



**Count on it.**

Form No. 3431-988 Rev A

# Service Manual

## PROLINE® Service Manual



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# Revision History

# Preface

This service manual was written expressly for Toro service technicians. The Toro Company has made every effort to make the information in this manual complete and correct.

Basic shop safety knowledge and mechanical/electrical skills are assumed. The Table of Contents lists the systems and the related topics covered in this manual.

We are hopeful that you will find this manual a valuable addition to your service shop. If you have any questions or comments regarding this manual, please contact us at the following address:

**The Toro Company**  
**RLC/SWS Customer Care Department**  
**8111 Lyndale Avenue South**  
**Bloomington, MN 55420**

The Toro Company reserves the right to change product specifications or make changes to this manual without notice.

# Service Procedure Icons

The following icons appear throughout this Service Manual to bring attention to specific important details of a service procedure.



## Critical Process

This icon is used to highlight:

- Installing safety equipment (shields, guards, seat belts, brakes, and R.O.P.S. components) that may have been removed
- Dimensions or settings that must be maintained for proper machine operation
- A specific fastener tightening sequence
- Component orientation that may not be obvious



## Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables.



## Fluid Specifications

This icon is used to highlight fluid specifications and capacities that are less common, and may not appear on the machine service decal or in the machine *Operator's Manual*.

**Note:** Refer to the service decal on the machine and the machine *Operator's Manual* for commonly used fluid specifications and capacities.



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# Safety Instructions



## DANGER



This safety symbol means danger. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions could cause serious permanent injury, disability, or death.

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## WARNING



This safety symbol means warning. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in serious injury.

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## CAUTION



This safety symbol means caution. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in minor to moderate injury and/or damage to property or equipment.

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## Think Safety First

### **Avoid unexpected starting of engine...**

Always turn off the engine, remove the ignition key and disconnect the spark plug wire(s) before cleaning, adjusting, or repair.

### **Avoid lacerations and amputations...**

Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

### **Avoid burns...**

Do not touch the engine, muffler, or other components, which may be hot during operation, while the unit is running or shortly after it has been running.

### **Avoid fires and explosions...**

Use extreme care in handling fuel. It is flammable and its vapors are explosive. Extinguish all cigarettes, cigars, pipes, and other sources of ignition. Avoid spilling fuel and never smoke while working with any type of fuel or lubricant. Wipe up any spilled fuel or oil immediately. Never remove the fuel cap or add fuel when the engine is running. Always use approved, labeled containers for storing or transporting fuel and lubricants. Do not add or drain fuel in an enclosed space. Do not store the machine or fuel container where there is an open flame, spark, or pilot light, such as on a water heater or other appliance.

### **Avoid asphyxiation...**

Do not operate an engine in a confined area without proper ventilation.

### **Avoid injury from batteries...**

# Think Safety First (continued)

Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

## **Avoid injury due to inferior parts...**

Use only original equipment parts to ensure that important safety criteria are met.

## **Avoid injury to bystanders...**

Always clear the area of bystanders before starting or testing powered equipment.

## **Avoid injury due to projectiles...**

Always clear the area of sticks, rocks or any other debris that could be picked up and thrown by the powered equipment.

## **Avoid modifications...**

Never alter or modify any part unless it is a factory approved procedure.

## **Avoid unsafe operation...**

Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Electrical section in this manual for more information.

## **Avoid electrical shock...**

Never touch electrical wires or components while the engine is running. They can be sources of shock. De-energize the system if you are having to do repairs. If testing electrical components ensure you are working in a dry environment.

## **Hydraulic System...**

Release all pressure in the hydraulic system before performing any work on the system. Keep your body and hands away from pin-hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use your hands to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate under the skin and cause serious injury. Seek medical attention right away if hydraulic fluid gets in the skin.

## **Personal Protective Equipment...**

Tie back long hair, and do not wear loose clothing or jewelry. Use appropriate personal protective equipment (PPE) for protecting yourself from potential hazards in the environment in which you will work. Each process outlined in this manual may need different PPE to protect the service person. Use the proper PPE for the task at hand.

## **Tools...**

All tools should be in proper working order. Do not use tools that are broken or in disrepair. Use the proper tool for the proper application.

## **Lifts, Hoists, and Jacks...**

All lifts, hoists, and jacks should be used in accordance with the manufacturer information. Inspect lifts, hoists, and jacks prior to use. Do not overload lifts, hoists, and jacks. Do not work under a suspended load. Ensure chock blocks are used on equipment that can move. Use lifts or jacks and jack stands that are rated to support the total weight of the machine and any attachments. Do not rely on jacks to support the machine. If you are unsure of the operation of any lifts, hoists, and jacks do not use.

## **Fire Extinguishers...**

## Think Safety First (continued)

The proper class of fire extinguisher should be used in case of fire.

**Class A** extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish. Geometric symbol (green triangle).

**Class B** fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish. Geometric symbol (red square).

**Class C** fires involve electrical equipment, such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. Geometric symbol (blue circle).

**ABC** fire extinguishers are a dry chemical type used for multiple purposes. See above information for description. Ensure fire extinguishers are serviceable and replace any that are discharged or out of inspection dates



# Specifications and Maintenance

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# Specifications

Model	44409	44410	44423
Height	114 cm (44.88 inches)		117 cm (45.93 inches)
Width Deflector Down	130 cm (50.88 inches)		161 cm (63.25 inches)
Width Deflector Raised	93 cm (36.75 inches)		125 cm (49.25 inches)
Length	197 cm (77.43 inches)		203 cm (79.75 inches)
Weight	270 kg (595 lb)		297 kg (654 lb)
Engine			
Engine Displacement	603cc		
Engine	Kawasaki		
Engine Model	FS481V-_AS37R		FS541V-_S06-R
Air Filter	Standard Air Cleaner		
Starter	Electric		
High Idle	3600 ± 100 rpm		
Low Idle	1550 ± 150 rpm		
Engine Oil	10W-30		
Oil Capacity	1.7 L (1.8 qt) with filter change		
CARB	Yes	No	Yes
Fuel Capacity	19 L (5 gallons)		
Spark Plug	NGKBP4ES		
Spark Plug Gap	0.76 mm (0.030 inches)		
Ignition Coil Air Gap	0.3 mm (0.011 inches)		
Battery	195 CCA		
Traction Drive			
Controls	Toro Twin Levers		
Transmission	Hydro-Gear ZT-2800		
Transmission Lubricant	20W–50 Engine oil		
Parking Brake	Standard Equipment		
Ground Speed	Infinitely Variable		
Drive Belt	HA Section with Aramid (Kevlar) cords		
Wheels and Tires			
Front Castor Tires	9 x 3.5 - 4 inches, smooth tread, semi-pneumatic		11 x 4 - 5 inches, smooth tread, semi-pneumatic
Front Castor Fork	7/8 inch Shaft		
Rear Traction Tires	18 x 6 - 8 inches, 2 ply with Turf Traction Tread		20 x 8 - 10 inches, 2 ply with Turf Traction Tread
Tire Pressure	12 - 14 psi		
Mower Drive			
Mower Engagement	142 N • m (105 ft-lb)		
Clutch Type	Warner		
Clutch ohms Range	2.89 - 3.20 ohms		



<b>PTO Drive Belt</b>	2 ply fabric cover, outer fabric is dry "clutching" fabric
<b>Mower Deck</b>	
<b>HOC Range</b>	1.5 – 4.5 inches, in 1/4 inch increments
<b>Blades</b>	3–16.5 inches Hi-Flow blades
<b>Construction</b>	10 gauge steel welded construction
<b>Anti-Scalp Rollers</b>	x2–wheels
<b>Skid Plate</b>	Standard Equipment
<b>Discharge Chute</b>	Plastic

Model	44424	44427	44430
Height	117 cm (45.93 inches)		
Width Deflector Down	161 cm (63.25 inches)	176 cm (69.31 inches)	192 cm (75.44 inches)
Width Deflector Raised	125 cm (49.25 inches)	140 cm (55.13 inches)	156 cm (61.31 inches)
Length	203 cm (79.75 inches)		210 cm (82.63 inches)
Weight	297 kg (654 lb)	305 kg (673 lb)	319 kg (704 lb)
Engine			
Engine Displacement	603cc		726cc
Engine	Kawasaki		
Engine Model	FS541V-_S06-R	FS600V-_AS38R	FS651V-_AS23–R
Air Filter	Standard Air cleaner		
Starter	Electric		
High Idle	3600 ± 100 rpm		
Low Idle	1550 ± 150 rpm		
Engine Oil	10W-30		
Oil Capacity	1.7 L (1.8 qt) with filter change		2.1 L (2.2 qt) with filter change
CARB	No		
Fuel Capacity	19 L (5 gallons)		
Spark Plug	NGKBPR4ES		
Spark Plug Gap	0.76 mm (0.030 inches)		
Ignition Coil Air Gap	0.3 mm (0.011 inches)		
Battery	195 CCA		
Traction Drive			
Controls	Toro Twin Levers		
Transmission	Hydro-Gear ZT-3100		
Transmission Lubricant	20W–50 Engine oil		
Parking Brake	Standard Equipment		
Ground Speed	Infinitely Variable		
Drive Belt	HA Section with Aramid (Kevlar) cords		
Wheels and Tires			
Front Castor Tires	11 x 4 - 5 inches, smooth tread, semi-pneumatic		
Front Castor Fork	7/8 inch Shaft		
Rear Traction Tires	20 x 8- 10 inches, 2 ply with Turf Traction Tread		

<b>Tire Pressure</b>	12 - 14 psi
<b>Mower Drive</b>	
<b>Mower Engagement</b>	142 N • m (105 ft-lb)
<b>Clutch Type</b>	Warner
<b>Clutch OMHs Range</b>	2.89 - 3.20 ohms
<b>PTO Drive Belt</b>	2 ply fabric cover, outer fabric is dry “clutching” fabric
<b>Mower Deck</b>	
<b>HOC Range</b>	1.5 – 4.5 inches, in 1/4 inch increments
<b>Blades</b>	3–16.5 inches Hi-Flow blades
<b>Construction</b>	10 gauge steel welded construction
<b>Anti-Scalp Rollers</b>	x2–Wheels
<b>Skid Plate</b>	Standard Equipment
<b>Discharge Chute</b>	Plastic

Model	44448	44454
Height	117 cm (45.93 inches)	203 cm (79.75 inches)
Width Deflector Down	161 cm (63.31 inches)	140 cm (55.13 inches)
Width Deflector Raised	125 cm (49.25 inches)	93 cm (36.76 inches)
Length	203 cm (79.75 inches)	
Weight	311 kg (686 lb)	318 kg (701 lb)
Engine		
Engine Displacement	726cc	
Engine	Kawasaki	
Engine Model	FX691V-S24–R	
Air Filter	Heavy Duty Air cleaner	
Starter	Electric	
High Idle	3600 ± 100 rpm	
Low Idle	1550 ± 150 rpm	
Engine Oil	10W-30	
Oil Capacity	2.1 L (2.2 qt) with filter change	
CARB	Yes	
Fuel Capacity	19 L (5 gallons)	
Spark Plug	NGKBPR4ES	
Spark Plug Gap	0.76 mm (0.030 inches)	
Ignition Coil Air Gap	0.3 mm (0.011 inches)	
Battery	195 CCA	
Traction Drive		
Controls	Toro Twin Levers	
Transmission	Hydro-Gear ZT-3100	
Transmission Lubricant	20W–50 Engine oil	
Parking Brake	Standard Equipment	
Ground Speed	Infinitely Variable	
Drive Belt	HA Section with Aramid (Kevlar) cords	

Wheels and Tires		
Front Castor Tires	11 x 4 - 5 inches, smooth tread, semi-pneumatic	
Front Castor Fork	7/8 inch Shaft	
Rear Traction Tires	20 x 8 - 10 inches, 2 ply with Turf Traction Tread	
Tire Pressure	12 - 14 psi	
Mower Drive		
Mower Engagement	142 N • m (105 ft-lb)	
Clutch Type	Warner	
Clutch OMHs Range	2.89 - 3.20 ohms	
PTO Drive Belt	2 ply fabric cover, outer fabric is dry “clutching” fabric	
Mower Deck		
HOC Range	1.5 – 4.5 inches in 1/4 inch increments	
Blades	3–16.5 inch	3–18.75 inch
Construction	10 gauge steel welded construction, 7 ga sides, 10 ga top	
Anti-Scalp Rollers	x2–Wheels	
Skid Plate	Standard Equipment	
Discharge Chute	Rubber Standard Equipment	
Model	44410TE	44424TE
Height	114 cm (44.88 inches)	203 cm (79.75 inches)
Width Deflector Down	129 cm (50.88 inches)	161 cm (63.25 inches)
Width Deflector Raised	93 cm (36.75 inches)	125 cm (49.25 inches)
Length	197 cm (77.43 inches)	203 cm (79.75 inches)
Weight	270 kg (595 lb)	297 kg (654 lb)
Engine		
Engine Displacement	603cc	
Engine	Kawasaki	
Engine Model	FS481V-_AS37–R	FS541V-_S06-R
Air Filter	Heavy Duty Air Cleaner	
Starter	Electric	
High Idle	3600 ± 100 rpm	
Low Idle	1550 ± 150 rpm	
Engine Oil	10W-30	
Oil Capacity	1.7 L (1.8 qt) with filter change	
CARB	No	
Fuel Capacity	19 L (5 gallons)	
Spark Plug	NGKBPR4ES	
Spark Plug Gap	0.76 mm (0.030 inches)	
Ignition Coil Air Gap	0.3 mm (0.011 inches)	
Battery	195 CCA	
Traction Drive		
Controls	Toro Twin Levers	
Transmission	Hydro-Gear ZT-2800	Hydro-Gear ZT-3100

Transmission Lubricant	20W-50 Engine oil	
Parking Brake	Standard Equipment	
Ground Speed	Infinitely Variable	
Drive Belt	HA Section with Aramid (Kevlar) cords	
Wheels and Tires		
Front Castor Tires	9 x 3.5 - 4 inches, smooth tread, semi-pneumatic	11 x 4 - 5 inches, smooth tread, semi-pneumatic
Front Castor Fork	7/8 inch shaft	
Rear Traction Tires	18 x 6 - 8 inches, 2 ply with Turf Traction Tread	20 x 8 - 10 inches, 2 ply with Turf Traction Tread
Tire Pressure	12 - 14 psi	
Mower Drive		
Mower Engagement	142 N • m (105 ft-lb)	
Clutch Type	Warner	
Clutch OMHs Range	2.89 - 3.20 ohms	
PTO Drive Belt	2 ply fabric cover, outer fabric is dry “clutching” fabric	
Mower Deck		
HOC Range	1.5 — 4.5 inches in 1/4 inch increments	
Blades	2-18 inch	3-16.5 inch
Construction	10 gauge steel welded construction	
Anti-Scalp Rollers	x2-Wheels	
Skid Plate	Standard Equipment	
Discharge Chute	Rubber Standard Equipment	

# Torque Specifications

The 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 the service manual.

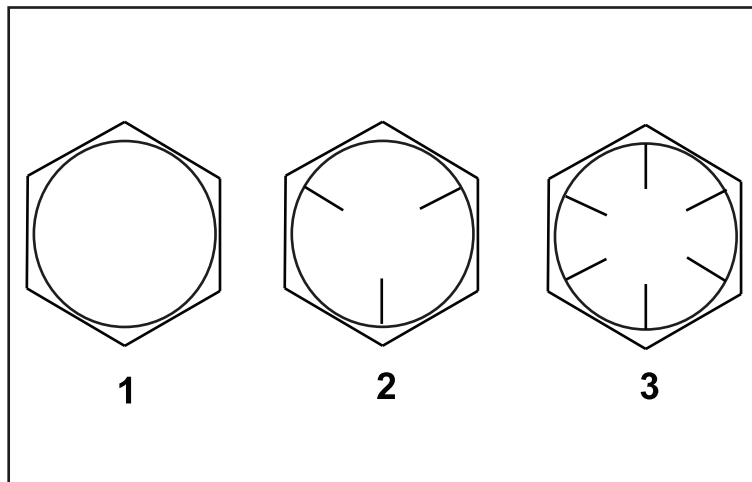
These torque specifications for the installation and tightening of fasteners shall apply for all fasteners which do not have a specific requirement identified in the service manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath of 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.

## Fastener Identification

### Inch Series Bolts and Screws

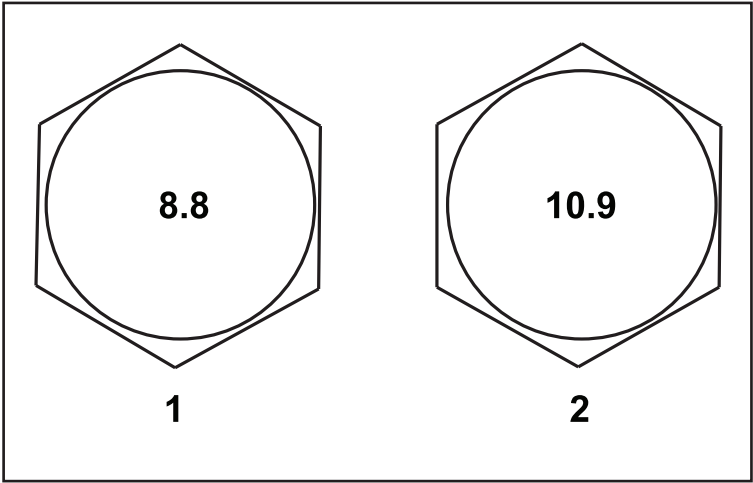


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**Figure 1**

- |            |            |
|------------|------------|
| 1. Grade 1 | 3. Grade 8 |
| 2. Grade 5 |            |

Metric Bolts and Screws



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**Figure 2**

1. Class 8.8
2. Class 10.9

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

Thread Size	Grade 1, 5, & 8 Fasteners with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE Grade 2 or Better Nut)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE Grade 5 or Better Nut)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE Grade 8 or Better Nut)	
		in-lb	N • cm	in-lb	N • cm	in-lb	N • cm
#6-32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	260 ± 34
#6-40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
#8-32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	328 ± 34	41 ± 5	463 ± 56
#8-36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
#10-24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
#10-32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4-20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4-28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16-18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16-24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	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 ± 5	58 ± 7
3/8-24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
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 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2-13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2-20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8-11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8-18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4-10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4-16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
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 ± 48	644 ± 65	667 ± 66	904 ± 89

**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.

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.

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 nuts include jam nuts.

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

Thread Size	Class 8.8 Bolts, Screws, Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, Studs with Regular Height Nuts (Class 10 or stronger Nuts)	
	in-lb	N • cm	in-lb	N • cm
<b>M5 X 0.8</b>	57 ± 6	644 ± 68	78 ± 8	881 ± 90
<b>M6 X 1.0</b>	96 ± 10	1085 ± 113	133 ± 14	1503 ± 158
	ft-lb	N • m	ft-lb	N • m
<b>M8 X 1.25</b>	19 ± 2	26 ± 3	28 ± 3	38 ± 4
<b>M10 X 1.5</b>	38 ± 4	52 ± 5	54 ± 6	73 ± 8
<b>M12 X 1.75</b>	66 ± 7	90 ± 10	93 ± 10	126 ± 14
<b>M16 X 2.0</b>	166 ± 17	255 ± 23	229 ± 23	310 ± 31
<b>M20 X 2.5</b>	325 ± 33	440 ± 45	450 ± 46	610 ± 62

**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.

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.

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. Thin height nuts include jam nuts.



## 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
1/2 - 13 UNC	75 ± 15 ft-lb	50 ± 10 ft-lb
3/8 - 16 UNC	35 ± 10 ft-lb	18 ± 3 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

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

### Conversion Factors

in-lb X 11.2985 = N • cm

ft-lb X 1.3558 = N • m

N • cm X 0.08851 = in-lb

N • cm X 0.73776 = ft-lb

## Thread Cutting Screws (Zinc Plated Steel)

Threads 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 and finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

# 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	16/32	0.53125	13.484
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
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	11/64	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	Grams	28.3495
Pressure	Pounds/Square Inch	Kilopascal	6.895
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 Flows	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract by 32°
			2. Multiply by 5/9





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General Troubleshooting .....	3-3
-------------------------------	-----

## GEARS

The Systematic approach to defining, diagnosing and solving problems.



### G

#### Gather Information

- Information reported by the customer
- Information observed by you
- Establish the what, where and when of the issue



### E

#### Evaluate Potential Causes

- Consider possible causes of the problem to develop a hypothesis
- Narrow down the focus of the problem



### A

#### Assess Performance

- Ensure you have all the necessary tools for testing
- Test all potential causes of the failure
- Reevaluate and create new hypotheses if necessary



### R

#### Repair

- Return the unit to service by repairing, rebuilding or replacing



### S

#### Solution Confirmation

- Did the issue go away
- Was the root cause of the issue correctly repaired
- Are there any other new symptoms

# General Troubleshooting

Problem	Possible Cause	Corrective Action
<b>The starter does not crank</b>	The blade control switch (PTO) is engaged.	Move the blade-control switch (PTO) to the disengaged position.
	The parking brake is not engaged.	Move the brake arm to the engaged position.
	The battery is dead.	Charge the battery.
	The electrical connections are corroded or loose.	Check the electrical connects for good contact.
	A switch is worn or damaged.	Test and replace the faulty switch.
	The fuse is blown.	Replace the fuse.
<b>The engine does not start, starts hard, or fails to keep running</b>	The engine dies after 5 seconds.	If you release the motion-control levers and do not engage the parking brake, the engine will shut off after 5 seconds.
	The fuel tank is empty.	Fill the fuel tank.
	The throttle is not in the correct position.	Be sure that the throttle control is always in the fast positions.
	There is dirt in the fuel filter.	Replace the fuel filter.
	There is dirt, water, or stale fuel in the fuel system.	Clean and flush the fuel system.
	The air cleaner is dirty.	Clean or replace the air cleaner element.
	The electrical connections are corroded, loose, or damaged.	Check the electrical connections for good contact. Clean the connector terminals thoroughly with electrical contact cleaner and apply dielectric grease.
	The spark plug is fouled or improperly gapped.	Adjust or replace the spark plug.
	The spark plug wire is not connected.	Check the spark plug wire connection.
	A switch is worn or damaged.	Test and replace faulty switch.
<b>Engine loses power</b>	The engine load is excessive.	Reduce the ground speed or raise height-of-cut.
	The air cleaner is dirty.	Clean or replace the air cleaner element.
	The oil level in the crankcase is low.	Add oil to the crankcase.
	The cooling fins and air passages above the engine are plugged.	Remove the obstruction and thoroughly clean cooling fins and the air passages.
	The fuel tank vent system is plugged.	Inspect fuel tank vent system for obstruction and repair system.
	There is dirt in the fuel filter.	Replace the fuel filter.
	There is dirt, water, or stale fuel in the fuel system.	Clean and flush the fuel system.

# General Troubleshooting (continued)

Problem	Possible Cause	Corrective Action
<b>The engine overheats</b>	The engine load is excessive.	Reduce the ground speed or raise height-of-cut.
	The oil level in the crankcase is low.	Add oil to the crankcase.
	The cooling fins and the air passages above the engine are plugged.	Remove the obstruction and thoroughly clean cooling fins and the air passages.
<b>The mower pulls to the left or right (with controls fully forward)</b>	The tracking needs adjustment.	Adjust the tracking.
	The tire pressure in the drive tires is not correct.	Adjust the tire pressure in the drive tires.
<b>The machine does not drive</b>	The bypass rods are in the manual move position.	Place the bypass rods into the drive position.
	The drive belt is worn, loose, off a pulley, or broken.	Replace the drive belt.
	The tensioner spring is broken or missing.	Replace the spring.
	The hydraulic oil level is low in the transaxle.	Add hydraulic oil to the transaxle.
<b>The machine vibrates abnormally</b>	The cutting blade(s) is/are bent or unbalanced.	Install new cutting blade(s).
	The blade mounting bolt is loose.	Tighten the blade mounting bolt.
	The engine mounting bolts are loose.	Tighten the engine mounting bolts.
	The engine pulley, idler pulley, or blade pulley is loose.	Tighten the appropriate pulley, check to make sure idler springs are not over stretched.
	The engine pulley is damaged.	Replace the engine pulley.
	The blade spindle is bent.	Replace the spindle.
	The motor mount is loose or worn.	Check the mounting bolts.
<b>The machine produces an uneven cutting height</b>	The blade(s) are not sharp.	Sharpen the blade(s).
	The cutting blade(s) are bent.	Install new cutting blade(s).
	The mower deck is not level.	Level the mower deck from side-to-side and front-to-rear.
	The underside of mower is dirty.	Clean the underside of the mower.
	The tire pressure is not correct.	Adjust the tire pressure.
	The blade spindle is bent.	Replace the spindle.
<b>The blades do not rotate</b>	The mower deck belt is damaged, worn, loose, or broken.	Install a new deck belt.
	The mower deck belt is off the pulley.	Install the mower belt on the deck pulley and check the idler pulley, idler arm, and spring for correct position and function.
	The idler spring is broken or missing.	Replace the spring.



# General Troubleshooting (continued)

Problem	Possible Cause	Corrective Action
The clutch does not engage	There is a low voltage supply at the clutch.	Check the coil resistance, battery charge, charging system, and wiring connections and replace parts if necessary.
	The coil is damaged.	Replace the clutch.
	There is inadequate current supply.	Repair or replace the clutch lead wire or electrical system. Clean the connector contacts.
	The rotor/armature air gap is too large.	Replace the clutch.
	The blade control switch (PTO) is faulty.	Replace the blade control switch (PTO).





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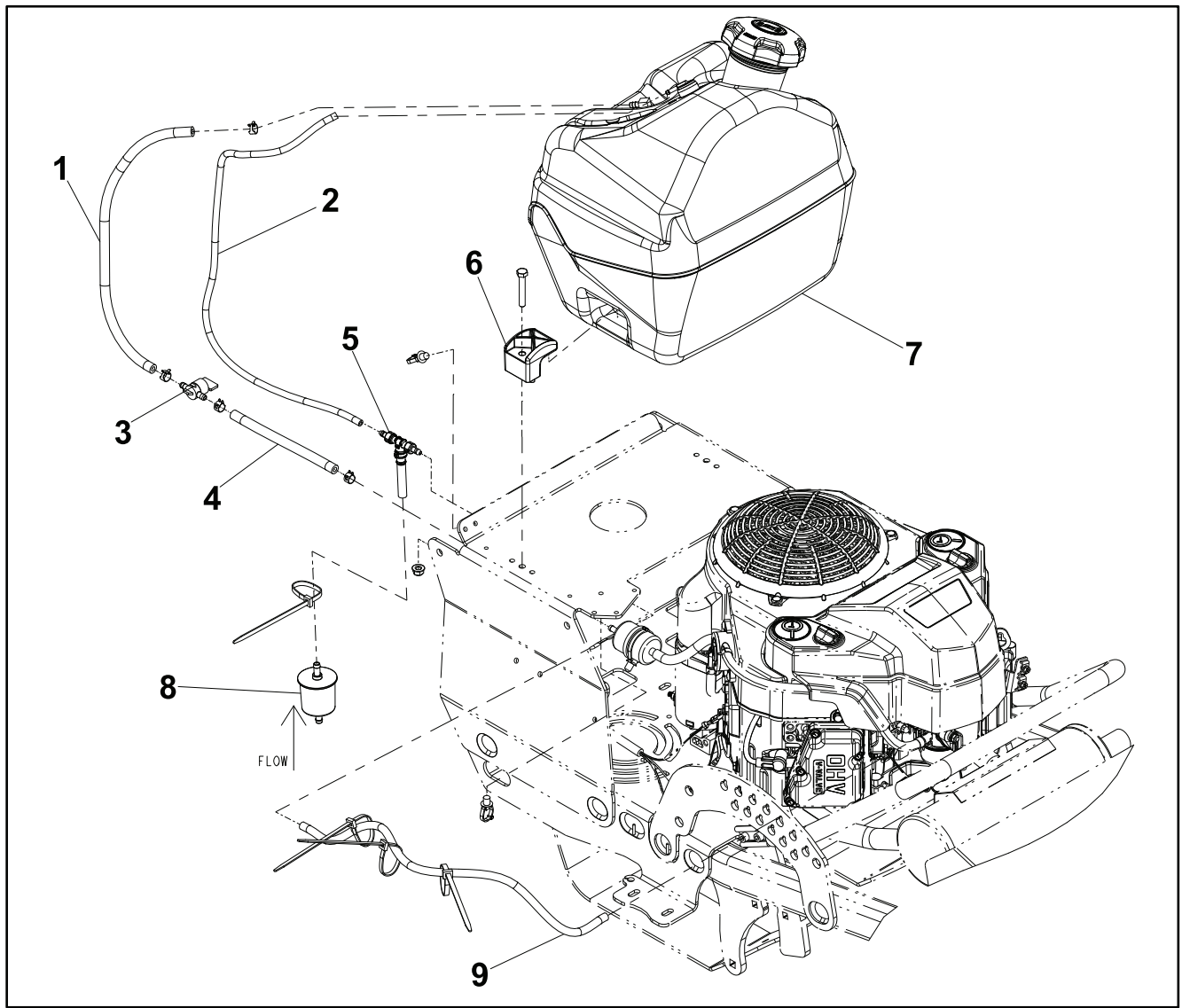
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Air Cleaner Replacement.....	4-18
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# General Information

Kawasaki is the only engine offered for this machine.

# Service and Repairs

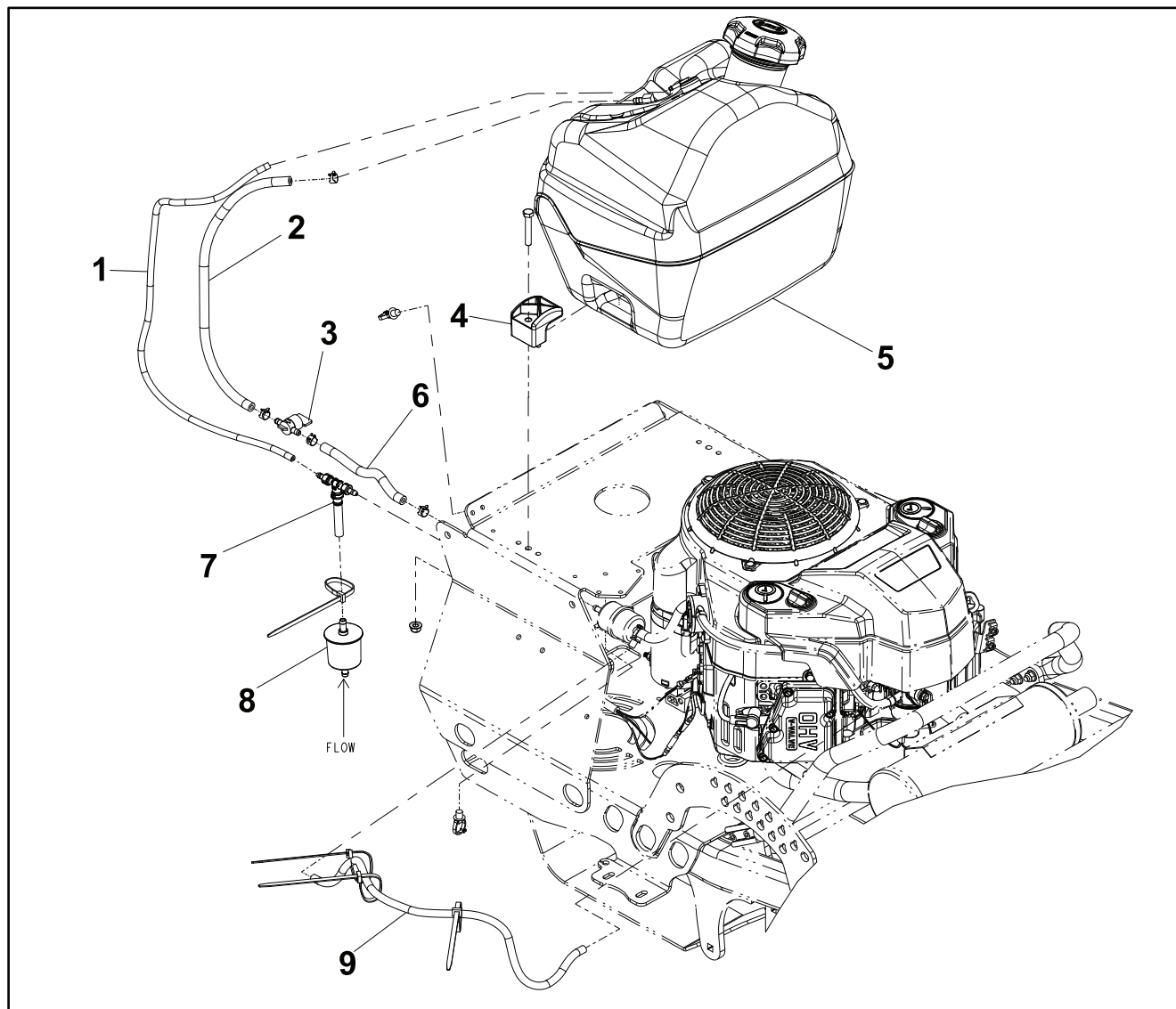
## Engine Assembly 1 (36 Inch and International Models)



g311924

**Figure 3**

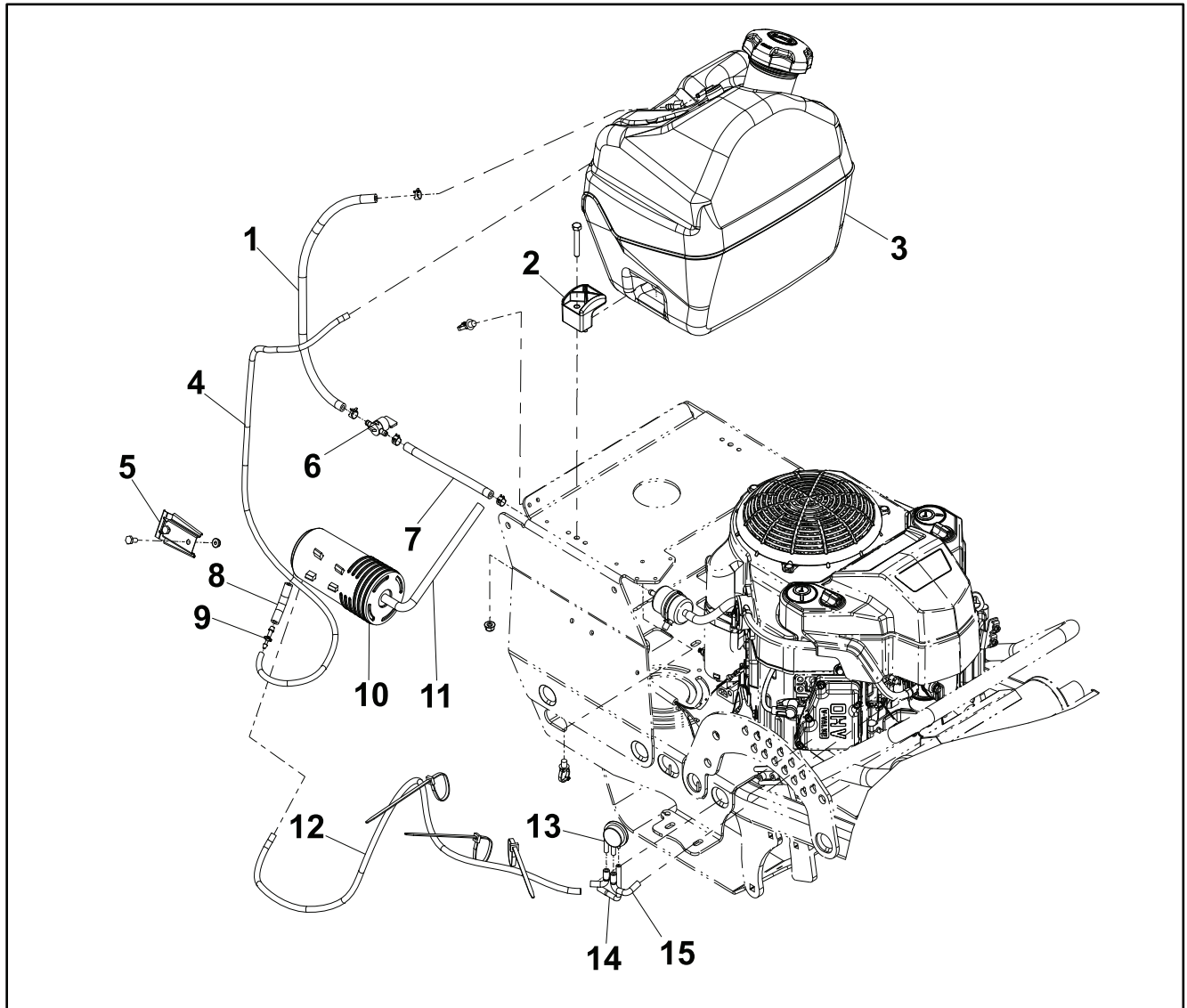
- |                   |                  |
|-------------------|------------------|
| 1. Fuel Hose      | 6. Clamp         |
| 2. Emissions Hose | 7. Fuel Tank Asm |
| 3. Fuel Valve     | 8. Fuel Filter   |
| 4. Fuel Hose      | 9. Fuel Hose     |
| 5. Tee and Check  |                  |



g311925

Figure 4

- |                   |                  |
|-------------------|------------------|
| 1. Emissions Hose | 6. Fuel Hose     |
| 2. Fuel Hose      | 7. Tee and Check |
| 3. Fuel Valve     | 8. Fuel Filter   |
| 4. Clamp          | 9. Fuel Hose     |
| 5. Fuel Tank Asm  |                  |

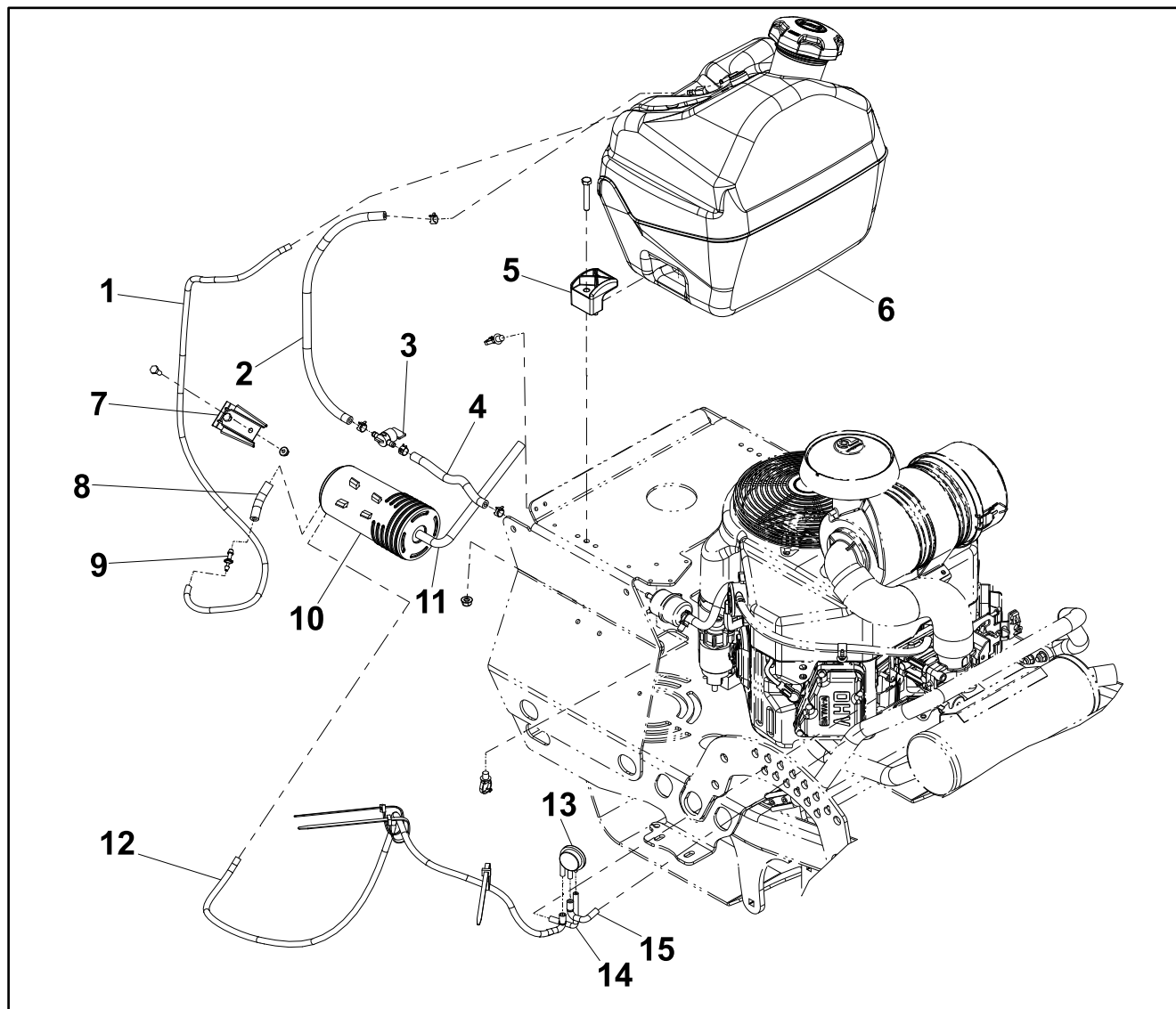


g311926

**Figure 5**

- |                            |                           |
|----------------------------|---------------------------|
| 1. Fuel Hose               | 9. Straight Fitting       |
| 2. Clamp                   | 10. 800cc Carbon Canister |
| 3. Fuel Tank Asm           | 11. Canister Vent Hose    |
| 4. Emission Hose           | 12. Formed Vent Hose      |
| 5. Carbon Canister Bracket | 13. Vacuum Control Valve  |
| 6. Fuel Valve              | 14. Formed Vent Hose      |
| 7. Fuel Hose               | 15. Formed Vent Hose      |
| 8. Fuel Hose               |                           |

## Engine Assembly 4 (48 and 54 Inch Premium & 48 Inch Carb Models)



g320688

**Figure 6**

- |                            |                           |
|----------------------------|---------------------------|
| 1. Emissions Hose          | 9. Straight Fitting       |
| 2. Fuel Hose               | 10. 800cc Carbon Canister |
| 3. Fuel Valve              | 11. Canister Vent Hose    |
| 4. Fuel Hose               | 12. Formed Vent Hose      |
| 5. Clamp                   | 13. Vacuum Control Valve  |
| 6. Fuel Tank Asm           | 14. Formed Vent Hose      |
| 7. Carbon Canister Bracket | 15. Formed Vent Hose      |
| 8. Fuel Hose               |                           |



# Engine Replacement

## Engine Removal



### WARNING



**Avoid inhaling exhaust fumes and never run an engine in a closed building or confined area.**

---

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Remove the 2 pull-down straps from the deck guard. Remove the deck guard from the frame.



g310218

**Figure 7**

- 
4. Remove the spring from the deck idler.

## Engine Removal (continued)



g311057

**Figure 8**

- 
5. Remove the deck belt from the PTO clutch.



g311058

**Figure 9**

- 
6. Disconnect the engine harness from the machine harness.

## Engine Removal (continued)



g311059

**Figure 10**

- 
7. Remove the positive battery cable to the starter.



g311098

**Figure 11**

- 
8. Remove the ground battery cable to the engine ground.
  9. Turn the fuel shut-off valve to the "OFF" position.

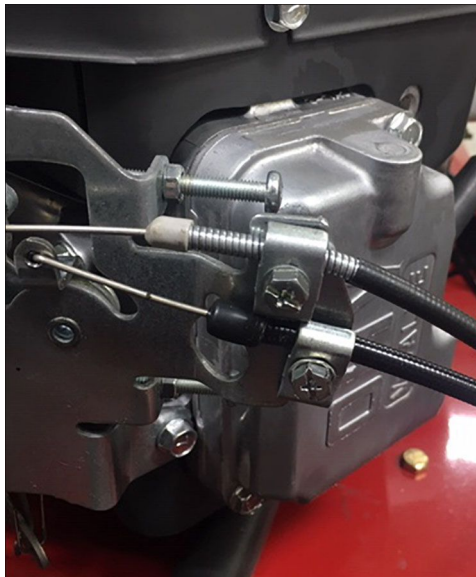
## Engine Removal (continued)



g311099

**Figure 12**

- 
10. Cut the 2 zip ties securing the vent hose, carbon canister hose, and fuel supply hose. Loosen the hose clamp on the fuel supply hose. Remove the fuel supply hose from the fuel pump.
  11. Cut the 2 zip ties securing the vent hose and fuel hose going to the carburetor. Remove the vent hose from the engine take.
  12. Disconnect the throttle and choke linkages.



g311104

**Figure 13**

- 
13. Remove the strap securing the carbon canister hose.
  14. Disconnect the PTO clutch from the wiring harness.

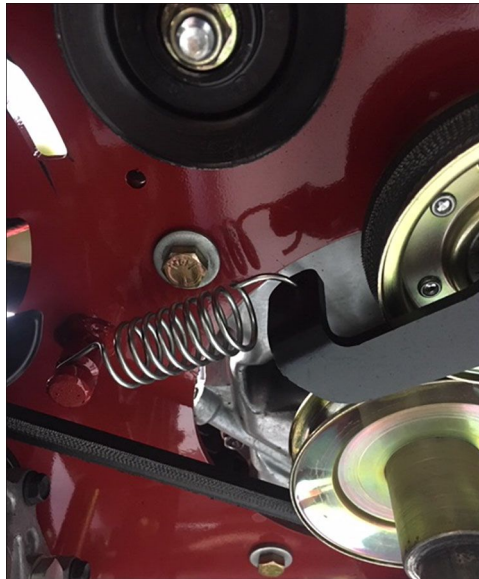
## Engine Removal (continued)



g311100

**Figure 14**

- 
15. Remove the bolt securing the PTO clutch to the machine. Remove the PTO clutch.
  16. Remove the idler spring for the drive belt.



g311101

**Figure 15**

- 
17. Remove the drive belt from the drive pulley. Remove the drive pulley.



## Engine Removal (continued)



g311102

Figure 16

---

18. Remove the 4 bolts securing the engine to the frame.



g311103

Figure 17



### WARNING



**Heavy object, to avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing heavy objects.**

---

19. Using an appropriate lifting device, remove the engine from the machine.



### WARNING



**Heavy object, to avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing heavy objects.**

1. Using an appropriate lifting device, install the engine onto the machine.



2. Reapply Loctite. Install the 4 bolts securing the engine to the frame. Torque to 40 N • m (30 ± 4 ft-lb).



g311103

**Figure 18**

3. Install the drive pulley.
4. Install the drive belt to the drive pulley.

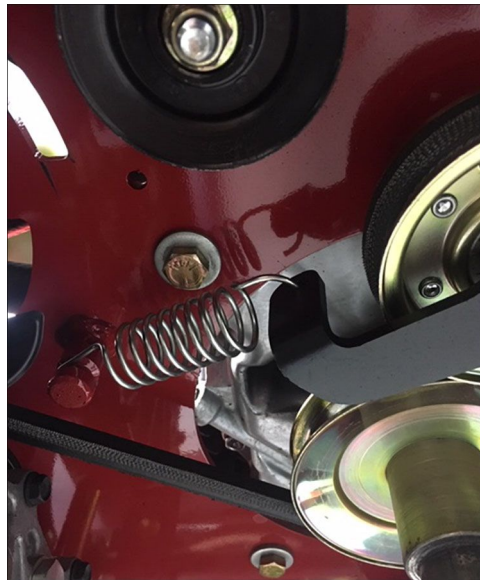
## Engine Installation (continued)



g311102

**Figure 19**

- 
5. Install the idler spring to the drive belt.



g311101

**Figure 20**



- 
6. Align the keyway. Install the PTO clutch. Reapply Loctite and secure with a bolt. Torque bolt to 74 N • m (55 ± 5 ft-lb).
  7. Connect the PTO clutch to the wire harness.



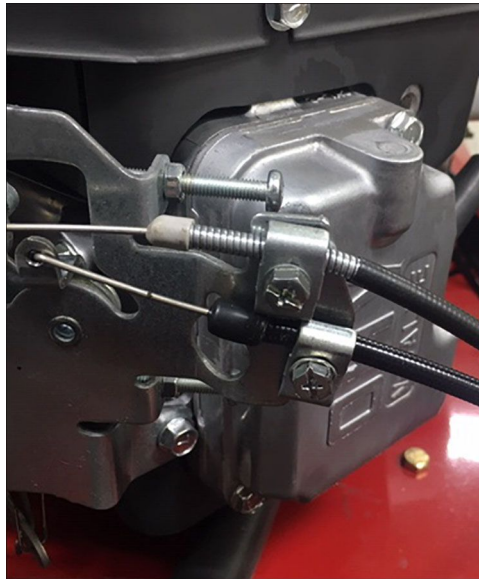
## Engine Installation (continued)



g311100

**Figure 21**

- 
8. Install the strap securing the carbon canister hose.
  9. Place the throttle lever into the detent position, engine should be at 3600 rpm. Connect the throttle and choke linkages.



g311104

**Figure 22**

- 
10. Install the vent hose to the engine take. Install 2 zip ties securing the vent hose and fuel hose going to the carburetor.
  11. Install the fuel supply hose to the fuel pump. Secure with a hose clamp on the fuel supply hose. Install 2 zip ties securing the vent hose, carbon canister hose, and fuel supply hose.
  12. Turn the fuel shut-off valve to the "ON" position.

## Engine Installation (continued)



g311099

**Figure 23**

---

13. Install the ground battery cable to the engine ground.

14. Install the positive battery cable to the starter.



g311098

**Figure 24**

---

15. Connect the engine harness to the machine harness.

## Engine Installation (continued)



g311059

**Figure 25**

---

16. Install the deck belt to the PTO clutch.



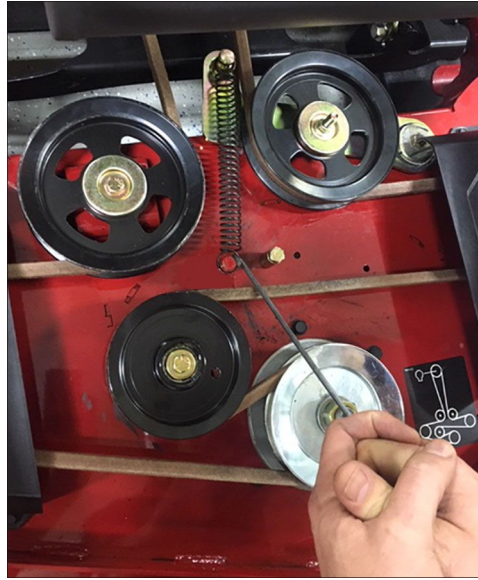
g311058

**Figure 26**

---

17. Install the spring to the deck idler.

## Engine Installation (continued)



g320690

**Figure 27**

18. Install the deck guard to the frame. Install the 2 pull-down straps to the deck guard.
19. Connect the positive battery cable first, then the negative battery cable to the battery.

## Carbon Canister Replacement

### Carbon Canister Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the fuel hose from the tank.
3. Disconnect the vent hose from the engine.
4. Push the carbon canister towards the engine and slide away from the machine.

### Carbon Canister Installation

1. Slide the carbon canister into position onto the machine.
2. Connect the vent hose to the engine.
3. Connect the fuel hose to the tank.

## Air Cleaner Replacement

### Air Cleaner Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Loosen the worm clamp from the intake tube to the take.

## Air Cleaner Removal (continued)



g311184

**Figure 28**

- 
4. Remove the 4 bolts from the retaining bracket to the bracket mounted on the engine.



g311185

**Figure 29**

- 
5. Remove the retaining bracket.
  6. Remove the air cleaner assembly from the machine.

## Air Cleaner Installation

1. Place the air cleaner assembly onto position on the machine.





## Air Cleaner Installation (continued)

2. Install the retainer bracket onto the machine. Secure with 4 bolts. Torque bolts to 60 N • m (52 in-lb).



g311185

**Figure 30**

- 
3. Tighten the worm clamp on the intake tube to the take.



g311184

**Figure 31**

- 
4. Connect the positive battery cable first, then the negative battery cable to the battery.

## Muffler Replacement

### Muffler Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.

## Muffler Removal (continued)

2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Remove the 2 pull-down straps from the deck guard. Remove the deck guard from the frame.



g310218

**Figure 32**

- 
4. Remove the spring from the deck idler.



g320690

**Figure 33**

- 
5. Remove the deck belt from the PTO clutch.

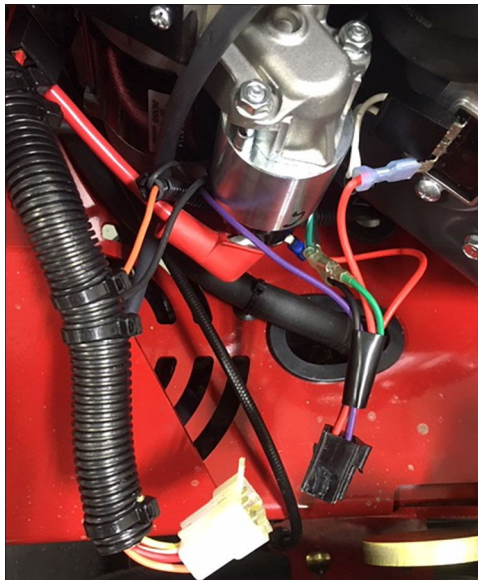
## Muffler Removal (continued)



g311058

**Figure 34**

- 
6. Disconnect the engine harness from the machine harness.



g311059

**Figure 35**

- 
7. Remove the positive battery cable to the starter.



## Muffler Removal (continued)



g311098

**Figure 36**

- 
8. Remove the ground battery cable to the engine ground.



g311099

**Figure 37**

- 
9. Cut the 2 zip ties securing the vent hose, carbon canister hose, and fuel supply hose. Loosen the hose clamp on the fuel supply hose. Remove the fuel supply hose from the fuel pump.
  10. Cut the 2 zip ties securing the vent hose and fuel hose going to the carburetor. Remove the vent hose from the engine take.
  11. Disconnect the throttle and choke linkages.

## Muffler Removal (continued)



g311104

**Figure 38**

- 
12. Remove the strap securing the carbon canister hose.
  13. Disconnect the PTO clutch from the wiring harness.

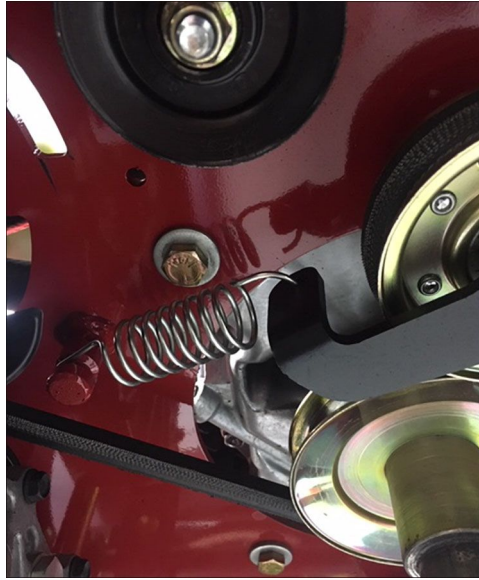


g311100

**Figure 39**

- 
14. Remove the bolt securing the PTO clutch to the machine. Remove the PTO clutch.
  15. Remove the idler spring for the drive belt.

## Muffler Removal (continued)



g311101

**Figure 40**

---

16. Remove the drive belt from the drive pulley. Remove the drive pulley.



g311102

**Figure 41**

---

17. Remove the 4 bolts securing the engine to the frame.

## Muffler Removal (continued)



g311103

Figure 42



### WARNING



**Heavy object, to avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing heavy objects.**

18. Using an appropriate lifting device, remove the engine from the machine.
19. Remove the 4 nuts securing the muffler to the exhaust manifold.
20. Remove the muffler from the machine.

## Muffler Installation



1. Install the muffler onto the machine. Secure the muffler to the exhaust manifold with 4 nuts. Torque nuts to 17 N • m (150–170 in-lb).



### WARNING



**Heavy object, to avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing heavy objects.**

2. Using an appropriate lifting device, install the engine onto the machine.



3. Install the 4 self-tapping bolts securing the engine to the frame. Torque bolts to 41 N • m (30 ± 4 ft-lb).
4. Install the drive pulley.
5. Install the drive belt to the drive pulley.

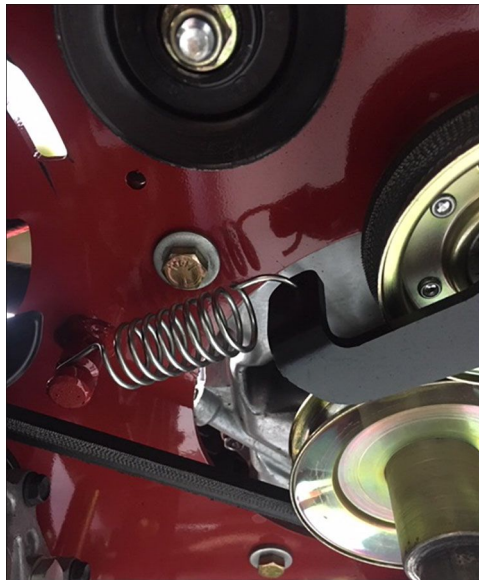
## Muffler Installation (continued)



g311102

**Figure 43**

- 
6. Install the idler spring for the drive belt.



g311101

**Figure 44**



- 
7. Install the PTO clutch. Secure with a bolt. Torque bolt to 67 N • m (55 ± 5 ft-lb).
  8. Connect the PTO clutch to the wiring harness.



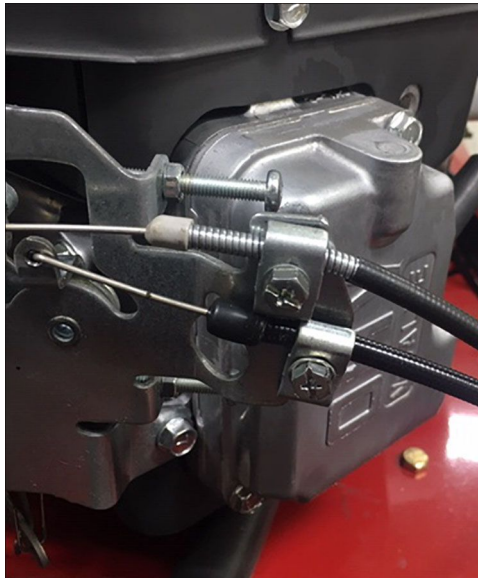
## Muffler Installation (continued)



g311100

**Figure 45**

- 
9. Install the strap securing the carbon canister hose.
  10. Connect the throttle and choke linkages.



g311104

**Figure 46**

- 
11. Install the vent hose to the engine take. Install 2 zip ties securing the vent hose and fuel hose going to the carburetor.
  12. Install the fuel supply hose to the fuel pump. Tighten the hose clamp on the fuel supply hose. Install 2 zip ties securing the vent hose, carbon canister hose, and fuel supply hose.
  13. Turn the fuel shut-off valve to the "ON" position.

## Muffler Installation (continued)



g311099

**Figure 47**

---

14. Install the ground battery cable to the engine ground.

15. Install the positive battery cable to the starter.



g311098

**Figure 48**

---

16. Connect the engine harness to the machine harness.

## Muffler Installation (continued)



g311059

**Figure 49**

---

17. Install the deck belt to the PTO clutch.



g311058

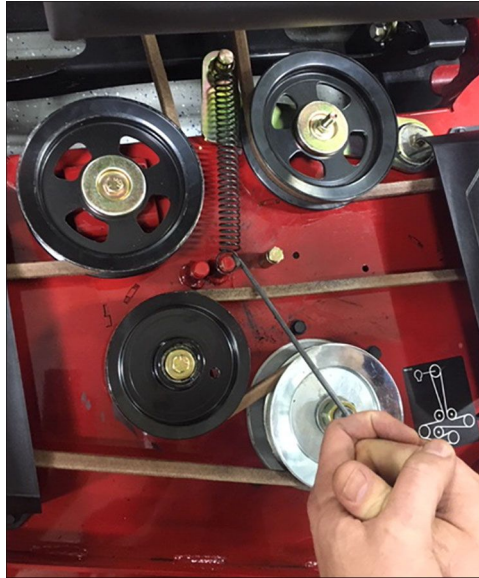
**Figure 50**

---

18. Install the spring to the deck idler.



## Muffler Installation (continued)



g311057

**Figure 51**

- 
19. Install the deck guard to the frame. Install the 2 pull-down straps to the deck guard.



g310218

**Figure 52**

- 
20. Connect the positive battery cable first, then the negative battery cable to the battery.

## Fuel Tank Assembly Replacement

### Fuel Tank Assembly Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.

## Fuel Tank Assembly Removal (continued)

3. Drain all fuel from the fuel tank.
4. Remove the fuel tank supply hose and fuel tank vent hose from the fuel tank.
5. Remove the 2 bolts securing the fuel tank to the fuel tank support.
6. Remove the fuel tank from the machine.

## Fuel Tank Assembly Installation



1. Install the fuel tank onto the machine.
2. Install the 2 bolts securing the fuel tank to the fuel tank support. Torque to 22 N • m (200 ± 25 in-lb).
3. Install the fuel tank supply hose and fuel tank vent hose to the fuel tank.
4. Add fuel to the fuel tank.
5. Connect the positive battery cable first, then the negative battery cable to the battery.



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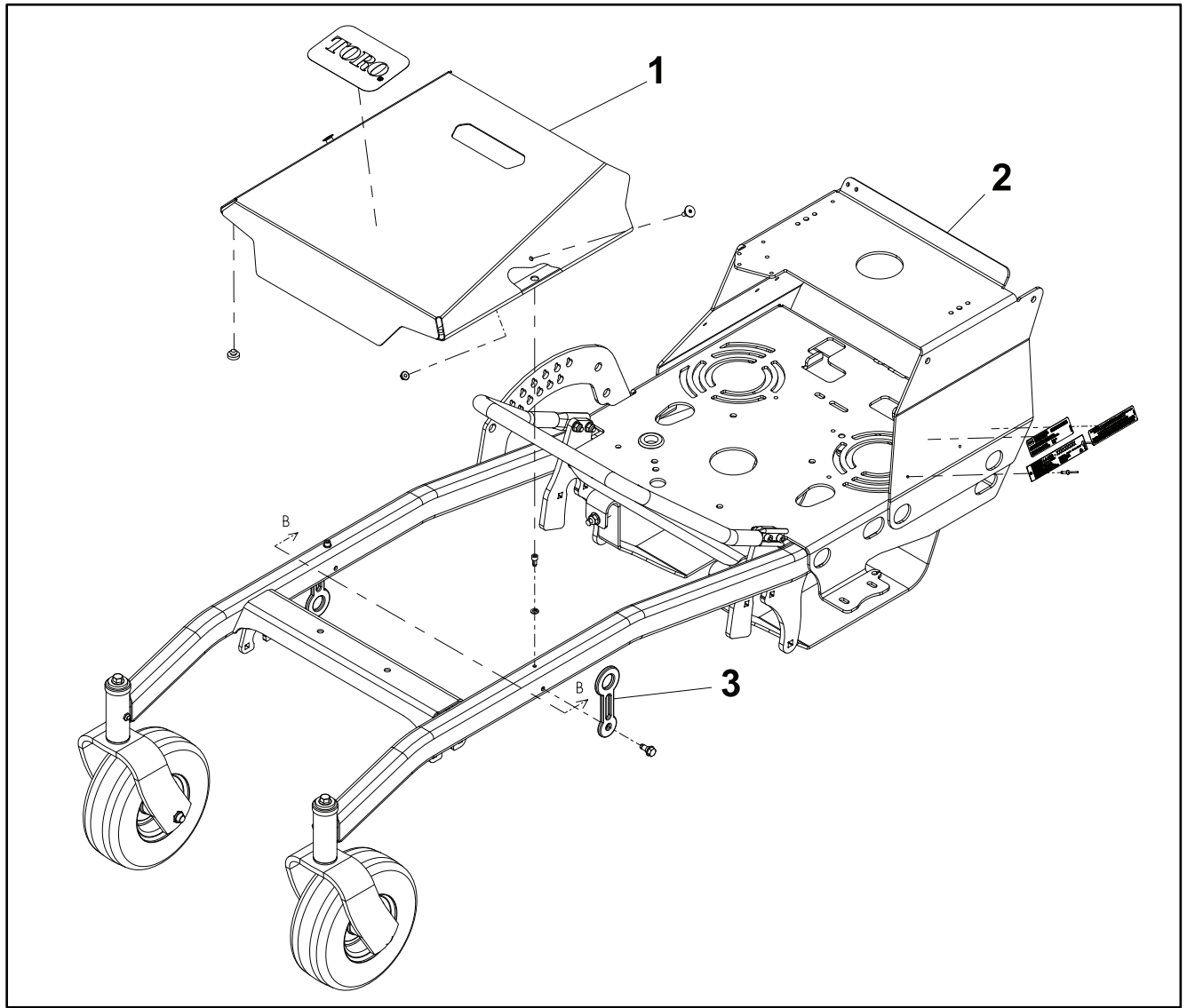
# General Information

There are three types of frames for this machine; 36 inch, 48–54 inch, and 60 inch. The 36 inch model will have a narrower frame than the larger models. It will also have different castor forks and wheels that are different than the larger frame. There are no other major changes between the two frames.

On the deck there is an adjustable deck idler to add tension to the belt as it wears. The adjustment is on the arm that holds the pulley. There is a slotted hole for this adjustment. It would also be recommend to check the deck idler yearly for wear.

# Service and Repairs

## Chassis Asm 1 (36 Inch Standard/Carb/International)

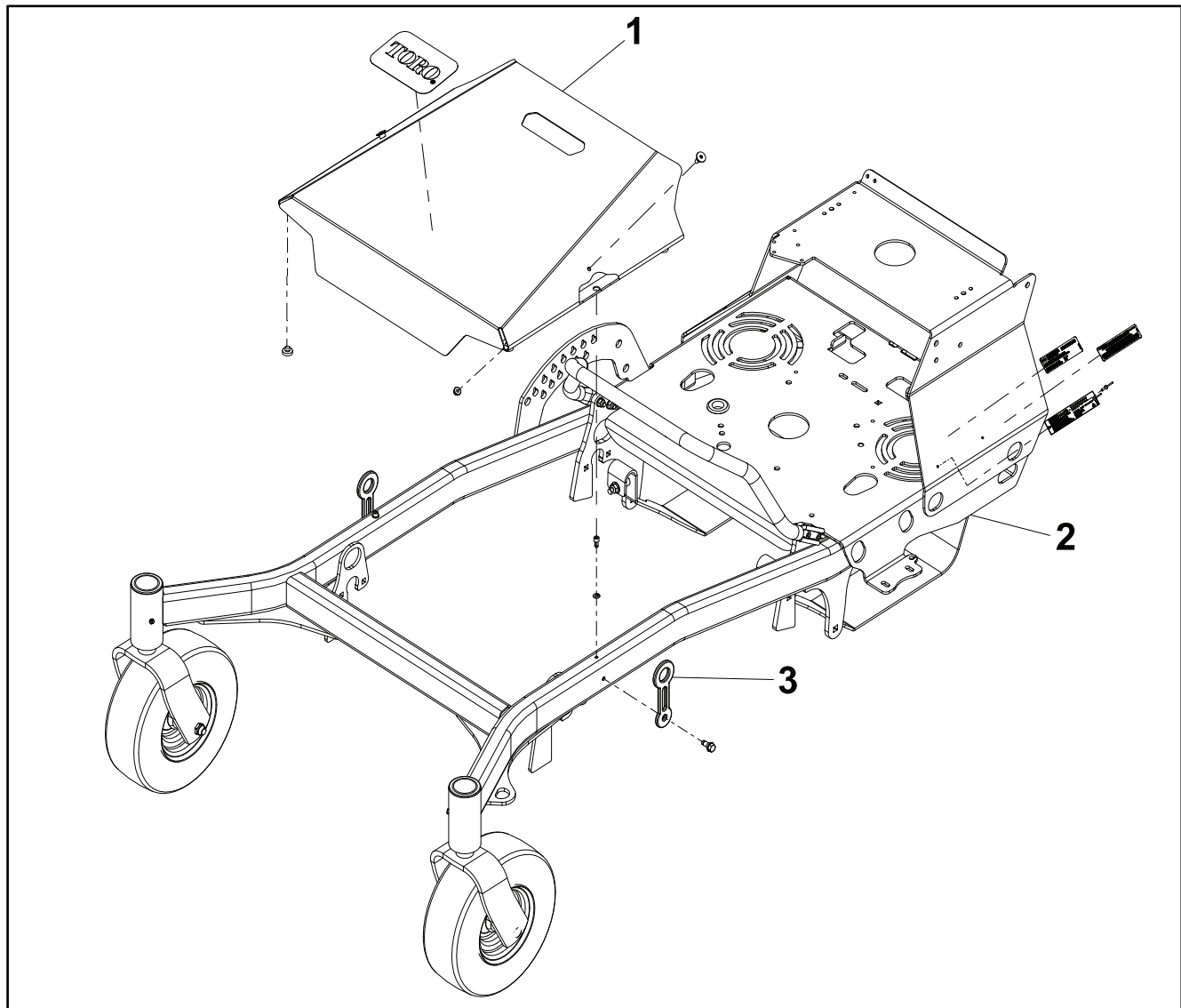


g312018

**Figure 53**

- 1. Deck Cover
- 2. Frame Assembly

- 3. Rubber Latch

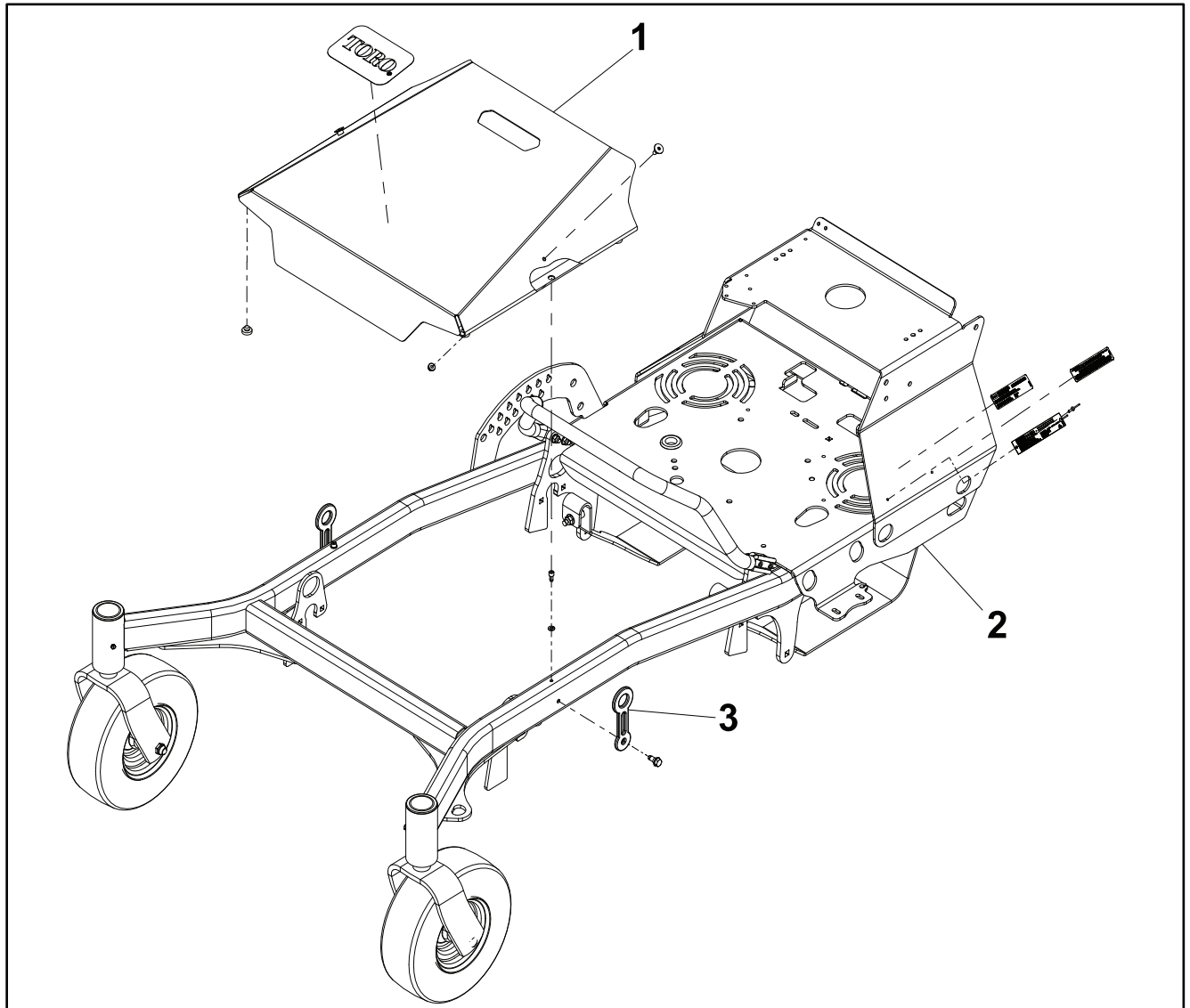


g312021

**Figure 54**

- 1. Wide Deck Cover
- 2. Frame Assembly

- 3. Rubber Latch

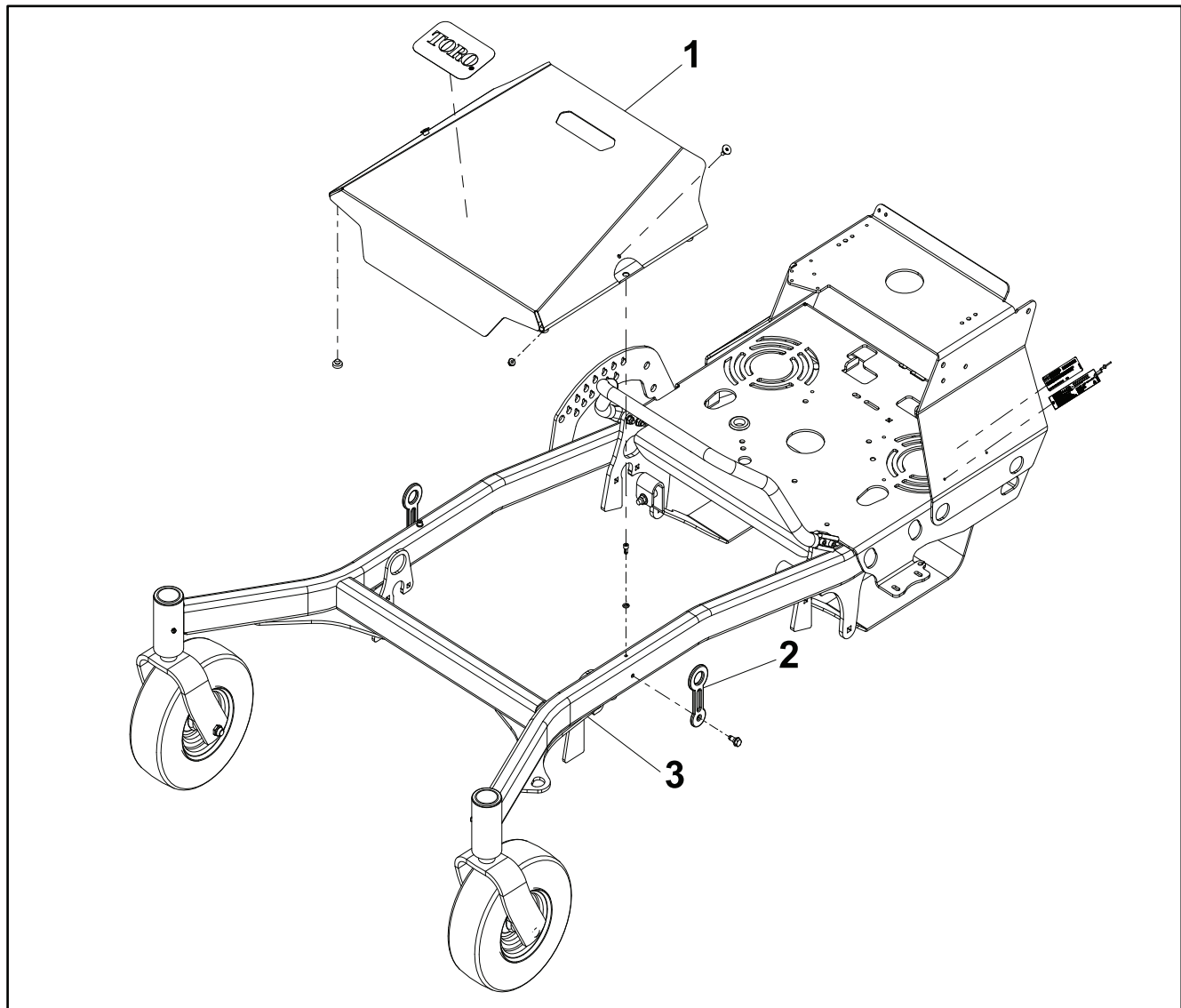


g312019

**Figure 55**

- 1. Wide Deck Cover
- 2. Frame Assembly

- 3. Rubber Latch



g312020

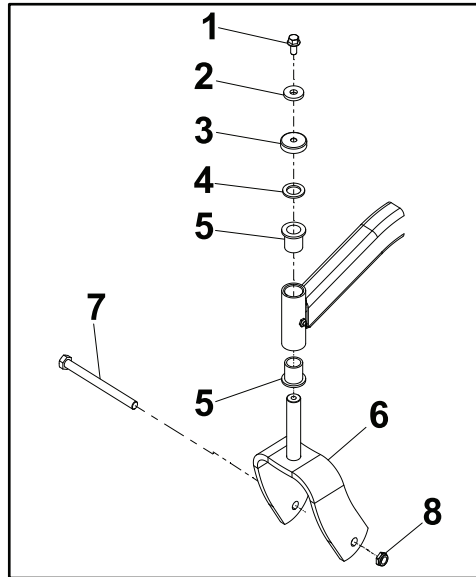
**Figure 56**

- 1. Wide Deck Cover
- 2. Rubber Latch
- 3. Frame Assembly



# 36 Inch Caster Replacement

## 36 Inch Caster Disassembly



g318027

**Figure 57**

- |                  |                    |
|------------------|--------------------|
| 1. HHF Screw     | 5. Flanged Bearing |
| 2. Washer        | 6. Caster Fork     |
| 3. Dust Cap      | 7. HH Screw        |
| 4. Thrust Washer | 8. Hex Nut         |

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Using an overhead lifting device, raise the front end of the machine off the ground.
4. Remove the screw (item 1) securing the caster fork to the frame.
5. Pull the castor fork out of the frame.
6. Remove the washer (item 2) from the frame.
7. Remove the dust cap (item 3) from the frame.
8. Remove the thrust washer (item 4) from the frame.
9. Remove the 2 flanged bearings (item 5) from the frame.

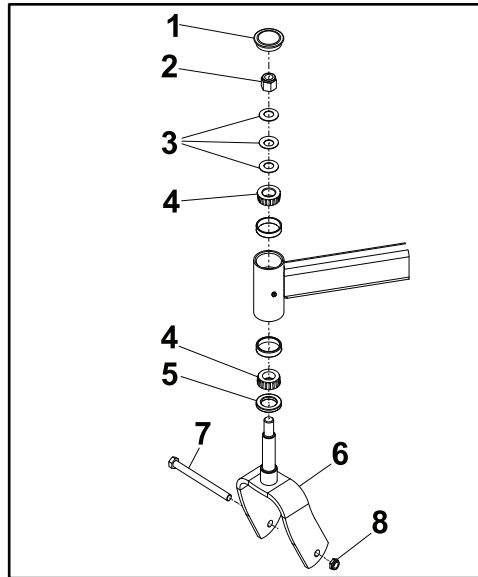
## 36 Inch Caster Assembly

**Note:** Apply grease to the hubs after installation.

1. Install the 2 flanged bearings (item 5) to the frame.
2. Install the thrust washer (item 4) to the frame.
3. Install the dust cap (item 3) to the frame.
4. Install the washer (item 2) to the frame.
5. Install the screw (item 1) securing the caster fork to the frame. Torque screw to 14 N • m (125 ± 15 in-lb). Turn back a quarter turn to ensure caster fork rotates freely.



## 48–54 and 60 Inch Caster Disassembly



g318028

**Figure 58**

- |                           |                |
|---------------------------|----------------|
| 1. Grease Cap             | 5. Grease Seal |
| 2. NI Lock Nut            | 6. Caster Fork |
| 3. Bellville Washers      | 7. HH Screw    |
| 4. Tapered Roller Bearing | 8. Hex Nut     |

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Remove the grease cap (item 1) from the top of the caster wheel pivot tube.
4. Remove the lock nut (item 2) from the caster fork shaft.
5. Remove the caster fork (item 6) and wheel assembly.
6. Remove the 3 Belleville washers (item 3) from the caster wheel pivot tube.
7. Remove the upper tapered roller bearing (item 4) from the caster wheel pivot tube.
8. Remove the grease seal (item 5) from the bottom of the caster wheel pivot tube. Remove the lower tapered roller bearing.
9. Using a blunt punch, remove the upper and lower bearing cups from the caster wheel pivot tube.
10. Remove the nut securing the caster wheel axle bolt. Remove the axle bolt.
11. Remove the caster wheel assembly from the caster fork.
12. Remove the seal guard from both sides of the wheel hub.
13. Remove the spacer nut from the caster axle.

**Note:** The spacer nuts are both threaded onto the caster axle. One of the spacer nuts will need to be removed after it has been removed from the caster wheel.

14. Remove the grease seal from both sides of the caster wheel.
15. Remove the LH and RH tapered bearings.

## 48–54 and 60 Inch Assembly

1. Pack the caster wheel tapered roller bearing with high temperature grease.

## 48–54 and 60 Inch Assembly (continued)

2. Install the bearing into the wheel hub.
3. Install the grease seal into the wheel hub.
4. Repeat steps 1-3 for the opposite side.
5. Fill the center of the wheel hub with high temperature grease.
6. Position the caster axle through the bearing and seal assembly.
7. Install a spacer nut onto both ends of the caster axle.

**Note:** There should be approximately 3 internal spacer nut threads visible on both sides, indicating the axle is centered.

8. Position the seal guard onto both sides of the caster wheel hub.
9. Secure the caster wheel assembly to the caster fork (item 6) using the axle bolt and nut.
10. Install the upper and lower bearing cups into the pivot tube.

**Note:** A socket can be used as a driver. Take care not to scar the race surface.

11. Pack the pivot tube tapered roller bearings with high temperature grease.
12. Install the lower bearing into the pivot tube.
13. Install the grease seal into the base of the pivot tube.
14. Install the upper bearing into the pivot tube.
15. Install the 3 Belleville washers (item 3) into the pivot tube.

- Bottom: Crown Up
- Middle: Crown Down
- Top: Crown Up

16. Position the caster wheel and fork assembly up through the pivot hub.
17. Secure the caster wheel and fork assembly with the nut.



18. Tighten the locknut until the spring washers are flat 20 N • m (15 ft-lb) and then back off a ¼ turn to properly set the preload on the bearings.

19. Remove the plug from the side of the pivot hub.
20. Install a grease zerk into the port on the side of the pivot hub.
21. Fill the pivot hub cavity until grease is purging out through the upper bearing.
22. Replace the grease zerk with the plug.
23. Install the grease cap (item 1) onto the top of the pivot hub.
24. Connect the positive battery cable first, then the negative battery cable to the battery.

## Spindle Replacement

### Spindle Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Remove the 8 screws (4 screws per side) securing the mower belt cover to the deck. Remove the mower belt covers.
4. Remove the mower deck belt. ([page](#) )

## Spindle Removal (continued)

5. Use an appropriate lifting device, raise the machine off the floor to remove the cutting blade.
6. Remove the cutting blade from the machine.
7. Remove the 6 self-tapping bolts that secure the spindle to the deck.
8. Pull the spindle assembly downward, through the deck and away from the machine.

## Spindle Disassembly

1. Clamp the spindle for service by placing the spindle shaft in a vise.
2. Remove the nut and washer from the top of the pulley.
3. Remove the pulley.
4. Remove the spindle housing from the shaft.
5. Remove the bearing shield.
6. Remove the bearing and the bearing spacer from the top of the spindle housing.
7. Flip over the spindle housing and remove the lower bearing.
8. Inspect the inside of the spindle housing for wear or damage.

## Spindle Assembly

1. Inspect the inside of the spindle housing for wear or damage.
2. Press the top bearing into the spindle housing by pressing equally on the inner and outer race.  
**Note:** Ensure that the bearing seats against the shoulder in the spindle housing.
3. Flip the spindle housing over and install the bearing spacer.
4. Press the lower bearing into the spindle housing by pressing equally on the inner and outer race.  
**Note:** The inner and outer race on the upper bearing must be supported while installing the lower bearing.
5. Apply anti-seize to the spindle shaft and install the spindle shaft.
6. Flip the spindle over while supporting the shaft through the spindle housing.
7. Install the bearing shield.
8. Install the pulley.



9. Install the washer and nut. Torque the top nut to 138–152 N • m (100–110 ft-lb).

## Spindle Installation

1. Position the spindle against the deck and align the mounting holes.

**Note:** Ensure that the underside of the deck is clean before proceeding with the spindle installation.



2. Install the 6 spindle mounting bolts. Torque to  $17 \pm 3$  N • m ( $150 \pm 25$  in-lb).

**Note:** Spindle mounting screws are thread forming. Do not reuse the spindle mounting screws.

## Spindle Installation (continued)



3. Install the Belleville washer with the concave side facing the cutting blade. Install the blade bolt. Torque the blade bolt to 100-110 ft-lbs. (138-152 Nm).
4. Install the mower deck belt.
5. Install the mower belt covers.
6. Connect the positive battery cable first, then the negative battery cable to the battery.





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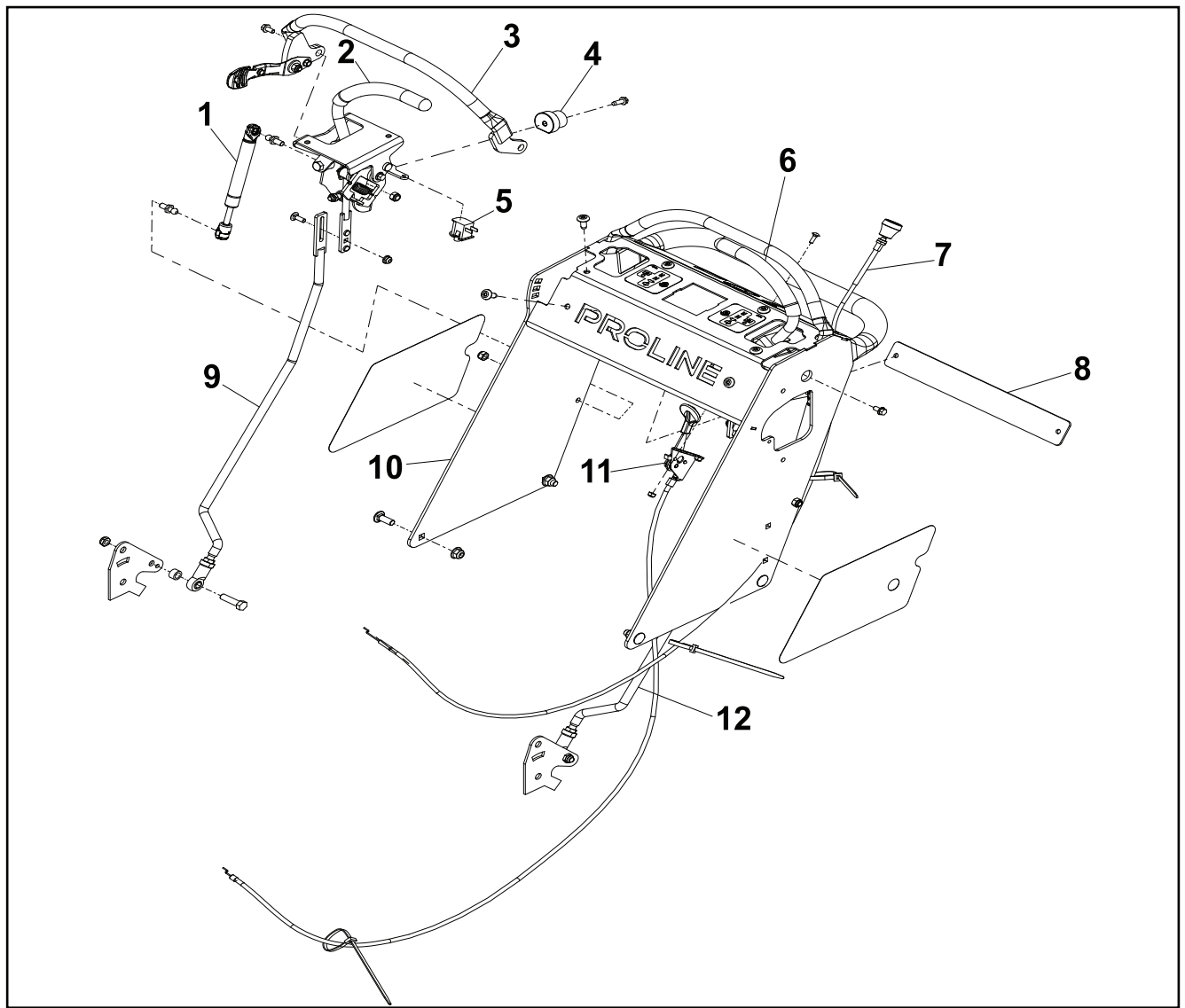
# General Information

The neutral setting and the tracking are adjusted with the control linkages. The adjustable reference bar is used to control the speed of machine. The operator can set the speed manually.



# Service and Repairs

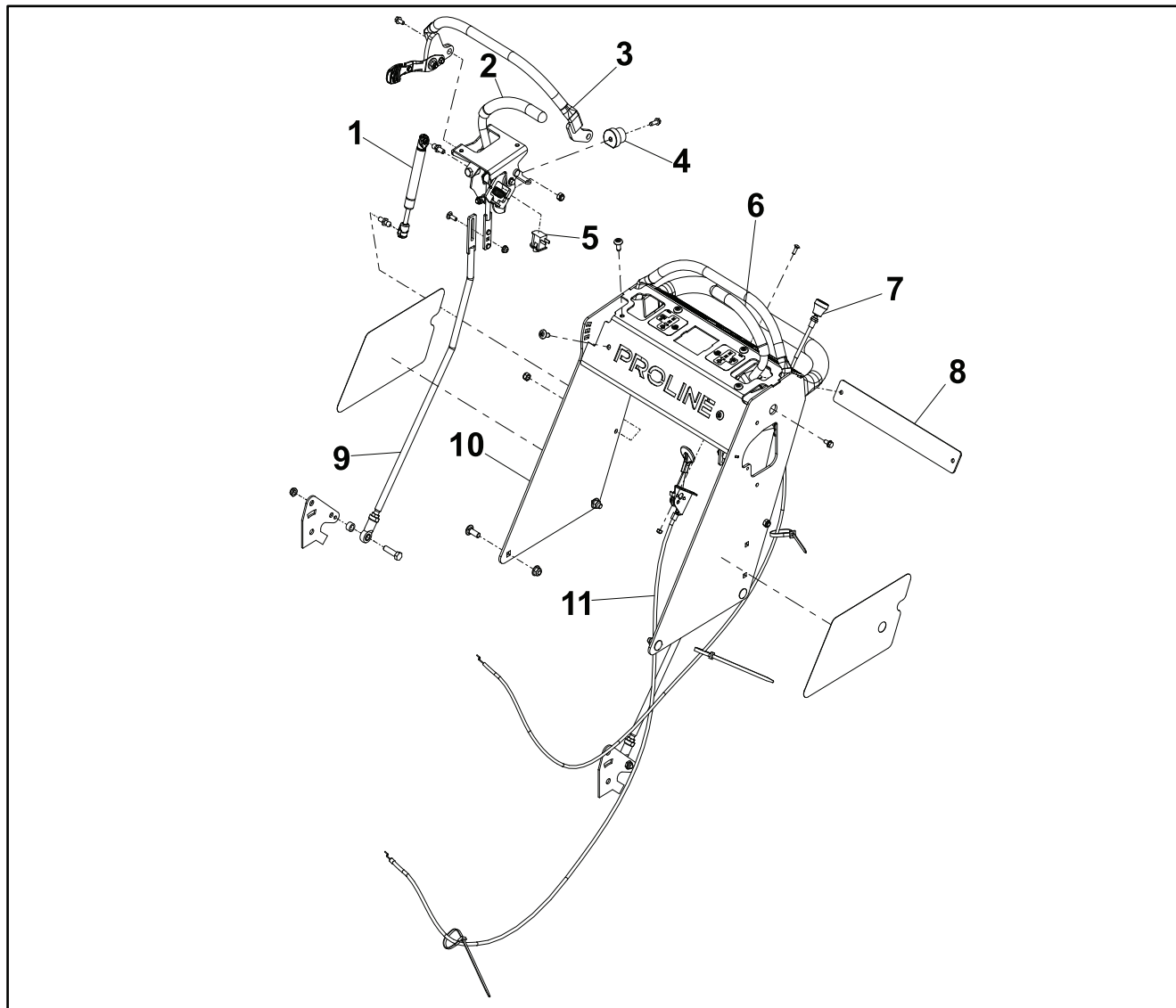
## Controls Asm 1 (36 Inch)



g312348

**Figure 59**

- |                          |                        |
|--------------------------|------------------------|
| 1. Damper                | 7. Choke Cable         |
| 2. RH Control Handle Asm | 8. Cover Plate         |
| 3. Reference Bar Asm     | 9. RH Control Rod Asm  |
| 4. Cam                   | 10. Tower Asm          |
| 5. Bail Switch           | 11. Throttle Control   |
| 6. LH Control Handle Asm | 12. LH Control Rod Asm |

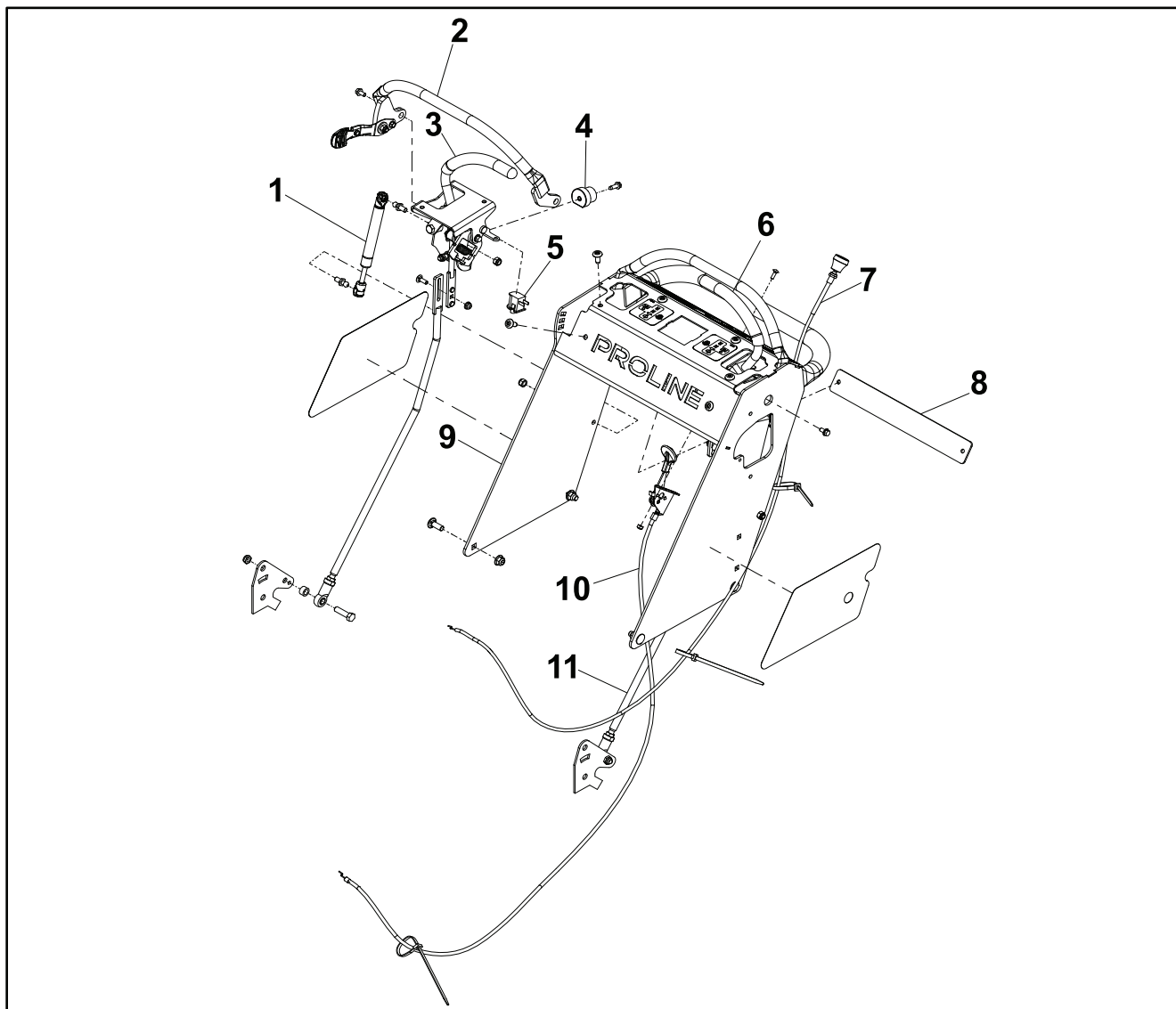


g312344

**Figure 60**

- |                          |                      |
|--------------------------|----------------------|
| 1. Damper                | 7. Choke Cable       |
| 2. RH Control Handle Asm | 8. Cover Plate       |
| 3. Reference Bar Asm     | 9. Control Rod Asm   |
| 4. Cam                   | 10. Tower Asm        |
| 5. Bail Switch           | 11. Throttle Control |
| 6. LH Control Handle Asm |                      |

## Controls Asm 3 (48 and 54 Inch Premium)

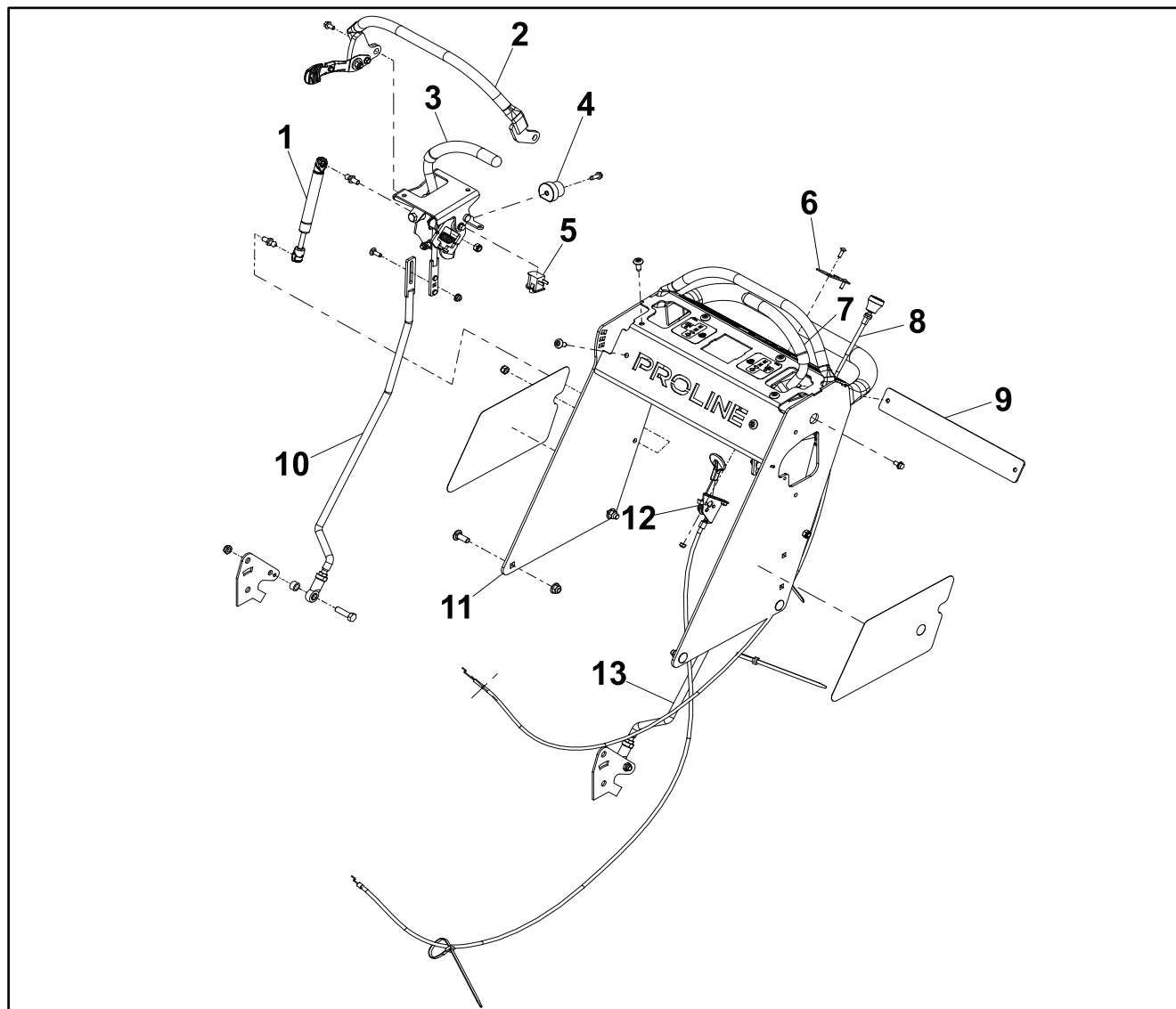


g312349

**Figure 61**

- |                          |                      |
|--------------------------|----------------------|
| 1. LH Control Handle Asm | 7. Choke Cable       |
| 2. Reference Bar Asm     | 8. Cover Plate       |
| 3. RH Control Handle Asm | 9. Tower Asm         |
| 4. Cam                   | 10. Throttle Control |
| 5. Bail Switch           | 11. Control Rod Asm  |
| 6. LH Control Handle Asm |                      |

## Controls Asm 4 (36 Inch International)

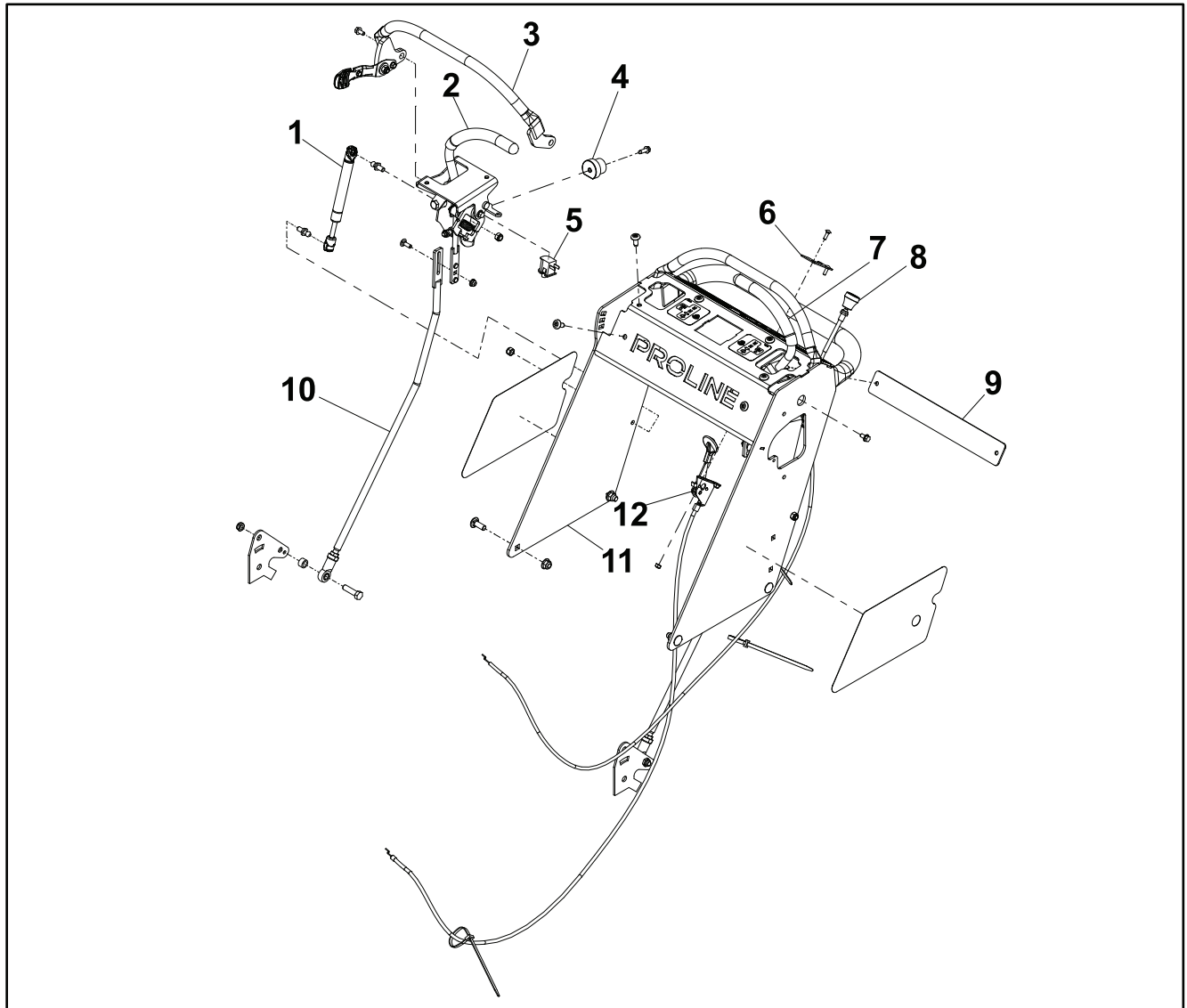


g312345

**Figure 62**

- |                          |                        |
|--------------------------|------------------------|
| 1. Damper                | 8. Choke Cable         |
| 2. Reference Bar Asm     | 9. Cover Plate         |
| 3. RH Control Handle Asm | 10. RH Control Rod Asm |
| 4. Cam                   | 11. Tower Asm          |
| 5. Bail Switch           | 12. Throttle Control   |
| 6. Plate Speed Limiter   | 13. LH Control Rod Asm |
| 7. LH Control Handle Asm |                        |

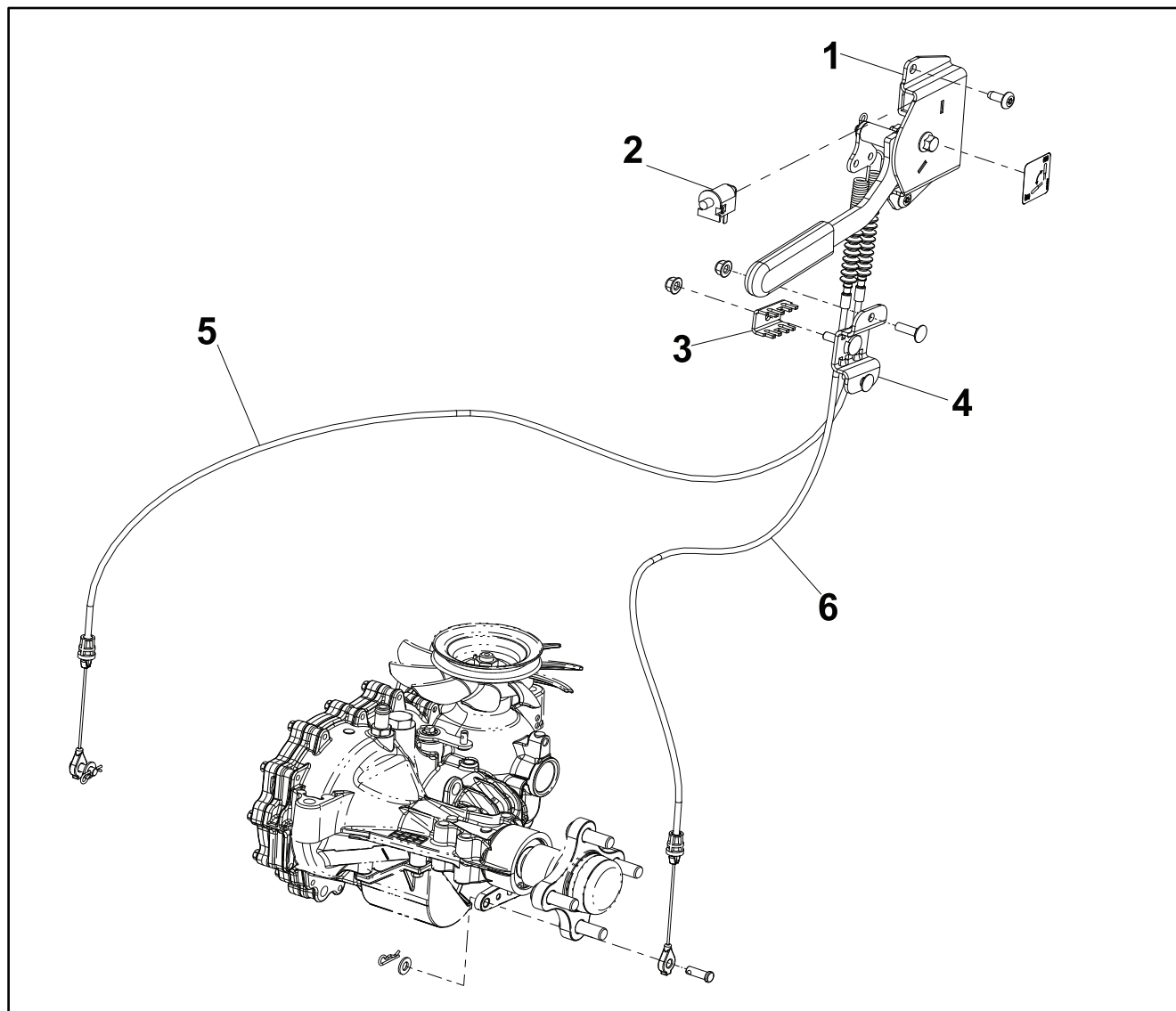
## Controls Asm 5 (48 Inch International)



g312346

**Figure 63**

- |                          |                          |
|--------------------------|--------------------------|
| 1. Damper                | 7. LH Control Handle Asm |
| 2. RH Control Handle Asm | 8. Choke Cable           |
| 3. Reference Bar Asm     | 9. Cover Plate           |
| 4. Cam                   | 10. Control Rod Asm      |
| 5. Bail Switch           | 11. Tower Asm            |
| 6. Speed Limiter Plate   | 12. Throttle Control     |



g312347

**Figure 64**

- |                |                      |
|----------------|----------------------|
| 1. Brake Asm   | 4. Brake Cable Mount |
| 2. Bail Switch | 5. Brake Cable       |
| 3. Cable Clamp | 6. Brake Cable       |

# Park Brake Replacement

## Park Brake Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Install blocks to the front and rear tires to prevent movement of the machine.
4. Lower the brake handle to remove tension from the brake cable keeper.
5. Disconnect the parking brake switch from the wiring harness.



g311219

**Figure 65**

- 
6. Remove the screw securing the park brake clamp to the tower.
  7. Remove the 2 parking brake cables from the parking brake arm.

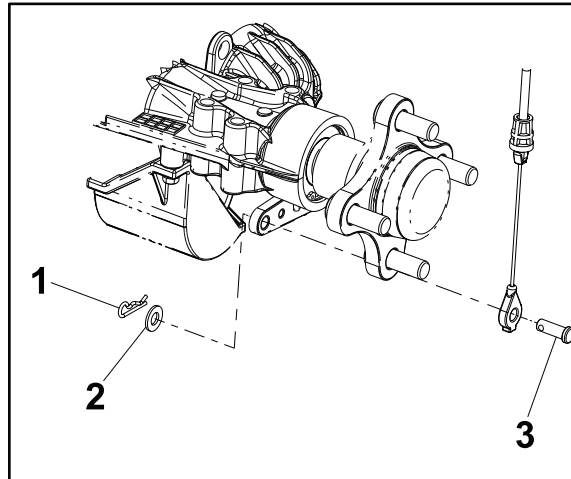


g311220

**Figure 66**

## Park Brake Removal (continued)

8. Remove the LH cotter pin and washer from the clevis pin on the brake arm on the hydro. Repeat for opposite side.

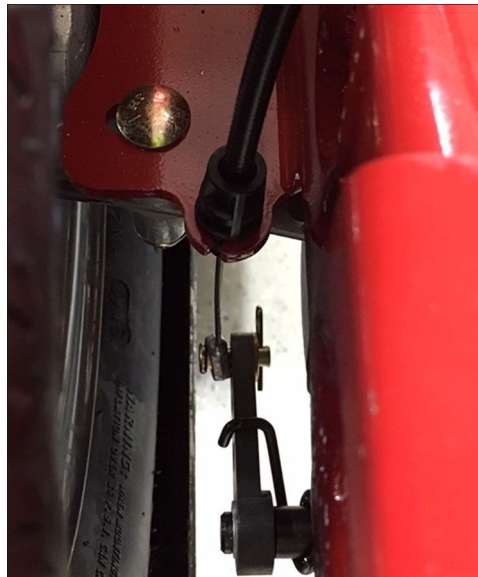


g311244

**Figure 67**

- |               |               |
|---------------|---------------|
| 1. Cotter Pin | 3. Clevis Pin |
| 2. Washer     |               |

- 
9. Remove the transmission cable keeper from the transmission mount. Repeat for opposite side.



g311221

**Figure 68**

- 
10. Remove the 2 torx bolts securing the parking brake arm to the side of the control tower.



## Park Brake Removal (continued)



g311222

**Figure 69**

- 
11. Rotate the parking brake arm towards the operator and remove from the control tower.

## Park Brake Installation

1. Install the parking brake arm onto the control tower.



2. Install the 2 torx bolts securing the parking brake arm to the side of the control tower. Torque bolts to 18 N • m (160 ± 20 in-lb).



g311222

**Figure 70**

- 
3. Install the transmission cable keeper to the transmission mount. Repeat for opposite side.

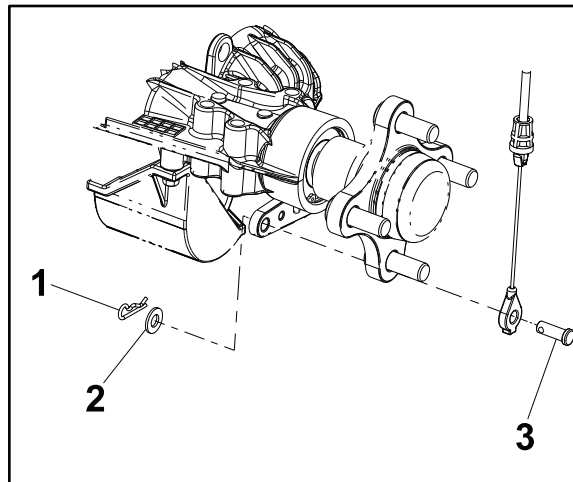
## Park Brake Installation (continued)



g311221

**Figure 71**

- 
4. Install the LH cotter pin and washer from the clevis pin on the brake arm on the hydro. Repeat for opposite side.



g311244

**Figure 72**

- 
5. Install the 2 parking brake cables to the parking brake arm.

## Park Brake Installation (continued)



g311220

**Figure 73**

- 
6. Connect the parking brake switch to the wiring harness.



g311219

**Figure 74**

- 
7. Pull the brake arm up to add tension to the brake cable keeper.
  8. Remove the blocks from the front and rear tires.
  9. Connect the positive battery cable first, then the negative battery cable to the battery.

## Park Brake Adjustment

1. Place the parking brake arm into the locked position.
2. Pull downward on both parking brake cables.
3. Tighten the parking brake cable keeper.
4. Test to ensure the machine does not move on its own.

# Choke Cable Replacement

## Choke Cable Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Loosen the bolt securing the choke cable to the engine choke mount cable outer housing.



g311104

**Figure 75**

- 
4. Remove the choke cable from the choke lever on the engine.
  5. Cut the zip ties securing the choke cable to the throttle cable.
  6. Loosen the nut on the underside of the control tower to the choke cable.
  7. Remove the choke cable from the control tower.

## Choke Cable Installation

1. Install the choke cable to the control tower.
2. Tighten the nut on the underside of the control tower to the choke cable.
3. Install zip ties securing the choke cable to the throttle cable.
4. Install the choke cable to the choke lever on the engine.
5. Tighten the bolt securing the choke cable to the engine choke mount. Torque bolt to 6 N • m (52 in-lb).



## Choke Cable Installation (continued)



g311104

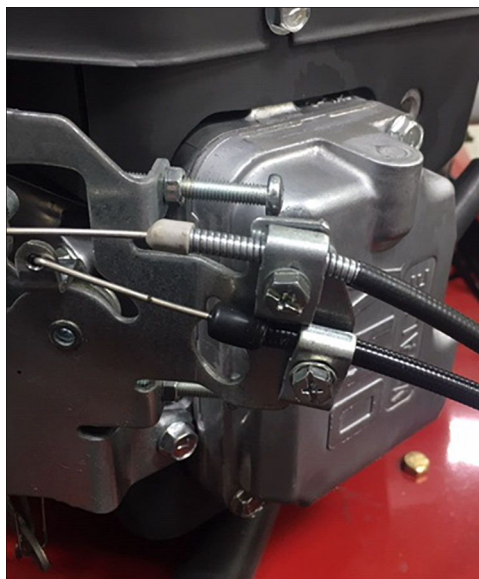
**Figure 76**

- 
6. Connect the positive battery cable first, then the negative battery cable to the battery.

## Throttle Control Replacement

### Throttle Control Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Loosen the bolt securing the throttle cable to the engine choke mount cable outer housing.



g311104

**Figure 77**

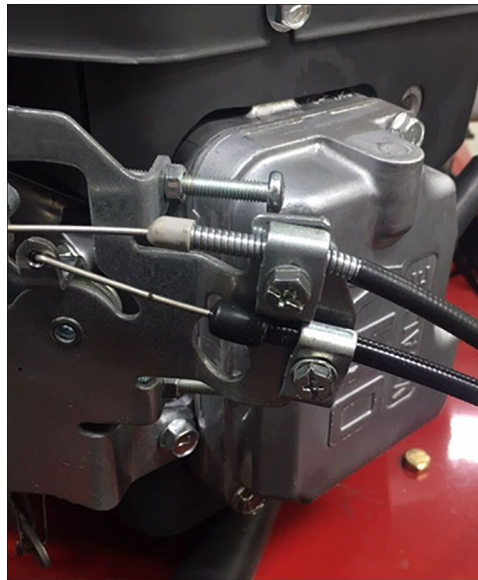
## Throttle Control Removal (continued)

4. Remove the throttle cable from the throttle lever on the engine.
5. Cut the zip ties securing the throttle cable to the choke cable.
6. Remove the 2 bolts and nuts securing the throttle control to the control tower.
7. Pull the throttle arm through the opening in the control tower and remove from the machine.

## Throttle Control Installation



1. Place the throttle arm into the opening in the control tower.
2. Install the 2 bolts and nuts securing the throttle control to the control tower. Torque bolts and nuts to 13 N • m (160 ± 20 in-lb).
3. Install zip ties securing the throttle cable to the choke cable.
4. Install the throttle cable to the throttle lever on the engine.
5. Tighten the bolt securing the throttle cable to the engine choke mount cable outer housing.



g311104

**Figure 78**

- 
6. Connect the positive battery cable first, then the negative battery cable to the battery.

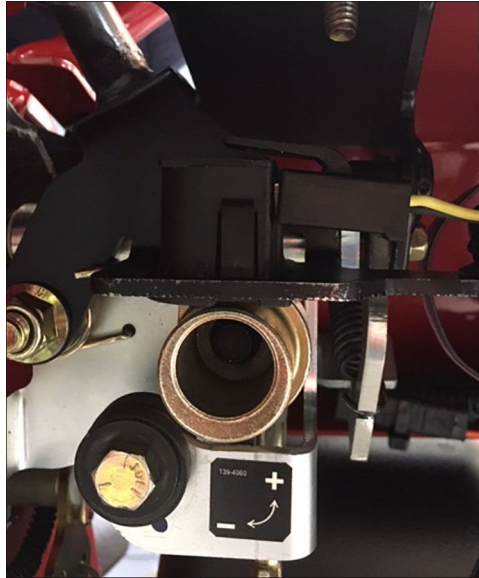
## Control Handle Replacement

### Control Handle Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Disconnect the wire harness from the operator's presence switch on the motion control arm.



## Control Handle Removal (continued)



g311245

**Figure 79**

- 
4. Cut the zip tie securing the wiring harness to the motion control.
  5. Remove the bolt and nut securing the damper to the control tower.



g311246

**Figure 80**

- 
6. Remove the upper and lower control rods.
  7. Remove the bolt and nut securing the motion control to the control rod.

## Control Handle Removal (continued)



g311247

**Figure 81**

- 
8. Remove the bolt securing the reference bar to the motion control arm.
  9. Remove the 2 torx bolts that secure the motion control arm to the control tower.



g311248

**Figure 82**

- 
10. Remove the motion control arm from the control tower.
  11. Remove the spring clip securing the damper to the motion control arm.



## Control Handle Removal (continued)



g311249

**Figure 83**

- 
12. Remove the motion control arm from the machine.

## Control Handle Installation

1. Install the motion control arm onto the machine. Install the spring clip securing the damper to the motion control arm.



g311249

**Figure 84**

- 
2. Install the motion control arm to the control tower.
  3. Install 2 torx bolts to secure the motion control arm to the control tower. Torque bolts to 18 N • m (160 ± 20 in-lb).



## Control Handle Installation (continued)



g311248

Figure 85



4. Reapply Loctite. Install the bolt securing the reference bar to the motion control arm. Torque bolt to 6 N • m (53 ± 7 in-lb).



5. Install the bolt and nut securing the motion control arm to the control rod. Torque bolt and nut to 6 N • m (53 ± 7 in-lb).



g311247

Figure 86



6. Install the bolt and nut securing the damper to the control tower. Torque bolt and nut to 5 N • m (48 ± 5 in-lb).

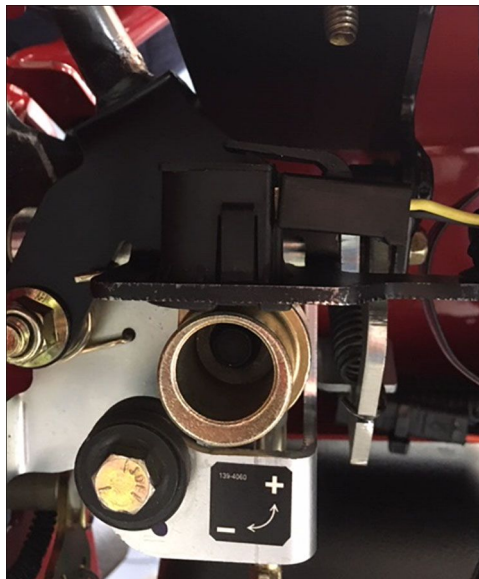
## Control Handle Installation (continued)



g311246

**Figure 87**

7. Install a zip tie securing the wiring harness to the motion control.
8. Connect the wire harness from the operator's presence switch to the motion control arm.



g311245

**Figure 88**

9. Connect the positive battery cable first, then the negative battery cable to the battery.

## Reference Bar Replacement

### Reference Bar Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Remove the 2 bolts securing the reference bar to the machine.

## Reference Bar Removal (continued)

3. Remove the reference bar.

## Reference Bar Installation

1. Install the reference bar onto the machine.



2. Install the 2 bolts securing the reference bar to the machine. Torque to 6 N • m (57 ± 3 in-lb).



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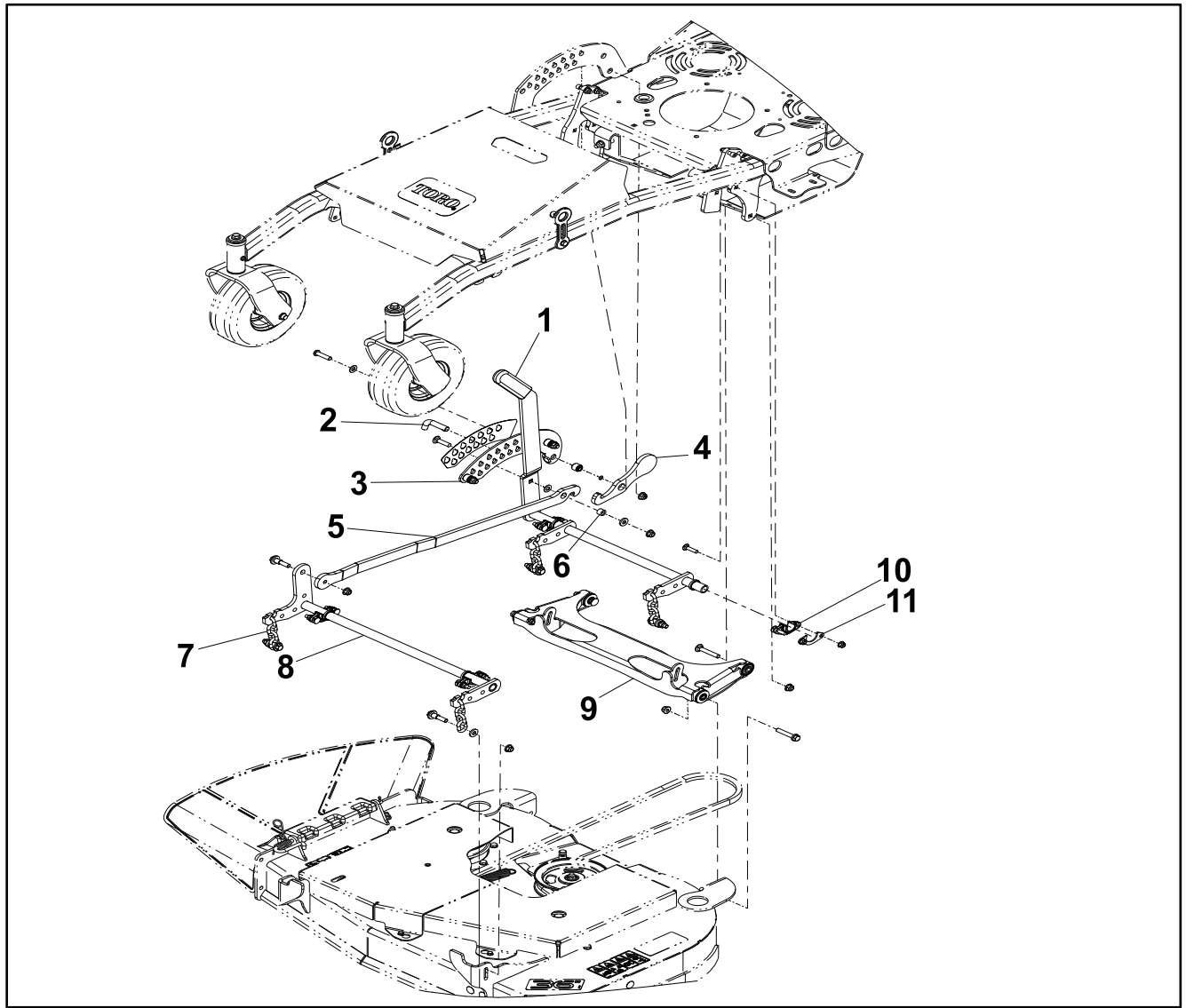
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Deck Lift Assembly .....	7-6

# General Information

On the deck there is an adjustable deck idler to add tension to the belt as it wears, adjustment is on the arm that holds the pulley through the slotted hold. It is recommended to check the deck idler yearly for wear.

# Service and Repairs

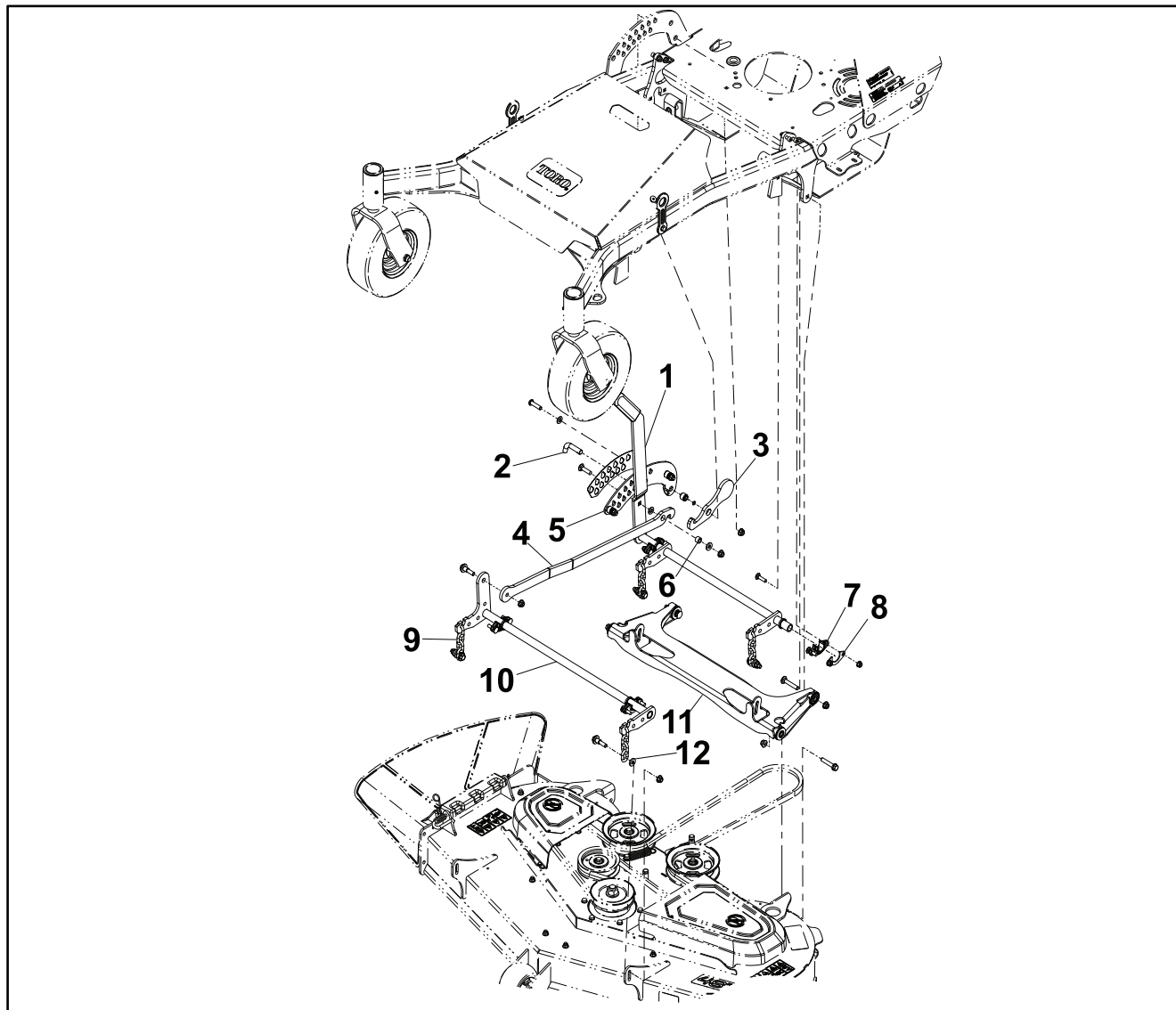
## Deck Asm 1 (36 Inch)



g312016

**Figure 89**

- |                     |                           |
|---------------------|---------------------------|
| 1. Pivot Asm        | 7. 4-Link Deck Lift Chain |
| 2. HOC Pin          | 8. Front Pivot Asm        |
| 3. HOC Standoff Asm | 9. Deck Strut Asm         |
| 4. Lock Lever       | 10. Bearing Flange        |
| 5. HOC Link         | 11. Deck Lift Gusset      |
| 6. Spacer           |                           |



g312017

**Figure 90**

- |                     |                          |
|---------------------|--------------------------|
| 1. Pivot Asm        | 7. Flange Bearing        |
| 2. HOC Pin          | 8. Deck Lift Gusset      |
| 3. Lock Lever       | 9. 4-Link Decklift Chain |
| 4. HOC Link         | 10. Front Pivot Asm      |
| 5. HOC Standoff Asm | 11. Deck Strut Asm       |
| 6. Spacer           | 12. Blower Hub Spacer    |



# Deck Replacement

## Deck Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Place blocks under the deck.
4. Remove the height-adjustment-pin and lower the deck to rest on the blocks.  
**Note:** Tension needs to be relieved from the chains.
5. Remove the mower deck belt.
6. Remove the 4 bolts (2 bolts per side) on the chain connecting the deck strut and deck.



g311250

**Figure 91**

7. Remove the 2 bolts and fasteners connecting the deck strut and deck shell.
8. Raise the height-of-cut to the transport position.
9. Slide the deck out from underneath the machine.

## Deck Installation

1. Slide the deck into position underneath the machine.
2. Lower the height-of-cut to the lowest HOC position.
3. Install the 2 bolts and fasteners connecting the deck strut and deck shell. Torque bolts to 40.6 N • m (30 ± 3ft-lb).



## Deck Installation (continued)

4. Install the 4 bolts (2 bolts per side) on the chain connecting the deck strut and deck. Torque bolts to 40 N • m (30 ± 3 ft-lb).



g311250

**Figure 92**

- 
5. Install the mower deck belt.
  6. Install the height adjustment pin.
  7. Remove the blocks from under the machine and lower the machine to the floor.
  8. Connect the positive battery cable first, then the negative battery cable to the battery.

## Deck Lift Assembly

### Deck Lift Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Using appropriate equipment, place supports under the machine to support the deck.
4. Remove the deck belt from the PTO clutch.
5. Loosen the lug nuts on the RH wheel only.
6. Using an appropriate lifting device, raise the rear of the machine off the floor.
7. Loosen the lug nuts on the wheel. Remove the wheel from the machine.
8. Lower the deck onto the supports.
9. Remove the 2 bolts and nuts securing the deck lift chains to the deck shell.
10. Remove the 2 bolts and nuts from the deck strut to the deck shell. Remove the deck strut from the deck shell.
11. Remove the 2 bolts and nuts securing the deck strut to the frame.
12. Remove the bolt and nut retaining the height-of-cut link to the front pivot assembly.

## Deck Lift Removal (continued)

13. Remove the bolt retaining the height-of-cut link to the rear pivot assembly.
14. Remove the height-of-cut link from the front and rear pivot assembly.
15. Remove the 3 Allen bolts and nuts from the height-of-cut stand-off assembly to the frame.
16. Remove the transmission guards from the rear pivot assembly.
17. Remove the 8 bolts and nuts securing the front and rear pivot assembly to the frame.
18. Remove the 2 deck pivot assemblies from the frame.

## Deck Lift Installation



1. Install the 2 deck pivot assemblies onto the frame. Secure the front and rear pivot assembly to the frame with 8 bolts and nuts. Torque bolts and nuts to 5 N • m (50 ± 3 in-lb).
2. Install the transmission guard to the rear pivot assembly.
3. Install the 3 Allen bolts and nuts to the height-of-cut stand-off assembly to the frame.
4. Install the height-of-cut link to the front and rear pivot assembly.
5. Install the bolt retaining the height-of-cut link to the rear pivot assembly.
6. Install the bolt and nut retaining the height-of-cut link to the front pivot assembly.



7. Install the 2 bolts and nuts securing the deck strut to the frame. Torque bolt to 40 N • m (30 ± 3 ft-lb).



8. Install the deck strut to the deck shell, secure with 2 bolts and nuts. Torque bolts and nuts to 40 N • m (30 ± 3 ft-lb).



9. Install the 4 bolts and nuts securing the deck lift chains to the deck shell. Torque bolts and nuts to 40 N • m (30 ± 3 ft-lb).

10. Raise the deck off the supports.



11. Install the wheel onto the machine. Secure with lug nuts. Torque lug nuts to 108 N • m (80 ± 10 ft-lb).
12. Using an appropriate lifting device, lower the rear of the machine onto the floor.
13. Install the deck belt to the PTO clutch.
14. Remove the supports from under the machine.
15. Connect the positive battery cable first, then the negative battery cable to the battery.





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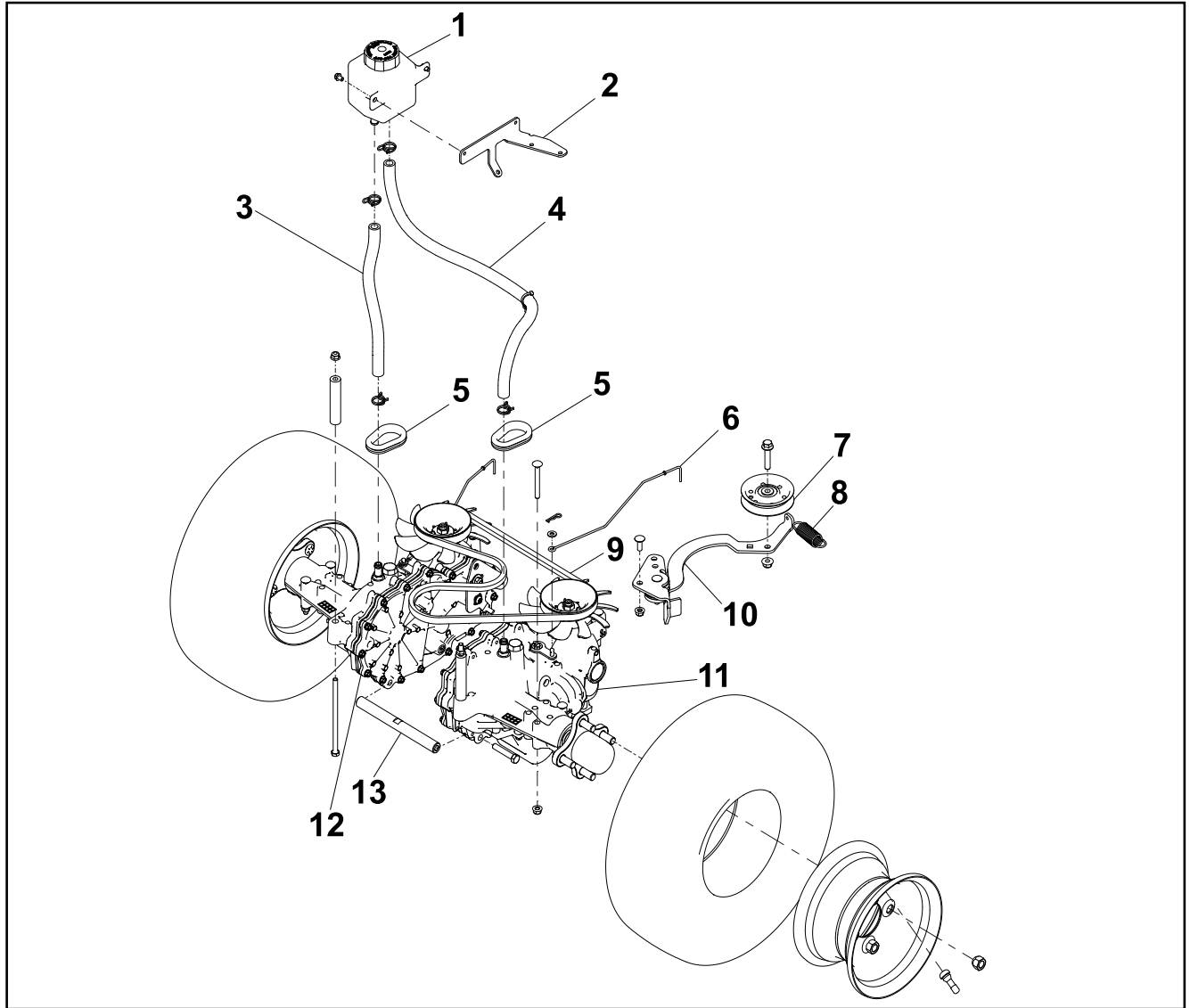
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# General Information

There is no neutral setting assembly on the hydraulic transmissions. Moving the skids guard will help gain access to the hydro filters for maintenance.

# Service and Repairs

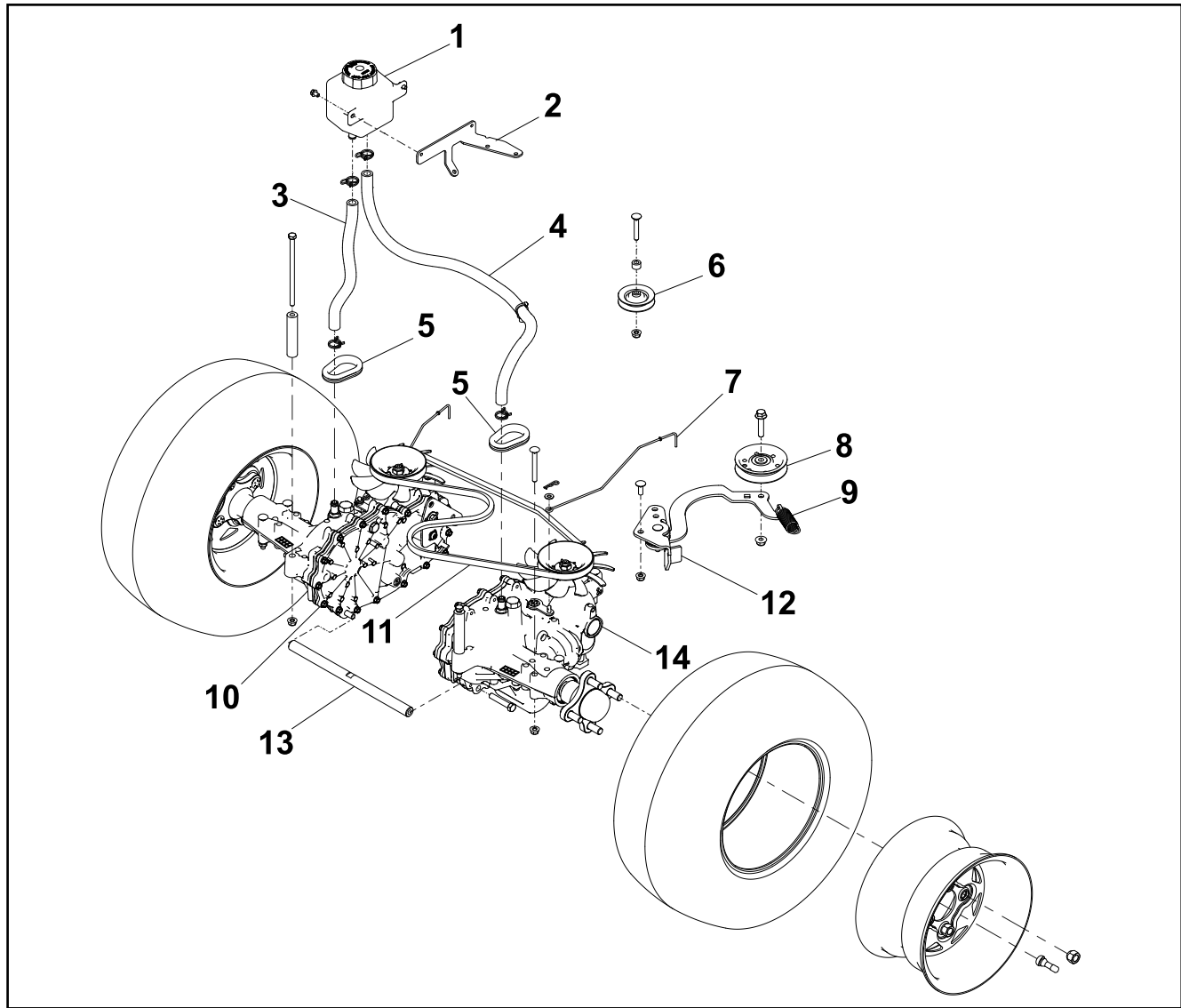
## 36 Inch Drive Asm 1



g313849

**Figure 93**

- |                           |                             |
|---------------------------|-----------------------------|
| 1. Hydraulic Tank         | 8. Extension Spring         |
| 2. Expansion Tank Bracket | 9. V-Belt                   |
| 3. Overflow Hose          | 10. Idler Arm Pivot Asm     |
| 4. Overflow Hose          | 11. LH ZT-2800 Transmission |
| 5. Rubber Grommet         | 12. RH ZT-2800 Transmission |
| 6. Bypass Rod             | 13. Hydro Cross Shaft       |
| 7. Flat Idler Pulley      |                             |



g313850

**Figure 94**

- |                           |                             |
|---------------------------|-----------------------------|
| 1. Hydraulic Tank         | 8. Flat Idler Pulley        |
| 2. Expansion Tank Bracket | 9. Extension Spring         |
| 3. Overflow Hose          | 10. RH ZT-2800 Transmission |
| 4. Hydro Hose             | 11. V-Belt                  |
| 5. Rubber Grommet         | 12. Idler Arm Asm           |
| 6. Idler Pulley           | 13. Hydro Cross Shaft       |
| 7. Bypass Rod             | 14. LH ZT-2800 Transmission |



# Transmission Replacement

## Transmission Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Remove the drive belt from the drive pulley.
4. Using appropriate lifting equipment, raise and support the rear of the machine. Loosen, then remove the 4 lug nuts on the wheel.



g312499

**Figure 95**

- 
5. Using an appropriate lifting device, raise the rear of the machine off the floor.
  6. Remove the wheel from the machine.
  7. Release the parking brake to relieve tension off the brake arm.
  8. Remove the cotter pin from the clevis pin on the brake arm.
  9. Remove the cotter pin securing the bypass arm to the transmission. Remove the bypass arm.
  10. Remove the 2 bolts securing the transmission guard to the frame. Remove the transmission guard.

## Transmission Removal (continued)



g312500

**Figure 96**

- 
11. Install a 5/6 inch nut to lock the hydro lever in neutral position.
  12. Remove the bolt and nut securing the motion control rod to the lever on the hydro. Remove the motion control rod from the lever on the hydro.
  13. Remove the drive belt from the fan pulley on the input shaft.

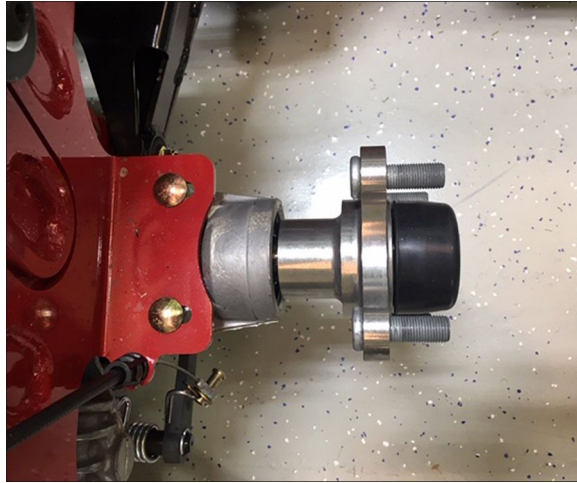


g312501

**Figure 97**

- 
14. Loosen the 4 mounting bolts securing the transmission to the frame.

## Transmission Removal (continued)



g312502

Figure 98

- 
15. Remove the bolt securing the crossmember to both transmissions.



g312503

Figure 99



### WARNING



**Heavy object, to avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing heavy objects.**

- 
16. Using an appropriate lifting device, lower the transmission a few inches. Disconnect the transmission reservoir hose from the top of the transmission. Continue lowering the transmission to the floor.

**Note:** Use a pan to catch fluid from the transmission reservoir hose when removing.



### WARNING



**Heavy object, to avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing heavy objects.**

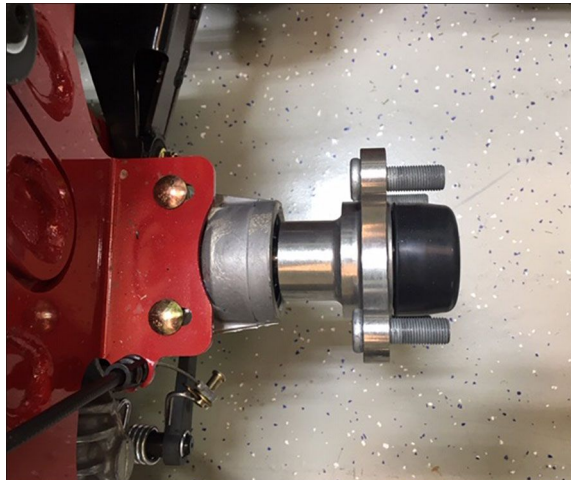
1. Using an appropriate lifting device, raise the transmission until able to connect the transmission reservoir hose to the top of the transmission. Continue to raise the transmission into position on the machine.



2. DO NOT use impact tools for bolts on the crossmember. Reapply Loctite. Install the bolt securing the crossmember to both hydros. Torque to 61 N • m (43 ± 5 ft-lb).

**Note:** If installing one or both transmissions simultaneously use the following hydro tightening sequence:

- Cross shaft between the transmissions
  - Rear mounting nut
  - Axle horn nuts
  - Front Mounting nut
3. Tighten the 4 mounting bolts securing the transmission to the frame.



g312502

**Figure 100**

4. Install the drive belt to the fan pulley on the input shaft.

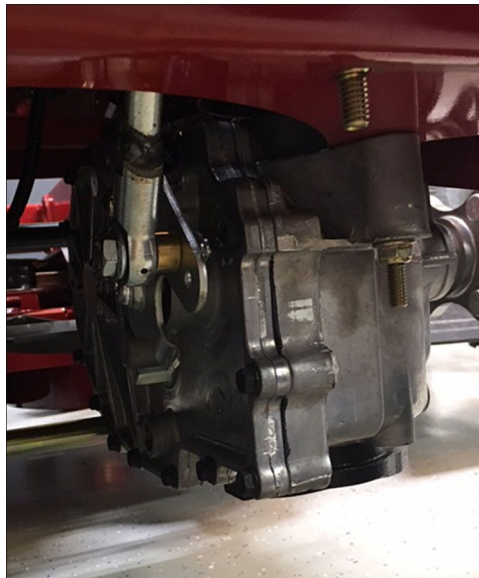
## Transmission Installation (continued)



g312501

**Figure 101**

- 
5. Install the motion control rod to the lever on the hydro. Install the bolt and nut securing the motion control rod to the lever on the hydro.



g312506

**Figure 102**

- 
6. Install the bypass arm. Install the cotter pin securing the bypass arm to the transmission.
  7. Install the transmission guard to the control tower. Install the 2 bolts securing the transmission guard to the control tower.



## Transmission Installation (continued)



g312500

**Figure 103**

8. Install the cotter pin to the clevis pin on the brake arm.
9. Set the parking brake to add tension to the brake arm.
10. Install the wheel onto the machine.
11. Using an appropriate lifting device, lower the rear of the machine onto the floor.



12. Tighten the lug nuts on the wheel. Torque lug nuts to 108 N • m (80 ± 10 ft-lb).



g312499

**Figure 104**

13. Install the drive belt to the drive pulley.
14. Connect the positive battery cable first, then the negative battery cable to the battery.

# Hydrostatic Drive Belt Replacement

## Hydrostatic Drive Belt Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Remove the PTO belt from the PTO clutch.
3. Remove the PTO clutch from the crankshaft.
4. Insert a 3/8 inch ratchet with the extension in the square hole in the tensioner idler arm. Rotate to release tension.
5. Remove the hydrostatic drive belt.

## Hydrostatic Drive Belt Installation

1. Install the hydrostatic drive belt onto the machine.
2. Insert a 3/8 inch ratchet with the extension in the square hole in the tensioner idler arm. Rotate to release tension.
3. Install the PTO clutch to the crankshaft.
4. Install the PTO belt to the PTO clutch.

# Wheel and Tire Assembly Replacement

## Wheel and Tire Assembly Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Loosen the lug nuts on the wheel.



g312499

**Figure 105**

3. Using an appropriate lifting device, raise the rear of the machine off the floor.
4. Remove the wheel from the machine.

## Wheel and Tire Assembly Installation

1. Place the wheel into position on the machine.
2. Using an appropriate lifting device, lower the rear of the machine to the floor.

## Wheel and Tire Assembly Installation (continued)



3. Tighten the lug nuts on the wheel. Torque lug nuts to 108 N • m (80 ± 10 ft-lb).

## Transmission Oil Filter Replacement

### Transmission Oil Filter Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Loosen the lug nuts on the wheel.



g312499

**Figure 106**

3. Using an appropriate lifting device, raise the rear of the machine off the floor.
4. Remove the wheel from the machine.
5. Remove the 2 bolts securing the transmission guard to the machine.



g312500

**Figure 107**



## Transmission Oil Filter Removal (continued)

6. Remove the 2 bolts securing the guard to the transmission oil filter.
7. Drain all fluid from the machine.
8. Remove the transmission oil filter from the machine.

## Transmission Oil Filter Installation

1. Install the new transmission oil filter onto the machine.
2. Add fluid to the machine.
3. Install the 2 bolts securing the guard to the transmission oil filter. Torque the bolts to 11.3–14.7 N • m (100–130 in-lb).
4. Install the 2 bolts securing the transmission guard to the machine.



g312500

**Figure 108**

- 
5. Install the wheel onto the machine.
  6. Install the wheel onto the machine.



## Transmission Oil Filter Installation (continued)

7. Tighten the lug nuts on the wheel. Torque to 108 N • m (80 ± 10 ft-lb).



g312499

Figure 109

---

## Setting the Neutral Position

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Lift the rear tires off the ground.
3. Loosen the nut securing the control rod to the motion control.
4. With the engine running at full throttle, find the neutral position on the transmission by moving the lower control rod up or down (this will rotate the transmission lever) until the tire stops rotating.
5. Tighten the nut in step 3. While tightening the nut, the control rod may move and neutral will be lost. If this happens, you will have to re-adjust.
6. Tracking may also need to be adjusted after setting neutral. Rotate the screws to speed up one side or slow down the other slightly.

## Tracking Adjustment

Neutral adjustment needs to be done before tracking adjustment.

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Start the machine with the rear wheels raised off the ground to make sure neutral is set. Wheels should not rotate with the brake off. If wheels rotate, see steps for setting the neutral.
3. Move the adjustable reference bar to fastest setting.
4. **Set the machine speed and tracking:** with the engine at full throttle, push the handles forward and measure axle rpm. Rubber axle cap can be removed to use a touch tachometer at the center of the axle. Should read 130 ± 3 rpm. Rotate speed and tracking adjustment screws to increase and decrease speed.
5. **Alternate method:** Adjust the speed and tracking screws until the machine drives in a straight line.



# Electrical System

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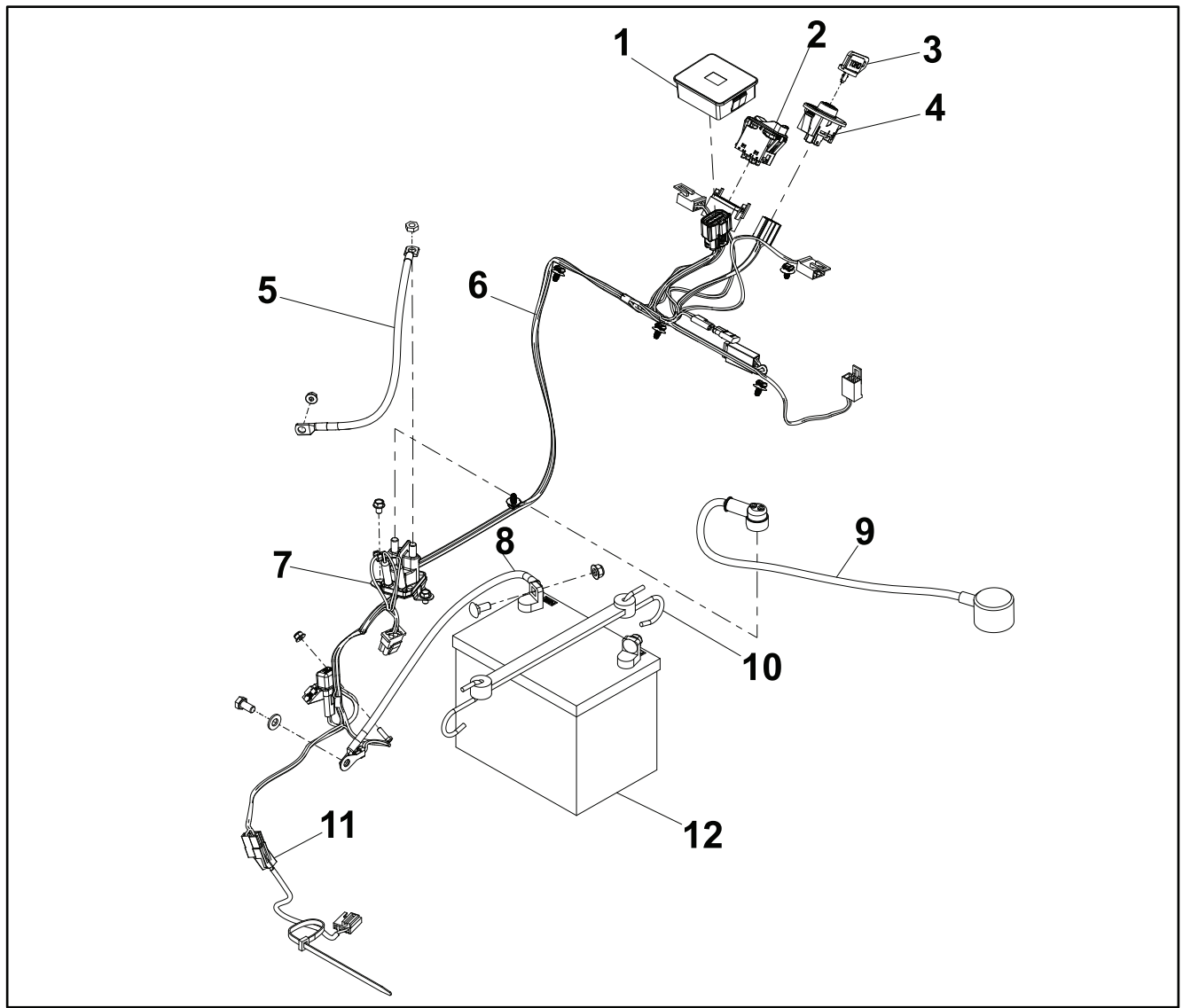
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# General Information

The hour meter is programmed with an automatic shut-off. If the machine is parked with the engine running and the brake off, the machine will shut off within 5 seconds. The parking brake should be set anytime the operator leaves the machine. Engaging the brake will allow the machine to start again.

# Service and Repairs

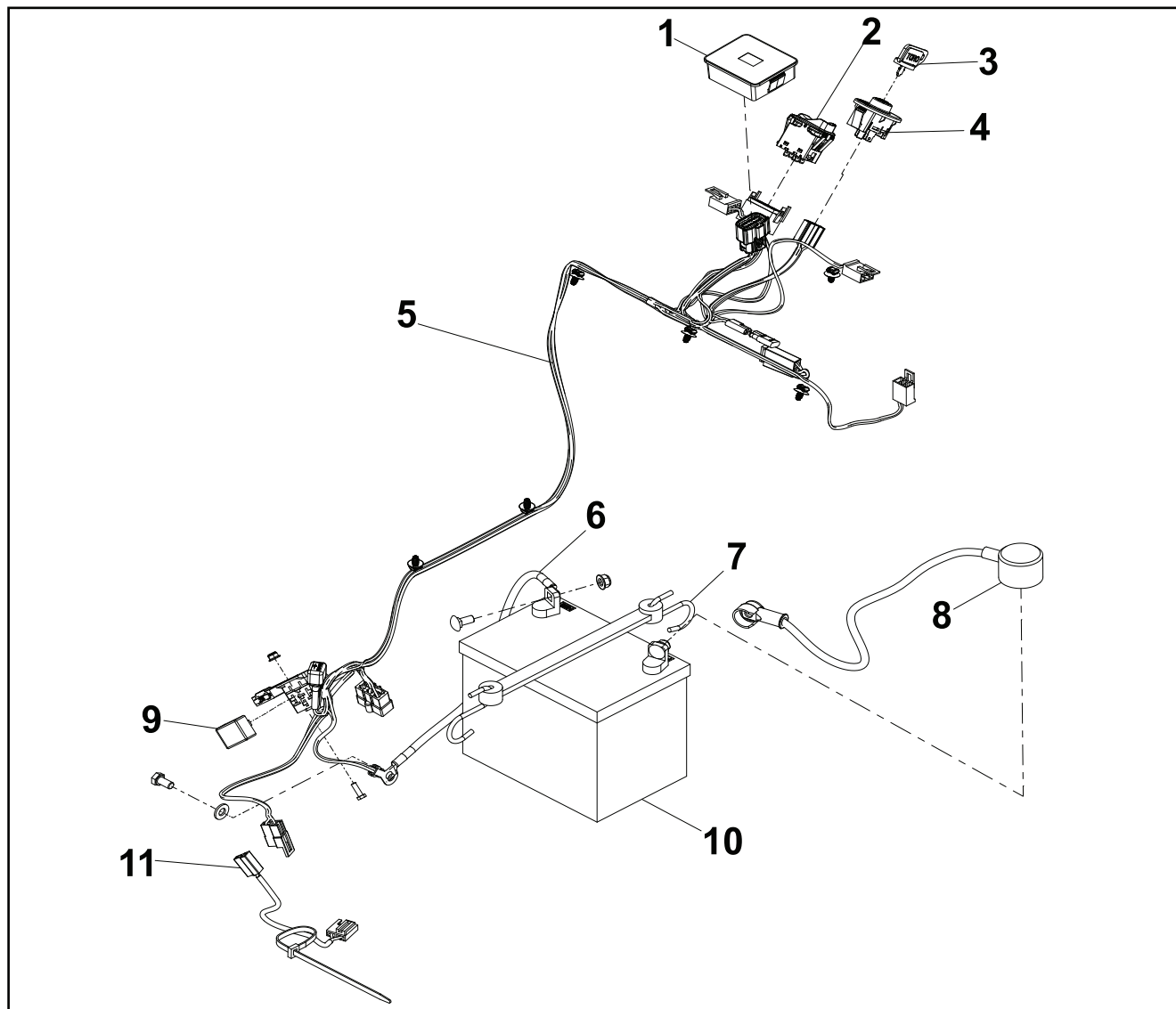
Electrical Asm 1 (36, 48, 54, and 60 Inch)



g312496

**Figure 110**

- |                           |                            |
|---------------------------|----------------------------|
| 1. Hour Meter Module      | 7. Solenoid                |
| 2. On-Off Rocker Switch   | 8. Negative Battery Cable  |
| 3. Ignition Key           | 9. Positive Battery Cable  |
| 4. Ignition Switch        | 10. Battery Hold Down      |
| 5. Positive Battery Cable | 11. Pigtail Clutch Harness |
| 6. Wire Harness           | 12. Battery                |



g312497

Figure 111

- |                           |                            |
|---------------------------|----------------------------|
| 1. Hour Meter Module      | 7. Battery Hold-Down       |
| 2. On-Off Rocker Switch   | 8. Positive Battery Cable  |
| 3. Ignition Key           | 9. Relay                   |
| 4. Ignition Switch        | 10. Battery                |
| 5. Wire Harness           | 11. Pigtail Clutch Harness |
| 6. Negative Battery Cable |                            |

# Battery Replacement

## Battery Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Unhook the bungee cord from the tab on the back of the tower.



### WARNING



**When removing or installing the battery, do not allow the battery terminals to touch any metal parts of the machine. Do not allow metal tools to short between the battery terminals and metal parts of the machine.**

4. Slide the battery outward and away from the machine.

## Battery Installation



### WARNING



**When removing or installing the battery, do not allow the battery terminals to touch any metal parts of the machine. Do not allow metal tools to short between the battery terminals and metal parts of the machine.**

1. Slide the battery into position on the machine.
2. Hook the bungee cord to the tab on the back of the tower.
3. Connect the positive battery cable first, then the negative battery cable to the battery.

## Battery Test

1. Connect your DVM to the battery, black lead to the negative post, red lead to the positive post of the battery.
2. Power up the DVM and set up measurements for DC voltage.
3. Turn the ignition switch to the "ON" position. Record the voltage reading.
4. Start the machine and let it run for 5 seconds or less. Battery voltage should read between 13.6 to 14.8 volts. Shut off the machine.
5. Push the min/max button on the DVM. Minimum voltage during cranking should be no less than 9.6 VDC (Volts Direct Current). If voltage is less than 9.6 VDC, charge the battery at 2 amps for a minimum of 4 hours. Repeat steps 1-3.
6. If minimum battery voltage is still below 9.6 VDC during cranking, replace the battery.

# Hour Meter Replacement

## Hour Meter Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.

## Hour Meter Removal (continued)

2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Disconnect the main wire harness from the hour meter.



g312507

**Figure 112**

- 
4. Press the tabs on the hour meter inward.
  5. Remove the hour meter.



g312508

**Figure 113**

---

## Hour Meter Installation

1. Place the hour meter onto the machine.
2. Connect the main wire harness to the hour meter.



## Hour Meter Installation (continued)



g312507

**Figure 114**

- 
3. Connect the positive battery cable first, then the negative battery cable to the battery.

## Ignition Switch Replacement

### Ignition Switch Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Disconnect the main wire harness from the ignition switch.



g312529

**Figure 115**

- 
4. Press the tabs on the ignition switch inward.

## Ignition Switch Removal (continued)

5. Remove the ignition switch from the control tower.



g312530

**Figure 116**

---

## Ignition Switch Test

1. Remove the ignition switch from the control tower.
2. Using a digital multi-meter set to the OHM or continuity setting, verify that continuity exists between the terminals listed for each switch position.
3. Using a digital multi-meter set to the OHM or continuity setting, verify that no continuity exists between the terminals not listed for each switch position.

Position	Circuit "Make"
OFF	None
RUN	B + R + I + A
START	B + R + I + S

## Ignition Switch Installation

1. Place the ignition switch into position on the control tower.

## Ignition Switch Installation (continued)



g312530

**Figure 117**

- 
2. Connect the main wire harness to the ignition switch.



g312529

**Figure 118**

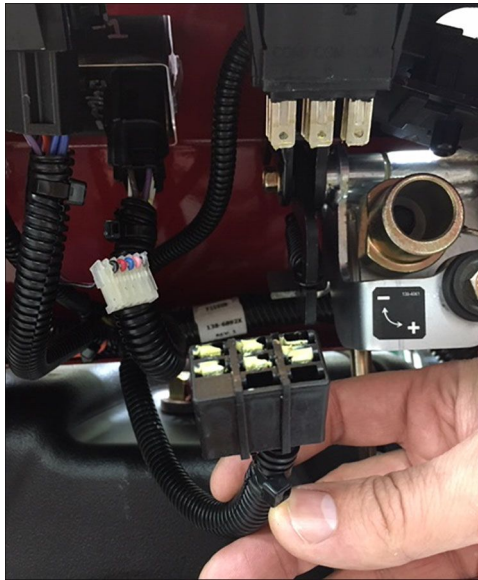
- 
3. Connect the positive battery cable first, then the negative battery cable to the battery.

## PTO Switch Replacement

### PTO Switch Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Disconnect the main wire harness from the PTO switch.

## PTO Switch Removal (continued)

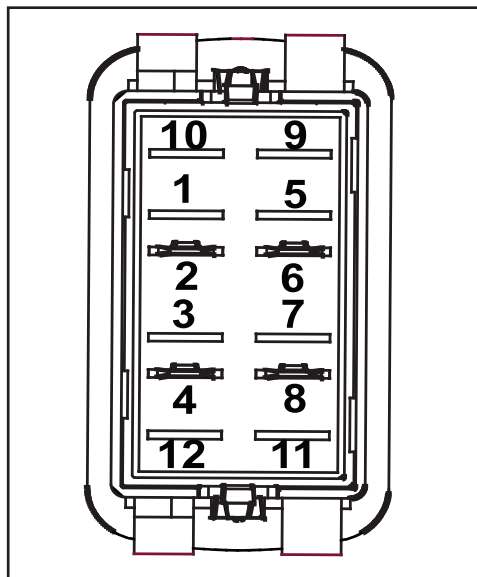


g312562

Figure 119

- 
4. Press the tabs on the PTO switch inward.

## PTO Switch Test



g318278

Figure 120

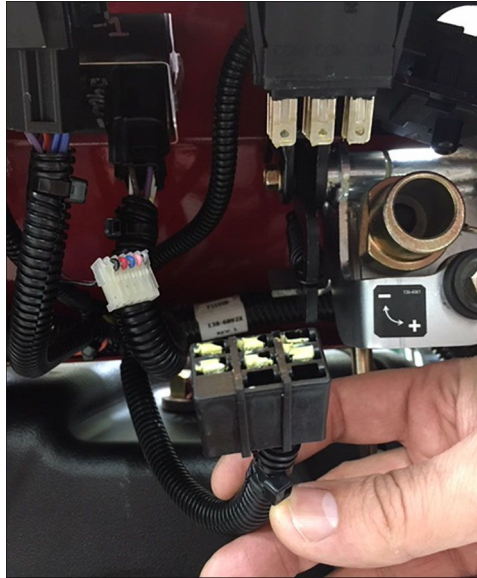
- 
1. Remove the PTO switch from the control tower. [PTO Switch Replacement \(page 9–9\)](#)
  2. Using a digital multi-meter set to the OHM or continuity setting, verify the following:
    - A. With the switch in the OFF position
      - Pins 2–4 should NOT have continuity (open)
      - Pins 7–8 should NOT have continuity (open)
    - B. With the switch in the ON position

## PTO Switch Test (continued)

- Pins 2–4 should have continuity (closed)
  - Pins 7–8 should NOT have continuity (open)
- C. With the switch in the ON momentary position
- Pins 2–4 should have continuity (closed)
  - Pins 7–8 should have continuity (closed)

## PTO Switch Installation

1. Place the PTO switch into position on the control tower.
2. Connect the main wire harness to the PTO switch.



g312562

**Figure 121**

3. Connect the positive battery cable first, then the negative battery cable to the battery.

## PTO Clutch Replacement

### PTO Clutch Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Remove the spring from the deck idler.
4. Remove the deck belt from the PTO.
5. Disconnect the PTO clutch from the wiring harness.
6. Remove the bolt securing the PTO clutch to the machine. Remove the PTO clutch.

### Coil Resistance Measurement Test

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the clutch wire connector.

## Coil Resistance Measurement Test (continued)

3. Set the multi-meter to measure resistance (OHMs setting).
4. Connect the meter lead wires to the terminals in the clutch connector.
5. See the PTO Clutch Electrical Specifications chart.

Resistance (OHMs)	Amp Draw	Continuity to Ground
3.05 ± 5%	3.93	Open

## PTO Clutch Continuity to Ground Check

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the clutch wire connector.
3. Set the multi-meter to measure resistance (OHM setting).
4. Connect one multi-meter lead to the engine, chassis or battery ground. Connect the other multi-meter lead to each of the clutch connector terminals.
5. The 2 clutch connector terminals should never have continuity to ground and should OPEN at all times.
6. If continuity is found between the PTO connector and ground, the PTO clutch and the PTO switch must be replaced.

## Measure Clutch Current Draw

Do not measure current draw if the clutch has shorted to ground or if the resistance measurement is out of specification.

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the clutch wire connector.
3. Set the multi-meter to measure amps (10 amp scale).
4. Connect the positive meter lead to the chassis harness terminal A.
5. Connect the negative meter lead to the corresponding wire terminal B.
6. Connect a short jumper lead from terminal C to terminal D.
7. Turn the ignition switch to the "RUN" position and the PTO clutch to the "ON" position.
8. Record the amp reading and refer to the PTO Clutch Electrical Specification Chart.

### PTO Clutch Electrical Specification Chart

Resistance (OHMs)	Amp Draw	Continuity to Ground
3.05 ± 5%	3.93	Open

## PTO Clutch Installation



1. Install the PTO clutch to the machine, secure with bolt. Torque bolt to 74 N • m (55 ± 5 ft-lb).
2. Connect the PTO clutch to the wiring harness.
3. Install the deck belt to the PTO.
4. Install the spring to the deck idler.
5. Connect the positive battery cable first, then the negative battery cable to the battery.

# Solenoid Replacement

## Solenoid Removal

1. Park the machine on a level surface and set the parking brake. Stop the engine, wait for all moving parts to stop and remove the key.
2. Disconnect the battery by removing the negative battery cable first, then the positive cable from the battery.
3. Disconnect the negative and positive terminals from the starter solenoid.
4. Disconnect the engine wire harness to the starter solenoid.
5. Remove the 2 screws securing the starter solenoid to frame.

## Solenoid Test

1. Disconnect the solenoid from the wiring harness.
2. With a multi-meter set to the Ohm or continuity setting, check to ensure that terminals C and D are open (no continuity).
3. Apply 12 volts to terminal A and ground terminal B. Terminals C and D should now be closed (continuity).

## Solenoid Installation



1. Install the 2 screws securing the starter solenoid to the frame. Torque screws to 6 N • m (53 ± 7 in-lb).
2. Connect the engine wire harness to the starter solenoid.
3. Connect the negative and positive terminals from the starter solenoid.
4. Connect the positive battery cable first, then the negative battery cable to the battery.







# Foldout Drawings

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# Electrical Drawing Abbreviations

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

Abbreviation	Color
BK	Black
BR or BM	Brown
BU	Blue
GN	Green
GY	Gray
OR	Orange
PK	Pink
R or RD	Red
T	Tan
VIO	Violet
W or WH	White
Y or YE	Yellow

Numerous harness wires include a line with an alternate color. These wires are identified with the wire color followed by a / or \_ and then the line color (e.g, R/BK is a red wire with a black line; OR\_BK is an orange wire with a black line).

**Note:** The electrical harness drawings in this chapter identify both the wire color and the wire gauge. For example, 16 BK on a harness diagram identifies a 16 gauge wire with black insulation.

**Note:** A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g., SP01 is splice number 1).

Electrical Schematic

