



Service Manual

Workman[®] e2050 & e2065

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing and repair of major systems and components on the Workman e2050 and e2065.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your machine. Replacement Operator's Manuals are available on the Internet at www.toro.com.

The Toro Company reserves the right to change product specifications or this publication without notice.



This safety symbol means DANGER, WARNING or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

NOTE: A **NOTE** will give general information about the correct operation, maintenance, service, testing or repair of the machine.

IMPORTANT: The **IMPORTANT** notice will give important instructions which must be followed to prevent damage to systems or components on the machine.



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Safety

Product Records
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Safety Instructions

The Workman e2050 and e2065 are designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.



WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Before Operating

1. Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with the controls and know how to stop the machine quickly. A replacement Operator's Manual is available on the Internet at www.Toro.com.
2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

While Operating



WARNING

The Workman e2050 and e2065 are off-highway vehicles only. They are not designed, equipped or manufactured for use on public streets, roads or highways.

1. Sit on the operator seat when starting and operating the vehicle.
2. Before starting the vehicle:
 - A. Make sure that the battery charger is disconnected from the vehicle charger receptacle.
 - B. Engage the parking brake.
 - C. Make sure accelerator pedal is not depressed.
 - D. Check position of forward/reverse switch and Hi/Low speed switch.
3. Before getting off the operator seat:
 - A. Stop vehicle, turn on/off switch OFF and remove key from switch.
 - B. Set parking brake.
4. If vehicle is parked on incline, chock or block the wheels after getting off the vehicle.

Maintenance and Service

1. Before servicing or making adjustments to the vehicle, stop vehicle, turn on/off switch to OFF, engage parking brake and remove key from the on/off switch.
2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.
3. Do not use open pans of flammable cleaning fluids for cleaning parts.
4. Keep battery area free of excessive grease, grass, leaves and dirt.
5. Disconnect batteries before servicing the machine. Carefully remove one of the battery cables from the battery pack as the first step in any repair. Once a battery cable has been removed, the electrical system on the vehicle can be safely worked on. Take care during repairs, however, to not allow tools or vehicle components to complete the battery circuit that was opened with the cable removal. Reattach the removed cable to the battery pack as the last step in any repair.
6. When using metal, uninsulated tools around batteries, do not allow tools to contact both positive and negative battery terminals simultaneously.
7. Remove jewelry and watches before servicing electrical components of the vehicle.
8. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with batteries.
9. Battery gases can explode. Keep cigarettes, sparks and flames away from the batteries. Always service, store and charge the vehicle batteries in a well ventilated area.
10. Never use an open flame to check level or leakage of battery electrolyte.
11. When connecting the battery charger to the vehicle, connect the charger cord to the vehicle charger receptacle before plugging the charger power cord into an outlet. After charging the vehicle batteries, unplug the charger power cord from the outlet before disconnecting the charger cord from the vehicle charger receptacle.
12. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.
13. To assure optimum performance and continued safety of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with safety standards and the warranty may be voided.
14. When raising the machine to change tires or to perform other service, use correct blocks, hoists and jacks. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions in the Operator's Manual and in this Chapter).

Jacking and Other Instructions

Jacking Vehicle



DANGER

POTENTIAL HAZARD

- A vehicle that is not properly supported may become unstable.

WHAT CAN HAPPEN

- The vehicle may move or fall. Personal injury or damage to the machine may result.

HOW TO AVOID THE HAZARD

- Make sure vehicle is parked on a solid level surface, such as a concrete floor.
- Make sure On/Off switch is OFF and key is removed from the switch before getting off the vehicle.
- Before raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle.
- Always chock or block wheels to prevent the vehicle from rolling.
- Make sure proper hoists, solid wooden blocks and jack stands are used to raise and support the vehicle.

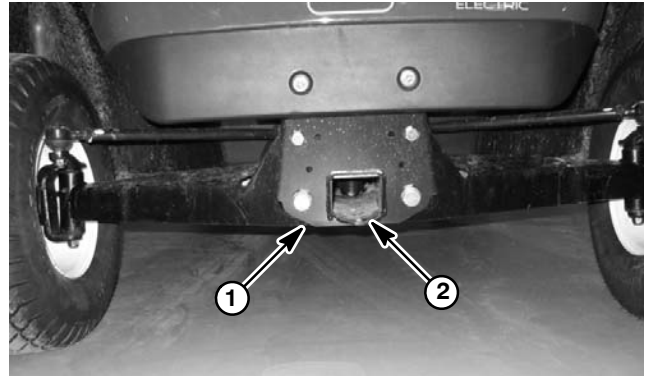


Figure 1

1. Front frame

2. Towing tongue

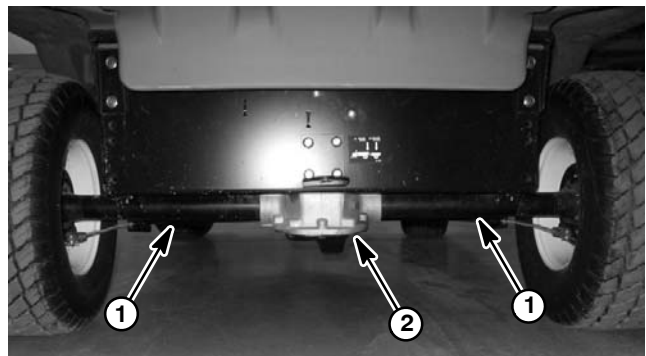


Figure 2

1. Axle tube

2. Transaxle case

Jacking Locations

1. Jack front of the vehicle on the front of the frame behind the towing tongue (Fig. 1).

2. Jack rear of the vehicle under each rear axle tube. Do not jack vehicle below the transaxle case (Fig. 2).

Towing Vehicle

IMPORTANT: Frequent or long distance towing of the Workman e2050/e2065 is not recommended.

In case of emergency, the vehicle can be towed for a **short** distance. See Operator's Manual for towing information.

IMPORTANT: If vehicle is towed, make sure that on/off switch is in the OFF position and key is removed from switch.

Transporting Vehicle

When moving the vehicle long distances, use a trailer or flatbed truck. Make sure vehicle is secured to the trailer properly. See Operator's Manual for transport information.

Safety and Instruction Decals

There are several safety and instruction decals attached to your Workman vehicle. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in the Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

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Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Workman vehicle at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your Workman, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm	
	1/64	0.015625	— 0.397	33/64	0.515625	— 13.097
	1/32	0.03125	— 0.794	17/32	0.53125	— 13.494
	3/64	0.046875	— 1.191	35/64	0.546875	— 13.891
1/16	—	0.0625	— 1.588	9/16	0.5625	— 14.288
	5/64	0.078125	— 1.984	37/64	0.578125	— 14.684
	3/32	0.09375	— 2.381	19/32	0.59375	— 15.081
	7/64	0.109275	— 2.778	39/64	0.609375	— 15.478
1/8	—	0.1250	— 3.175	5/8	0.6250	— 15.875
	9/64	0.140625	— 3.572	41/64	0.640625	— 16.272
	5/32	0.15625	— 3.969	21/32	0.65625	— 16.669
	11/64	0.171875	— 4.366	43/64	0.671875	— 17.066
3/16	—	0.1875	— 4.762	11/16	0.6875	— 17.462
	13/64	0.203125	— 5.159	45/64	0.703125	— 17.859
	7/32	0.21875	— 5.556	23/32	0.71875	— 18.256
	15/64	0.234375	— 5.953	47/64	0.734375	— 18.653
1/4	—	0.2500	— 6.350	3/4	0.7500	— 19.050
	17/64	0.265625	— 6.747	49/64	0.765625	— 19.447
	9/32	0.28125	— 7.144	25/32	0.78125	— 19.844
	19/64	0.296875	— 7.541	51/64	0.796875	— 20.241
5/16	—	0.3125	— 7.938	13/16	0.8125	— 20.638
	21/64	0.328125	— 8.334	53/64	0.828125	— 21.034
	11/32	0.34375	— 8.731	27/32	0.84375	— 21.431
	23/64	0.359375	— 9.128	55/64	0.859375	— 21.828
3/8	—	0.3750	— 9.525	7/8	0.8750	— 22.225
	25/64	0.390625	— 9.922	57/64	0.890625	— 22.622
	13/32	0.40625	— 10.319	29/32	0.90625	— 23.019
	27/64	0.421875	— 10.716	59/64	0.921875	— 23.416
7/16	—	0.4375	— 11.112	15/16	0.9375	— 23.812
	29/64	0.453125	— 11.509	61/64	0.953125	— 24.209
	15/32	0.46875	— 11.906	31/32	0.96875	— 24.606
	31/64	0.484375	— 12.303	63/64	0.984375	— 25.003
1/2	—	0.5000	— 12.700	1	1.000	— 25.400
1 mm = 0.03937 in.			0.001 in. = 0.0254 mm			

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32°
			2. Multiply by 5/9

Torque Specifications

Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener’s head or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Product Records
and Maintenance

Fastener Identification

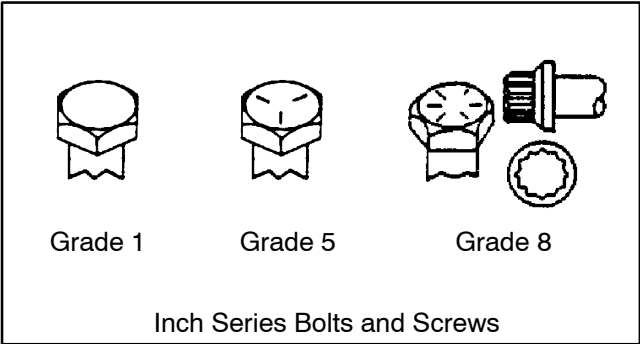


Figure 1

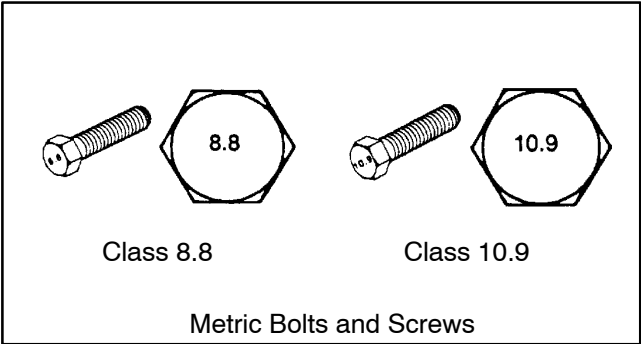


Figure 2

Standard Torque for Dry, Zinc Plated and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	in-lb	N-cm	in-lb	N-cm	in-lb	N-cm
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 – 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 – 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 – 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 – 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft-lb	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 – 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

Standard Torque for Dry, Zinc Plated and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 5 in-lb	640 ± 60 N-cm	78 ± 7 in-lb	885 ± 80 N-cm
M6 X 1.0	96 ± 9 in-lb	1018 ± 100 N-cm	133 ± 13 in-lb	1500 ± 150 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	27 ± 2 ft-lb	36 ± 3 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	53 ± 5 ft-lb	72 ± 7 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	92 ± 9 ft-lb	125 ± 12 N-m
M16 X 2.0	166 ± 15 ft-lb	225 ± 20 N-m	229 ± 22 ft-lb	310 ± 30 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 37 ft-lb	610 ± 50 N-m

Product Records
and Maintenance

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 – 20 UNC	140 ± 20 in-lb	73 ± 12 in-lb
5/16 – 18 UNC	215 ± 35 in-lb	145 ± 20 in-lb
3/8 – 16 UNC	35 ± 10 ft-lb	18 ± 3 ft-lb
1/2 – 13 UNC	75 ± 15 ft-lb	50 ± 10 ft-lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 – 20 UNF Grade 5	65 ± 10 ft-lb	88 ± 14 N-m
1/2 – 20 UNF Grade 5	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.25 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.5 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23 or Type F	
Thread Size	Baseline Torque*
No. 6 – 32 UNC	20 ± 5 in-lb
No. 8 – 32 UNC	30 ± 5 in-lb
No. 10 – 24 UNC	38 ± 7 in-lb
1/4 – 20 UNC	85 ± 15 in-lb
5/16 – 18 UNC	110 ± 20 in-lb
3/8 – 16 UNC	200 ± 100 in-lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in-lb
No. 8	15	18	30 ± 5 in-lb
No. 10	12	16	38 ± 7 in-lb
No. 12	11	14	85 ± 15 in-lb

* Hole size, material strength, material thickness & finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Conversion Factors

$$\text{in-lb} \times 11.2985 = \text{N-cm}$$

$$\text{ft-lb} \times 1.3558 = \text{N-m}$$

$$\text{N-cm} \times 0.08851 = \text{in-lb}$$

$$\text{N-m} \times 0.7376 = \text{ft-lb}$$

Maintenance

Maintenance procedures and recommended service intervals for the Workman e2050 and e2065 are covered in the Operator's Manual. Refer to that publication when performing regular vehicle maintenance.

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Electrical System

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Electrical Diagrams

The electrical schematic, circuit drawings and wire harness drawings for the Workman e2050 and e2065 are located in Chapter 6 – Electrical Diagrams.

General Information

The Workman e2050 and e2065 use a 48 volt DC electrical system that is an isolated circuit. The vehicle frame is not used for any ground connections.

The vehicle controller monitors operator and vehicle inputs to determine voltage to the traction motor. If a problem exists that will prevent normal vehicle operation, an LED on the controller and the vehicle status light on the dash panel will flash a fault code to assist in identifying the problem.

After performing any repair on electrical components on the vehicle, make sure that wiring is routed and secured so as to prevent abrasion or contact with moving parts.

Opening Battery Circuit

To prevent allowing a current path through tools used during vehicle electrical circuit repairs, remove one of the battery cables from the battery pack as the first step in any repair (Fig. 1). Once a cable has been removed, the electrical system on the vehicle can be safely worked on. Take care during repairs, however, to not allow tools or vehicle components to complete the battery circuit that was opened with the cable removal.

Reattach the removed cable to the battery pack as the last step in any repair. Secure cable on each battery terminal with lock washer and nut. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

Battery pack cable routing is shown in Figure 2.

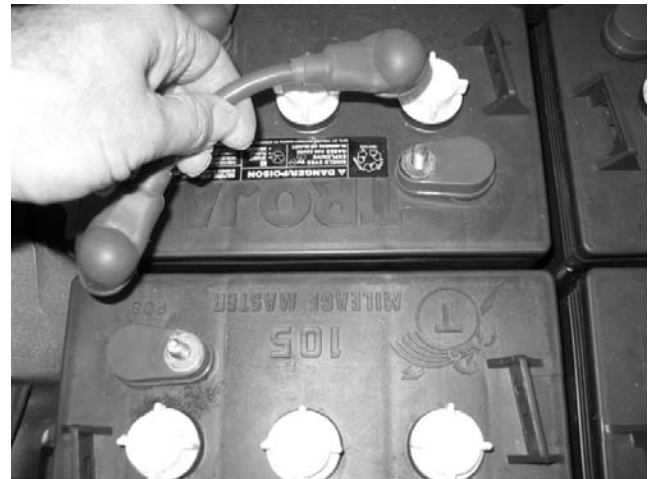


Figure 1

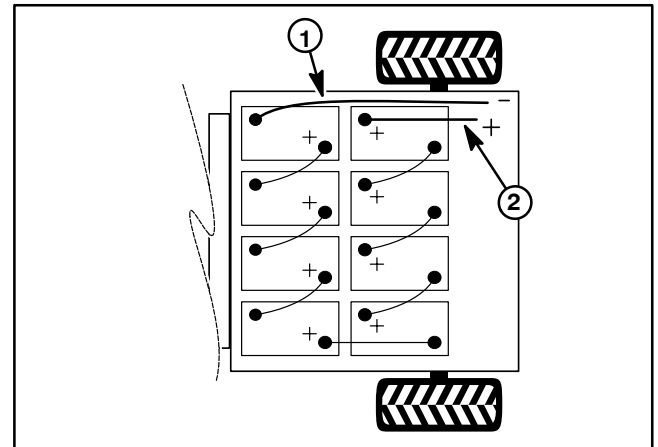


Figure 2

1. Negative cable to vehicle 2. Positive cable to vehicle

Vehicle Operation

The Workman e2050 and e2065 electrical system use a 48 volt battery pack, an electric traction motor, a vehicle controller and numerous other electrical components to allow vehicle operation.

Eight, 6 volt, deep cycle batteries that are connected in series provide current for a 48 volt DC, high torque traction motor, the vehicle controller and vehicle accessories (headlights, horn, various optional accessories). The batteries are discharged as the vehicle is used so charging the batteries after using the vehicle is necessary. A battery discharge indicator gauge on the dash provides the operator with information on battery charge level. Demands on the vehicle during use (speed, payload, incline use), battery condition (age, charge level), ambient temperature and vehicle condition will all put constraints on how long a vehicle can be used before the batteries are discharged.

An automatic, 115 VAC (230 VAC on international models) battery charger is included with the vehicle. An interlock switch on the vehicle charger receptacle prevents the vehicle from operating when the charger cord is plugged into the vehicle.

The electric traction motor directly drives a double reduction transaxle with differential. Operator inputs for forward/reverse, supervisor switch position (high or low speed) and accelerator pedal position are used by the controller to determine voltage to the traction motor.

The traction motor is cooled with an external fan. Additionally, the motor is protected from overheating by a thermal switch in the motor housing. If unsafe motor temperature is sensed by the switch, the controller is signaled to limit vehicle speed and torque until the motor temperature reduces to a normal level.

The vehicle controller is a sealed electronic logic device that uses inputs from several vehicle components to control motor speed and direction. These inputs include several switches (on/off, forward/reverse, accelerator, supervisor, charger), a motor temperature sensor, an accelerator pedal potentiometer and the vehicle contactor (solenoid). The controller also provides regenerative braking to assist in slowing the vehicle. The controller has fault detection capabilities to help identify system problems. Battery current is available to the controller whenever the on/off switch is ON which energizes the main contactor. A high current fuse protects this high current circuit.

The Workman controller also provides a roll off warning in instances when the vehicle begins to move (roll away) after being stopped. On an incline and with the on/off switch in the ON position, if the vehicle starts moving, the alarm will sound warning the operator that the vehicle is moving. When the vehicle goes into this roll-off mode, regenerative braking will limit vehicle speed.

Vehicle accessories include headlights, horn and optional electrical equipment. The accessories contactor (solenoid) on the vehicle provides battery current to these components when the on/off switch is ON. Fuses provide circuit protection for these accessories.

Special Tools

Multimeter

The multimeter can test electrical components and circuits for current, resistance or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt–Ohm–Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

NOTE: Workman e2050 and e2065 vehicles use a 48 volt, DC electrical system. If multimeter is not of the auto–range type, make sure to properly set multimeter range before performing any voltage test.

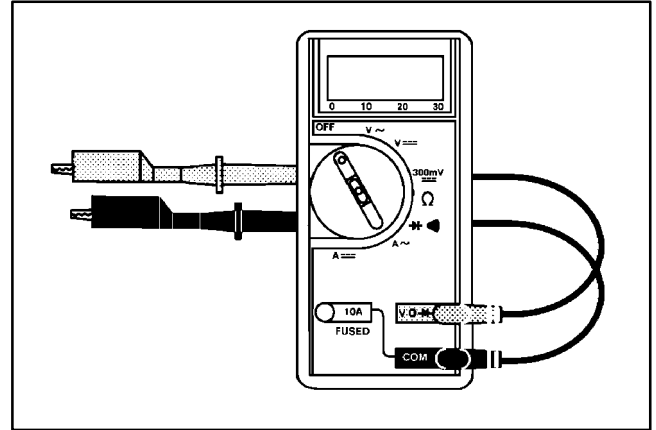


Figure 3

Battery Terminal Protector

Battery Terminal Protector (Toro Part No. 107–0392) is an aerosol spray that should be used on all battery and controller terminals to reduce corrosion problems. Apply terminal protector after cable has been secured to terminal.



Figure 4

Dielectric Gel

Dielectric gel (Toro Part No. 107–0342) should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.



Figure 5

Battery Watering Dispenser

Use the battery watering dispenser when adding distilled water to vehicle batteries. Obtain watering dispenser locally.



Figure 6

Battery Hydrometer

Use the battery hydrometer when measuring specific gravity of battery electrolyte. Obtain hydrometer locally.



Figure 7

Battery Lift Strap

Use the battery lift strap to remove and install batteries from the vehicle. Lift strap allows use of case loops on battery tops as safe battery lifting points. Obtain battery lift strap locally.



Figure 8

36/48 Volt Battery Discharge Unit

The 36/48 Volt Battery Discharge Unit (TOR4106) is recommended for quick and accurate load testing for the batteries on the Workman e2050 and e2065. This tool is used to determine the capacity of the Workman battery pack and also for finding faulty battery or batteries in the battery pack.

Order the 36/48 Volt Battery Discharge Unit (TOR4106) from your Toro Distributor.



Figure 9

Troubleshooting



CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect a battery cable from the battery pack to open the battery circuit unless a test procedure requires battery voltage.

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this vehicle (see Electrical Schematic in Chapter 6).

If the vehicle has any switches by-passed, they must be reconnected for proper vehicle operation, troubleshooting and safety.

General Run Problems

NOTE: Check vehicle status light on dash panel and controller LED for possible faults whenever diagnosing vehicle problems (see Controller in the Component Testing section of this chapter).

Problem	Possible Causes
Main contactor clicks, but vehicle will not operate.	Battery charge is low. Battery cables are loose, corroded or damaged. Cable connection(s) at controller is/are loose or corroded. Cable connection(s) at traction motor is/are loose or corroded. Traction motor is faulty. Controller is faulty.
Nothing happens when on/off switch is turned to ON.	Battery charge is extremely low. Battery cables are loose, corroded or damaged. Cable connection(s) at controller is/are loose or corroded. 10 ampere fuse (F2) to the on/off switch is loose or blown. Fusible link FL2 is faulty. Main fuse (F1) is loose or blown. The on/off switch or circuit wiring is faulty. Controller is faulty.

General Run Problems (Continued)

Problem	Possible Causes
Traction motor stops during operation.	<p>Wiring to the traction motor components (e.g. main contactor, controller, traction motor) loose, corroded or damaged (see Electrical Schematic in Chapter 6 – Electrical Diagrams).</p> <p>Battery cables are loose, corroded or damaged.</p> <p>Controller is overheated.</p> <p>Traction motor is overheated.</p> <p>Traction motor is faulty.</p> <p>Brake or transaxle problem (see Chapter 4 – Transaxle and Brakes).</p>
Vehicle runs slowly.	<p>Supervisor speed limit switch in slow position.</p> <p>Tire pressure is low (see Chapter 5 – Chassis).</p> <p>Brakes improperly adjusted (see Chapter 4 – Transaxle and Brakes).</p> <p>Battery charge is extremely low.</p> <p>Controller is overheated.</p> <p>Traction motor is overheated.</p>
Vehicle movement is erratic or jerky.	<p>Collar on throttle is loose.</p> <p>Accelerator potentiometer is improperly adjusted.</p> <p>Accelerator system is out of adjustment.</p>

Battery Charger Operation

Light Status	Indicates
Green light on battery charger illuminated (not flashing).	Batteries is fully charged. Vehicle ready to operate.
Green light on battery charger flashing.	<p>Slow flash (once per second): Batteries being charged (batteries less than 80% charged). Continue charging.</p> <p>Rapid flash (four times per second): Batteries being charged (batteries more than 80% charged). Continue charging.</p>
Red light on battery charger flashing.	<p>Rapid flash: Charger timer shutoff has occurred after 20 hours of charging.</p> <p>Slow flash: No current to charger. Check AC outlet.</p>

Battery Charger Problems

Problem	Possible Causes
Battery charger does not turn on.	AC outlet fuse/circuit breaker blown. AC outlet is faulty. Vehicle wiring is loose or damaged (see electrical schematic in Chapter 6 – Electrical Diagrams). Fusible link FL1 is damaged. Vehicle charger interlock switch or circuit wiring faulty. Vehicle charger receptacle or circuit wiring damaged. Battery charger is faulty.
Battery charger does not turn off.	Battery charger is faulty. NOTE: Charging new batteries or charging batteries in cold temperatures may require extended charge time to achieve full charge.
Battery charger fuse blows.	Vehicle battery polarity is reversed (vehicle battery cables incorrectly attached). Vehicle charger receptacle polarity is reversed. Battery charger is faulty.
The AC outlet circuit breaker or fuse blows when using the battery charger.	Overloaded AC circuit. Battery charger is faulty.

Adjustments

Accelerator Switch Adjustment

1. Position vehicle on a level surface, turn On/Off switch OFF and remove key. Apply parking brake.
2. Make sure that at complete brake pedal travel, the park detent and pawl are fully engaged. If needed, adjust the accelerator pedal stop cap screw to allow full engagement (Fig. 11).
3. Disengage the parking brake.
4. With the accelerator pedal released, check that the distance between the head of the accelerator switch stop cap screw and the body of the switch is 5/8 inch (1.6 cm) (Fig. 12).
5. If distance is incorrect, loosen lock nut and adjust accelerator switch stop cap screw position (Fig. 11).
6. After adjustment, make sure that switch plunger is not bottomed out when accelerator pedal is released.
7. After adjustment to switch stop cap screw, make sure that the switch does not open when the parking brake is engaged. Readjust switch stop cap screw if required.
8. Calibrate accelerator system after adjusting accelerator switch (see Accelerator System Calibration in this section).

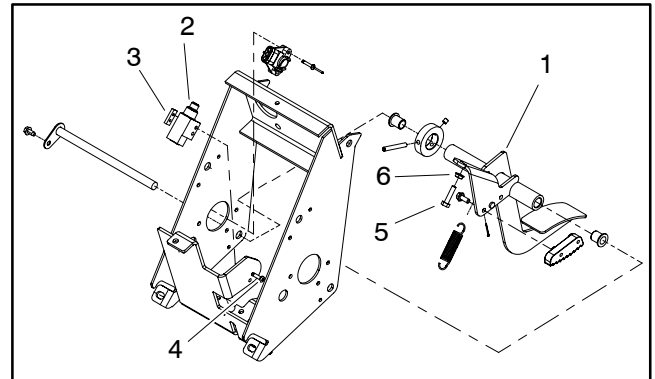


Figure 10

- | | |
|-----------------------|--------------------------|
| 1. Accelerator pedal | 4. Screw (2 used) |
| 2. Accelerator switch | 5. Switch stop cap screw |
| 3. Plate | 6. Lock nut |

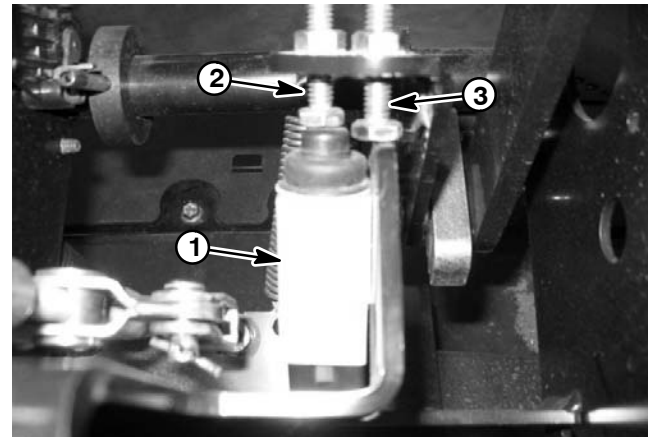


Figure 11

- | |
|-------------------------------|
| 1. Accelerator switch |
| 2. Switch stop cap screw |
| 3. Accelerator stop cap screw |

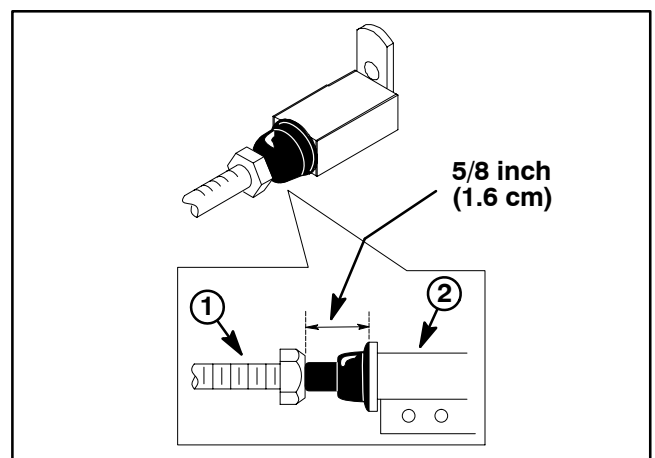


Figure 12

- | | |
|--------------------------|-----------------------|
| 1. Switch stop cap screw | 2. Accelerator switch |
|--------------------------|-----------------------|

Accelerator Potentiometer Adjustment

The accelerator potentiometer is used as one of the inputs for the vehicle controller and is attached to the pedal frame under the dash (Fig. 13). A collar with roll pin on the accelerator pedal shaft positions the accelerator potentiometer lever.

If the accelerator potentiometer is out of adjustment, the diagnostic light on the dash will flash six (6) times. Additionally, if vehicle movement is erratic and jerky, potentiometer adjustment and calibration of the accelerator system should be performed.

Adjustment

1. Position vehicle on a level surface, turn On/Off switch OFF and remove key.

2. Make sure that accelerator potentiometer is securely attached to the pedal frame of the machine.

3. Check accelerator switch adjustment and adjust if necessary (see Accelerator Switch Adjustment in this section).

4. Check movement of the accelerator potentiometer lever:

A. With the accelerator pedal released, the roll pin on the throttle position collar should keep the potentiometer lever from 0.050" to 0.100" (1.3 to 2.5 mm) from the lower stop on the potentiometer body (Figure 14).

B. With the accelerator pedal fully depressed, the input lever of the potentiometer should not contact the upper stop on the potentiometer body (Figure 15).

5. If potentiometer lever movement is incorrect, adjust location of collar on accelerator pedal shaft:

A. Loosen two (2) set screws that secure throttle position collar to throttle pedal shaft and reposition collar to allow correct potentiometer movement. Make sure that there is clearance between roll pin and side of potentiometer lever to prevent binding.

B. Remove set screws one at a time from collar and apply Loctite #242 (or equivalent) to set screw threads. Install and tighten set screws to secure collar to accelerator pedal shaft.

C. Recheck potentiometer lever movement.

6. Calibrate accelerator system after any accelerator potentiometer adjustment (see Accelerator System Calibration in this section).

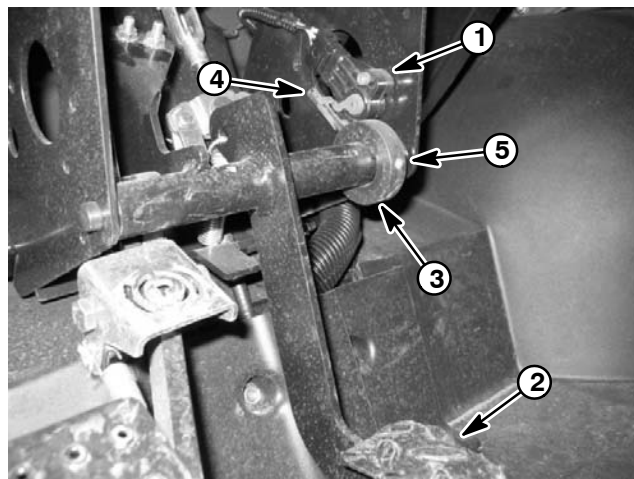


Figure 13

- | | |
|-----------------------------|-----------------------|
| 1. Potentiometer | 4. Roll pin |
| 2. Accelerator pedal | 5. Set screw (2 used) |
| 3. Throttle position collar | |

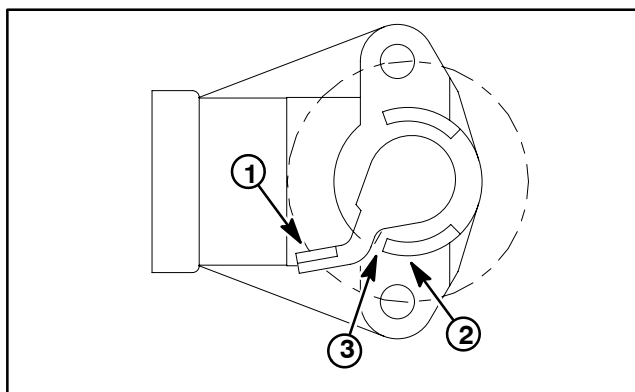


Figure 14

- | |
|---|
| 1. Potentiometer lever (accelerator pedal released) |
| 2. Potentiometer lower stop |
| 3. Gap of 0.050" to 0.100" (1.3 to 2.5 mm) |

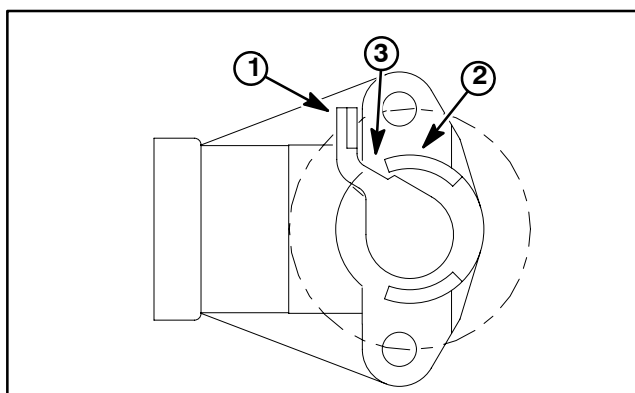


Figure 15

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| 1. Potentiometer lever (accelerator pedal fully depressed) |
| 2. Potentiometer upper stop |
| 3. No lever contact with stop |

Accelerator System Calibration

The accelerator system on the Workman e2050 and e2065 includes the accelerator pedal assembly, the accelerator potentiometer, the accelerator switch and the controller. If any of these components are adjusted, removed or replaced, the following calibration procedure should be performed. Additionally, if vehicle movement is erratic and jerky or if the diagnostic light on the dash is flashing six (6) times, calibration of the accelerator system should be performed.

1. Position vehicle on a level surface, turn On/Off switch OFF and remove key. Raise bed and secure with prop rod. Remove controller cover.
2. Check accelerator switch adjustment and adjust if necessary (see Accelerator Switch Adjustment in this section).
3. Check accelerator potentiometer adjustment and adjust if necessary (see Accelerator Potentiometer Adjustment in this section).
4. Using a jumper wire, connect gray controller lead to ground post (B-) on controller (Fig. 16).

NOTE: During calibration, the vehicle status light on the dash should flash the same as the controller LED.

5. Turn On/Off switch ON. The alarm should sound and the controller LED should flash six (6) times.
6. Slowly depress accelerator pedal until the alarm momentarily stops and hold pedal in position. This should take a very small movement of the pedal. Once alarm resumes, release accelerator pedal completely.
7. Depress and hold accelerator pedal fully. Alarm will momentarily stop while controller calibration occurs. Hold pedal fully depressed until alarm resumes and then release pedal.
8. If calibration process was successful, alarm will chirp and diagnostic light on the dash will be lit continuous (not flashing). If alarm continues to sound or if diagnostic light is flashing, turn On/Off switch OFF and repeat steps 5, 6 and 7.
9. Turn On/Off switch OFF and remove key. Disconnect jumper wire from gray controller lead and controller ground post (B-).
10. Install controller cover and lower bed.
11. If vehicle operation continues to be erratic after completing the accelerator system calibration procedure, evaluate the components in the accelerator system: accelerator switch, accelerator potentiometer, accelerator pedal, circuit wiring and controller.

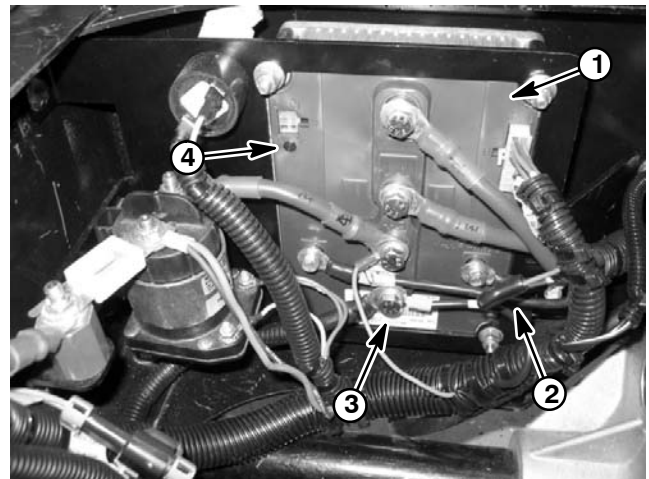



Figure 16

- | | |
|-------------------------|---------------------|
| 1. Controller | 3. Ground post (B-) |
| 2. Gray controller lead | 4. Controller LED |

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. disconnect the harness wire connectors from the vehicle on/off switch before doing a continuity check on the on/off switch).


**CAUTION**

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

On/Off Switch

The Workman on/off switch is located on the dash panel (Fig. 17). The switch has two (2) positions (OFF and ON) and three (3) switch terminals. Only two of the terminals are used on the Workman e2050 and e2065. The switch terminals are positioned as shown in Figure 18.

Testing

**CAUTION**

When testing the on/off switch for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

When the on/off switch is in the OFF position, no continuity should exist between the common (center) switch terminal and the switched (side) terminal. In the ON position, continuity should exist between the common (center) switch terminal and the switched (side) terminal.

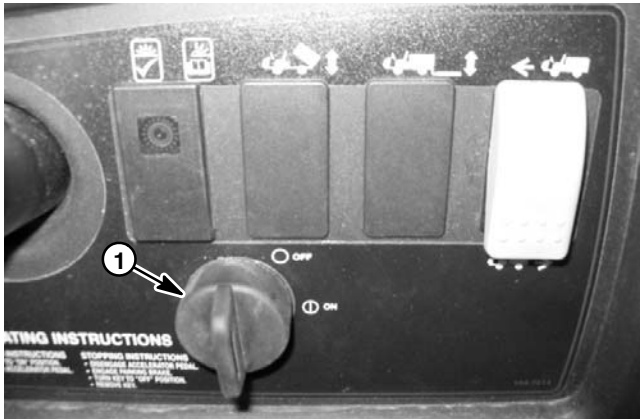


Figure 17
1. On/Off switch

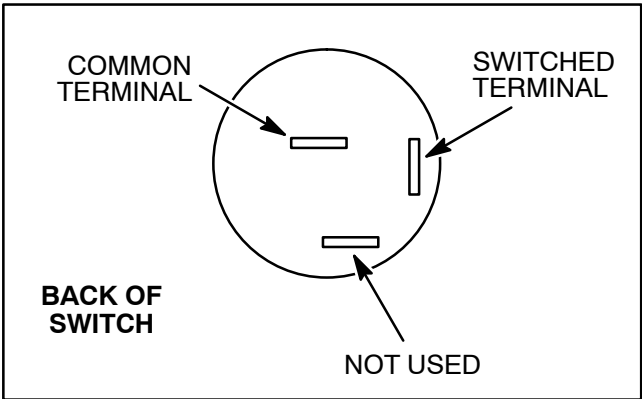


Figure 18

Battery Discharge Indicator and Hour Meter Gauge

The combination battery discharge indicator and hour meter gauge is located on the dash panel (Fig. 19).

The battery indicator identifies state of charge of the battery pack. The battery indicator reads full (10 bars) when the battery pack is fully charged (approximately 51 volts). As battery pack voltage decreases with vehicle use, fewer battery indicator bars are shown.

When the battery indicator reaches 2 bars, a warning light illuminates and a battery icon flashes on the gauge face to identify that battery charge level is extremely low. At this point, the batteries should be charged.

If the battery indicator reaches 1 bar, the warning light begins flashing and the vehicle will go into an energy saving mode: vehicle speed will be reduced to 3 MPH. At this point, the batteries should be charged to prevent serious battery damage.

The hour meter registers operating time of the vehicle. Whenever the vehicle is in motion, the hour meter increases one tenth every 6 minutes. If the vehicle remains stationary for 30 seconds (even if the on/off switch is ON), the hour meter quits increasing.

The back of the gauge is shown in Figure 20. A wire harness connector plugs into the gauge. Terminals 1, 2 and 5 are not used on the Workman e2050/e2065. See Chapter 6 – Electrical Diagrams for schematic and wire harness information.

If the battery discharge indicator or the hour meter prove to be inaccurate, the gauge should be replaced.

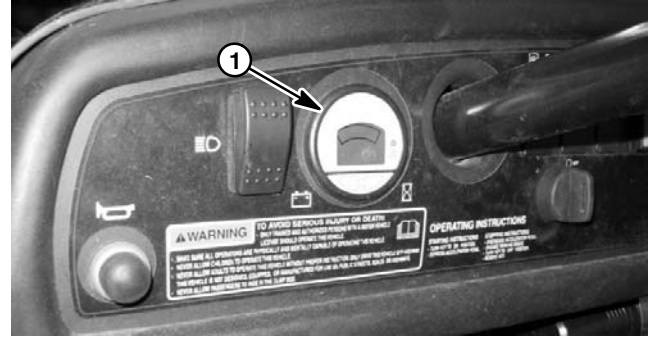


Figure 19

1. Battery discharge indicator and hour meter

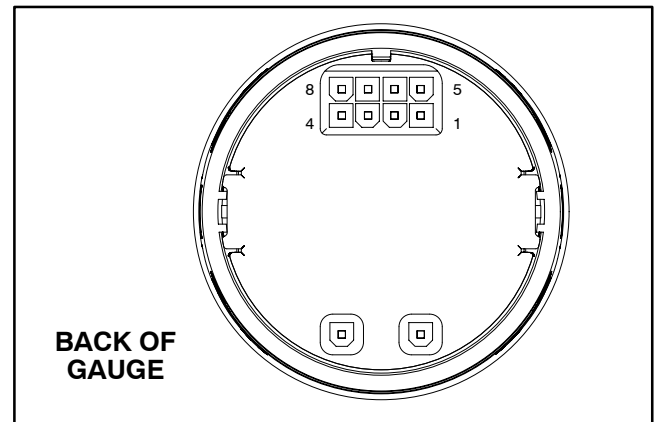


Figure 20

Vehicle Direction (Forward/Reverse) and Headlight Switches

The vehicle direction (forward/reverse) switch (Fig. 21) and headlight switch (Fig. 22) are located on the control panel. These two switches have identical logic.

The vehicle direction switch is one of several inputs for the vehicle controller and allows the direction (forward/reverse) of the vehicle to be changed by the operator.

The headlight switch allows the headlights to be turned on and off.

NOTE: The headlight system on the Workman e2050 and e2065 consists of two (2) 24 volt lamps connected in series. If one lamp is burned out or disconnected, neither lamp will illuminate.

Testing

The switch terminals for these switches are marked as shown in Figure 23. The circuitry of the switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF / FORWARD	1 + 2	4 + 5
ON / REVERSE	2 + 3	5 + 6

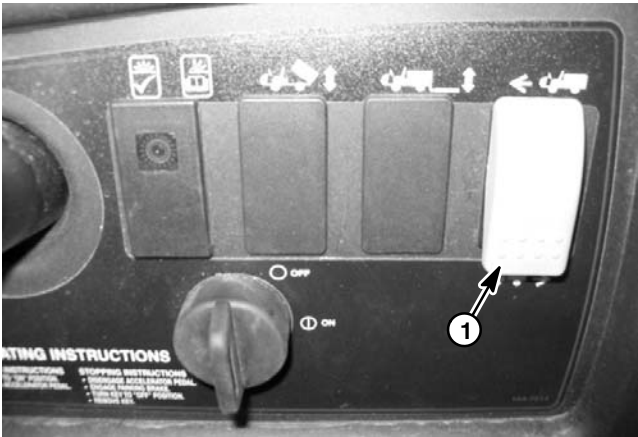


Figure 21
1. Direction switch



Figure 22
1. Headlight switch

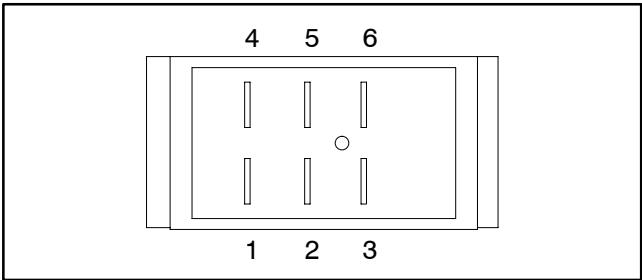


Figure 23

Vehicle Status Light

The vehicle status light is located on the control panel (Fig. 24). During normal operation, the status light should be continuously illuminated. A vehicle electrical problem will be identified by a flashing status light.

The vehicle status light and LED on the vehicle controller should have the same condition (off, illuminated or flashing). If the vehicle status light does not illuminate when the on/off switch is turned ON, check the LED on the vehicle controller to make sure it is illuminated. If the controller LED is illuminated and the vehicle status light is not illuminated, check the vehicle status light and circuit wiring.

See Controller (in this section) and your Operator's Manual for information on a flashing vehicle status light.

Testing

1. Make sure on/off switch is turned OFF. Remove key from switch.
2. Disconnect wire harness from vehicle status light.

NOTE: The vehicle status light is a 12 volt DC component. **Do not** test the light using jumper wires from the vehicle battery pack (48 VDC).

3. The terminals for the light are marked as shown in Figure 25. Correctly connect 12 VDC source to the light terminals.

4. Light should illuminate. Remove voltage source from the light and reconnect wire harness. Replace status light if needed.

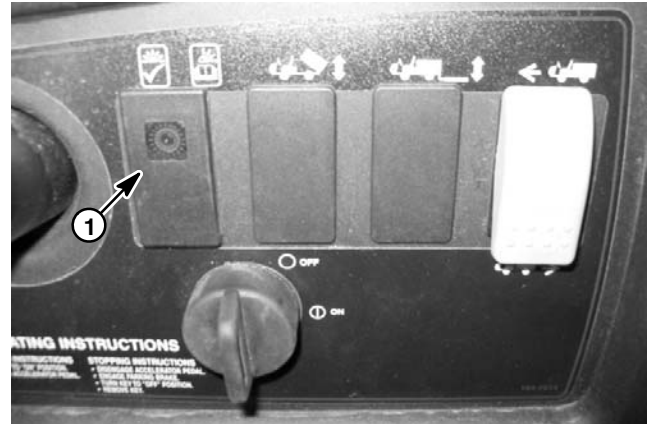


Figure 24

1. Vehicle status light

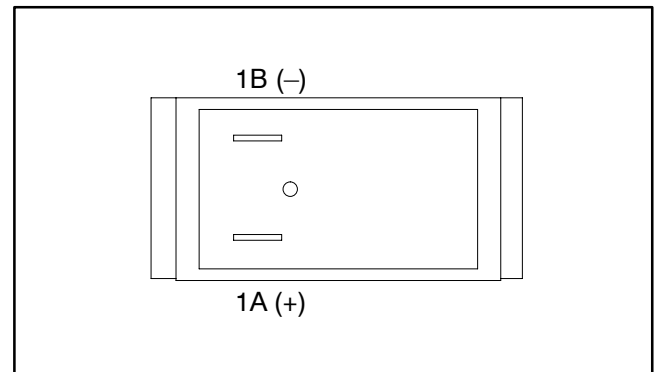


Figure 25

Supervisor Speed Limit Switch (Workman e2050)

The supervisor speed limit switch is open in Off position (key vertical) and closed in On position (key rotated clockwise). The speed limit switch is one of several inputs for the vehicle controller and allows the speed of the vehicle to be limited.

Test the switch by disconnecting the wiring and connecting a continuity tester across the two switch terminals. Rotate key to On position: there should be an indication of continuity. Rotate key to Off position: there should be no continuity.

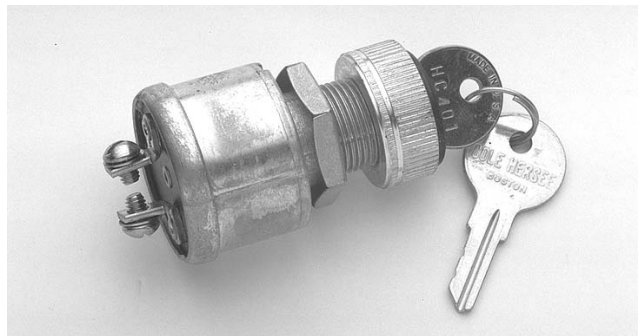


Figure 26

Supervisor Speed Limit Switch (Workman e2065)

The supervisor speed limit switch is open in Off position (key vertical) and closed in On position (key rotated clockwise). The speed limit switch is one of several inputs for the vehicle controller and allows the speed of the vehicle to be limited.

Test the switch by disconnecting the wiring and connecting a continuity tester across switch terminals A and D (Fig. 27). Rotate key to On position: there should be an indication of continuity. Rotate key to Off position: there should be no continuity.

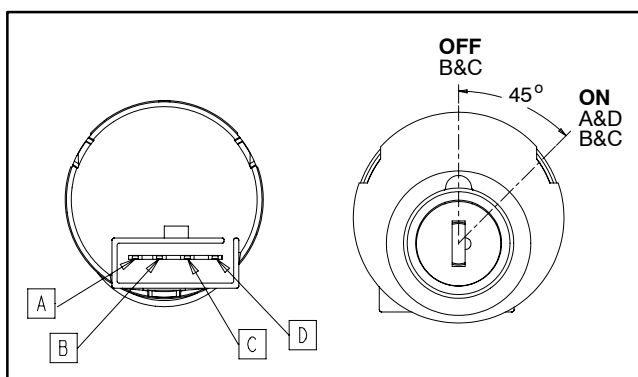


Figure 27

Audio Alarm (Reverse)

The audio alarm sounds when the forward/reverse switch is placed in the reverse position. The alarm is located under the controller cover beneath the bed.

Testing

IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

NOTE: The audio alarm is a 12 volt DC component. Do not test the alarm using jumper wires from the vehicle battery pack (48 VDC).

1. Make sure on/off switch is turned OFF. Remove key from switch. Raise bed and remove controller cover.
2. Disconnect wire harness connectors from alarm (Fig. 28). Using jumper wires, correctly connect 12VDC source to the alarm terminals noting polarity shown on alarm decal.

3. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit or replace alarm if needed.

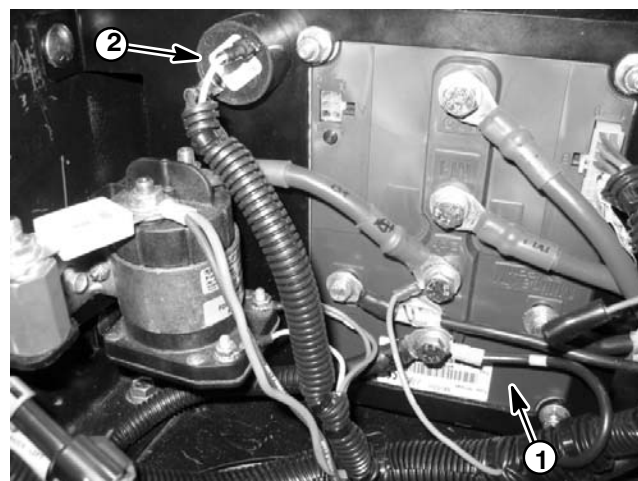


Figure 28

1. Controller
2. Audio alarm

Charger Interlock Switch

The charger interlock switch is located behind the charger receptacle plate on the front of the seat base (Fig. 29). When the battery charger is plugged into the charger receptacle, the interlock switch closes and provides an input to the vehicle controller to inhibit vehicle operation.

NOTE: The vehicle should not operate if the charger plug is connected to the charger receptacle.

1. Make sure vehicle On/Off switch is OFF. Remove key from switch.
2. Remove receptacle plate from front of seat base.
3. Locate charger interlock switch on rear of receptacle plate. Disconnect harness connector from the switch.
4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
5. When the switch plunger is extended there should not be continuity between the switch terminals.
6. When the switch plunger is depressed, there should be continuity between the switch terminals.
7. Reconnect harness connector to switch. Install receptacle plate to front of seat base.

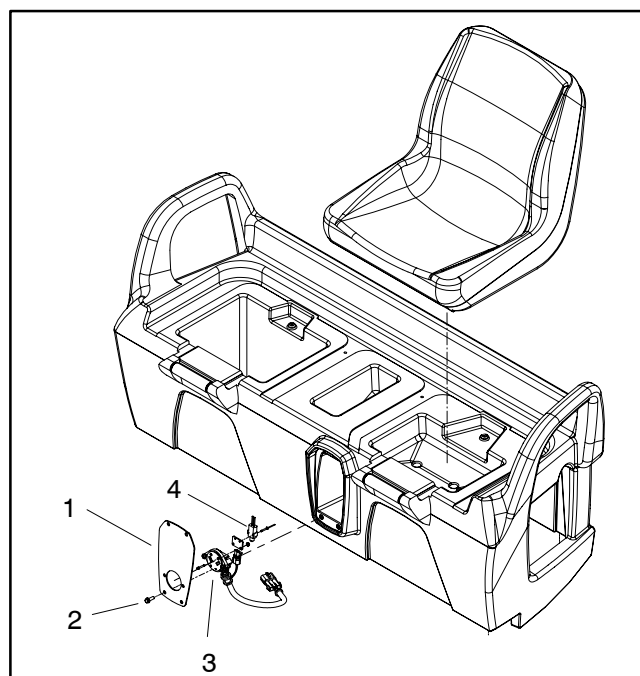


Figure 29

- | | |
|---------------------|-----------------------------|
| 1. Receptacle plate | 3. Charger receptacle |
| 2. Screw (4 used) | 4. Charger interlock switch |

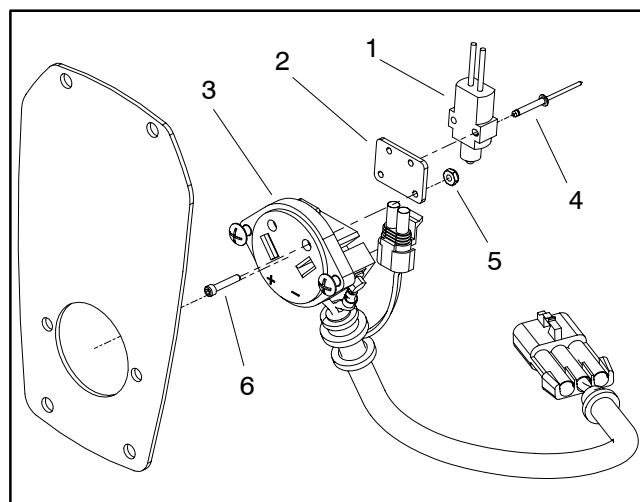


Figure 30

- | | |
|-----------------------------|----------------------|
| 1. Charger interlock switch | 4. Rivet (2 used) |
| 2. Switch plate | 5. Lock nut (2 used) |
| 3. Charger receptacle | 6. Socket head screw |

Main and Accessories Contactors

Two contactors (solenoids) are used on the Workman e2050 and e2065 for circuit control.

The main contactor provides current to the vehicle controller and is energized when the on/off switch is ON. The main contactor is located under the controller cover beneath the bed (Fig. 31).

The accessories contactor provides current to the headlights, horn and optional electrical accessories. The accessories contactor is energized when the on/off switch is ON. The accessories contactor is located beneath the dash panel.

Testing

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less) that is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Make sure on/off switch is turned OFF. Open the battery circuit by removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter and Fig. 32).

2. Locate contactor that is to be tested. Disconnect all vehicle harness electrical connections from contactor. Note wire connector locations on contactor for reassembly purposes.

3. Using jumper wires, apply 48 VDC directly across the contactor coil posts (Fig. 33). The contactor should click. With the contactor coil energized, resistance across the main contact posts should be less than **1 ohm**.

4. Remove voltage from contactor coil posts. The contactor should click. With the contactor coil not energized, resistance across the main contact posts should be **infinite ohms**.

5. Measure resistance across the contactor coil posts (Fig. 33):

A. For the main contactor, the resistance should be approximately 126 ohms.

B. For the accessories contactor, the resistance should be approximately 200 ohms.

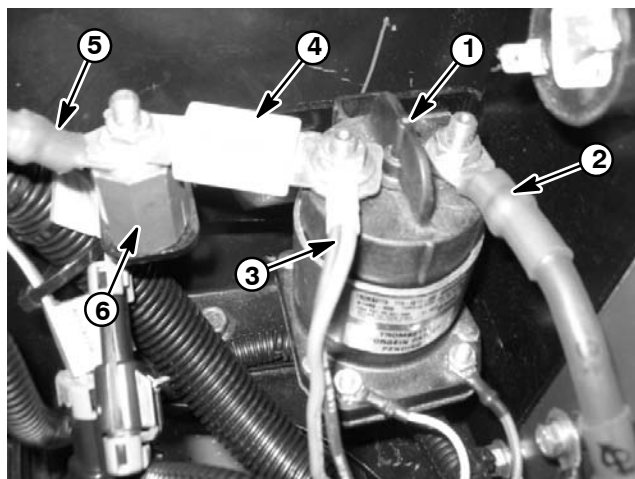


Figure 31

- | | |
|---------------------------|---------------------------|
| 1. Main contactor | 4. Fuse (F1) |
| 2. Cable to controller B+ | 5. Positive battery cable |
| 3. Wire harness connector | 6. Isolator |

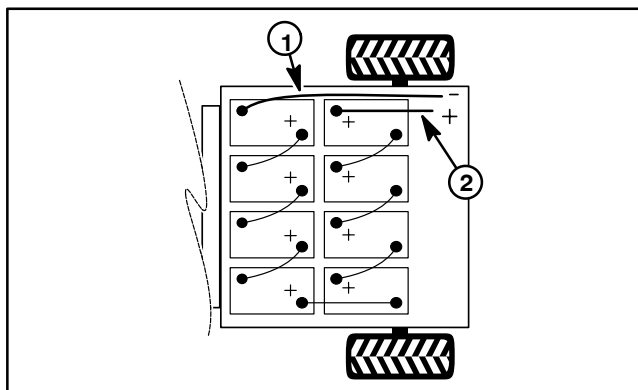


Figure 32

- | | |
|------------------------------|------------------------------|
| 1. Negative cable to vehicle | 2. Positive cable to vehicle |
|------------------------------|------------------------------|

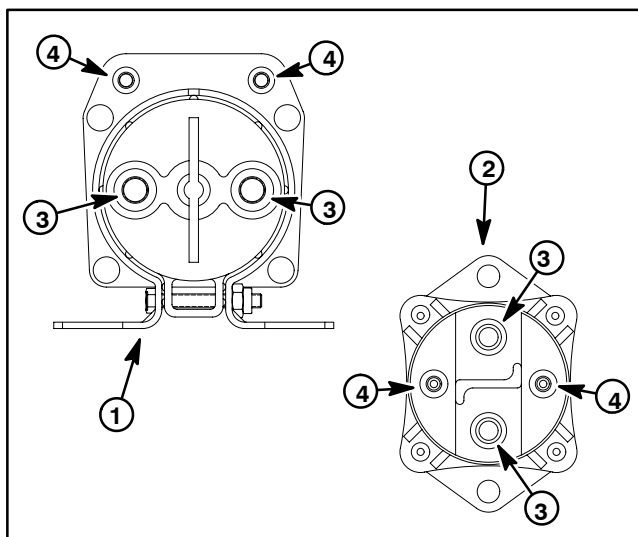


Figure 33

- | | |
|--------------------------|-------------------------|
| 1. Main contactor | 3. Main contact posts |
| 2. Accessories contactor | 4. Contactor coil posts |

6. Replace contactor if necessary.

7. Reconnect electrical connections to contactor. If main contactor connections were removed, use Figure 34 as a guide for reattaching cable and wire harness connections.

8. Reconnect battery cable that was removed from battery pack.

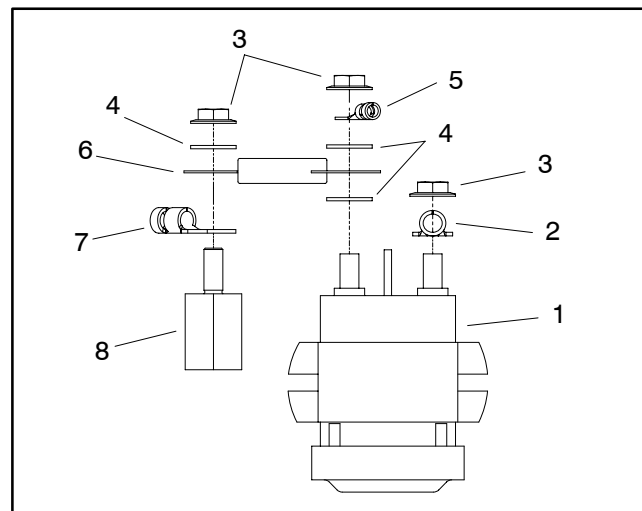


Figure 34

- | | |
|---------------------------|---------------------------|
| 1. Main contactor | 5. Wire harness connector |
| 2. Cable to controller B+ | 6. Fuse (F1) |
| 3. Lock nut | 7. Positive battery cable |
| 4. Flat washer | 8. Isolator |

Fuses

There are three (3) fuses in the Workman electrical system.

Two (2) of the fuses are located beneath the steering column (Fig. 35). These fuses supply power to the following:

The upper 10 ampere fuse (F2) supplies power to the on/off switch and switched circuits.

The lower 10 ampere fuse (F3) supplies power to optional accessories.

The third fuse (F1) is located under the controller cover beneath the bed (Fig. 36). This fuse is rated at 355 amperes continuous and allows current flow between the batteries and the vehicle. If this fuse has failed, vehicle operation will not occur.

Testing



CAUTION

When testing fuses for continuity with a multimeter (ohms setting), make sure that fuse is removed from circuit.

IMPORTANT: Before removing fuse F1 (355 Amp) for testing, open the battery circuit by removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

Make sure on/off switch is turned OFF. Remove fuse to check continuity. The test meter should read **less than 1 ohm**.

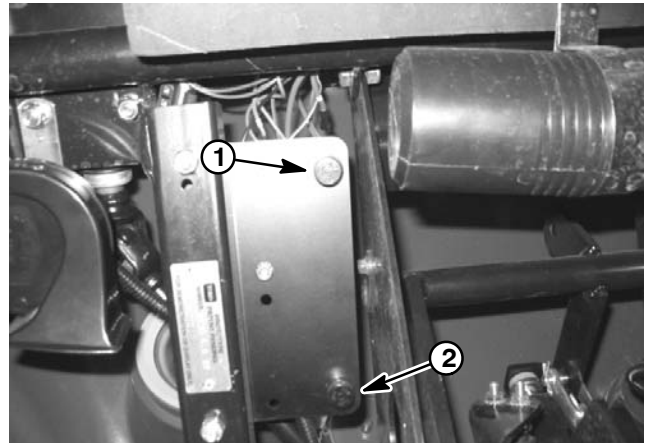


Figure 35

1. Fuse (F2)

2. Fuse (F3)

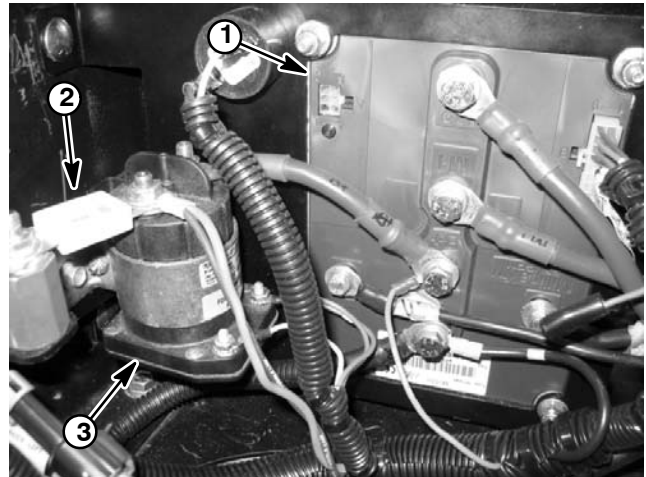


Figure 36

1. Controller
2. Fuse (F1)

3. Main contactor

Fusible Links

The wiring harness for the Workman includes three (3) fusible links for circuit protection (Fig. 37).

Two fusible links attach to the same main contactor post as the main fuse. One of these fusible links (FL2) is used for the switched power circuit. The other fusible link (FL1) protects the charger circuit.

The third fusible link (FL3) is attached to the controller B+ terminal. This link provides protection for the charge indicator/hour meter gauge.

If any of these fusible links should fail, the affected circuit will not function. See Chapter 6 – Electrical Diagrams for schematic and wire harness information.

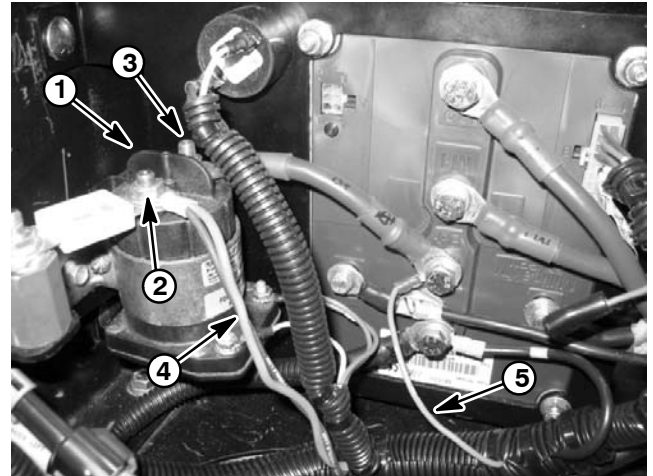


Figure 37

- | | |
|-----------------------------|----------------------------|
| 1. Main contactor | 4. Fusible links FL1 & FL2 |
| 2. Main fuse contactor post | 5. Fusible link FL3 |
| 3. Switched contactor post | |

Accelerator Switch

The accelerator switch is a four terminal, two circuit switch that is located on the control pedal frame (Fig. 38). The Workman e2050 and e2065 use only one of the switch circuits (terminals 3 and 4). When the accelerator pedal is depressed, the switch allows a closed circuit (input) for the controller to allow traction motor operation. When the accelerator pedal is released, the switch provides an open circuit (no input) for the controller to prevent traction motor operation.

Testing

1. Park vehicle on a level surface, turn On/Off switch OFF and remove key from switch.
2. Locate accelerator switch on pedal frame under dashboard of vehicle.
3. Unplug wiring harness connector from accelerator switch.
4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the switch terminals for both switch positions. Verify continuity between switch terminals using the following table:

PLUNGER POSITION	CONTINUITY	NO CONTINUITY
IN	1 and 2	3 and 4
OUT	3 and 4	1 and 2

5. When reconnecting wiring harness connector to switch after testing, harness connector and switch terminal area should be filled with dielectric gel (see Special Tools) to prevent corrosion of connection terminals. Apply gel fully to both harness connector and switch terminal area, plug harness connector into switch to distribute gel, unplug harness connector, reapply gel to both surfaces and replug harness connector into switch.

6. If switch replacement is needed, see Accelerator Switch Adjustment procedure in the Adjustments section of this chapter.

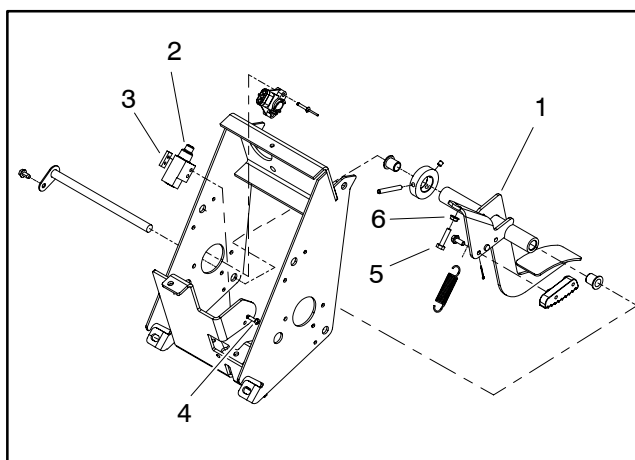


Figure 38

- | | |
|-----------------------|-------------------|
| 1. Accelerator pedal | 4. Screw (2 used) |
| 2. Accelerator switch | 5. Stop cap screw |
| 3. Plate | 6. Lock nut |

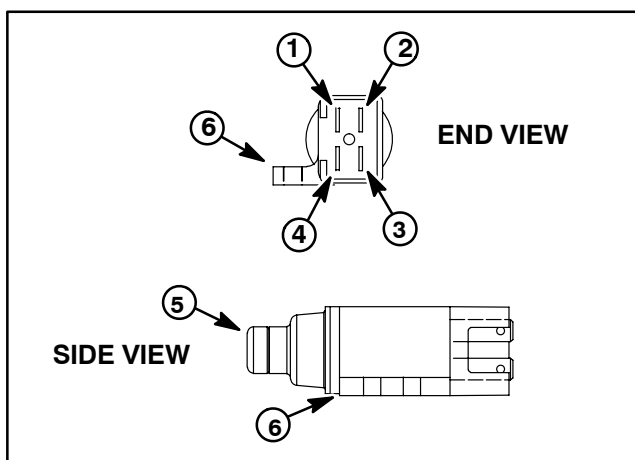


Figure 39

- | | |
|---------------|-------------------|
| 1. Terminal 1 | 4. Terminal 4 |
| 2. Terminal 2 | 5. Switch plunger |
| 3. Terminal 3 | 6. Mounting tab |

Accelerator Potentiometer

The accelerator potentiometer is attached to the pedal frame under the dash (Fig. 40). This potentiometer is used as one of the inputs for the vehicle controller to command vehicle speed. The accelerator pedal positions the accelerator potentiometer lever. When the operator presses or releases the accelerator pedal, the potentiometer resistance changes. This resistance change is used by the controller to determine current flow to the traction motor.

If the accelerator potentiometer is out of adjustment, the diagnostic light on the dash will flash six (6) times. Additionally, if vehicle movement is erratic and jerky, calibration of the accelerator system should be performed. See Accelerator Potentiometer Adjustment and Accelerator System Calibration in the Adjustments section of this chapter.

Before suspecting a faulty potentiometer, follow adjustment procedures for the accelerator switch, accelerator potentiometer and acceleration system calibration found in the Adjustments section of this chapter.

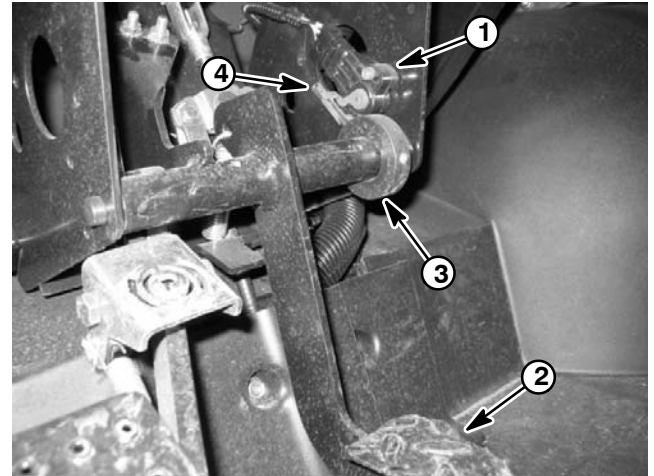


Figure 40

- | | |
|----------------------|-------------|
| 1. Potentiometer | 3. Collar |
| 2. Accelerator pedal | 4. Roll pin |

Controller

The Workman controller is secured to the rear frame under the controller cover beneath the bed (Fig. 41). The controller uses inputs from several vehicle switches (on/off, forward/reverse, accelerator pedal, supervisor, charger interlock, motor temperature, accelerator potentiometer) to accurately control vehicle speed, vehicle direction (forward and reverse) and regenerative braking. An internal thermal sensor prevents overheating of the controller.

Cable connections for the controller are as follows:

Terminal B-: Negative (-) battery cable and wire harness ground.

Terminal B+: Positive (+) cable from main contactor post and wire harness fusible link (FL3).

Terminal M1: Cable to traction motor armature A2 post.

Terminal M2: Cable to traction motor armature A1 post.

Terminal F1: Cable to traction motor field F1 post.

Terminal F2: Cable to traction motor field F2 post.

When installing cables to controller, torque screws at terminals B-, B+, M1 and M2 from 85 to 90 in-lb (9.6 to 10.2 N-m) and torque screws at terminals F1 and F2 from 55 to 60 in-lb (6.2 to 6.8 N-m) (Fig. 42). Apply Toro battery terminal protector (see Special Tools) to controller connections after tightening terminal screws.

If wire harness connector is removed from controller, both harness connector and controller socket should be filled with dielectric gel to prevent corrosion of connection terminals and potential controller damage. Apply gel fully to both harness connector and controller socket, plug harness connector into controller to distribute gel, unplug harness connector, reapply gel to both surfaces and plug harness connector into controller.

A LED exists on the controller to identify normal operation or faults that will prevent the vehicle from operating correctly. The vehicle status light on the dash panel displays the same information as the LED on the controller. See chart below for light pattern fault codes identified by the controller LED and vehicle status light.

NOTE: If the controller LED and vehicle status light are flashing, attempt to reset the controller by turning the On/Off switch to OFF, waiting a few seconds and then turning the switch to ON. If LED and status light continue flashing, proceed with fault code identification and necessary action.

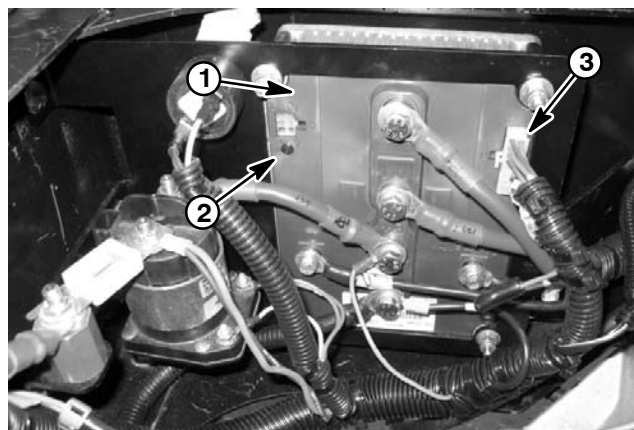


Figure 41

1. Controller
2. Controller LED
3. Wire harness connector

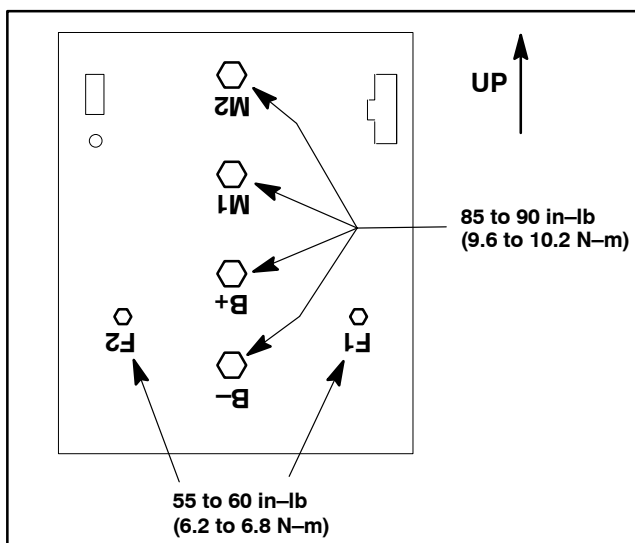


Figure 42

Light Pattern	Cause	Necessary Action
Always on (not flashing)	System functioning correctly.	None
Always off	System inoperable.	<p>Check for low battery voltage, faulty fuse(s), loose battery cable connections, damaged battery cables and/or faulty main contactor.</p> <p>If batteries, cables and other electrical components are in good condition, controller replacement may be necessary.</p>

1 Flash	System inoperable.	Turn on/off switch OFF, wait several seconds and turn on/off switch ON. If controller does not reset correctly, controller replacement may be necessary.
2 Flashes	The accelerator pedal was depressed when on/off switch was turned ON.	Turn on/off switch OFF, release accelerator pedal and turn on/off switch to ON. If controller does not reset correctly, accelerator switch adjustment may be necessary or switch may be faulty.
3 Flashes	System inoperable.	Turn on/off switch OFF, wait several seconds and turn on/off switch ON. If controller does not reset, check battery pack voltage and all battery cable connections. Also check main contactor wire and cable connections and main contactor. NOTE: If main contactor audibly clicks when on/off switch is turned ON, problem is most likely a faulty wire or cable connection. Controller replacement may be necessary.
4 Flashes	Main contactor malfunction.	Turn on/off switch OFF, wait several seconds and turn on/off switch ON. If controller does not reset, inspect main contactor (see Main and Accessories Contactors in this section). Check main contactor wire and cable connections. If problem continues, contactor replacement may be necessary.
5 Flashes	The charger cord is plugged into the vehicle charger receptacle.	Turn on/off switch OFF, unplug charger cord from vehicle and turn on/off switch ON. If controller does not reset correctly, check charger interlock switch.
6 Flashes	Accelerator control (accelerator switch and potentiometer) is out of adjustment.	Adjust accelerator switch and potentiometer (see Accelerator Switch and Accelerator Potentiometer adjustment/calibration in the Adjustments section of this chapter).
7 Flashes	Battery voltage is out of range.	Inspect and test vehicle batteries and battery cable connections (see Battery Service in the Service and Repairs section).
8 Flashes	The controller is overheated.	The vehicle will continue to operate but at reduced power until the controller temperature lowers.
9 Flashes	The traction motor is overheated (battery discharge indicator displays more than 1 bar). The battery is nearly discharged and the vehicle is in the energy saving mode (reduced speed and battery discharge indicator displays 1 bar with red light illuminated).	Stop vehicle and allow motor to cool before continuing operation. Traction motor high temperature switch may be faulty. Charge the batteries immediately to prevent battery damage.

Service and Repairs

Battery Service

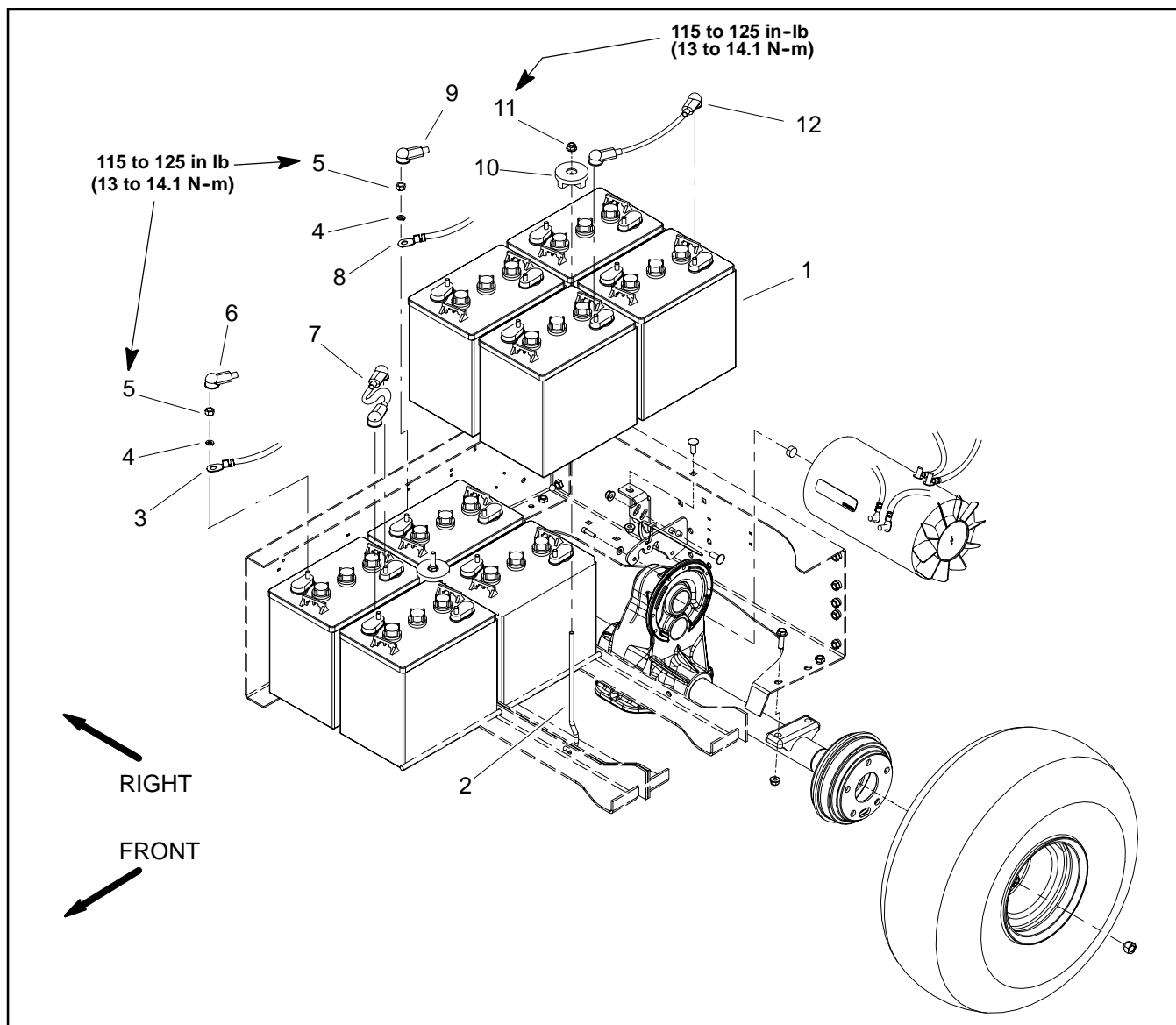


Figure 43

- | | | |
|-------------------------------------|---------------------------------|-------------------------------|
| 1. Battery (8 used) | 5. Hex nut (2 used per battery) | 9. Cable terminal boot |
| 2. Battery rod (2 used) | 6. Cable terminal boot | 10. Battery retainer (2 used) |
| 3. Negative cable to vehicle | 7. Battery cable (6 used) | 11. Flange nut (2 used) |
| 4. Lock washer (2 used per battery) | 8. Positive cable to vehicle | 12. Battery cable |

The batteries are the heart of the Workman electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

Workman e2050 Battery Specifications:


Trojan model T-105 Battery (6 Volt Deep Cycle)
Weight: 62 lbs (28 kg)
Capacity: 140 minutes @ 56.25 amps discharge

Workman e2065 Battery Specifications:

Trojan model T-145 Battery (6 Volt Deep Cycle)
Weight: 72 lbs (33 kg)
Capacity: 210 minutes @ 56.25 amps discharge

NOTE: Trojan model T-145 batteries can be used in the Workman e2050. These batteries have a higher capacity than the standard Workman e2050 batteries and therefore, have a longer run time.

Removal (Fig. 43)

**WARNING**

POTENTIAL HAZARD:
The battery terminals, metal tools and metal vehicle parts could short together.

WHAT CAN HAPPEN:
Sparks can cause the battery gasses to explode. Damaged cables could short against metal vehicle parts and cause sparks.

HOW TO AVOID THE HAZARD:
When removing or installing the batteries, do not allow the battery terminals to short against metal parts of the vehicle.
Do not allow metal tools or metal vehicle parts to short between the battery terminals or battery cables.
Always keep the battery retainers in place to protect and secure the batteries.

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Position vehicle on a level surface, set parking brake, turn On/Off switch OFF and remove key.
2. Raise bed and secure with prop rod.
3. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).
4. Once initial cable has been removed from vehicle, disconnect and remove remaining battery cables from all battery terminals.
5. Remove flange nuts (item 11) and battery retainers (item 10) used to secure batteries to vehicle (Fig. 44).
6. Make sure that all battery filler caps are on tightly.

IMPORTANT: When removing batteries from vehicle, do not lift batteries using battery terminals as lift points: battery damage may occur.

7. Using case loops on battery tops as lifting points, remove batteries from vehicle.

Installation (Fig. 43)

IMPORTANT: To prevent possible electrical problems, install only fully charged batteries.

1. Make sure vehicle on/off switch and all accessories are OFF. Raise bed and secure with prop rod.

2. Make sure the battery supports are clean and repainted if necessary. Make sure cables, terminals, rods and hold down retainers are in good condition.

IMPORTANT: When installing batteries into vehicle, do not lift batteries using battery terminals as lift points: battery damage may occur.

3. Using case loops on battery tops as lifting points, set batteries on the battery supports with battery posts properly orientated (Fig. 45). Make sure that battery rods are positioned to allow installation of retainers.
4. Install two (2) battery retainers and nuts to secure batteries to vehicle (Fig. 44). Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).
5. Install all but one of the battery cables used to connect battery pack including the positive (red) cable and negative (black) cable from vehicle (Figures 43 and 45). Make sure that cables are connected to correct battery terminal noting battery polarity. Install lock washer and nut on each battery terminal. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m) to secure cables.
6. Connect final battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).
7. Apply Toro battery terminal protector (see Special Tools) to all battery posts and cable connectors to reduce corrosion after connections are made. Make sure that terminal boots are positioned over all connections.
8. Lower bed.

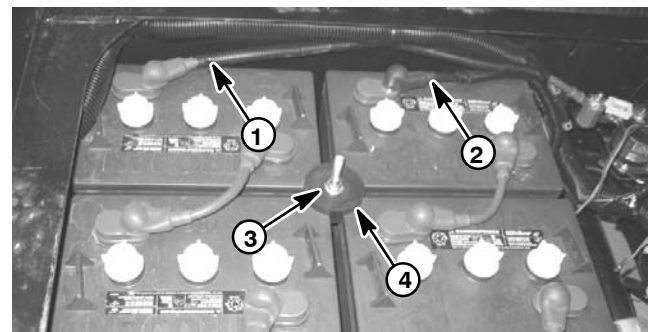


Figure 44

- | | |
|------------------------------|---------------------|
| 1. Negative cable to vehicle | 3. Flange nut |
| 2. Positive cable to vehicle | 4. Battery retainer |

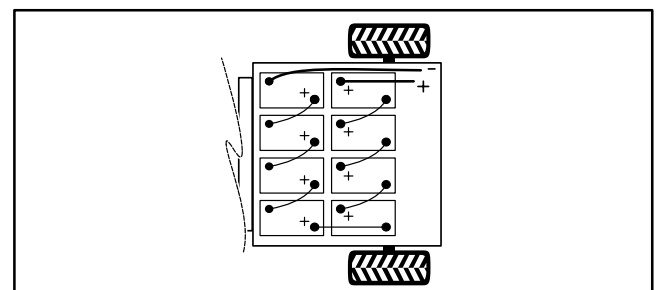


Figure 45

Charging


When the vehicle is not in use, it is recommended to keep the batteries charged by connecting the battery charger that is included with the vehicle. The Workman e2050/e2065 charger is designed to automatically charge the batteries fully without overcharging. Indicator lights (green and red) and an ammeter on the charger give information about the charging operation.

Make sure to have the battery cell plates covered with electrolyte before charging the batteries (Fig. 46). Periodically (at least every 50 operating hours) check electrolyte level in the batteries and add distilled water to ensure proper charging and the best battery performance and life.

Colder temperatures will increase the time needed to fully charge the batteries. NEVER attempt to charge frozen batteries. Also, if temperatures below freezing are expected, do not add water to battery after charging as added water could freeze and damage battery.

For additional battery charging information, see your Operator's Manual and the Battery Charger Operating Instructions.

Inspection and Maintenance

**WARNING**

POTENTIAL HAZARD:
Battery electrolyte contains sulfuric acid which is a deadly poison and it causes severe burns.

WHAT CAN HAPPEN:
If you carelessly drink electrolyte you could die or if it gets onto your skin you will be burned.

HOW TO AVOID THE HAZARD:
Do not drink electrolyte and avoid contact with skin, eyes or clothing. Wear safety glasses to shield your eyes and rubber gloves to protect your hands.

Fill the battery where clean water is always available for flushing the skin.

Follow all instructions and comply with all safety messages on the electrolyte container.

1. Check for cracks in battery case caused by overly tight or loose hold-down retainer. Replace any battery that is cracked and/or leaking.

2. Check battery terminal posts for corrosion. Use a terminal brush to clean corrosion from the battery terminal posts.

IMPORTANT: Before cleaning the battery, make sure the filler caps are on tightly.

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling.

4. Check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse battery with clean water.

5. Check that the battery cover seal is not broken away. Replace the battery if the seal is broken or leaking.

IMPORTANT: Make sure the area around the battery filler caps is clean before opening the caps.

IMPORTANT: Do not add acid to the battery. Use only distilled water to adjust the electrolyte level.

6. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, add just enough **distilled** water to the cell to cover the plates. Replace filler caps and charge the battery (see Operator's Manual). After charging, check electrolyte level in all cells and add **distilled** water until the level is 1/8" (3 mm) below the bottom of the fill well (Fig. 46).

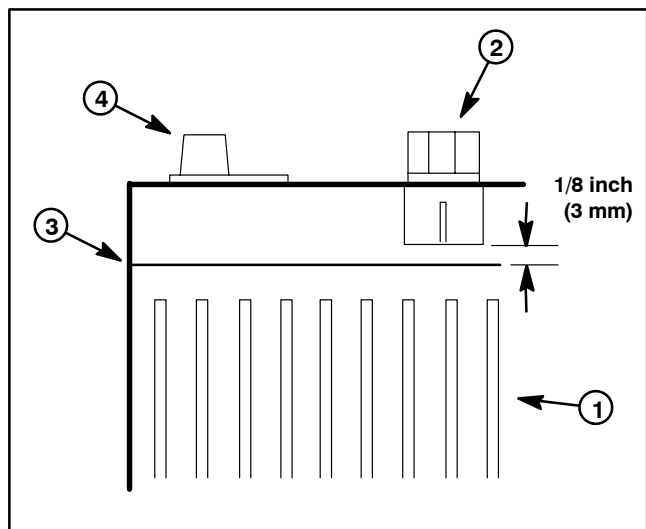


Figure 46

1. Battery plates
2. Filler cap

3. Electrolyte level
4. Battery terminal

Testing

When testing batteries in the Workman e2050 and e2065, it is important to test all batteries. Proper performance of the vehicle depends on all batteries being in good condition. Testing will determine if one (or more) of the batteries needs to be replaced.

1. The preferred testing procedure is to use the Lester Electrical 36/48 Volt Battery Discharge Unit (Model 17770). This instrument puts a known discharge load (56.25 Amps) on the battery pack until the battery pack reaches 42 volts. A timer incorporated into the discharger measures the time needed to reach that voltage level. Battery capacity and remaining life can be determined from the test results. Refer to Discharge Unit Operating Instructions for further information.

Other types of battery load testers can also be used to test the Workman batteries. Many locally available battery load testers do not, however, have any adjustment on the load that is put on the battery. Results received from using load testers should follow the recommendations of the load tester manufacturer.

2. If the Lester Battery Discharge Unit (or other load tester) is not available, an alternate battery test can be done using a multimeter to perform a voltage test of each battery. Use the following procedure:

A. For accurate voltage testing, allow batteries to remain idle (no charging, no discharging) for at least 6 hours and preferably 24 hours.

B. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter). Then, disconnect both cables from battery to be tested.

C. Measure the battery voltage with the multimeter. Record battery voltage. The measured voltage will determine battery state of charge.

D. If voltage readings below 70% charged (see Fig. 47) exist, charge battery (see Operator's Manual) and take voltage measurements again. If voltage remains low after charging, consider battery replacement.

3. A third option for battery testing is to perform a specific gravity test of the battery electrolyte using a hydrometer. Use the following procedure:

IMPORTANT: Make sure the area around the battery fill caps is clean before removing the caps.

A. Remove battery filler caps. Do not add water prior to testing specific gravity of battery electrolyte. If electrolyte level is low, add **distilled** water and charge battery (see Operator's Manual) before performing specific gravity test.

B. Measure the specific gravity of each cell with a hydrometer. Fill and drain the hydrometer two to four times before drawing a sample. At the same time, take the temperature of the cell.

C. Have enough electrolyte in the hydrometer to completely support the hydrometer float. Record the hydrometer reading and return the electrolyte to the battery cell.

D. Repeat test for remaining battery cells.

E. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example:	Cell Temperature	100°F
	Cell Specific Gravity Reading	1.245
	ADD (20° above 80°F)	<u>0.008</u>
	Correction to 80°F	1.253

F. The specific gravity of all battery cells should be $1.277 \pm .007$. If low cell readings exist (see Fig. 47), charge battery (see Operator's Manual) and take specific gravity readings again.

G. If specific gravity of any cells remain low after complete charging, battery should be replaced.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.277	6.37
90%	1.258	6.31
80%	1.238	6.25
70%	1.217	6.19
60%	1.195	6.12
50%	1.172	6.05
40%	1.148	5.98
30%	1.124	5.91
20%	1.098	5.83
10%	1.073	5.75

Figure 47

Battery Storage

If the vehicle will be stored for any period of time, check battery electrolyte level, adjust level if needed and then connect battery charger to vehicle. Allow charger to remain connected to vehicle during storage to prevent battery discharge and potential battery damage.

If the vehicle will be stored for more than 30 days and the battery charger cannot be used for some reason, charge the batteries fully. Either store batteries on a shelf or in the vehicle. Store the batteries in a cool atmosphere to avoid quick deterioration of the charge in the batteries. To prevent batteries from freezing, make sure they are fully charged before storage. During the storage period, charge the batteries at least once every three (3) months to prevent battery damage. Before returning the vehicle to service, make sure to fully charge the batteries.

Traction Motor Brushes

The traction motor in the Workman e2050/e2065 uses eight (8) brushes. Traction motor brushes should be inspected every 500 hours of operation or annually.

Inspection

1. Make sure that on/off switch is OFF. Raise and latch bed to allow access to traction motor.

2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

3. Unlatch headband of traction motor and reposition headband to allow inspection of a brush at the top of the motor.

4. If end of brush is even with the brush holder (Figs. 48 and 50), brushes should be removed from motor for inspection and measurement (see Traction Motor Service in this section).

5. In most instances, wear of all traction motor brushes should be similar to wear found on the top brushes. If inspection of remaining brushes is needed or if brushes require replacement, traction motor should be removed from vehicle (see Traction Motor and Traction Motor Service in this section).

6. If vehicle is often operated in severely dirty environments, brush should be removed from motor to allow inspection of mating surface of brush (Fig. 49). If brush surface is rough, pitted, arced or scored, additional brush and/or motor inspection should be completed (see Traction Motor and Traction Motor Service in this section).

7. Visually inspect commutator surface of motor armature. If commutator surface is rough, pitted, arced or scored, additional motor inspection should be completed (see Traction Motor and Traction Motor Service in this section).

8. After brush inspection, make sure brush is correctly installed in brush holder and tensioned by spring. Refit headband to traction motor and latch headband.

9. Carefully connect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

10. Lower bed.

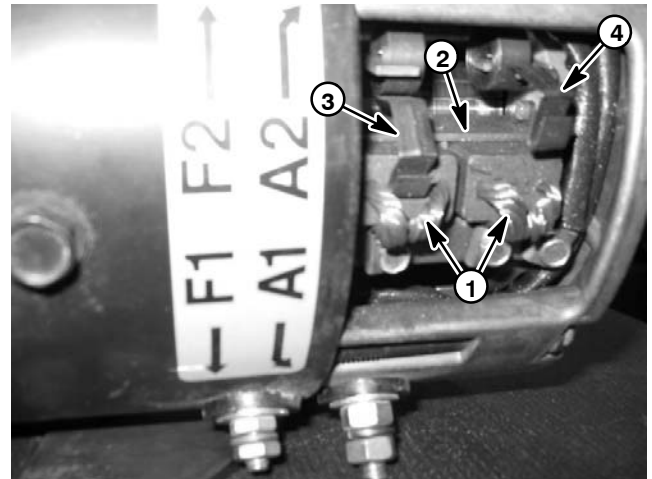


Figure 48

- | | |
|-----------------|-----------------------------|
| 1. Brush | 3. Brush spring (tensioned) |
| 2. Brush holder | 4. Brush spring (released) |

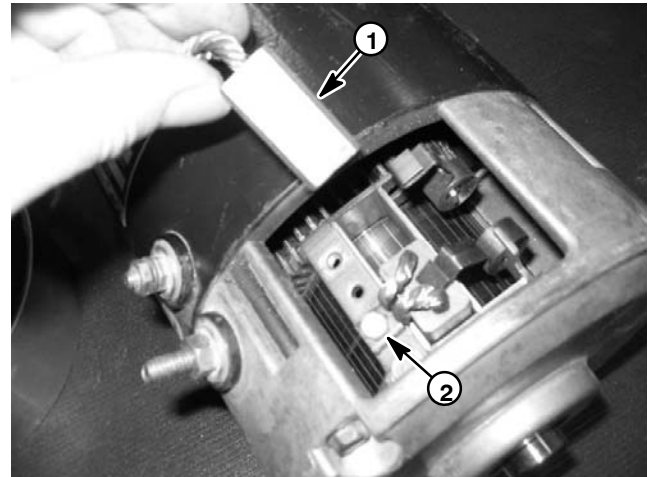


Figure 49

- | | |
|------------------|--------------|
| 1. Removed brush | 2. Cap screw |
|------------------|--------------|

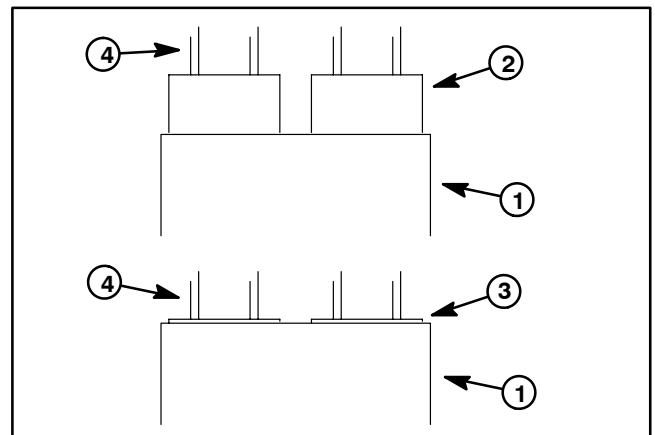


Figure 50

- | | |
|-----------------------------|---------------------|
| 1. Brush holder (side view) | 3. Worn brush |
| 2. Normal brush | 4. Brush shunt wire |

Traction Motor

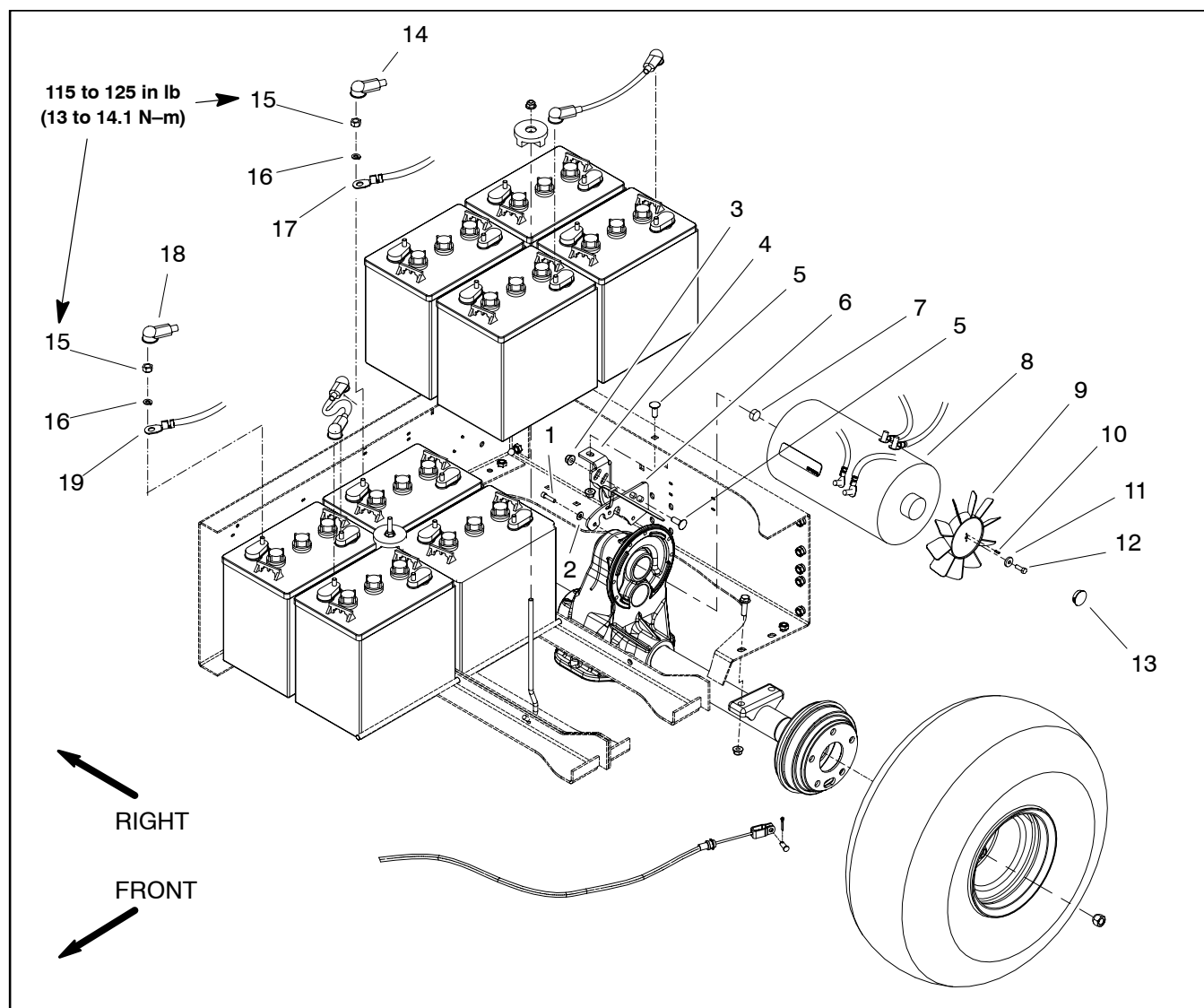


Figure 51

- | | | |
|-------------------------------|--------------------------------------|----------------------------|
| 1. Socket head screw (6 used) | 8. Traction motor | 14. Cable terminal boot |
| 2. Flat washer (6 used) | 9. Fan | 15. Hex nut |
| 3. Flange nut | 10. Roll pin (2 used) | 16. Lock washer |
| 4. Support bracket | 11. Washer | 17. Positive battery cable |
| 5. Carriage screw | 12. Socket head screw | 18. Cable terminal boot |
| 6. Transaxle mount plate | 13. Plastic cap (fits in rear frame) | 19. Negative battery cable |
| 7. Rubber damper | | |

Removal (Fig. 51)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from switch.
2. Remove cargo bed from vehicle (see Cargo Bed Removal in Service and Repairs section of Chapter 5 – Chassis).
3. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

NOTE: Label all electrical leads for reassembly purposes.

IMPORTANT: When removing wires from motor terminals (A1, A2, F1 and F2), use a wrench to retain lower nut while loosening upper nut (Fig. 53). If terminal studs are allowed to turn during upper nut removal, internal motor damage can occur.

4. Disconnect wires from traction motor (Fig. 52):
 - A. While retaining lower nut, remove upper nut and wire connector from motor terminals A1, A2, F1 and F2.
 - B. Unplug motor temperature sensor from vehicle wire harness. Note location of cable tie that secures temperature sensor wires to vehicle.
 - C. Position disconnected wires away from motor.
5. Remove plastic plug from rear frame to allow access to socket head screw that retains fan to traction motor. Remove screw and washer and then remove fan from motor.



CAUTION

To prevent motor damage and personal injury, make sure that traction motor is well supported as it is removed. Motor weighs approximately 62 pounds (28.1 kg).

6. Support traction motor to prevent it from falling. Two suggestions for traction motor support are as follows:

IMPORTANT: Damage to traction motor field coils will result if eyebolt is threaded into motor housing to far.

- A. Remove silver flange head screw from top of motor and carefully install a 3/8 – 16 eyebolt into motor (Fig. 54). Thread eyebolt into motor approximately four (4) turns taking care to not bottom eyebolt into internal field coils. Secure eyebolt with jam nut. Use eyebolt for support and as a lifting point for motor removal.
 - B. Use lifting strap wrapped around motor housing for support and as a lifting point for motor removal.
7. Remove six (6) socket head screws (item 1) and flat washers (item 2) that secure motor to transaxle.
8. Slide motor away from transaxle to disengage motor shaft from transaxle input shaft. Carefully lift motor from vehicle. Take care to not damage thermal switch while motor is removed.
9. Locate and retrieve rubber damper from motor shaft internal spline.
10. If needed, remove two (2) roll pins from motor shaft.

Installation (Fig. 51)

1. If removed, install two (2) roll pins into motor shaft.

2. Make sure that rubber damper is installed into the motor shaft internal spline with the damper flat side toward the motor (Fig. 52).

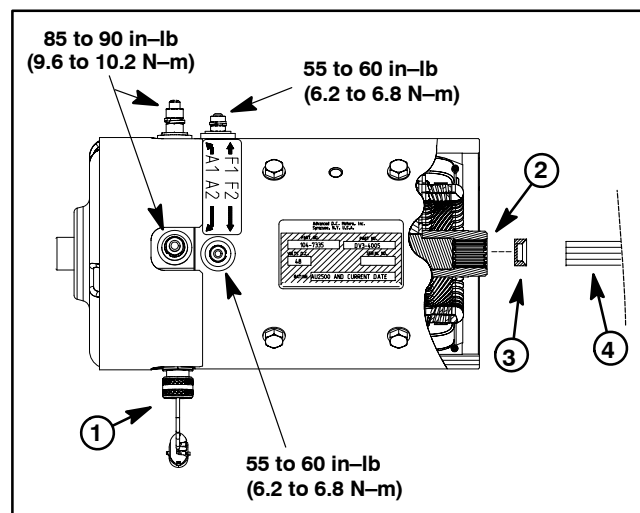


Figure 52

- | | |
|-----------------------|--------------------------|
| 1. Thermal switch | 3. Rubber damper |
| 2. Motor shaft spline | 4. Transaxle input shaft |

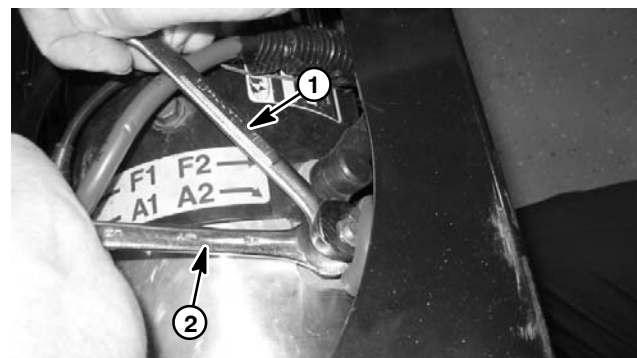


Figure 53

- | |
|--|
| 1. Loosening/tightening wrench (upper nut) |
| 2. Retaining wrench (lower nut) |

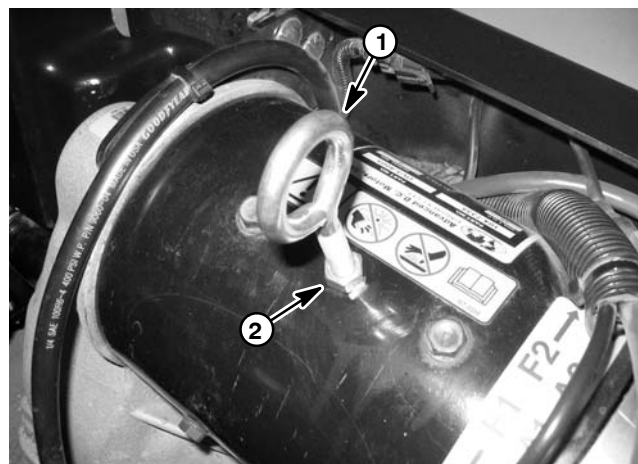


Figure 54

- | | |
|------------|------------|
| 1. Eyebolt | 2. Jam nut |
|------------|------------|

3. Apply antiseize lubricant or axle grease to the splines of the transaxle and motor shafts. Apply grease to lip of seal in transaxle bore.



CAUTION

To prevent motor damage and personal injury, make sure that traction motor is well supported as it is installed. Motor weighs approximately 62 pounds (28.1 kg).

4. Carefully lower motor into vehicle. Align motor shaft with transaxle input shaft and slide motor to transaxle. Take care to not damage thermal switch while installing motor.

5. Align mounting holes of motor, transaxle and transaxle mount plate. Secure motor to transaxle with six (6) socket head screws (item 1) and flat washers (item 2).

IMPORTANT: When connecting wires to motor terminals (A1, A2, F1 and F2), use a wrench to retain lower nut while tightening upper nut (Fig. 53). If terminal studs are allowed to turn during upper nut installation, internal motor damage can occur.

6. Connect wires to traction motor (Fig. 52):

A. Make sure that fasteners and cable connectors are properly positioned on motor terminals (Fig. 56).

B. Install correct cable connector and nut to motor terminals A1 and A2. While retaining lower nut, torque upper nut on terminals A1 and A2 from 85 to 90 in-lb (9.6 to 10.2 N-m).

C. Install correct wire connector and nut to motor terminals F1 and F2. While retaining lower nut, torque upper nut on terminals F1 and F2 from 55 to 60 in-lb (6.2 to 6.8 N-m).

D. Plug motor temperature sensor connector into vehicle wire harness.

7. Position fan to traction motor and secure with socket head screw and washer. Install plastic plug in hole in rear frame.

8. Carefully connect removed battery cable to battery terminals. Install lock washers and nuts on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

9. Install cargo box to the rear frame (see Cargo Box Installation in Service and Repairs section of Chapter 5 – Chassis).

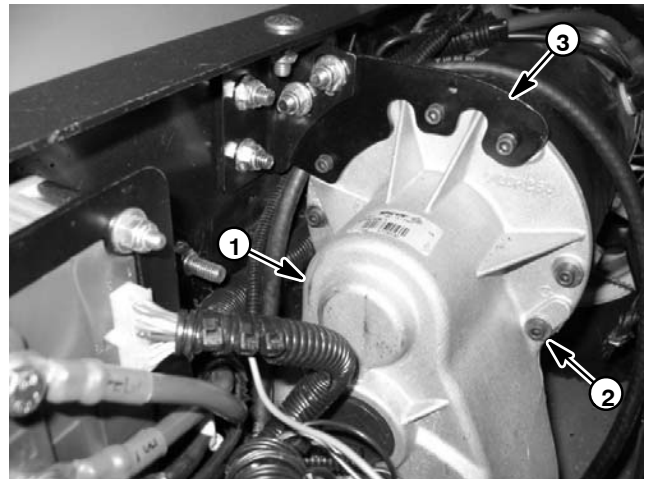


Figure 55

- | | |
|--------------------------|--------------------------|
| 1. Transaxle | 3. Transaxle mount plate |
| 2. Screw/washer (6 used) | |

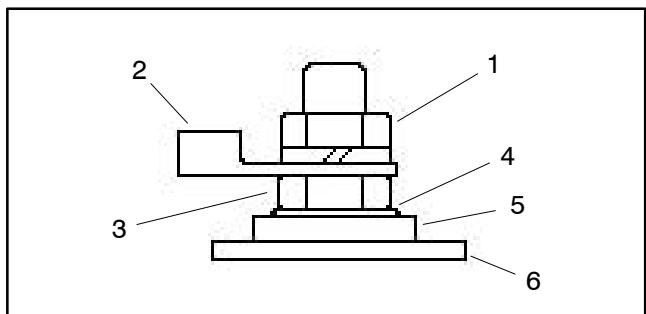


Figure 56

- | | |
|--------------------|----------------------|
| 1. Upper nut | 4. Flat washer |
| 2. Cable connector | 5. Insulating washer |
| 3. Lower nut | 6. Motor housing |

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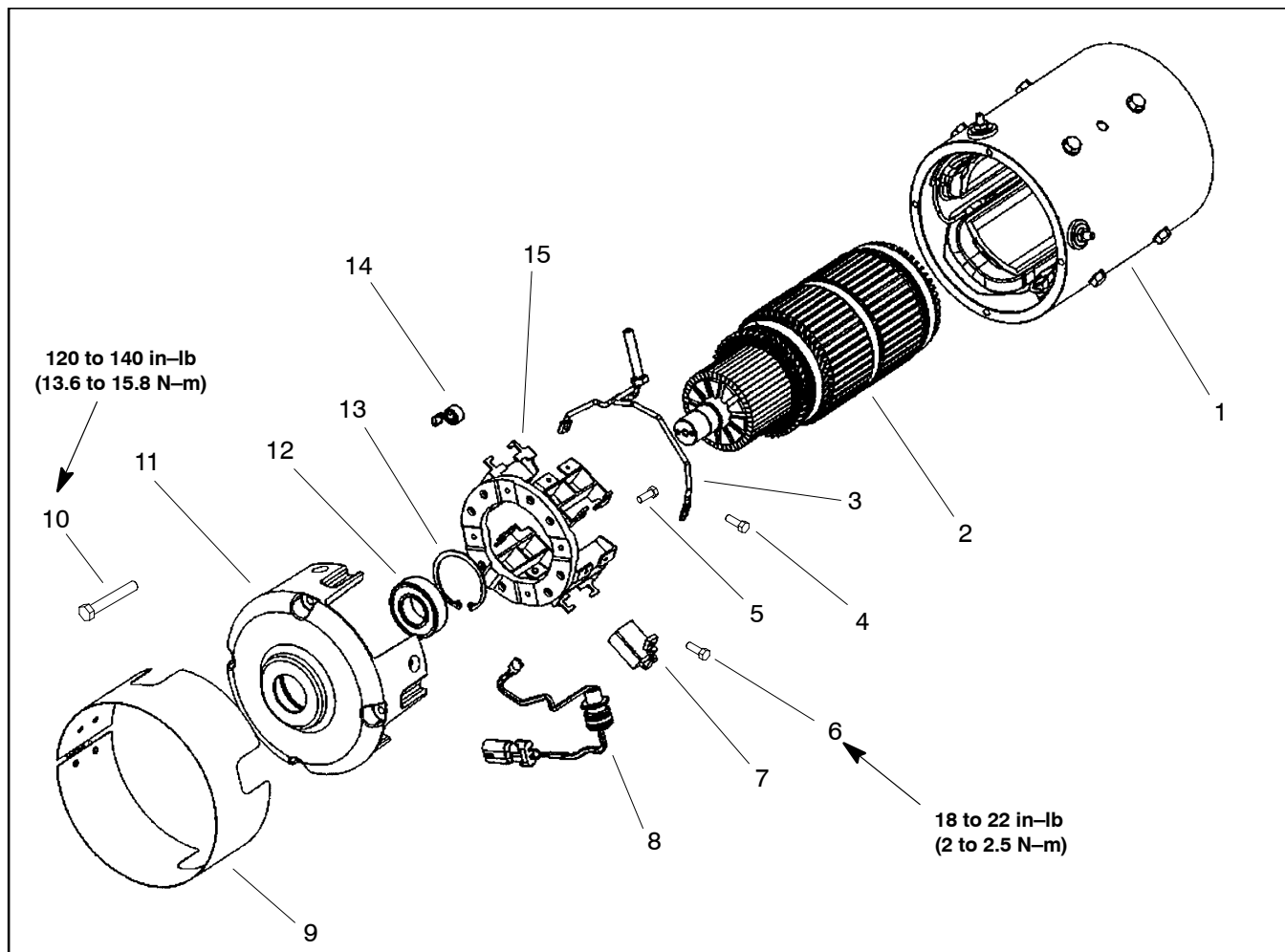


Figure 57

- | | | |
|--------------------------------------|----------------------------|---------------------------|
| 1. Frame and field assembly | 6. Cap screw (8 used) | 11. Commutator end head |
| 2. Armature | 7. Brush (8 used) | 12. Bearing |
| 3. Brush lead (2 used) | 8. High temperature sensor | 13. Retaining ring |
| 4. Cap screw (2 used per brush lead) | 9. Headband | 14. Brush spring (8 used) |
| 5. Cap screw (4 used) | 10. Bolt (4 used) | 15. Brush box |

Disassembly (Fig. 57)

1. Unlatch and slide headband from traction motor.
2. Pull back the brush springs and latch them in the open position on the spring holders. Slide brushes from the brush holders.
3. Use an arbor press or a bearing puller to remove the armature from the commutator end head and frame and field assembly (Fig. 58).
4. Remove four (4) bolts that secure the commutator end head to the frame and field assembly. Remove commutator end head from frame and field assembly.

5. Remove the retaining ring and press bearing from the commutator end head. Discard the bearing.



CAUTION

When using compressed air for cleaning motor components, follow all safety instructions, including wearing eye and respiratory protection.

6. Carefully blow out any accumulated carbon dust and dirt from the commutator end head and the frame and field assembly using clean, oil free, compressed air.

Brush Service

1. Check the brush springs for correct alignment on the back of the brush. A brush spring that does not apply equal pressure on the center of the brush will cause the brush to wear unevenly. Check for correct clearance and freedom of brush movement in the holder.

2. Replace brushes that are worn to a length of 0.620" (16 mm). Also, replace brushes if they show signs of uneven wear or show signs of overheating, such as discolored brush shunts and brush springs.

3. Brushes should always be replaced in complete sets of eight. Use identical replacement parts; do not substitute brush grades as the brushes are matched to the motor type and application to provide the best service. Substituting brushes of the wrong grade can cause premature commutator failure and excessive brush wear. Remove old brushes and replace with identical replacement parts. Hold brush shunts in position and torque brush screws from 18 to 22 in-lbs (2 to 2.5 N-m) (Fig. 60). Make sure brushes move freely in the holders and that shunts do not interfere with brush spring movement.

4. Make sure the brush box assembly is tight on the commutator end head. Replace brush box assemblies in the commutator end head if they are physically damaged or brush holders are loose on the brush plate.

5. Brush springs should be checked for proper tension using the following procedure (Fig. 59):

A. Place paper strip between brush face and commutator. Hook spring scale as shown.

B. Pull spring scale on a line directly opposite the line of force exerted by the brush spring. When the paper strip begins to move freely, read the spring tension on the scale. Brush tension for a new brush should be 65 ounces (1820 grams) and for a worn brush should be 40 ounces (1120 grams).

Frame and Field Service

1. Motors that have been disassembled for servicing should be given a complete inspection of the frame and field assembly. If damage to the field coils or frame is found, replace traction motor. Individual frame and field components are not available.

2. Accumulated carbon dust, grease and other foreign material can produce a ground path from the field winding to the frame. The frame and field should be cleaned with Safety-Kleen 105 washing solvent or equivalent. After cleaning, the frame and field must be oven-dried for one hour at 300°F (148° C) to remove any cleaning residue.

3. It is also recommended that the field be coated with PD George 1000-70 or RanBar B-535-5S varnish for proper insulation protection. Both recommended varnishes are Class H water-soluble varnishes. A similar air-dry varnish may also be used providing it has a Class H rating.

4. Screws securing the pole pieces to the frame should be torqued from 250 to 300 in-lb (28.3 to 33.9 N-m) (Fig. 60).

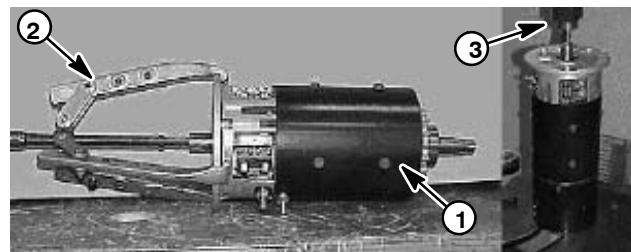


Figure 58

- 1. Motor housing
- 2. Puller
- 3. Arbor press

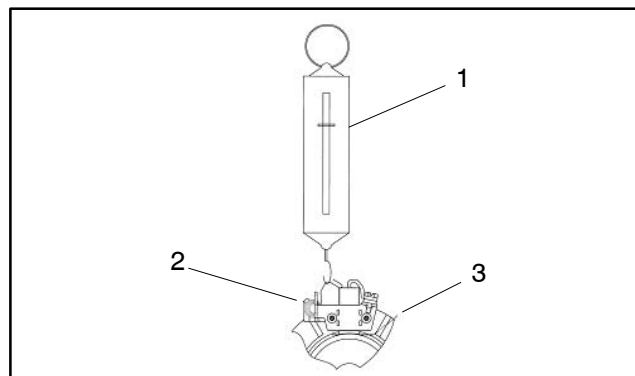


Figure 59

- 1. Spring scale
- 2. Brush spring
- 3. Paper



Figure 60

- 1. Brush screw
- 2. Pole piece screw

Commutator Service

1. Chuck armature on the commutator end-bearing journal and support the drive end of armature using the "live" center of the shaft. With the armature supported on both ends, measure the commutator runout and the bar to bar differences with a dial gauge. Total indicated runout should not exceed 0.003" (0.08 mm) and not more than 0.0005" (0.013 mm) between any two bars. If the readings fall outside this limit, the commutator must be turned and re-undercut.

2. If the commutator must be turned, use only high quality cutting tools with a controlled cutting rate. Remove only enough copper to bring total indicated runout and bar to bar height differences into specification.

3. The minimum commutator diameter is 2.750" (70 mm). If the commutator diameter falls below this diameter after turning, the armature must be replaced.

4. After the commutator is turned, undercut the mica to a uniform depth of 0.040" (1.0 mm). Be careful to only cut the mica and not increase the slot width (Fig. 61).

CAUTION

When using compressed air for cleaning motor components, follow all safety instructions, including wearing eye and respiratory protection.

5. After undercutting, use No. 00 sandpaper to lightly remove any burrs left from the undercutting operation. Clean commutator with dry, oil free compressed air and recheck commutator runout.

Armature Testing

Before an armature is reassembled into the motor, the following tests should be performed:

NOTE: Armature is wave wound and can be short circuit tested in the following manner.

1. Check for grounded circuits by placing one test lead of a dielectric tester on the commutator and the other lead at the armature shaft. If the test light comes on, the armature is grounded.

2. Check for short circuits by placing the armature on a growler. Use a long, flat piece of metal (such as a hacksaw blade) to locate any shorted windings.

If armature is found to be shorted, grounded or otherwise damaged, replace the traction motor.

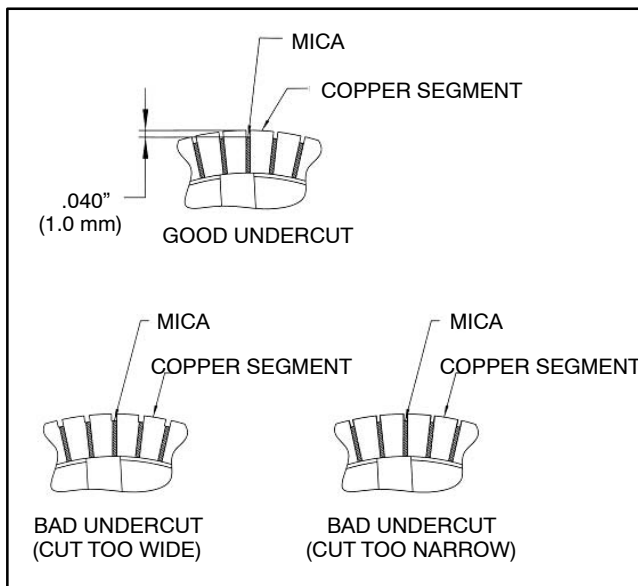


Figure 61

Traction Motor Specifications

BRUSH LENGTH		
Maximum	1.300 in	33 mm
Minimum	0.620 in	16 mm
BRUSH SPRING TENSION		
New Brush	65 ounces	1820 grams
Worn Brush	40 ounces	1120 grams
COMMUTATOR		
New Diameter	2.920 in	74 mm
Minimum Diameter for Reslotting	2.800 in	71 mm
Reject Diameter	2.750 in	70 mm

Assembly (Fig. 57)

NOTE: After the motor has been disassembled, it is recommended that a new commutator end head bearing be installed because removed bearing may have been damaged during disassembly. Although the bearing may appear and feel good, the bearing could be "brinelled" (races or balls deformed) and may exhibit noise and vibration problems or fail within a relatively short period of service. When installing new bearing, always press against the race that is absorbing the pressure or bearing damage may occur.

1. After servicing the commutator and brushes, re-assemble the wiring in the commutator end head as originally found. Ensure the wiring does not contact metal and rotating parts. Also, make sure that the wiring allows the brushes to move unrestricted in the brush holders.
2. Press a new bearing into the commutator end head, pressing on the bearing outer race only (Fig. 62). Secure bearing with retaining ring.
3. Position the commutator end head to the frame and field assembly and secure with four (4) bolts. Torque bolts from 120 to 140 in-lb (13.6 to 15.8 N-m).
4. Ensure the brushes are pushed out of the way.
5. While supporting the inner-race of the bearing in commutator end head, carefully press the armature into the end head and bearing assembly (Fig. 62).
6. Position brushes in brush holders and carefully release the brush springs allowing the brushes to contact the commutator. Make sure brush shunts do not interfere with spring movement.
7. Repair or replace the headband if damaged. Install the headband on the motor.
8. Make sure that lower nuts are properly tightened on traction motor terminals (Fig. 63 and 64). Lower nuts on F1 and F2 terminals should be torqued from 50 to 60 in-lb (5.7 to 6.8 N-m). Lower nuts on A1 and A2 terminals should be torqued from 110 to 140 in-lb (12.4 to 15.8 N-m).

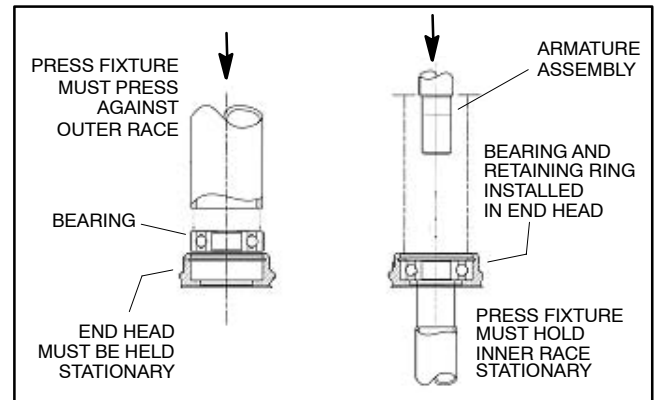


Figure 62

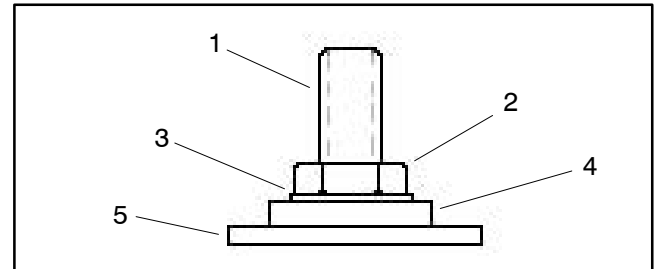


Figure 63

- | | |
|----------------|----------------------|
| 1. Terminal | 4. Insulating washer |
| 2. Lower nut | 5. Motor housing |
| 3. Flat washer | |

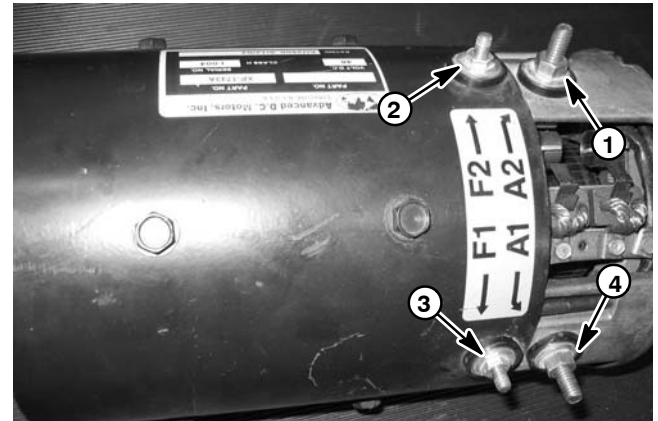


Figure 64

- | | |
|----------------|----------------|
| 1. A2 terminal | 3. F1 terminal |
| 2. F2 terminal | 4. A1 terminal |

Battery Charger

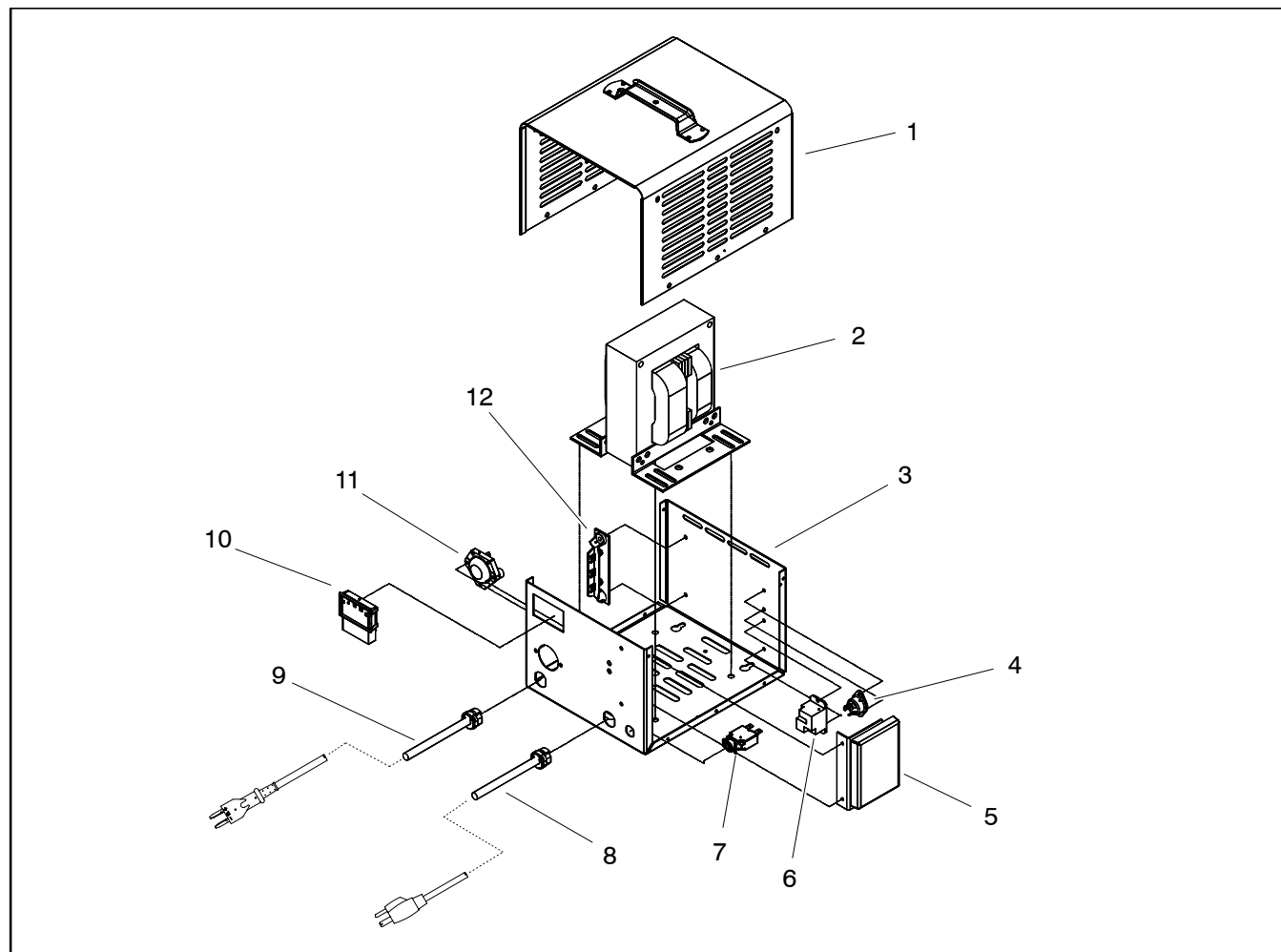


Figure 65

- | | | |
|-----------------|--------------------|--------------------|
| 1. Upper case | 5. Control board | 9. DC cordset |
| 2. Transformer | 6. Relay | 10. Ammeter |
| 3. Lower case | 7. Circuit breaker | 11. Fuse |
| 4. SCR assembly | 8. AC cordset | 12. Diode assembly |

For service of the battery charger, see the Lester Electrical Technician Service Guide at the end of this chapter.



Transaxle and Brakes

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SPICER OFF-HIGHWAY COMPONENTS MODEL	
12 (ELECTRIC) MAINTENANCE MANUAL	

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Specifications

Item	Description
Transaxle Transaxle Fluid Capacity Transaxle Fluid	2 quarts (1.9 liters) 10W–30 Motor Oil

Transaxle and Brakes

Troubleshooting

Brakes

Problem	Possible Cause
Brake pedal goes to the floor.	Brakes are incorrectly adjusted (Workman e2050). Brake cable is loose or broken (Workman e2050). Rear brake shoes are excessively worn. Front brake pads are excessively worn (Workman e2065). Brake fluid level low (Workman e2065). Brake fluid leak at hose, caliper or wheel cylinder (Workman e2065). Brake master cylinder faulty (Workman e2065).
Brake pedal is spongy.	Rear brake drums are excessively worn or cracked. Rear brake shoes are not burnished. Brake cable is loose or broken (Workman e2050). Brakes are incorrectly adjusted (Workman e2050). Air in brake lines (Workman e2065).
Brakes pull to either side.	Tire pressure is incorrect or uneven between tires. Brake linings are contaminated. Front wheel alignment (toe-in) is incorrect. Brake cable is binding, loose or broken (Workman e2050). Brake shoes are distorted. Tires on same axle are unmatched.
Brakes squeal.	Brake lining is glazed or saturated. Rear shoe-to-shoe spring(s) is (are) weak or broken. Brake shoes are distorted. Anchor plate is bent (Workman e2050). Brake drums and shoes are dusty. Rear brake drums are scored or out-of-round.

Brakes (continued)

Problem	Possible Cause
Brakes drag.	Parking brake is applied. Brakes are incorrectly adjusted (Workman e2050). Rear shoe-to-shoe spring(s) is (are) weak or broken. Brake pedal is binding. Brake cable is binding (Workman e2050). Brake linings are saturated. Rear brake drums are bent or out-of-round. Front brake calipers or rotors are damaged (Workman e2065)
Brake pedal is hard to push.	Incorrect brake lining material. Brake pedal linkage is binding. Brake cable is binding (Workman e2050).
Wheels lock-up when braking.	Brake linings are contaminated. Brake linings are loose or damaged. Wheel or transaxle bearings are damaged. Rear brake shoe-to-shoe springs are weak. Rear brake drums are grooved in the contact face with brake shoes.
Brakes fade.	Brake drums or rotors are overheated. Brake linings are saturated.
Vehicle surges at slow speeds and chatters at fast speeds.	Brake drums or rotors are bent or out-of-round.
Rear brakes do not self adjust.	Adjuster bolt is seized. Adjuster lever does not engage star wheel.

Adjustments

Adjust Brakes (Workman e2050)

The recommended brake pedal travel is from 1" to 1 1/2" (25.4 to 38.1 mm) with a 75 to 100 pound (34 to 45.4 kg) input force to the brake pedal.

Adjustment Procedure (Figures 1 and 2)

1. Park vehicle on a level surface, turn on/off switch OFF and remove key from the on/off switch.

2. Depress brake pedal lightly (10 to 15 pound input force) until resistance is achieved. Check the gap between the brake lever and the brake lever stop to determine the distance the brake equalizer needs to be adjusted (Fig 2).

3. Remove the cotter pin and clevis pin that secure the brake rod clevis to the brake lever.

4. Disconnect the spring from the hole near the end of the brake rod.

5. Press the brake pedal down fully to raise the brake lever away from the brake rod clevis.

6. Thread the brake rod in or out of the brake equalizer as needed to remove the gap identified in Step 2. Do not overtighten or brakes will drag and wear prematurely.

7. Reinstall the spring into the hole in the brake rod.

NOTE: Use a pry bar placed between the accelerator pivot shaft and the brake equalizer to aid in installation of the clevis pin that secures the brake rod clevis to the brake lever.

8. Connect the brake rod clevis to the brake lever using the clevis pin and cotter pin removed previously.

9. Verify that brake pedal travel is from 1" to 1 1/2" (25.4 to 38.1 mm) with a 75 to 100 pound (34 to 45.4 kg) input force to the brake pedal.

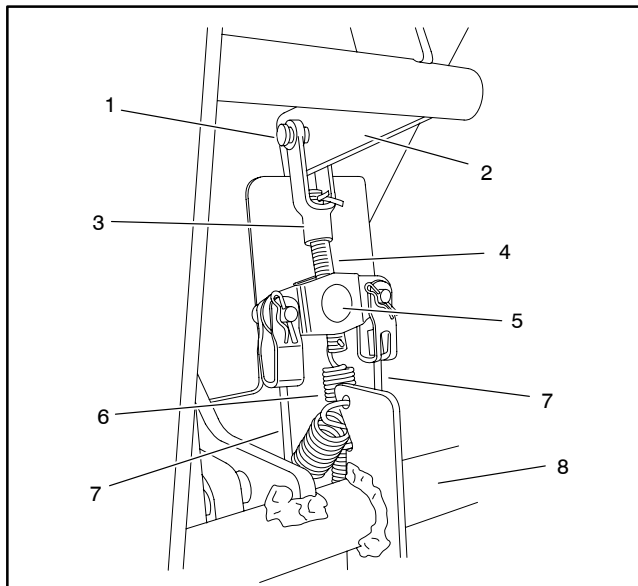


Figure 1

- | | |
|--------------------------|----------------------------|
| 1. Clevis pin/cotter pin | 5. Brake equalizer |
| 2. Brake lever | 6. Spring |
| 3. Brake rod clevis | 7. Brake cable |
| 4. Brake rod | 8. Accelerator pedal shaft |

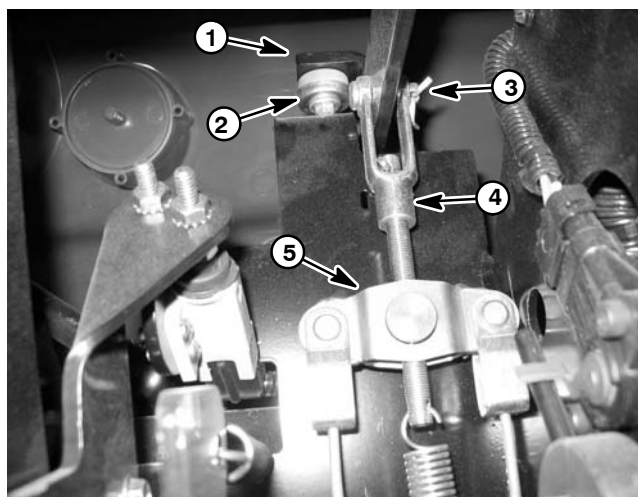


Figure 2

- | | |
|--------------------------|---------------------|
| 1. Brake lever | 4. Brake rod clevis |
| 2. Brake lever stop | 5. Brake equalizer |
| 3. Clevis pin/cotter pin | |

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Service and Repairs

Rear Wheels and Brakes

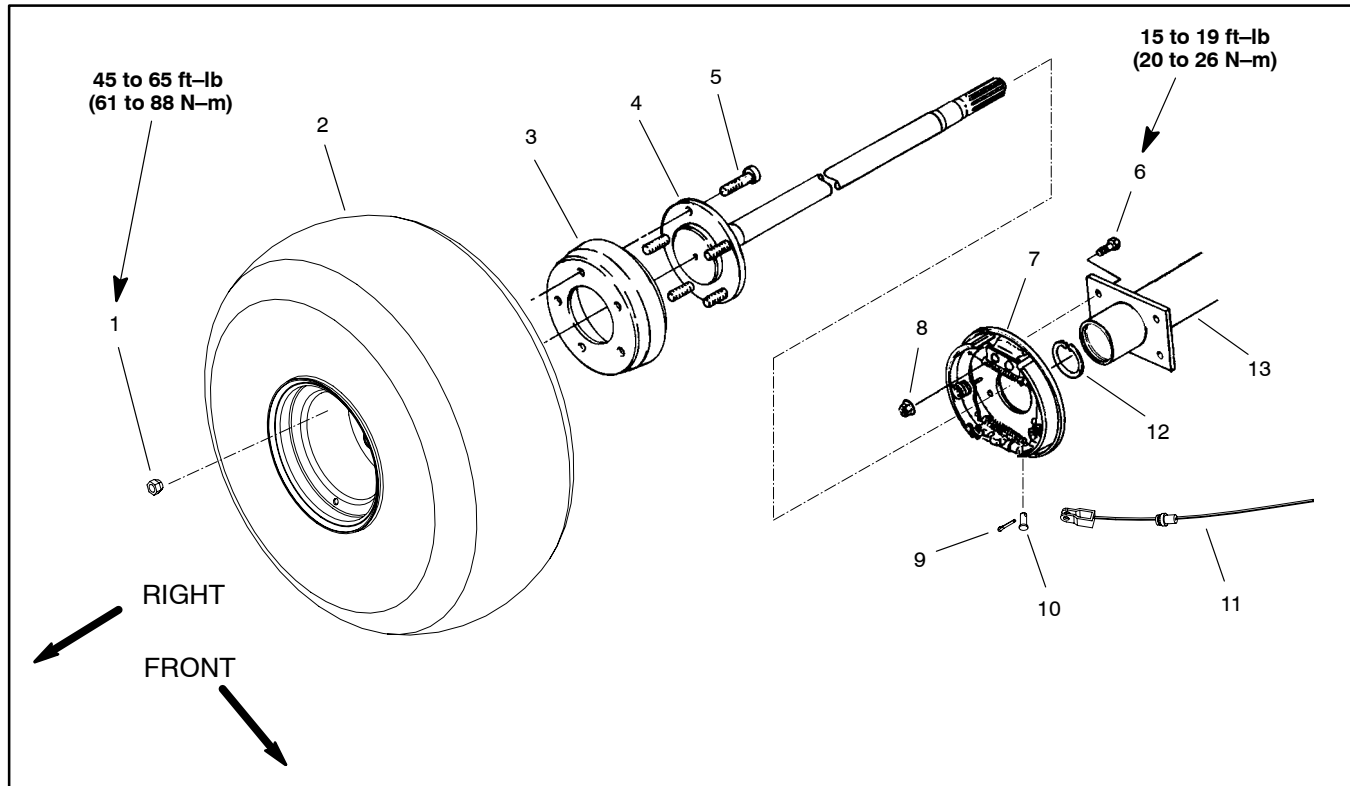


Figure 3

- | | | |
|----------------------------------|---|----------------------------|
| 1. Lug nut (5 used per wheel) | 6. Flange head screw (4 used per brake) | 10. Clevis pin |
| 2. Wheel assembly | 7. Brake assembly (RH shown) | 11. Brake cable (RH shown) |
| 3. Brake drum | 8. Nut (4 used per brake) | 12. Retaining ring |
| 4. Axle shaft | 9. Cotter pin | 13. Transaxle |
| 5. Wheel stud (5 used per wheel) | | |

Removal (Fig. 3)

1. Park vehicle on a level surface, turn on/off switch OFF and remove key from the on/off switch.



WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Operator's Manual and Chapter 1 – Safety.

2. Chock wheels not being jacked up. Lift rear wheel off the ground using a jack and place jack stand or blocks beneath the rear frame to support vehicle.

NOTE: To remove brake drum, it may be necessary to loosen brake cable adjustment or remove brake cable from brake actuator lever.

3. Remove five (5) lug nuts, wheel assembly and brake drum from the wheel hub.

Transaxle and Brakes (Rev. B)

4. Remove the axle shaft from the transaxle (see the Spicer Off-Highway Components Model 12 (Electric) Maintenance Manual at the end of this chapter).

5. If necessary, remove brake assembly as follows:

A. Remove cotter pin and clevis pin securing the brake cable bracket to the brake actuator lever (Fig. 4).

B. On Workman e2065, clean hydraulic brake line area of rear brake cylinder to prevent contamination. Loosen and disconnect hydraulic brake line from wheel cylinder. Plug brake line and position it away from wheel cylinder.

C. Remove four (4) cap screws and nuts securing the brake assembly to the transaxle. Remove brake assembly from the transaxle.

Installation (Fig. 3)

IMPORTANT: On Workman e2050 vehicles, the brake actuator levers must be positioned below the transaxle mount. On Workman e2065 vehicles, the levers should be positioned above the transaxle mount. When positioned correctly, the brake actuator levers will point toward the rear of the vehicle (Fig. 4).

1. If brake assembly was removed from axle, position brake assembly to the transaxle.

A. Secure brake assembly to the transaxle with four (4) cap screws and nuts. Torque screws from 15 to 19 ft-lb (20 to 26 N-m).

B. On Workman e2065, position hydraulic brake line to wheel cylinder. Connect brake line to wheel cylinder.

C. Secure brake cable bracket to the brake actuator lever with clevis pin and cotter pin (Fig. 4).

2. Install axle shaft into transaxle (see the Spicer Off-Highway Components Model 12 (Electric) Maintenance Manual at the end of this chapter).

3. Slide brake drum onto wheel hub making sure that hole in drum aligns with hole in wheel hub on axle.

4. Position wheel assembly to the vehicle with valve stem facing out and secure with five (5) lug nuts. Torque lug nuts in a criss-cross pattern from 45 to 65 ft-lb (61 to 88 N-m).

5. Lower vehicle to ground.



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

6. Check and adjust brakes (see Operator's Manual).

Burnish Brake Shoes

To provide maximum brake performance after rear brake shoes are replaced, burnish new brake shoe linings.

IMPORTANT: To prevent brake overheating, do not drive vehicle with the brakes applied.

IMPORTANT: When burnishing brake shoes, do not allow the brakes to lock up. Also, allow brakes to cool between stops.

1. Drive vehicle while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at 10 to 15 mph (16 to 24 KPH).

2. Make several normal stops with the vehicle going in the reverse direction. This will self adjust the clearance between the brake shoes and drum.

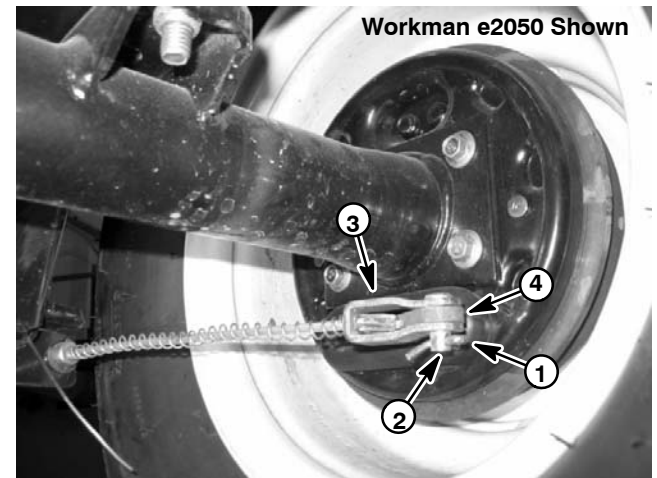


Figure 4

1. Cotter pin
2. Clevis pin

3. Brake cable bracket
4. Brake actuator lever

Brake Service (Workman e2050)

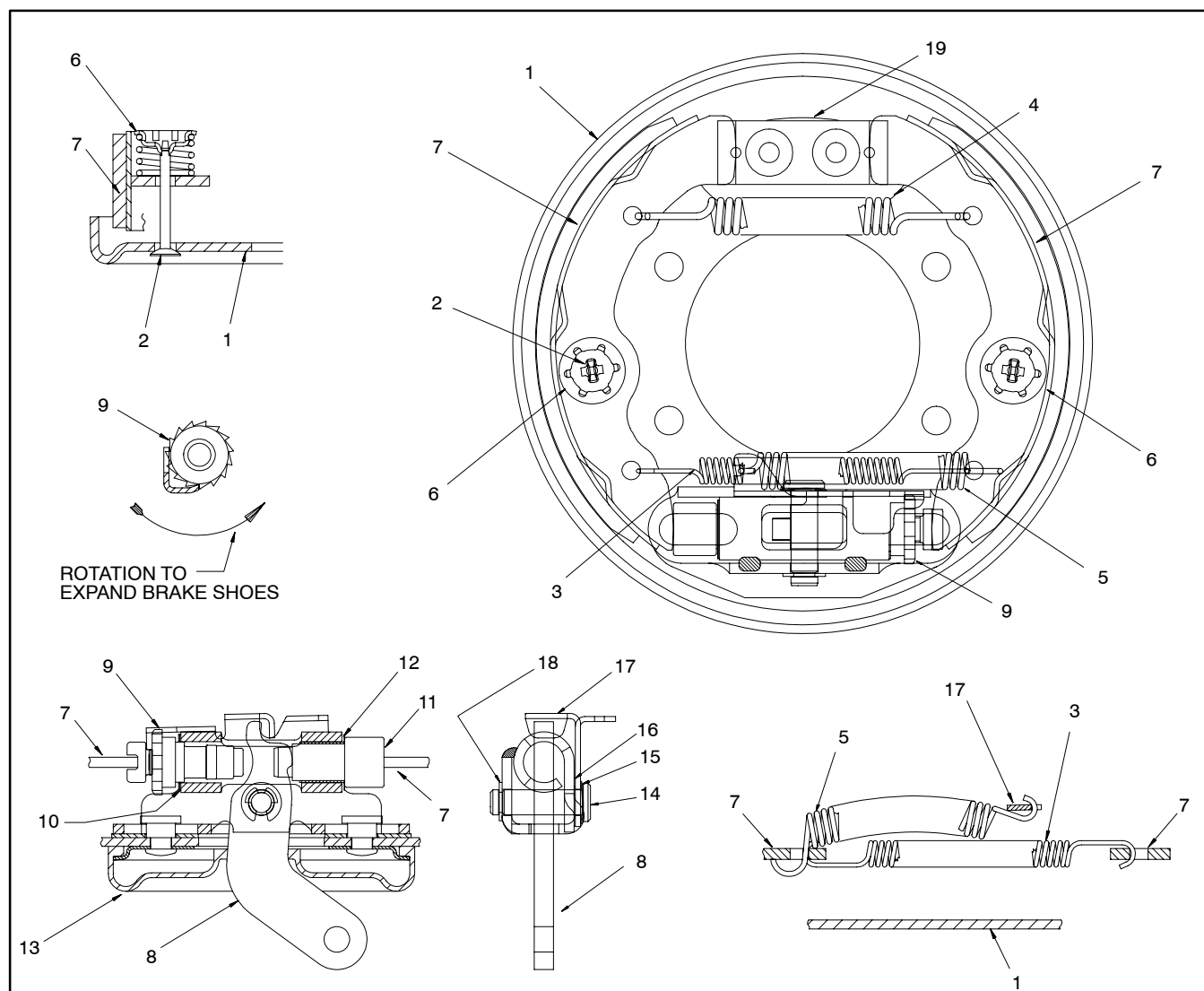


Figure 5

- | | | |
|-------------------------------|------------------------|---------------------|
| 1. Backing plate | 8. Actuator lever | 14. Pivot pin |
| 2. Hold down pin | 9. Adjusting screw | 15. Wave washer |
| 3. Bottom shoe-to-shoe spring | 10. PTFE coated washer | 16. Washer |
| 4. Top shoe-to-shoe spring | 11. Push rod | 17. Adjusting lever |
| 5. Auto adjust spring | 12. Shim washer | 18. Retaining clip |
| 6. Shoe cup (spring loaded) | 13. Protective boot | 19. Anchor abutment |
| 7. Brake shoe | | |

Disassembly (Fig. 5)

1. Remove auto adjust spring and shoe-to-shoe springs from brake shoes.
2. Remove hold down pins and shoe cups securing the brake shoes to the backing plate.
3. Remove brake shoes from backing plate.

Inspection

1. Inspect brake drums.

IMPORTANT: Brake drum machining is not recommended. Replace brake drums as a set to maintain equal braking forces.

A. Clean drums with denatured alcohol. Check braking surface diameter in at least three places. If the diameter exceeds 6.320 inches (16.05 cm), replace both brake drums.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out-of-round, scored, excessively rusted or heat spotted.

C. Minor scoring can be removed with sandpaper.

2. Inspect brake shoe linings.

IMPORTANT: Replace brake shoes as a set (all four shoes) to maintain equal braking forces.

A. Replace brake shoes if damaged or if lining is worn to 1/16" (1.6 mm). Also, replace shoes if lining is contaminated by oil, grease or other fluids.

NOTE: Overheated springs lose their tension and can cause brake linings to wear out prematurely.

B. Inspect brake shoe webbing, shoe-to-shoe springs and auto adjust spring for overheating. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

C. Inspect hold down pins and shoe cups for bends, rust and corrosion. Replace as necessary.

3. Inspect backing plate surfaces which contact with the brake shoes for grooves that may restrict shoe movement. Replace backing plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace backing plate if cracked, warped or excessively rusted.

4. Inspect anchor abutment and rivets for deformation. Replace entire brake assembly if deformation or excessive rust is found.

5. Replace adjuster screw and shim washers if rusted, corroded, bent or fatigued.

6. Replace brake cables if frayed, stretched or kinked.

Assembly (Fig. 5)

IMPORTANT: Brake shoe lining surfaces must be free of grease, oil and other foreign matter.

1. Apply a light film of lubricant to the following:

A. Surfaces of the shoe web that contact the backing plate, push rod and adjusting screw.

B. Six ledges on which the brake shoes rest.

C. Entire surfaces of PTFE coated washers.

D. Entire surface of pivot pin.

E. Slot in push rod that contacts actuator lever.

F. Surfaces of adjusting lever that contact wave washer, washer and pivot pin.

G. Surfaces of the actuator bracket that contact the star wheel of the adjusting screw.

2. Position brake shoes to backing plate. Secure shoes to plate with shoe cups and hold down pins.

3. Secure brake shoes with shoe-to-shoe springs and auto adjust spring.

Rear Brake Service (Workman e2065)

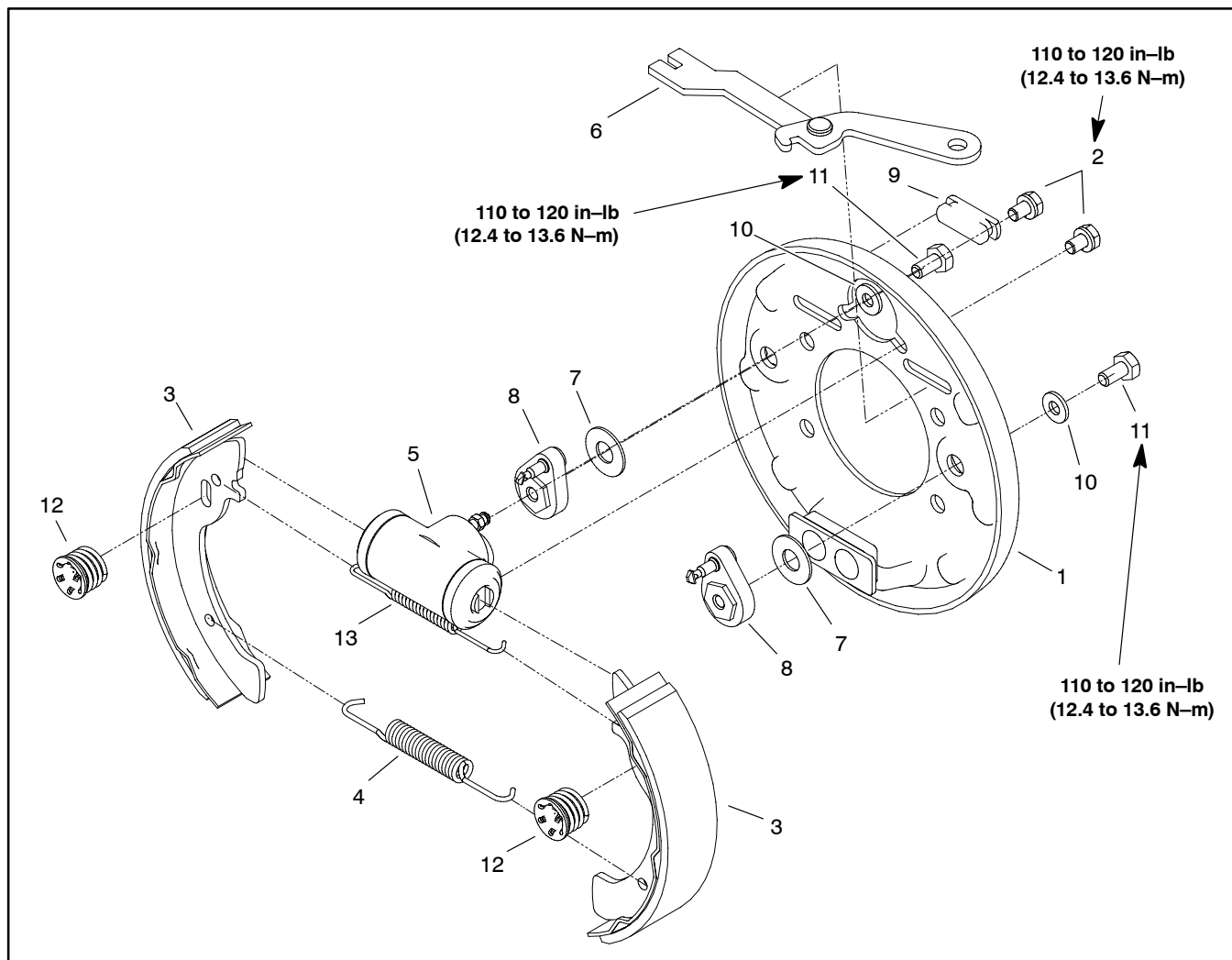


Figure 6

- 1. Brake backing plate
- 2. Washer head screw
- 3. Brake shoe
- 4. Lower spring
- 5. Wheel cylinder

- 6. Parking brake lever (LH shown)
- 7. Belleville washer
- 8. Adjuster lever
- 9. Dust cover

- 10. Flat washer
- 11. Bolt
- 12. Shoe hold down cup and spring
- 13. Upper spring

Disassembly (Fig. 6)



CAUTION

Be careful when removing springs from brake shoes. The springs are under heavy load and may cause personal injury.

1. Remove upper and lower springs from brake shoes.
2. Remove shoe hold down cups and springs that secure the brake shoes to the backing plate.
3. Remove brake shoes from backing plate.

4. If required, slide parking brake lever from slot and dust cover in backing plate.

5. If necessary, remove two (2) washer head screws that secure wheel cylinder to backing plate. Remove wheel cylinder from backing plate.

6. If necessary, remove bolts and washers to allow adjuster levers to be separated from backing plate. Locate and remove belleville washers from between adjuster levers and backing plate.

Inspection (Fig. 6)

1. Inspect brake drums.

IMPORTANT: Brake drum machining is not recommended. Replace brake drums as a set to maintain equal braking forces.

A. Clean drums with denatured alcohol. Check braking surface diameter in at least three places. If the diameter exceeds 6.320" (16.05 cm), replace both brake drums.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out-of-round, scored, heat spotted or excessively rusted.

C. Minor scoring can be removed with sandpaper.

2. Inspect brake shoe linings.

IMPORTANT: Replace brake shoes as a set (all four shoes) to maintain equal braking forces.

A. Replace brake shoes if damaged or if lining is worn to 1/16" (1.6 mm). Replace if lining is contaminated by oil, grease, or other fluids.

NOTE: Overheated springs lose their tension, and can cause brake linings to wear out prematurely.

B. Inspect brake shoe webbing, upper and lower springs, and shoe hold down springs for overheating. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

C. Inspect hold down pins on adjuster levers for bends, rust and corrosion. Replace as necessary.

3. Inspect backing plate surfaces, which contact with the brake shoes for grooves that may restrict shoe movement. Replace plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace plate if cracked, warped or excessively rusted.

4. Inspect adjuster levers for deformation. Replace levers if deformation or excessive rust is found.

5. Replace parking brake cables if frayed, stretched or kinked.

Assembly (Fig. 6)

IMPORTANT: Brake shoe lining surfaces must be free of grease, oil and other foreign matter.

1. Apply a light film of lubricant to the following:

A. Ledges on which the brake shoes rest.

B. Pin surfaces on adjuster levers.

C. Anchor block surface that contacts shoe webs.

D. Both surfaces of belleville washers that are positioned between adjuster levers and backing plate.

2. If removed, position lubricated belleville washer between lever adjuster and backing plate. Secure adjuster to backing plate with washer and bolt. Torque bolt from 110 to 120 in-lb (12.4 to 13.6 N-m).

3. If removed, secure wheel cylinder to backing plate with two (2) washer head screws. Torque screws from 110 to 120 in-lb (12.4 to 13.6 N-m).

4. If removed from backing plate, slide parking brake lever into slot and dust cover in backing plate.

5. Position brake shoes to backing plate. Make sure that each shoe is properly positioned at anchor block, parking brake lever, wheel cylinder and pin on adjuster lever. Secure shoes to backing plate with shoe hold down cups and springs.



6. Secure brake shoes with upper and lower springs.

Hydraulic Brake System (Workman e2065)

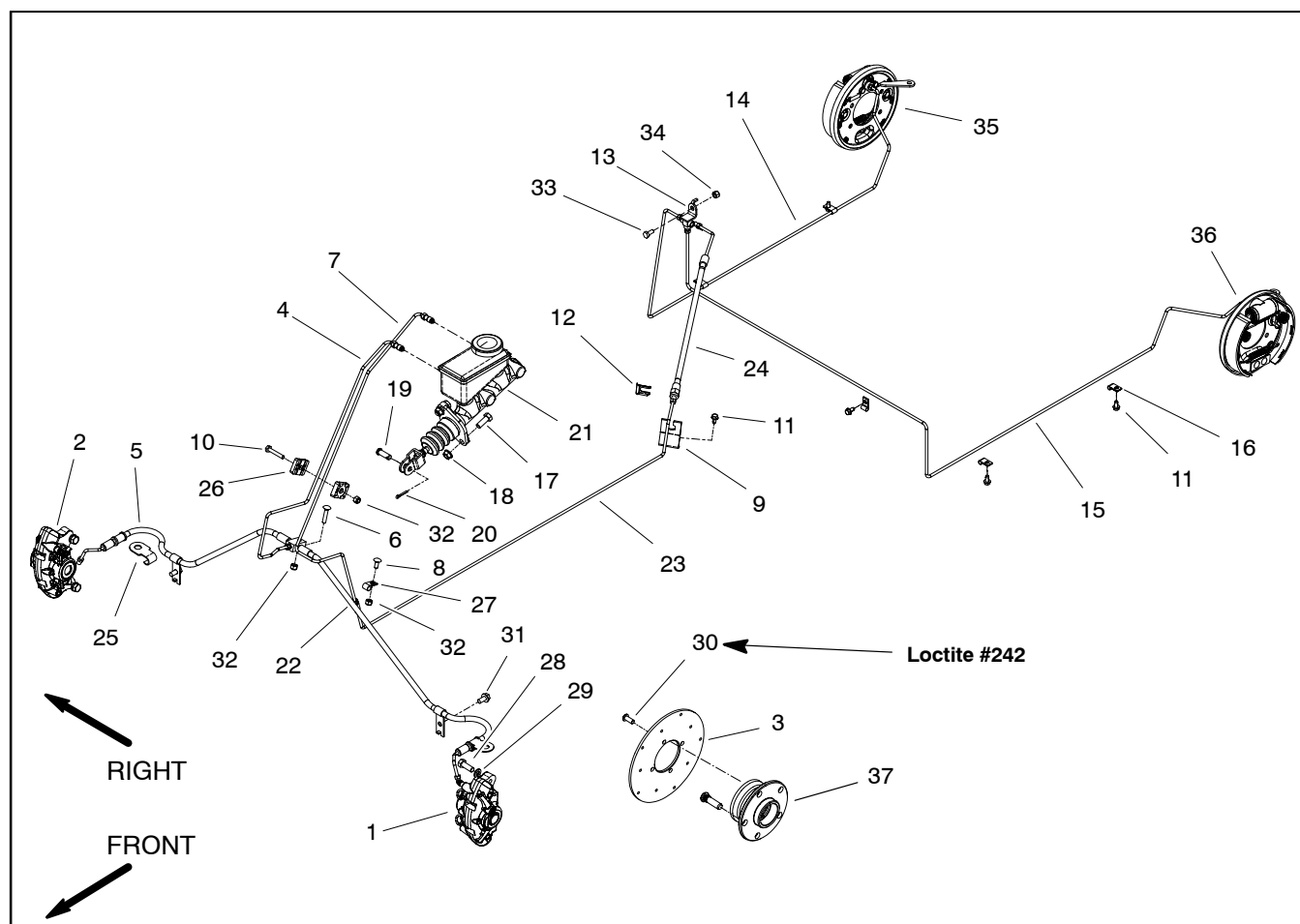


Figure 7

- | | | |
|-----------------------------------|-----------------------------|--|
| 1. Brake caliper (LH) | 14. Rear brake tube (RH) | 26. Tube clamp (2 used) |
| 2. Brake caliper (RH) | 15. Rear brake tube (LH) | 27. R-Clamp |
| 3. Brake rotor (2 used) | 16. Insulated clip (5 used) | 28. Cap screw (2 per caliper used) |
| 4. Front brake tube | 17. Cap screw (2 used) | 29. Lock washer (2 per caliper used) |
| 5. Front brake hose | 18. Flange nut (2 used) | 30. Socket head screw (4 per rotor used) |
| 6. Carriage screw | 19. Clevis pin | 31. Washer head screw (2 used) |
| 7. Rear brake tube | 20. Cotter pin | 32. Lock nut |
| 8. Carriage screw | 21. Master cylinder | 33. Cap screw |
| 9. Rear brake hose bracket | 22. Union fitting | 34. Lock nut |
| 10. Cap screw | 23. Rear brake tube | 35. Rear brake (RH) |
| 11. Thread forming screw (6 used) | 24. Rear brake hose | 36. Rear brake (LH) |
| 12. Clip | 25. Hose bracket (2 used) | 37. Wheel hub assembly (2 used) |
| 13. Tee fitting | | |

When performing service work on the Workman e2065 hydraulic brake system, make sure to thoroughly clean components before disassembly. Use Figure 7 as a guide for removal and installation of hydraulic brake components.

Bleed Brake System (Workman e2065)

1. Connect a suitable transparent hose to bleeder valve on a wheel cylinder or caliper. Submerge other end of hose in a glass container partially filled with clean brake fluid.
2. Have a helper pump brake pedal several times, then hold pedal down firmly.
3. With pedal firmly depressed, open bleeder valve until pedal fades to floor. Close bleeder valve before releasing pedal.
4. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve. **Make sure fluid level is maintained in brake fluid reservoir at all times.**

5. Repeat steps 1 to 4 for other brake cylinders and calipers.



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

6. After bleeding of brakes is completed, test vehicle to make sure brakes are operating correctly and brake pedal is solid.

Front Brake Calipers (Workman e2065)

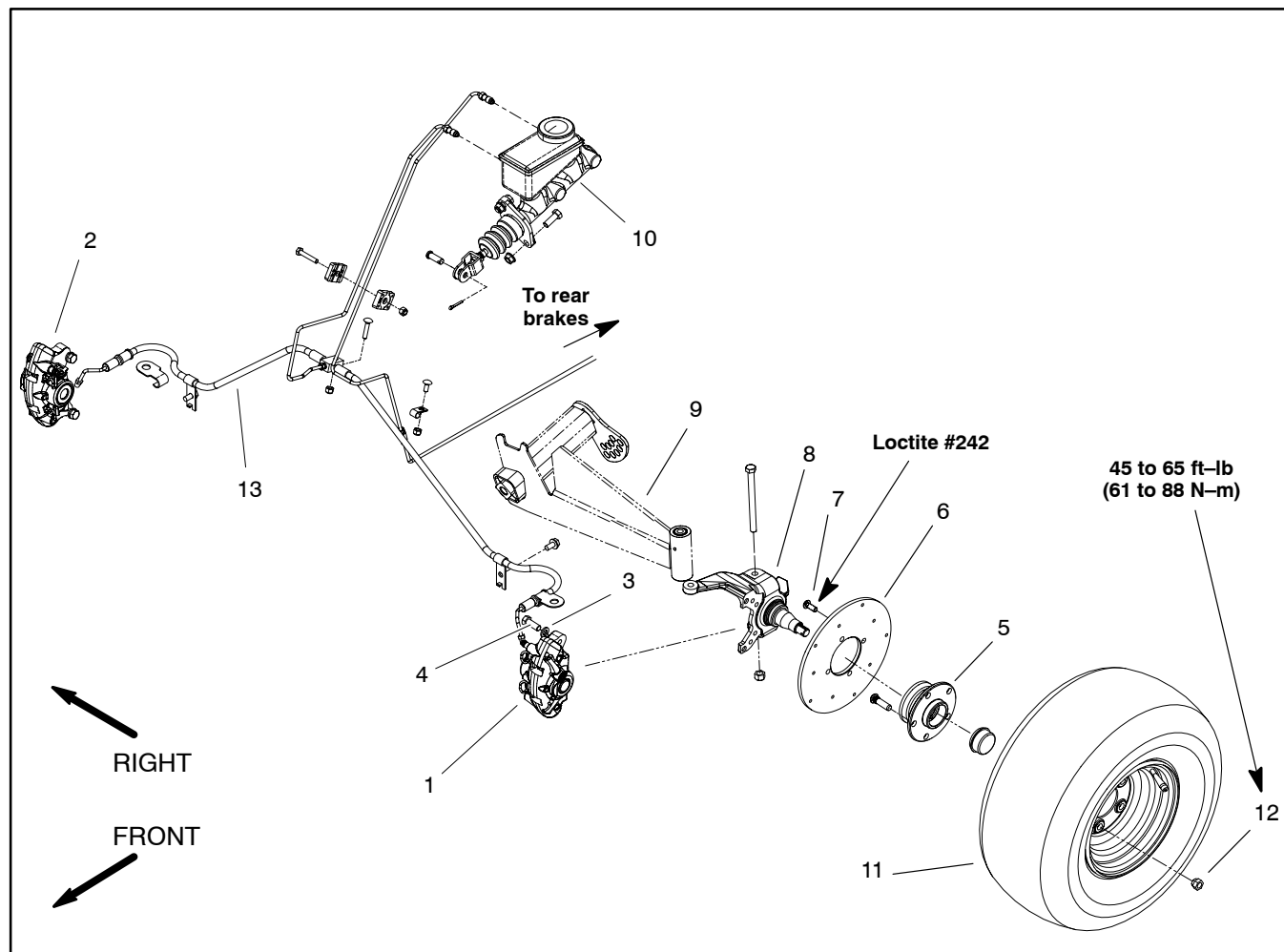


Figure 8

- | | | |
|-------------------------------------|---|---------------------------|
| 1. LH brake caliper | 6. Brake rotor | 10. Brake master cylinder |
| 2. RH brake caliper | 7. Socket head screw (4 per rotor used) | 11. Wheel assembly |
| 3. Lock washer (2 per caliper used) | 8. Spindle (LH shown) | 12. Lug nut |
| 4. Cap screw (2 per caliper used) | 9. A-arm (LH shown) | 13. Front brake hose |
| 5. Wheel hub assembly | | |

Removal (Fig. 8)

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

**WARNING**


Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.
3. Remove front wheel from machine (see Lower Steering and Front Wheel Removal).
4. Clean hydraulic brake line area of brake caliper to prevent contamination. Loosen and disconnect brake line from caliper. Plug brake line and position it away from caliper.
5. Remove two (2) cap screws and lock washers that secure the brake caliper to the spindle.
6. Slide brake caliper from brake rotor and remove caliper from machine.
7. If necessary, remove brake pads from caliper (Fig. 9):
 - A. Remove anti-rattle clip from caliper.
 - B. Remove pins from caliper by prying with a flat blade screwdriver through loop in pins.
 - C. Slide brake pads from caliper. For assembly purposes, note orientation of inner and outer pads as the pads are not the same.
 - D. Replace the brake pads if the friction material is worn to less than 1/32" (0.8 mm).

Installation (Fig. 8)

1. If brake pads were removed from caliper, install pads (Fig. 9):
 - A. If brake pads are being replaced, it will be necessary to push caliper pistons back into the caliper bore before installing new pads.
 - B. Slide brake pads into caliper. Make sure that friction material on pads is toward brake rotor position.
 - C. Secure pads into caliper with two (2) pins. Make sure that pins snap into caliper slots. Install anti-rattle clip to caliper, pin and brake pads.
2. Slide brake caliper onto brake rotor. Make sure that rotor is between brake pads.

3. Align caliper mounting holes with spindle. Secure caliper with two (2) cap screws and lock washers.
4. Install brake hose to caliper.
5. Install front wheel assembly. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m).
6. Lower machine to ground.
7. Bleed brakes (see Bleed Brake System in this section).

**CAUTION**

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

8. Check brake operation.

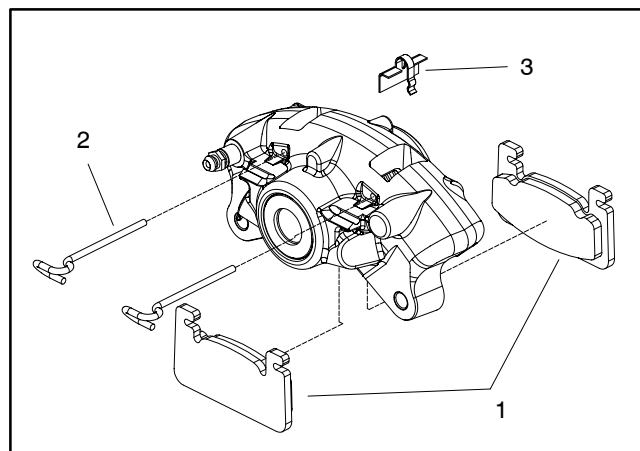


Figure 9

1. Brake pad
2. Pin (2 used)
3. Anti-rattle clip

Brake Master Cylinder (Workman e2065)

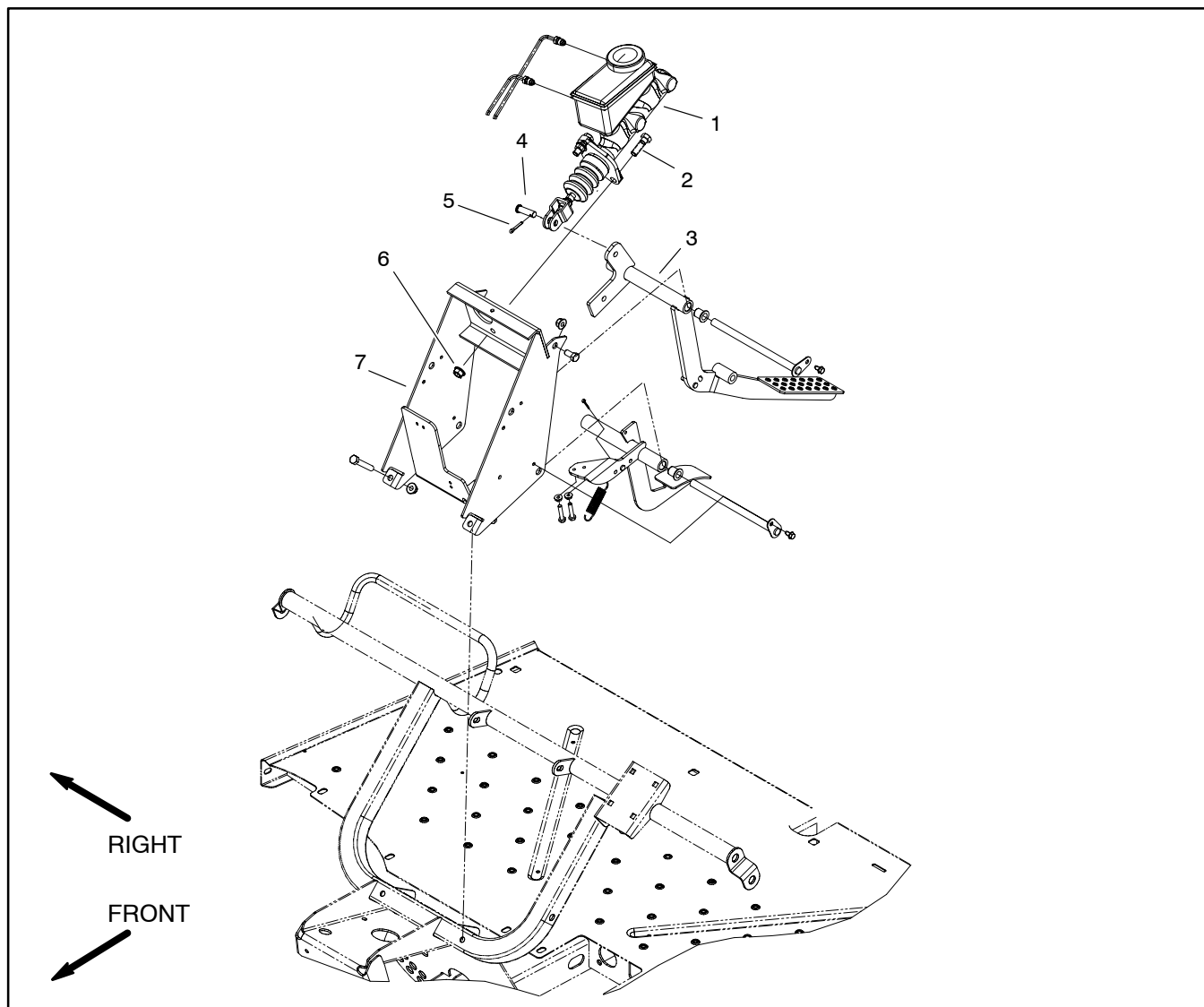


Figure 10

- 1. Master cylinder
- 2. Cap screw
- 3. Brake pedal

- 4. Clevis pin
- 5. Cotter pin

- 6. Flange head nut
- 7. Pedal frame

Removal (Fig. 10)

1. Remove front hood from machine.
2. Remove cotter pin from the clevis pin that connects master cylinder to brake pedal.
3. Clean hydraulic brake line area of master cylinder to prevent contamination. Remove both brake lines from master cylinder. Cap ends of brake lines and position them away from master cylinder.
4. Remove flange head nuts from cap screws that secure master cylinder to pedal frame.
5. Pull master cylinder from machine.

Installation (Fig. 10)

1. Position master cylinder to pedal frame and secure with cap screws and flange nuts.
2. Remove plugs from brake lines. Install brake lines to master cylinder.
3. Connect master cylinder to brake pedal with clevis pin and cotter pin.
4. Install front hood to machine.
5. Bleed brakes (see Bleed Brake System in this chapter). Check brake operation.

Brake Master Cylinder Service (Workman e2065)

Disassembly (Fig. 11)

1. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.
2. Disconnect lower end of the dust cover from the housing.
3. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.
4. Remove primary piston assembly and secondary piston assembly from cylinder housing.

Inspection

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.
2. Check cylinder bore, pistons and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring or cracks are evident in cylinder bore.

Assembly (Fig. 11)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.
2. Install secondary piston assembly and primary piston assembly into cylinder.
3. Install retainer washer.
4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.
5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.

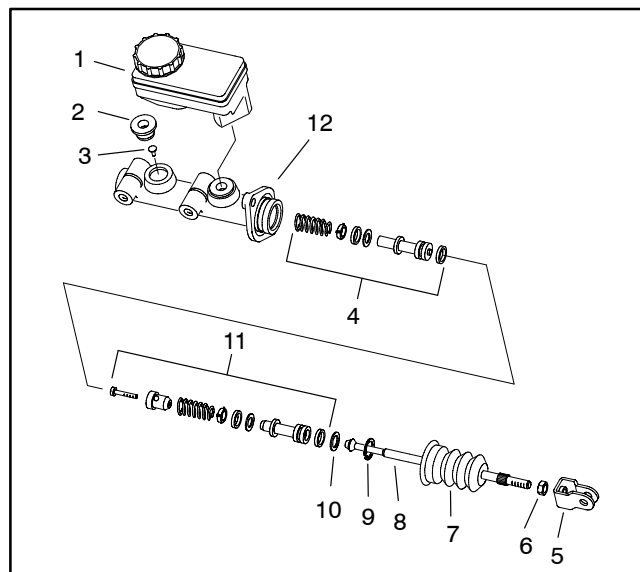


Figure 11

- | | |
|--------------------------|-------------------------|
| 1. Reservoir | 7. Dust cover |
| 2. Flange seal | 8. Push rod |
| 3. Stop pin | 9. Circlip |
| 4. Secondary piston assy | 10. Retainer washer |
| 5. Clevis | 11. Primary piston assy |
| 6. Jam nut | 12. Cylinder housing |

Parking Brake (Workman e2065)

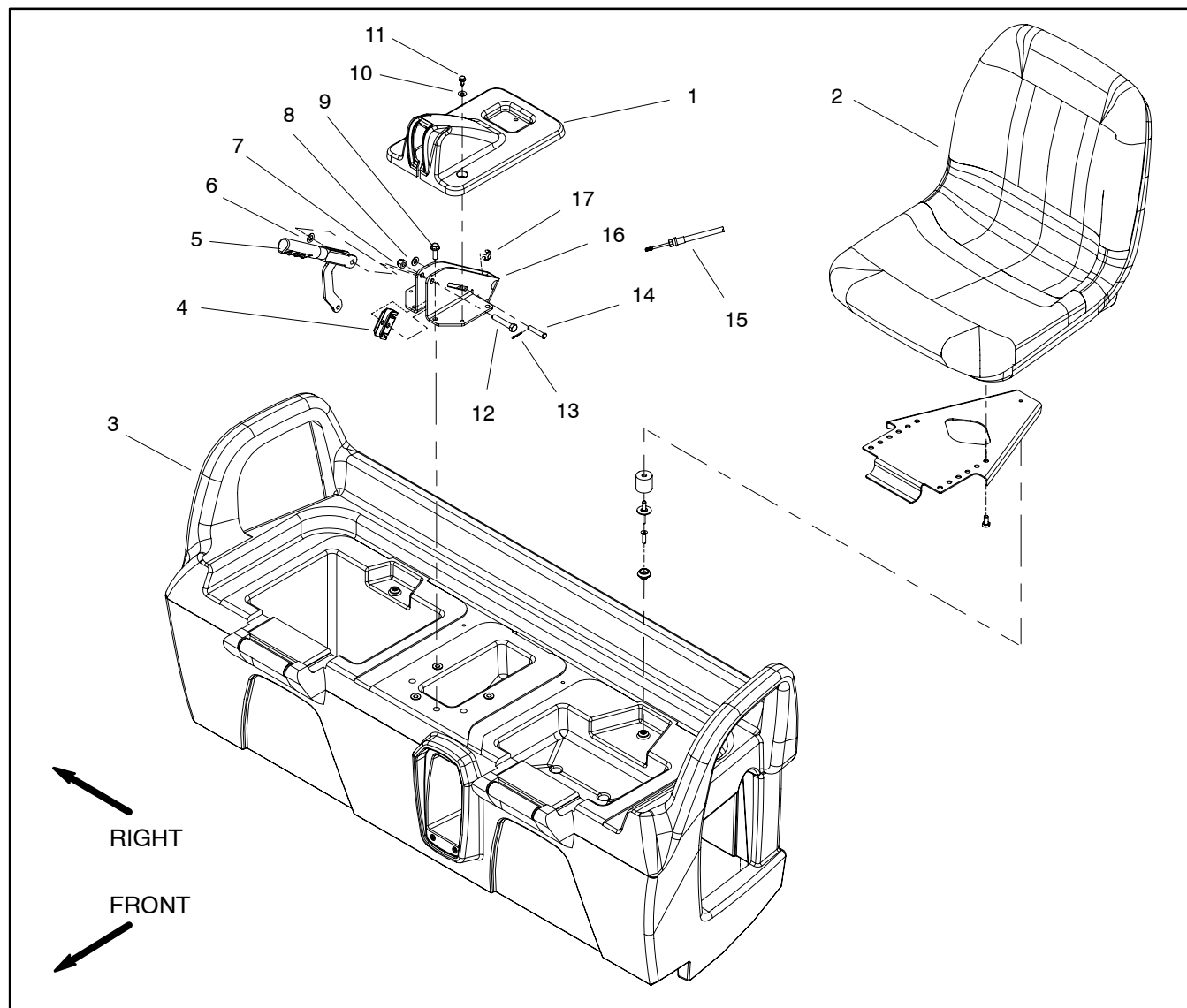


Figure 12

- | | | |
|----------------------------|-------------------------------|-----------------------------------|
| 1. Parking brake cover | 7. Lock nut | 13. Cotter pin |
| 2. Operator seat | 8. Flat washer | 14. Clevis pin |
| 3. Seat base | 9. Flange head screw (4 used) | 15. Parking brake cable (2 used) |
| 4. Cable equalizer bracket | 10. Flat washer (2 used) | 16. Parking brake support |
| 5. Parking brake lever | 11. Screw (2 used) | 17. Cable retaining ring (2 used) |
| 6. Curved washer | 12. Cap screw | |

Disassembly (Fig. 12)

1. Park machine on a level surface, stop engine and remove key from the ignition switch. Chock wheels to prevent the machine from moving.
2. Disconnect both brake cables from rear of machine:
 - A. Remove cotter pin and clevis pin that secures each brake cable end to brake lever.
 - B. Remove retaining ring that secures each brake cable to frame.
 - C. Remove screw and flange nut that secure each R-clamp to rear frame.
3. Note routing of brake cables for assembly purposes.
4. Remove parking brake cover from seat base.
5. Remove four (4) flange head screws that secure parking brake support to seat base.
6. Carefully remove parking brake support and brake cables from machine. Take care to not damage brake cables while removing them from seat base opening.
7. Remove brake cables from parking brake support and cable equalizer bracket using Figure 12 as a guide.

Assembly (Fig. 12)

1. Secure brake cables to parking brake support and cable equalizer bracket using Figure 12 as a guide.
2. Route brake cables through seat base opening taking care to not damage cables. Position parking brake support to seat base.
3. Secure parking brake support to seat base with four (4) flange head screws.
4. Position brake cables to rear brake assemblies using cable routing noted during disassembly.
5. Secure brake cables to rear of machine:
 - A. Secure each R-clamp to rear frame with screw and flange nut.
 - B. Secure each brake cable to frame with retaining ring.
 - C. Secure each brake cable end to brake lever with clevis pin and cotter pin.
6. Check parking brake operation and adjust if necessary.

Transaxle

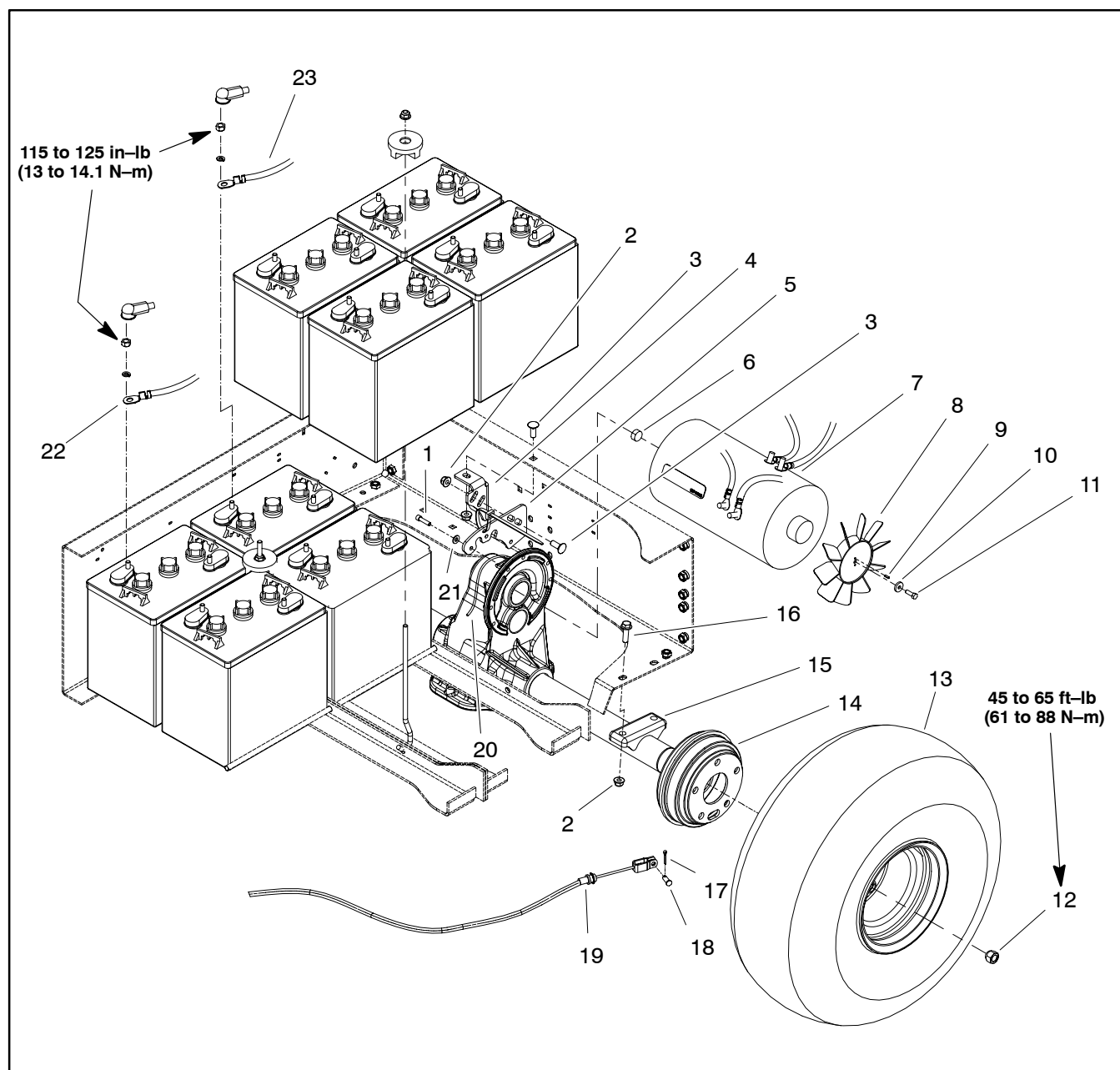


Figure 13

- | | | |
|-------------------------------|--------------------------------|----------------------------|
| 1. Socket head screw (6 used) | 9. Roll pin (2 used) | 17. Cotter pin |
| 2. Flange nut | 10. Washer | 18. Clevis pin |
| 3. Carriage screw (5 used) | 11. Socket head screw | 19. Brake cable |
| 4. Support bracket | 12. Lug nut (5 used per wheel) | 20. Transaxle vent hose |
| 5. Transaxle mount plate | 13. Wheel assembly | 21. Flat washer (6 used) |
| 6. Rubber damper | 14. Brake drum | 22. Negative battery cable |
| 7. Traction motor | 15. Transaxle | 23. Positive battery cable |
| 8. Fan | 16. Flange head screw (4 used) | |

Removal (Fig. 13)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from switch.
2. Remove cargo bed from vehicle (see Cargo Bed Removal in Service and Repairs section of Chapter 5 – Chassis).
3. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).

NOTE: Label all electrical leads for reassembly purposes.

IMPORTANT: When removing cables from traction motor terminals (A1, A2, F1 and F2), use a wrench to retain lower nut before loosening upper nut (Fig. 14). If terminal studs are allowed to turn during upper nut removal, internal motor damage can occur.

4. Disconnect cables from traction motor:
 - A. While retaining lower nut, remove upper nut and cable connector from motor terminals A1, A2, F1 and F2.
 - B. Unplug motor temperature sensor from vehicle wire harness.
 - C. Position disconnected cables away from motor.



WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Operator's Manual and in Chapter 1 – Safety.

5. Jack up rear of vehicle enough to remove rear wheels.
 - A. Chock the front and rear of both front tires to prevent the vehicle from moving.
 - B. Support both sides of the rear frame with jack-stands positioned just in front of the axle tubes. This will allow the transaxle to be removed from the rear of the vehicle.
6. Remove rear wheels from vehicle.
7. Remove cotter pins and clevis pins that secure brake cables to brake actuator levers (Fig. 15). Position brake cables away from transaxle assembly.
8. Attach hoist or chain fall to the transaxle and motor assembly. Make sure lifting device is attached so it can hold the full weight of the transaxle and motor.

Workman e2050/e2065

9. Loosen and remove two (2) flange nuts and carriage screws that secure transaxle mount plate (item 5) to support bracket (item 4) (Fig. 16).

10. Remove four (4) flange head screws and flange nuts securing the transaxle to the rear frame.

11. Carefully lower transaxle and motor assembly from the rear of the vehicle.

12. If necessary, remove traction motor from transaxle (see Traction Motor Removal in Service and Repairs section of Chapter 3 – Electrical System).

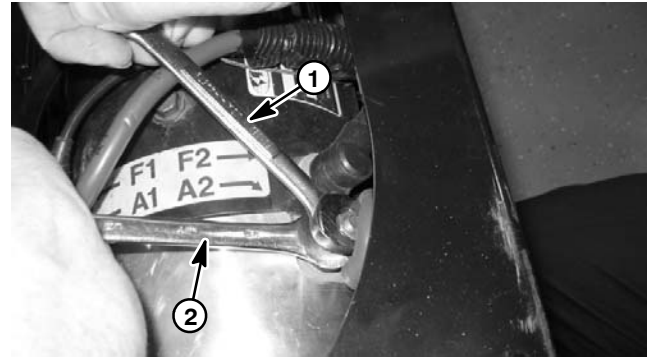


Figure 14

1. Loosening/tightening wrench (upper nut)
2. Retaining wrench (lower nut)

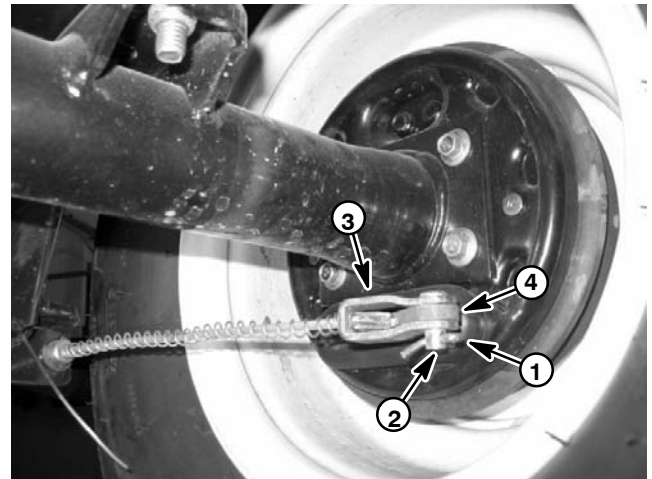


Figure 15

1. Cotter pin
2. Clevis pin
3. Brake cable bracket
4. Brake actuator lever

Installation (Fig. 13)

1. If removed, install traction motor to transaxle (see Traction Motor Installation in Service and Repairs section of Chapter 3 – Electrical System).

2. Position transaxle and motor assembly to the rear frame. Loosely install all fasteners used to secure transaxle to vehicle. Tighten fasteners in the following order:

A. Tighten four (4) flange head screws and flange nuts that secure transaxle to the rear frame.

B. Tighten two (2) flange nuts and carriage screws that secure transaxle mount plate (item 5) to support bracket (item 4).

3. Install brake cables to brake actuator levers with clevis pins and cotter pins.

4. Position wheel assemblies to the vehicle with valve stems facing out. Secure each wheel with five (5) lug nuts. Torque lug nuts in a criss-cross pattern from 45 to 65 ft-lb (61 to 88 N-m).

5. Lower vehicle from jackstands.

6. Connect wires to traction motor (Fig. 17):

IMPORTANT: When connecting cables to motor terminals (A1, A2, F1 and F2), use a back-up wrench to retain lower nut before tightening upper nut (Fig. 14). If terminal studs are allowed to turn during upper nut installation, internal motor damage can occur.

A. Install cable connector and upper nut to motor terminals A1 and A2. While retaining lower nut, torque upper nut on terminals A1 and A2 from 85 to 90 in-lb (9.6 to 10.2 N-m).

B. Install cable connector and upper nut to motor terminals F1 and F2. While retaining lower nut, torque upper nut on terminals F1 and F2 from 55 to 60 in-lb (6.2 to 6.8 N-m).

C. Plug motor temperature sensor connector into vehicle wire harness.

7. Carefully connect removed battery cable to battery terminals. Install lock washers and nuts on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

8. Install cargo box to the rear frame (see Cargo Box Installation in Service and Repairs section of Chapter 5 – Chassis).

9. Check brakes for proper adjustment (see Operator's Manual).

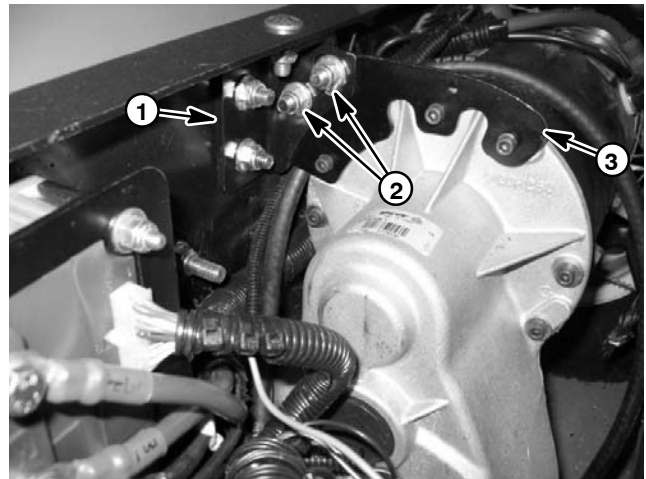


Figure 16

- 1. Support bracket
- 2. Carriage screws/nuts
- 3. Transaxle mount plate

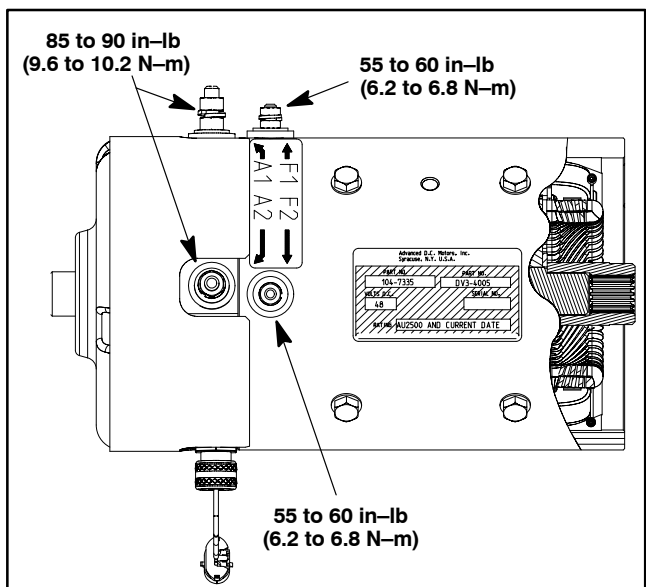


Figure 17

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Transaxle Service

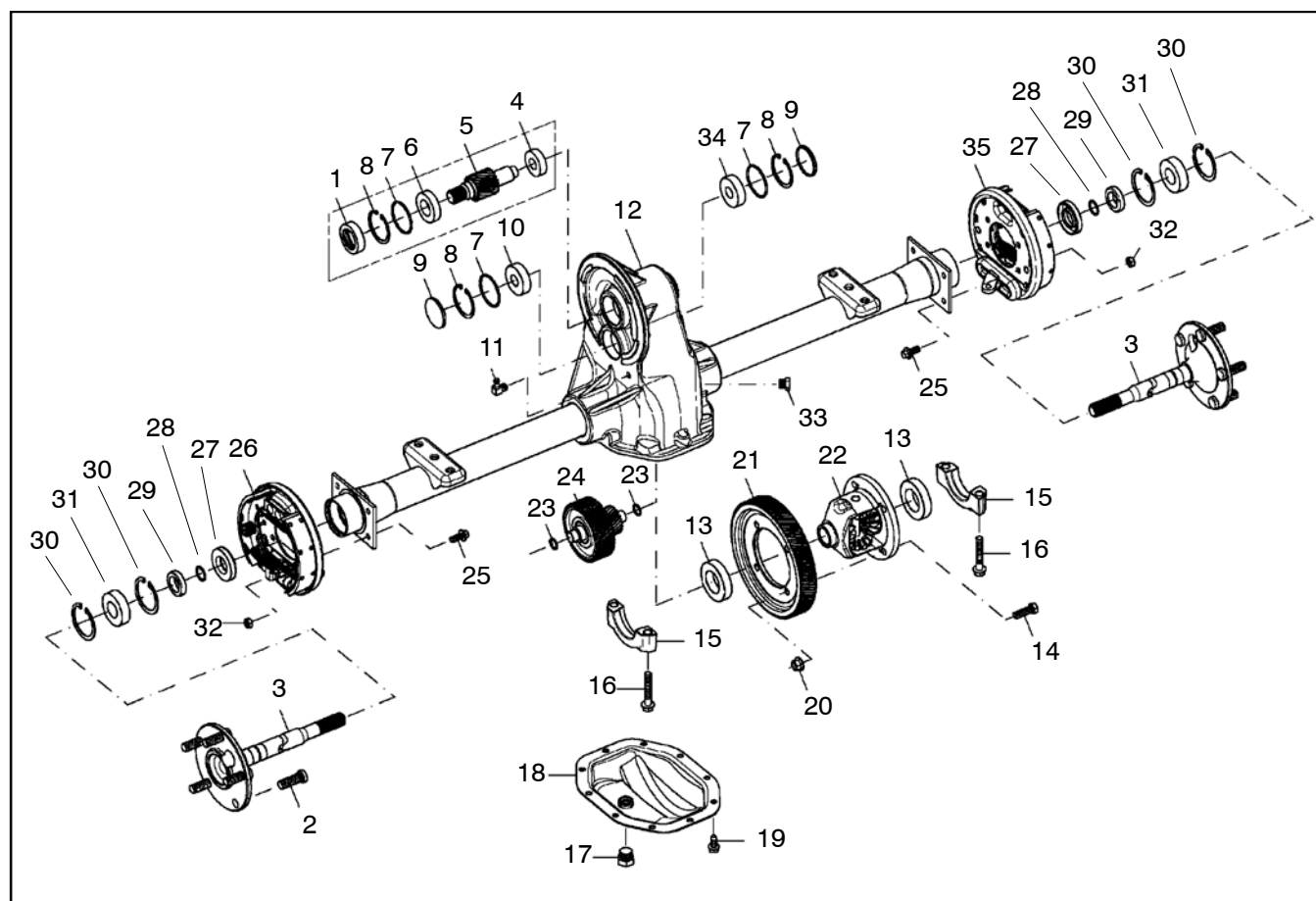


Figure 18

- | | | |
|---------------------------------|---------------------------------------|-------------------------------------|
| 1. Oil seal | 13. Bearing | 25. Flange head screw (4 per brake) |
| 2. Wheel stud (5 used per side) | 14. Cap screw (4 used) | 26. LH brake assembly |
| 3. Axle shaft | 15. Bearing cap | 27. Oil seal |
| 4. Ball bearing | 16. Bearing cap bolt (2 used per cap) | 28. Retaining ring |
| 5. Input shaft | 17. Plug | 29. Bearing retaining ring |
| 6. Ball bearing | 18. Cover plate | 30. Retaining ring |
| 7. O-ring | 19. Screw (10 used) | 31. Ball bearing |
| 8. Retaining ring | 20. Lock nut (4 used) | 32. Lock nut (4 used per brake) |
| 9. Endcap plug | 21. Final drive gear | 33. Plug |
| 10. Ball bearing | 22. Differential assembly | 34. Ball bearing |
| 11. Vent elbow | 23. O-ring | 35. RH brake assembly |
| 12. Transaxle housing | 24. Intermediate shaft & gear | |

NOTE: For service of the transaxle, see the Spicer Off-Highway Components Model 12 (Electric) Maintenance Manual at the end of this chapter.



Chapter 5

Chassis

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Specifications

Item	Description
Front tire (22 x 9.5 – 10, 4 ply) pressure	8 to 22 PSI (0.55 to 1.52 bar)
Rear tire (22 x 9.5 – 10, 4 ply) pressure	8 to 22 PSI (0.55 to 1.52 bar)
Front wheel cap screw torque (Workman e2050)	135 to 165 ft–lb (183 to 224 N–m)
Wheel lug nut torque (front and rear)	45 to 65 ft–lb (61 to 88 N–m)

Troubleshooting

Suspension and Steering

Problem	Possible Cause
Front end is noisy.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Front end components are loose or worn. Steering gear is loose.
Rear end is noisy.	Rear wheel lug nuts are loose. Transaxle problem (see Chapter 4 – Transaxle and Brakes).
Excessive steering play.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Steering linkage is loose or worn. Tie rod ends are loose or worn. Steering gear is incorrectly adjusted.
Front end shimmies.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Front wheel alignment (toe-in) is incorrect. Steering linkage is loose or worn. Tie rod ends are loose or worn. Rubber insert in A-arm is worn.
Vehicle is unstable or wanders.	Tire pressure is low or uneven between tires. Wheel lug nuts are loose. Front wheel bearings are loose. Front wheel alignment (toe-in) is incorrect. Steering column bushings are worn. Rubber insert in A-arm is worn. Steering gear is incorrectly adjusted.

Suspension and Steering (continued)

Problem	Possible Cause
Steering is hard.	Tire pressure is low or uneven between tires. Front wheel alignment (toe-in) is incorrect. Steering linkage is binding or damaged. Steering gear is damaged or worn.
Vehicle pulls to one side when not braking.	Tire pressure is low or uneven between tires. Front wheel alignment (toe-in) is incorrect. Steering or suspension component may be bent.

Service and Repairs

Check Tire Pressure

The tire pressure range for front and rear tires is 8 to 22 PSI (0.55 to 1.52 bar). The tire pressure needed is determined by the payload carried.

The **lower** the air pressure, the less the compaction and tire marks are minimized. Lower pressure should not be used for heavy payloads at higher speeds.

Higher pressures should be used for heavier payloads at higher speeds. Do not exceed the maximum tire pressure.

Inspect Tires and Wheels

Operating accidents, such as hitting curbs, can damage a tire or rim and also disrupt wheel alignment, so inspect wheel condition (tire and rim) and wheel alignment (toe-in) after any accident.

Check wheels to ensure they are mounted securely. Torque wheel lug nuts (front and rear) from 45 to 65 ft-lb (61 to 88 N-m). On Workman e2050 vehicles, the front wheel cap screws should be torqued from 135 to 165 ft-lb (183 to 224 N-m).

If desired, tires can be moved from one position of the vehicle to another to extend tread life (e.g. front tires to rear and rear tires to front). All tires on the Workman e2050 and e2065 are the same size.

Upper Steering

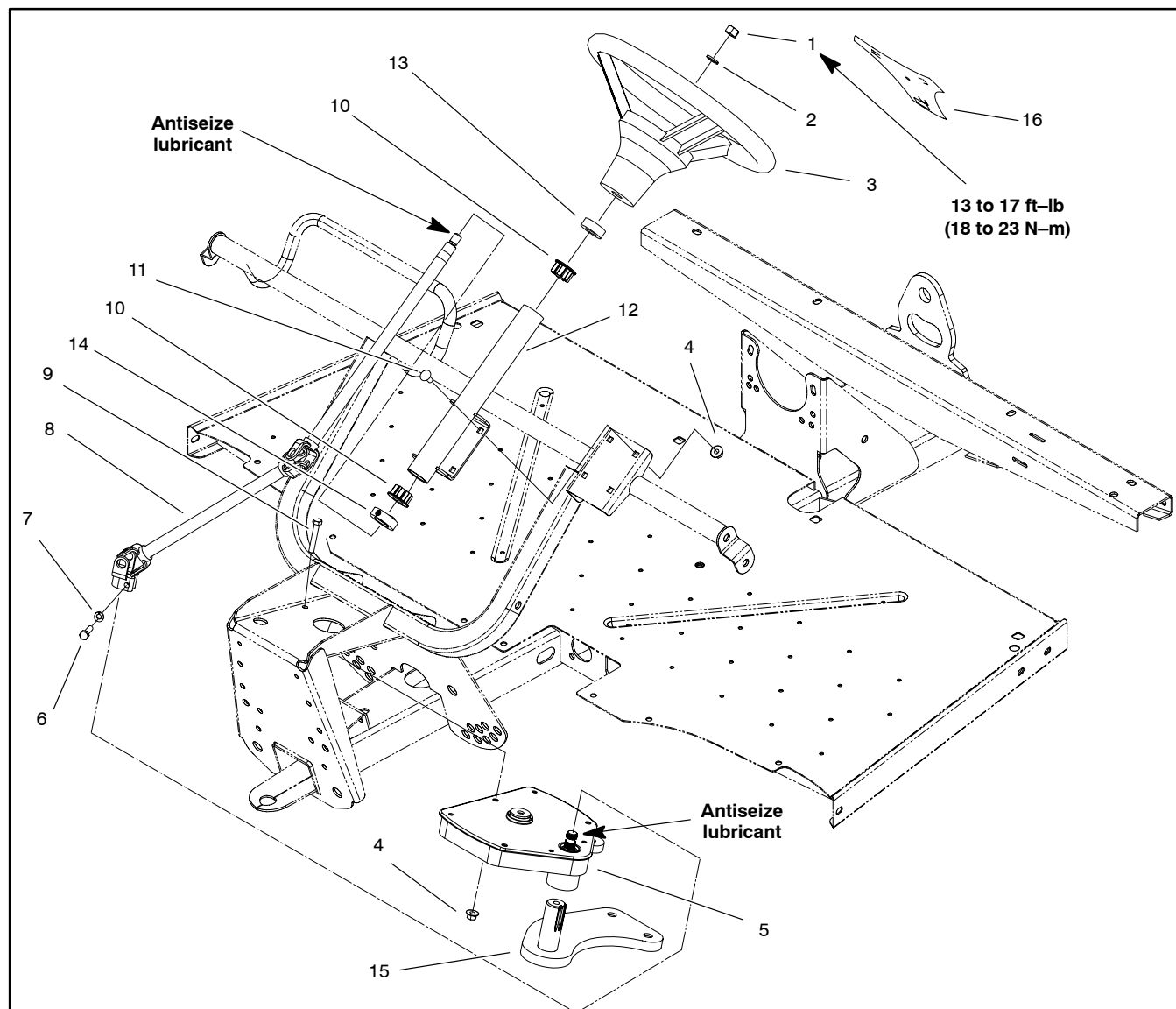


Figure 1

- | | | |
|---------------------|----------------------------|--------------------------|
| 1. Nut | 7. Lock washer | 12. Steering column |
| 2. Lock washer | 8. Steering shaft | 13. Dust cover |
| 3. Steering wheel | 9. Cap screw (3 used) | 14. Collar |
| 4. Flange lock nut | 10. Upper steering bushing | 15. Pitman arm |
| 5. Steering gearbox | 11. Carriage bolt (4 used) | 16. Steering wheel cover |
| 6. Cap screw | | |

Removal (Fig. 1)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the switch.
2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).
3. Remove front hood to gain access to the steering mechanism (see Front Hood Removal in this section).
4. Remove steering wheel cover carefully from the steering wheel. Remove nut and lock washer securing the steering wheel to the steering shaft. Pull steering wheel from the shaft.
5. Remove cap screw and lock washer securing the lower steering shaft knuckle to the steering gearbox shaft. Pull knuckle from the gearbox shaft.
6. Remove four (4) flange lock nuts and carriage bolts securing the steering column to the mounting plate on the frame.
7. Remove dust cover from the steering shaft. Replace cover if damaged. Slide steering shaft out of the steering column.
8. Disconnect both tie rods from the Pitman arm on the steering gearbox (see Lower Steering Removal in this section).
9. Remove three (3) flange lock nuts and cap screws securing the steering gearbox to the tower plate on the front frame. Remove gearbox from the tower plate.

Installation (Fig. 1)

1. Position steering gearbox to the tower plate of the front frame with the Pitman arm facing down and to the rear. The gearbox shaft must be to the left side of the tower.
2. Secure steering gearbox to the tower plate with three (3) cap screws and flange lock nuts.

3. Insert steering shaft up through the steering column. Place dust cover onto the shaft.

4. Secure steering column to the mounting plate on the frame with four (4) carriage screws and flange lock nuts.

NOTE: Apply antiseize lubricant to the steering gearbox shaft before installing steering shaft knuckle.

5. Position knuckle of the lower steering shaft onto the gearbox shaft. Secure knuckle to the steering gearbox shaft with cap screw and lock washer.

6. Connect both tie rods to the Pitman arm on the steering gearbox (see Lower Steering Installation in this section).

NOTE: Apply antiseize lubricant to the steering shaft splines before installing the steering wheel.

7. Position front tires straight ahead. Position steering wheel to the steering shaft so that the leg of the “Y” formed by the wheel struts is directed towards the operator platform.

8. Secure steering wheel to shaft with lock washer and nut. Torque nut from 13 to 17 ft-lb (18 to 23 N-m). Install steering wheel cover to steering wheel.

9. Install front hood to the frame and fenders (see Front Hood Installation in this section).

10. Reconnect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

11. Check front wheel alignment and adjust if required (see Operator's Manual).

Steering Gearbox

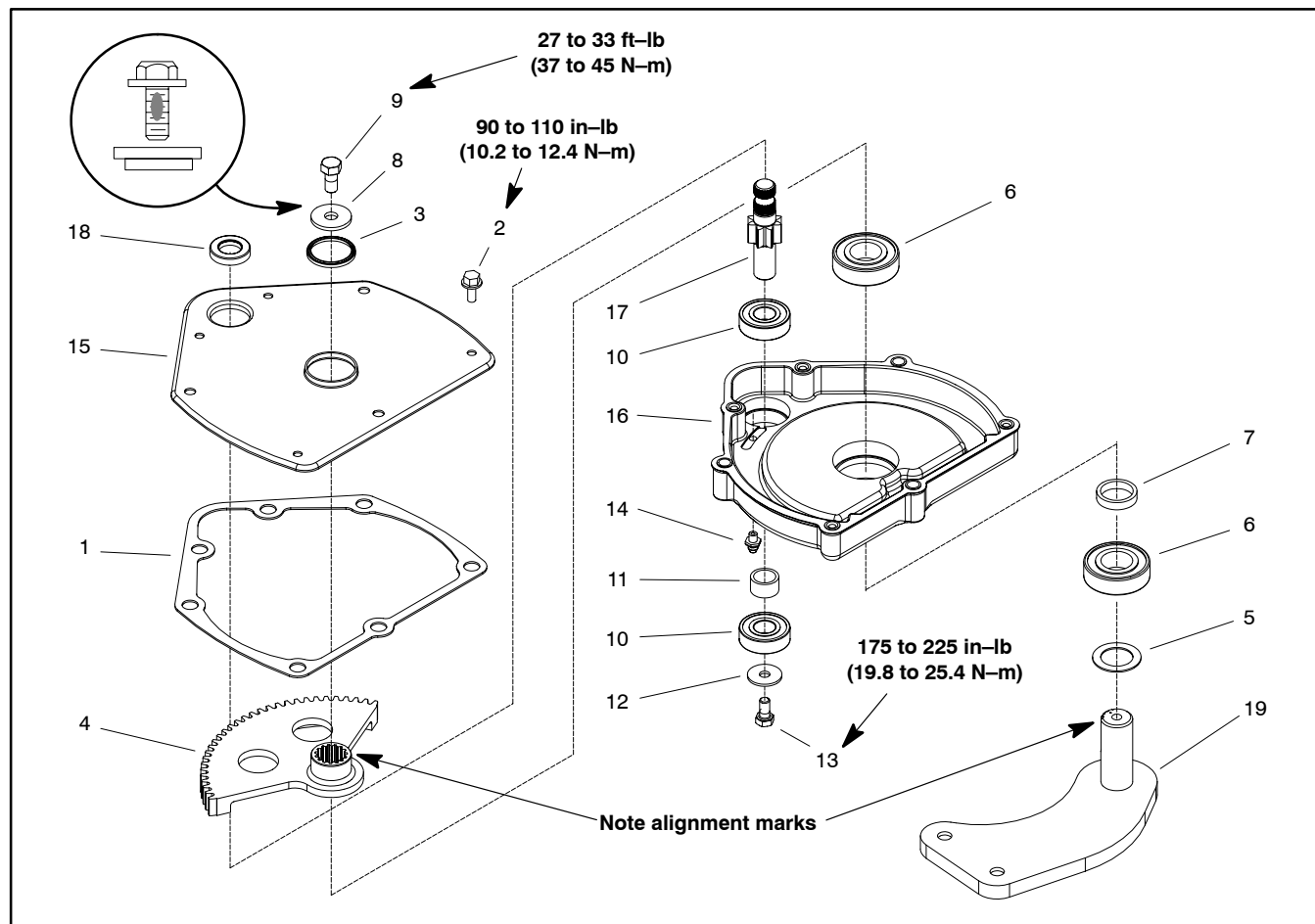


Figure 2

- | | | |
|-----------------------------------|--------------------------------------|----------------------------|
| 1. Gasket | 8. Stepped washer | 14. Grease fitting |
| 2. Hex washer head screw (4 used) | 9. Flange head screw with patch lock | 15. Steering housing cover |
| 3. Seal | 10. Ball bearing | 16. Steering housing |
| 4. Sector gear | 11. Input shaft spacer | 17. Pinion gear |
| 5. Flat washer | 12. Flat washer | 18. Oil seal |
| 6. Ball bearing | 13. Cap screw | 19. Pitman arm |
| 7. Output shaft spacer | | |

Disassembly (Fig. 2)

IMPORTANT: Do not reuse flange head screw with patch lock (item 9) after it has been removed.

1. Remove flange head screw with patch lock (item 9) and stepped washer (item 8) from Pitman arm. Discard flange head screw.
2. Remove cap screw (item 13) and flat washer (item 12) from pinion gear shaft.
3. Remove four (4) hex washer head screws (item 2) securing the housing cover and gasket to the steering housing. Remove cover and gasket from the housing. Replace gasket if damaged.
4. Inspect gears. Sector and pinion gear teeth must be free of damage that prevents them of free movement.
5. Remove pinion gear (item 17) from the housing.

IMPORTANT: Note alignment marks on Pitman arm shaft and sector gear. If marks are not visible, matchmark shaft and gear before disassembly. Their position is critical during assembly.

6. Separate Pitman arm (item 19) from the sector gear (item 4) and steering housing. Remove Pitman arm from the housing.
7. Inspect bearings. Bearings must spin smoothly and be free of damage. Press bearings and spacer out of housing if necessary.

NOTE: If seals are removed, note orientation of seal lips for installation purposes.

8. Inspect seals. Seals must be free of rips and tears. Replace seals if necessary.

Assembly (Fig. 2)

IMPORTANT: Always replace ball bearings as a set.

1. If ball bearings were removed:
 - A. Press new bearing into housing from the inside first.
 - B. Turn housing over. Insert spacer and press new bearing into housing.
2. If seals (items 3 and 18) were removed, press new seals into housing. Install seals with seal lips up.
3. Place flat washer onto shaft of the Pitman arm. Insert shaft into steering housing.

IMPORTANT: The position of the Pitman arm and sector gear is critical during assembly. If either or both of these parts is replaced, make sure their alignment matches the alignment of the original gear and Pitman arm.

4. Position sector gear onto the spline of the Pitman arm shaft while aligning marks.

IMPORTANT: Make sure sector gear is centered to the pinion gear.

5. Insert pinion gear into the small bearing in the steering housing.
6. Fill steering housing with number 2 general purpose grease. Make sure all gear teeth on the sector and pinion gears are covered with grease.
7. Place gasket and steering housing cover onto the housing. Secure cover to housing with four (4) hex washer head screws. Torque screws from 90 to 110 in-lb (10.2 to 12.4 N-m).

IMPORTANT: Flange head screw with patch lock (item 9) should be replaced whenever it is removed.

8. Secure flange head screw with patch lock (item 9) and step washer (item 8) to the Pitman arm. Make sure to position step washer as in Figure 2. Torque screw from 27 to 33 ft-lb (37 to 45 N-m).
9. Secure cap screw (item 13) and flat washer (item 12) to the pinion gear shaft. Torque cap screw from 175 to 225 in-lb (19.8 to 25.4 N-m).

Front Wheels (Workman e2050)

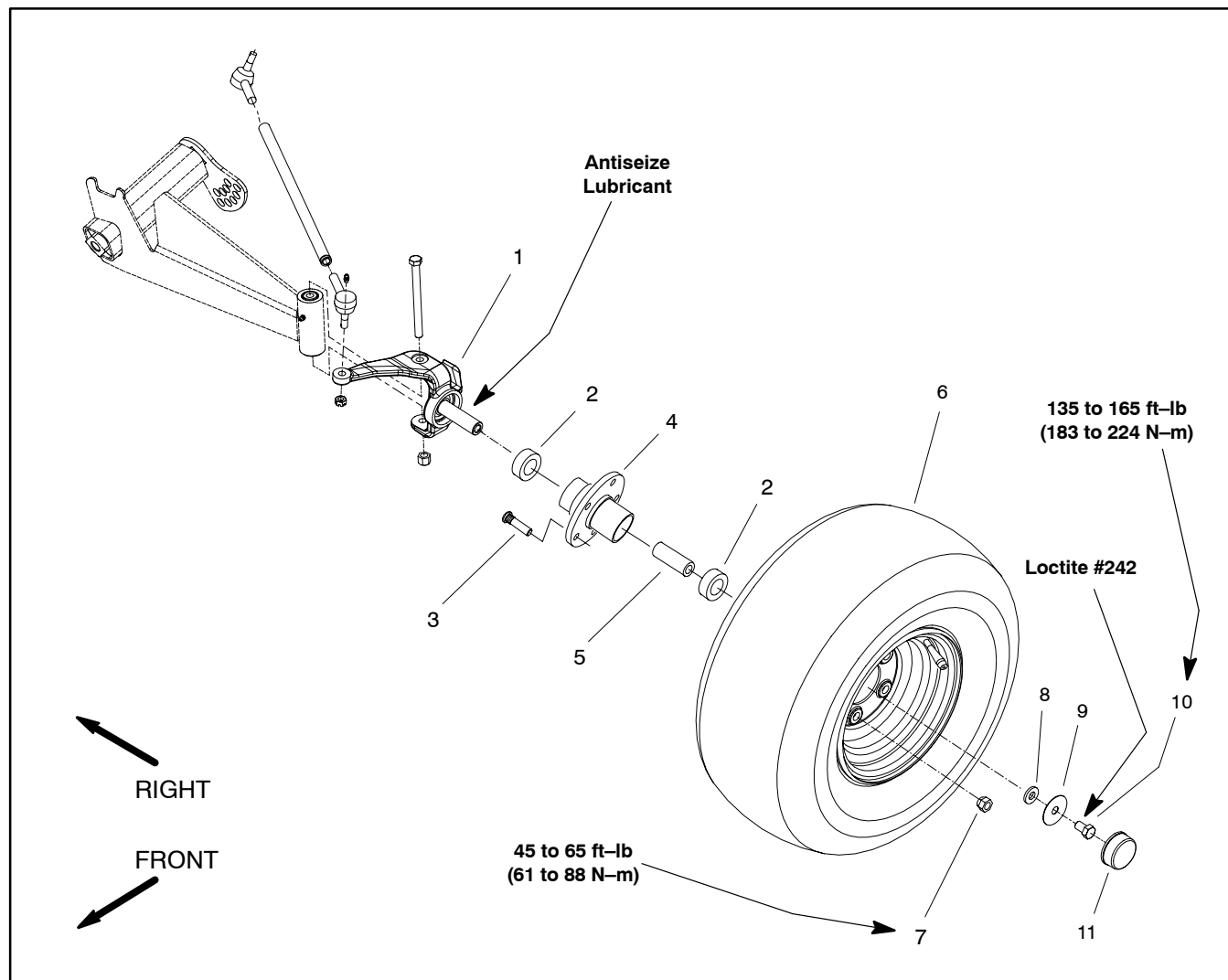


Figure 3

1. Spindle (LH shown)
2. Bearing (with retaining ring)
3. Wheel stud (5 per wheel)
4. Wheel hub

5. Spacer
6. Tire/wheel assembly
7. Lug nut (5 per wheel)
8. Flat washer

9. Large flat washer
10. Cap screw
11. Dust cap

Removal (Fig. 3)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.



2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.
3. Loosen and remove five (5) lug nuts that secure wheel to machine. Remove wheel from vehicle.
4. Remove wheel hub from spindle:
 - A. Carefully remove dust cap from the wheel to prevent damage to the cap.
 - B. Remove cap screw and two (2) washers that secure the wheel hub to the spindle. Slide wheel hub from the spindle shaft.
5. If necessary, remove bearings from both sides of the wheel hub (Fig. 4). Discard removed bearings. Retrieve spacer from wheel hub. Clean the spacer and the inside of the wheel hub.

Installation (Fig. 3)

1. If bearings were removed from wheel hub, position spacer in wheel hub and press new bearings into the hub until the bearing retaining rings seat against hub (Fig. 4).
2. Install wheel hub to spindle:
 - A. Apply antiseize lubricant to spindle shaft.
 - B. Slide wheel hub onto spindle shaft with the wheel studs facing out.

NOTE: Apply Loctite #242 (or equivalent) to the threads of the cap screw.

- C. Place large washer and then small washer onto the cap screw. Thread cap screw with washers into the spindle shaft.
- D. Torque cap screw from 135 to 165 ft-lb (183 to 224 N-m).

3. Position wheel to studs in wheel hub and secure with five (5) lug nuts. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m).
4. Lower machine to ground. Remove chocks from wheels.

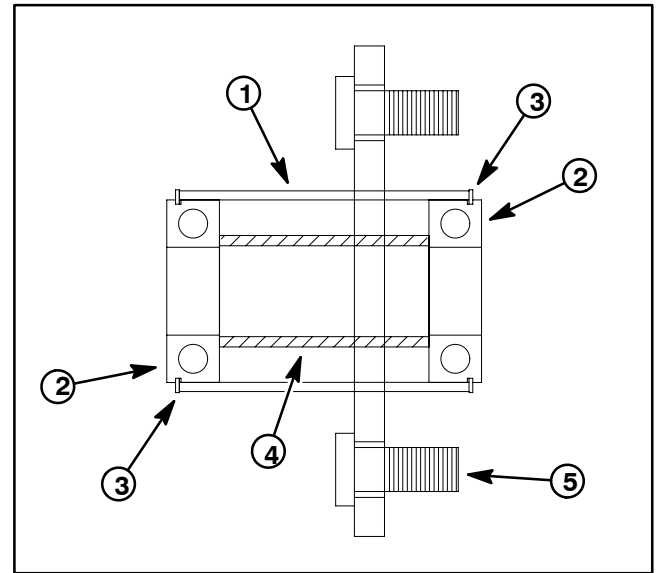


Figure 4

- | | |
|-------------------|---------------|
| 1. Wheel hub | 4. Spacer |
| 2. Bearing | 5. Wheel stud |
| 3. Retaining ring | |

Lower Steering (Workman e2050)

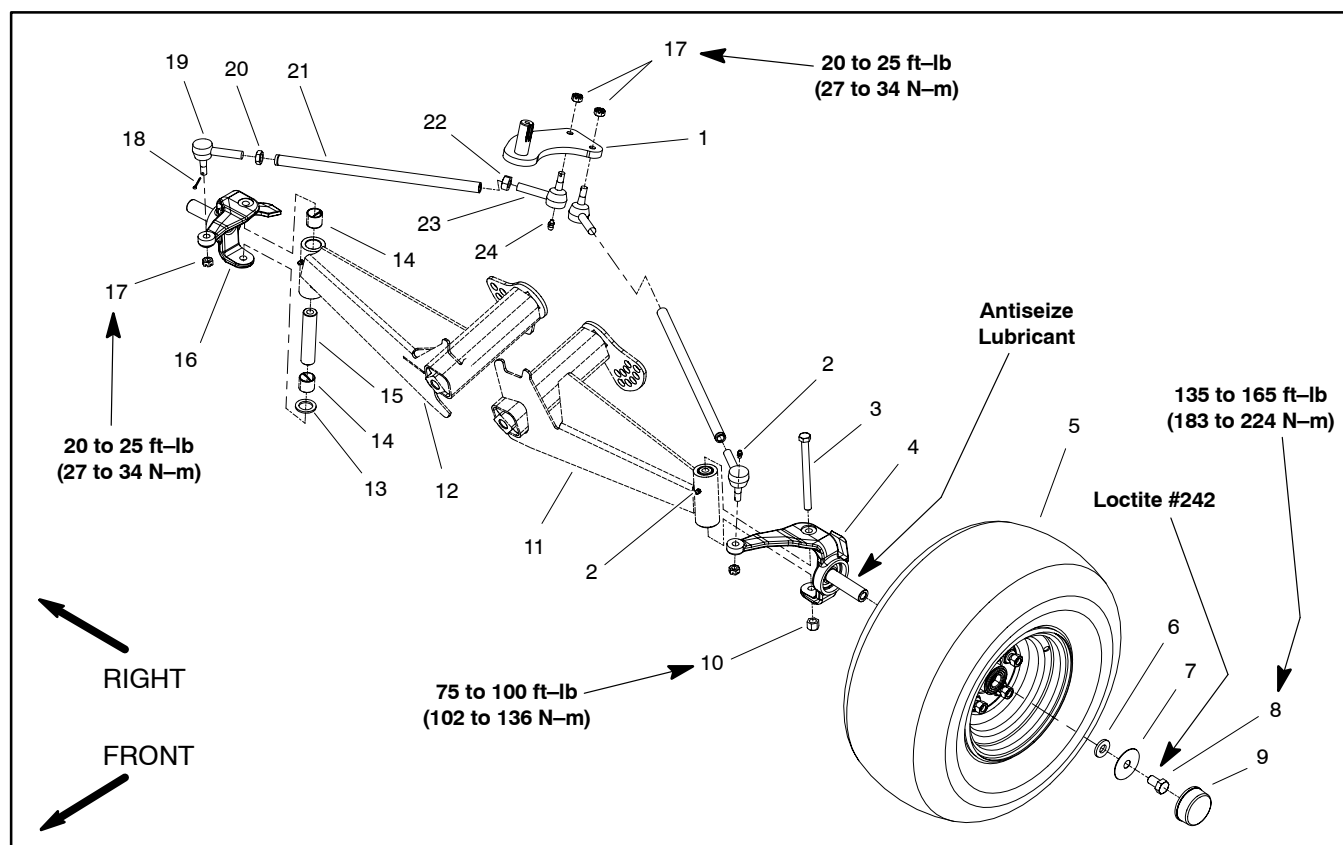


Figure 5

- 1. Pitman arm
- 2. Grease fitting
- 3. Cap screw (king pin)
- 4. Spindle (LH)
- 5. Front wheel assembly
- 6. Flat washer
- 7. Large flat washer
- 8. Cap screw

- 9. Dust cap
- 10. Lock nut
- 11. A-arm (LH)
- 12. A-arm (RH)
- 13. Thrust washer
- 14. Bushing
- 15. Kingpin sleeve
- 16. Spindle (RH)

- 17. Slotted hex nut (2 used per tie rod)
- 18. Cotter pin (2 used per tie rod)
- 19. Ball joint (RH thread)
- 20. Jam nut (RH thread)
- 21. Tie rod
- 22. Jam nut (LH thread)
- 23. Ball joint (LH thread)
- 24. Grease fitting

NOTE: Both tie rod assemblies consist of two ball joints (items 19 and 23) with jam nuts, two slotted hex nuts (item 17), two cotter pins (item 18) and tie rod (item 21).

Removal (Fig. 5)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.



2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.
3. Remove front wheel assembly as follows:
 - A. Remove dust cap carefully from the wheel to prevent damage to the cap.
 - B. Remove cap screw and two (2) washers that secure the wheel assembly to the spindle. Slide wheel assembly from the spindle shaft.
4. Remove spindle as follows:
 - A. Remove cotter pin and slotted hex nut that secure tie rod ball joint to the spindle. Separate ball joint from the spindle.
 - B. If necessary, remove tie rod from Pitman arm.
 - C. Remove lock nut and cap screw (king pin) securing the spindle to the A-arm. Separate spindle from the A-arm. Locate and retrieve thrust washer (item 13).

Installation (Fig. 5)

1. Install spindle as follows:
 - A. Position king pin sleeve into the pivot hub of the A-arm. Spacer must extend through the bottom of the hub.
 - B. Place thrust washer onto the bottom of the king pin sleeve. Then position spindle over the hub, king pin sleeve and thrust washer.

NOTE: Make sure cap screw (king pin) is inserted down through the spindle and A-arm hub.

 - C. Secure spindle to A-arm hub with cap screw (king pin) and lock nut. Torque lock nut from 75 to 100 ft-lb (102 to 136 N-m).
 - D. If tie rod was removed from Pitman arm, insert tie rod ball joint up through Pitman arm and secure with slotted hex nut.
 - E. Insert tie rod ball joint down through the spindle. Secure with slotted hex nut.
 - F. Torque slotted hex nut(s) from 20 to 25 ft-lb (27 to 34 N-m) to secure ball joint to spindle (and Pitman arm, if installed). If necessary, tighten nut to allow cotter pin to be inserted. Install cotter pin to secure assembly.
2. Install front wheel assembly:
 - A. Place antiseize lubricant on spindle shaft.
 - B. Slide wheel assembly onto spindle shaft with the valve stem facing out.

NOTE: Apply Loctite #242 (or equivalent) to the threads of the cap screw.

 - C. Place large washer and then small washer onto the cap screw. Thread cap screw with washers into the spindle shaft.
 - D. Torque cap screw from 135 to 165 ft-lb (183 to 224 N-m).
3. Lower machine to ground. Remove chocks from wheels.
4. Align steering and toe-in (see Operator's Manual).
5. Lubricate tie rod ball joints and king pin (see Operator's Manual).

Front Wheels and Lower Steering (Workman e2065)

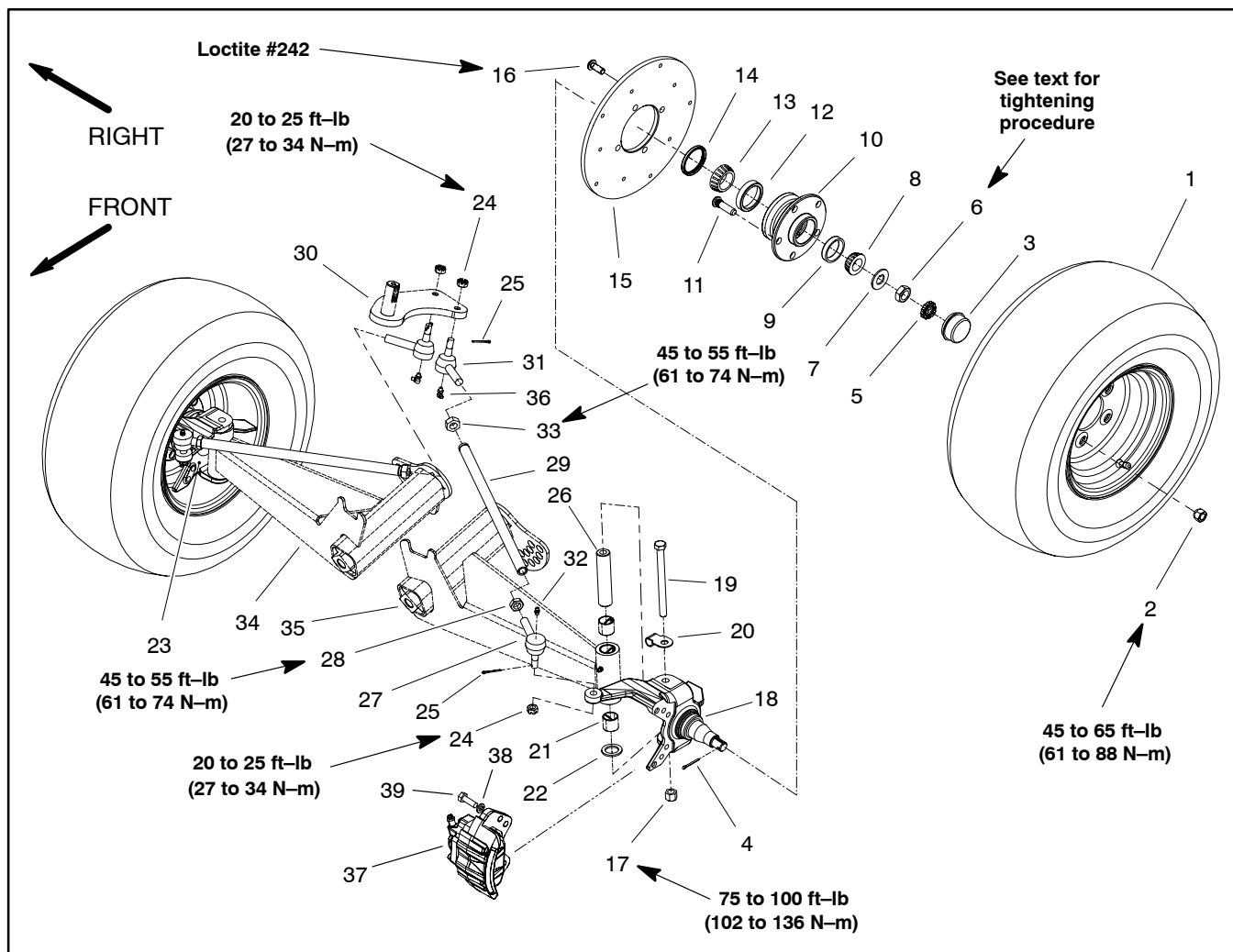


Figure 6

- | | | |
|---------------------------------|--|--------------------------------------|
| 1. Wheel assembly | 14. Seal | 27. Ball joint (RH thread) |
| 2. Lug nut (5 used per wheel) | 15. Brake rotor | 28. Jam nut (RH thread) |
| 3. Dust cap | 16. Socket head screw (4 used per rotor) | 29. Tie rod tube |
| 4. Cotter pin | 17. Lock nut | 30. Pitman arm |
| 5. Nut retainer | 18. LH spindle | 31. Ball joint (LH thread) |
| 6. Jam nut | 19. Cap screw | 32. Grease fitting |
| 7. Tab washer | 20. Brake hose bracket | 33. Jam nut (LH thread) |
| 8. Bearing cone | 21. Bushing (2 used per A-arm) | 34. A-arm (RH) |
| 9. Bearing cup | 22. Thrust washer | 35. A-arm (LH) |
| 10. Wheel hub | 23. RH spindle | 36. Grease fitting |
| 11. Wheel stud (5 used per hub) | 24. Castle nut | 37. Brake caliper (LH shown) |
| 12. Bearing cup | 25. Cotter pin | 38. Lock washer (2 used per caliper) |
| 13. Bearing cone | 26. Kingpin sleeve | 39. Cap screw (2 used per caliper) |

NOTE: Both tie rod assemblies consist of the following parts: ball joints (27 and 31), jam nuts (28 and 33), tie rod tube (29) and grease fittings (32 and 36).

Removal (Fig. 6)

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.

3. Remove lug nuts and pull wheel assembly from machine.
4. Remove brake caliper from spindle (see Front Brake Calipers in the Service and Repairs section of Chapter 4 – Transaxle and Brakes). Position caliper away from wheel hub and spindle.
5. Carefully pry dust cap from wheel hub.
6. Remove cotter pin and nut retainer from spindle.
7. Remove jam nut that secures wheel hub to spindle. Slide wheel hub with bearings and rotor from spindle.
8. Disassemble the wheel hub:
 - A. Pull the seal out of the wheel hub.
 - B. Remove bearings from both sides of the wheel hub. Clean bearings in solvent. Make sure bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.
 - C. If necessary, remove four (4) socket head screws and brake rotor from wheel hub.
9. Remove spindle:
 - A. Remove cotter pin and castle nut securing tie rod ball joint to the spindle. Separate ball joint from the spindle. Remove tie rod from Pitman arm if necessary.
 - B. Remove lock nut and cap screw (19) securing the spindle to the A-arm. Separate spindle from A-arm.
 - C. Locate and remove thrust washer from bottom of kingpin sleeve in A-arm. Remove kingpin sleeve from A-arm if necessary.

Installation (Fig. 6)

1. Install spindle as follows:
 - A. Position king pin sleeve into the pivot hub of the A-arm. Sleeve must extend through the bottom of the hub.
 - B. Place thrust washer onto the bottom of the king pin sleeve. Then position spindle over the hub, king pin sleeve and thrust washer.

NOTE: Make sure cap screw (19) is inserted down through the spindle and A-arm hub.

- C. Install brake hose bracket (20) onto cap screw (19). Secure spindle to A-arm hub with cap screw (19) and lock nut. Torque lock nut from 75 to 100 ft-lb (102 to 136 N-m).

D. Insert tie rod ball joints down through the spindle and up through the Pitman arm. Secure with castle nuts.

E. Torque castle nuts from 20 to 25 ft-lb (27 to 34 N-m) to secure ball joint while aligning castle nut slot with hole in ball joint stud. If necessary to align holes, castle nut torque may be slightly more than specification. Install cotter pin.

2. Assemble wheel hub:

A. If bearing cups were removed from the wheel hub, press inner and outer cups into the hub until they seat against the hub shoulder.

B. Pack both bearings with grease. Install inner bearing into the cup on inboard side of the wheel hub.

IMPORTANT: The lip seal must be pressed in so it is flush with the end of the hub. The lip of the seal must be toward the bearing.

C. Apply grease to the inside of the new lip seal and press it into the wheel hub.

D. If brake rotor was removed, apply Loctite #242 (or equivalent) to socket head screws and install brake rotor to hub. Make sure that the brake rotor bore chamfer is assembled toward the wheel hub.

3. Slide wheel hub assembly onto spindle. Install outer bearing, tab washer and jam nut onto spindle.

4. While rotating the wheel by hand, tighten the jam nut from 75 to 100 in-lb (8.5 to 11.3 N-m) to set the bearings. Then, loosen the nut until the hub has end play.

5. While rotating the wheel by hand, re-tighten the jam nut from 15 to 20 in-lb (1.7 to 2.3 N-m).

6. Position nut retainer over jam nut and install cotter pin through spindle shaft hole. Install dust cap to hub.

7. Install brake caliper to spindle (see Front Brake Calipers in the Service and Repairs section of Chapter 4 – Transaxle and Brakes).

8. Install wheel assembly with valve stem facing out. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m).

9. Lower machine to ground.

10. Align steering and toe-in (see Operator's Manual).

11. Lubricate tie rod ball joints and king pin.

A-arm and Frame Pivot Yoke

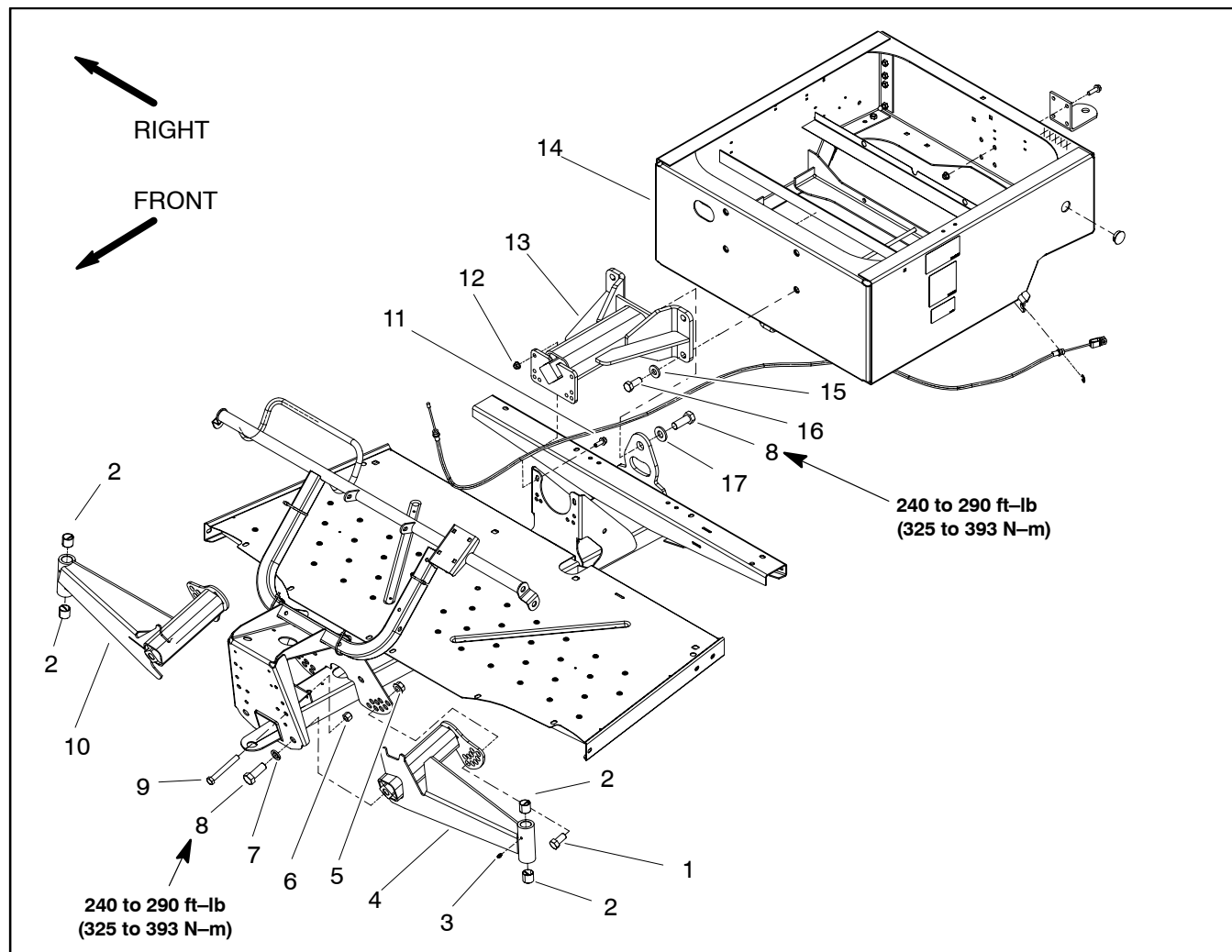


Figure 7

- | | | |
|--------------------------------|--------------------------------------|--------------------------|
| 1. Ride height adjustment bolt | 7. Lock washer | 13. Pivot yoke |
| 2. Bushing | 8. Centering bolt (2 used per A-arm) | 14. Rear frame |
| 3. Grease fitting | 9. Travel limiting bolt | 15. Flat washer (4 used) |
| 4. A-arm (LH) | 10. A-arm (RH) | 16. Cap screw (4 used) |
| 5. Flange nut | 11. Flange head screw (4 used) | 17. Hardened washer |
| 6. Lock nut | 12. Flange nut (4 used) | |

A-arm Removal (Fig. 7)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.



2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.
3. Remove front wheel and spindle from A-arm (see Lower Steering Removal in this section).
4. Remove lock nut (item 6) and travel limiting bolt (item 9) from the frame.

NOTE: To aid reassembly, note hole location of ride height adjustment bolt in A-arm (Fig. 9).

5. Remove flange nut (item 5) and ride height adjustment bolt (item 1) from the adjustment pattern of the A-arm and frame.
6. Remove two centering bolts (item 8) and lock washers (item 7) securing the A-arm to the frame. Lower A-arm from the frame.

A-arm Installation (Fig. 7)

1. Position A-arm to the frame. Secure A-arm to the frame with two (2) centering bolts (item 8) and lock washers (item 7). Do not tighten bolts.
2. Install spindle and front wheel to the A-arm (see Lower Steering Installation in this section).

NOTE: If A-arm is being replaced, look for number between 200 and 400 written next to the serial tag on the bottom of the replacement A-arm. This number should be used to identify the location of the ride height adjustment bolt (Fig. 9):

- Number from 200 to 220 use hole 4.
- Number from 225 to 285 use hole 3.
- Number from 290 to 400 use hole 2.

3. Install ride height adjustment bolt (item 1) and flange nut (item 5) into correct hole location.

4. Lower machine to ground. Remove chocks from wheels.
5. Adjust front ride height (see Operator's Manual).
6. Make sure that travel limiting bolt and lock nut are installed and tightened. Tighten lock nut only enough to snug travel limiting bolt. Do not deform frame plate by overtightening lock nut.
7. Make sure that centering bolts are torqued from 240 to 290 ft-lb (325 to 393 N-m).
8. Check front wheel toe-in (see Operator's Manual). Adjust toe-in if necessary.

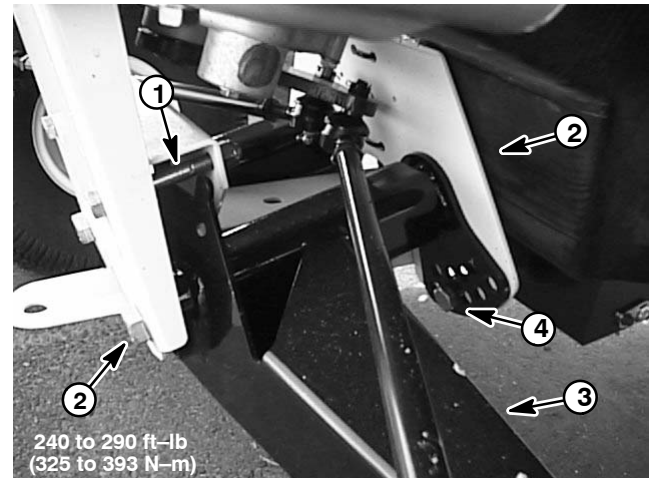


Figure 8

- | | |
|-------------------------|--------------------------|
| 1. Travel limiting bolt | 3. A-arm (LH shown) |
| 2. Centering bolt | 4. Ride height adj. bolt |

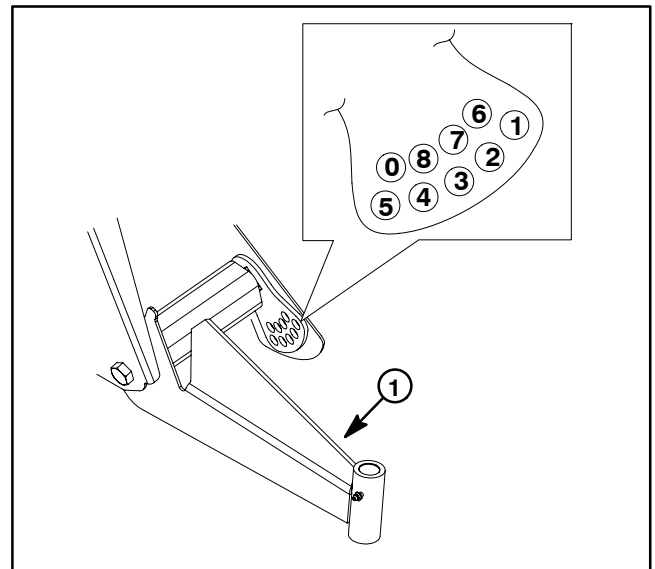


Figure 9

1. Front A-arm (LH shown)

Pivot Yoke Removal (Fig. 7)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.
2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).
3. Remove cargo bed from the rear frame (see Cargo Bed Removal in this section).
4. Remove seat base from the front frame (see Seat Base Removal in this section).



WARNING

Make sure all tires are chocked to prevent the machine from moving. Before removing the pivot yoke, make sure front and rear frames are supported with jack stands. Support both the front and back of each frame.

5. Remove four (4) cap screws and flat washers securing the pivot yoke to the rear frame (Fig. 10).
6. Remove cap screw and hardened washer securing the pivot yoke to the front frame tab.



WARNING

Support pivot yoke while removing it from the front frame to prevent dropping and causing serious injury and damage to the machine.

7. Remove four flange head screws and flanged lock nuts securing the pivot yoke to the front frame. Remove pivot yoke from the machine.

Pivot Yoke Installation (Fig. 7)



WARNING

Support pivot yoke while installing it to the front frame to prevent dropping and causing serious injury and damage to the machine.

1. Position pivot yoke to the front frame so the diamond pattern faces up (Fig. 10). Secure yoke to front frame with four flange head screws and flanged lock nuts. Tighten lower two fasteners first, then tighten upper two fasteners.

2. Secure pivot yoke to the front frame tab with cap screw and hardened washer. Torque cap screw from 240 to 290 ft-lb (325 to 393 N-m).
3. Secure pivot yoke to the rear frame with four cap screws and flat washers.
4. Install seat base to the front frame (see Seat Base Installation in this section).
5. Install cargo bed to the rear frame (see Cargo Bed Installation in this section).
6. Reconnect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

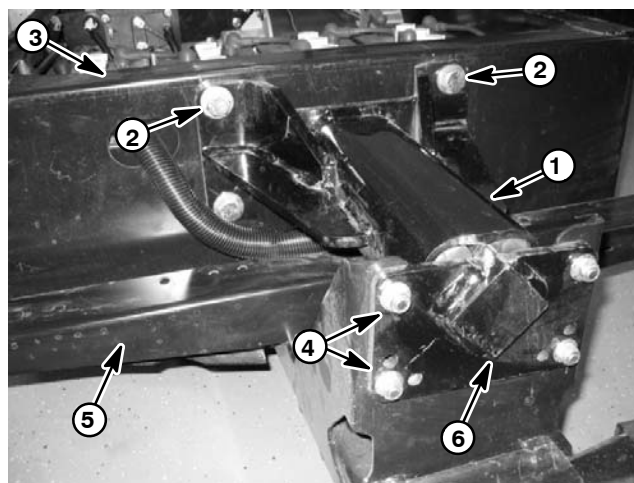


Figure 10

- | | |
|----------------------------|--------------------|
| 1. Pivot yoke | 4. Flange lock nut |
| 2. Cap screw & flat washer | 5. Front frame |
| 3. Rear frame | 6. Diamond pattern |

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Seat Base

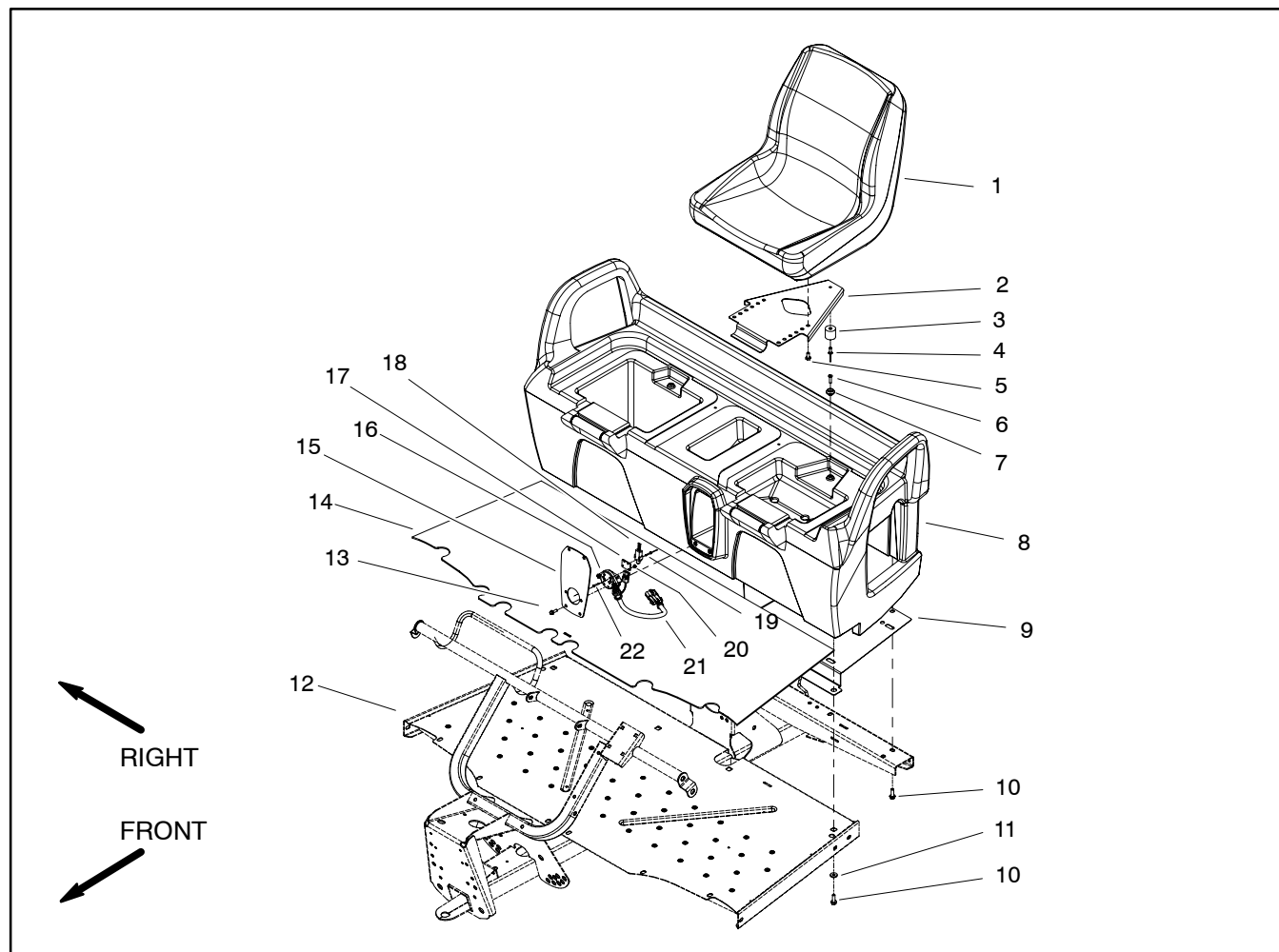


Figure 11

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 1. Seat | 9. Seat base tray | 16. Charger receptacle |
| 2. Seat bracket | 10. Flange head screw (8 used) | 17. Switch plate |
| 3. Rubber receptacle | 11. Flat washer (4 used) | 18. Charger interlock switch |
| 4. Rivet | 12. Front frame | 19. Pop rivet (2 used) |
| 5. Cap screw (4 used per seat) | 13. Screw (4 used) | 20. Lock nut (2 used) |
| 6. Screw | 14. Floor mat | 21. Charger wire harness |
| 7. Holding post | 15. Charger receptacle plate | 22. Socket head screw (2 used) |
| 8. Seat base | | |

Removal (Fig. 11)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.
2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).
3. Remove seats from seat base.
4. Remove four (4) screws (item 12) that secure receptacle plate to front of seat base. Unplug charger wire harness from vehicle wire harness and remove receptacle plate assembly from vehicle.
5. On Workman e2065, remove parking brake assembly from seat base (Fig. 13) (see Parking Brake (Workman e2065) in the Service and Repairs section of Chapter 4 – Transaxle and Brakes).
6. Remove eight (8) flange head screws (item 10) that secure seat base to vehicle. Locate and retrieve flat washers (item 11) from screws that secure front of seat base.
7. Carefully lift seat base from vehicle.

Installation (Fig. 11)

1. Position seat base to the vehicle.

NOTE: Do not tighten fasteners securing the seat base until all fasteners are in place.

2. Install four (4) flange head screws (item 10) through holes in front frame and into rear seat base threaded inserts. Install four (4) flange head screws (item 10) and flat washers (item 11) through holes in front frame and into front seat base threaded inserts.
3. Starting at the middle of the vehicle, tighten flange head screws to secure seat base to vehicle.
4. On Workman e2065, install parking brake assembly to seat base (see Parking Brake (Workman e2065) in the Service and Repairs section of Chapter 4 – Transaxle and Brakes).
5. Connect charger wire harness to vehicle wire harness. Secure receptacle plate to seat base with four (4) screws (item 12).
6. Install seats to vehicle.
7. Reconnect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

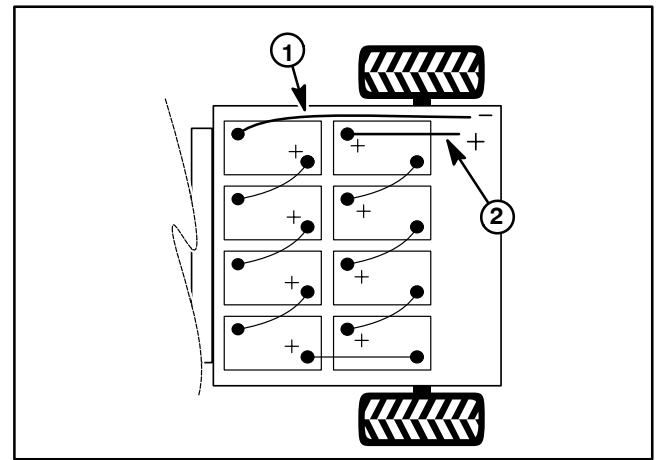


Figure 12

1. Negative cable to vehicle
2. Positive cable to vehicle

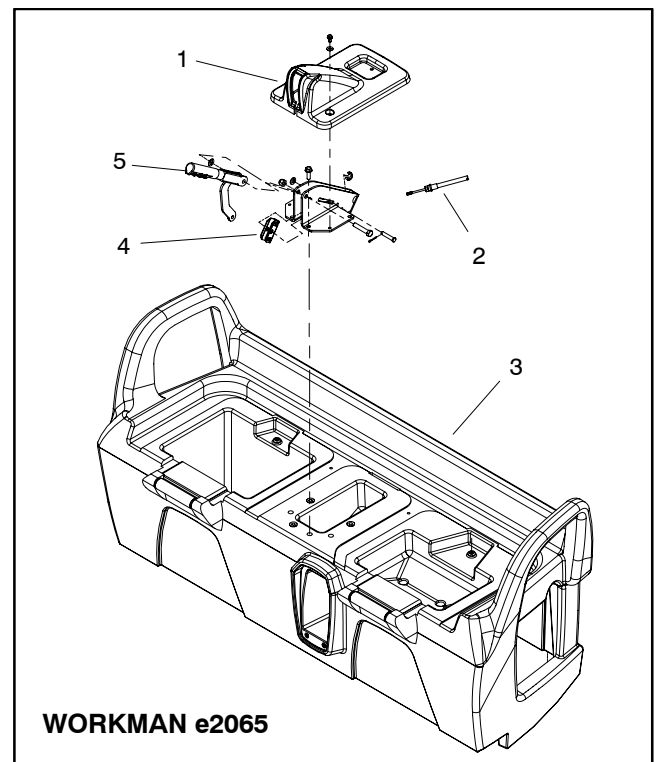


Figure 13

1. Parking brake cover
2. Brake cable (2 used)
3. Seat base
4. Brake equalizer
5. Parking brake lever

Front Hood

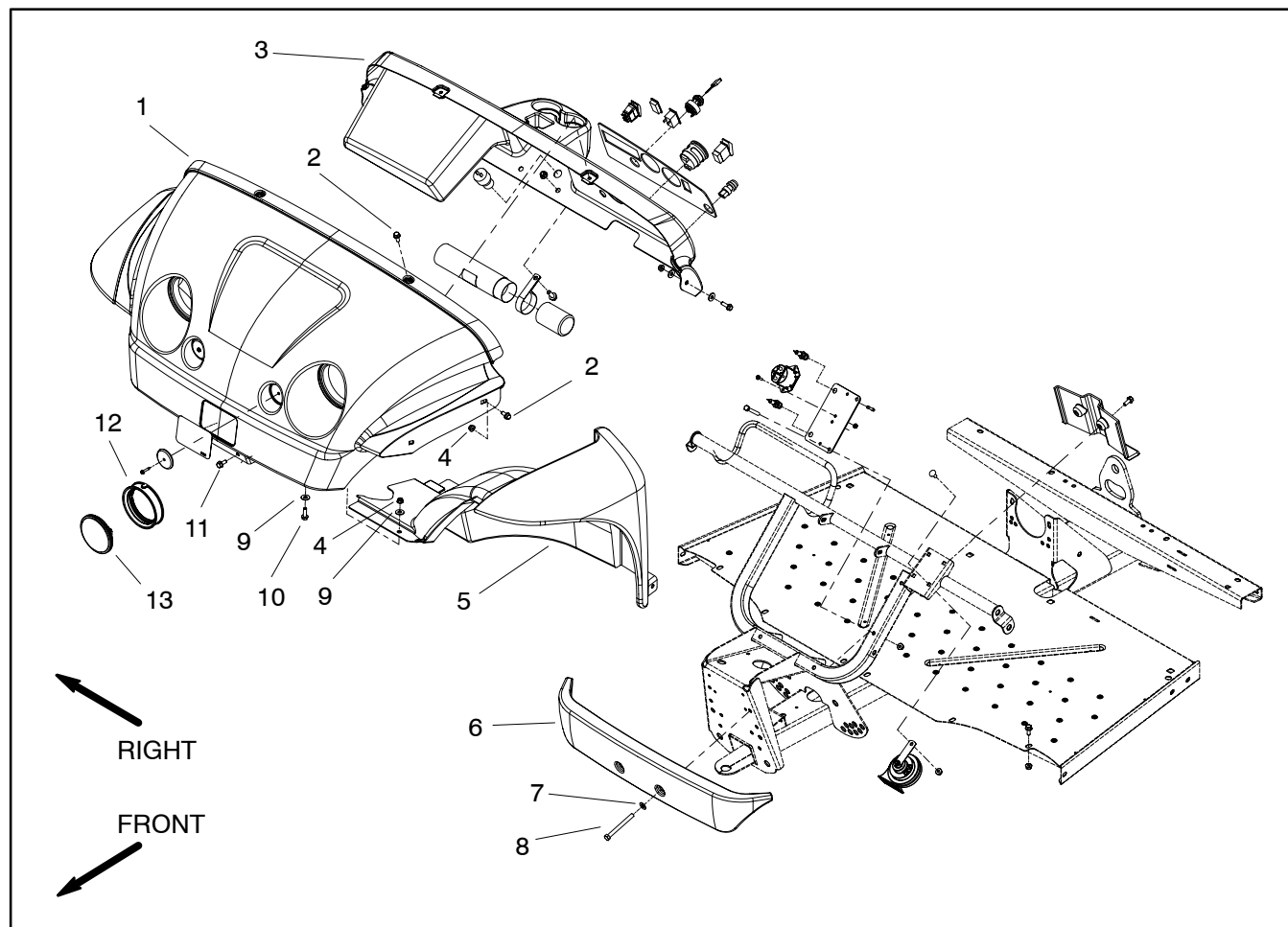


Figure 14

- 1. Hood
- 2. Flange head screw (6 used)
- 3. Dash
- 4. Flange nut (6 used)
- 5. Fender (LH shown)

- 6. Bumper
- 7. Flat washer (2 used)
- 8. Cap screw (2 used)
- 9. Flat washer (4 used)

- 10. Flange head screw (2 used)
- 11. Flange head screw (2 used)
- 12. Headlight mount (2 used)
- 13. Headlight (2 used)

Removal (Fig. 14)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.
2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).
3. Remove screws attaching the wire harness connectors to each headlight.
4. Remove two (2) cap screws (item 8) and flat washers (item 7) that secure bumper to vehicle. Remove bumper.
5. Remove both flange head screws (item 11) securing the center-lower hood to the front frame support.
6. Remove flange nut (item 4), both flat washers (item 9) and flange head screw (item 10) securing the hood to each fender front.
7. Remove both flange nuts (item 4) and flange head screws (item 2) securing the hood to the top of each fender.
8. Remove two (2) flange head screws (item 2) securing the hood to the dash. Remove hood from the vehicle.

Installation (Fig. 14)

1. Position hood to the vehicle.

NOTE: Do not tighten fasteners securing the hood until all fasteners are in place.

2. Install fasteners removed during hood removal:
 - A. Two (2) flange head screws (item 2) that fasten hood to the dash.
 - B. Two (2) flange head screws (item 2) and flange nuts (item 4) that fasten hood to the top of each fender.
 - C. Flange head screw (item 10), two flat washers (item 9) and flange nut (item 4) that fasten hood to each fender front.
 - D. Two flange head screws (item 11) that fasten center-lower hood to the front frame support.
3. Tighten all fasteners securing the hood.
4. Secure bumper to vehicle with two (2) cap screws (item 8) and flat washers (item 7).

5. Connect wire harness connectors to headlight terminals with screws.

6. Reconnect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from 115 to 125 in-lb (13 to 14.1 N-m).

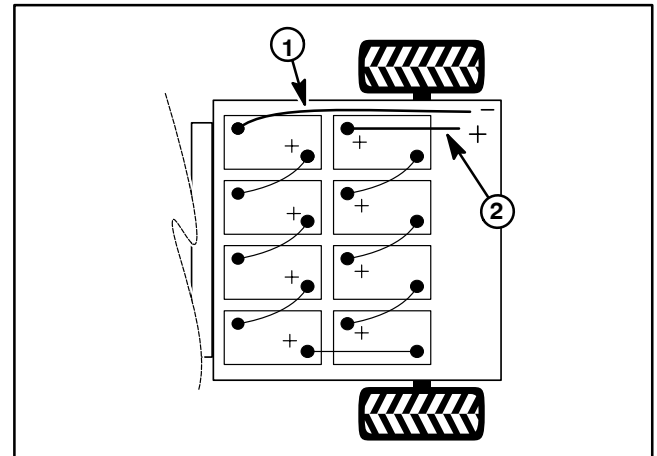


Figure 15

1. Negative cable to vehicle 2. Positive cable to vehicle

Cargo Bed

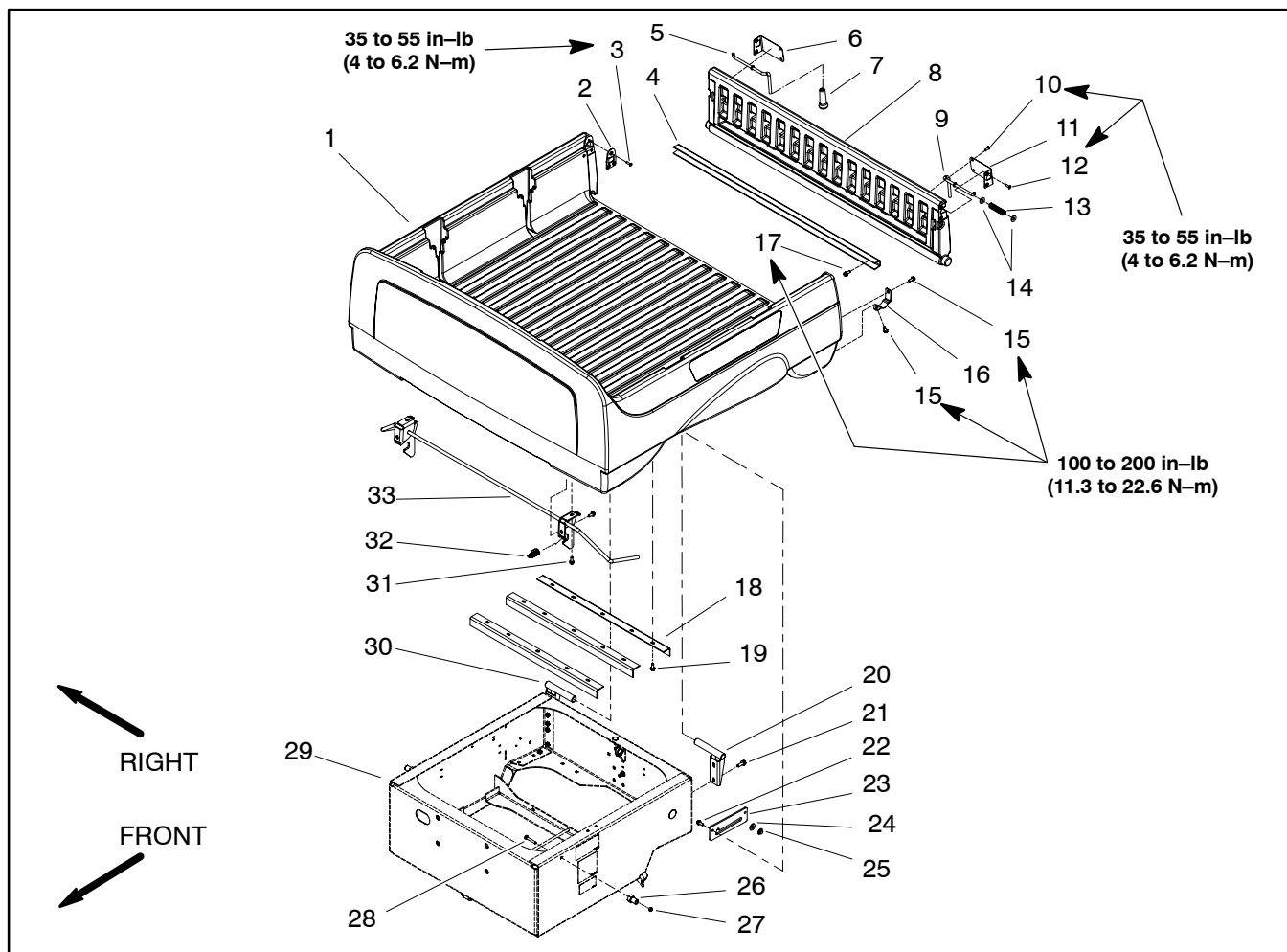


Figure 16

- | | | |
|--------------------------------|---------------------------------------|--------------------------------|
| 1. Cargo bed | 12. Screw (2 per bracket) | 23. Prop rod bracket |
| 2. Striker plate (2 used) | 13. Spring | 24. Flat washer |
| 3. Screw (3 per striker plate) | 14. Flat washer | 25. Push nut |
| 4. Tailgate channel | 15. Flange head screw (2 per bracket) | 26. Latch pin (2 used) |
| 5. RH latch rod | 16. Pivot bracket (2 used) | 27. Lock nut (2 used) |
| 6. RH latch bracket | 17. Flange head screw (6 used) | 28. Carriage screw (2 used) |
| 7. Grip knob | 18. Box brace (3 used) | 29. Rear frame |
| 8. Tailgate | 19. Flange head screw (5 per brace) | 30. RH pivot bracket |
| 9. LH latch rod | 20. LH pivot bracket | 31. Flange head screw (4 used) |
| 10. Screw (2 per bracket) | 21. Flange head screw (2 per bracket) | 32. Tension spring |
| 11. LH latch bracket | 22. Flange head screw (2 used) | 33. Latch rod |

Removal (Fig. 16)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.
2. Remove two (2) flange head screws (item 21) that secure RH and LH pivot brackets (items 30 and 20) to the rear frame.
3. Release latch rod (item 33) from the latch pins (item 26). Remove cargo bed from the frame. Disassemble cargo bed as necessary using Figure 16 as a guide.

Installation (Fig. 16)

1. Reassemble cargo bed using Figure 16 as a guide.
2. Position cargo bed to the frame locking the latch rod (item 33) to the latch pins (item 26).
3. Secure both pivot brackets (items 30 and 20) to the rear frame with flange head screws (item 21).

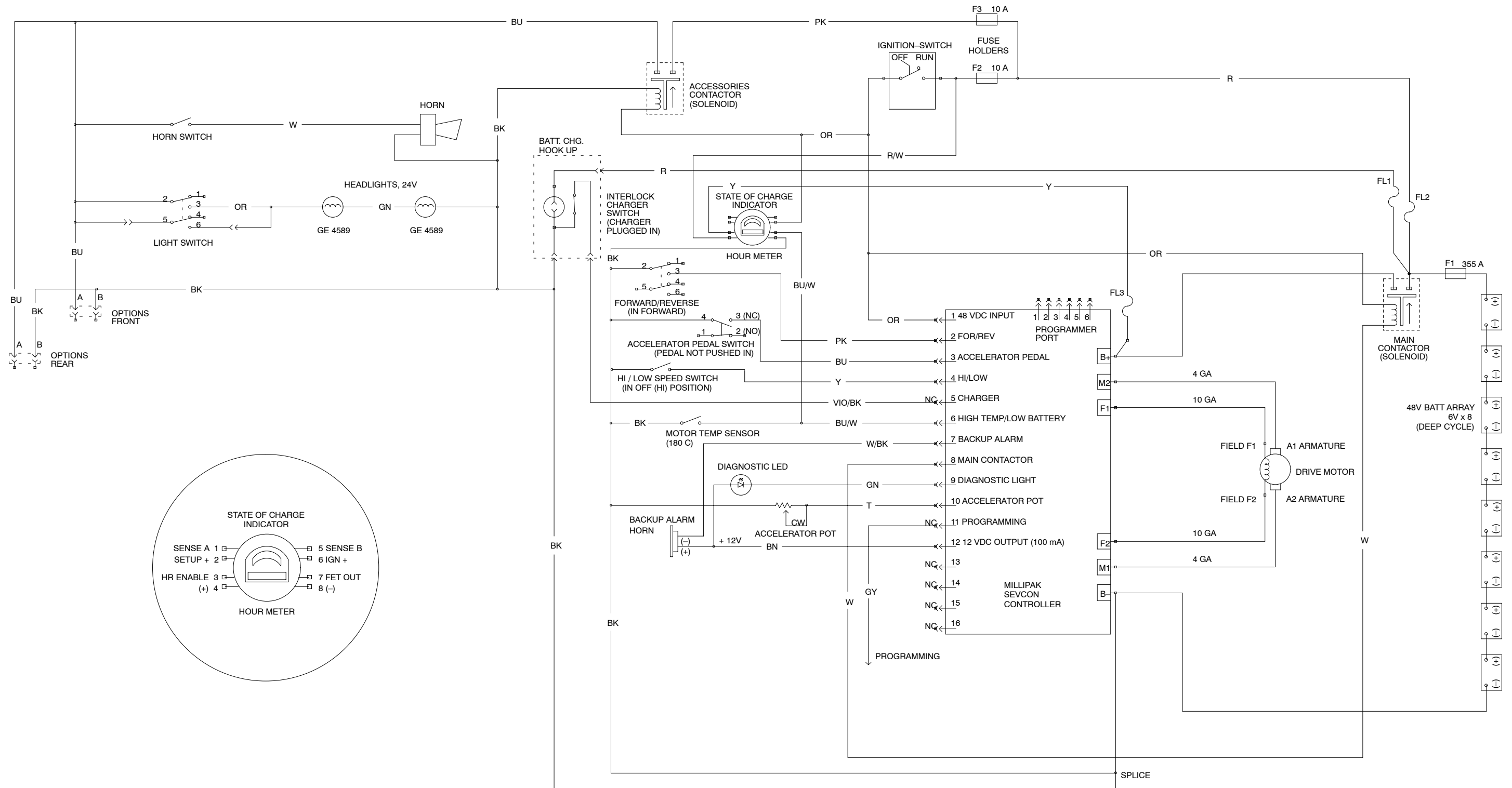


Electrical Diagrams

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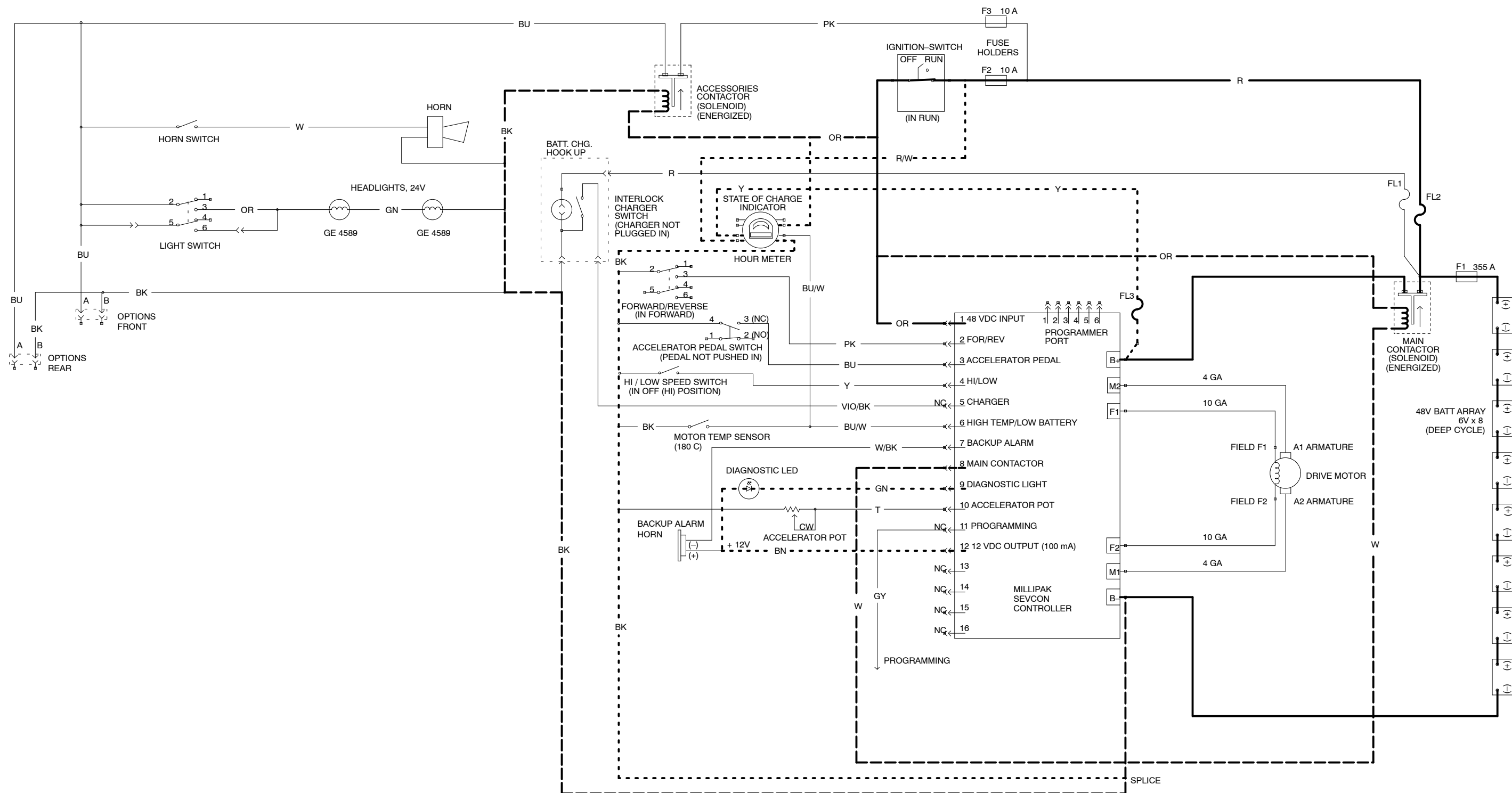
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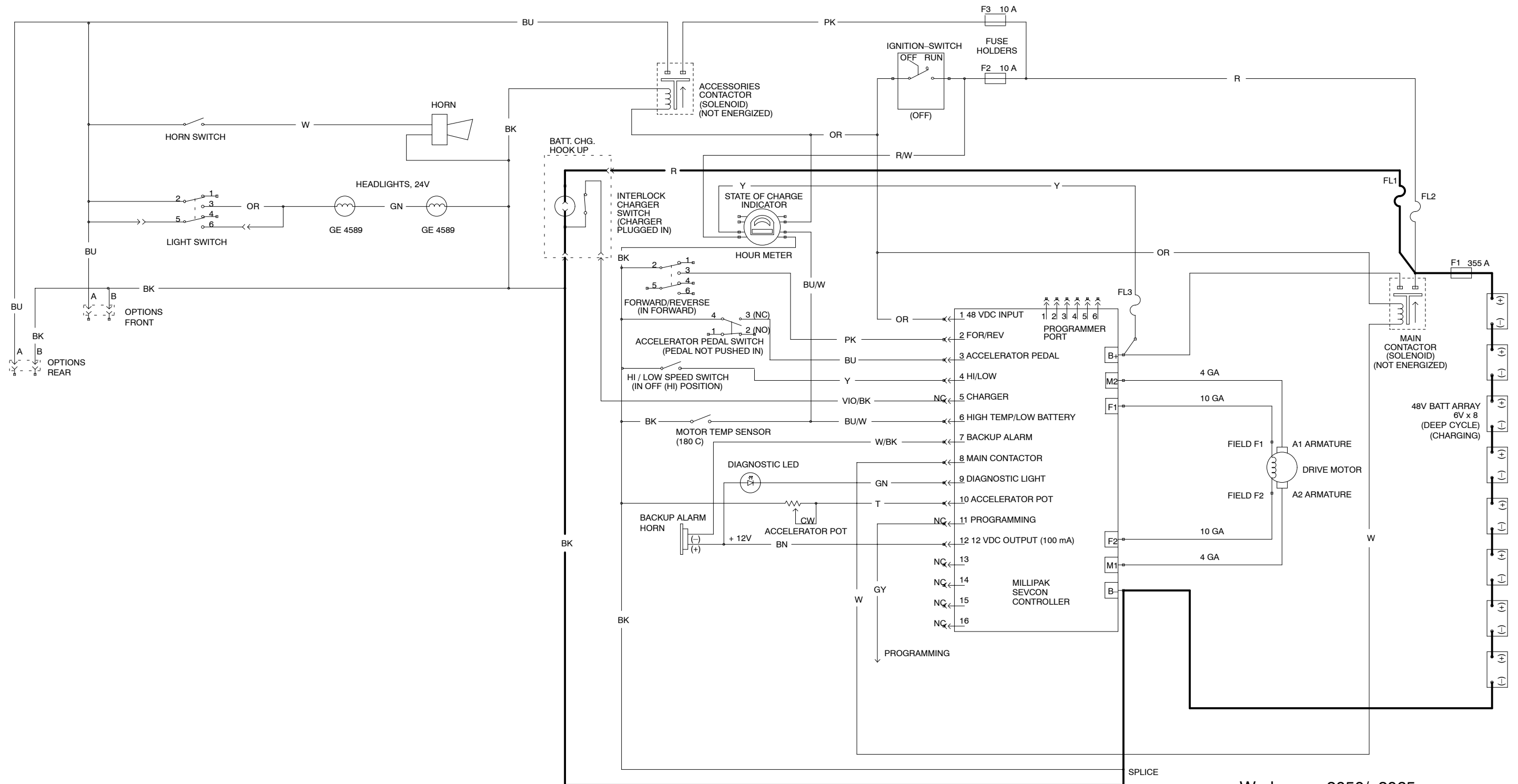
Workman e2050/e2065
Electrical Schematic

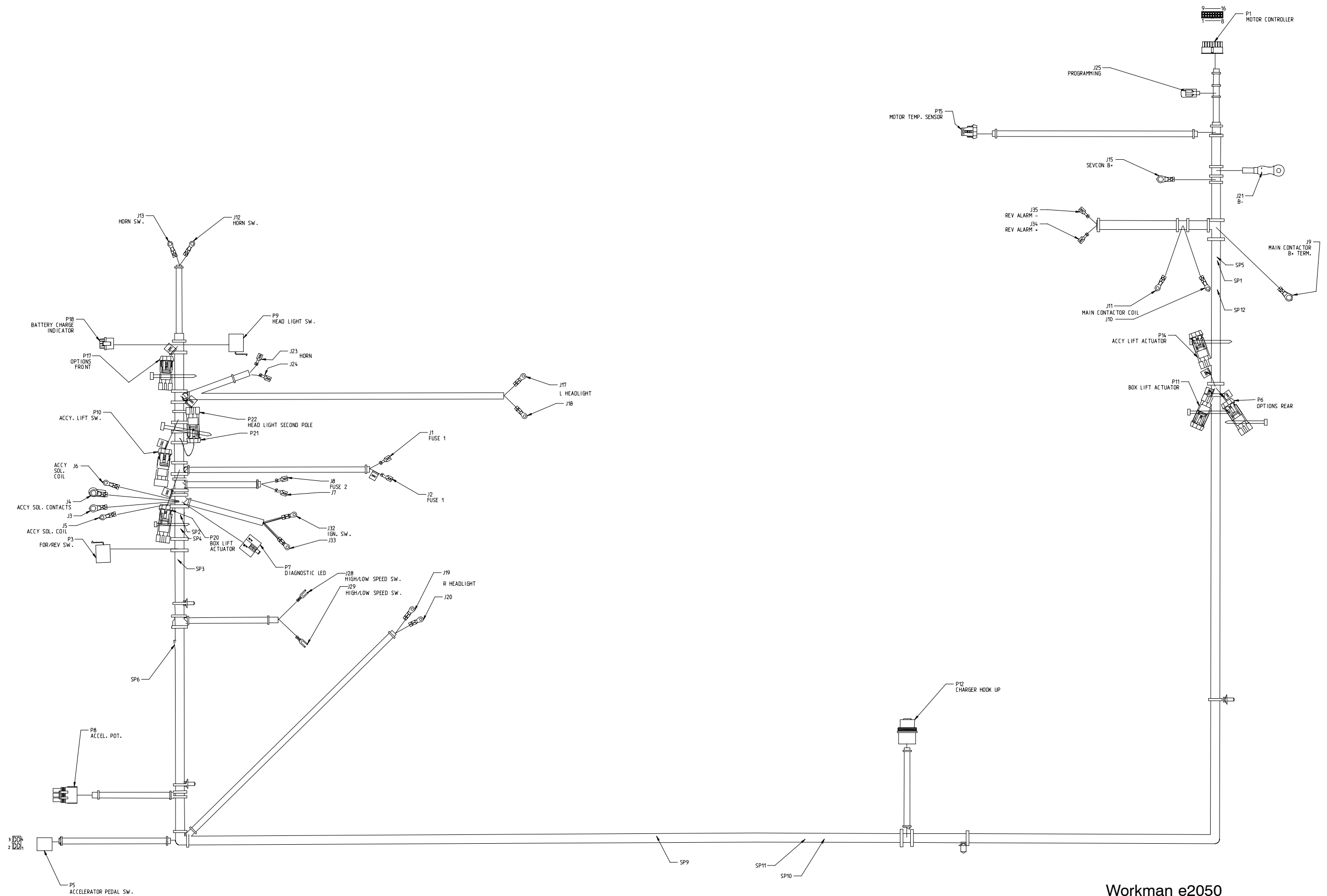
Contactors shown de-energized

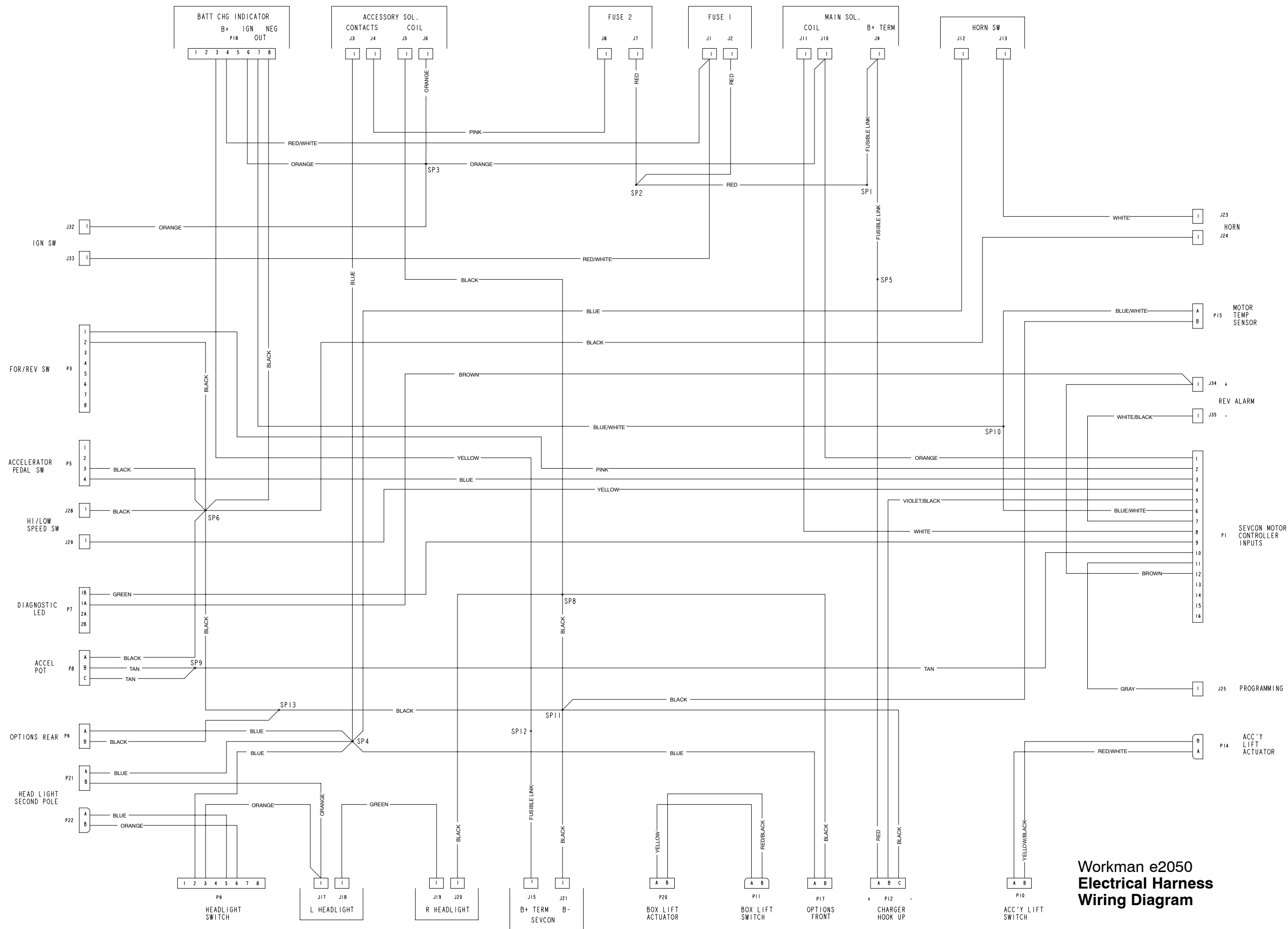


Workman e2050/e2065
On/Off Switch Turned On

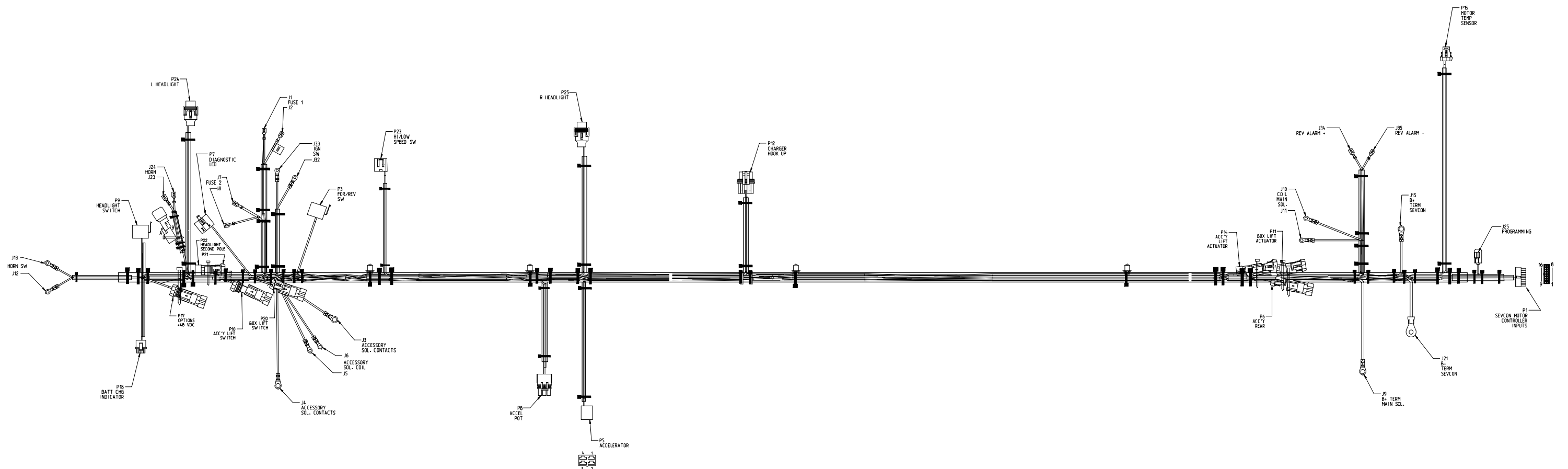
- Power Current
- Control Current
- Indication Current



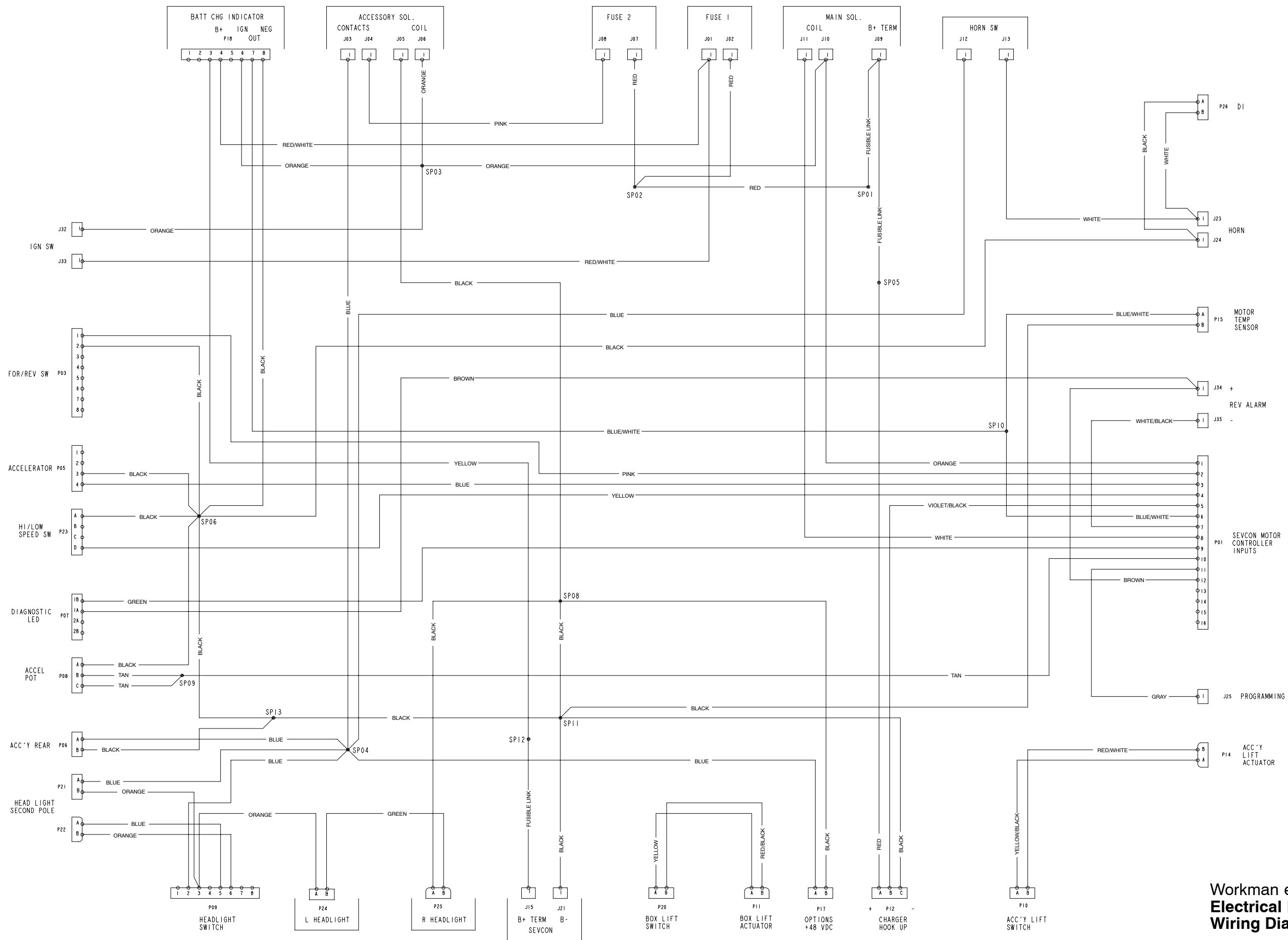




Workman e2050
 Electrical Harness
 Wiring Diagram



Workman e2065
Electrical Harness Drawing



Workman e2065
Electrical Harness
Wiring Diagram