly	91
Figure 5-1: Control Box Pressure Regulator Gauges	94
Figure 5-2: Setting up the Ultrasonic Sensor and Target	96
Figure 5-3: “MODE” button	96
Figure 5-4: Charge Arm Up/Down Travel Rate Regulators	98
Figure 5-5: Charge Arm Travel Rate Regulators - Red Collars	99
Figure 5-6: Charge Arm Travel Rate Regulators - Color Stripes	99
Figure 5-7: Charge Arm Up/Down Position Sensors	100
Figure 5-8: Positioning the Arm Up Sensor	101
Figure 5-9: Positioning the Arm Down Sensor	102
Figure 6-1: Trouble-Tree – Head Home Error, Start	115
Figure 6-2: Trouble-Tree – Head Home Error, Mechanical Issue	116

Figure 6-3: Trouble-Tree – Head Home Error, Sense Wire Issue	117
Figure 6-4: Trouble-Tree – Head Home Error, Air Issue	118
Figure 6-5: Trouble-Tree – Charge/Ground Brush Home Error, Start	119
Figure 6-6: Trouble-Tree – Charge/Ground Brush Home Error, Brushes Extend	120
Figure 6-7: Trouble-Tree – Charge/Ground Brush Home Error, Some Brushes Not Extend	121
Figure 6-8: Trouble-Tree – Charge/Ground Brush Home Error, CAN Does Not Report Extend	122
Figure 6-9: Trouble-Tree – Charge/Ground Brush Home Error, Sensors Appear Correct	123
Figure 6-10: Trouble-Tree – Charge/Ground Brush Home Error, Act Issue in Head	124
Figure 6-11: Trouble-Tree – Charge/Ground Brush Home Error, Air Tube Diag	125
Figure 6-12: Trouble-Tree – Charge/Ground Brush Home Error, Entire Side Not Issue	126
Figure 6-13: Trouble-Tree – Charge/Ground Brush Home Error, No Brush Extend	127
Figure 6-14: Trouble-Tree – Charge/Ground Brush Home Error, Major Leak	128
Figure 6-15: Trouble-Tree – Charge/Ground Brush Home Error, Arm Lowers Test Tag	129
Figure 6-16: Trouble-Tree – Charge/Ground Brush Home Error, Gauge Press	130

List of Tables

Table 2-1: Monthly High-Voltage System Preventive Maintenance	11
Table 2-2: Monthly Pneumatic System Preventive Maintenance	12
Table 2-3: Monthly Mechanical System Preventive Maintenance	13
Table 2-4: Monthly Sensor Preventive Maintenance	14
Table 2-5: Monthly Charger Preventive Maintenance	14
Table 2-6: Monthly General Preventive Maintenance	15
Table 2-7: Semi-Annual (6 Month) Preventive Maintenance (Requires a Scissor Lift)	16
Table 2-8: Optional Annual (12 Month) Preventive Maintenance	16
Table 5-1: Charge Head Control Box Pressure Regulator Values	94

This page intentionally left blank

Chapter 1: Introduction

The On-Route charging station is the core of the fast charge concept for the Proterra Battery-Electric buses. The charge station can be located at any site, specified by the transit authority, which allows for a suitable approach and departure area to properly position the bus for charging. Charging stations are typically located at a Transit Hub or other stop-over location and can have one or more docking positions available for the buses depending on customer requirements.



Figure 1-1. Proterra Battery-Electric Bus at On Route Charge Station

Notes, Cautions, and Warnings

This document contains embedded Notes, Cautions, and Warnings to convey important information to the reader. The use of each of these messages is defined in the following sections.

Notes

Notes are used to emphasize important information by visually distinguishing it from the rest of the text. Notes can contain any type of information except safety information, which must always be placed in cautions or warnings.

Example:

Note: In all Proterra manuals, notes point out something of special interest or importance to the reader. Failure to read the note will not result in physical harm to the reader, equipment, or data.

Cautions

Cautions draw special attention to anything that could damage equipment or cause the loss of data. The caution will describe what could happen if the caution is ignored. Cautions will be placed before the step it applies to. An ‘attention’ icon will be located beside a caution.

Example:



Do not turn the monitor off by unplugging it from the computer or wall socket. Severe damage to the monitor may result. Turn the monitor off before unplugging it.

Warnings

Warnings draw special attention to anything that could injure or kill the reader. Like cautions, they are always placed before the step in the procedure they relate to, and are used with the ‘attention’ icon.

Example:



Unplug the computer before removing the outer case. If you don't, severe electrical shock may result.

Terminology

The following terms are associated with the On Route Charge Station and the related equipment.

Charging Components on Bus:

Charge Blade - The bus charging feature that has the high-voltage electrical contacts. It is about two inches wide, 4 inches tall, and 39.5 inches long. It's located on top, near the rear of the bus.

Manual Charge Receptacle - Located behind the curbside rear fender, this component is used when connecting the charge plug(s) located inside the Manual Charge Box or on the Shop Charger.

Scoop - The composite form on top of the rear section of the bus that funnels the charge head to the charge blade.

Docking Control Equipment:

Compressor Box Assembly - The Compressor Assembly supplies the air pressure required to operate the Charge Head Arm. This assembly is mounted in its own enclosure.

High-Voltage Distribution Box Assembly - This device is used to distribute high-voltage power from the Charger to either the Charge Head or the Manual Charge Box. This assembly is mounted in its own enclosure.

Low-Voltage Distribution Box Assembly - This device controls the Charger, Charge Head and Manual Charge Box. This assembly is mounted in its own enclosure.

Note: Customers have the option of housing the Compressor Box, Low-Voltage Distribution Box and High-Voltage Distribution Box in one Docking Control Box, or in three separate box assemblies as listed above.

Charging Components at Charge Station:

Charge Head - The charge head contains the high-voltage brushes and actuators that contact the charge blade to transfer energy into the bus.

Charge Head Arm - The charge head arm is the moveable structure that holds the charge head, head control box, and head junction box. The charge head arm moves to position the charge head on the charge blade when the fast charging process is initiated.

Charge Head Control Box - The control box is mounted above the charge head arm. It contains low voltage connections that read and actuate the charge head. It also contains the RFID reader, the air solenoids, and the pressure switch.

Charge Head Junction Box - The terminal connection box between the high voltage cables from the pole and the high voltage cables to the charge head arm. High-Voltage may be present here.

Charge Stall - The parking position where the buses charge.

Charge Station - This term refers to the whole charging station setup including the building (if applicable), charge stalls, and all equipment involved in charging the bus.

Manual Charge Box - This optional enclosure houses the manual charging cables and the switch used to select between Overhead Charge or Manual Charge.

RFID - Radio-frequency identification (RFID) is a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from the bus, for the purposes of automatic identification and tracking.

General Information:

NFPA 70E, Standard for Electrical Safety in the Workplace - This standard provides a guideline for protecting electrical workers from electric shock, electrocution, arc-flash, and arc-blast hazards while performing electrical-based construction and maintenance work.

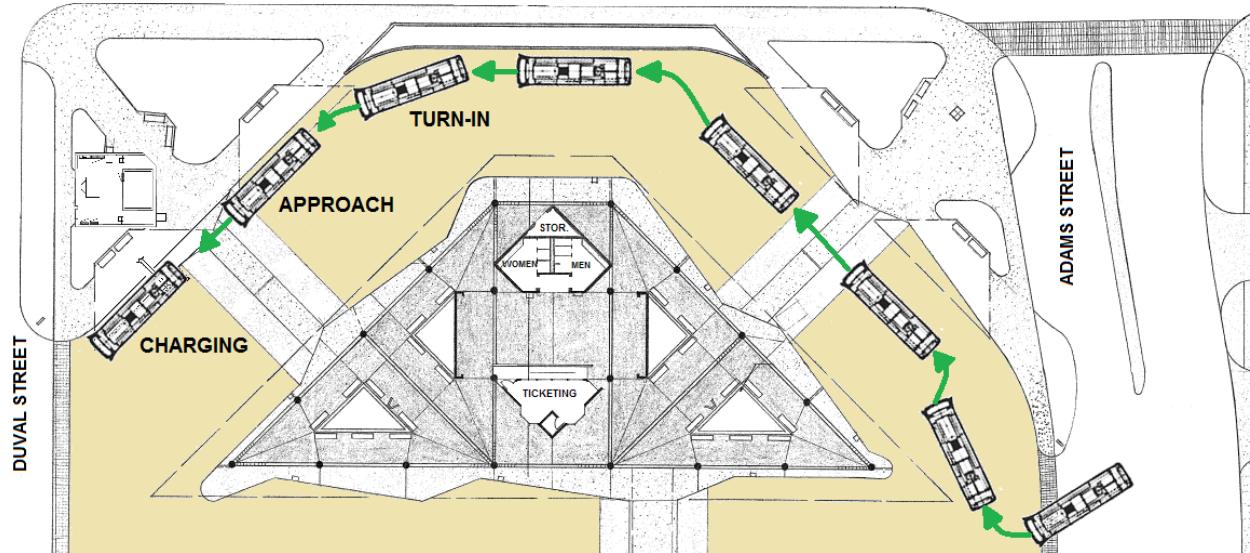
Lockout/Tagout (LOTO):

29 CFR 1910 Subpart S (1910.333), Selection and Use of Work Practices - This OSHA standard provides a guideline for proper locking and tagging of electrical circuits and states "*Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized. The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards.*"

System Overview

A typical charge station is a combination of Proterra-supplied charging equipment and the supporting equipment supplied by the customer during site preparation. The charge station must be laid out so that the bus can approach directly under the overhead charge assembly, in a path parallel to the curb. The charge equipment is located off to the side of the overhead equipment. Emergency shutoffs for the charge station are clearly labeled and located with the charge equipment.

One-Stall Charge Site



Two-Stall Charge Site

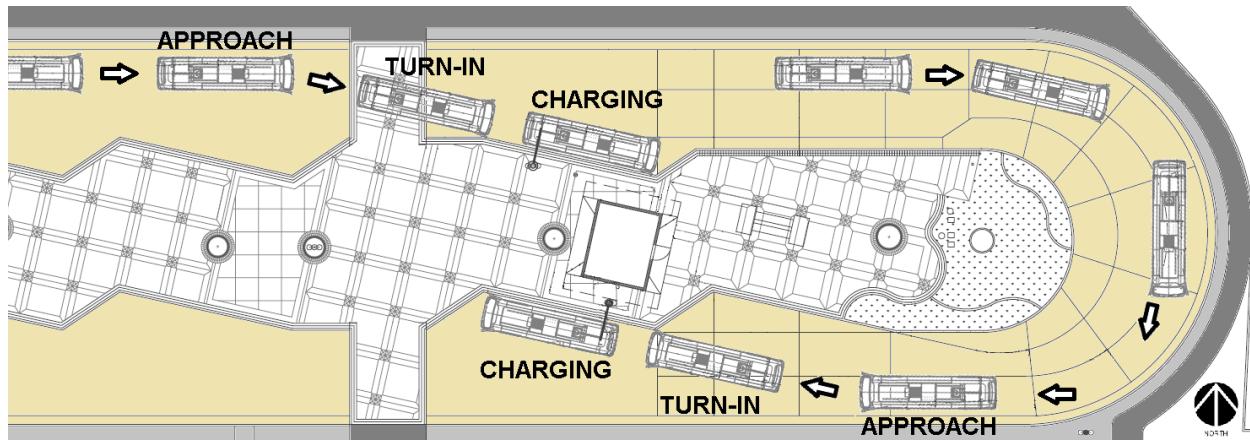


Figure 1-2. One-Stall and Two-Stall Transit On-Route Charge Site

Proterra-Supplied Charge Station Components

For each customer site Proterra provides a standardized, but configurable, combination of components required to On Route-charge the Proterra Battery-Electric bus. To assist with installation, Proterra provides a transit agency with some flexibility in locating and mounting the components. Each of the Proterra standard components are described below:

Charger/Charger Enclosure - An indoor Charger may be installed in a custom enclosure, building, or room. An outdoor Charger may be installed outside. The Charger may be installed against a wall, but must have at least 36 inches of clearance in front of it for airflow and door access. It must also have at least 6 inches clearance on the right side. This component must be pad-mounted. The pad should be raised by at least 2 inches and should be 6 inches larger on each side than the mounting footprint of the Charger or Charger Enclosure.

Manual Charge Box - The optional Manual Charge Box can be pad, wall, or pole-mounted with 21 inches of clearance allowed for the door on the front of the cabinet. The pad should be 2 inches larger on each side than the mounting footprint and raised by at least two inches.

Wireless Antenna - The Wireless Antenna location will vary by site, but it should be installed on a capped pole using a mounting plate and lightning arrestor. The antenna is a hockey-puck style and needs to be oriented so that it allows communication with the bus during docking and charging.

RFID Antenna - The RFID Antenna location will vary by site, but it should be installed on the Charge Head and Arm Assembly or on a bracket located inside the Canopy or Awning. The RFID Antenna should be oriented so that it detects the bus as it approaches, but not if it is passing the charge station.

Emergency Stop Buttons - The number of Emergency Stop buttons to be installed will vary depending on Local Codes at the site and customer preference. A typical installation may use two (2) E-stop buttons with one located inside the equipment security fence and one located outside the equipment security fence. Locate and wire the Emergency Stops based on the wiring schematic.

Charge Head Assembly- The Charge Head Assembly requires a site-specific mounting arrangement. It is typically pole mounted to allow for proper height clearance and range of motion. In cases where there are special architectural requirements or a suitable existing structure, the charge head assembly may be mounted to another structure. The Overhead Charge Interface consists of the Charge Head and Arm, Head Control Box, and Head Junction Box.

Air Compressor Box - The Air Compressor Box should be pad-mounted with 21 inches of clearance allowed for the door on the front of the cabinet. The pad should be 2 inches larger on each side than the mounting footprint and raised by at least two inches.

Low-Voltage Distribution Box - The Low-Voltage Distribution Box enclosure should be wall-mounted with 30 inches of clearance allowed for the door on the front of the cabinet.

High-Voltage Distribution Box - The High-Voltage Distribution Box enclosure should be wall-mounted with 30 inches of clearance allowed for the door on the front of the cabinet.

Note: Customers have the option of housing the Air Compressor Box, Low-Voltage Distribution Box and High-Voltage Distribution Box in one Docking Control Box, or in three separate box assemblies.

System Operation

As a bus approaches the charge station, wireless communication is used to link the serial data on the bus with the charge station. When the bus is in close proximity to the charge head, the charge station will identify the bus using radio frequency identification (RFID) technology.

The bus operator drives the bus toward the charge stall where he/she is interested in charging. When the bus is identified, the charge station knows which charging stall is being used. The charge station then checks the status of the stall being used to ensure that it is functional and ready to be used. If the station is OK, the bus gets speed limited as the docking process starts. The driver must still press the accelerator pedal to continue driving into the stall. Sensors in the charge head are used in conjunction with distance measurements made by the bus to handle positioning for the docking process. As the bus proceeds through the docking process, the speed gets automatically limited further.

The bus has a composite scoop feature on the rear section of the roof. This feature provides a large, sturdy, landing zone for the charge head as well as raised edges that act to funnel the charge head toward the charge blade as the bus moves forward. The charge blade is the main contact point on the bus where the charge head electrically mates for the fast charge. When the charge head detects the scoop, the bus automatically stops and the charge station lowers the head onto the bus. When the head is down, the bus can again proceed forward, this time limited at an even slower rate. When the charge head detects the blade, it then extends the brushes in order to drag them on the blade for the final few inches of the dock process.

When the charge head system determines that the proper distance has been traveled, it stops the bus completely and the high-voltage contactors on the Charge Station close. The bus operator then sets the park brake and the bus communicates wirelessly with the charge station to set up the charge parameters with the chargers. The high voltage contactors on the bus that connect the blade contacts to the battery then close. The contactors in the chargers then close and the chargers begin matching voltage with the bus voltage. When the voltage is matched, the chargers ramp up current to charge the bus.

During the charge process, the bus, the charge station, and chargers are in constant communication. The charge rate is adjusted as the battery SOC raises. When the battery on the bus is sufficiently full, the charge process is ended and the contactors open. The head then rises off of the scoop and charge blade.

This page intentionally left blank

Chapter 2: Maintenance Schedule

Proper service and repair is important for the safe, reliable operation of the On-Route Charge Station. The maintenance procedures recommended and described in this manual are effective methods for performing the maintenance operations. Some of these maintenance operations require the use of tools, specially designed for the purpose. These special tools should be used, when recommended.



CAUTION

It is important to note that this manual contains various Warnings, Cautions, and Notes, which should be carefully read in order to minimize the risk of personal injury to maintenance personnel, or the possibility that improper maintenance methods will be followed, which may damage the vehicle, or render it unsafe. It is also important to understand that these Warnings, Cautions, and Notes are not exhaustive. We could not possibly know, evaluate, and advise of all the conceivable ways in which maintenance might be done, or of the possible hazardous consequences of each way. Consequently, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a maintenance procedure or tool, which is not recommended by the manufacturer, must first satisfy themselves thoroughly, that neither their safety, nor the vehicle safety will be jeopardized by the maintenance method they select.

Service Precautions

**CAUTION**

Never attempt to maintain this On-Route Charge Station without referring to the section of the manual that fully describes the task you are to work on.

**WARNING**

There are multiple power sources entering the charger and docking control equipment. Ensure you have the breaker off and follow the lock out tag out procedure specified in OSHA 29 CFR 1910 Subpart S.

**WARNING**

Never attempt to service the Charge Station with the RFID “Test Tag” in your pocket.

General Preventive Maintenance Schedules

The following charts list preventive maintenance procedures which should be performed with regularity to maintain the On-Route Charge Station.

The following schedules show recommended minimum service intervals. More frequent service intervals should be considered if the charging station has been operated in extreme conditions such as high humidity, rain, snow, and dusty environments. Time intervals are shown in terms of months. Some of the components used in the charging station require inspection and/or servicing at intervals specified by their respective manufacturers. Because the interval criteria differs among various component or system manufacturers, compiling an all-inclusive table of regularly scheduled service for the charging station is impractical.

Some components should be regularly inspected, but do not lend themselves to universal intervals, since their normal service life is highly dependent upon local conditions. For these components, any estimated interval would result in overservicing in some locales and underservicing in others. Such intervals are left to the judgment of the local service manager, and the service interval indicated is “As Required”. It is important to understand that this designation should not be taken as an optional inspection. Every item in the following tables should be considered mandatory, and an “As Required” interval should be viewed as emphasizing the importance of the local service operation first determining, and then strictly adhering to, an appropriate interval. Regardless of the interval determined appropriate, the operation must not be overlooked.

IMPORTANT! The initial 20 hours of operation (break-in) on the air compressor will be performed at Proterra and the pump oil will be drained for shipment. After the initial filling on-site, the synthetic oil should be changed monthly. Reference the Dewalt Instruction Manual (Model D55151 Type 3) for specific oil change procedures.

NOTICE: Inspection and maintenance of the Canopy and Charge Arm Assembly will require a ladder in order to access the various components.

Table 2-1: Monthly High-Voltage System Preventive Maintenance

HIGH-VOLTAGE SYSTEM - Monthly	
High-Voltage Distribution Box or Backplane:	
<ul style="list-style-type: none">• Cable Inspection - Perform a visual inspection and look for discoloration or chaffing of visible cables.• Lug Inspection - Perform a visual inspection and look for indications that any lugs are loose. Note: Torque putty on lugs will provide an indicator.• Contactor Inspection - Perform a visual inspection and look for deformations or discoloring in contactors.• Control Wiring - Perform a visual inspection and ensure that the control wiring to the high-voltage contactors is not in contact with high-voltage buss bars or high-voltage wiring.	
Charge Head:	
<ul style="list-style-type: none">• Cable Inspection - Perform a visual inspection and look for discoloration or chaffing of visible high-voltage cables.• Control Wiring - Perform a visual inspection and ensure that the control wiring is allowed to move freely with actuation and that wires are not chaffing.	

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

Table 2-2: Monthly Pneumatic System Preventive Maintenance

PNEUMATIC SYSTEM - Monthly	
Air Compressor:	
<ul style="list-style-type: none"> • Follow all air compressor manufacturer guidelines for monthly checks. • Safety Valve - Ensure that the safety valve operates freely. • Air Filter Element - Visually check the element for cleanliness. • If <u>not</u> equipped with an autodrain circuit, drain Air Compressor Tanks. Open each drain valve and ensure that all water is removed from tanks. Check for rust. • Pump Oil - Check the oil level indication. Reference Dewalt Instruction Manual (Model D55151 Type 3) for specific procedures for draining and refilling the Compressor Pump Oil. 	
Air Lines:	
<ul style="list-style-type: none"> • Lower Line Inspection - Visually and audibly check air line from the compressor through the distribution box(es) and ensure there is no chaffing, leaking, or kinking. • Upper Line Inspection - Visually and audibly check air lines from the control box to the charge head and ensure there is no chaffing, kinks, pinch points, or leaks. 	
Air Dryer:	
<ul style="list-style-type: none"> • Follow all manufacturer guidelines for monthly checks. Change when the color changes (DFD-10). • Monitor desiccant discoloration. Record percent consumption of the desiccant to the nearest 10%. 	
General:	
<ul style="list-style-type: none"> • Listen for air leaks at the compressor, charge head, and at all fittings. Spray exposed air fittings with soapy water. • Verify correct pressure regulator settings of 120 psi at compressor. In the control box, the pressure regulator settings should be set at 90 psi. 	

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

Table 2-3: Monthly Mechanical System Preventive Maintenance

MECHANICAL SYSTEM - Monthly
Arm Up/Down Actuation (using Test Tag):
<ul style="list-style-type: none"> • Check Charge Head resting position is correct. • Using Test Tag, verify smooth reasonable speed during the downward motion. Give deploy time of 3 seconds. • Using Test Tag, verify quick upward motion: <3 sec. return. • Verify that the Charge Head returns home when air is shutoff at the air supply. • Lubricate all joints and pivot points.
Arm Sway:
<ul style="list-style-type: none"> • Verify the Charge Arm has free sway movement. • Verify the Charge Arm will return to center. • Lubricate all joints and pivot points.
Head Twist:
<ul style="list-style-type: none"> • Verify the Charge Head has free twist movement. • Verify the Charge Head will return to center. • Inspect all cables and security of cable terminations. • Lubricate all joints and pivot points.
Head Roll:
<ul style="list-style-type: none"> • Verify the Charge Head has free roll movement. • Verify the Charge Head will return to flat (horizontal) position. • Inspect the Guide Pins to ensure sturdiness. • Lubricate all joints and pivot points.
Brush Actuation and Condition:
<ul style="list-style-type: none"> • Check Neutral Brush for wear with test tag. • Verify Neutral Brush actuation distance of at least 3/4". Record the brush measurement while extended. • Check Charge Brushes for wear. • Verify Charge Brushes actuation distance of at least 1" with test tag. While extended record the shortest three brush measurements on each side of the Charge Head. • Verify Charge Brushes freedom of movement. • Check Pilot Brush travel. • Check Pilot Brush for wear. Record the brush measurement.

MECHANICAL SYSTEM - Monthly
Head Condition:
<ul style="list-style-type: none"> Visually check for gouges or cracks on bottom or sides. Contact the manufacturer regarding any large gouges. Visually check for distortion. Contact the manufacturer if distortion exists. Check for loose fasteners and tighten them as necessary. Visually inspect and confirm that all cotter pins and snap rings are in place.

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

Table 2-4: Monthly Sensor Preventive Maintenance

SENSORS - Monthly
Head Land Detent Sensors:
<ul style="list-style-type: none"> Ensure free movement. Ensure proper clocking of 75 degrees using a protractor.
Ultrasonic Sensor:
<ul style="list-style-type: none"> Ensure bottom surface is clean. Ensure wiring is not pinched or chaffed.

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

Table 2-5: Monthly Charger Preventive Maintenance

CHARGER - Monthly
<ul style="list-style-type: none"> Follow all Manufacturer's Guidelines for monthly checks. The items below are common high level things to pay attention to.
<ul style="list-style-type: none"> Inspect and replace Air Filters if needed.
<ul style="list-style-type: none"> Listen for any abnormal sounds, such as fans failing or debris in fans.
<ul style="list-style-type: none"> Visually check for infestation or nests built by birds, bats, bugs, or other animals.
<ul style="list-style-type: none"> Check for the presence of unusual odors or any changes in appearance of the components.

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

Table 2-6: Monthly General Preventive Maintenance

GENERAL - Monthly
<ul style="list-style-type: none">• Verify operation of the Docking Control Box exhaust fan. Listen for any abnormal sounds.• Visually check for moisture inside all enclosures and boxes.• Visually check for infestation or nests built by birds, bats, bugs, or other animals.• Verify proper operation of each Emergency Stop to ensure that it disables the system and prevents docking/charging.• Remove, clean, and replace Docking Control Box aluminum air inlet filter elements (2).• Remove, clean, and replace Docking Control Box exhaust fan filter element.• Check all pneumatic hoses for any wear and listen for air leaks.• Check counter-balance spring assemblies on charge arm for correct tension and release movement.• Check condition of all electrical cables for cracks.• Check condition of all electrical connections for corrosion.• Check spring loaded pilot signal brush movement (underside of the head assembly). Min. 3/4" travel.• Check Control Box for nests, etc.• Check Junction Box for nests, etc.

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

NOTICE: The Preventive Maintenance schedule shown below should include all of the items listed in the Monthly Preventive Maintenance tables, in addition to the following items.

At 6 months, use a scissor lift to more thoroughly perform monthly maintenance.

**Table 2-7: Semi-Annual (6 Month) Preventive Maintenance
(Requires a Scissor Lift)**

6 Months
<ul style="list-style-type: none"> • Check all pneumatic hoses for any air leaks and wear by spraying exposed air fittings with soapy water. Listen and look for leaks. • Check counter-balance spring assemblies on charge arm for correct tension and release movement. • Check condition of all electrical cables for cracks. • Check condition of all electrical connections for corrosion. • Check spring loaded pilot signal brush movement (underside of the head assembly). Min. 3/4" travel. • Verify Charge Brushes actuation distance of at least 1" with test tag. While extended record the shortest three brush measurements on each side of the Charge Head. NOTE: Brushes need replacing when two or more brushes on the same side fail to extend further than 3/4" from brush housing. Replacement is done at factory. • Check Control Box for nests, etc. • Check Junction Box for nests, etc.

NOTE: For photos and detailed instructions on how to perform each of the tasks listed above, refer to Chapter 3 of this Maintenance Manual.

NOTICE: The Annual Preventive Maintenance schedule shown below should include all of the items listed in the Monthly and Semi-Annual Preventive Maintenance tables, in addition to the following items..



The Charge Head and Charge Arm Assembly is very heavy and requires a properly rated lifting device to lift and reposition the assembly. Follow all site-specific requirements for moving heavy objects when performing this installation.

Table 2-8: Optional Annual (12 Month) Preventive Maintenance

12 Months
<ul style="list-style-type: none"> • Remove the Charge Arm and/or Head Assembly and send back to the manufacturer for refurbishment. This will incur a charge from the manufacturer. <p>NOTICE: Reference the following section for the details of this optional annual preventive maintenance procedure.</p>

Optional Annual Preventive Maintenance

Note: This optional annual preventive maintenance requires a spare Charge Head and Charge Arm Assembly, scissor lift, and Proterra bus.

IMPORTANT! This annual preventive maintenance procedure is considered *OPTIONAL* due to the fact that the agency must have an entire Charge Arm and Charge Head Assembly available for installation to replace the assembly being removed from service.

As part of the optional annual preventive maintenance you must perform all of the monthly and semi-annual preventive maintenance items as well as a full head and arm system swap. The new/refurbished head and arm systems will be covered in the PMI contract and will become the property of the agency. The Charge Head and Charge Arm Assembly removed from service will be returned to Proterra for full refurbishment.

Full refurbishment will include:

- Completely disassembling the Charge Head.
- Performing a detailed inspection (including water, wear/tear, High-Voltage terminations, brush actuators, air lines, current sensors, brush health, and general physical condition of the unit).
- Replacing and resurfacing worn brushes, as needed.
- Replacing any other fatigued or deteriorating parts at cost.
- Providing a report of the issues and resolved items with the unit when it is returned to the agency after refurbishment.

Note: If parts other than the brushes are determined to be near failure during the refurbishment process, a quote will be provided to the agency detailing the issues and the repair cost. The agency may then choose to go ahead with the repairs, or forego them. The refurbished Charge Head will be shipped back to the agency to be held as full spares to be used in an emergency or to be used as the replacement Charge Head installed at the next annual preventive maintenance checkup.

Optional Annual Charge Station Inspection Service

A Proterra Charge Station system expert will perform a detailed on-site inspection of the charging systems on a yearly basis. This will involve a full inspection of all systems and components to verify that everything is operating properly and as intended in the design.

This level of thoroughness may identify more subtle operational issues before they become items that cause unexpected downtime. This inspection process will also help Proterra improve the *Charge Station Maintenance Manual* and provide a check and balance to the progressive preventative maintenance schedule that is performed all year.

NOTICE: This level of attention is encouraged because it is similar to your yearly physical with a doctor. The doctor knows a lot more about what should and shouldn't be happening and what might be causing it.

Chapter 3: Maintenance Procedures

Proper service and repair is important for the safe, reliable operation of the On-Route Charge Station. The maintenance procedures recommended and described in this manual are effective methods for performing the maintenance operations. Some of these maintenance operations require the use of tools, specially designed for the purpose. These special tools should be used, when recommended.



CAUTION

It is important to note that this manual contains various Warnings, Cautions, and Notes, which should be carefully read in order to minimize the risk of personal injury to maintenance personnel, or the possibility that improper maintenance methods will be followed, which may damage the vehicle, or render it unsafe. It is also important to understand that these Warnings, Cautions, and Notes are not exhaustive. We could not possibly know, evaluate, and advise of all the conceivable ways in which maintenance might be done, or of the possible hazardous consequences of each way. Consequently, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a maintenance procedure or tool, which is not recommended by the manufacturer, must first satisfy themselves thoroughly, that neither their safety, nor the vehicle safety will be jeopardized by the maintenance method they select.

Service Precautions



CAUTION

Never attempt to maintain this On-Route Charge Station without referring to the section of the manual that fully describes the task you are to work on.



WARNING

There are multiple power sources entering the charger and docking control equipment. Ensure you have the breaker off and follow the lock out tag out procedure specified in OSHA 29 CFR 1910 Subpart S.

Servicing the High-Voltage System

The following service tasks should be performed to maintain proper performance of the High-Voltage system for the On-Route Charge Station. The scheduled service tasks for the High-Voltage distribution box or back plane include:

- Visually inspecting the cables
- Visually inspecting the lugs
- Visually inspecting the contactors
- Visually inspecting the control wiring to the high-voltage contactors

The scheduled service tasks for the Charge Head High Voltage include:

- Visually inspecting the cables
- Visually inspecting the control wiring

Note: Always reference the manufacturer's instruction manual for specific maintenance procedures and intervals.

Visually Inspecting High-Voltage Cables

Proper maintenance of the High Voltage Cables is very important.



There are multiple power sources entering the charger and docking control equipment. Ensure you have the breaker off and follow the lock out tag out procedure specified in OSHA 29 CFR 1910 Subpart S.

Look for discoloration or chaffing of visible cables.

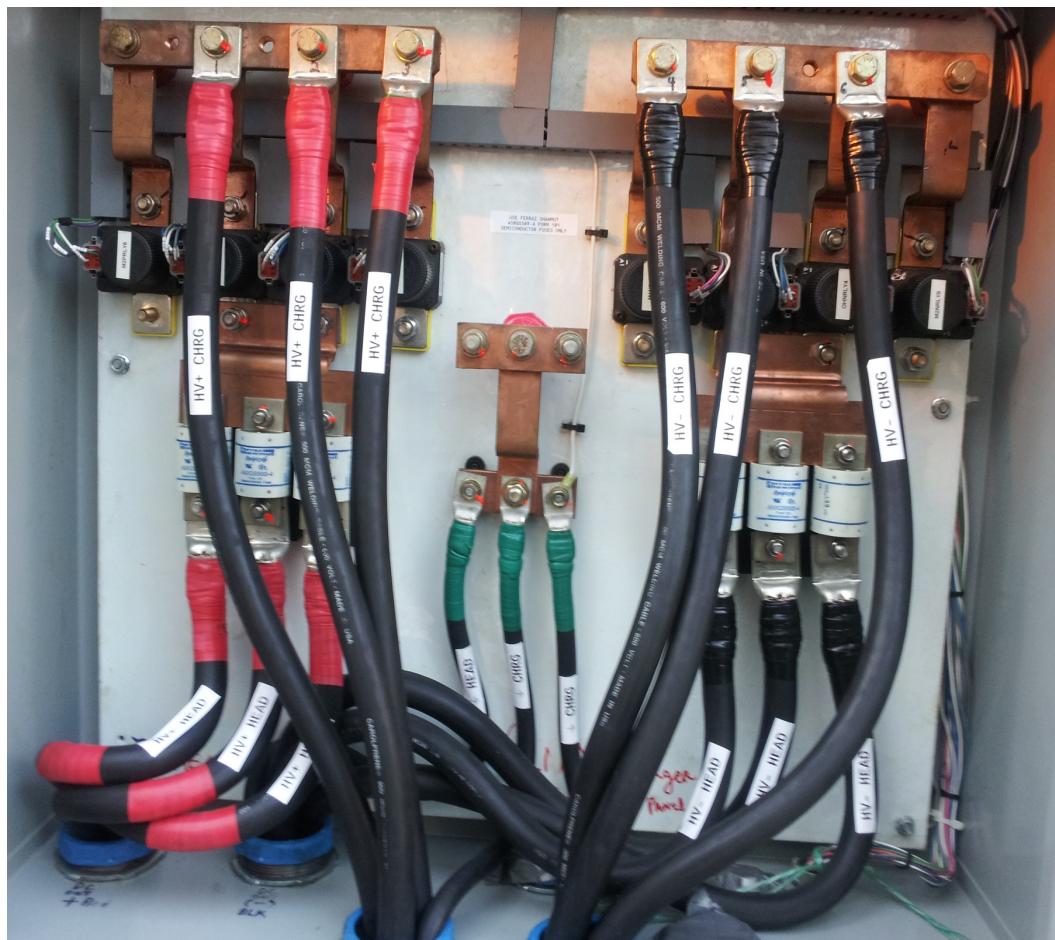


Figure 3-1. High-Voltage Cables

Visually Inspecting Lugs

Look for indications that any lugs are loose.

Note: Torque putty on lugs will provide an indicator.



Figure 3-2. Lugs

Visually Inspecting Contactors

Look for deformations or discoloring in the High-Voltage box contactors.

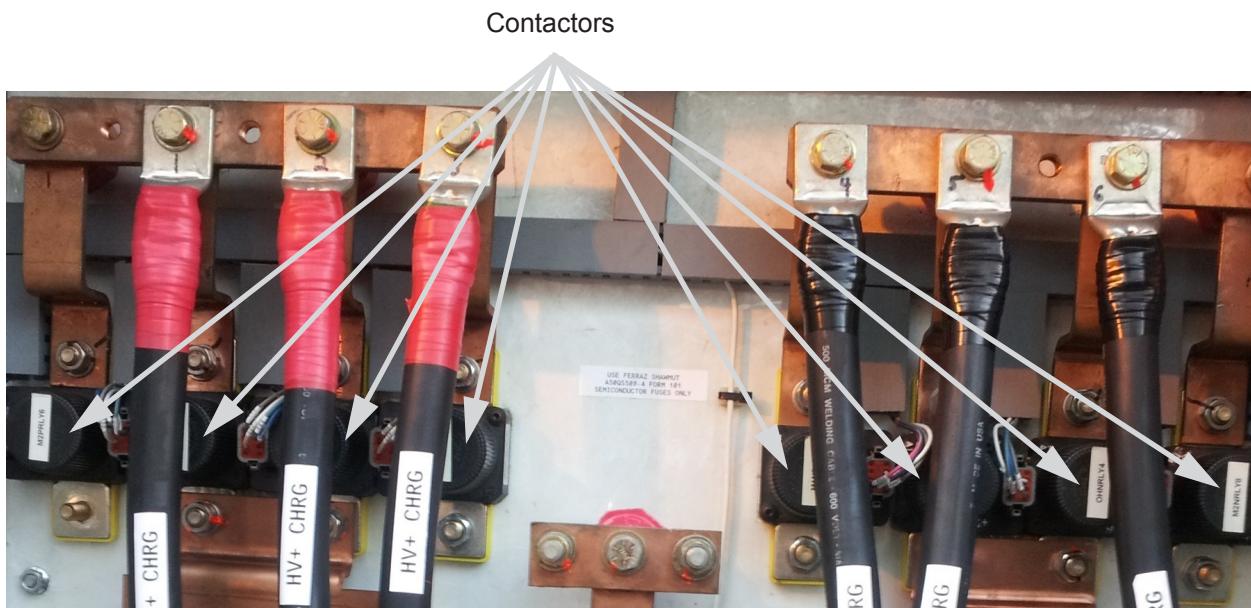


Figure 3-3. Contactors

Visually Inspecting Control Wiring

Ensure that the control wiring to the high-voltage contactors is not in contact with high-voltage buss bars or high-voltage wiring.



Figure 3-4. Control Wiring

Visually Inspecting Charge Head Cables

Look for discoloration or charring of visible high-voltage cables. Specifically look at cable clamps and replace if protective rubber is falling off.

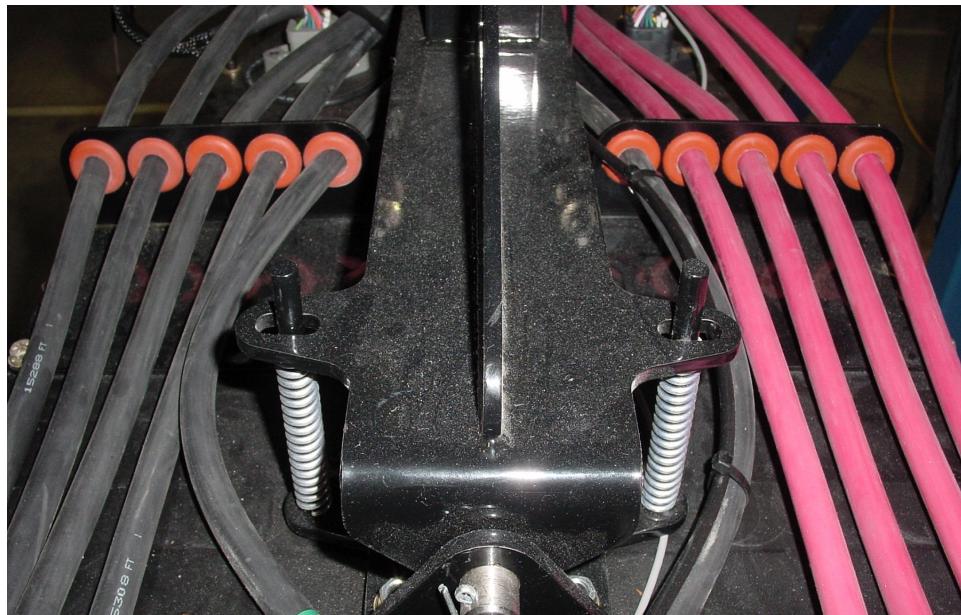


Figure 3-5. Charge Head Cables

Visually Inspecting Charge Head Lugs

Remove covers and look for indications that any lugs are loose. When replacing covers, ensure that cables are not pinched.

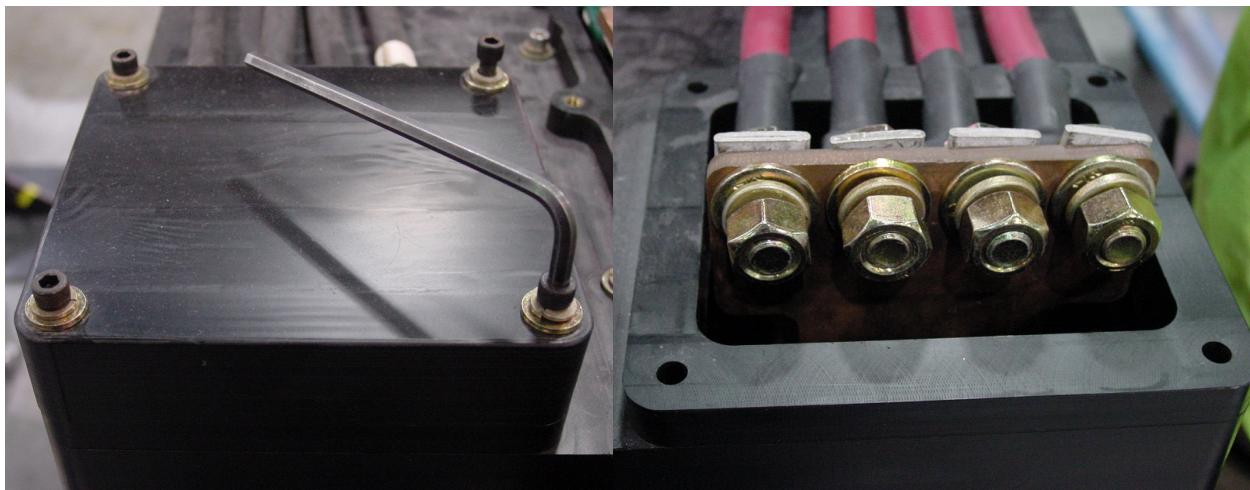


Figure 3-6. HV Cable Cover and Lugs

Visually Inspecting Charge Head Control Wiring

Ensure that the control wiring is allowed to move freely with actuation.



Figure 3-7. Charge Head Control Wiring

Servicing the Pneumatic System

Servicing the Air Compressor

The following service tasks should be performed to maintain proper performance of the Air Compressor system used on the On-Route Charge Station. The scheduled service tasks for the Air Compressor include:

- Checking Operation of the Safety Valve
- Checking/Cleaning the Air Filter Element
- Monitoring Desiccant Discoloration in the Air Dryer
- Draining the Air Tanks to Remove Water (if not equipped with auto drain)
- Checking the Compressor Pump Oil
- Draining/Refilling the Compressor Pump Oil (Monthly)
- Changing the Compressor Pump Oil (Semi-Annually)

Note: Always reference the manufacturer's instruction manual for specific maintenance procedures and intervals.

Checking Operation of the Safety Valve

Proper operation of the Air Compressor Safety Valve is very important. If the safety valve does not operate properly, over-pressurization may occur, causing an air tank rupture.



The Air Compressor components can be very hot after operation of the unit and should be avoided. If possible, allow the air compressor to cool prior to servicing.

Before starting the compressor, or while the compressor is not running, pull the ring on the safety valve to ensure that the safety valve operates freely. If the safety valve is stuck or does not operate freely, it must be replaced before the air compressor is returned to normal operation.

Air Compressor Tank Safety Valve



Figure 3-8. Air Compressor Tank Safety Valve

Checking/Cleaning the Air Filter Element

The air inlet filter on the Air Compressor should be checked monthly to ensure unrestricted airflow into the compressor.

1. Turn the Air Compressor On/Off switch to the OFF position.



The Air Compressor components can be very hot after operation of the unit and should be avoided. If possible, allow the air compressor to cool prior to servicing.

2. Unbolt the Air Compressor and tilt it in order to access the Air Filter Element.
3. Remove the Air Filter Element from the unit.



Figure 3-9. Air Filter Element

4. Carefully pry the filter top from the base and check the element for cleanliness.
5. If the element requires cleaning, use compressed air to remove accumulated debris. Replace the air filter element as needed.
6. Place the filter element back in the filter base.
7. Snap the filter top onto the filter base.
8. Replace the air filter element onto the Air Compressor unit, ensuring that the exhaust outlet points down.

Monitoring Desiccant Discoloration in the Air Dryer

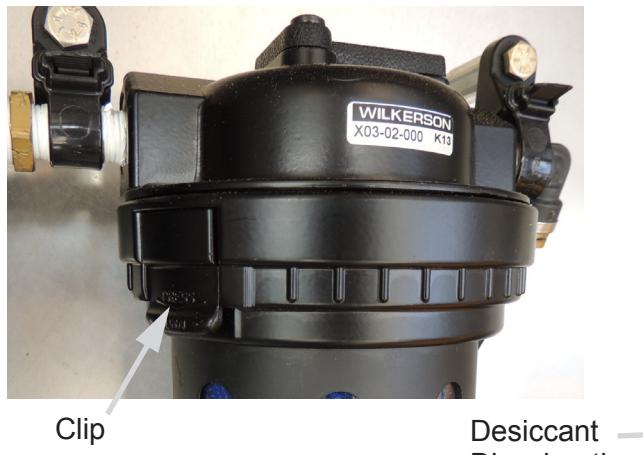
The desiccant in the Air Dryer should be checked monthly for discoloration.

1. Visually check the desiccant discoloration level.
2. On the monthly PMI checklist, record percent consumption of the desiccant to the nearest 10%.
3. When completely discolored, replace the desiccant cartridge.



The Air Compressor components can be very hot after operation of the unit and should be avoided. If possible, allow the air compressor to cool prior to servicing.

- Turn the Air Compressor On/Off switch to the OFF position.
- Un-clip the Air Dryer canister in order to access the desiccant cartridge.



Clip
Desiccant Discoloration



Figure 3-10. Air Dryer Desiccant

- Remove old desiccant cartridge and insert new cartridge.
- Clip canister into place.

Draining the Air Tanks to Remove Water

NOTE: If the Air Compressor Tanks are not equipped with an autodrain circuit, follow the instructions below.

At a minimum, the Air Compressor air tanks should be drained monthly to remove any condensate (water) that has accumulated.

1. Turn the Air Compressor On/Off switch to the OFF position..



The Air Compressor components can be very hot after operation of the unit and should be avoided. If possible, allow the air compressor to cool prior to servicing.

2. Unbolt the Air Compressor and tilt it in order to access the drain valve.
3. Place a suitable container below each drain valve to catch the discharge.
4. Slowly open each drain valve to gradually bleed air and condensate from the tank.



Figure 3-11. Drain Valve

5. Monitor the air pressure gauge and when the gauge reads 10 psi, fully open each drain valve to allow all remaining air and condensate to be discharged from the tanks.
6. When the tanks have completely drained, close each of the drain valves.

Checking the Compressor Pump Oil

The compressor pump oil should be checked periodically to ensure that the level is full.

1. Turn the Air Compressor On/Off switch to the OFF position.
2. Unbolt the Air Compressor and turn it in order to access the dipstick.
3. Remove the dipstick from the compressor and wipe clean.

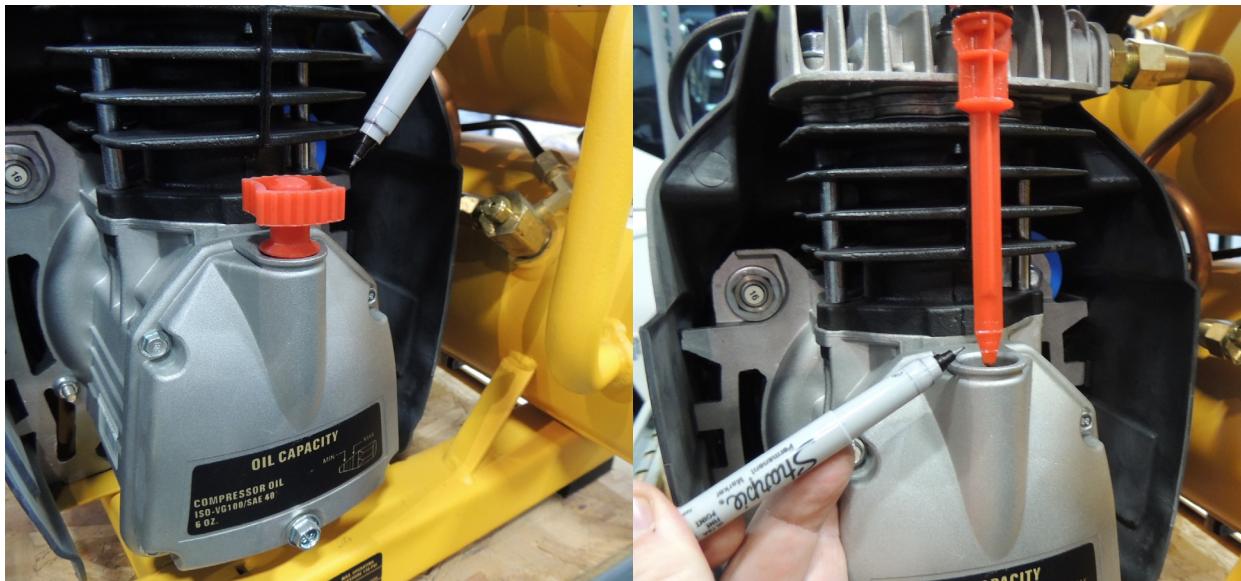


Figure 3-12. Air Compressor Pump Oil Dipstick

4. Reinsert the dipstick fully into the compressor oil fill port for a few seconds to allow oil to collect on the dipstick.
5. Remove the dipstick and check the oil level indication. The oil level should not exceed the top raised line (MAX) on the dipstick. If the oil level is below the lower mark (MIN), add the recommended oil to the crankcase.
Note: When adding oil to the crankcase it will flow into the pump very slowly. If added too quickly, it may overflow and appear to be full.
6. Replace the dipstick fully into the oil fill port.

Draining/Refilling the Compressor Pump Oil (Monthly)

The compressor pump oil should be drained and refilled monthly to ensure proper performance of the air compressor unit. Due to the mounting location of the air compressor and the inability to tilt the unit toward the drain hole, you can only drain approximately half of the compressor oil from the unit during the monthly oil change.

NOTE: During semi-annual service, the entire compressor unit should be removed from the enclosure so the oil can be entirely drained/refilled.

1. Turn the Air Compressor On/Off switch to the OFF position.



The Air Compressor components can be very hot after operation of the unit and should be avoided. If possible, allow the air compressor to cool prior to servicing.

2. Unbolt the Air Compressor and turn it in order to access the drain plug.
3. Position a suitable container below the compressor oil drain plug.
4. Remove the dipstick from the oil fill port.
5. Remove the oil drain plug from the crankcase and allow the oil to drain into the container. Allow ample time for the oil to drain.



Figure 3-13. Compressor Pump Oil Draining

6. When the oil has drained as much as possible, install the oil drain plug in the crankcase.
7. Carefully fill the pump crankcase with the recommended oil.
IMPORTANT! Fill the crankcase slowly and check the level often to prevent overfilling.
8. When the crankcase is filled to the appropriate level (MAX), replace the dipstick in the oil fill port and turn the unit ON to return it to service.

Changing the Compressor Pump Oil (Semi-Annually)

During semi-annual service, the entire air compressor unit should be removed from the enclosure so the oil can be entirely drained/refilled.

Reference Dewalt Instruction Manual (Model D55151 Type 3) for specific procedures for draining and refilling the Compressor Pump Oil.

1. Turn the Air Compressor On/Off switch to the OFF position.



The Air Compressor components can be very hot after operation of the unit and should be avoided. If possible, allow the air compressor to cool prior to servicing.

2. Drain the air tanks.
3. Unplug the air compressor from the outlet.
4. Disconnect the air line connections.
5. Remove the four (4) mounting bolts securing the air compressor in the enclosure and carefully lift the air compressor unit out of the enclosure.
Note: Place the air compressor on the floor or onto a suitable workbench.
6. Position a suitable container below the compressor oil drain plug.
7. Remove the dipstick from the oil fill port.
8. Remove the oil drain plug from the crankcase and allow the oil to drain into the container. Tilt the compressor toward the drain plug hole to allow all of the oil in the crankcase to flow towards the drain hole.
Note: Allow ample time for the oil to drain.
9. When the oil has drained as much as possible, install the oil drain plug in the crankcase.
10. Carefully fill the pump crankcase with the recommended oil.
IMPORTANT! Fill the crankcase slowly and check the level often to prevent overfilling.
11. When the crankcase is filled to the appropriate level (MAX), replace the dipstick in the oil fill port and turn the unit ON to return it to service.

Servicing the Air Lines

Visually Inspecting the Lower Air Lines

1. Ensure that there is no chafing, leaking or kinking in the lower air lines.
2. Spray exposed air fittings with soapy water every six (6) months to check for leaks.



Do not spray high-voltage or electrical areas.



Lower air lines running to air dryer

Lower air lines running through Docking Control Box wall



Figure 3-14. Lower Air Lines

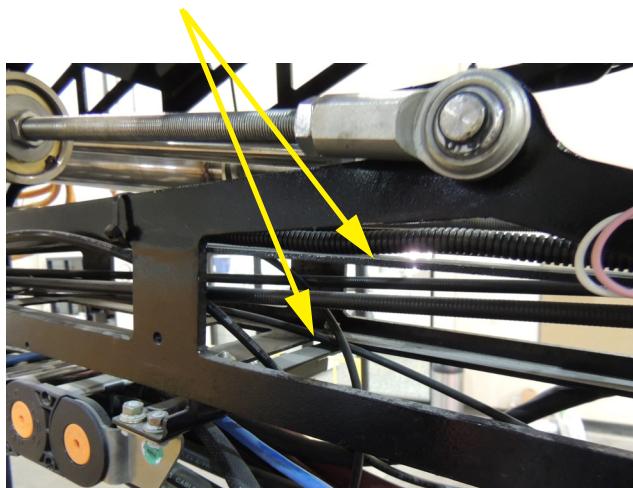
Visually Inspecting the Upper Air Lines

1. Ensure that there is no chaffing, leaking or kinking in the upper air lines.
2. Spray exposed air fittings with soapy water every six (6) months to check for leaks.

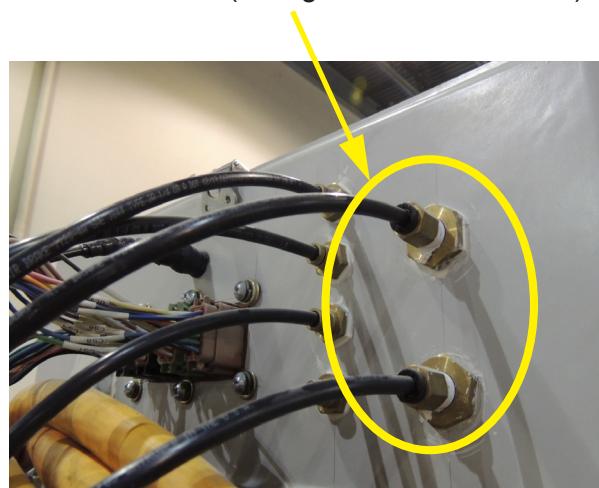


Do not spray high-voltage or electrical areas.

Air Lines (Charge Arm)



Air Lines (Charge Head Control Box)



Charge Head air lines

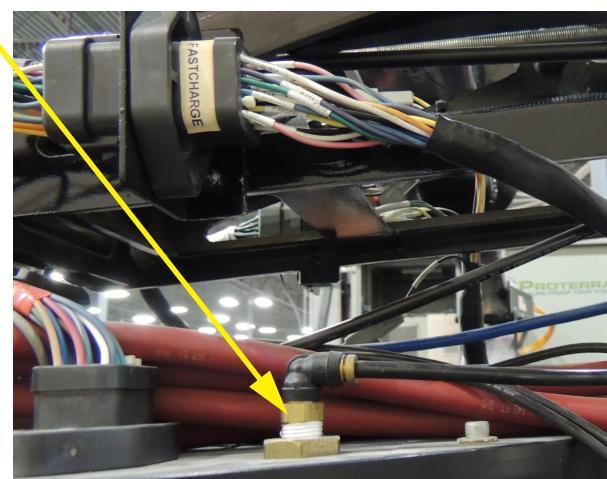
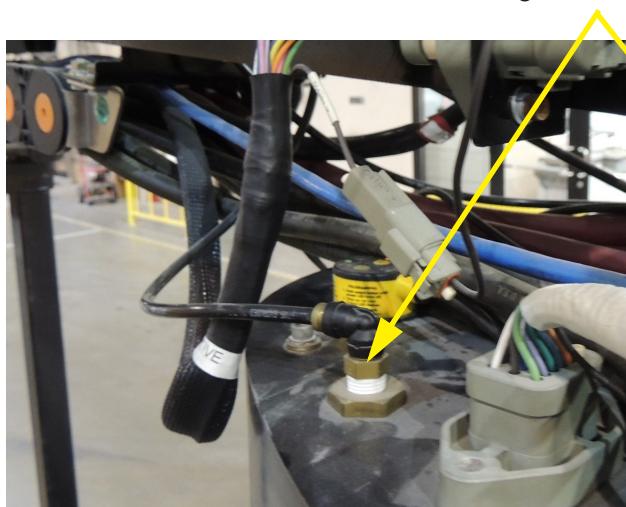


Figure 3-15. Upper Air Lines

Inspecting Hardware

Do not reuse hardware, such as C-clips, snap rings and cotter pins. When inspecting major components, always check for gouges or damage to the grooves in the clevis pins. Ensure that C-clips and snap rings are fully seated in the clevis pin grooves.

Servicing the Mechanical System

The following service tasks should be performed to maintain proper performance of the Mechanical System. The scheduled service tasks for the Mechanical System include checking:

- Lubricating the Charge Arm assembly
- Arm up/down actuation
- Arm sway
- Head twist
- Head roll
- Head return
- Brush actuation and condition
- Head condition

Lubricating the Charge Arm Assembly

The charge arm assembly will require monthly lubrication to ensure proper operation of the assembly components. You should sparingly use a high-quality Teflon-Silicon lubricant to lubricate the charge arm assembly pivot points, actuator rods, and cables.

Perform the following steps to lubricate the Charge Arm Assembly:

1. At the Charge Head, lubricate the horizontal pivot pin allowing the Head Roll movement at each end.

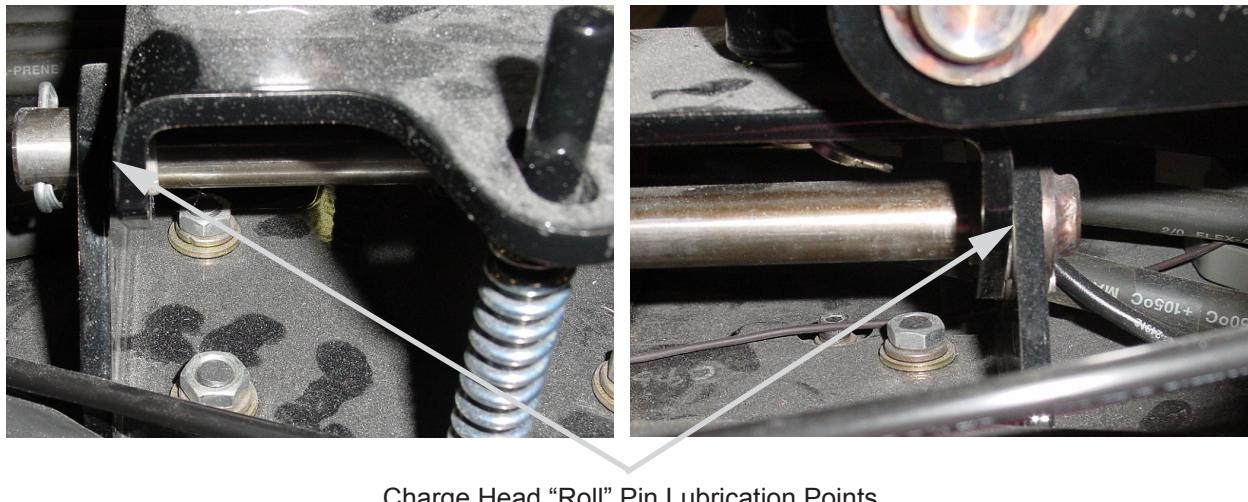


Figure 3-16. Charge Head "Roll" Pin Lubrication

2. At the Charge Head, lubricate the vertical pivot pin allowing the Head Twist movement at each end.

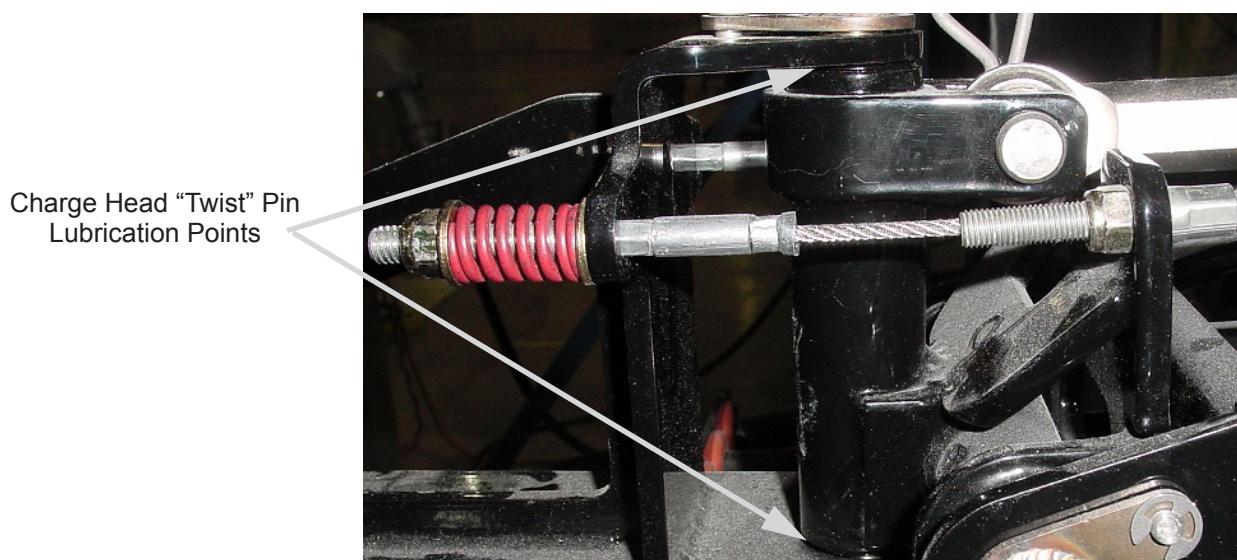


Figure 3-17. Charge Head "Twist" Pin Lubrication

3. At the Charge Head, lubricate the horizontal pivot pin where the Charge Arm attaches to the Charge Head.

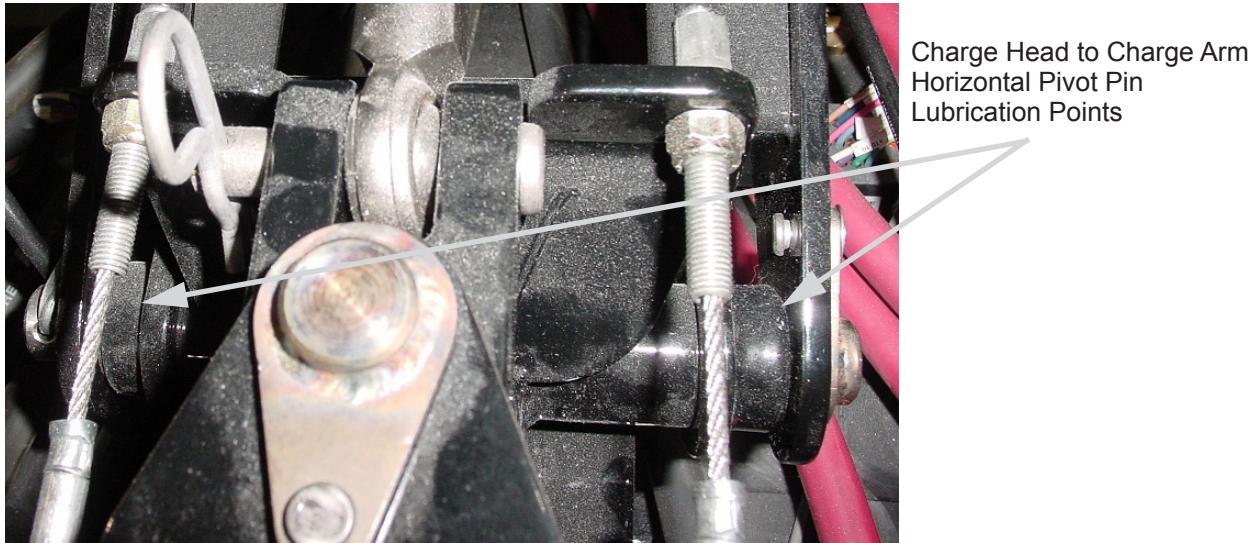


Figure 3-18. Charge Head to Charge Arm Pivot Pin Lubrication

4. At the Charge Head, Lubricate the center Guide Rod pivot pin.

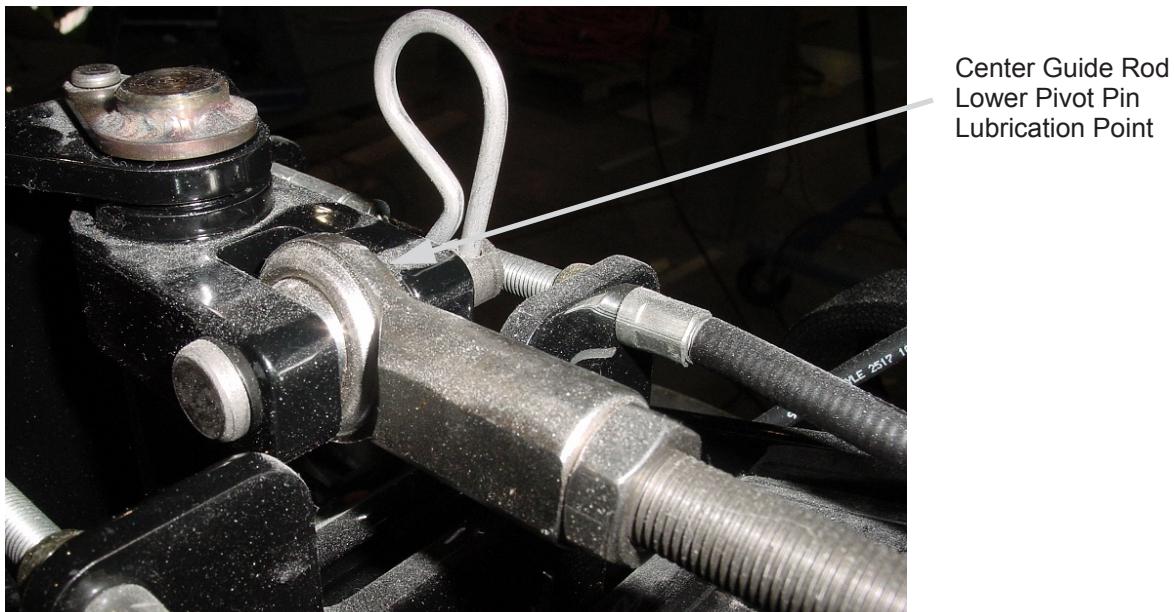
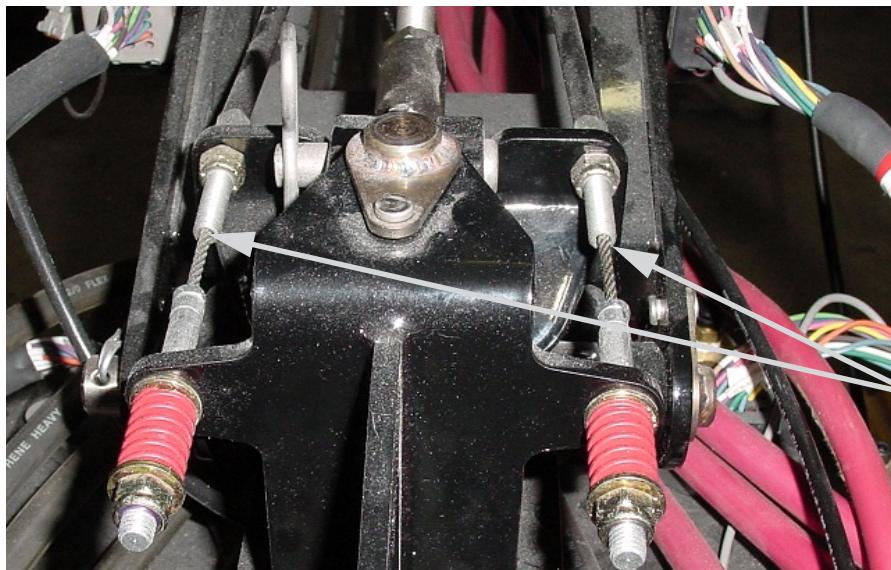


Figure 3-19. Center Guide Rod Lower Pivot Pin Lubrication

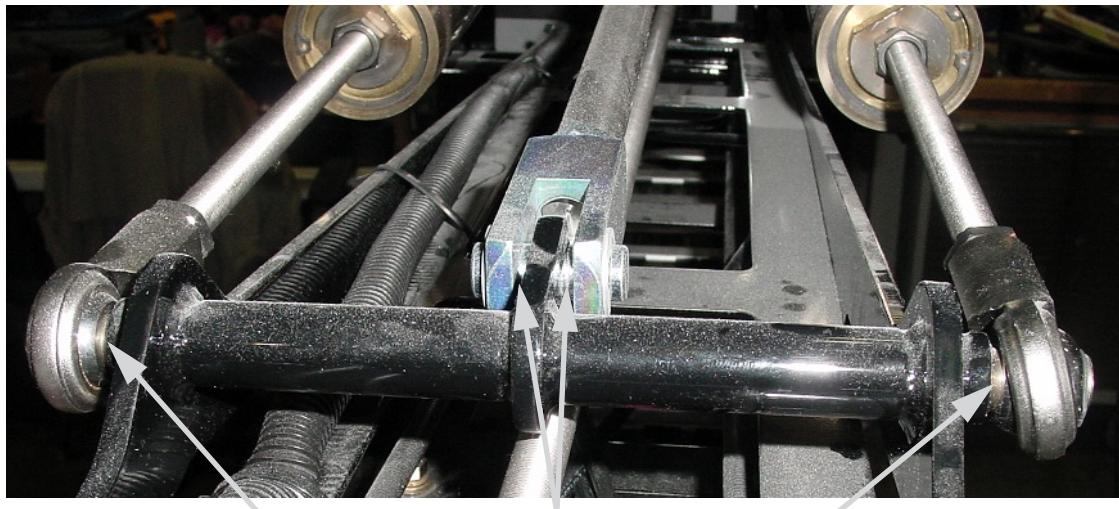
5. At the Charge Head, lubricate the spring-return-to-center cables.



Spring Return-to-Center
Lubrication points

Figure 3-20. Spring Return-to-Center Cable Lubrication

6. At the Charge Head end of the Charge Arm, lubricate the Air Cylinder Actuator Rod pivot pin.



Air Cylinder Actuator Rod
Pivot Pin Lubrication Point

Spring Cylinder Rod
Pivot Pin Lubrication Points

Figure 3-21. Air Cylinder Actuator Rod Lower Pivot Pin and Spring Cylinder Pivot Pin Lubrication

7. At the Charge Head end of the Charge Arm, lubricate the Spring Cylinder Rod pivot pins (2), shown above.

8. Lubricate the Spring Cylinder Rods (2) at the point where they enter the cylinder.

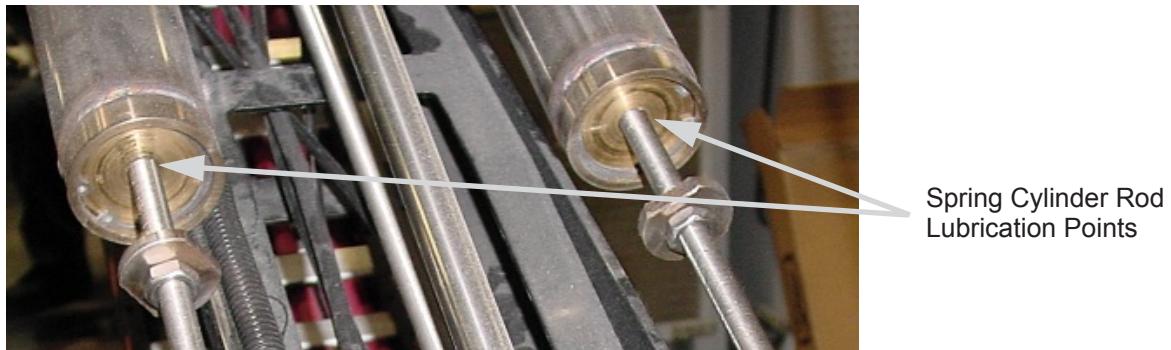


Figure 3-22. Spring Cylinder Rod Lubrication

9. Lubricate the Air Cylinder Actuator Rod at the point where the rod enters the cylinder.

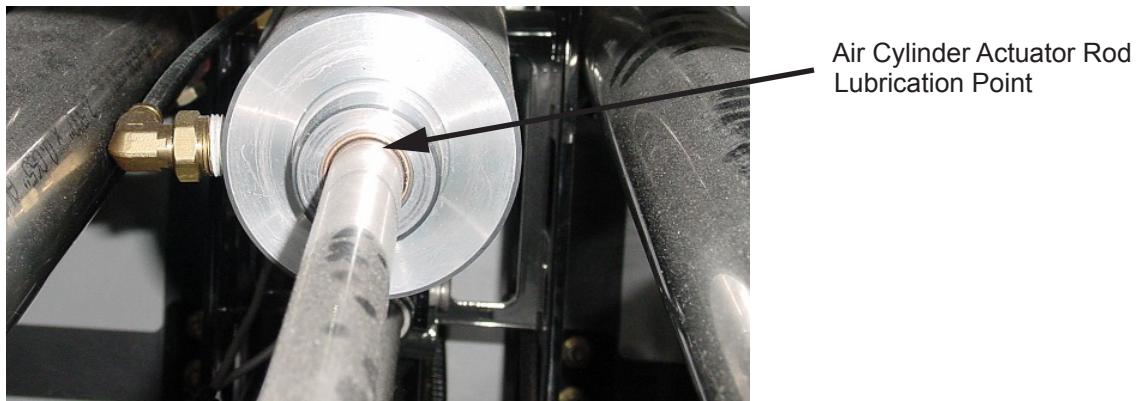


Figure 3-23. Air Cylinder Actuator Rod Lubrication

10. Lubricate the Spring Cylinder upper pivot pins (2).

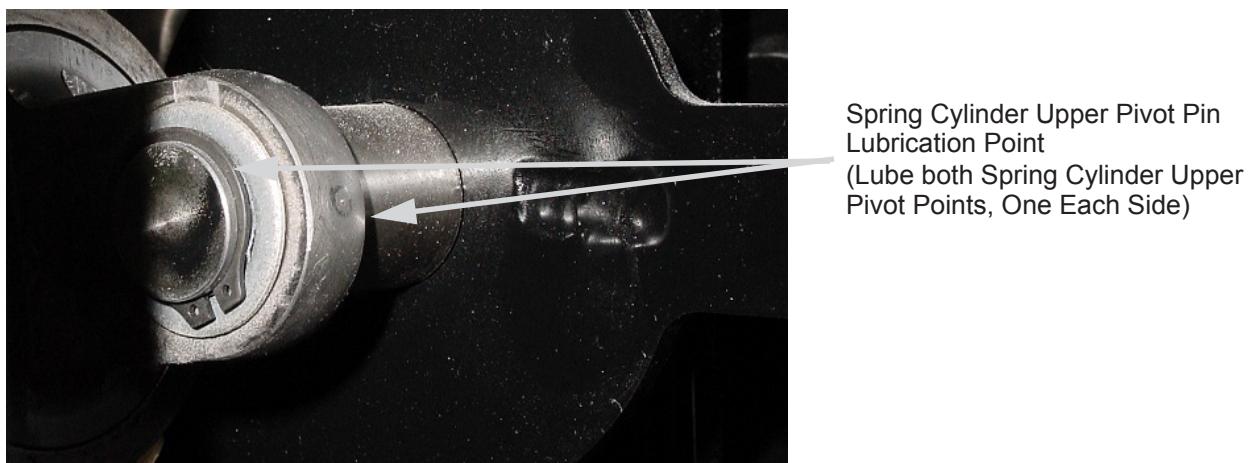


Figure 3-24. Spring Cylinder Upper Pivot Pin Lubrication

11. Lubricate the Guide Rod upper pivot pin.



Guide Rod Upper Pivot Pin
Lubrication Point

Figure 3-25. Guide Rod Upper Pivot Pin Lubrication

12. Lubricate the Charge Arm horizontal lower main pivot pin at both ends.



Charge Arm Lower Pivot Pin
Lubrication Points

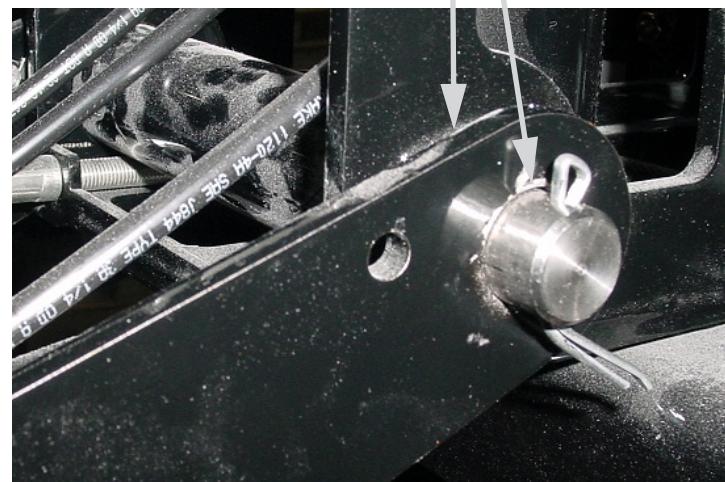


Figure 3-26. Charge Arm Lower Pivot Pin Lubrication

13. Lubricate the Charge Arm vertical main pivot pin at both ends.



Figure 3-27. Charge Arm Vertical Pivot Pin Lubrication

Charge Arm Up/Down Actuation

Perform the following steps to test the Charge Arm Actuation:

1. Check Charge Head resting position is correct.

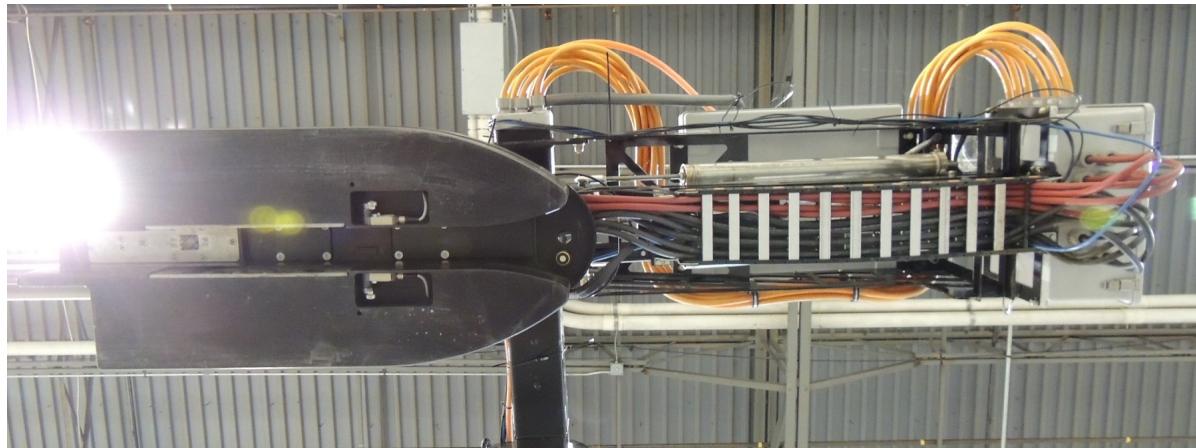


Figure 3-28. Charge Head in correct resting position.

2. Using Test Tag, verify smooth reasonable speed during the downward motion. Deploy time of 3 seconds.
3. Using Test Tag, verify a quick upward motion with <3 second return time.
4. Verify that the Charge Head returns home when the air is shutoff at the air supply.
5. Lubricate all joints and pivot points.

Charge Arm Sway

Perform the following steps to test the Charge Arm Sway:

1. Verify the Charge Arm has free twist movement.
2. Verify the Charge Arm will return to center. Pull the head to the side and it should return. Do this in both directions.
3. Lubricate all joints and pivot points.

Charge Head Twist

Perform the following steps to test the Charge Head Twist:

1. Verify the Charge Head has free twist movement.
2. Verify the Charge Head will return to center.
3. Inspect all cables and security of cable terminations.
4. Lubricate all joints and pivot points.

Charge Head Roll

Perform the following steps to test the Charge Head Roll:

1. Verify the Charge Head has free roll movement.
2. Verify the Charge Head will return to flat (horizontal) position.
3. Inspect the guide pins to ensure sturdiness.
4. Lubricate all joints and pivot points.

Charge Head Return

Perform the following steps to test the Charge Head Spring Return Feature:

1. Verify the Charge Head spring return feature works.
2. Turn air pressure regulator at the compressor down to 0 PSI.
3. Use lift or ladder to access the Charge Head.
4. Physically pull the Charge Head down.
5. Release the Charge Head.
NOTE: It should return to its home position even without air pressure.
6. After performing this test, turn the pressure regulator back up and test with a bus to ensure everything is working properly.

Brush Actuation and Condition

Perform the following steps to test the Charge Head Brushes:

1. Check Neutral Brush for wear with Test Tag. Neutral Brush should deploy at least 3/4".
2. Verify Neutral Brush actuation distance. Record the brush measurement while extended.
3. Check Charge Brushes for wear.

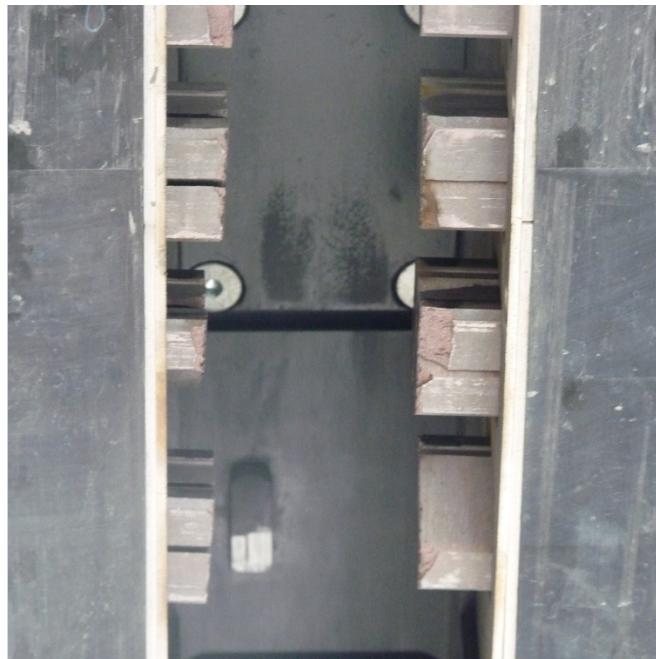


Figure 3-29. Charge Brushes showing wear

4. Verify Charge Brushes actuation distance of at least 1" with test tag. While extended record the shortest three brush measurements on each side of the Charge Head.

NOTE: Brushes need replacing when two or more brushes on the same side fail to extend further than 3/4" from brush housing. Replacement is done at factory.



De-energize the Charger at the main disconnect before performing the test. Failure to do so could result in an arc flash.

5. Verify Charge Brushes freedom of movement. They should wiggle.
6. Check Pilot Brush travel of at least 1" extension. Record the brush measurement.
7. Check Pilot Brush for wear.

Head Condition

Perform the following steps to inspect the Charge Head:

1. Visually check for gouges or cracks on bottom or sides. Contact the manufacturer for large gouges.
2. Visually check for distortion. Contact the manufacturer if distortion exists.
3. Check for loose fasteners and tighten as necessary.

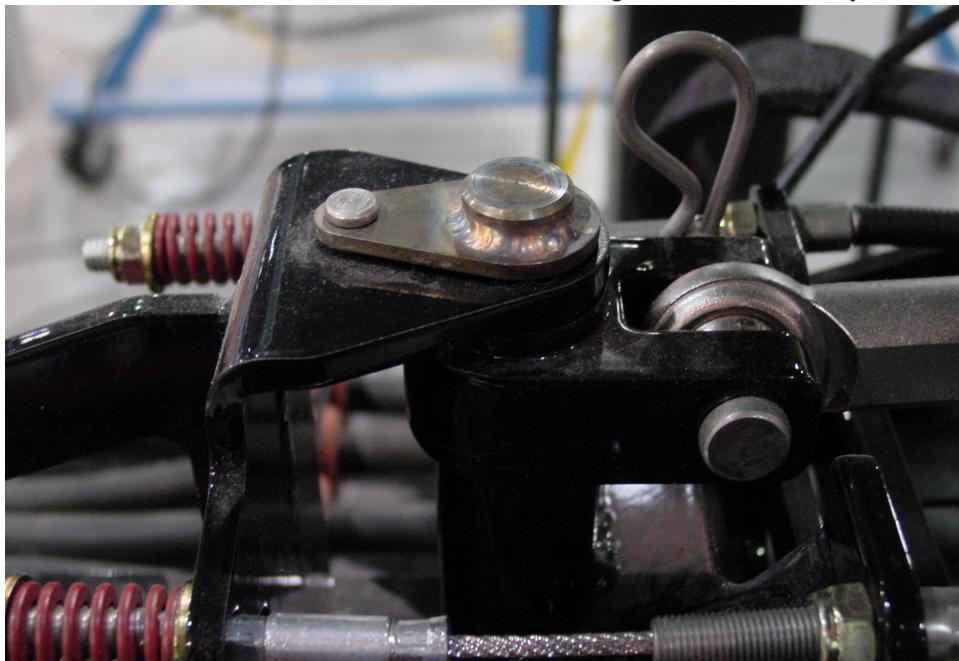


Figure 3-30. Charge Head Fasteners

4. Visually inspect and confirm that all cotter pins and snap rings are in place.

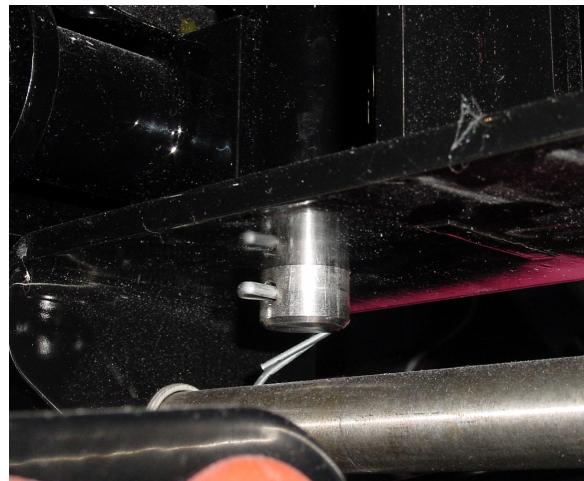
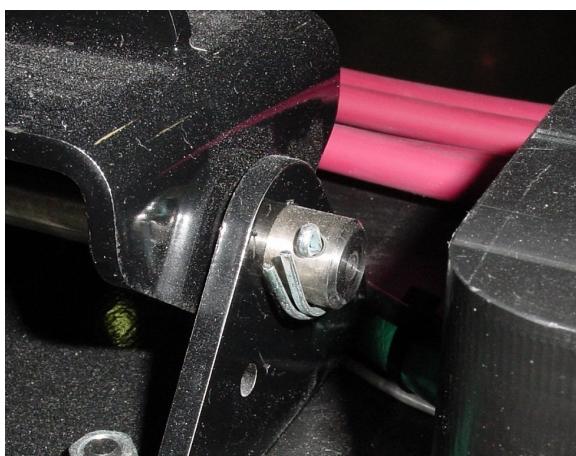


Figure 3-31. Charge Head Cotter Pins

Servicing the Sensors

The following service tasks should be performed to maintain proper performance of the Sensors. The scheduled service tasks for the Sensors include:

- Inspecting the Head Land Detent Sensors (2)
- Inspecting the Ultrasonic Sensor

Perform the following steps to test the Head Land Detent Sensors:

1. Ensure free movement.
2. Ensure proper clocking at 75 degrees. Use a protractor.



Figure 3-32. Head Land Detent Sensor at 75 degrees

Perform the following steps to test the Ultrasonic Sensor:

1. Ensure the bottom surface is clean.

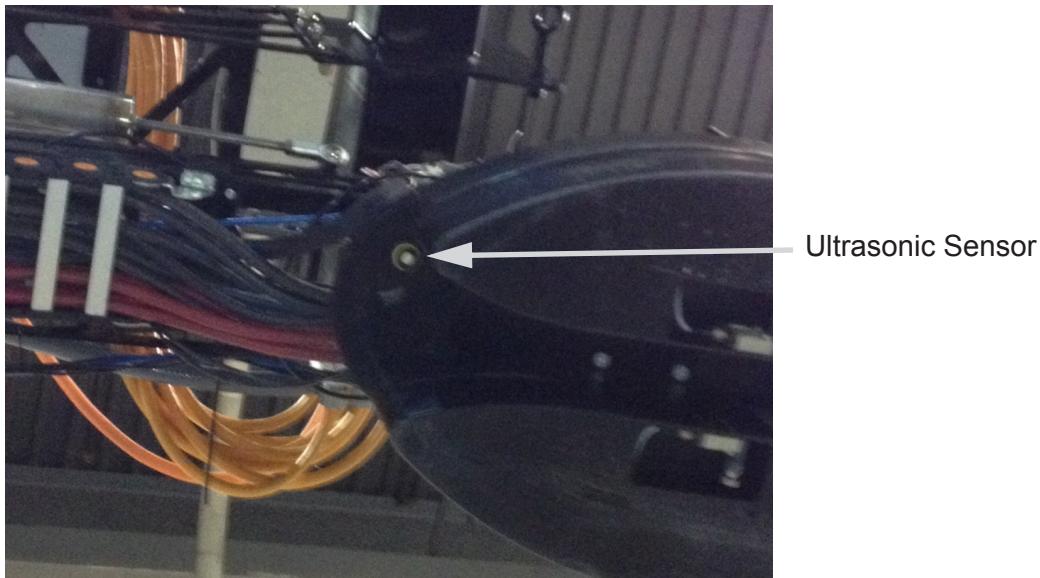


Figure 3-33. Bottom Surface of Ultrasonic Sensor

2. Ensure wiring is not pinched or chaffed.

Servicing the Charger

The following items are common high level issues to pay attention to. These service tasks should be performed to maintain proper performance of the Charger used at the On-Route Charge Station.

1. Inspect and replace Air Filters if needed.
2. Listen for any abnormal sounds, such as fans failing or debris in fans.
3. Visually check for infestation or nests built by birds, bats, bugs, or other animals.
4. Check for the presence of unusual odors or any changes in appearance of the components.

Note: Always reference the manufacturer's instruction manual for specific maintenance procedures and intervals.

Cleaning the Air Filters

Proper operation of the Charger is very important. To ensure continued proper operation of the Charger you should inspect and clean the filter elements monthly to remove any accumulated debris.



The Charger contains both low-voltage and high-voltage components. Ensure that you have followed all lock-out/tag-out procedures to properly de-energize the Charger prior to performing any service procedures.

1. Ensure the Charger is de-energized and that all safety procedures have been followed for high-voltage and arc-flash hazards listed in NFPA 70E.
2. Open the front access door of the Charger to access the air filter elements.
3. Remove the screws securing the air filter elements to the front door frame.

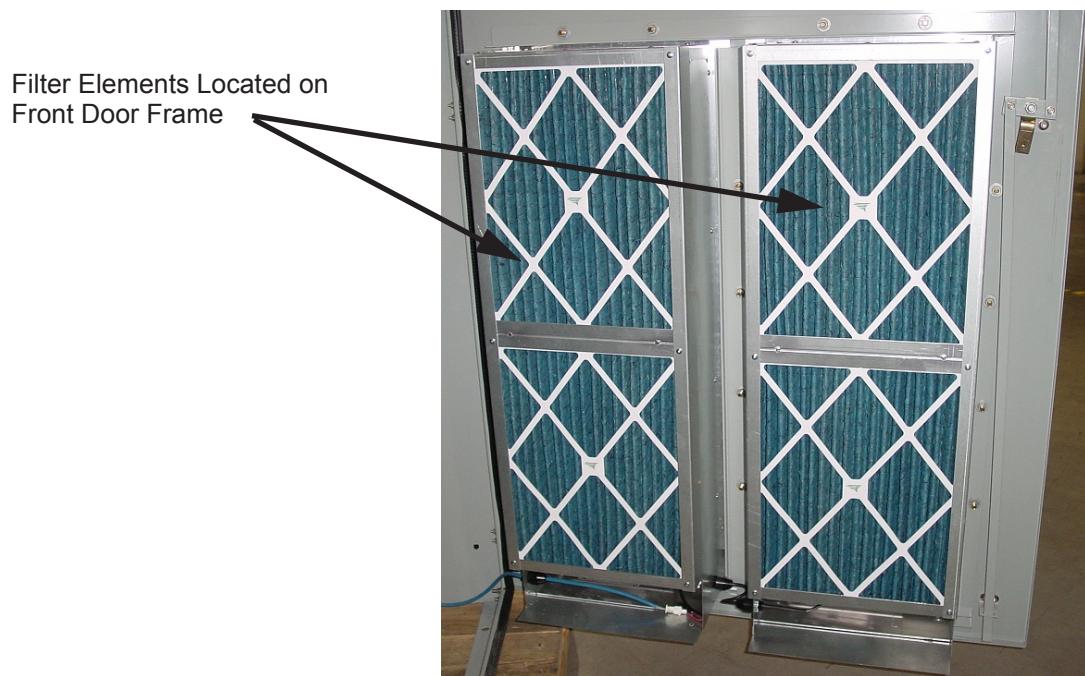


Figure 3-34. Filter Elements

4. Remove the air filter elements from the filter frame.
5. Using a vacuum cleaner, remove accumulated dust and debris from the filter element.
Note: If the filter is extremely dirty, wash the filter in water and allow it to dry completely.
6. Install the filter elements into the filter frame and secure it in position with screws.

General Service

These service tasks should be performed on the Docking Control Box to maintain proper performance of the Charger used at the On-Route Charge Station.

1. Verify operation of the Docking Control Box fan. To force fan operation, ensure that the fan is plugged in and adjust the temperature set point up or down as needed to verify operation of the fan.



Figure 3-35. Docking Control Box Thermostat

2. Visually check for moisture inside all enclosures and boxes.
3. Visually check for infestation or nests built by birds, bats, bugs, or other animals.
4. Verify proper operation of each Emergency Stop to ensure that it disables the system and prevents docking/charging.
5. Remove, clean, and replace Docking Control Box aluminum air inlet filter elements (2).
6. Remove, clean, and replace Docking Control Box exhaust fan filter element.

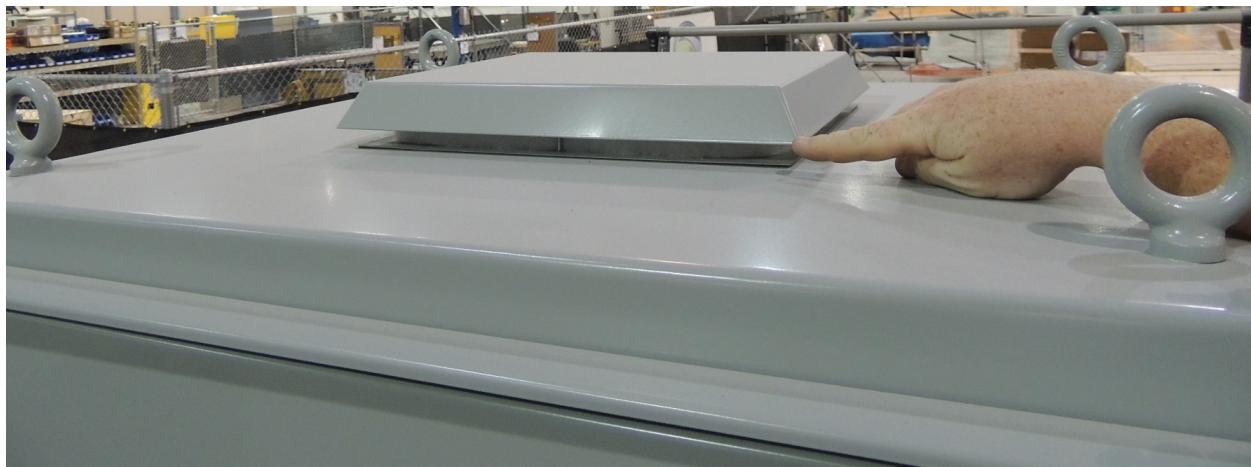


Figure 3-36. Docking Control Box Exhaust Fan Filter Element

7. Check all pneumatic hoses for any wear and listen for air leaks.
8. Check counter-balance spring assemblies on Charge Arm for correct tension and release movement. Ensure that the bushing is properly seated against the C-clip. Occasionally during shipment or replacement, the bushing can become stuck behind the weld lip. Test the release movement by pushing down on the Head using two hands. The Head should move in a smooth downward motion without requiring too much pressure.

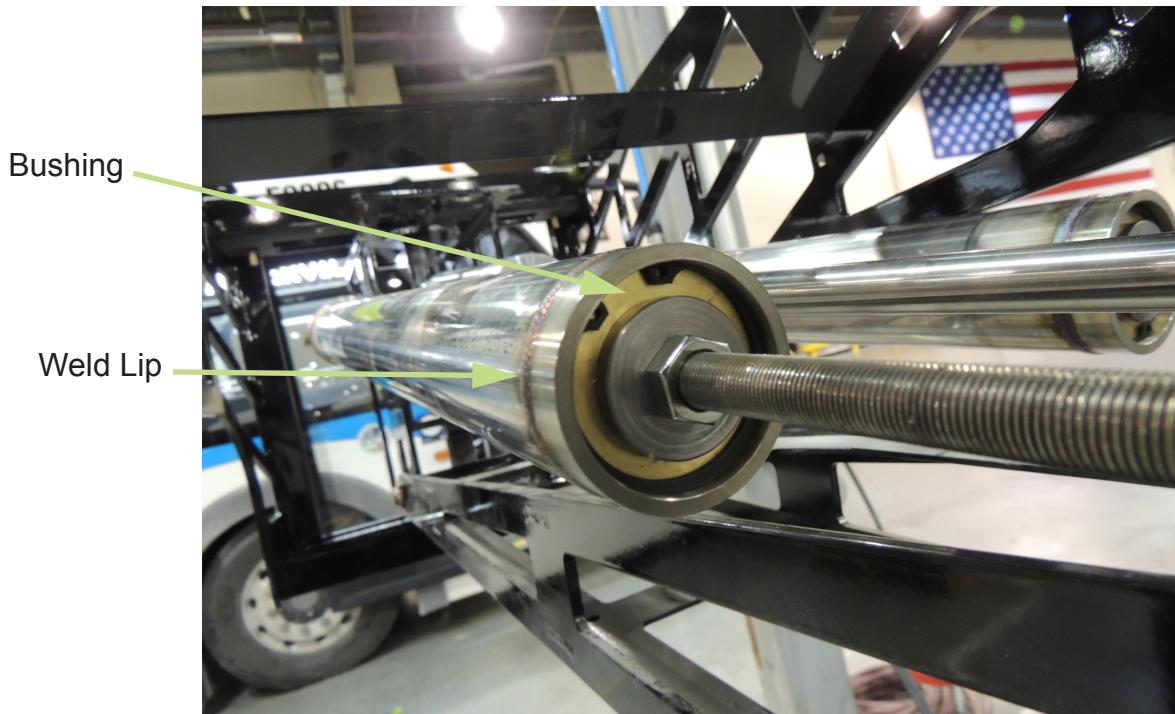


Figure 3-37. Spring Assembly Bushing

9. Check the condition of all electrical cables for cracks.
10. Check spring-loaded pilot signal brush movement (underside of the head assembly). There should be a minimum of 3/4 in. travel.
11. Check the Docking Control Box and/or Junction Boxes for nests, etc.

Chapter 4: Replacement Procedures

**CAUTION**

Please note the various Warnings, Cautions, and Notes, which should be carefully read in order to minimize the risk of personal injury to maintenance personnel, and to prevent damage the charger, or render it unsafe.

**WARNING**

There are multiple power sources entering the charger and docking control equipment. Ensure you have the breaker off and follow the lock out tag out procedure specified in OSHA 29 CFR 1910 Subpart S.

Included in this chapter are the following replacement procedures:

- Replacing the Charge Head
- Replacing the Charge Arm Assembly
- Replacing the Main Cylinder
- Replacing the Main Springs
- Replacing a Boat Unit
- Replacing the Neutral Brush Assembly
- Replacing the Pilot Brush

NOTE: For all replacement procedures, do not reuse certain hardware, such as C-clips, and snap rings.

Replacing the Charge Head

The following procedure details how to properly remove and replace the Charge Head on the Charge Arm Assembly.



The Charge Head is very heavy and requires a properly rated lifting device to lift and position the unit. Follow all site-specific requirements for moving heavy objects when performing this installation.



- Ensure that the entire charging station is properly locked out and tagged to prevent unexpected energizing.
- Ensure that there are no service “Test Tags” near the Charge Station area.
- Turn off the Air Compressor and completely drain the air tanks.

1. Using a 3/16" Allen wrench, remove the covers from the high-voltage cable termination areas on each side of the Charge Head.

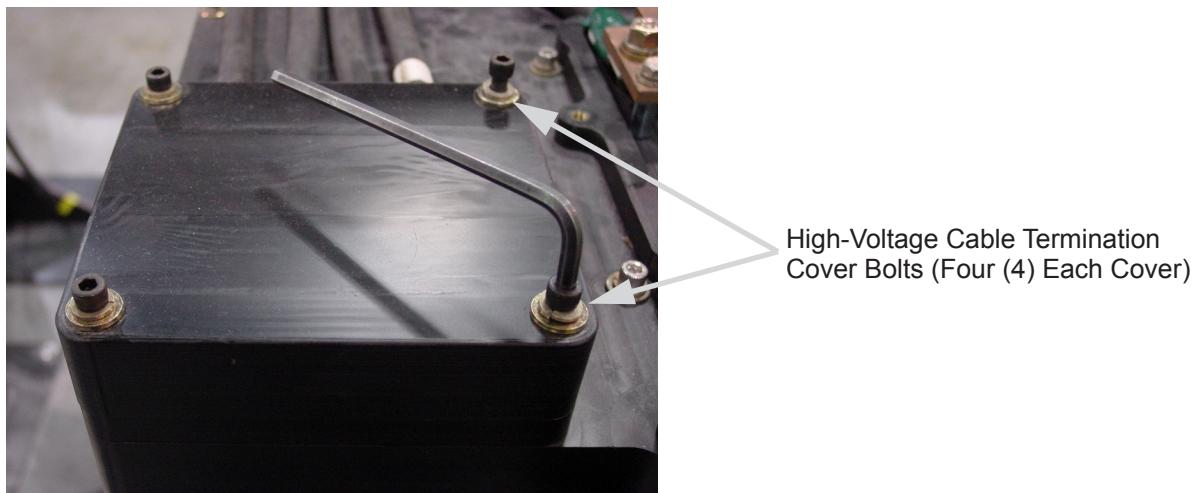


Figure 4-1. High-Voltage Termination Cover Removal

2. Using two 3/4" wrenches, un-lug the high-voltage cables from the Charge Head.



High-Voltage Cable Termination Lugs, Nuts, Washers, and Bolts

Figure 4-2. High-Voltage Terminations

3. Pull each of the eight (8) high-voltage cables and lugs back through the cable grommets and allow them to hang free.

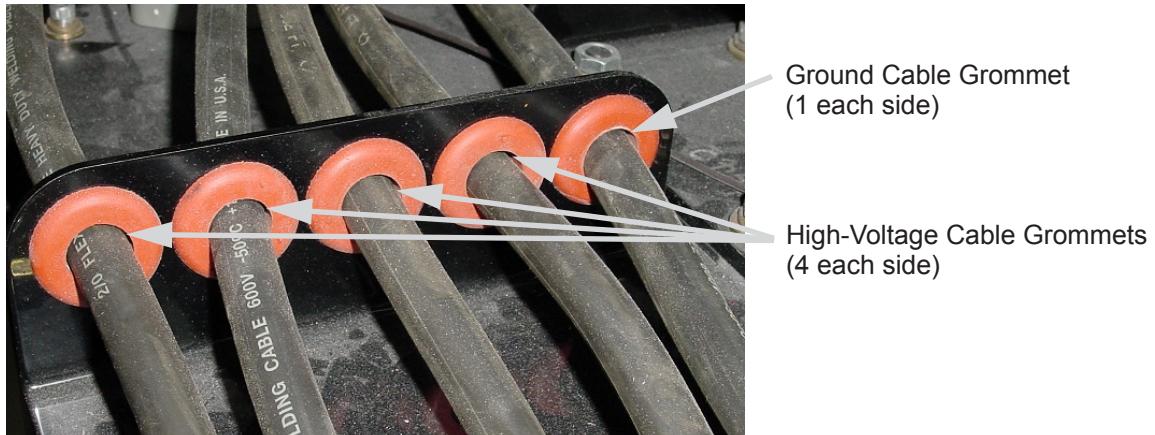


Figure 4-3. High-Voltage Cable and Ground Cable Grommets

4. Using a ratchet and 7/16" socket, remove the ground brush actuator cover from the Charge Head.

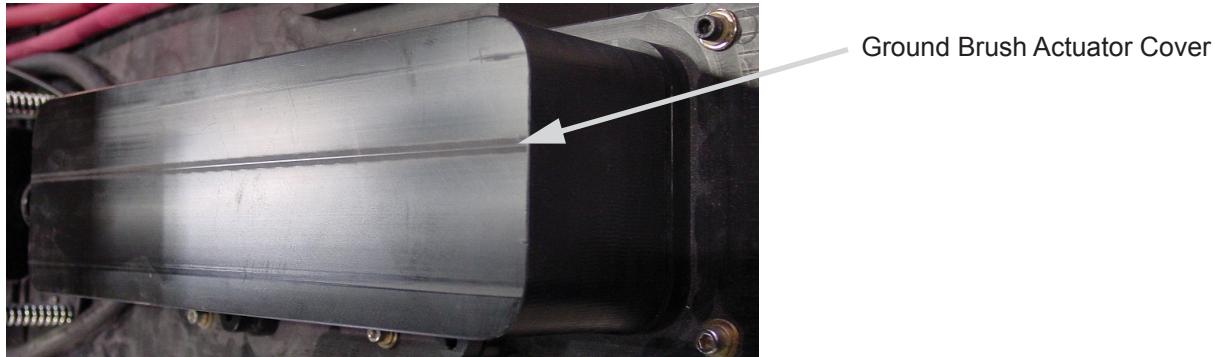


Figure 4-4. Ground Brush Actuator Cover

5. Using a ratchet and 7/16" socket remove the three (3) bolts securing the grounding bracket to the Charge Head.

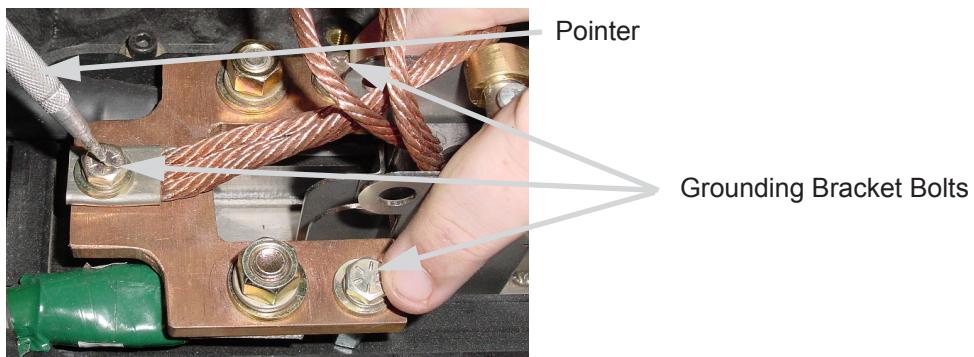


Figure 4-5. Grounding Bracket Bolts

6. Using two 9/16" wrenches, un-lug the two ground cables from the grounding bracket.

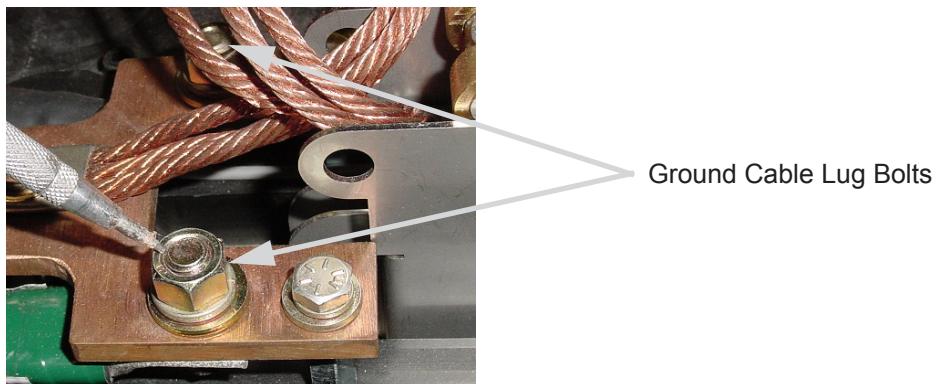


Figure 4-6. Ground Cable Lug Bolts

7. Pull both of the ground cables and lugs back through the cable grommets and allow them to hang free.
8. Label and disconnect the Air Line from the Ground Brush Actuator.

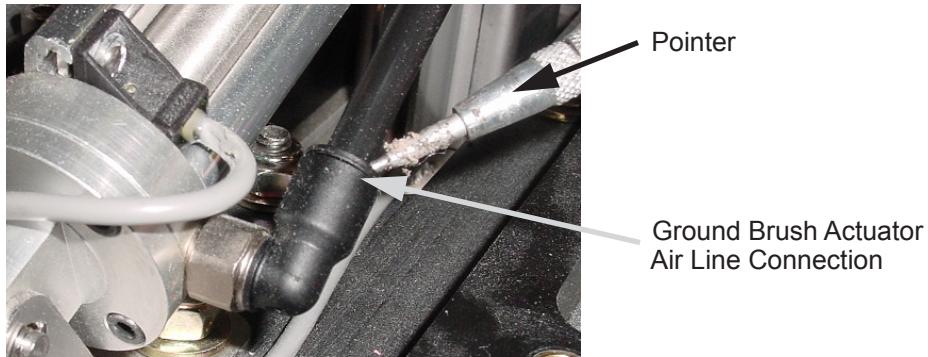


Figure 4-7. Ground Brush Actuator Air Line Connection

9. Using needle-nose vise grips and a 1/2" wrench/socket, remove the two guide cable spring retaining nuts.



The cable will snap if the vise grips are not held properly. This could lead to serious injury.

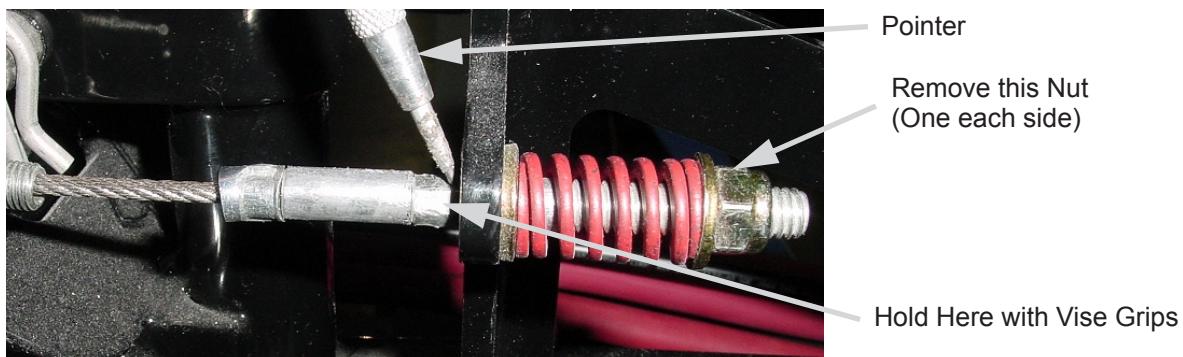


Figure 4-8. Guide Cable Nuts

10. Disconnect the two low-voltage connectors, one on each side of the Charge Head (gray and black).

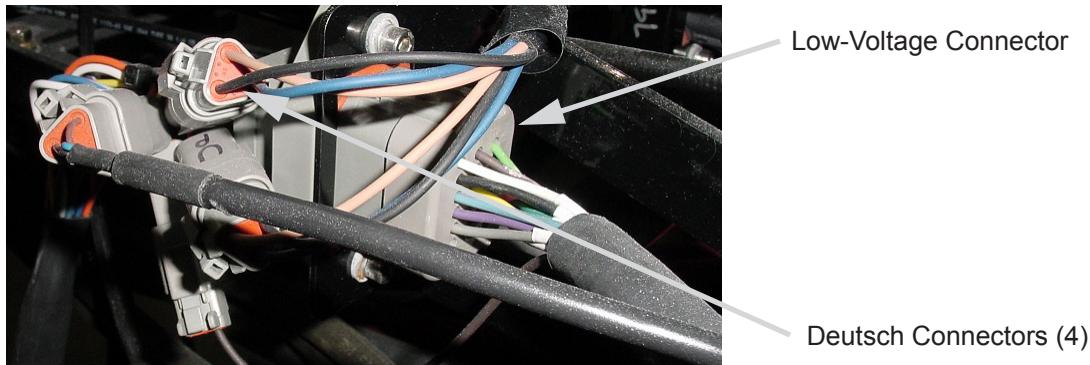


Figure 4-9. Low-Voltage and Deutsch Connectors

11. Label and disconnect the four (4) Deutsch connectors for the Charge Head.
12. Label and disconnect the two Air Lines from the Charge Head elbow.

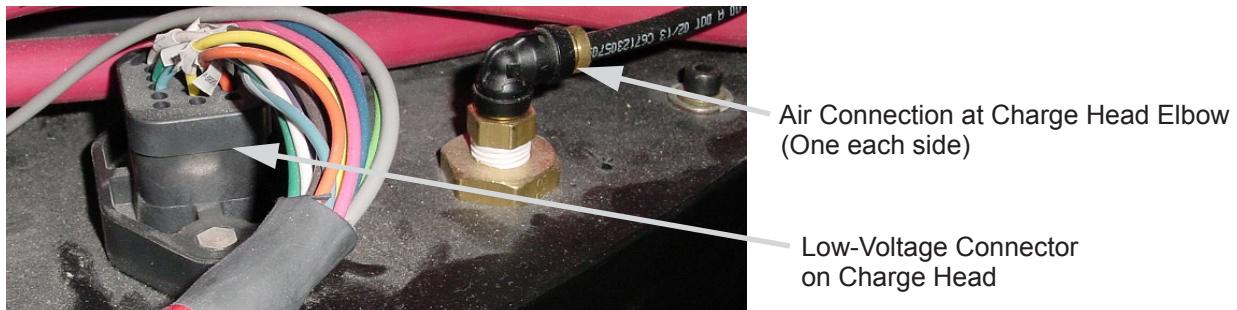


Figure 4-10. Charge Head Air Connections

13. Using an adequate lifting device, properly secure and support the Charge Head prior to performing the following steps.
14. Remove the lower cotter pin from the “twist” motion pivot pin.
NOTE: Do not reuse cotter pin.

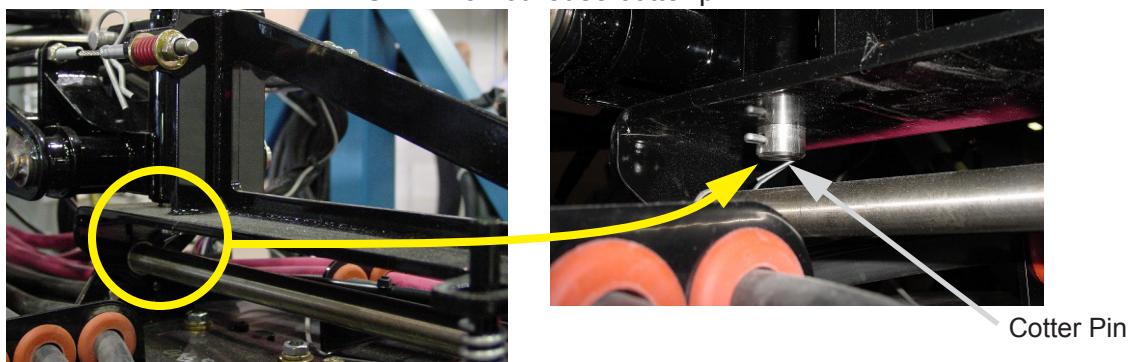


Figure 4-11. Cotter Pin Location on bottom of Pivot Pin

15. Remove the small C-clip from the pivot pin retaining pin and then remove the retaining pin from the flange.
NOTE: Do not reuse C-clip.

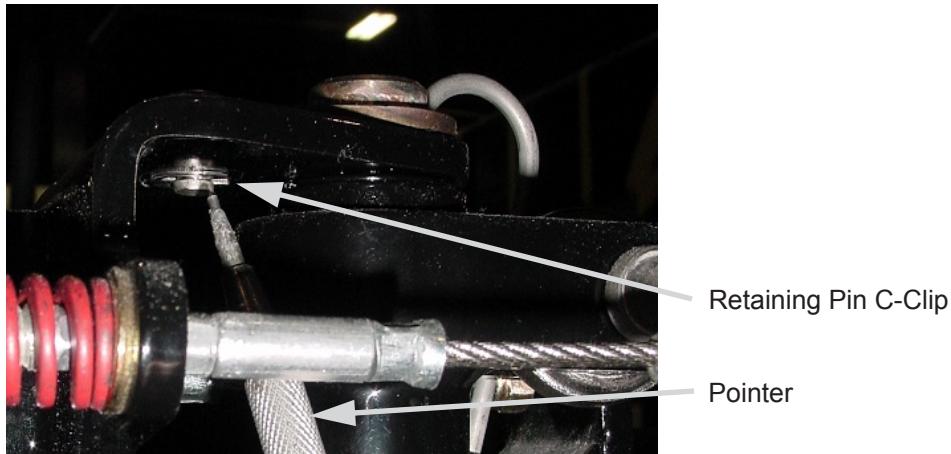


Figure 4-12. Retaining Pin C-Clip

16. Remove the “twist” motion pivot pin, being very careful not to bend the flange on the top of the pivot pin.

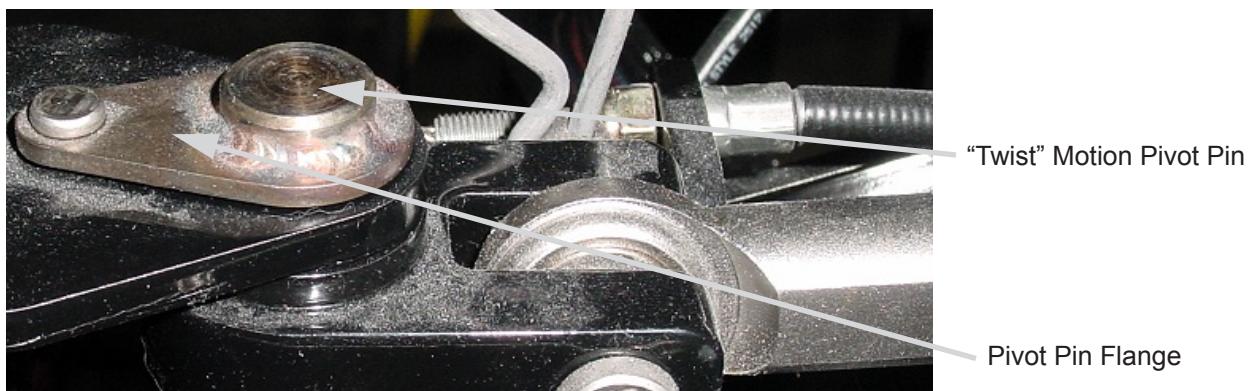


Figure 4-13. ‘Twist’ Motion Pivot Pin

17. With the Charge Head properly supported, carefully shift the charge head to remove the Charge Head from the articulated arm (slide it out).
18. Carefully lower the Charge Head to the ground.

19. With the Charge Head on the ground, remove the cotter pin securing the roll movement pivot pin in the brackets and place aside.

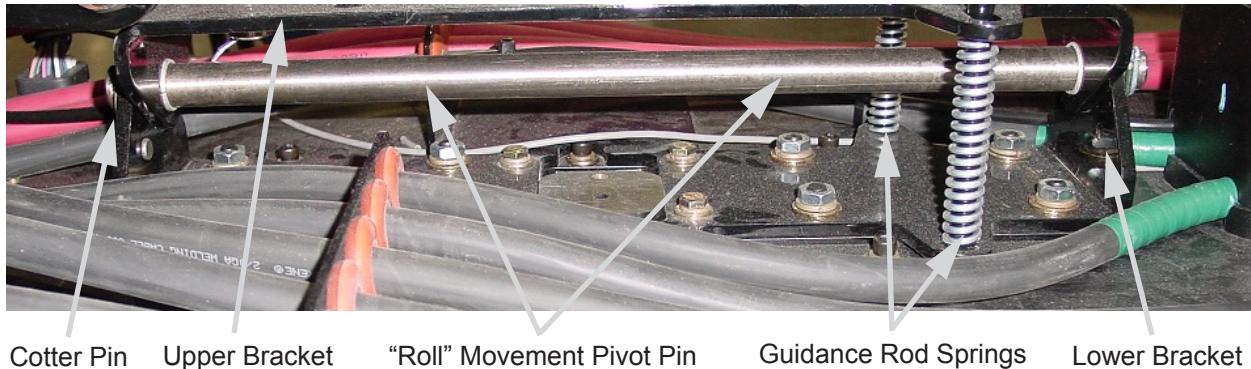


Figure 4-14. “Roll” Movement Pivot Pin

20. Carefully tap the pivot pin to remove the pin from the brackets and place the pivot pin, upper bracket, and guidance rod springs aside for installation on the replacement Charge Head.
21. On the replacement Charge Head, install the two guidance rod springs on the guidance rods and then position the upper bracket to allow the roll movement pivot pin to be installed.
22. Carefully install the roll movement pivot pin through the holes in the upper and lower bracket, ensuring the flange is fully seated and the retaining pin is positioned inside the retaining hole.
23. Install the cotter pin in the roll movement pivot pin.
NOTE: Use a new cotter pin.
24. Transfer the lifting device to support lifting of the replacement Charge Head.
25. With the replacement Charge Head properly supported, carefully lift the Charge Head into position for mounting on the articulated arm.

26. Shift the position of the Charge Head until the “twist” motion pivot pin will drop down through the mounting holes.

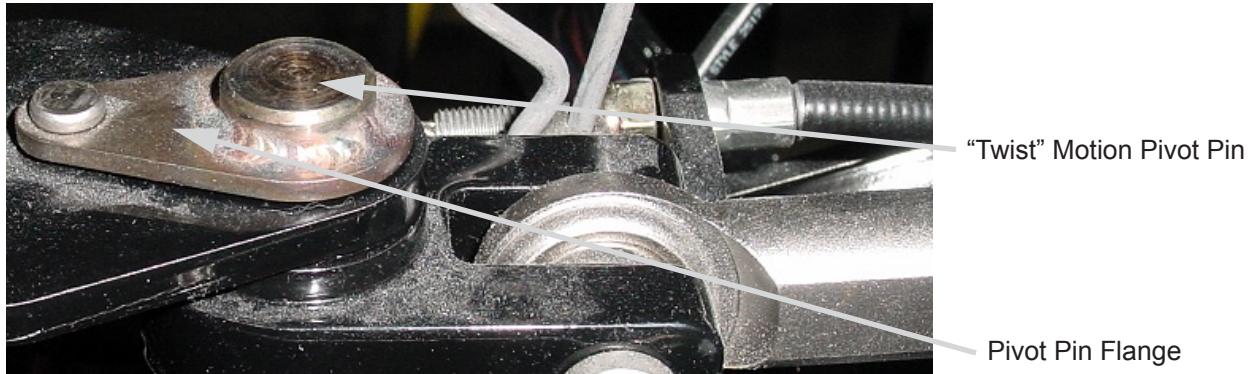


Figure 4-15. “Twist” Motion Pivot Pin

27. Position the pivot pin flange to allow the securing pin to be inserted and then install a new C-clip in the securing pin.

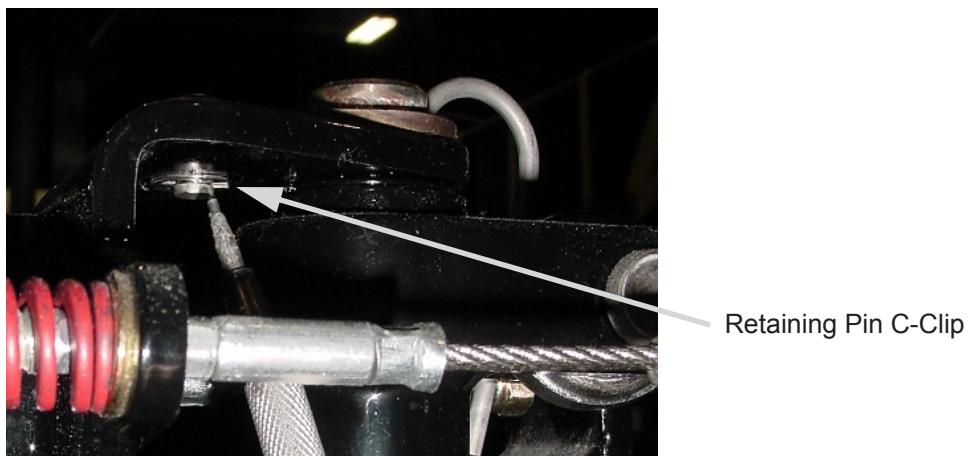


Figure 4-16. Retaining Pin C-Clip

28. Install the new lower cotter pin in the “twist” motion pivot pin.

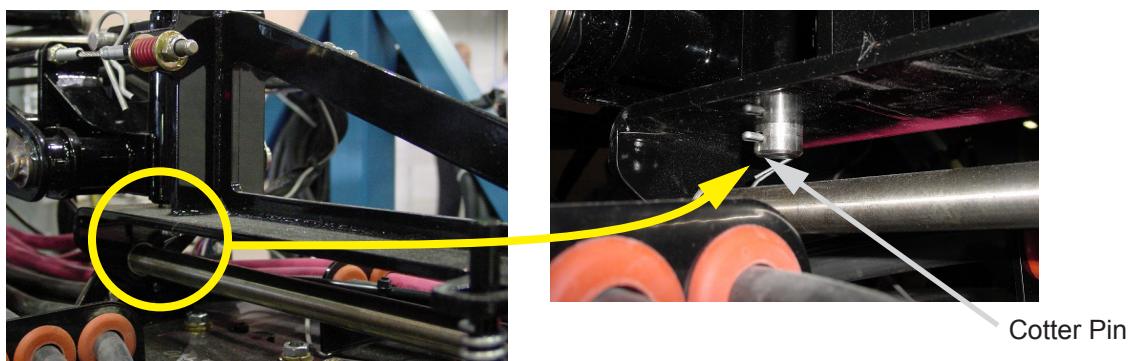


Figure 4-17. Cotter Pin Location on bottom of Pivot Pin

29. With the replacement Charge Head mounted on the articulated arm, remove the lifting device from the replacement Charge Head.
30. Reference the label and connect the air line to the Charge Head elbow.

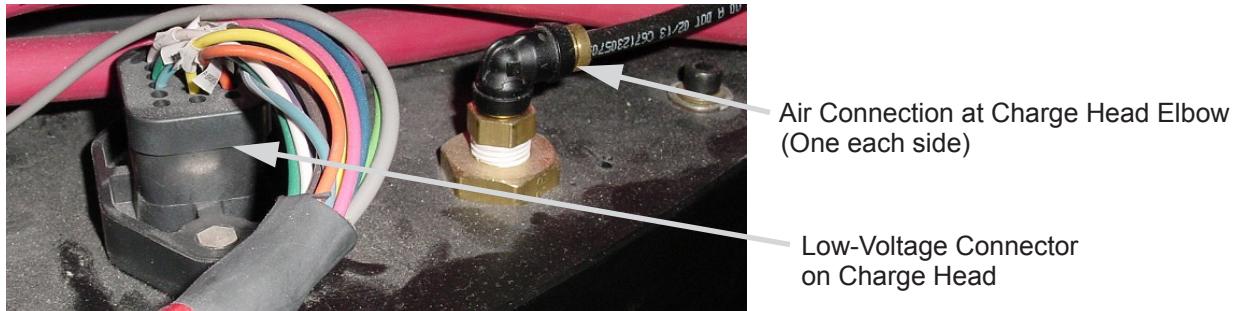


Figure 4-18. Charge Head Air Connections

31. Reference the labels and connect the four (4) Deutsch connectors for the Charge Head.

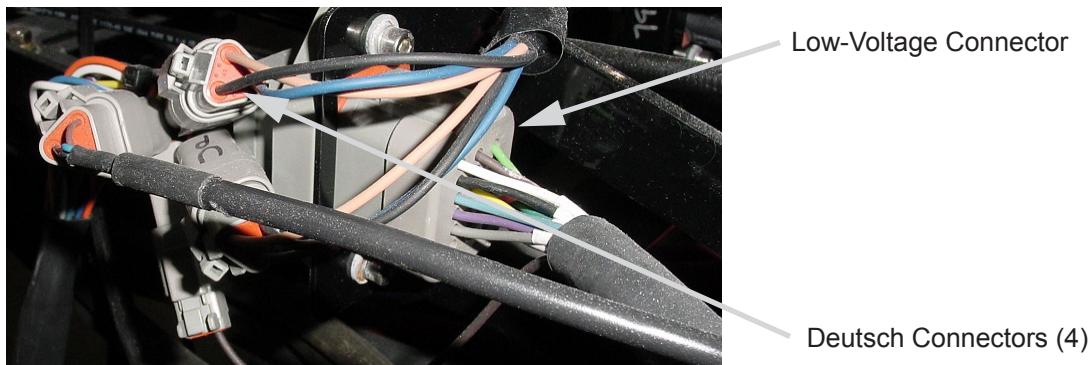


Figure 4-19. Low-Voltage and Deutsch Connectors

32. Connect the two low-voltage connectors, one on each side of the Charge Head (gray and black).

33. Using needle-nose vise grips and a 1/2" wrench/socket, install the two guide cable spring retaining nuts. Adjust the tension on the springs until the Charge Head is centered.



The cable will snap if the vise grips are not held properly. This could lead to serious injury.

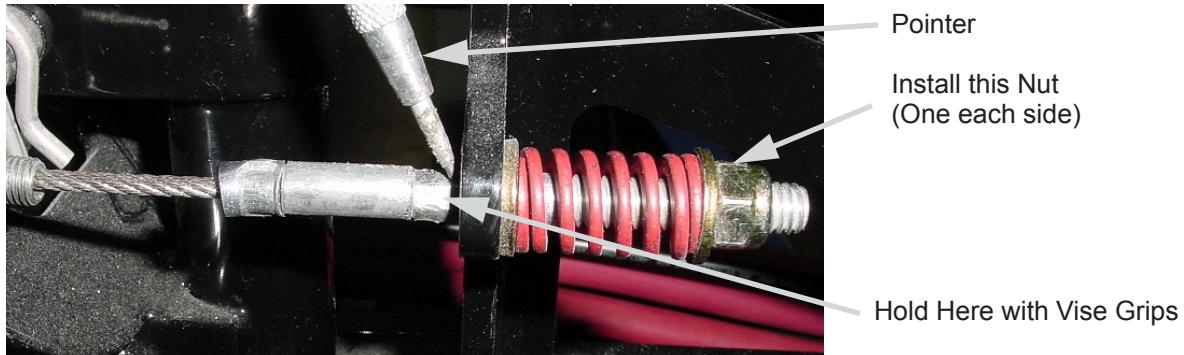


Figure 4-20. Guide Cable Nuts

34. Reference the label and connect the Air Line to the Ground Brush Actuator.

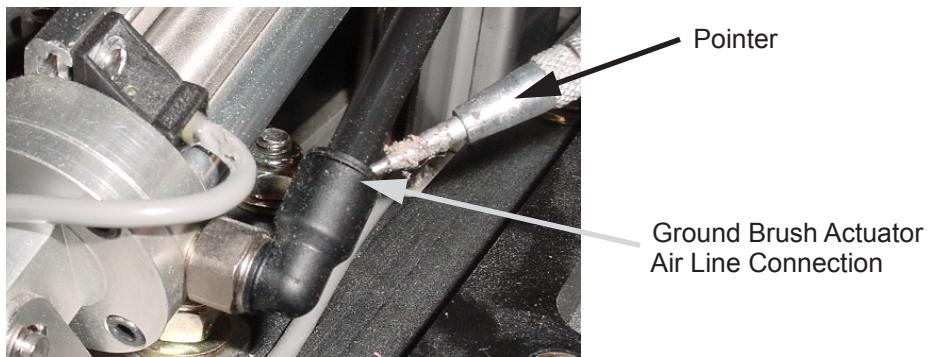


Figure 4-21. Ground Brush Actuator Air Line Connection

35. Pull both of the ground cables and lugs through the cable grommets.

36. Using two 9/16" wrenches, lug the two ground cables to the grounding bracket. Torque the bolts to 39 ft-lb and then apply a torque stripe to each nut.

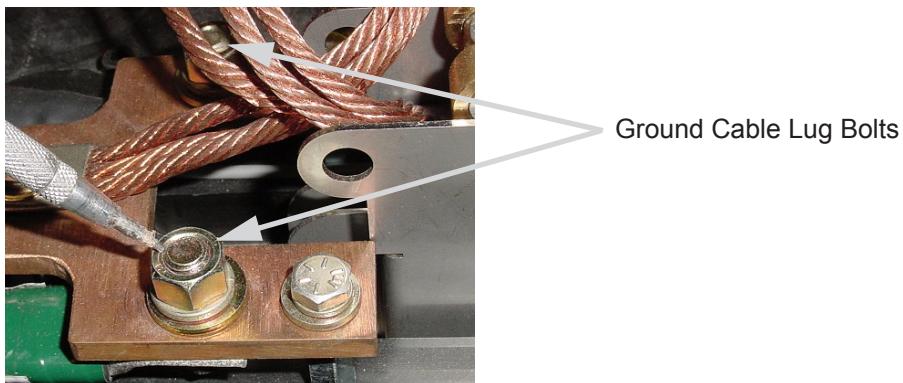


Figure 4-22. Ground Cable Lug Bolts

37. Using a ratchet and 7/16" socket install the three (3) bolts securing the grounding bracket to the Charge Head.

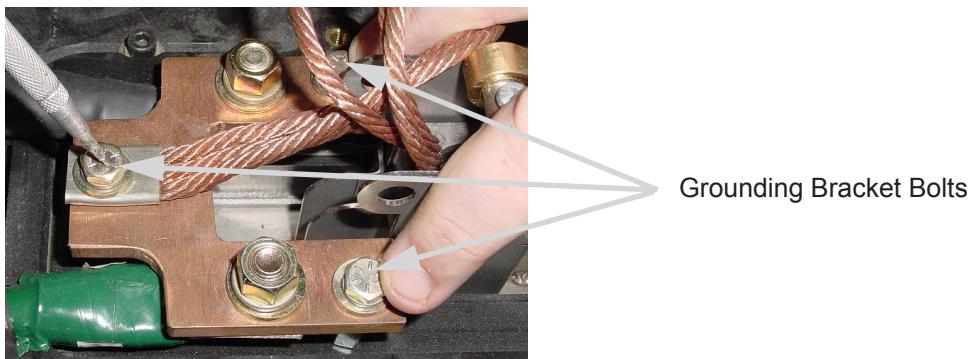


Figure 4-23. Grounding Bracket Bolts

38. Using a ratchet and 7/16" socket, install the ground brush actuator cover to the Charge Head.

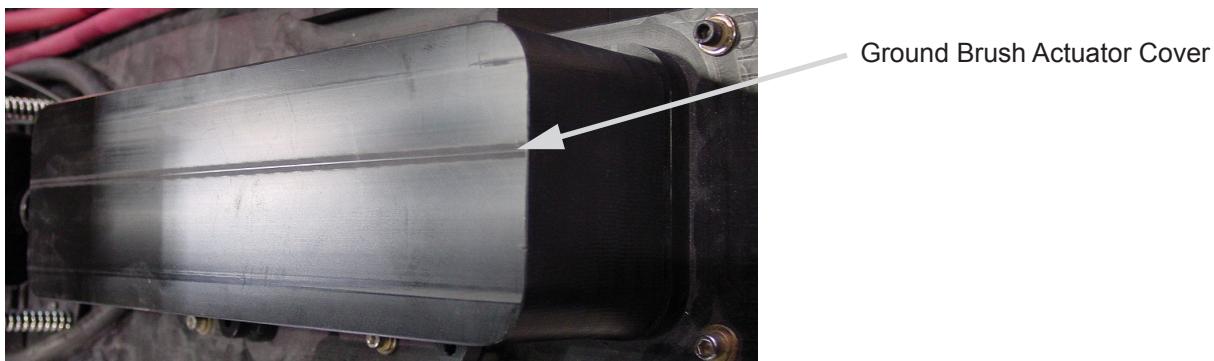


Figure 4-24. Ground Brush Actuator Cover

39. Pull each of the eight (8) high-voltage cables and lugs through the cable grommets.

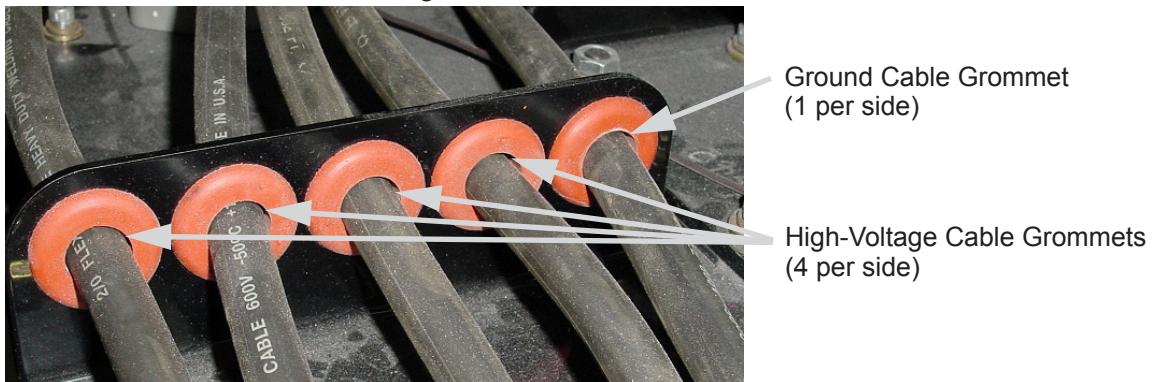


Figure 4-25. High-Voltage Cable and Ground Cable Grommets

40. Using two 3/4" wrenches, lug the high-voltage cables to the Charge Head. Torque the lugs to 96 ft-lb and then place a torque stripe on each nut.

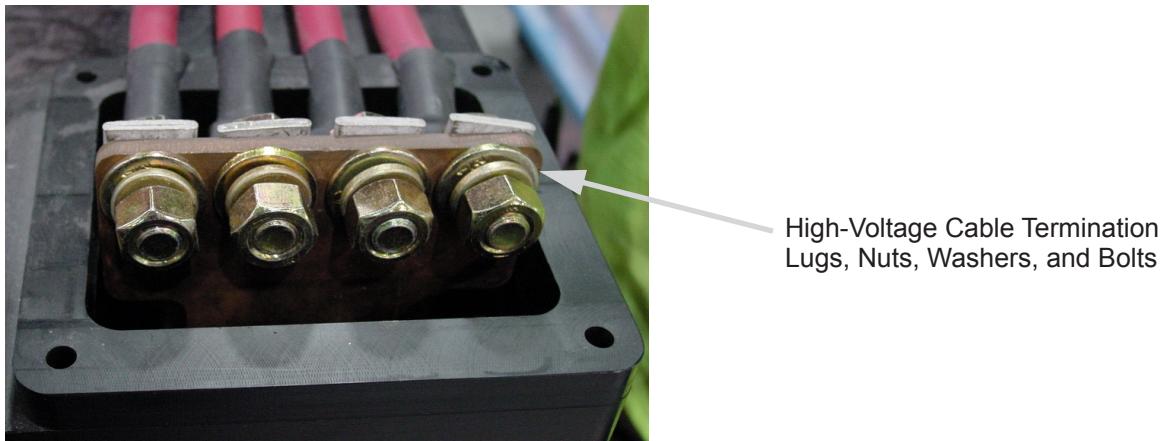


Figure 4-26. High-Voltage Terminations

41. Using a 3/16" Allen wrench, install the covers over the high-voltage cable termination areas on each side of the Charge Head.

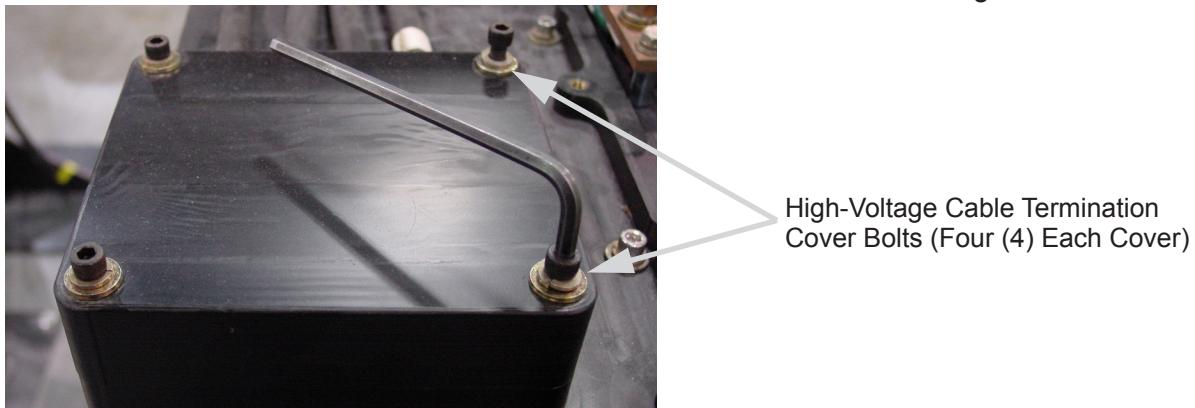


Figure 4-27. High-Voltage Termination Cover Installation

Replacing the Charge Arm Assembly

The following procedure details how to properly remove and replace the Charge Arm Assembly on the mast.



The Charge Arm Assembly is very heavy and requires a properly rated lifting device to lift and position the unit. Follow all site-specific requirements for moving heavy objects when performing this installation.



- Ensure that the entire charging station is properly locked out and tagged to prevent unexpected energizing.
- Ensure that there are no service “Test Tags” near the Charge Station area.
- Turn off the Air Compressor and completely drain the air tanks.

1. Following the Charge Arm strapping procedure, secure the movable portion of the charge arm to the fixed upper charge arm frame in order to prevent unintentional movement.
2. Disconnect the air line from the side of the Control Box.
3. Label/record the positions of each of the high-voltage cables in the Charge Arm Junction Box and then remove the high-voltage terminations for each cable and pull the cable through the cord grips.
4. Route the high-voltage cables and the air line out of the P-clamps so that they are not attached to the Charge Arm Assembly.
5. Inside the Charge Arm Control Box, label and then disconnect each of the low-voltage wires.
6. Loosen and remove the conduit (LiquidTight) from the side of the Control Box and carefully pull all wires out.
7. Disconnect the RFID Antenna cable from the bulkhead connector on the side of the Control Box.
8. Secure the Charge Arm Assembly to an adequate lifting device such as an overhead crane or high-lift fork lift. Use the recommended lift points and slings/spreader bars to properly support the charge arm and to prevent warping the charge arm frame.
9. Carefully lift up on the Charge Arm Assembly just enough to provide support to the unit when it is disconnected from the mast.

10. With the entire Charge Arm Assembly properly supported by the lifting device, remove the six (6) bolts securing the Charge Arm Assembly to the mast.
11. Carefully move the Charge Arm Assembly into position to be lowered to the ground and then slowly lower the Charge Arm Assembly to the ground.
12. Ensure the Charge Arm Assembly is stable on the ground and then remove the lifting straps/spreader bars from the Charge Arm Assembly.
13. Secure the replacement Charge Arm Assembly to the lifting device using the recommended lift points and slings/spreader bars to properly support the charge arm and to prevent warping the charge arm frame.
14. Slowly and carefully lift the replacement Charge Arm Assembly into mounting position on the mast.
15. Install the six (6) bolts securing the Charge Arm Assembly to the mast. Torque each mounting bolt to 96 ft-lb and then place a torque stripe on each nut.
16. With the Charge Arm Assembly supported on the mast, remove the lifting straps and spreader bars from the Charge Arm Assembly.
17. Carefully remove the shipping straps from the Charge Arm Assembly.
18. Route the High-Voltage cables and air line through the p-clamps and through the cord grips located on the junction box.
19. Referencing the labels, terminate each of the high voltage cables in the same position where they were terminated in the removed Charge Arm Assembly. Torque each of the terminations to 20 ft-lb and place a torque stripe on the termination to indicate that it was properly tightened.
20. Connect the air line at the Control Box.
21. Connect the RFID Antenna cable to the bulkhead connector on the side of the Control Box.
22. Carefully insert the low-voltage wires through the conduit hole in the side of the Control Box and then install and tighten the conduit (LiquidTight) on the side of the Control Box.
23. Referencing the labels, connect each of the low-voltage wires inside the Control Box.
24. Using the lifting device, lifting straps and spreader bars, lift the removed Charge Arm Assembly and position it onto the pallet that the replacement Charge Arm assembly was removed from.

25. Following the strapping procedures, secure the removed Charge Arm Assembly onto the pallet in preparation for return to Proterra.
NOTICE! While strapping the Charge Arm onto the pallet for shipment, ensure that none of the high-voltage cables are pinched or chaffing.

Replacing the Main Cylinder

The following procedure details how to properly remove and replace the Charge Arm Cylinder on the frame.



The Charge Arm Assembly is very heavy and requires a properly rated lifting device to lift and position the unit. Follow all site-specific requirements for moving heavy objects when performing this installation.



- Ensure that the entire charging station is properly locked out and tagged to prevent unexpected energizing.
- Ensure that there are no service “Test Tags” near the Charge Station area.
- Turn off the Air Compressor and completely drain the air tanks.

Removing the Main Cylinder

Perform the following steps in order to properly and safely remove the Main Cylinder.

1. Following the Charge Arm strapping procedure, secure the movable portion of the charge arm to the fixed upper charge arm frame in order to prevent unintentional movement.
2. Remove the C-clips on either end of the clevis pin.
NOTE: Do not reuse C-clips.



C-clips

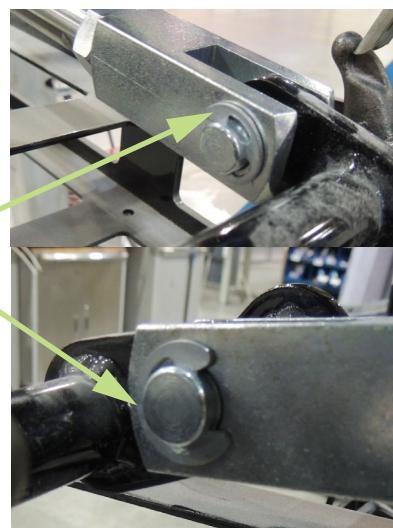


Figure 4-28. Main Cylinder - Removing C-clips

3. Remove the clevis pin from the lower end of the Cylinder.

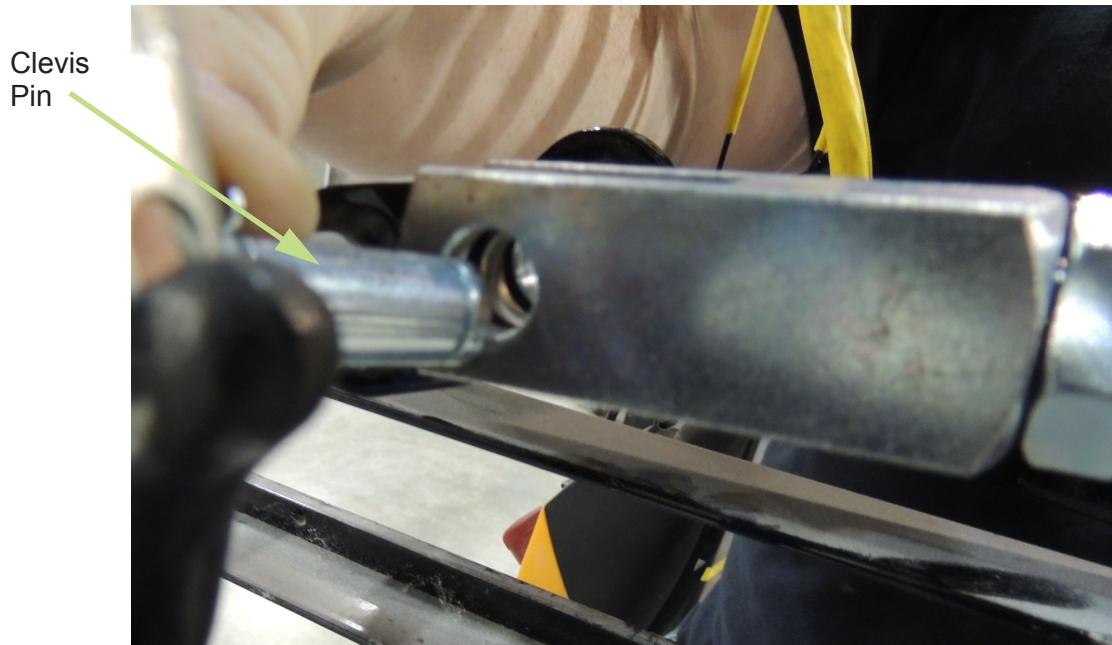


Figure 4-29. Main Cylinder - Removing Clevis Pin on Lower End

4. Slide the hairpin-style cotter pin out from the end of the clevis pin at the upper end of the Cylinder.

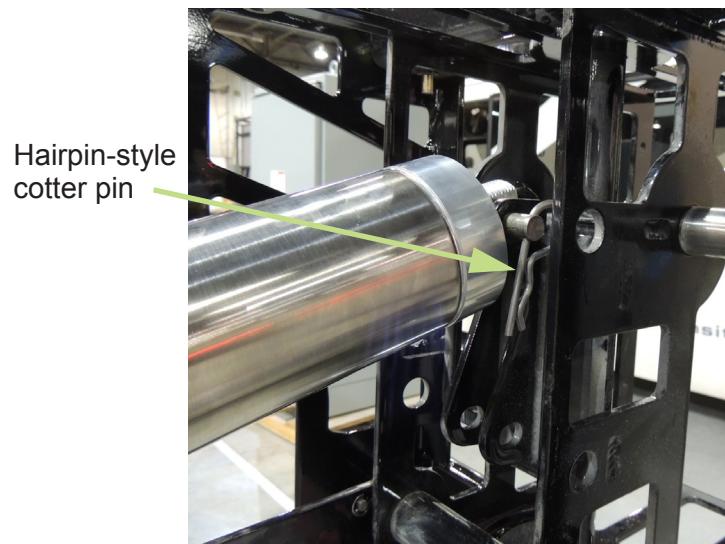


Figure 4-30. Main Cylinder - Removing Cotter Pin

5. Slide the clevis pin out from the upper end of the Cylinder.

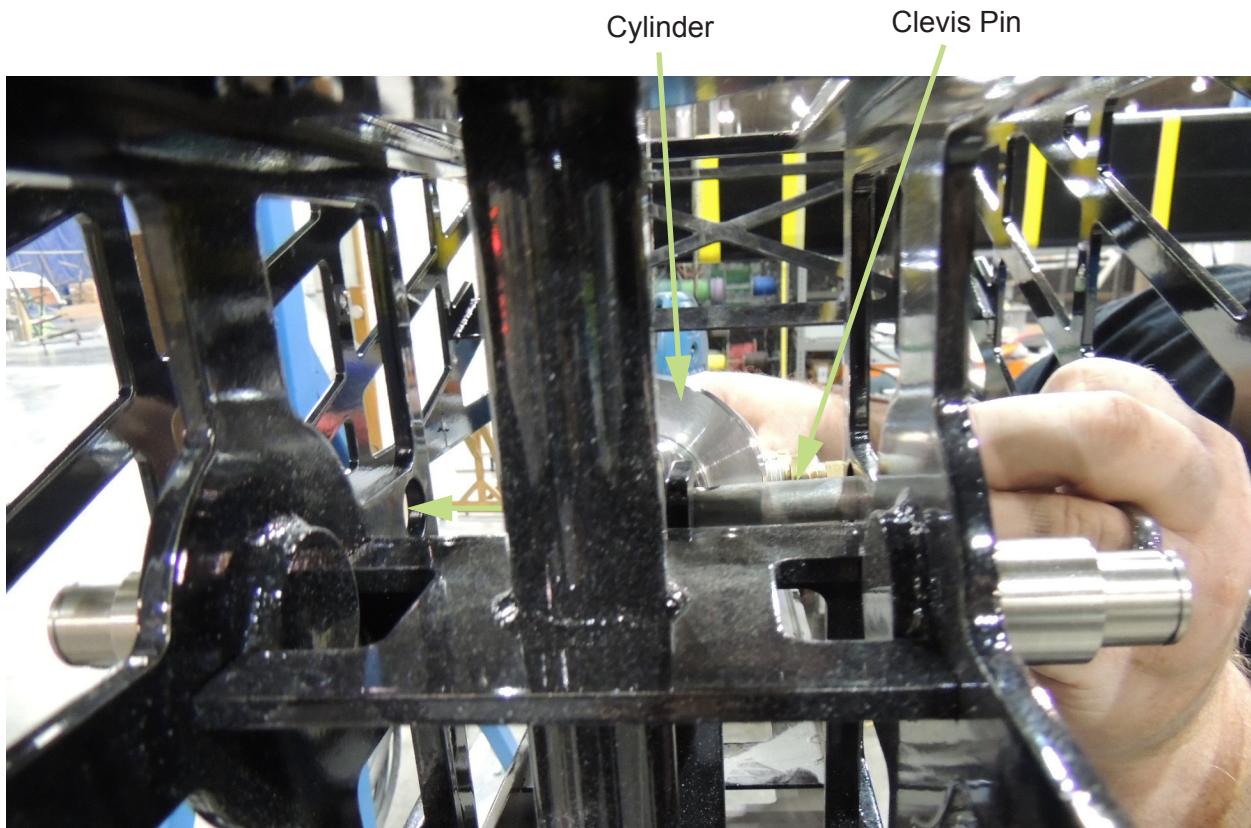


Figure 4-31. Main Cylinder - Installing Clevis Pin on Upper End

6. Carefully lift the Cylinder out from the Charge Arm frame.

Installing the Main Cylinder

Perform the following steps in order to properly and safely install the Main Cylinder.

1. Following the Charge Arm strapping procedure, secure the movable portion of the charge arm to the fixed upper charge arm frame in order to prevent unintentional movement.
2. Install two (2) elbows onto the main cylinder.

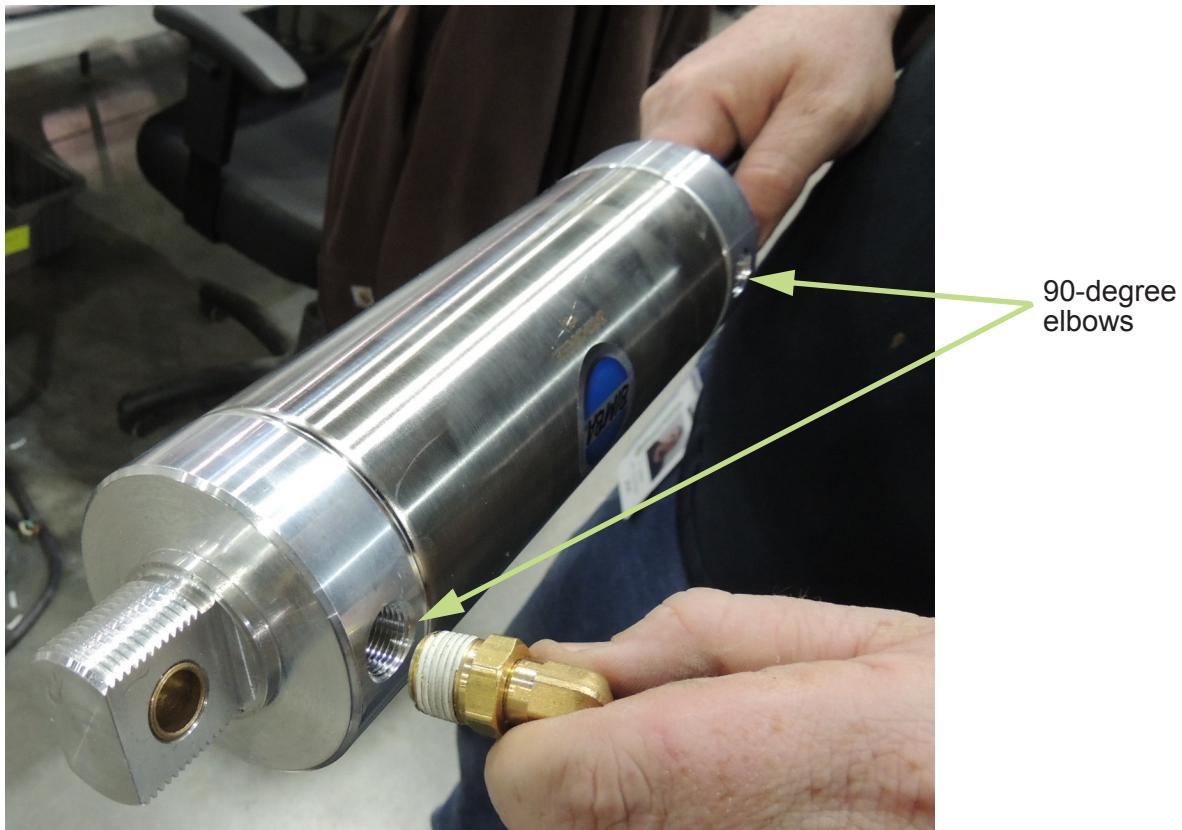


Figure 4-32. Main Cylinder - Installing 90-degree elbows

3. At the end of the shaft, install the nut and bracket that came as part of the original Cylinder package.

NOTE: The third item in this package is a clevis pin. This item is installed in a later step.

4. Install the Cylinder onto the Charge Arm frame using a clevis pin (retaining bolt) to secure the upper end of the Cylinder.

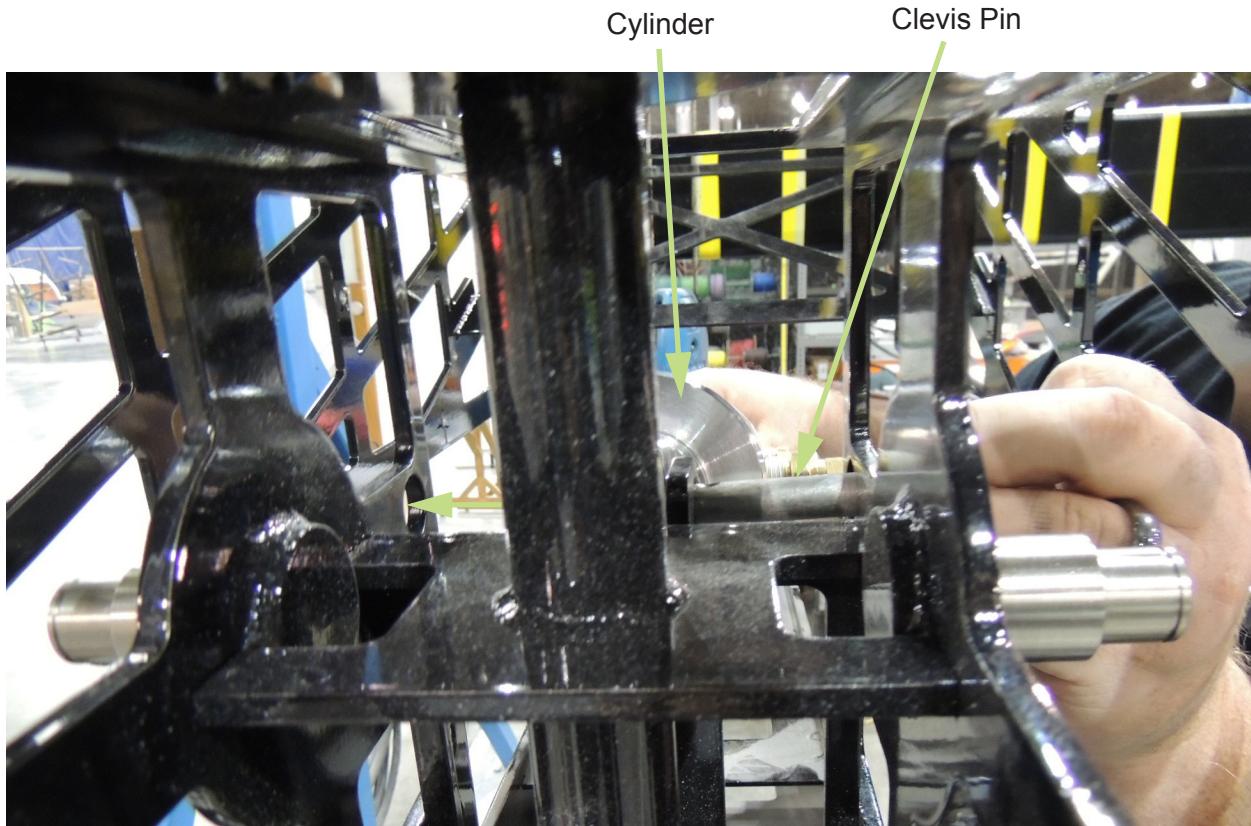


Figure 4-33. Main Cylinder - Installing Clevis Pin on Upper End

5. Slide a hairpin-style cotter pin into the end of the clevis pin.

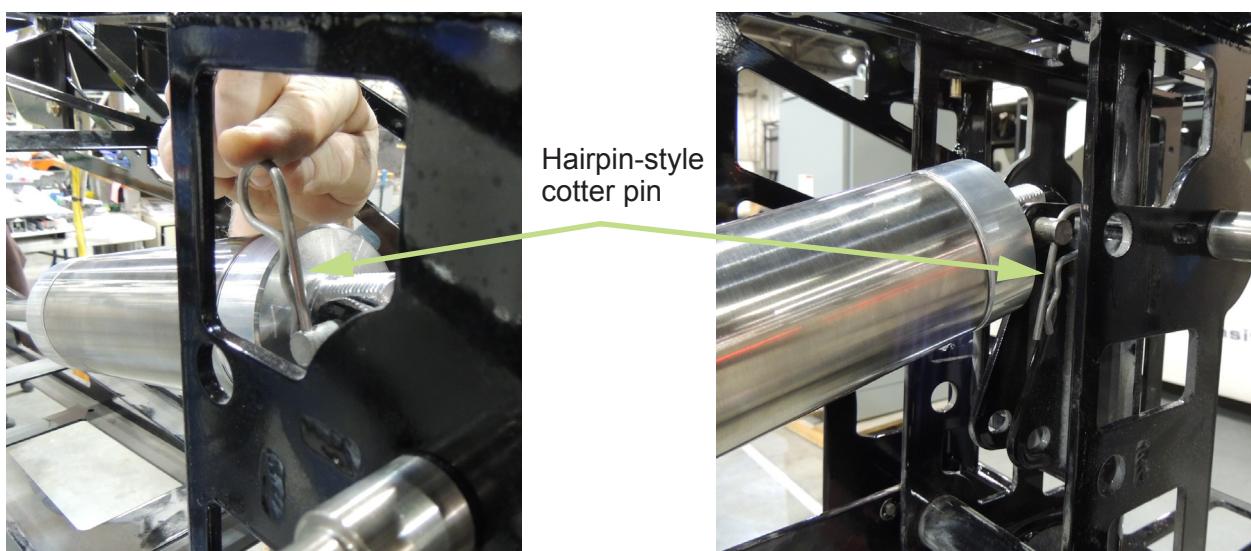


Figure 4-34. Main Cylinder - Installing Cotter Pin

6. Install the lower end of the Cylinder onto the Charge Arm frame using the clevis pin that came as part of the bolt, bracket and clevis pin package.

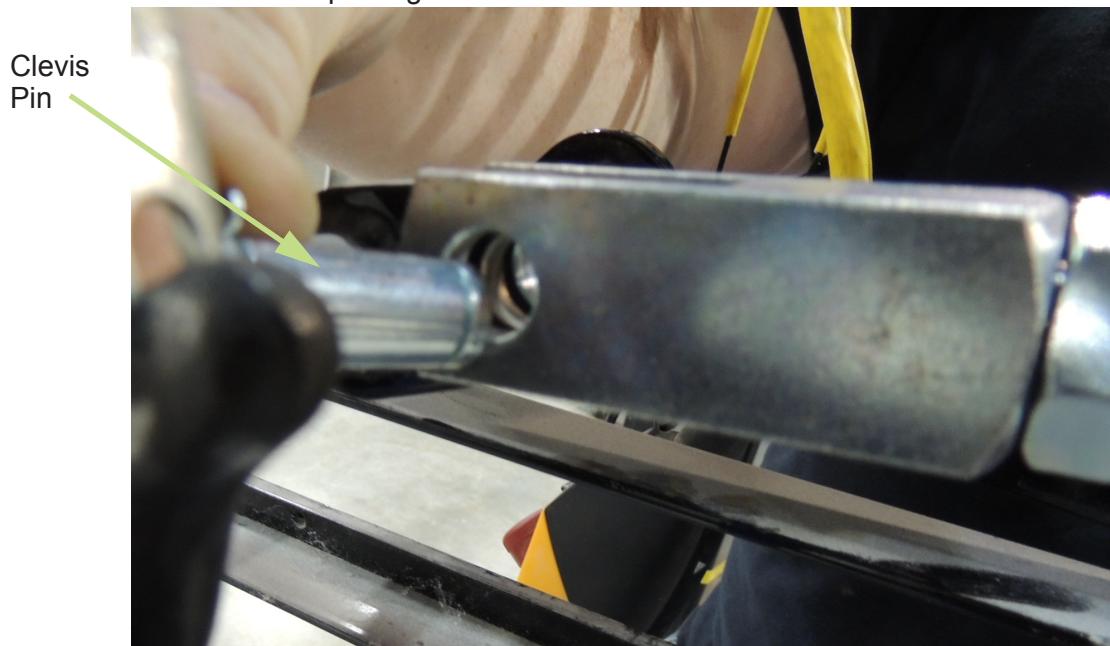


Figure 4-35. Main Cylinder - Installing Clevis Pin on Lower End

7. Install a new C-clip on either end of the clevis pin. Ensure that the C-clip is seated in the groove of the clevis pin.

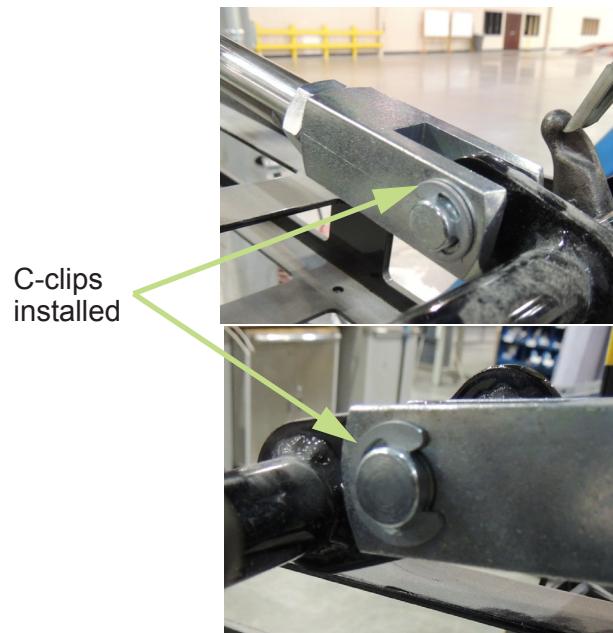


Figure 4-36. Main Cylinder - Installing C-clip

Replacing the Main Springs

The following procedure details how to properly remove and replace the Charge Arm Springs on the frame.



The Charge Arm Assembly is very heavy and requires a properly rated lifting device to lift and position the unit. Follow all site-specific requirements for moving heavy objects when performing this installation.



- Ensure that the entire charging station is properly locked out and tagged to prevent unexpected energizing.
- Ensure that there are no service “Test Tags” near the Charge Station area.
- Turn off the Air Compressor and completely drain the air tanks.

Removing the Main Springs

Perform the following steps in order to properly and safely remove the Main Springs.

1. Following the Charge Arm strapping procedure, secure the movable portion of the charge arm to the fixed upper Charge Arm frame in order to prevent unintentional movement.
2. Remove the snap rings from both the lower and upper retaining bolts of the Main Spring.
NOTE: Do not reuse snap rings.

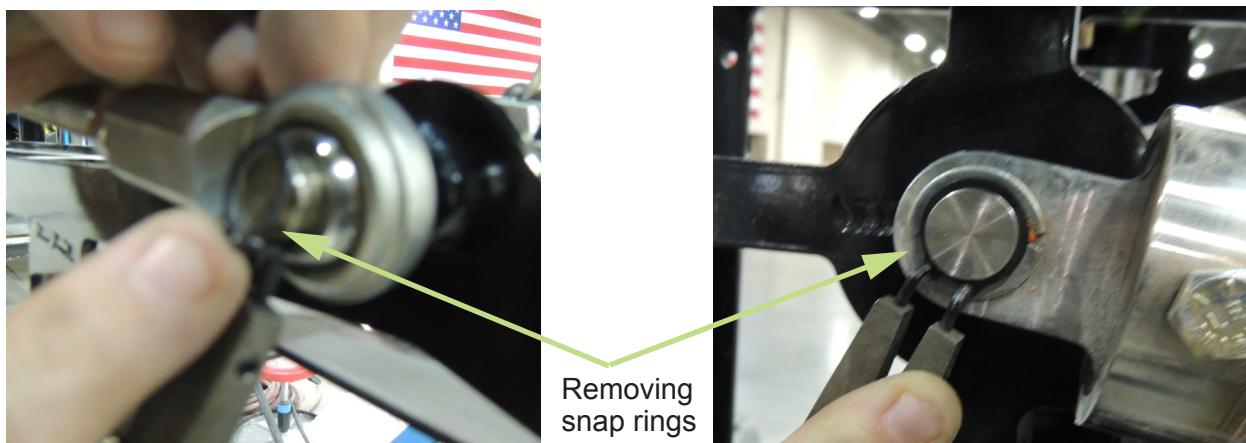


Figure 4-37. Main Spring Removal (1 of 2)

3. Slide the spring off the upper and lower retaining bolts.

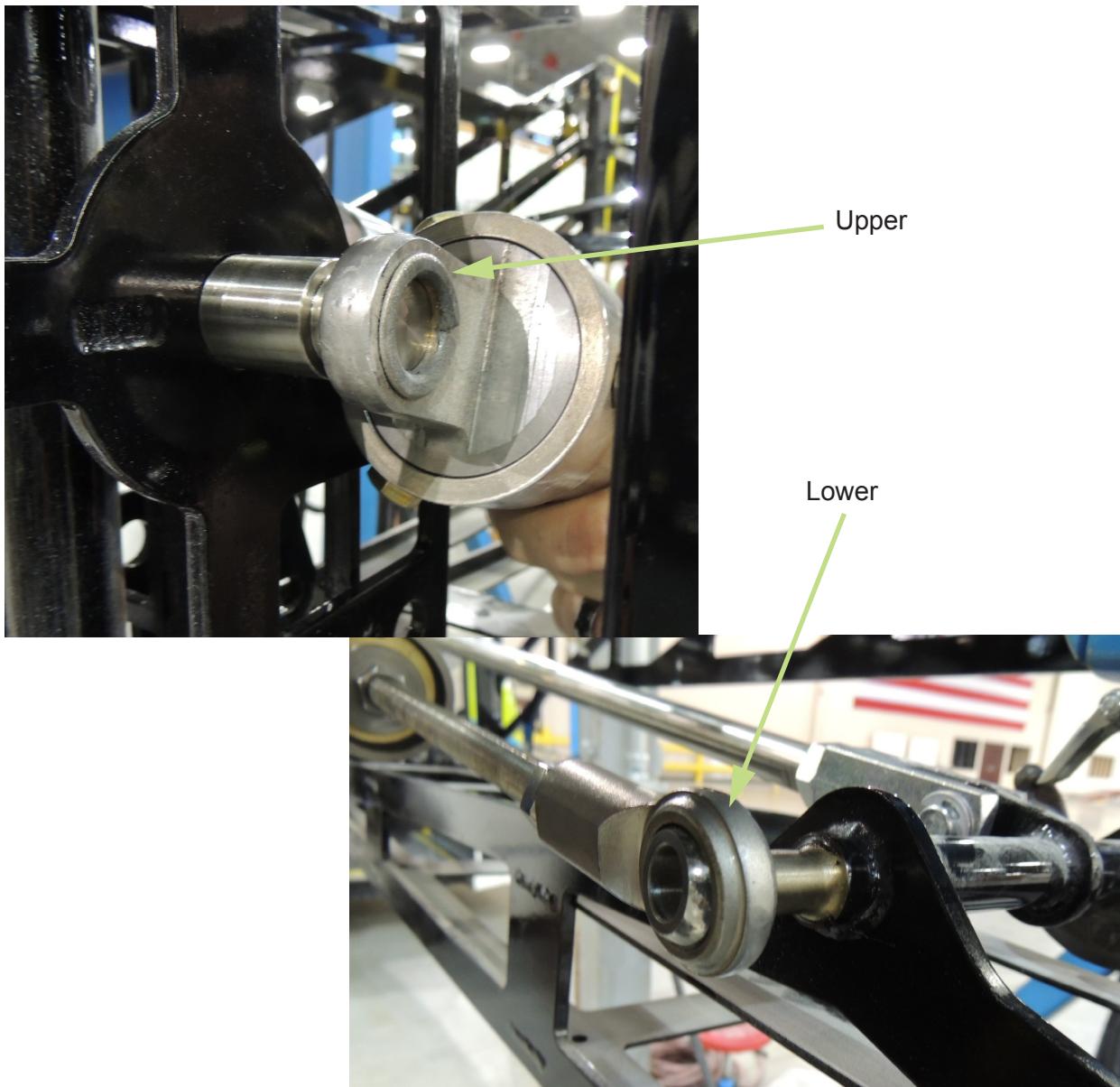


Figure 4-38. Main Spring Removal (2 of 2)

Installing the Main Springs

Perform the following steps in order to properly and safely install the Main Springs on either side of the Main Cylinder.

1. Following the Charge Arm strapping procedure, secure the movable portion of the charge arm to the fixed upper charge arm frame in order to prevent unintentional movement.
2. Install the spring by fitting the upper and lower ends over their respective retaining bolts.
NOTE: Ensure that the flat edge of the spring is against the frame.

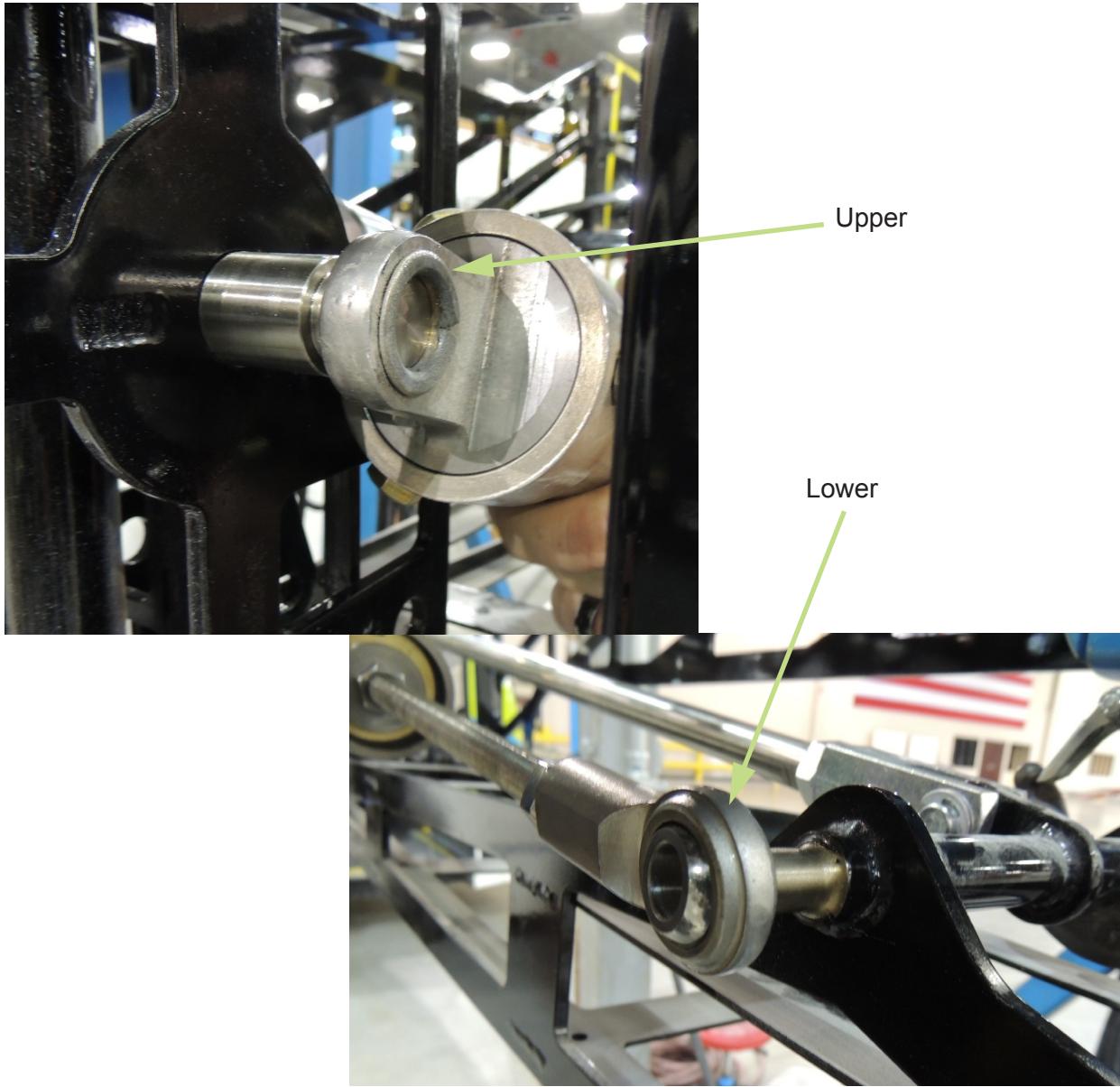
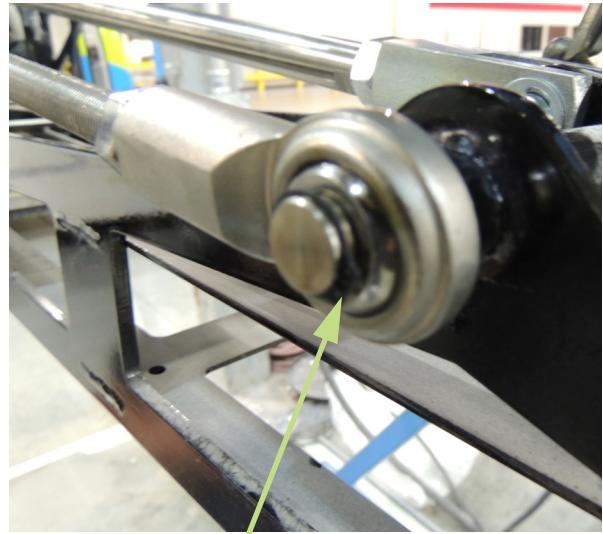


Figure 4-39. Main Spring Installation (1 of 2)

3. Install a new snap ring over the retaining bolt on the lower and upper ends. Ensure that the snap ring is seated in the retaining bolt's groove.



Installing snap ring



Snap ring seated

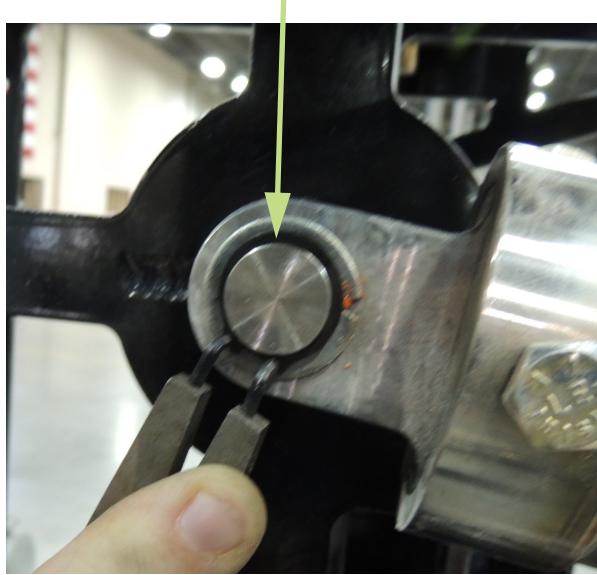


Figure 4-40. Main Spring Installation (2 of 2)

Replacing the Boat Unit

The following procedure should be performed to maintain proper performance of the Boat Unit and brushes for the On-Route Charge Station. This procedure should be performed when the brushes require replacement.

Removing the Boat Unit

Perform the following steps in order to properly and safely remove the Boat Unit.



Support the Boat Unit with a lift. If the Boat is not supported, it may fall as fasteners are removed.

1. Ensure the breaker is OFF and the proper lockout/tagout procedure has been followed.
2. Remove the eight (8) long screws for the HV Cable Covers.

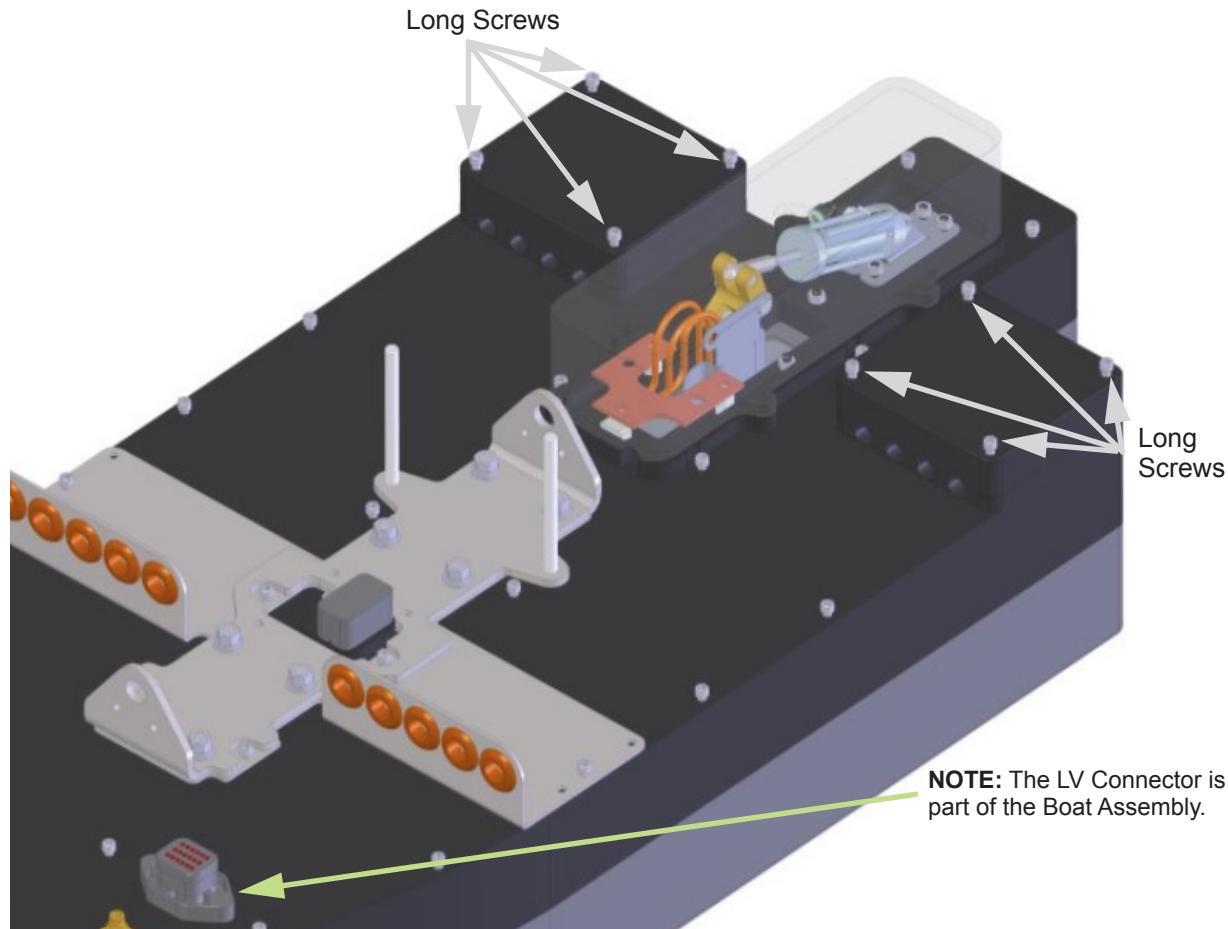


Figure 4-41. Removing Long Screws on Boat Unit

3. Remove the six (6) HV Lugs.

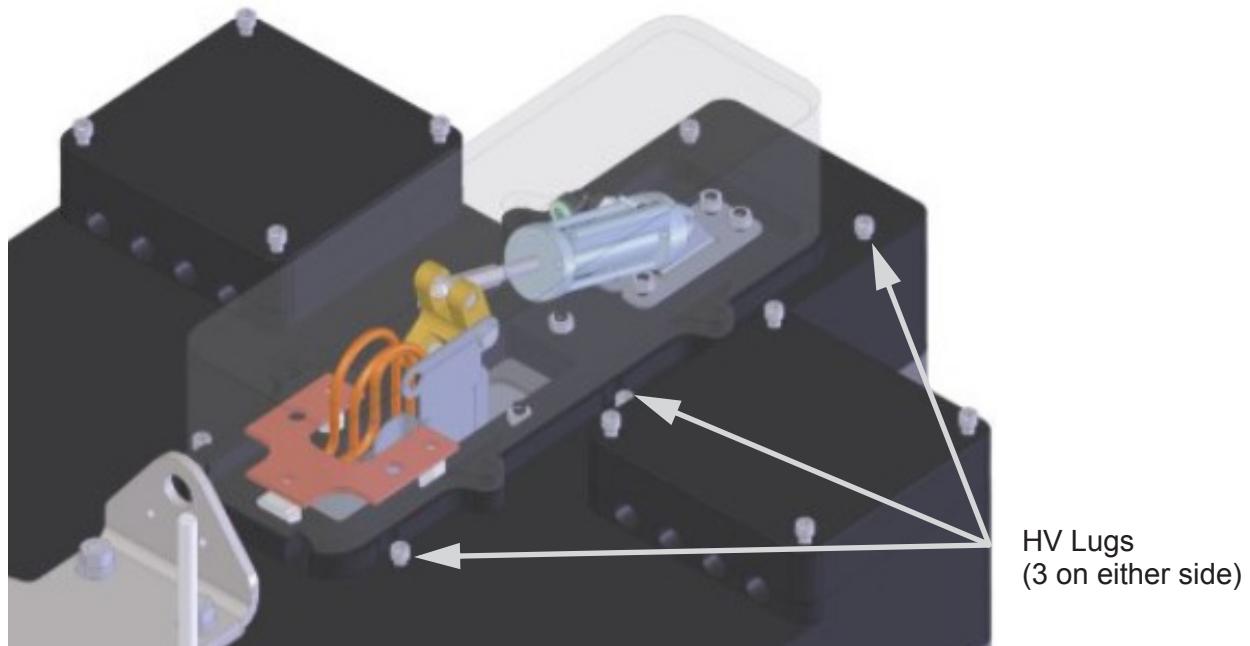


Figure 4-42. Removing HV Lugs on Boat Unit

4. Remove twelve (12) screws around the edge of the Charge Head.

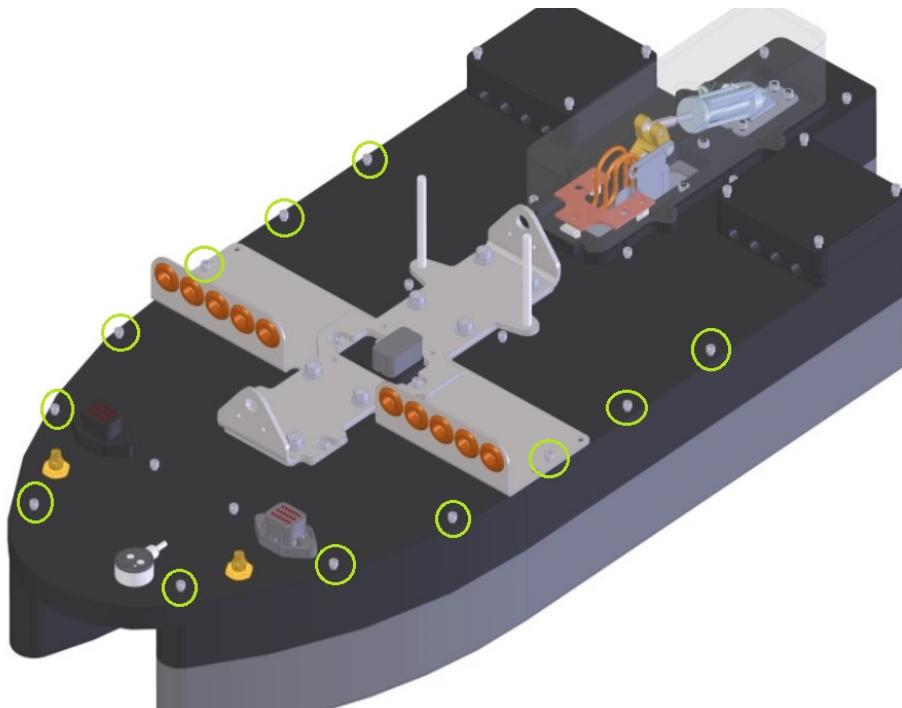


Figure 4-43. Removing Charge Head Screws

5. Remove the cover to the Boat Unit.
6. Disconnect the Harness Pigtail from the top of the Boat Unit.

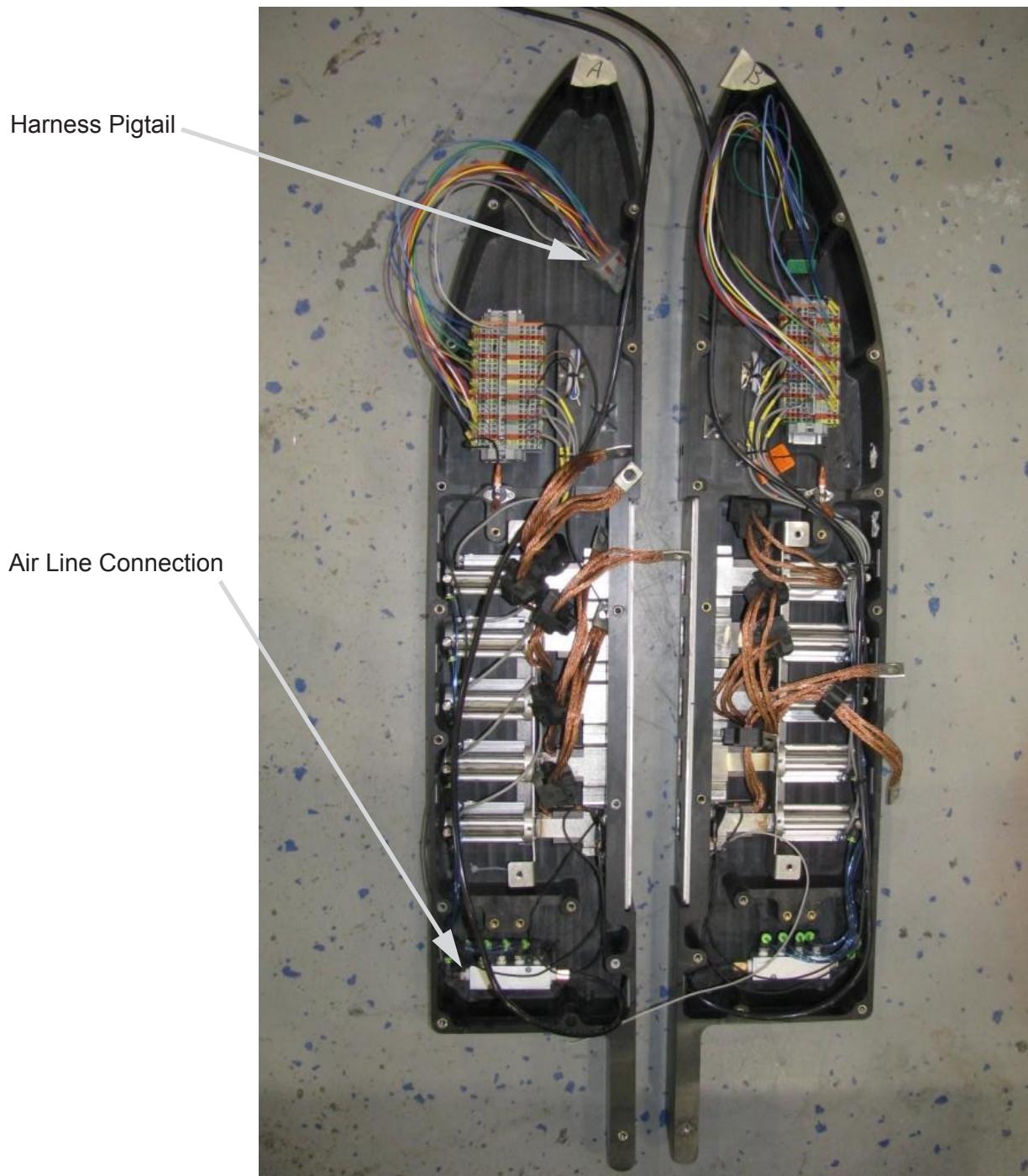


Figure 4-44. Actuation Brush Assembly - Disconnecting Harness Pigtail and Air Line Connection

7. Disconnect the airline.

Installing the Boat Unit

Perform the following steps in order to properly and safely install the Boat Unit.



Support the Boat Unit with a lift. If the Boat is not supported, it may fall as screws are being installed.

1. Ensure the breaker is OFF and the proper lockout/tagout procedure has been followed.
2. Connect the air line.
3. Connect the Harness Pigtail.

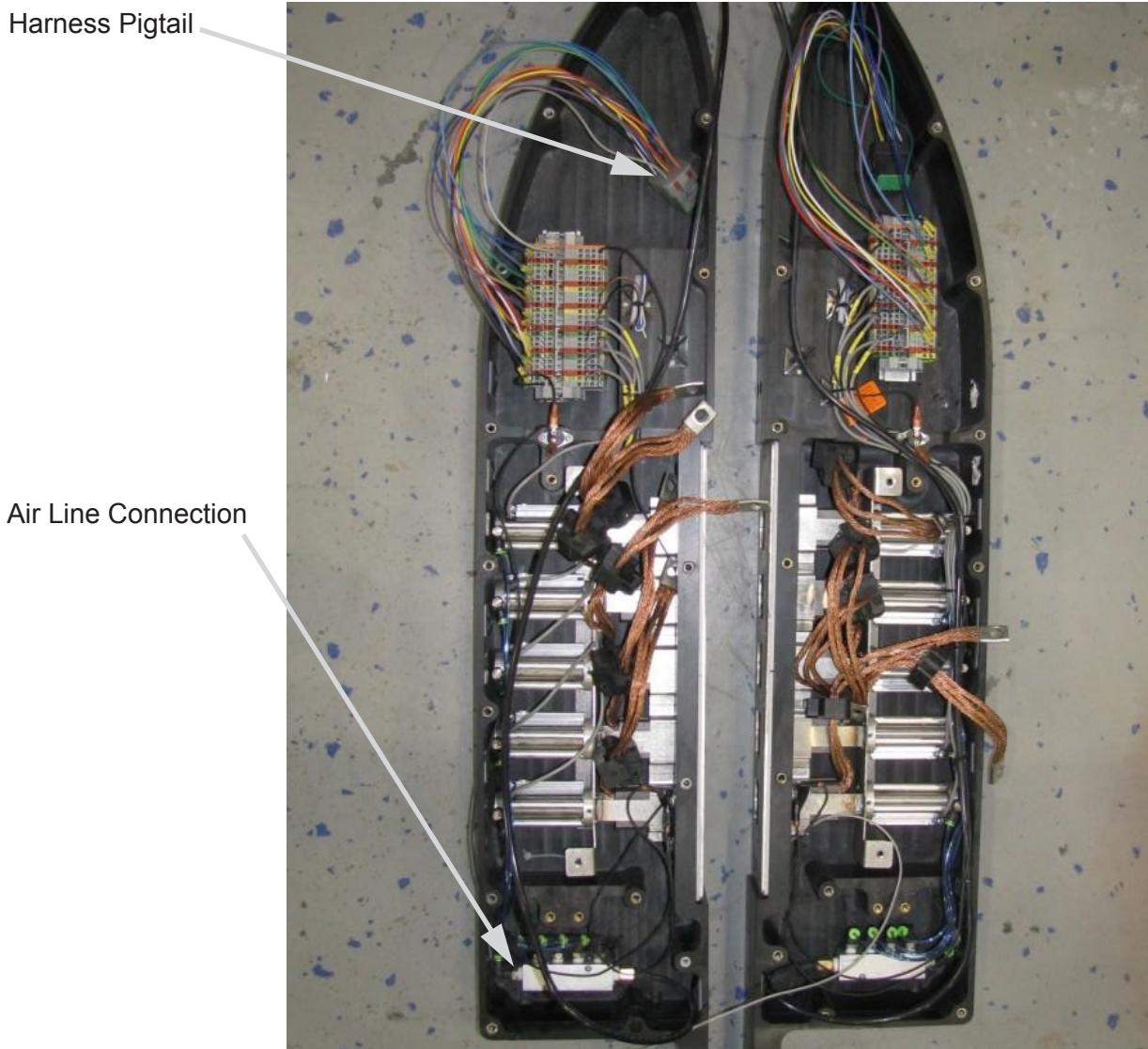


Figure 4-45. Actuation Brush Assembly - Connecting Harness Pigtail and Air Line Connection



Be careful not to pinch wires or kink airlines when reassembling the Boat Unit.

4. Replace the Boat Unit cover.
5. Install twelve (12) screws around the edge of the Charge Head.

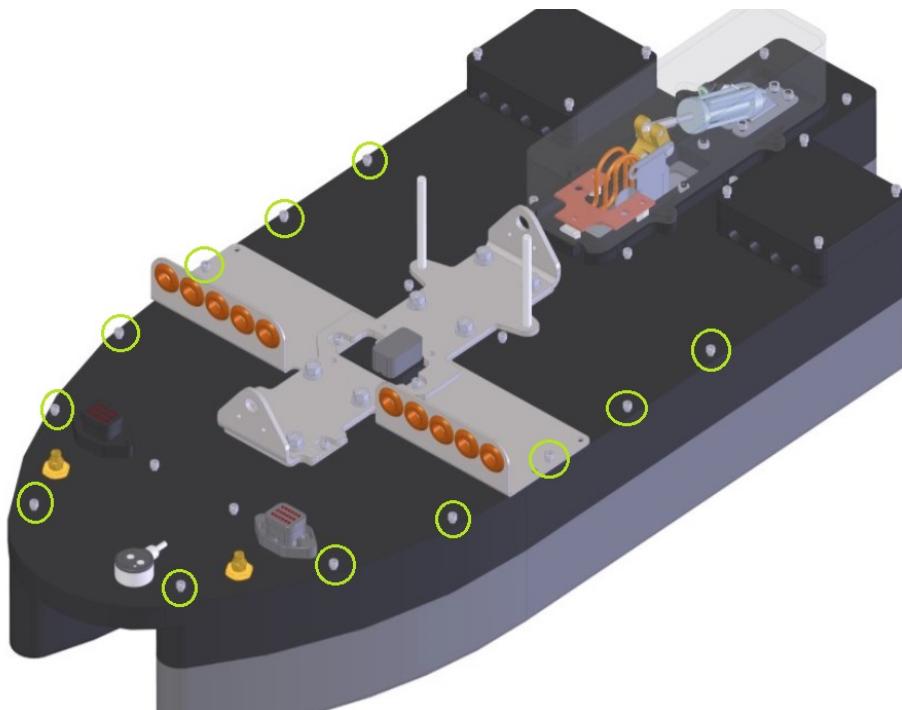


Figure 4-46. Installing Charge Head Screws



Do not over torque inserts. They can strip easily.

-
6. Install the six (6) HV Lugs.
-



Do not over torque.

CAUTION

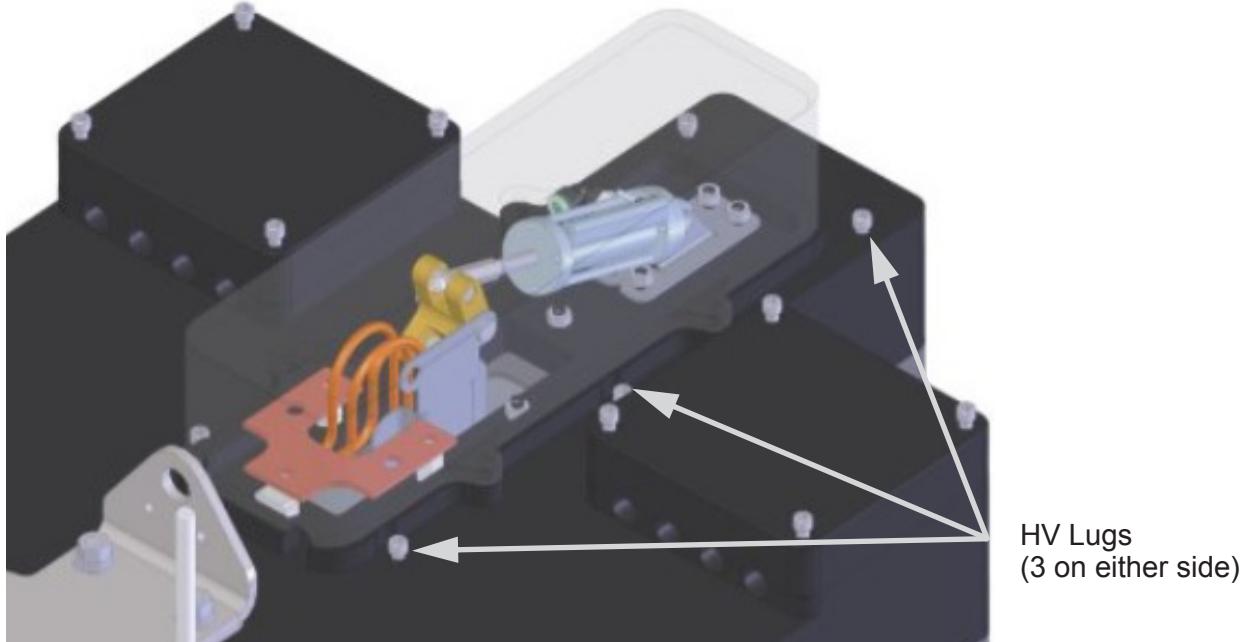


Figure 4-47. Installing HV Lugs on Boat Unit

7. Install the eight (8) long screws for the HV Cable Covers.

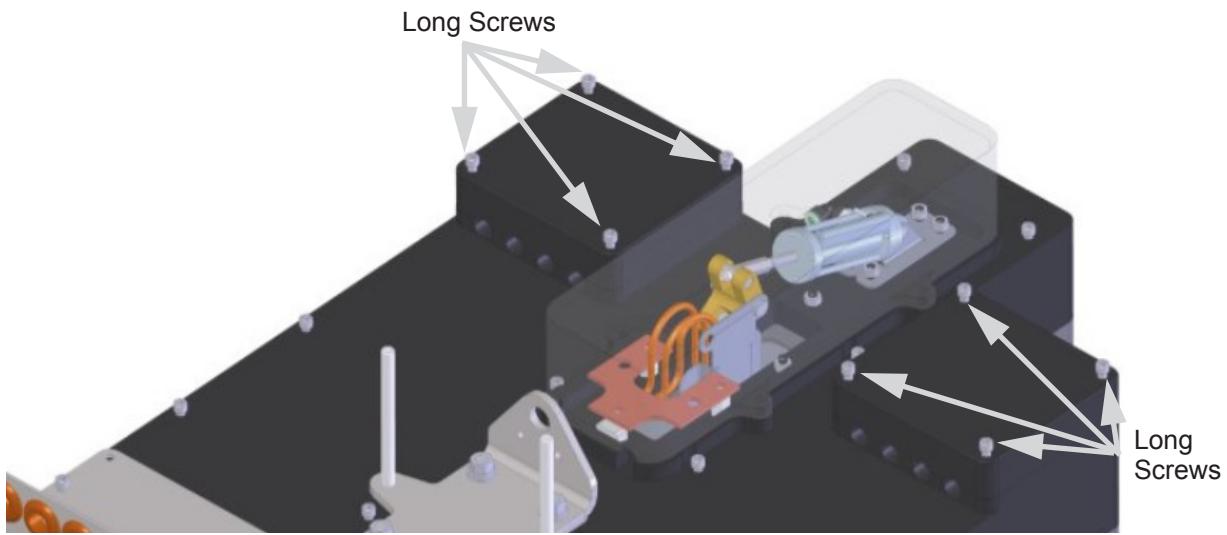


Figure 4-48. Installing Long Screws on Boat Unit

Replacing the Ground Brush

The following procedure should be performed to maintain proper performance of the Ground Brush (also called Neutral Brush) for the On-Route Charge Station. This procedure should be performed when the ground brush requires replacement.

- Ensure that the entire charging station is properly locked out and tagged to prevent unexpected energizing.
- Ensure that there are no service “Test Tags” near the Charge Station area.
- Turn off the Air Compressor and completely drain the air tanks.



Removing the Ground Brush

Perform the following steps in order to properly and safely remove the Ground Brush.

1. Ensure the proper lockout/tagout procedure has been followed and that the Charge Head is completely de-energized.
2. Using a ratchet and 7/16" deep well socket, remove the ground brush assembly cover which is secured with four (4) 1/4-20 hex bolts, flat washers and lock washers.

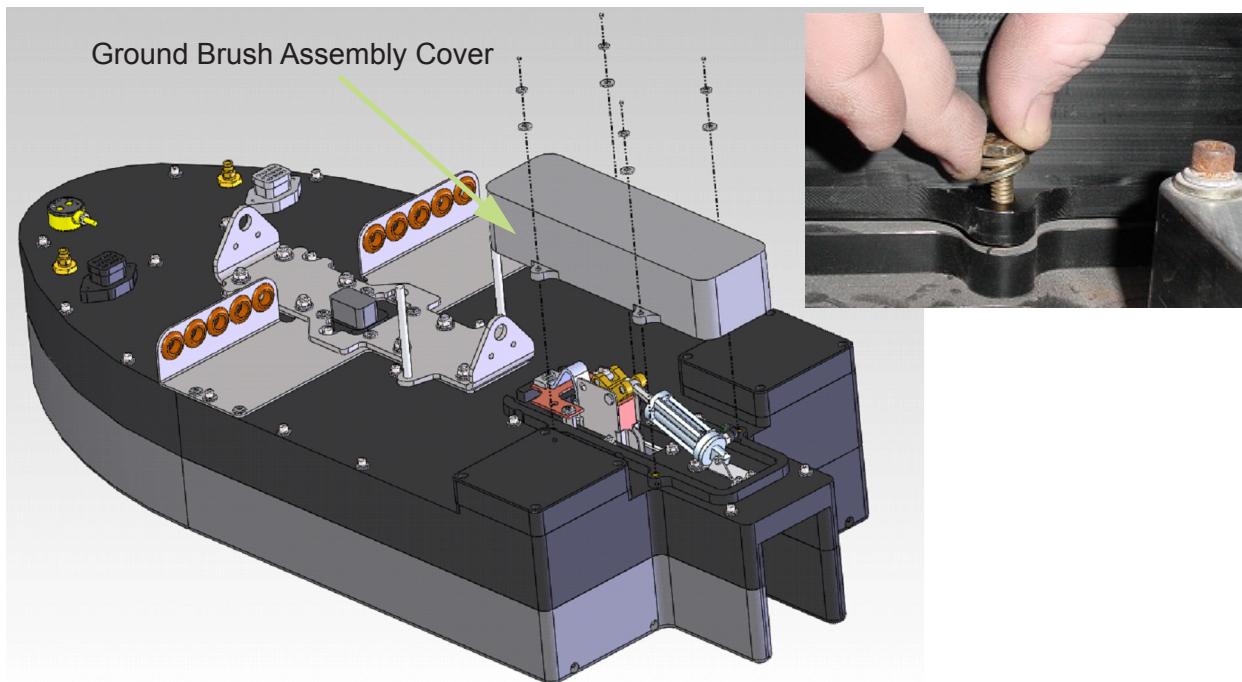


Figure 4-49. Removing Ground Brush Assembly Cover

- Using a ratchet and 7/16" deep well socket, loosen and remove the hex bolt, flat washer and lock washer securing the ground brush cable lug to the buss bar.

Note: The standoff located below the buss bar should not rotate when removing the hex bolt, but if it does, use an open-end wrench or pliers to prevent movement while removing the hex bolt.

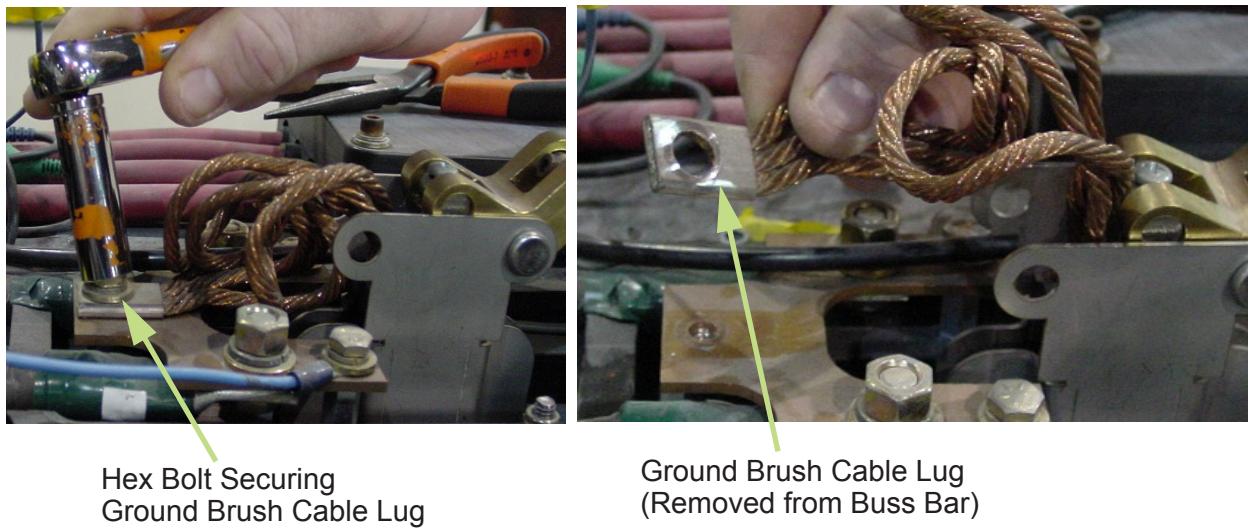


Figure 4-50. Ground Brush Cable Lug

- Using pliers, straighten the bent ends of the cotter pin and remove the cotter pin from the ground brush rocker clevis pin.

NOTE: Do not reuse the cotter pin.

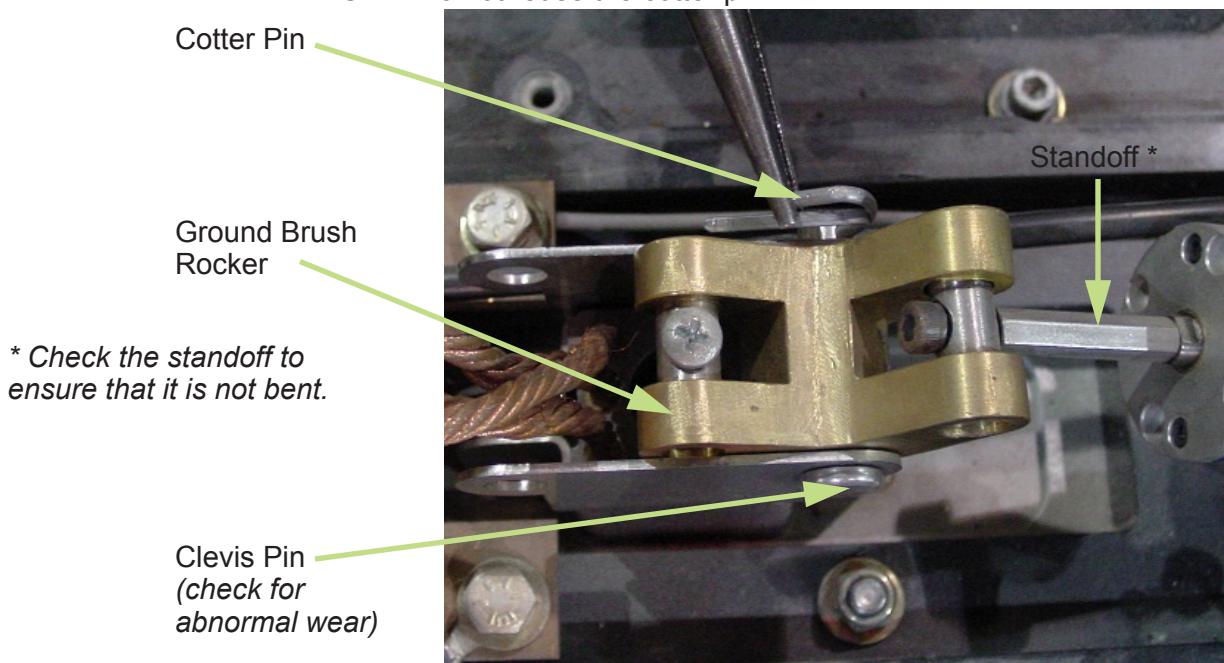


Figure 4-51. Ground Brush Rocker

5. Remove the Ground Brush Rocker Clevis Pin and carefully lift the Ground Brush from its mounting position.

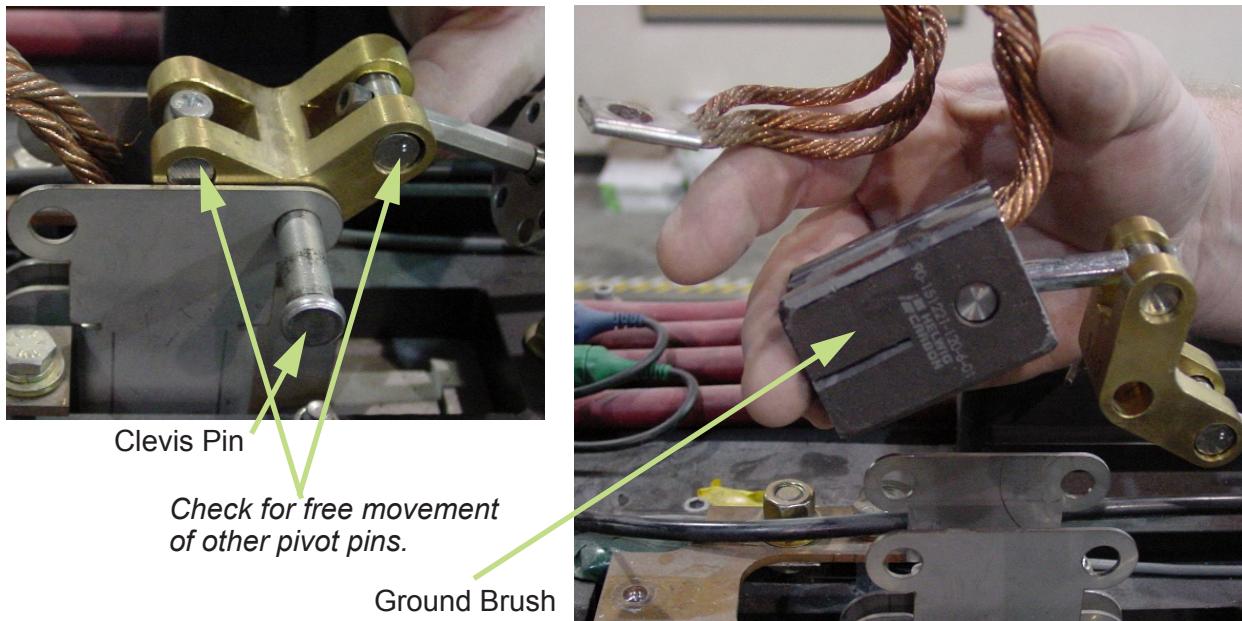


Figure 4-52. Removing Ground Brush Clevis Pin

6. Using a Phillips-head screwdriver, remove the screw securing the Ground Brush Pivot Pin and Standoff.

Note: The standoff and pivot pin will be loose when the screw is removed, ensure that they are not lost.

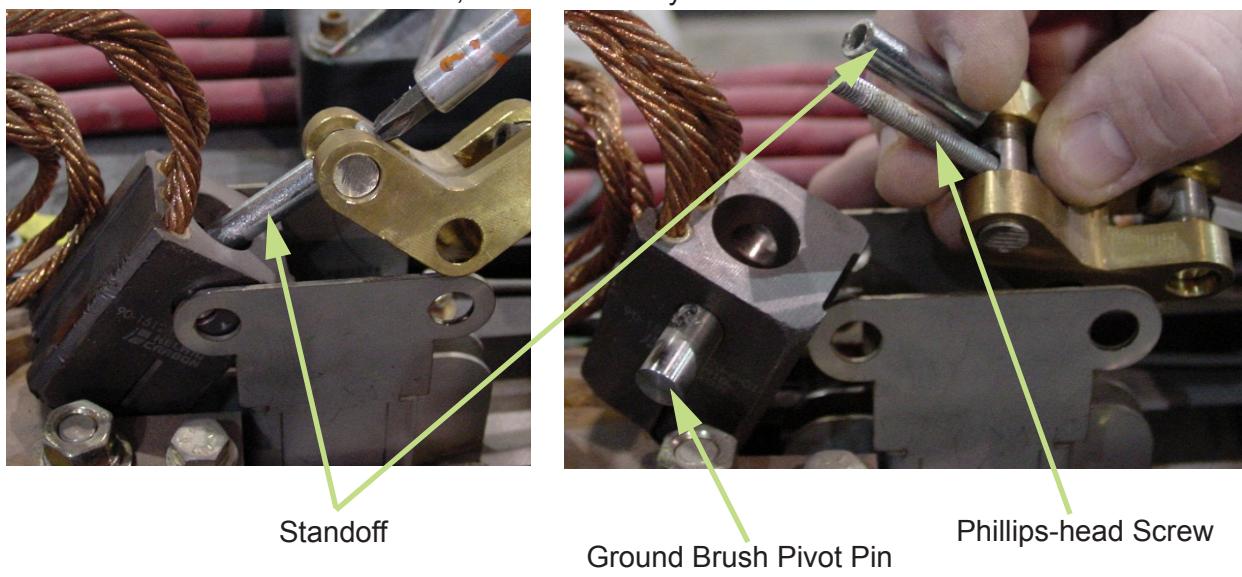


Figure 4-53. Removing Ground Brush Standoff and Pivot Pin

7. Remove the Pivot Pin from the existing Ground Brush and place the existing Ground Brush aside for return to Proterra Engineering.

Installing the Ground Brush

Perform the following steps in order to properly and safely install the Ground Brush.

1. Insert the Ground Brush Pivot Pin into the new Ground Brush.

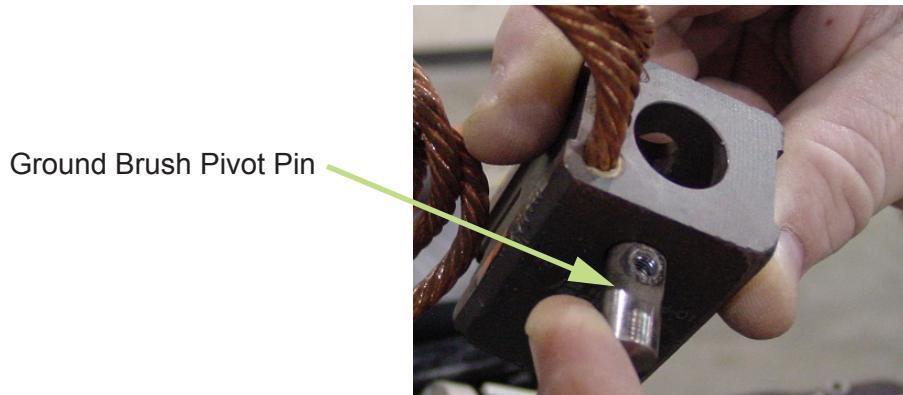


Figure 4-54. Installing Ground Brush Pivot Pin

2. Slide the standoff over the Phillips-head screw and then, using a Phillips-head screwdriver, tighten the screw into the Ground Brush Pivot Pin. Be careful not to over tighten the screw.

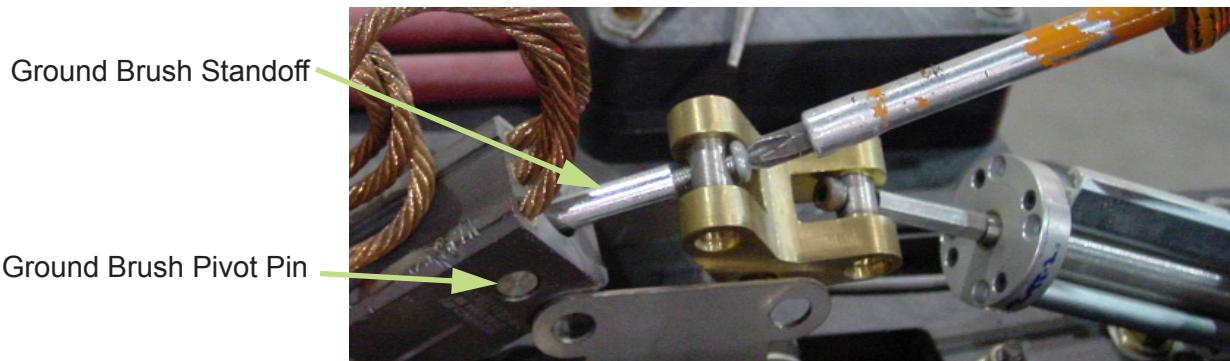


Figure 4-55. Securing Ground Brush Standoff and Pivot Pin

3. Insert the new Ground Brush into position and insert the clevis pin through the Ground Brush Rocker.

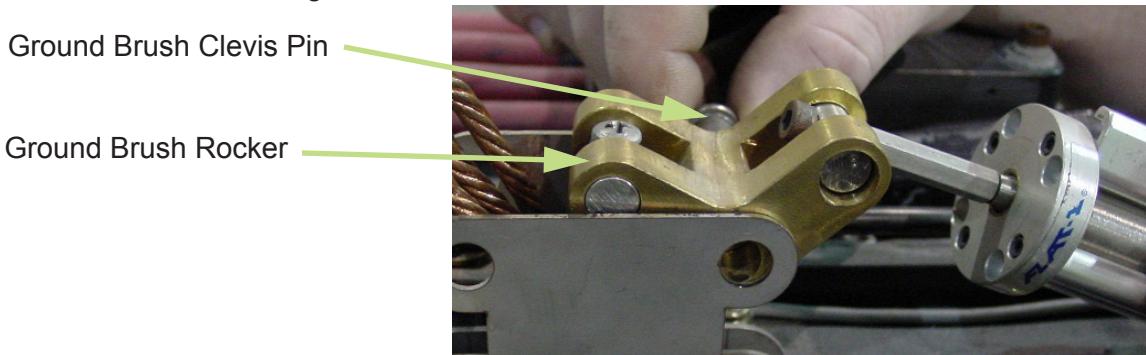


Figure 4-56. Installing Ground Brush Rocker

4. Install a new Cotter Pin through the hole in the Clevis Pin and bend the ends to secure the Cotter Pin.

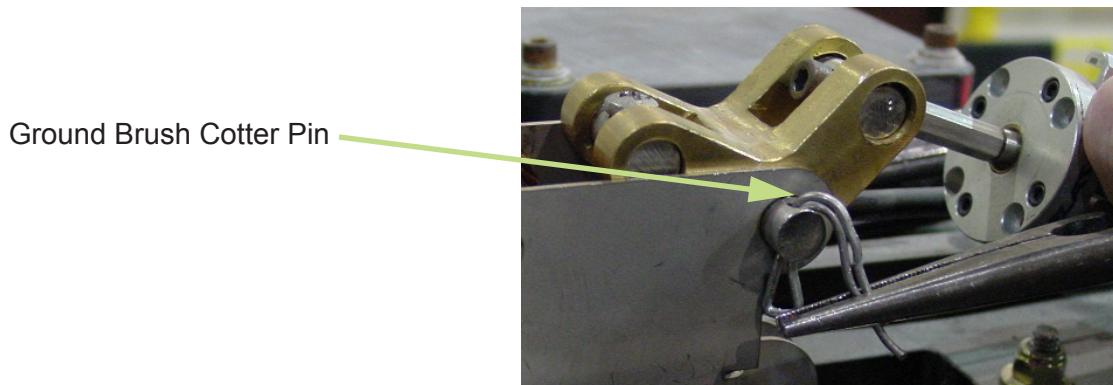


Figure 4-57. Installing Cotter Pin

5. Position the Grounding Cable Lug and install the hex bolt, flat washer, and lock washer used to secure the Lug to the Buss bar.

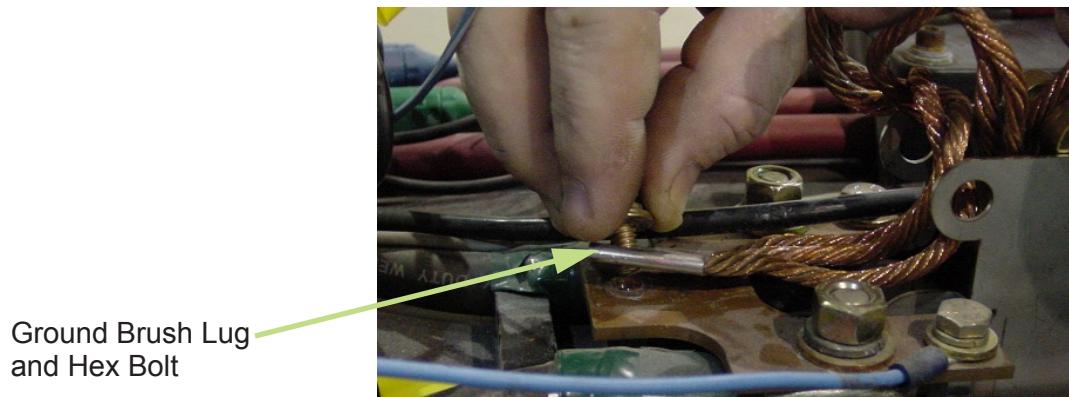


Figure 4-58. Installing Ground Brush Cable Lug

6. Using a ratchet and 7/16" deep well socket, tighten the hex bolt securing the ground brush cable lug to the buss bar.

Note: Use an open-end wrench or pliers to hold the standoff below the buss bar, if needed. Be careful not to over tighten the bolt.

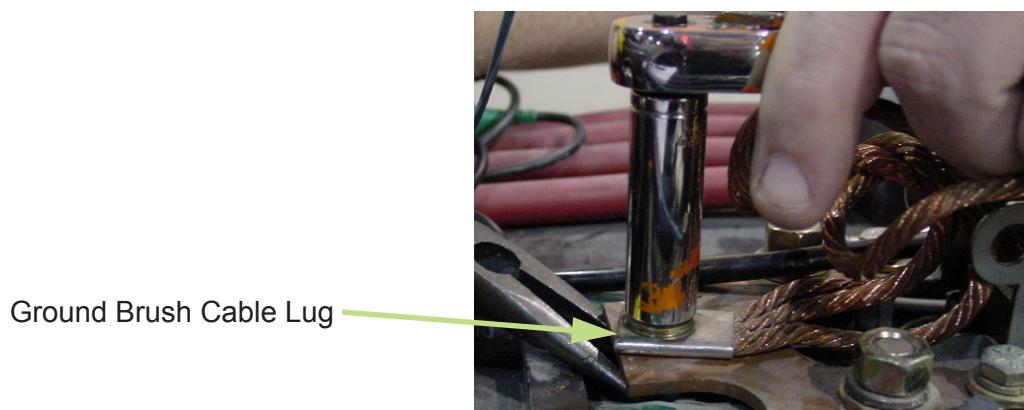


Figure 4-59. Tightening Ground Brush Cable Lug

7. Using your fingers, rock the Ground Brush back and forth to ensure that it moves freely before putting the Cover back on.
8. When placing the Cover back over the Ground Brush, ensure that the cover does not interfere with the movement of the Ground Brush.
9. Using a ratchet and 7/16" deep well socket, install the Ground Brush Assembly Cover using the four (4) hex bolts, flat washers, and lock washers.
IMPORTANT! Ensure that the cover is positioned to allow the wires to pass through the openings. Shift the cover side-to-side slightly so that the cover sits completely flush with the surface of the Charge Head.

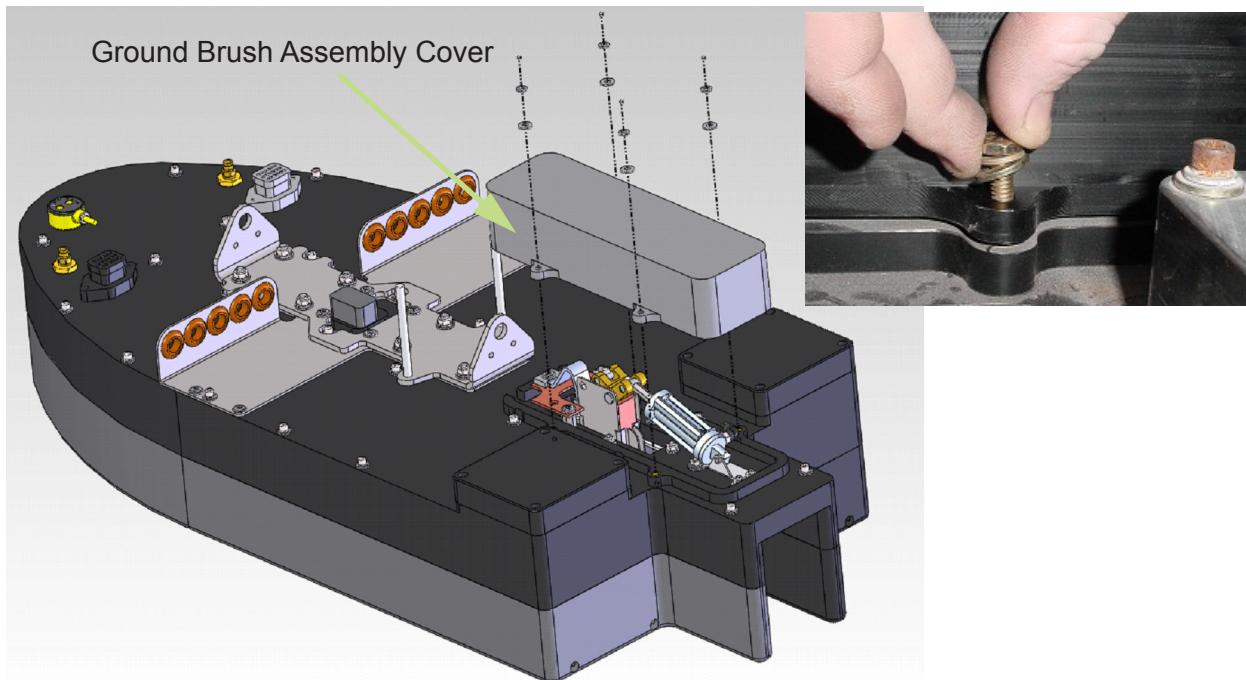


Figure 4-60. Installing Ground Brush Assembly Cover

10. Put the removed Ground Brush into a plastic bag and write the removal date and the Charge Station number on the bag. Return the removed Ground Brush to Proterra Engineering.

Replacing the Pilot Brush

The following procedure should be performed to maintain proper performance of the Pilot Brush for the On-Route Charge Station. This procedure should be performed when the brush requires replacement.

Perform the following steps in order to properly and safely replace the Pilot Brush.

1. Ensure the breaker is OFF and the proper lockout/tagout procedure has been followed.
2. The top of the Charge Head can be accessed via a number of means. Some methods involve taping an RFID test tag in a location so that the head will lower and stay down. The top can then be reached on a step ladder. Other methods involve accessing the Charge Head from the roof of a bus or by using a lift.



Safety first! DO NOT take for granted that the Head will stay down for sure, when using the RFID test tag method.

3. In the top center of the Charge Head, there is a black Delrin cover (1 inch by 1.5 inch by 2 inches). This cover is secured by a single Allen head screw. Because of the clearance above the screw, use a standard Allen wrench rather than a bit and driver in order to remove the cover.

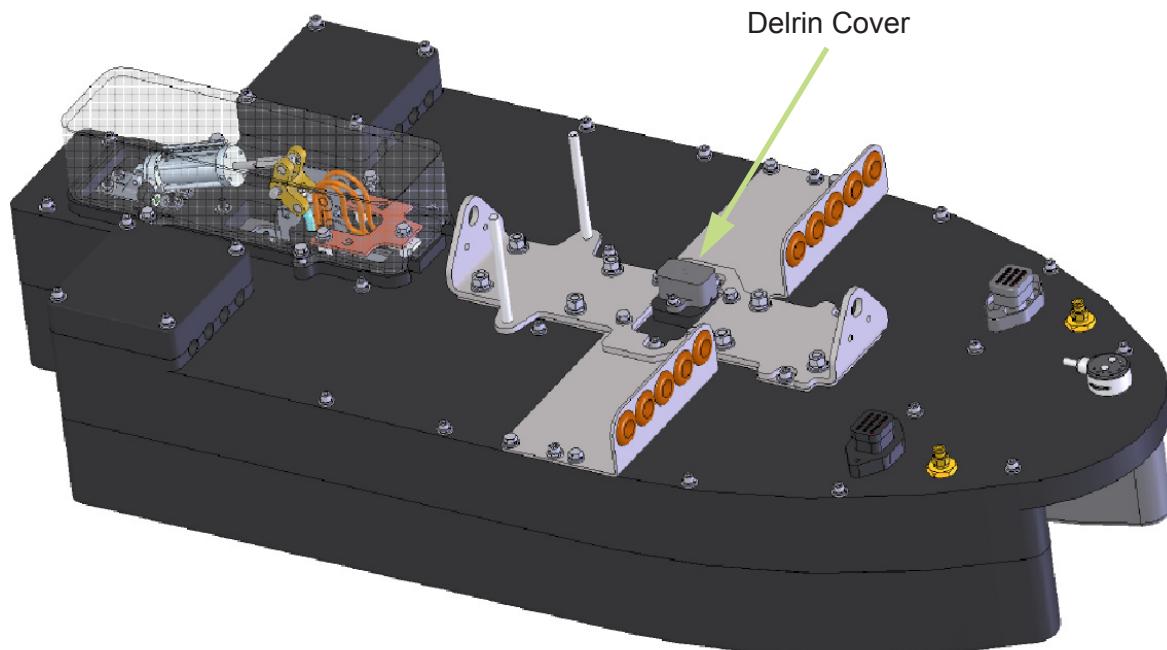


Figure 4-61. Delrin Cover Over Pilot Brush

4. After removing the cover, you'll see a ring terminal sandwiched between two nuts at the very end of a 1/4-20 threaded rod.
NOTE: It's important that these nuts remain at the very end of the threaded rod when performing the replacement.
5. As you remove these nuts, keep one hand underneath the Charge Head holding the pilot brush in order to prevent it from falling to the ground.
NOTE: The pilot brush has a light duty compression spring between the actual brush and the bottom of the Charge Head. Please be aware of this spring.

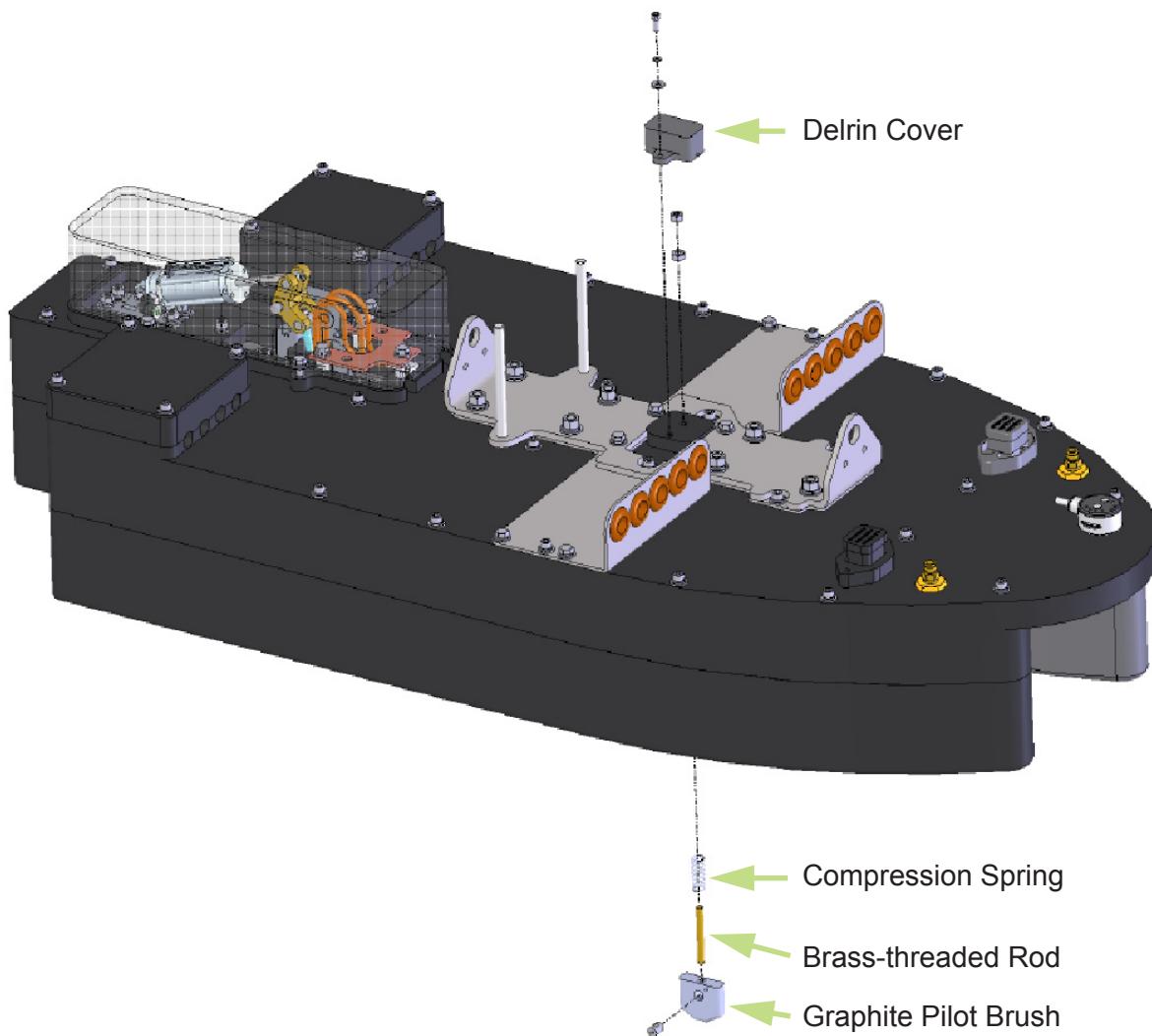


Figure 4-62. Pilot Brush Compression Spring

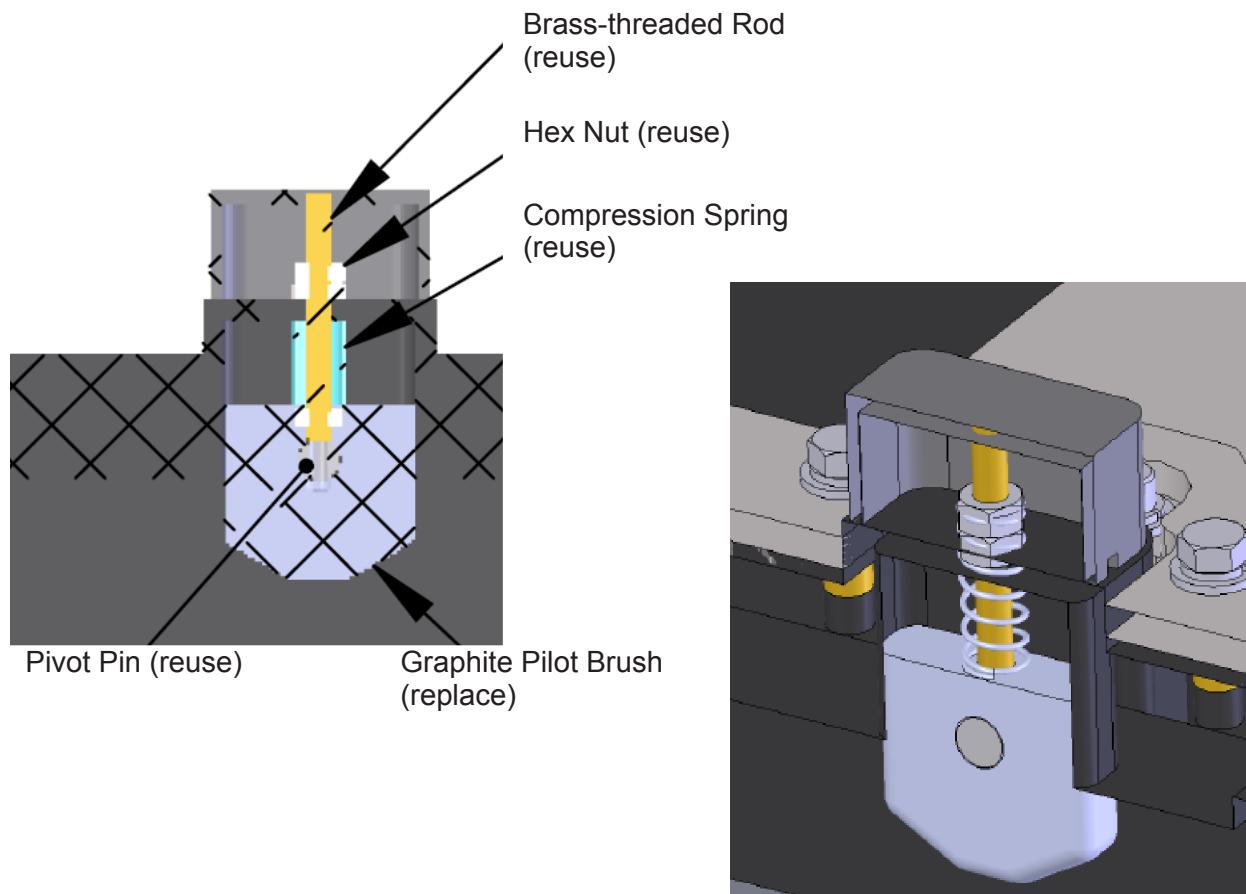


Figure 4-63. Pilot Brush Assembly

6. The 1/4-20 threaded rod should be threaded into a short Pivot Pin that goes through the graphite pilot brush.
7. Unscrew the threaded rod from the Pivot Pin, slide the Pivot Pin out and install it in the new graphite brush. Then re-thread the 1/4-20 rod into the new brush.
8. Put the spring on the 1/4-20 threaded rod and slide it back into the Charge Head from the bottom.
9. Reinstall the nuts sandwiching the ring terminal and torque them on each other. Ensure that they are at the very end of the threaded rod.
10. Reinstall the Delrin cover.

This page intentionally left blank.

Chapter 5: Calibration Procedures



CAUTION

Please note the various Warnings, Cautions, and Notes, which should be carefully read in order to minimize the risk of personal injury to maintenance personnel, and to prevent damage the charger, or render it unsafe.



WARNING

There are multiple power sources entering the charger and docking control equipment. Ensure you have the breaker off and follow the lock out tag out procedure specified in OSHA 29 CFR 1910 Subpart S.

Included in this chapter are the following calibration procedures:

- Calibrating the Ultrasonic Sensor
- Calibrating Head Up/Down Travel Rate
- Calibrating the Up/Down Position Sensors

Control Box Pressure Regulator Values

Reference the table below for the proper pressure regulator values in the control box.

Table 5-1: Charge Head Control Box Pressure Regulator Values

SOLENOID	CHARGE ARM PART	PRESSURE SETTING
SLD6-8	Arm Cylinders	90
SLD9	Charge Brushes	50
SLD10	Neutral Brush	50

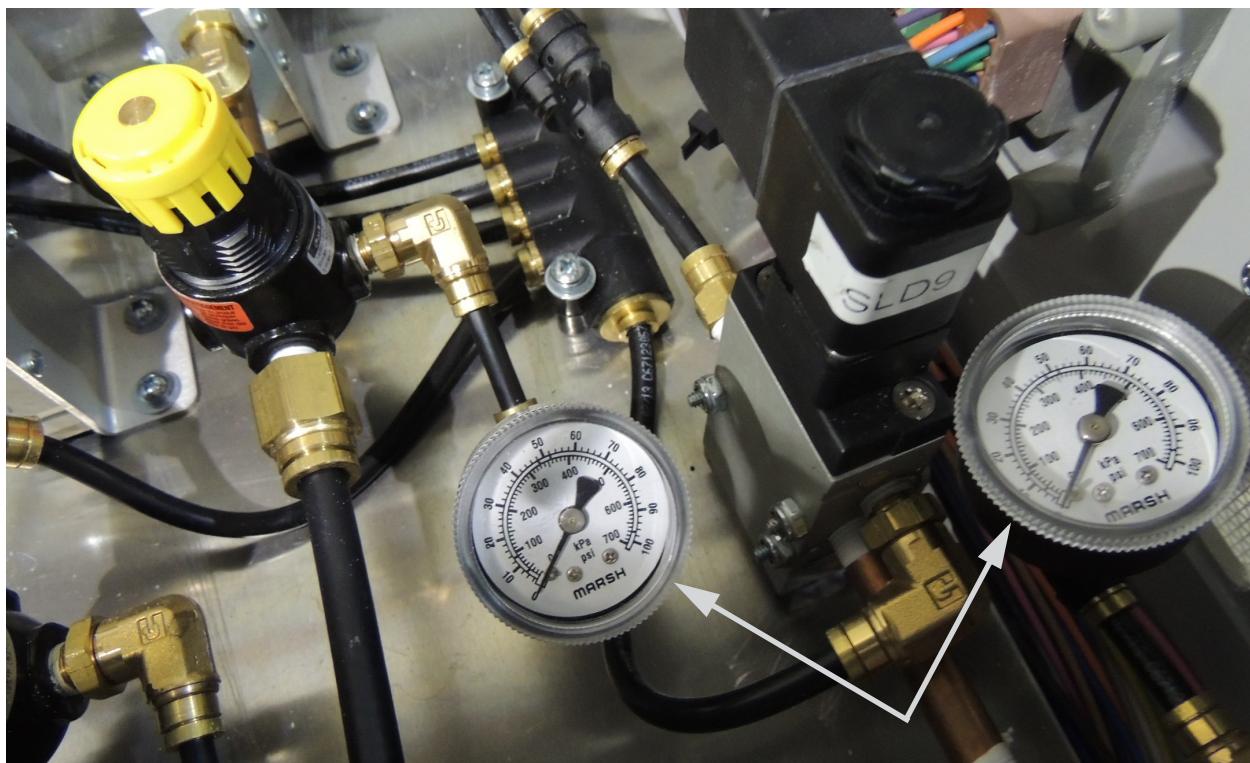


Figure 5-1. Control Box Pressure Regulator Gauges

Calibrating the Ultrasonic Sensor

The following procedure should be performed to properly calibrate the Ultrasonic Sensor for the On-Route Charge Station.

1. Ensure the On-Route charging system is powered up.
2. Disable high voltage supply by turning off the charger circuit breaker.
Note: Low voltage functions should still be operational.
3. Use normal procedure to gain access to the charge head assembly.
 - a lift
 - a ladder
 - temporarily securing the RFID test tag to the front of the canopy
4. Locate yellow and black ultrasonic sensor.
5. Physically remove ultrasonic sensor by unscrewing plastic retaining nut from underside of charge head housing.
 - Leave it electrically connected to the existing harness.
 - Some zip-ties might need to be removed so that sensor can be moved around.
6. Verify the part number on unit.
7. Set up the work area so the target can be put in a position where the sensor can be "pointed" at it and it will be perpendicular to the sensor.
 - For one set point, target needs to be approximately 12 cm from sensor.
 - For another set point, the target needs to be approximately 90 cm from the sensor.
 - Target needs to be angled such that ultrasonic sound emitted from sensor will reflect directly back to sensor. This means the target must be flat to the sensor.

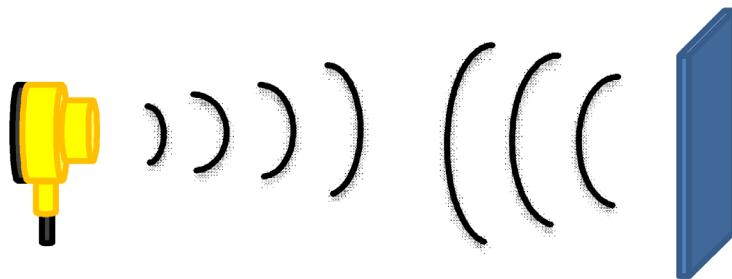


Figure 5-2. Setting up the Ultrasonic Sensor and Target

8. Put the sensor into mode calibration by holding the "MODE" button for greater than 2 seconds.
 - The power LED should turn off and the Amber Mode LED will indicate previously selected response speed.



Figure 5-3. "MODE" button

9. Toggle the "MODE" button to select "SLOW" response.
 - The Amber Mode LED will indicate the selected response speed.
 - There is a time-out if no response is received in 120 seconds.
10. Push and hold the "MODE" button for greater than 2 seconds to save the settings.

11. Put the sensor into analog calibration by holding the "ANALOG" button for greater than 2 seconds.

- The power LED should turn off and the output LED should turn on.



12. Hold the target 12 cm from the front of the sensor.

- The Signal LED should be on or flashing red.

13. Push the "ANALOG" button to store the distance.

- There is a time-out if no response is received in 120 seconds.
- When the distance is stored, the output LED will flash.

14. Position the target 90 cm from the front of the sensor.

- The Signal LED should be on or flashing red.

15. Push the "ANALOG" button to store the distance.

- There is no time-out response for this setting.
- When the distance is stored, the power and output LEDs will be on.

16. Put sensor back into position on the charge head and secure using plastic nut.

17. Replace any zip-ties that needed to be removed.

18. Remove any accessibility equipment such as ladders and lifts.

19. Re-energize HV system.

Calibrating Charge Head Up/Down Travel Rate

The following procedure should be performed to properly calibrate the Charge Head Up/Down Travel Rate for the On-Route Charge Station.

1. Ensure the On-Route charging system Low-Voltage is powered up.
2. Disable High-Voltage supply by turning off the charger circuit breaker.
NOTE: Low voltage functions should still be operational.
3. Access to the Charge Head assembly, using the normal procedure.
 - a lift
 - a ladder
 - canopy top access panel
4. Locate the two regulators with red collars in the rear corner of the Charge Head control box (shown below).

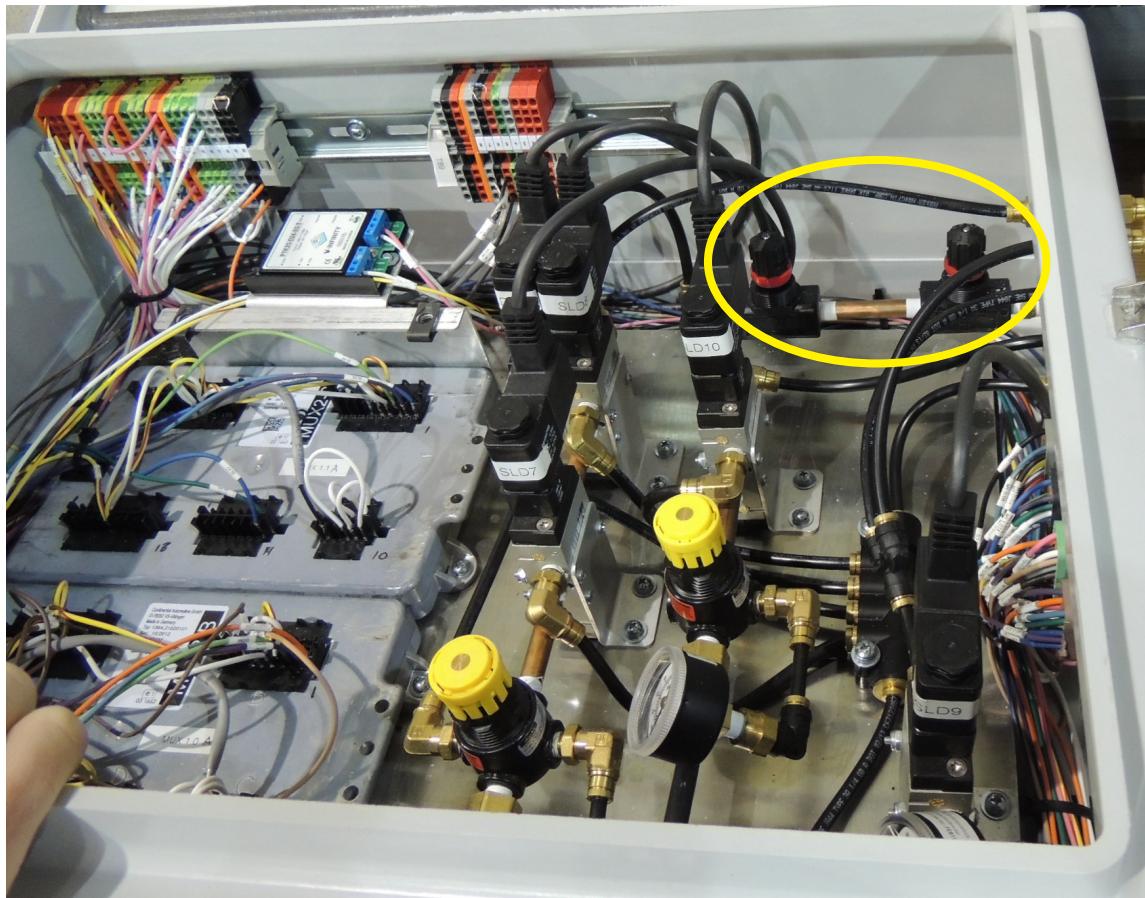


Figure 5-4. Charge Arm Up/Down Travel Rate Regulators

5. Lift the red collar in order to unlock the regulator for adjusting.
NOTE: The corner (right) regulator adjusts arm down speed. The left regulator adjusts arm up speed.

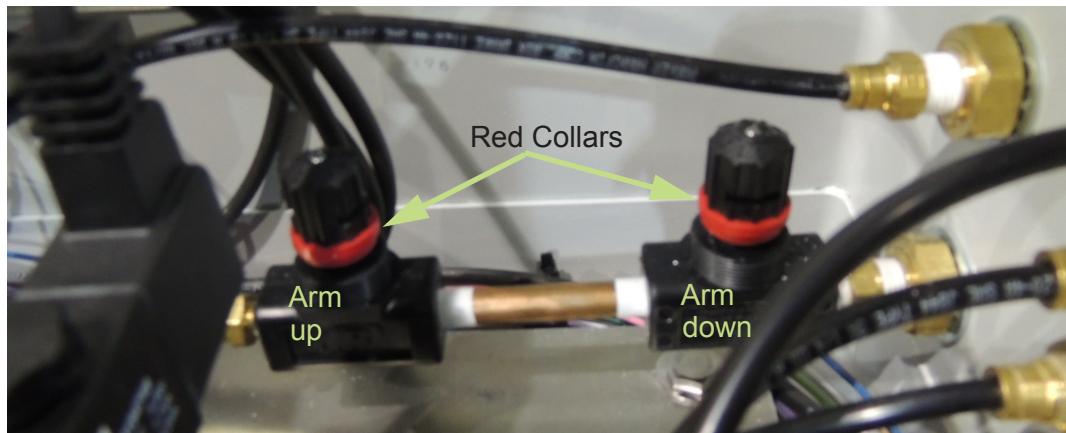


Figure 5-5. Charge Arm Travel Rate Regulators - Red Collars

6. Adjust the knob(s) by quarter turns. Turning the knob to the right (clockwise) will decrease pressure. Turning the knob to the left (counterclockwise) will increase pressure. After each adjustment, actuate the Charge Arm using the test tag and observe the travel rate.
7. Continue adjusting each regulator and actuating the Charge Arm until the desired travel rate is reached.
NOTE: When turning the regulators, you will see stripes of color through the sight glass. Typically, the best travel rate will be reached when the blue or green stripe is visible.

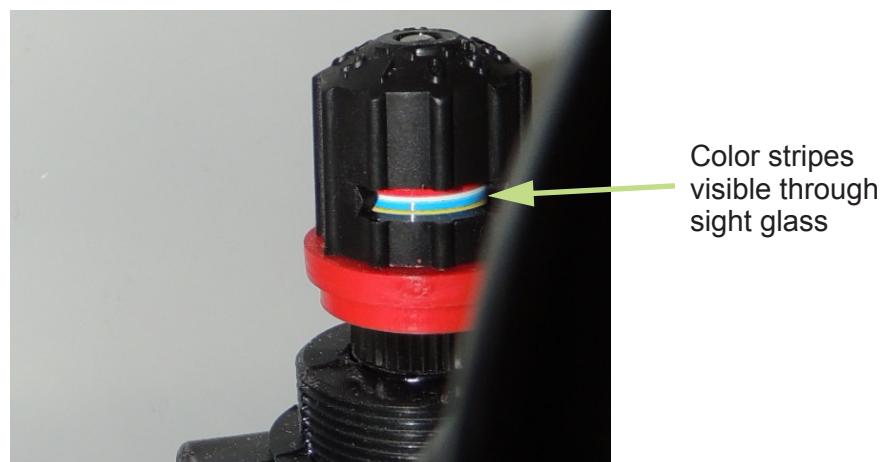


Figure 5-6. Charge Arm Travel Rate Regulators - Color Stripes

8. Once the desired Charge Arm travel rate has been reached, push the red collars down into the locked position.

Calibrating the Charge Arm Up/Down Position Sensors

The following procedure should be performed to properly calibrate the Charge Arm Up/Down Position Sensors for the On-Route Charge Station.

1. Ensure the On-Route charging system is powered up.
2. Disable high voltage supply by turning off the charger circuit breaker.
- Note:** Low voltage functions should still be operational.
3. Use normal procedure to gain access to the charge head assembly.
 - a lift
 - a ladder
4. Locate the Arm Up and Arm Down sensors on the air cylinder.
5. Orient the Arm Up and Arm Down sensors as shown in the figure below.
 - Ensure the Arm Up sensor is closer to the pole side than the Arm Down sensor.
 - It might be necessary to remove the clamp(s) to re-orient the sensors.

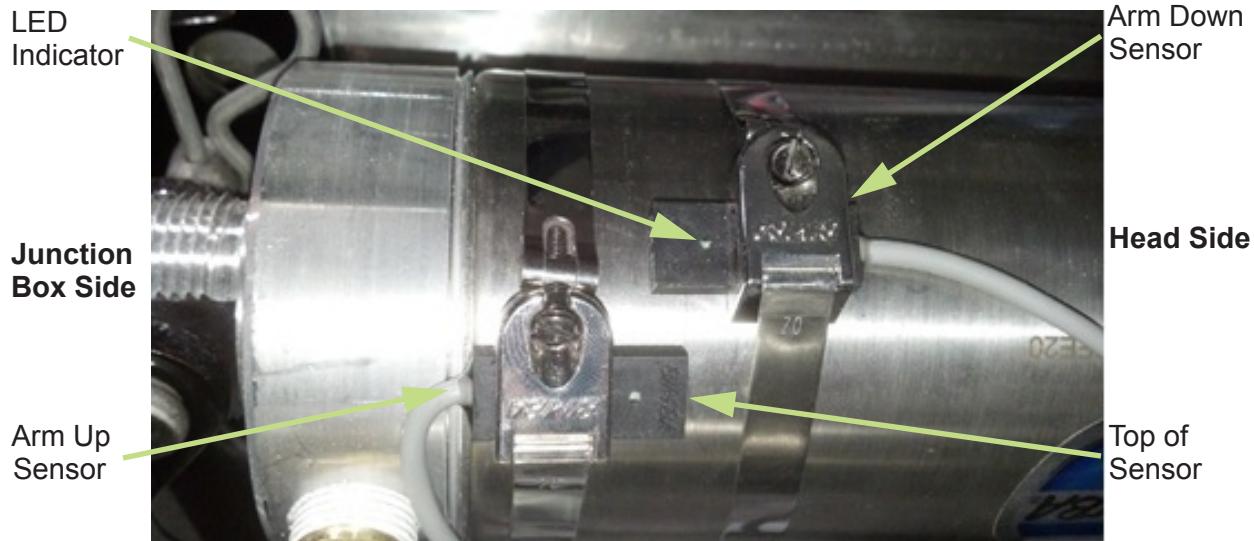


Figure 5-7. Charge Arm Up/Down Position Sensors

6. Ensure the charge head is in the home position before proceeding.

7. Position the Arm Up sensor as shown in the figure below.

- Use a permanent marker to mark the top of the sensor at each edge of the sensor range.
- Move the sensor lengthwise along the air cylinder until the LED illuminates.
- Slowly move the sensor towards the Pole Side until the LED goes off. Mark the location of the top of the sensor.
- Move the sensor towards the Head Side until the LED illuminates.
- Slowly move the sensor towards the Head Side until the LED goes off. Mark the location of the top of the sensor.
- Secure the Arm Up sensor 1/16" in from the Head Side edge of the sensor range. See figure below.
- Measure 1/16" from the Head Side edge mark in the previous step. This should be in between the 2 edge range marks. Mark this location.
- Position the top of the sensor at this mark.
- Secure the sensor.

- The sensor LED should be illuminated at the home position.

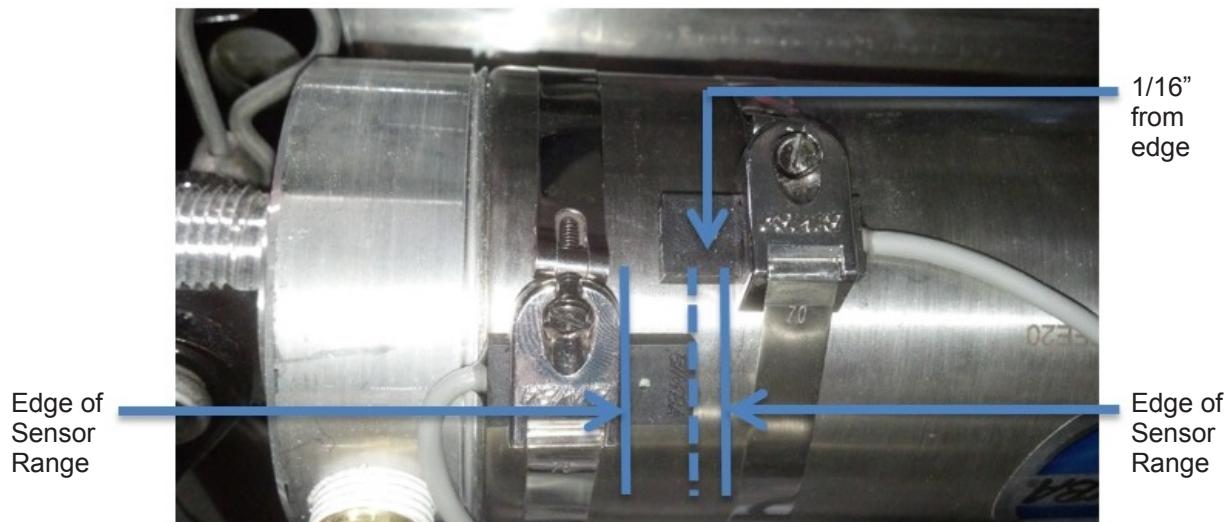


Figure 5-8. Positioning the Arm Up Sensor

8. Position the Arm Down sensor as shown in the figure below.

- Use a permanent marker to mark the top of the sensor at each edge of the sensor range.
- Move the sensor lengthwise along the air cylinder until the LED illuminates.
- Slowly move the sensor towards the Pole Side until the LED goes off. Mark the location of the top of the sensor.
- Move the sensor towards the Head Side until the LED illuminates.
- Slowly move the sensor towards the Head Side until the LED goes off. Mark the location of the top of the sensor.
- Secure the Arm Down sensor 1/8" out from the Head Side edge of the sensor range.
- Measure 1/8" from the Head Side edge mark in the previous step. This should be outside the 2 edge range marks. Mark this location.
- Position the top of the sensor at this mark.
- Secure the sensor.

- The sensor LED should not be illuminated at the home position.

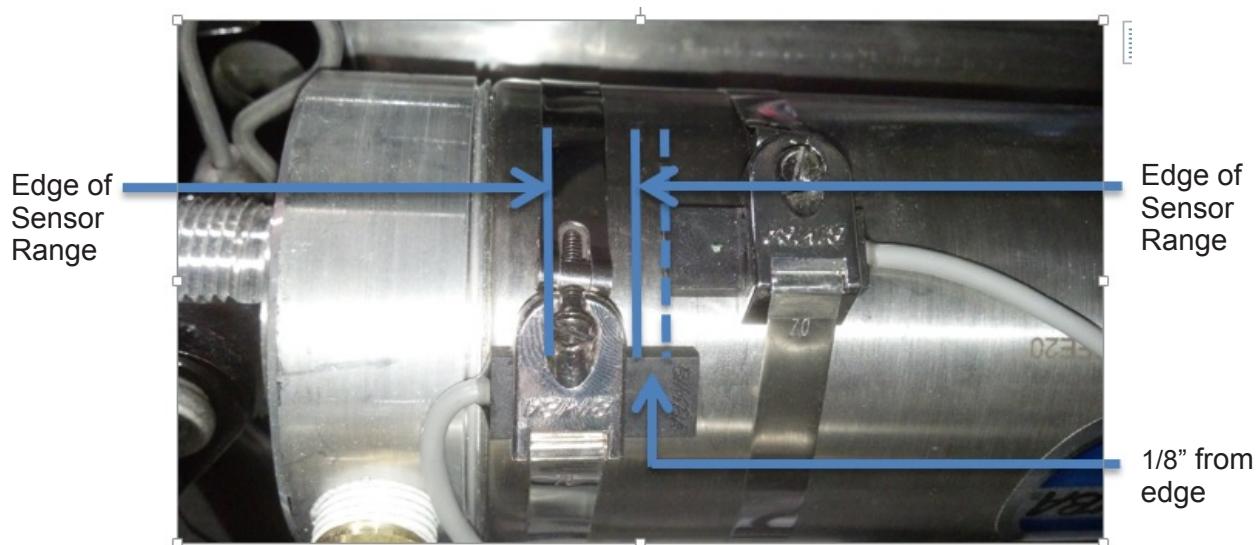


Figure 5-9. Positioning the Arm Down Sensor

9. Verify that the sensors are in the correct position.
 - In the home position, only the Arm Up sensor should be illuminated.
 - Pushing the head down approximately 1" should illuminate both sensors.
 - Pushing the head down approximately 1 ½" should illuminate only the Arm Down sensor.
10. Remove any accessibility equipment such as ladders and lifts.
11. Re-energize HV system.

This page intentionally left blank.

Chapter 6: Troubleshooting

Overview

The purpose of the troubleshooting section is to quickly identify the likely symptoms of problems, along with a preliminary resolution, encountered during normal operations. Part of troubleshooting involves understanding the stages of the docking and charging process and also interpreting the fault codes shown on the Driver's Display.



WARNING If the On-Route Charge Station exhibits any indication of hazardous problems, immediately consult the vendor manuals or contact the vendor directly for help.

Docking and Charging Stages

There are several stages involved in the docking and charging process. Each stage has exit criteria for both progressing to the next stage as well as aborting out of the docking and charging process. The following details the stages of docking and charging:

Docking Not Available: This is the first stage on startup and the first stage after abort. The bus remains in this stage until communication is established with the charge station.

Docking Available: This stage is only entered from “Docking Not Available” when wireless communication is established with the charge station. If the bus is in this stage and wireless communication is lost, the bus transitions right back to “Docking Not Available”. This stage does not transition to abort.

Docking Initiated: This stage is only entered from “Docking Available”. The bus must be in drive and a valid bus RFID sensor must be detected while there is nothing currently detected under the ultrasonic sensor. Manual charging must not be in process.

Positioning Started: This stage is only entered from “Docking Initiated”. Positioning Started is entered when the ultrasonic sensor detects the front of the bus.

Head Land Stop: This stage is only entered from “Positioning Started”. This stage is entered when the ultrasonic sensor detects the front edge of the scoop. The bus must be in Drive and the doors must be closed.

Head Landing: This stage is only entered from “Head Land Stop”. When the bus reaches a stop, and the doors remain closed, this stage is entered.

Final Positioning: This stage is only entered from “Head Landing” when the head landed detents are both triggered.

Extend Brushes: This stage is only entered from “Final Positioning” when the bus has traveled far enough that the head is positioned on the blade.

Head Docked: This stage is only entered from “Extend Brushes” when the proximity switch indicates that the head is in position over the blade.

Charge Ready: This stage is only entered from “Head Docked”. This stage is entered when charger senses the 24V pilot sent through the charge head and when the operator sets the park brake.

Charging: This stage is only entered from “Charge Ready”. This transition occurs when the charge mode of a connected charger reports that it is beginning the charge process.

Charge Completed: This stage is only entered from “Charging” when both of the chargers report charge finished and neither of them report charge failed.

Charge Process Abort: This stage is entered from a lot of different stages for a lot of different reasons. If an abort should occur during the docking process, the abort reasons will show up on the driver display. While the abort screen exists, a short moniker will appear in the lower left hand corner and a two-digit number will appear in the lower right-hand corner. This moniker/number pair is a code for the item that caused the fault. If more than one fault items coexist, then the display will cycle through them. At the end of each cycle, the screen will briefly show no fault codes. The operator must observe the screen for long enough to see the cycle of fault codes repeat. This will ensure that no fault codes are inadvertently missed.

Fault Codes and Causes

When a charge process is aborted a two-digit fault code number and a short moniker (name) will be shown on the Driver's Display. The following list details the Fault Code numbers, moniker, and the likely cause.

01 - Dock Fault Air Pressure - This fault is only caused if the air pressure sensor at the charge head is showing insufficient pressure.

02 - Dock Fault Arm Max Travel - Arm is reporting maximum travel. This is a sensor issue unless the arm is physically lowered as far as it will go. The arm that lowers the head has sensors on it to indicate that it is all of the way down or all of the way up. When a bus is present, the arm can't go all of the way down.

03 - Dock Fault Head Temp - Temperature sensors in the charge head show high temperature.

04 - Dock Fault Arm Not Home - Charge head arm should be completely seated in the up position, but the position sensor is not reporting that to be the case.

05 - Dock Fault Charge Brush Home - Charge brush sensors report that at least one of the charge brushes is in the home position when it should be extended.

06 - Dock Fault Charge Brush Not Home - Charge brush sensors report that at least one of the charge brushes is not in the home position when it should be parked in the home position.

07 - Dock Fault Neutral Brush Home - Neutral brush sensor reports that the neutral brush is in the home position when it should be extended.

08 - Dock Fault Neutral Brush Not Home - Neutral brush sensor reports that the neutral brush is not in the home position when it should be parked in the home position.

09 - Dock Fault High Voltage Relay Open - High voltage contactor in the distribution box is open when it should be closed.

10 - Dock Fault High Voltage Relay Closed - High voltage contactor in the distribution box is closed when it should be open.

11 - 16 Reserved - Reserved for fault where the operator should contact dispatch.

17 - Dock Fault Charger Error - Error messages are reported from chargers.

18 - Dock Fault Charger Response - Docking process requested charge process to start, but chargers did not respond.

19 - Dock Fault Docked Late - During final positioning, the bus travelled past distance window for where the bus should have stopped.

20 - Dock Fault Identification - This should only occur if there is a software bug.

21 - Dock Fault Lost Communication - The bus lost wireless communication with the charge station.

22 - Dock Fault Manual Charge - The charge station detected that a manual charge cable was plugged into one of the chargers attached to it.

23 - Dock Fault Ultrasonic - This fault is caused by the ultrasonic sensor not detecting the edges of the bus in the proper series within the proper measured distance windows.
A) This fault is most likely an issue with the operator not driving the bus directly under the charge head.

- B) It may be a sensor issue with something on the ultrasonic lens or an insect flying around or something.
C) It may be an issue with the drive tires being under-inflated or the transmission slipping while proceeding through the docking process.
D) It may be an issue with debris (leaves, snow, etc.) being on top of the bus.
E) It may be an ultrasonic sensor electrical or wiring issue.

24 - Dock Fault Pilot - The pilot signal is supplied from the bus to the charge station, but the chargers are not reporting pilot observed.

- A) Pilot contact issues on the charge head or charge blade.
B) Ground Brush contact issues.
C) Bus final position not being in correct location. This is a result of the ultrasonic sensor, proximity sensor, or the wheel rotation measurements.

25 - Dock Fault Arm Not Down - This fault is set if any of the arm sensors report information that doesn't align with the arm being lowered onto the bus.

- A) Arm travel sensors report head in the home position.
B) Head landing issue.

26 - 32 Reserved - Reserved for fault where the operator should try docking again.

33 - Dock Fault Drive Selected During Charge - The operator selected drive after setting park brake in the final stage of docking.

34 - Dock Fault Escape Opened - Someone opened the roof-top escape hatch during the docking or charging procedure.

35 - Dock Fault Master Switch - The operator turned the bus off during the docking procedure.

36 - Dock Fault Park Released During Charge - The operator released the parking brake before the charge completed.

37 - Dock Fault Reverse Selected - The operator selected reverse any time during the docking procedure.

38 - 40 Reserved - Reserved for fault where the operator canceled the charge or docking procedure.

Fault Cause Troubleshooting

Arm Max Travel Issues

- Ensure that the arm-down sensor is physically aligned properly so that it is triggered only when the arm is down as far as it will go.
- Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Ensure that the arm down MUX input reads the proper voltage in the charge head control box.
 - Ensure proper voltage at the arm down supply.
 - Ensure proper voltage at the arm down supply reference.
 - Ensure proper voltage for the supply at sensor.
 - Ensure proper voltage for the reference at sensor.
 - Replace sensor, if needed.

Arm Home Travel Issues

- Ensure that the arm-home sensor is physically aligned properly so that it is triggered only when the arm is fully up.
- Move the sensor until the red LED on the sensor comes on. .
- Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Ensure that the arm home MUX input reads the proper voltage in the charge head control box.
 - Ensure proper voltage at the arm home supply.
 - Ensure proper voltage at the arm home supply reference.
 - Ensure proper voltage for the supply at home sensor.
 - Ensure proper voltage for the reference at home sensor.
 - Replace sensor, if needed.

Air Pressure Sensor Issues

- Check the air pressure gauge in the charge station. It should be above 80 psi.
- Listen for air leaks in the system.

- If multiple systems are fed off the same supply, see if docking at another charge stall has the same fault. This would help differentiate a sensor issue from a true pressure loss.
- Use the access panel on top of charge head cover to get to charge head control box and then look at the pressure gauges in the charge head control box:
 - Measure the MUX input voltage for the pressure sensor. See that it varies with pressure by lowering the pressure at the main tank. Unplug it and then pull the relief valve to let the pressure out. Plug the compressor back in after the test.
 - Measure the output of the pressure sensor mounted in the charge head control box.
 - Measure the voltage supply at the pressure sensor in the charge head control box.
 - Measure the reference at the pressure sensor in the charge head control box.
 - Replace the pressure sensor, if needed.

Ultrasonic Sensor Electrical Issues

- Ensure that LED is lit on sensor on the top rear of the charge head.
- Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Measure signal voltage from ultrasonic sensor at MUX module. Put an object in front of sensor, and about 2 feet from it, to see that it changes.
 - Check supply voltage to sensor in charge head control box.
 - Check reference voltage to sensor in charge head control box.
 - Check supply voltage at sensor
 - Check reference at sensor
 - Check signal voltage at sensor

Distribution Box High Voltage Contactor Issues

- Ensure no bus is present under the charge head.
- Place a cone to prevent a bus from using the stall while testing.
- Open the distribution box:
 - Hotwire the pilot signal by jumpering 24V to the pilot input at the pilot relay coil.
 - Measure continuity across the four high voltage contactors.
 - Check the low voltage supply signals to the contactors.

- Check the low voltage reference signals to the contactors.
- Check that the pilot voltage is at the low voltage relays that supply the high voltage contactors.
- Check the reference at the low voltage relays that supply the high voltage contactors.
- Swap the low voltage relays that supply the signals to the high voltage contactors.

Brush Control Issues

This can be checked at a high level by observing the charge head while a bus is not under it. All ten charge brushes should be retracted.

- Ensure no bus is present.
- Bring the test RFID key out and the head should come down and all ten brushes should be extended.
- If either of these cases does not show the expected behavior, then the issue is in the actuation. Otherwise, the issue is probably in the sensing (but it does not have to be.)
- Command failure to actuate:
 - Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Check electrical solenoid outputs source (or sink) from MUX module.
 - Check electrical solenoid return (or source).
 - Check pneumatic connections from supply to solenoid.
 - Check that solenoid is physically moving when actuated.
 - Open the actual charge head (Lower head, then support bottom of charge head with lift and remove screws from both sides of top of charge head. High voltage cable lugs will need to be removed as well.)
 - Check that the 10 pistons are physically moving when actuated.
 - Replace cylinder, if needed.
- Feedback failure to register proper information:
 - Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Check 10 electrical detent inputs to MUX module.
 - Check electrical reference connections in charge head control box.
 - Open the actual charge head (Lower head, then support bottom of charge head with lift and remove screws from both sides of top of charge head. High voltage cable lugs will need to be removed as well.)

- Check that magnetic detents physically line up when pistons are home.
- Ensure that the detent sensors are mounted flush against the air cylinders.
- Ensure that the detent sensors are mounted as close to the end of the cylinder as possible.
- Replace detent, if needed.

Head Landing Issues

This issue may be caused by an actuation problem or a sensor problem. While the bus is attempting to dock, the head should come down during the head landing phase. If the head is observed coming down, and it appears to be landing on a flat part of the bus, then this indicates a sensor issue. If the bus stops and the head partially comes down or does not even attempt to come down, then this indicates a command/actuation failure. If the head lands in the wrong area of the bus, this is likely operator error, but it may be an ultrasonic problem or a rotation measurement problem.

- Command failure to actuate - There are three solenoids that actuate in order to drive the head down. If there is an issue with any of these three devices, then the head will not lower.
 - Visually inspect charge head arm to ensure that it isn't obstructed.
 - Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Ensure nothing is below the charge head.
 - Use the manual triggers on the solenoids to verify that commanding the three devices will lower the charge head.
 - Measure the output voltages from the MUX for the three solenoids.
 - Measure the return connections from the three solenoids.
 - Verify that there is pressure at all three solenoids.
 - Ensure there are no gross air leaks down-stream of the solenoids in the large pistons.
 - Replace solenoid or piston, if needed.
- Feedback failure to register:
 - Ensure that the two detent switches on the bottom of the head are clocked so that they are both untriggered while the head is not resting on a surface but both triggered while it is resting on a flat surface.
 - Observe charge head while it is in the home position. The bottom of the charge head should appear to be parallel to the ground on both axes. If it appears to be tilted on the longitudinal axis, then it's likely that the rotational travel exceeded the guidance-rod length. The guidance rod is therefore holding the

charge head at an angle. This can be verified by observing the head from the roof of a bus or from a lift. It can be corrected by knocking the guidance rod back into its slot. Please report this issue if you observe it.

- Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Measure input signals for detents into the MUX (with sensors triggered and untriggered).
 - Measure supply voltages to sensors.
 - Measure reference signals to sensors.
 - Open the actual charge head (Lower head, then support bottom of charge head with lift and remove screws from both sides of top of charge head. High voltage cable lugs will need to be removed as well.)
 - Measure voltages and references at the sensors.
 - Measure signals at the sensors.
 - Replace sensor, if needed.

Head Over Temp Issues

There are several normally-closed temperature-based switches mounted in the charge head. They are all wired in series so that if any switch gets too hot, the circuit is opened.

- Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
- Ensure the input at the MUX module in the charge head control box is the same voltage as the supply to the temperature switches.
- Open the actual charge head (Lower head, then support bottom of charge head with lift and remove screws from both sides of top of charge head. High voltage cable lugs will need removed as well.)
- Check the voltage between each of the temperature switches until the problematic switch is found.
- Replace switch, if needed.

Pilot Not Received Issue

- Contact between charge head and bus is not good.
 - Ensure docking process is cancelled.
 - Use Scotch-bright to clean contacts, then try docking again.
- Pressure switch in charge head control box has opened.

- Verify that system pressure looks good.
- Use the access panel on top of the charge head cover to get to the charge head control box and then open the charge head control box:
 - Measure resistance across pressure switch.
 - Replace and recalibrate pressure switch.
- Wiring issue between head and distribution box.
 - Use 18V cordless tool battery (and some wire leads) to supply voltage directly to the charge head pilot and ground brush.
 - Ensure polarity is correct
 - * Apply positive lead to pilot contact
 - * Apply negative lead to main neutral contact
- Output is not actually being supplied from bus.
 - Re-dock bus, but do not set emergency brake
 - Verify that 24V pilot can be measured inside the distribution box
 - This may still be a contact issue if 24V does not reach distribution box
 - Right after docking, use a ladder to look down through the connection points between the charge head and the bus. Ensure that the pilot and ground brush make contact with the bus blades.
- Proper voltage is not supplied to the individual chargers.
- Individual chargers have a pilot measurement failure.
- Bus stopped in the wrong place.
 - Proximity sensor issue on the bus
 - Wiring issue
 - Sensor issue
 - Foreign metal object on charge head causing premature proximity reading
 - Bus did not stop quickly enough
 - Motor control issue on bus

Chargers Not Responding Issue

- One (or multiple) chargers faulted out
 - Check charger screens to verify that they are not faulted
 - Reset faulted chargers (if equipped with a RESET button)
 - Reset main breakers for chargers to clear the screen

Trouble-Trees – Head Home

Trouble-Tree – Head Home Error, Start

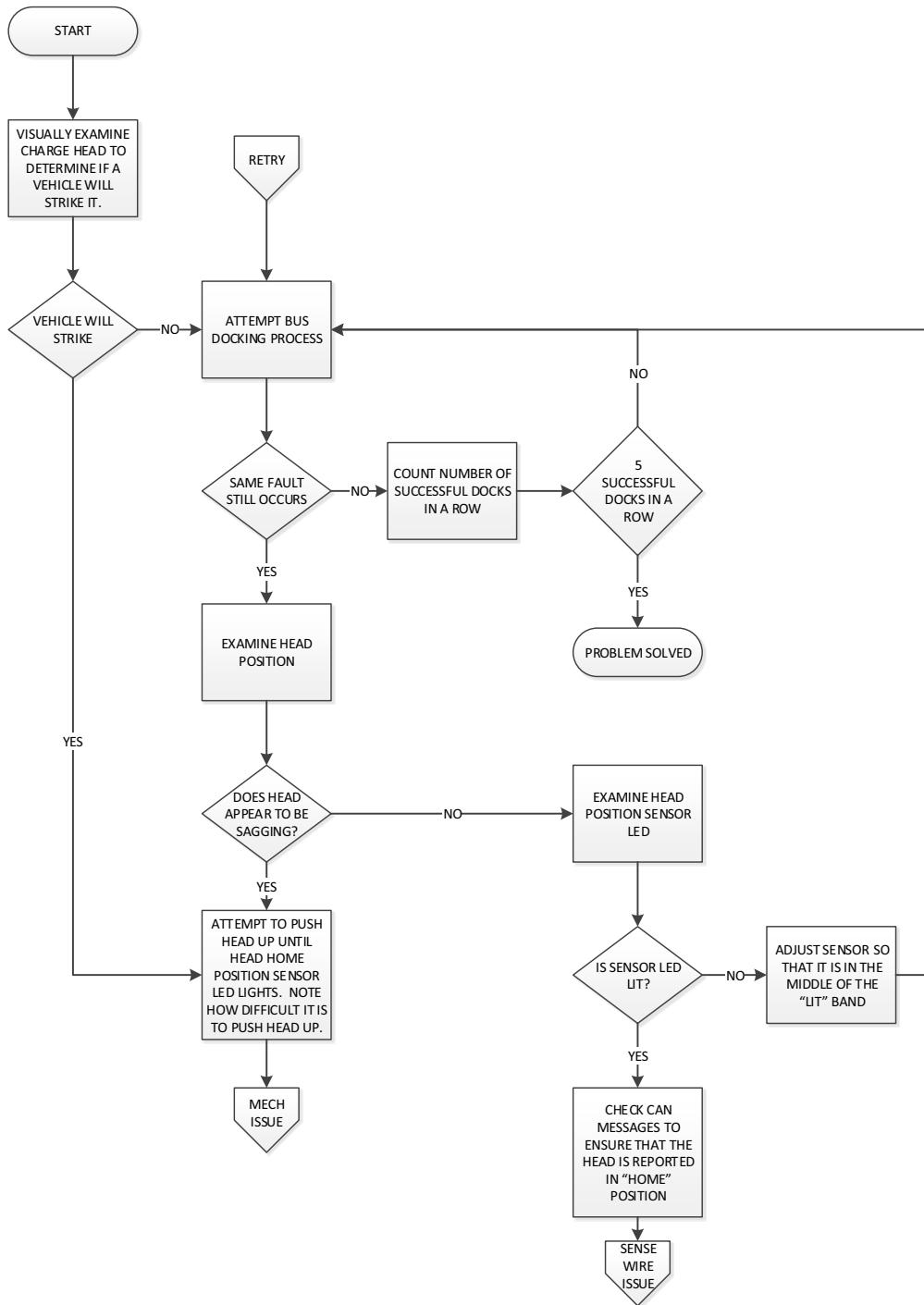


Figure 6-1. Trouble-Tree – Head Home Error, Start

Trouble-Tree – Head Home Error, Mechanical Issue

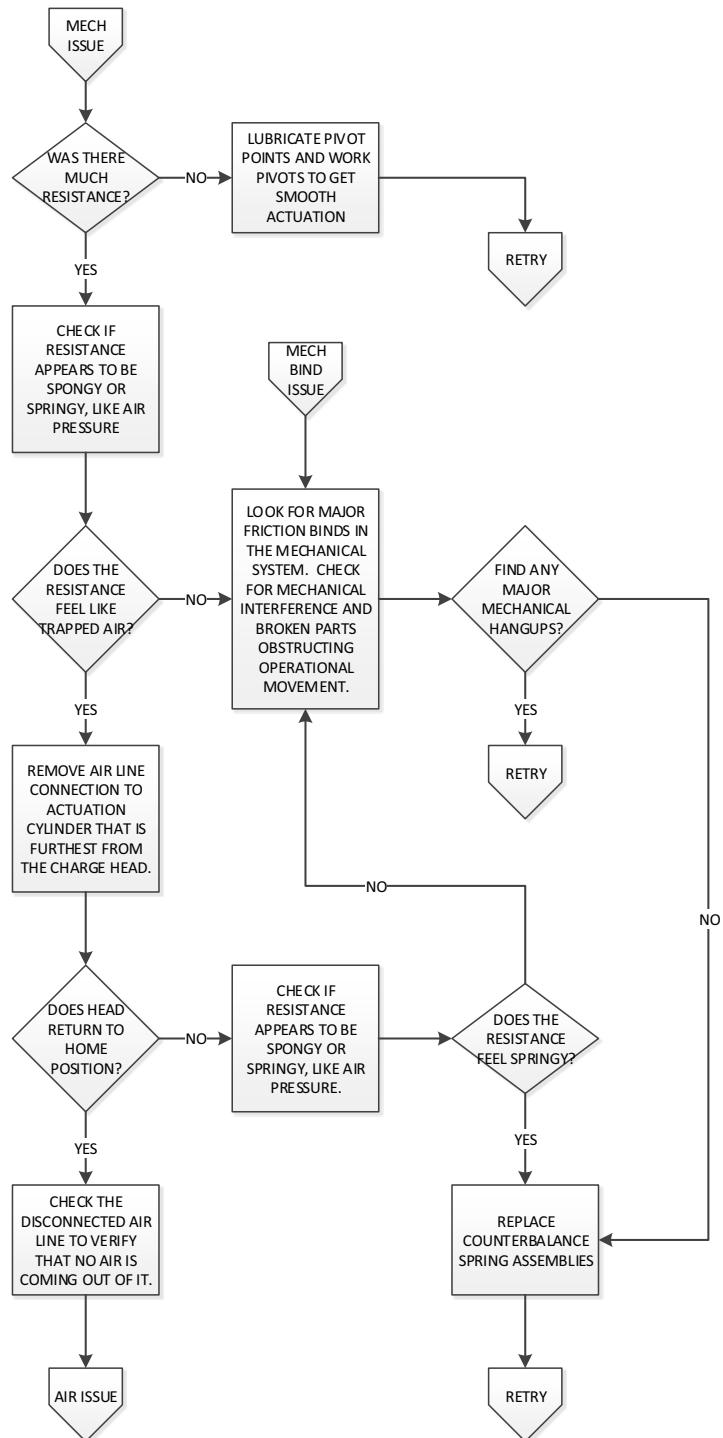


Figure 6-2. Trouble-Tree – Head Home Error, Mechanical Issue

Trouble-Tree – Head Home Error, Sense Wire Issue

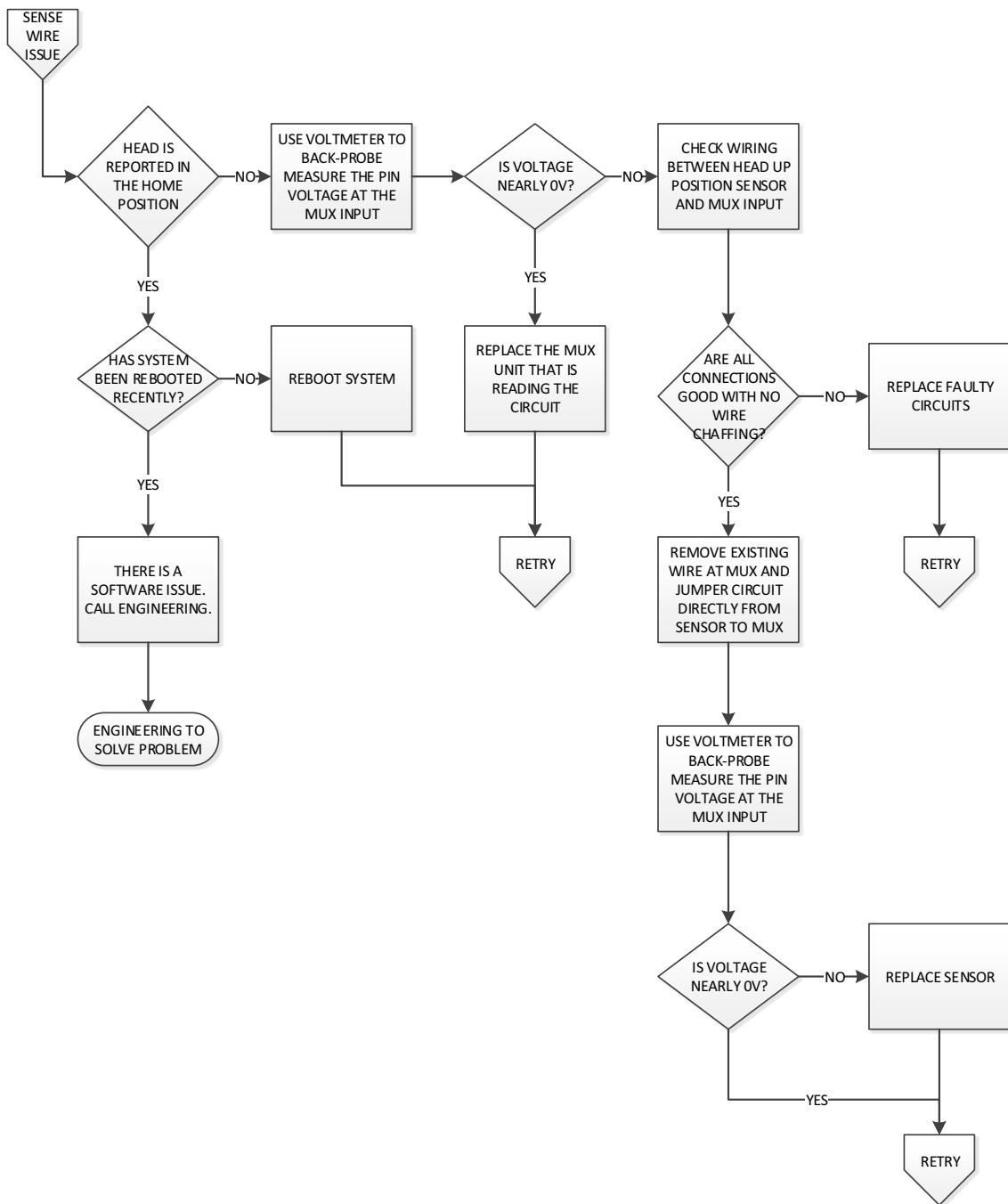


Figure 6-3. Trouble-Tree – Head Home Error, Sense Wire Issue

Trouble-Tree – Head Home Error, Air Issue

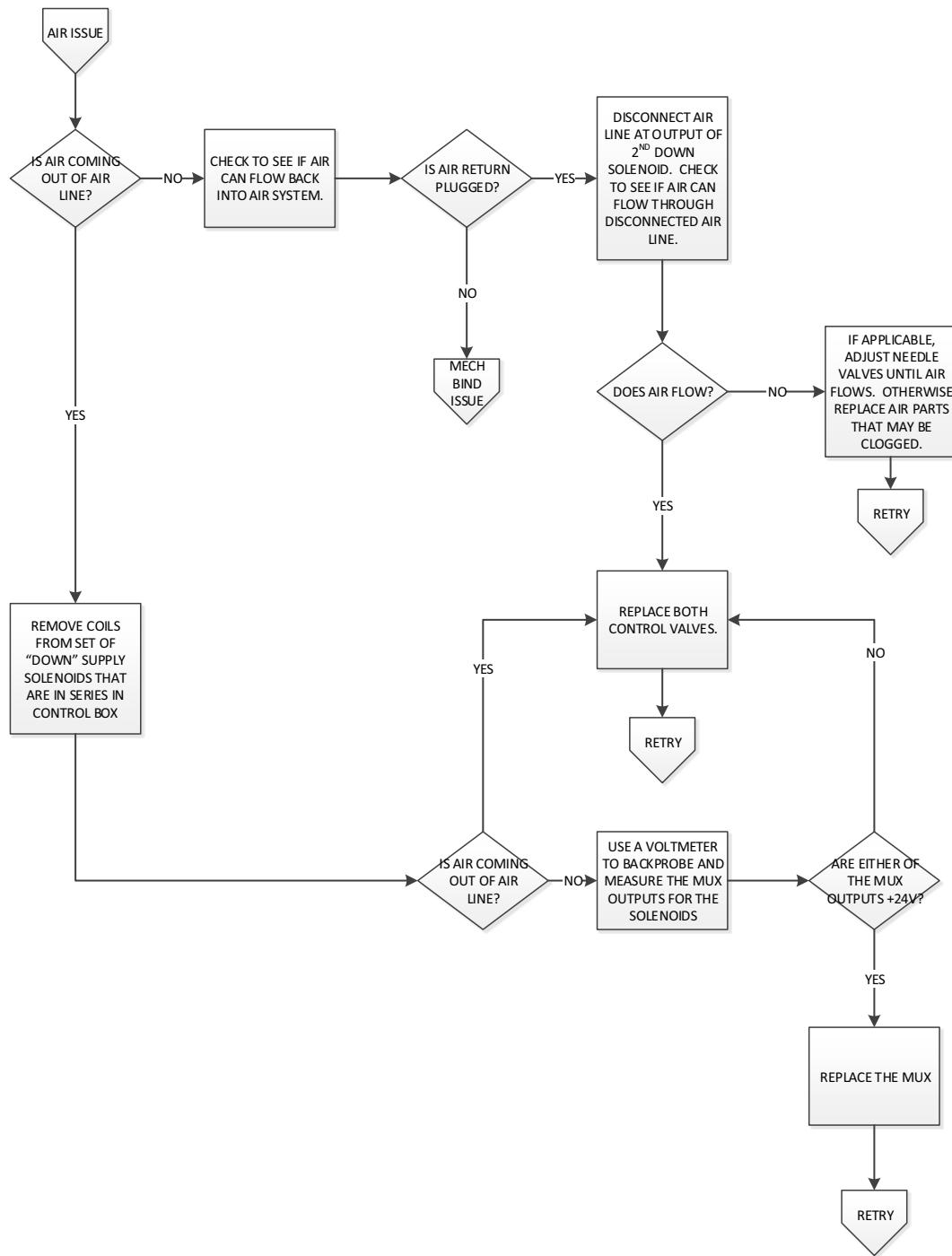


Figure 6-4. Trouble-Tree – Head Home Error, Air Issue

Trouble-Trees – Charge/Ground Brush Home

Trouble-Tree – Charge/Ground Brush Home Error, Start

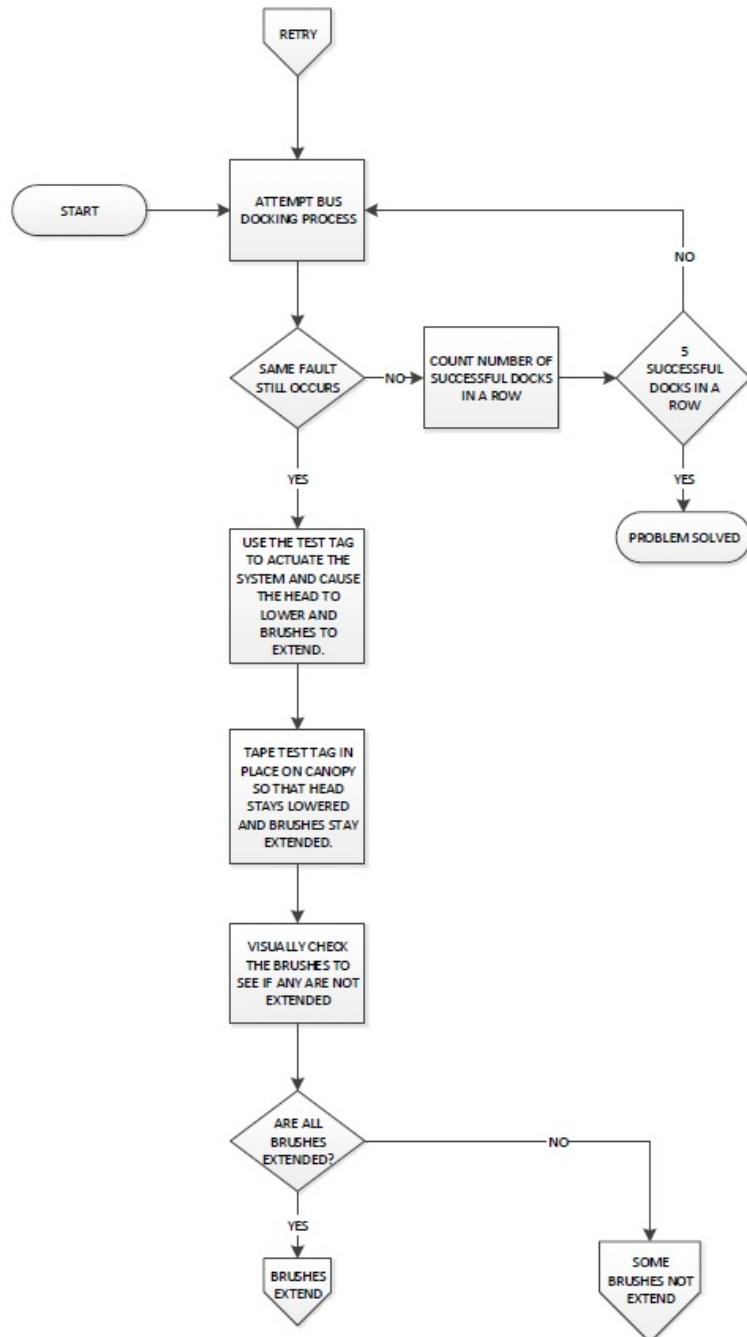


Figure 6-5. Trouble-Tree – Charge/Ground Brush Home Error, Start

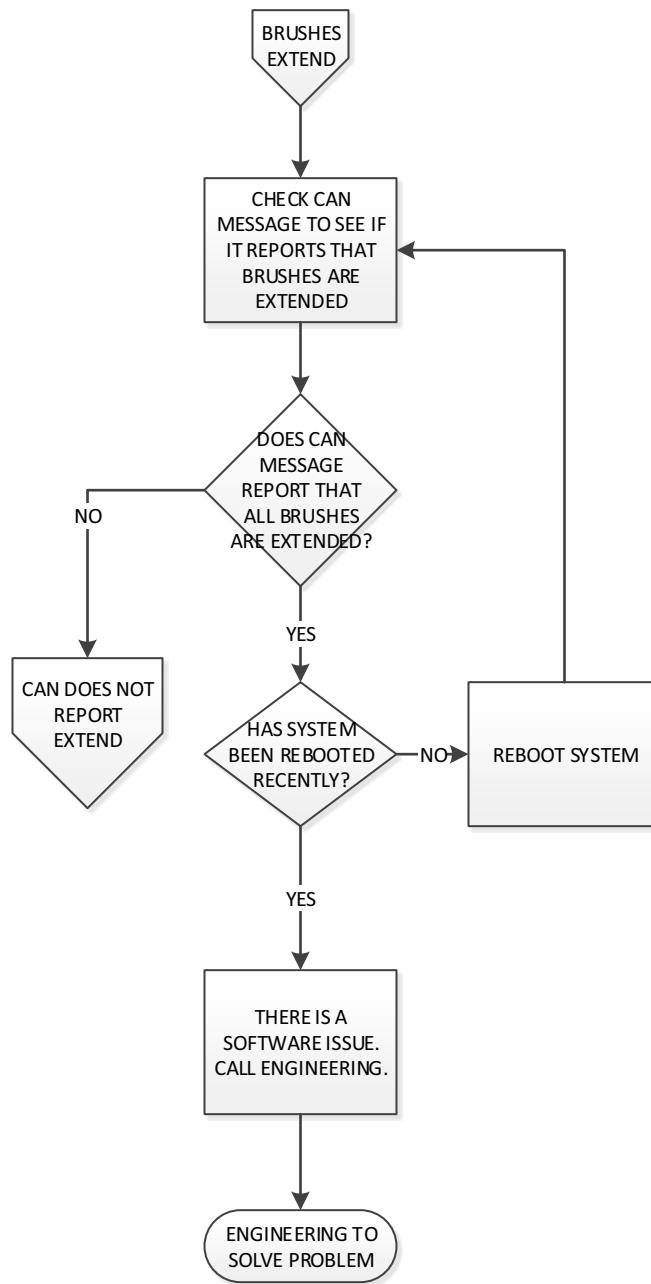
Trouble-Tree – Charge/Ground Brush Home Error, Brushes Extend

Figure 6-6. Trouble-Tree – Charge/Ground Brush Home Error, Brushes Extend

Trouble-Tree – Charge/Ground Brush Home Error, Some Brushes Not Extend

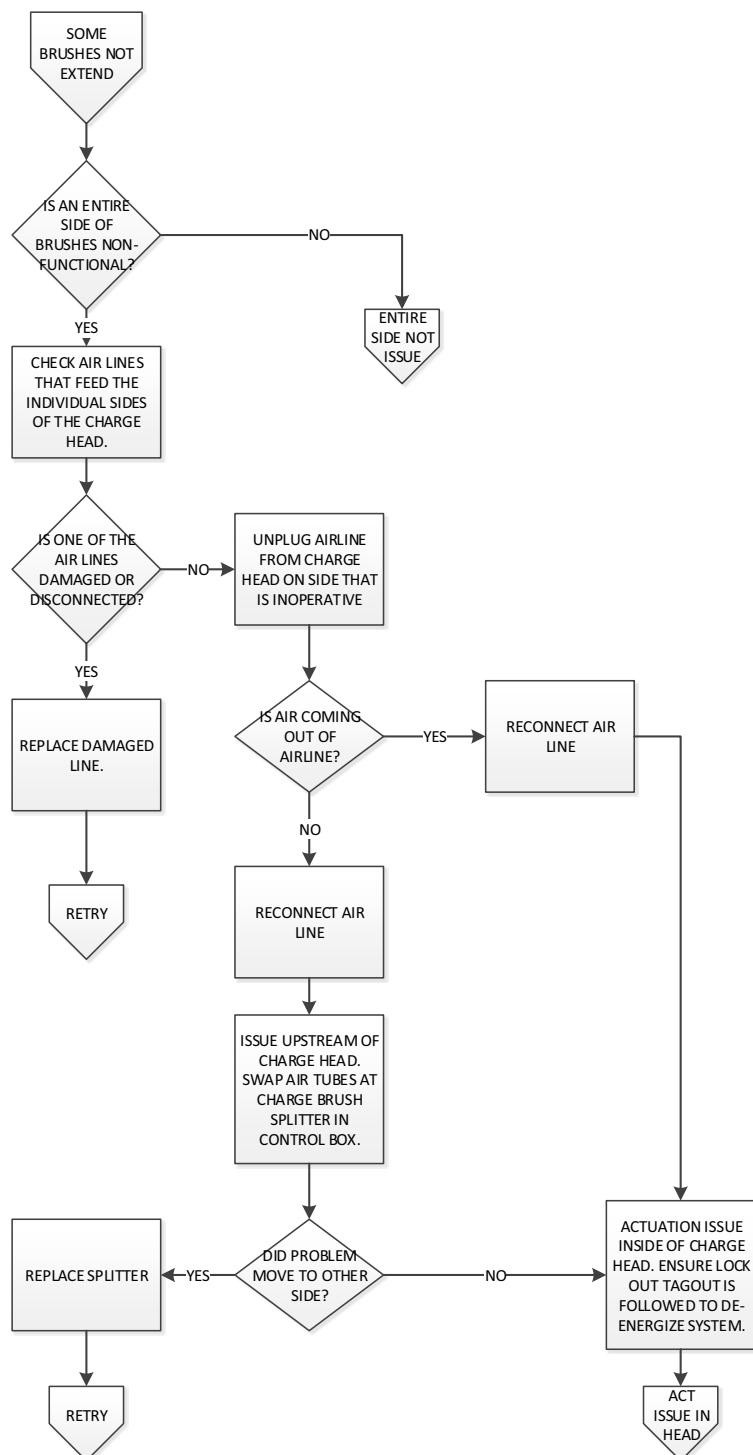


Figure 6-7. Trouble-Tree – Charge/Ground Brush Home Error, Some Brushes Not Extend

Trouble-Tree – Charge/Ground Brush Home Error, CAN Does Not Report Extend

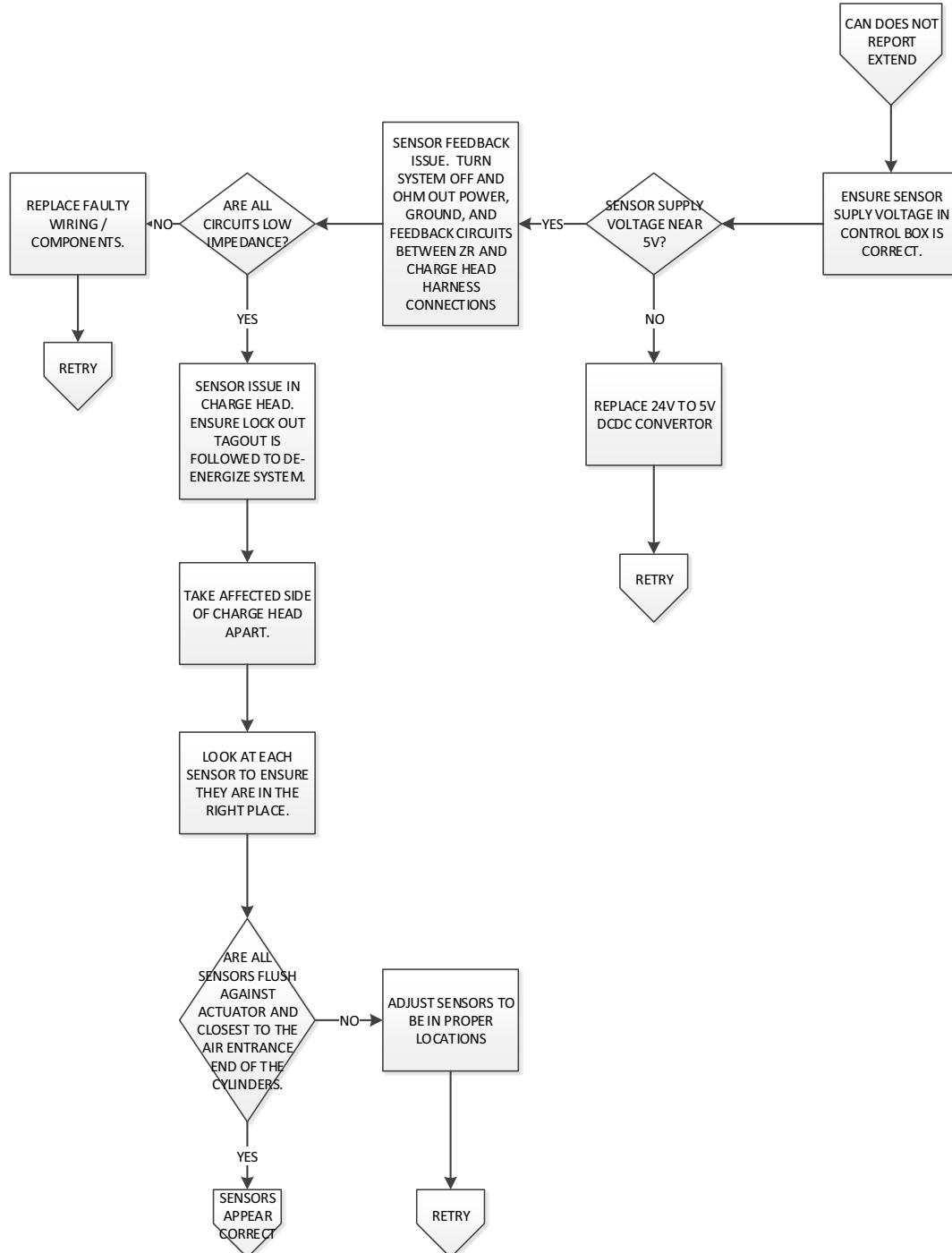


Figure 6-8. Trouble-Tree – Charge/Ground Brush Home Error, CAN Does Not Report Extend

Trouble-Tree – Charge/Ground Brush Home Error, Sensors Appear Correct

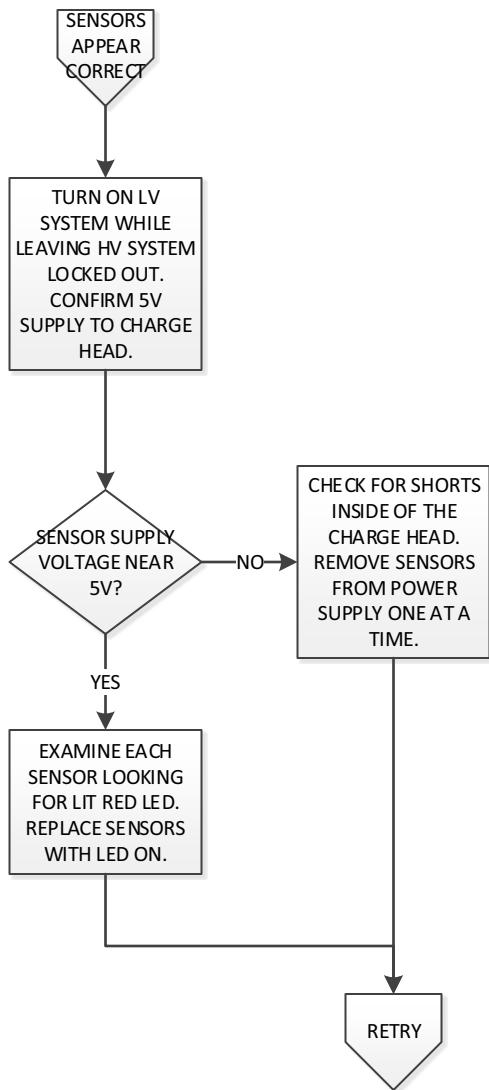


Figure 6-9. Trouble-Tree – Charge/Ground Brush Home Error, Sensors Appear Correct

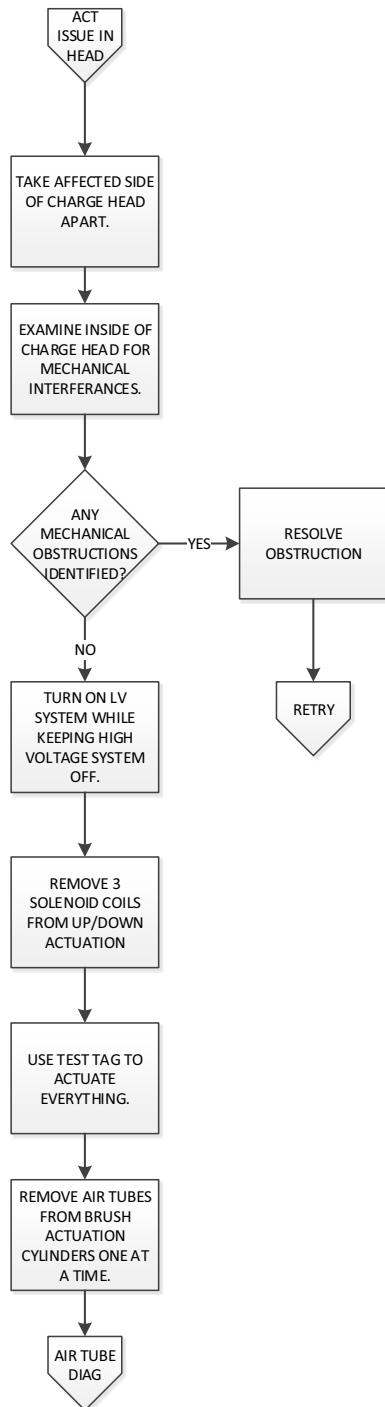
Trouble-Tree – Charge/Ground Brush Home Error, Act Issue in Head

Figure 6-10. Trouble-Tree – Charge/Ground Brush Home Error, Act Issue in Head

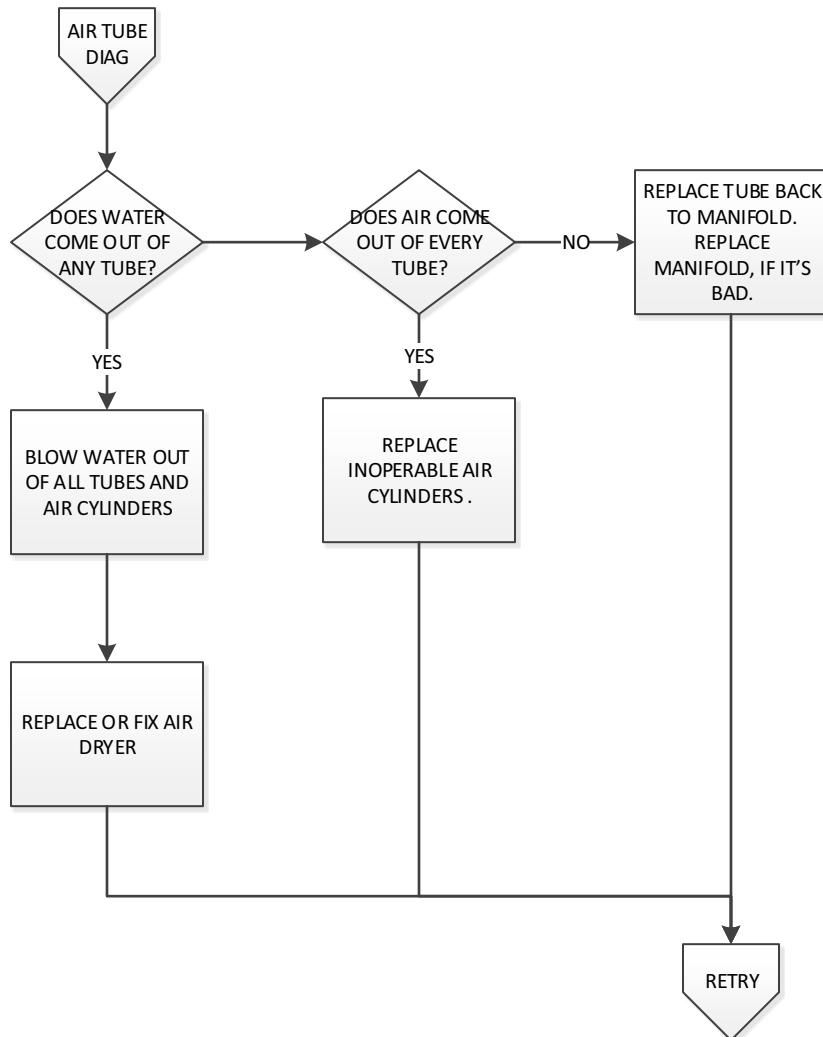
Trouble-Tree – Charge/Ground Brush Home Error, Air Tube Diag

Figure 6-11. Trouble-Tree – Charge/Ground Brush Home Error, Air Tube Diag

Trouble-Tree – Charge/Ground Brush Home Error, Entire Side Not Issue

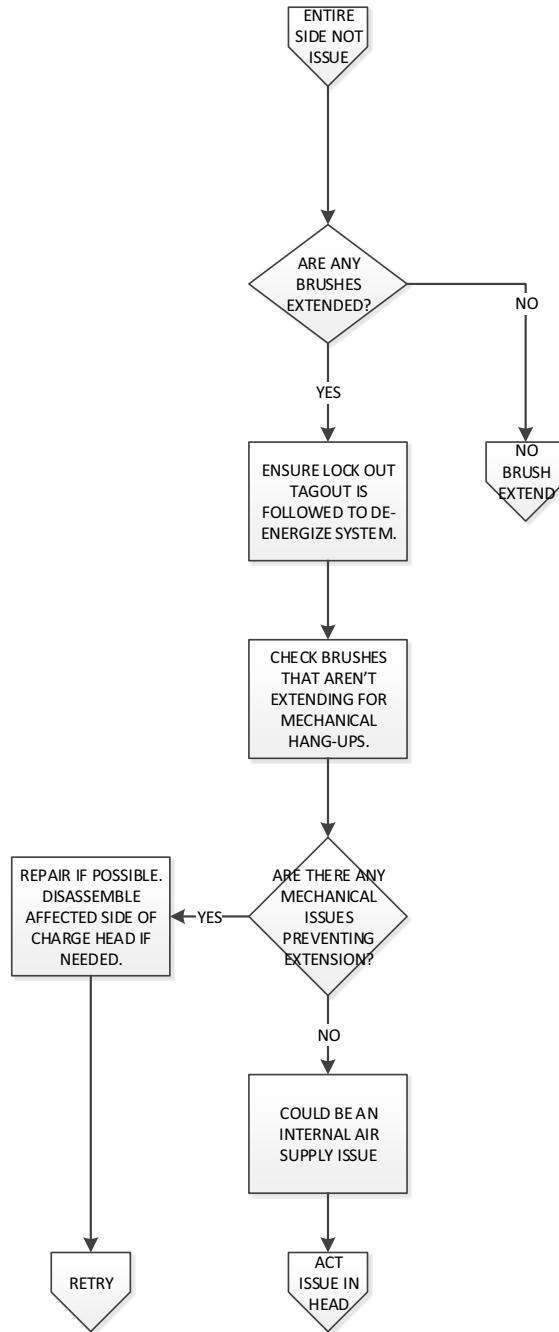


Figure 6-12. Trouble-Tree – Charge/Ground Brush Home Error, Entire Side Not Issue

Trouble-Tree – Charge/Ground Brush Home Error, No Brush Extend

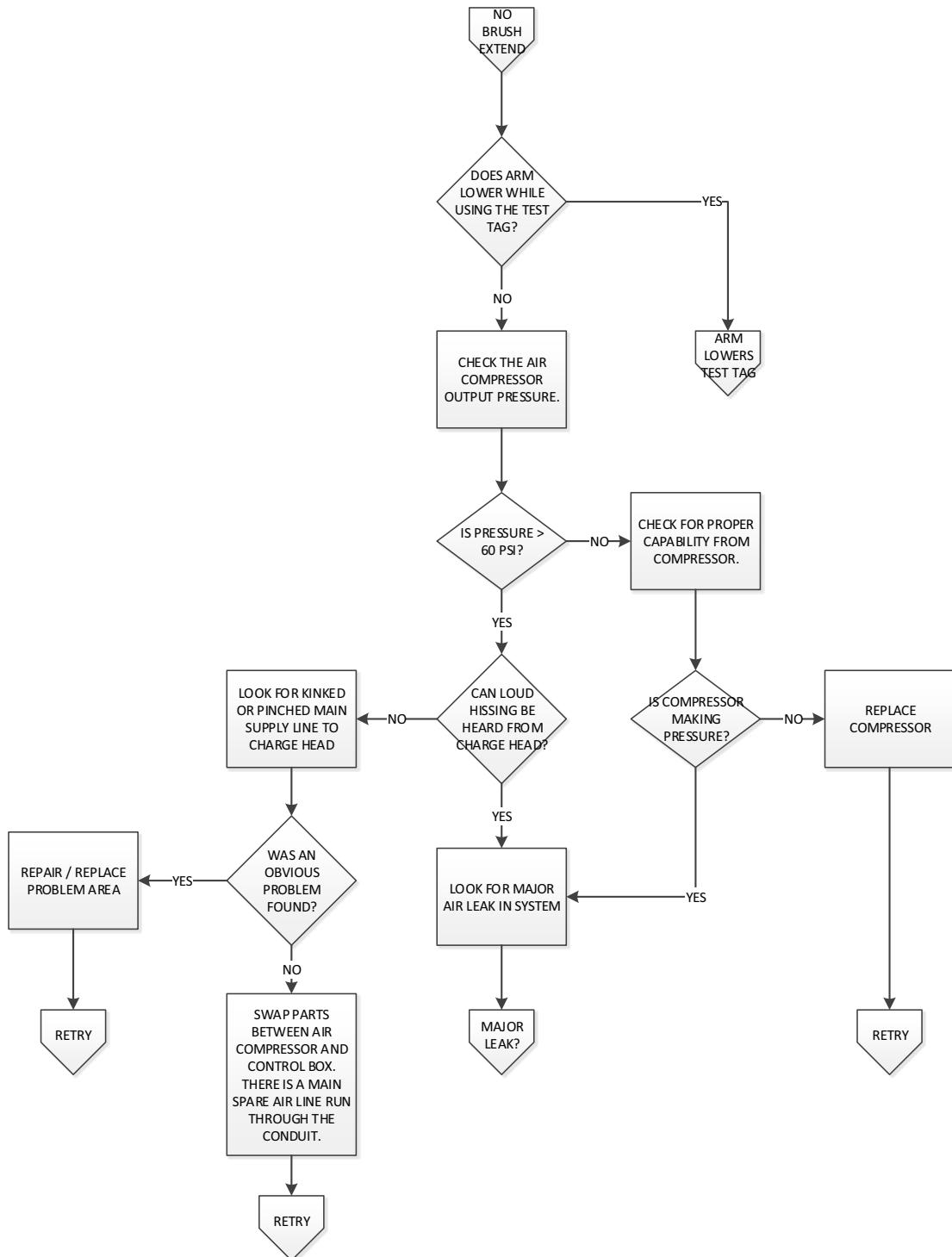


Figure 6-13. Trouble-Tree – Charge/Ground Brush Home Error, No Brush Extend

Trouble-Tree – Charge/Ground Brush Home Error, Major Leak

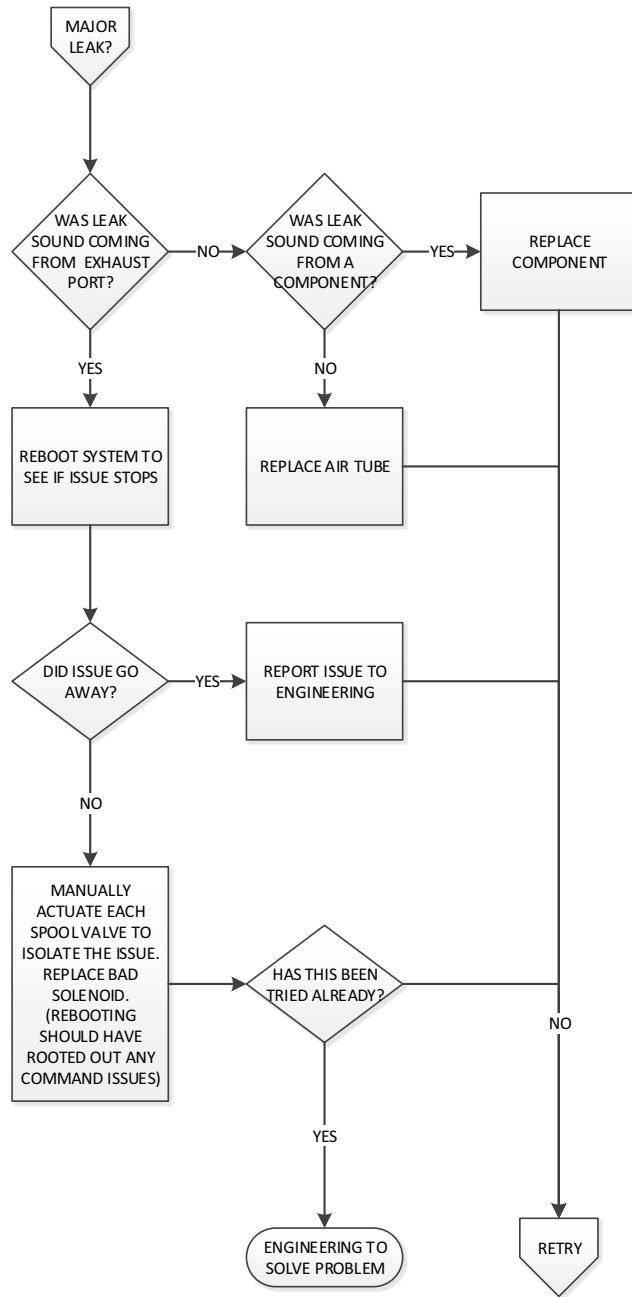


Figure 6-14. Trouble-Tree – Charge/Ground Brush Home Error, Major Leak

Trouble-Tree – Charge/Ground Brush Home Error, Arm Lowers Test Tag

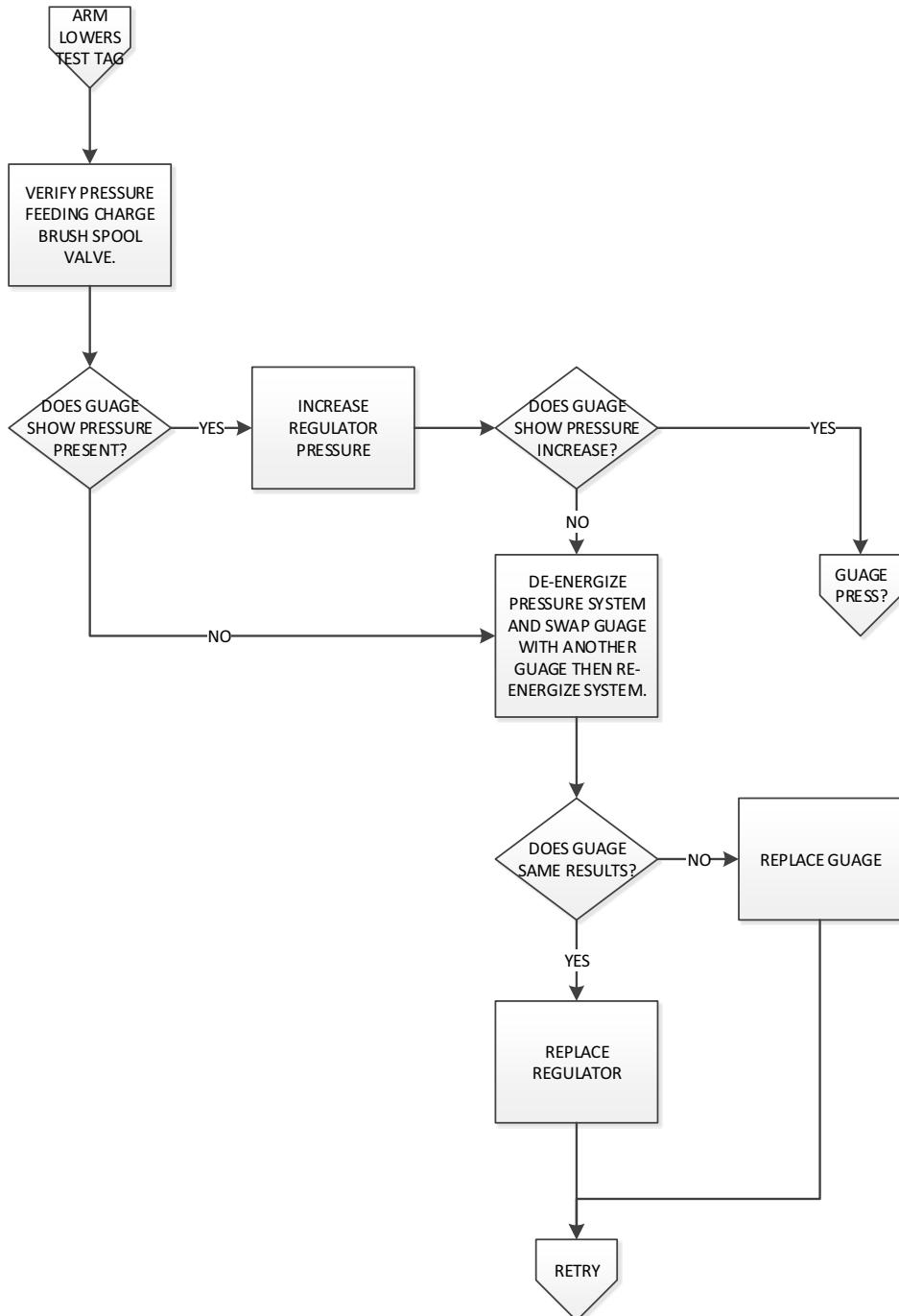


Figure 6-15. Trouble-Tree – Charge/Ground Brush Home Error, Arm Lowers Test Tag

Trouble-Tree – Charge/Ground Brush Home Error, Gauge Press

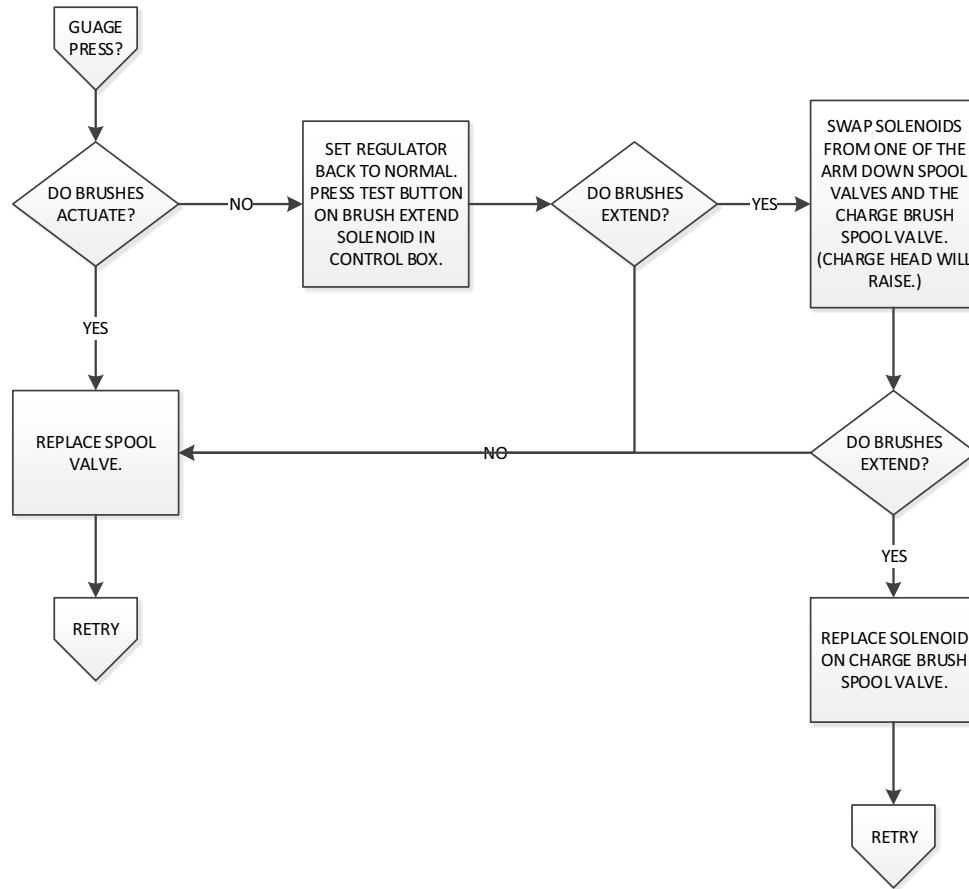


Figure 6-16. Trouble-Tree – Charge/Ground Brush Home Error, Gauge Press