

P-REX:

Pioneer Remover/Extractor

General Service Manual



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WARNING

The engine exhaust from this product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.

NOTICE OF REQUIREMENT OF SPARK ARRESTER MUFFLER

This equipment may create sparks that can start fires around dry vegetation. California Public Resources Code Section 4442.6 provides that it is unlawful to use or operate an internal combustion engine on any forest-covered, brush-covered, or grass-covered land unless the engine is equipped with a spark arrester maintained in effective working order. A spark arrester is a device constructed of nonflammable materials specifically for the purpose of removing and retaining carbon and other flammable particles over 0.0232 of an inch in size from the exhaust flow of an internal combustion engine that uses hydrocarbon fuels or which is qualified and rated by the United States Forest Service. Other states or federal areas may have similar laws. The Operator Should Contact Local Fire Agencies For Laws or Regulations Relating to Fire Prevention Requirements. **THIS EQUIPMENT DOES NOT HAVE A SPARK ARRESTER AND YOU SHOULD CONTACT YOUR AUTHORIZED DEALER FOR THE PURCHASE OF A SPARK ARRESTER.**

Inspect spark arrester daily; replace every 500 hours or as needed.

The Engine Owner's Manual provides information regarding the U.S. Environmental Protection Agency (EPA) and the California Emission Control Regulation of emission systems, maintenance and warranty.

Keep Engine Owner's Manual with your unit. Should the Engine Owner's Manual become damaged or illegible, replace immediately. Replacements may be ordered per the information found in the Product Information section of the owner's manual.

Federal law and California State law prohibit the following acts or the causing thereof:

- 1. The removal or rendering inoperative by any person other than for purposes of maintenance, repair, replacement, of any device or element of design incorporated into any equipment for the purposes of emissions control prior to or after its sales or delivery to the ultimate purchaser or while it is in use, or**
- 2. The use of the equipment after such device or element of design has been removed or rendered inoperative by any person.**

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GENERAL INFORMATION

Service Program

This manual is part of a service package for the P-Rex. Use of this manual in conjunction with other component manuals will provide the information necessary for service and maintenance.

This manual is to assist owners in the operation and maintenance of the Pioneer P-REX extractor. Please review this portion of your manual for correct operation of the unit before you begin. The Pioneer P-REX uses a Hustler Super HD as a base drive unit on which a complete vacuum system, a low-pressure water and Blitz spray system, and a hydraulic brush system have been added to extract paint from synthetic turf. These portions of the unit are unique to the P-REX. Please follow the recommendations for routine maintenance and procedures that apply to the central unit. It's important that you read and understand the Operator's Manual before using the P-REX.

This General Service Manual is a service guide for use by Service Technicians. It provides the necessary information needed to perform normal maintenance requirements on these units.

The Parts Manual provides a complete parts listing for the base unit. Use this manual when ordering parts.

The Operator's Manual provides fundamental operational information and operational safety that is needed when operating the P-Rex.

The component manuals are furnished by the various manufacturers to be used for the troubleshooting and servicing of their components.

Information included in this manual was current at the time of printing, but subsequent production changes may cause your machine to vary slightly in detail. Pioneer reserves the right to redesign and change the machine as deemed necessary, without notification. If a change has been made to your machine which is not reflected in this service manual contact the Customer Service Department at Pioneer for additional information.

Warranty

Warranty repair must be approved by Pioneer before warranty credit can be allowed.

SAFETY



This safety alert symbol is used to call attention to a message intended to provide a reasonable degree of **PERSONAL SAFETY** for operators and other persons during the normal operation and servicing of this equipment.



– denotes immediate hazards which **WILL** result in severe personal injury or death.



– denotes a hazard or unsafe practice which **COULD** result in severe personal injury or death.

Safe Servicing Practices

Refer to the Safety Precautions section of this manual for more service safety information.

Understand Correct Service

- Be sure you understand a service procedure before you work on the machine.
- Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.
- If it is necessary to make checks with the engine running, always use two people - with the operator at the controls, able to see the person doing the checking.

Pre-Operation Precautions

Fuel Handling

- To avoid personal injury or property damage, use extreme care when handling gasoline. Gasoline is extremely flammable and the vapors are explosive.

- A fire or explosion from gasoline can burn you and others and can damage property.
- Observe the usual gasoline handling precautions:
- Do not smoke while refueling. Extinguish all cigarettes, cigars, pipes and other sources of ignition.
- Do not remove fuel cap or fill tank with engine running or while engine is hot. Clean up any gasoline spills.
- If gasoline is spilled, do not attempt to start the engine but move the machine away from the area of spillage and avoid creating any source of ignition until gasoline vapors have dissipated.
- Keep gasoline away from open flame or spark and store machine away from open flame or spark or pilot light such as on a water heater or appliances.
- Refuel outdoors. Never refuel or drain the gasoline from the machine indoors, or while in an enclosed trailer or other enclosed area.
- Never attempt to start the engine when there is a strong odor of gasoline fumes present. Locate and correct the cause.
- Store gasoline in an approved container and keep it out of the reach of children. Never buy more than a 30-day supply of gasoline.
- Do not fill fuel containers inside a vehicle or on a truck or trailer bed with interior carpets or plastic truck bed liners. Always place gasoline containers on the ground away from your vehicle before filling.
- When practical, remove the machine from the truck or trailer and refuel the machine with its wheels on the ground. If this is not possible, then refuel such machine on the truck or trailer using a portable container and not a fuel dispenser nozzle. If a fuel dispenser nozzle must be used, keep the nozzle in contact with the rim of the fuel tank or container opening at all times until fueling is complete. Do not use a nozzle lock-open device.
- Never use gasoline for cleaning parts.
- Read and observe safety precautions elsewhere in this manual.
- Gasoline is harmful or fatal if swallowed.
- Avoid prolonged breathing of vapors.
- Long-term exposure to vapors can cause serious injury and illness.
- Keep gasoline away from eyes and skin.

- Keep face away from nozzle and fuel tank or fuel container opening.
- If gasoline is spilled on clothing, change clothing immediately.

Understand Machine Operation

- Only qualified and trained personnel should operate the equipment.
- Carefully read the operator's manual and all manuals furnished with the attachments. Learn the location and purpose of all controls, instruments, indicators and labels.

Wear Protective Clothing

- Do not operate or service the equipment while wearing sandals, tennis shoes, sneakers, shorts or any type of loose-fitting clothing. Long hair, loose clothing or jewelry may get tangled in moving parts.
- Always wear long pants, safety glasses, ear protection and safety shoes when operating or servicing this machine.
- Always wear adequate eye protection when servicing the hydraulic system, battery and removing accumulated debris.
- Prolonged exposure to loud noise can cause impairment or loss of hearing.
- Always wear adequate ear protection, such as earplugs, when operating this equipment as prolonged exposure to uncomfortable or loud noises can cause impairment or loss of hearing.
- Do not wear radios or music headphones while operating the machinery. Safe operation requires your full attention.

Operation Precautions

Avoid Fire Hazards

- Clean flammable material from machine. Prevent fires by keeping engine compartment, exhaust area, battery, hydraulic lines, fuel line, fuel tank and operator's station clean of accumulated debris. Always clean up spilled fuel and oil.

Start Engine Safely

- Avoid possible injury or death from machine runaway.
- Do not start engine by shorting across starter terminals.

- Before you start the engine:
- Sit on the operator's seat.
- Move control levers to the neutral/brake position.

Operate Machine Safely

- Refer to the unit's operator's manual for complete safety information on safe machine operation.
- Always maintain a safe distance from people and pets when operating
- Always be aware of what is behind the machine before backing up.
- Never leave machine unattended with ignition key in switch, especially with children present.
- Follow daily and weekly checklists, making sure hoses are tightly secured and bolts are tightened.
- Always keep engine and machine clean, removing accumulated dirt, trash and other material from machine.
- Never put hands or feet under any part of the machine while it is running.
- Never attempt to start engine when there is a strong odor of gasoline fumes present. Locate and correct cause.
- Keep all safety shields and covers in place, except for servicing.
- Do not touch hot parts of machine.

Maintenance Introduction

Regular maintenance is the best prevention for downtime or premature failure. The following pages contain suggested maintenance information and schedules which the operator/ mechanic should follow on a routine basis.

Remain alert for unusual noises, they could be signaling a problem. Visually inspect the machine for any abnormal wear or damage. A good time to detect potential problems is while performing scheduled maintenance service. Correcting the problem as quickly as possible is the best insurance.

Clear away heavy build-up of grease, oil and dirt, especially in the engine compartment and under the seat platform areas; minute dust particles are abrasive to close-tolerance engine and hydraulic assemblies.

Daily inspect accumulated debris. To do this it will be necessary to raise, using jack stands or blocks. Some repairs require the assistance of a trained service mechanic and should not be attempted by unskilled personnel.

General Maintenance Precautions

- Repairs or maintenance requiring engine power should be performed by trained maintenance personnel only.
- Never run the engine in an enclosed area unless exhaust is vented to the outside. Exhaust gases contain carbon monoxide which is an odorless and deadly poison.
- Unless specifically required, DO NOT have the engine running when servicing or making adjustments to the unit.
- Park the unit on level ground
- Disengage the brush clutch.
- Place the steering control levers in the park brake position.
- Stop the engine.
- Remove the ignition key.
- Disconnect the negative battery cable.
- Wait for all movement to stop before adjusting, cleaning or repairing.
- Repairs or maintenance requiring engine power should be performed by trained maintenance personnel only.
- To prevent carbon monoxide poisoning, operate the engine in a well-ventilated area only.
- Read and observe all safety warnings in this manual.
- Before working on or under the machine, make certain engine cannot be accidentally started. Shut engine off, remove ignition switch key and disconnect negative battery cable for maximum safety.
- Except when changing or checking belt, always keep belt covers in place for safety as well as cleanliness.
- Use a stick or similar instrument to clean under the machine making sure that no part of the body, especially arms and hands are under the machine.
- Keep your machine clean and remove any debris which can cause engine fires and hydraulic overheating as well as excessive belt wear. Clean up oil or fuel spillage.
- Allow the unit, especially the engine, to cool in a well-ventilated area before storing inside a building or other enclosure.
- Always wear adequate eye protection when servicing the hydraulic system, battery and removing accumulated debris.
- Never attempt to make any adjustments or repairs to the drive system while the engine is running or brush clutch is engaged.

- Exercise caution when releasing spring tension from any of the belt idlers or when working with any of the deck lift components.
- Never work under the machine or attachment unless it is safely supported with jack stands. Make certain machine is secure when it is raised and placed on the jack stands. The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating. Use only certified jack stands. Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up. Use in pairs only. Follow the instructions supplied with the vehicle stands.
- Keep nuts and bolts tight. Keep equipment in good working condition.
- Never tamper with safety devices. Check their proper operation regularly.
- Use original replacement parts or parts that are equivalent in overall performance.

Maintenance Precautions

Avoid Fire Hazards

- Be prepared if an accident or fire should occur. Know where the first aid kit and the fire extinguishers are located and how to use them.
- Provide adequate ventilation when charging batteries.
- Do not smoke near battery.
- Never check fuel level with an open flame.
- Never use an open flame to look for leaks anywhere on the equipment.
- Never use an open flame as light anywhere on or around the equipment.
- When preparing engine for storage, remember that fuel stabilizer is volatile and therefore dangerous. Seal and tape openings after adding the inhibitor. Keep container tightly closed when not in use.
- Inspect electrical wiring for worn or frayed insulation. Install new wiring if wires are damaged.

Prepare for Emergencies

- Be prepared if a fire starts.
- Keep a first aid kit and fire extinguishers available.
- Keep emergency numbers for doctor, ambulance service, hospital, and fire department near the telephone.

Prevent Battery Explosions

- Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.
- Charge batteries in a well-ventilated open area, away from sparks and flames. Unplug charger before connecting or disconnecting from battery. Wear protective clothing and use insulated tools.
- Avoid skin and clothing contact with battery acid.
- Always wear eye protection when checking the battery. Acid can cause serious injury to skin and eyes. If contact occurs, flush area with clean water and call a physician immediately. Acid will also damage clothing.
- Do not drink the battery electrolyte.
- Do not allow open flame near the battery when charging.
- Hydrogen gas forms inside the battery. This gas is both toxic and flammable and may cause an explosion if exposed to flame. Always disconnect the negative (black) battery cable(s) before disconnecting the positive (red) cable(s). Always connect the positive (red) battery cable(s) before connecting the negative (black) cable(s).
- Do not overfill the battery.
- Electrolyte may overflow and damage paint, wiring or structure. When cleaning the battery, use soap and water. Be careful not to get soap and water into the battery. Clean the battery terminals with a solution of four parts water and one part baking soda when they become corroded.
- Shorts caused by battery terminals or metal tools touching metal components can cause sparks. Sparks can cause a battery gas explosion which will result in personal injury.

- Prevent the battery terminals from touching any metal parts when removing or installing the battery.
- Do not allow metal tools to short between the battery terminals and metal parts.
- Incorrect battery cable routing could cause damage to the machine and battery cables. This can cause sparks which can cause a battery gas explosion which will result in personal injury.
- Always disconnect the negative (black) battery cable(s) before disconnecting the positive (red) cable(s).
- Always connect the positive (red) battery cable(s) before connecting the negative (black) cable(s).

Avoid Acid Burns

- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing and cause blindness if splashed in eyes.

Avoid the hazard by:

- Filling batteries in a well-ventilated area.
 - Wearing eye protection and rubber gloves.
 - Avoiding breathing fumes when electrolyte is added.
 - Avoiding spilling or contacting dripped electrolyte.
- If you spill acid on yourself:
- Flush your skin with water.
 - Apply baking soda or lime to help neutralize the acid.
 - Flush your eyes with water for 10–15 minutes. Get medical attention immediately.

If acid is swallowed:

- Drink large amounts of water or milk.
- Then drink milk of magnesia, beaten eggs or vegetable oil.
- Get medical attention immediately.

TORQUE

Standard Torques

The following chart lists the standard torque values for the threaded fasteners found in this manual. Torque all cap screws, nuts and set screws to these values unless a different torque is shown in the Special Torques section.

Size	ft-lbs	N•m	Size	ft-lbs	N•m
#10	32.4 IN.-LBS.	3.6	M3	12 IN.-LBS.	1.3
.250	98.4 IN.-LBS.	11.1	M4	26.4 IN.-LBS.	3
.312	204 IN.-LBS.	23	M5	54 IN.-LBS.	6.1
.375	30	40	M6	92.4 IN.-LBS.	10.4
.438	48	65	M8	222 IN.-LBS.	25
.500	73	99	M10	37	50
.562	105	143	M12	64	87
.625	145	200	M14	103	140
.750	260	350	M16	160	215
.875	420	565	M20	320	435

Special Torques

Description	ft-lbs	N•m
Wheel (lug) nuts ¹	70	95
Blade spindle bolt top	70	95
Blade spindle bolt bottom	118	160
Electric clutch mounting bolt ³	47	63
Front wheel axle bolt	100	136
Wheel motor hub nut	230	312
Hydraulic pump pulley screw	14	19
Engine torques ²	N/A	N/A

NOTE:

- Lug nuts only** – It is recommended that these be checked after the first 2 hours of operation and every 50 hours and following removal for repair or replacement.
- Engine torque values** – Refer to the respective engine owner's manual.
- If the clutch mounting bolt is loosened or removed, **do not re-use**. Replace with a new bolt. Use only hand tools to install this fastener.



Particular attention must be given to tightening the drive wheel lug nuts. Failure to correctly torque these nuts may result in the loss of a wheel, which can cause serious damage or personal injury.

POWER UNIT MAINTENANCE

Steering Adjustments

Steering Control Lever Neutral Adjustment

The unit's steering has been adjusted to eliminate creeping when the steering control levers are in the neutral position. However, should the unit begin to creep, the steering control lever linkage can be adjusted.

Before considering any adjustment, check the tire air pressure. Unequal tire pressure will cause the unit to drift to one side. Refer to tire pressure information in the Tires section for detailed information.

NOTE: Proper parking brake adjustment must be completed before the steering control lever neutral adjustment can be done. Refer to the Park Brake Spring Adjustment section for detailed information. Fine adjustment to the unit's steering is made with the transmission's control rod.

Neutral is properly adjusted when the steering control levers are in the park brake position and the transmissions do not "whine".

If this occurs, the steering control linkage may be adjusted as follows:



Never work under the machine or attachment unless it is safely supported with jack stands.

- Make certain machine is secure when it is raised and placed on the jack stands.
- Use only certified jack stands. Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
- Use in pairs only.
- Follow the instructions supplied with the jack stands.
- The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
- Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself.
- To prevent injury, stay clear and exercise caution when rotating the wheels.



Untrained maintenance personnel should never attempt to make any adjustments or repairs to the drive system while the engine is running. **The following procedures should be performed by trained maintenance personnel only.**

1. Raise the rear of the unit and block with certified jack stands. The rear wheels need to be able to rotate freely and clear of all obstructions.
 2. Chock the front tires.
 3. Raise the seat platform and disconnect the harness from the seat switch harness. Bypass the seat switch by connecting the two (2) harness female spades together. [Figure 1]
 4. Start the engine.
 5. Position the steering control lever in the neutral position and observe which way the wheels are rotating. [Figure 2]
 6. If wheel(s) are rotating forward, loosen the jam nuts on the pump linkage rods and rotate the rod to lengthen the steering control linkage until the wheel(s) come to a stop. [Figure 3]
 7. Repeat for the opposite side if necessary.
 8. If wheel(s) are rotating in reverse then loosen the jam nuts on the pump linkage rods and rotate the rod to shorten the steering control linkage until the wheel(s) come to a stop. [Figure 3]
- Repeat for the opposite side if necessary
9. When both wheels remain in neutral, tighten the jam nuts to lock the turnbuckle in place.
 10. Test again by moving the steering control levers forward and backward before returning them to the neutral position. If the tires are in neutral, the unit is now ready for operation.
 11. After adjusting for neutral it may be necessary to re-adjust the control lever stop and/or damper.
 12. **IMPORTANT:** With the engine off, disconnect the two female spade connectors from each other (from step #3) and reconnect them to the seat switch. This must be completed so that the safety circuit is functioning properly. [Figure 1]
 13. Check to make sure all tools or obstructions are removed from under the unit.
 14. Raise the rear of the unit and remove the jack stands. Lower the unit.
 15. Lower and secure the seat platform.

WARNING

Do not operate without plugging the wiring harness into the seat switch. This switch is an important part of the safety start interlock system. Serious injury can result if the seat switch is not plugged into the wiring harness.

WARNING

Never operate with a non-functioning seat switch. Always reconnect the seat switch to the harness.

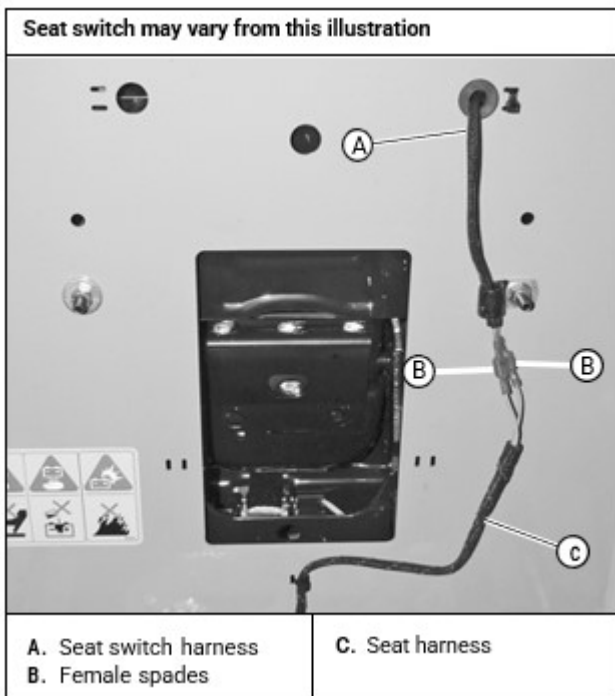


Figure 1

Steering control lever in neutral position

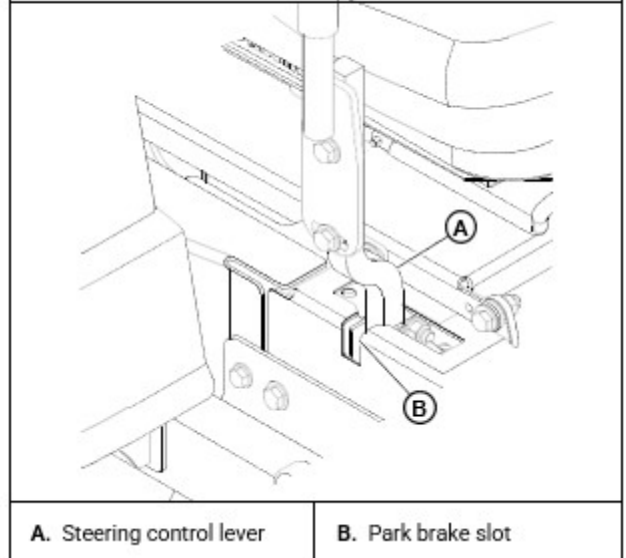


Figure 2

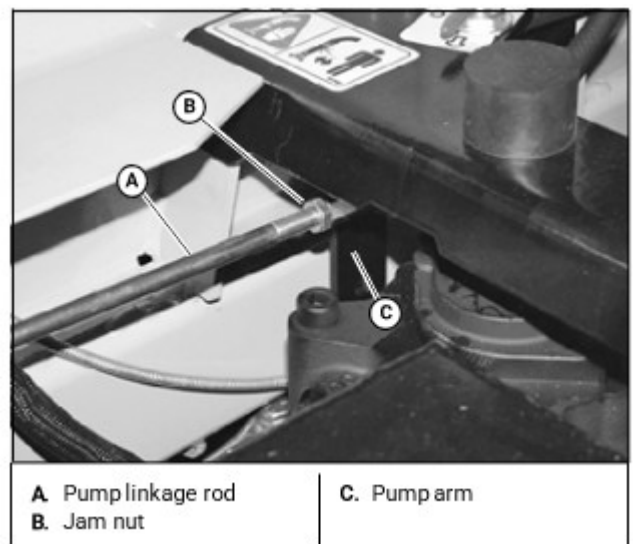


Figure 3

Control Lever Stops

The steering control lever stops (see Figure 4) are designed to do two things: First, and most important, they must keep the pumps from bottoming out internally. Secondly, the stops may be adjusted to help drive straight when the steering control levers are pushed forward against the stops.

To keep the pumps from bottoming out internally use the following procedure:

This adjustment is only required if the hydraulic pump(s) have been replaced.

1. To make the first adjustment the tractor engine must not be running.
2. Check to make sure the steering control levers are against the stops before the pumps are bottomed out internally.
3. To do this, gently and slowly move the steering control levers forward and feel if there is some resistance on the pump lever before the control levers hit the stops. Check one side at a time. If you sense that the pump arms are stopping the forward motion of the control arms, loosen the jam nut on the adjustable stop of the corresponding side, turn the stop (set screw) inward to stop the steering control levers slightly before the pump bottoms out. Lock in place when the adjustment is correct by re-tightening the jam nut. Do this for each side.



Figure 4

To adjust the stops for driving straight when steering control levers are against the stops during operation:

1. Determine which drive tire is rotating too fast when both steering control levers are against the stops in the control panel. [Figure 5]
 2. Then, stop the unit and loosen the lock nut on the side which is rotating too fast and turn the stop (set screw) inward to stop the steering control lever sooner. Tighten the lock nut on the stop and test again.
 3. Repeat this procedure until unit drives straight.
- NOTE:* Since this is a hydrostatic drive, variables such as temperature of oil, efficiency of pumps and motors, tire pressure, etc. may affect the consistency of the ability to rely on the stops to

drive straight without the operator making minor steering adjustments with the control arms.

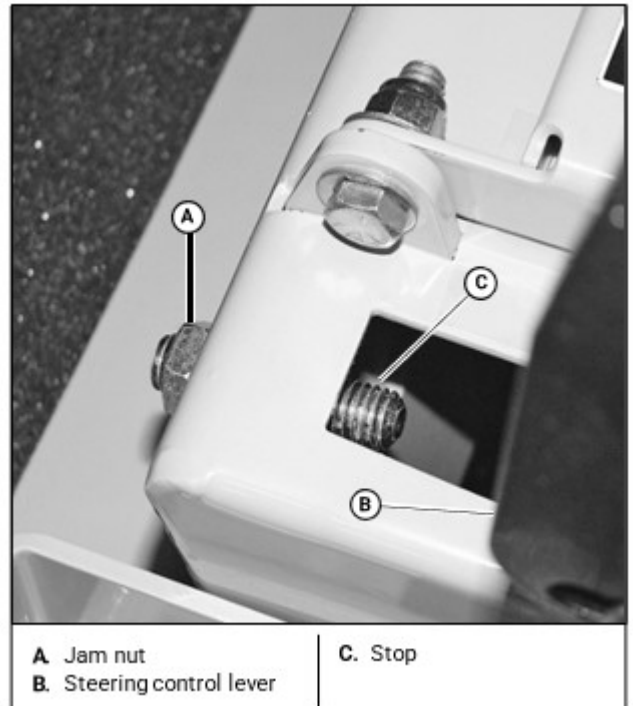


Figure 5

Steering Damper

The steering dampers are spring loaded to return the control levers to the neutral position from the reverse position. This gives the operator a sense of neutral during operation.

To set the steering dampers in the correct operating position follow these steps:

1. Shut engine off, place steering control levers in the park brake position, disengage brush clutch, remove ignition switch key and disconnect negative battery cable before doing any adjustments.
2. Place the steering control lever in the neutral position. [Figure 6]
3. Loosen the steering damper's rear ball stud. [Figure 7]
4. Pull the damper spring housing past the point that the internal spring is engaged. [Figure 7]
5. Release the damper spring housing and allow the internal spring to bring the housing back to the neutral position.
6. Tighten the nut on the steering damper's front ball stud.

- NOTE: The damper must not bottom out when the pump lever is fully stroked in either direction.
7. Reconnect the negative battery cable.
 8. Lower and secure the seat platform.
 9. To check, move the steering control lever to the reverse position and release. The steering control lever should return to the neutral position. If not, repeat steps 1 through 6.

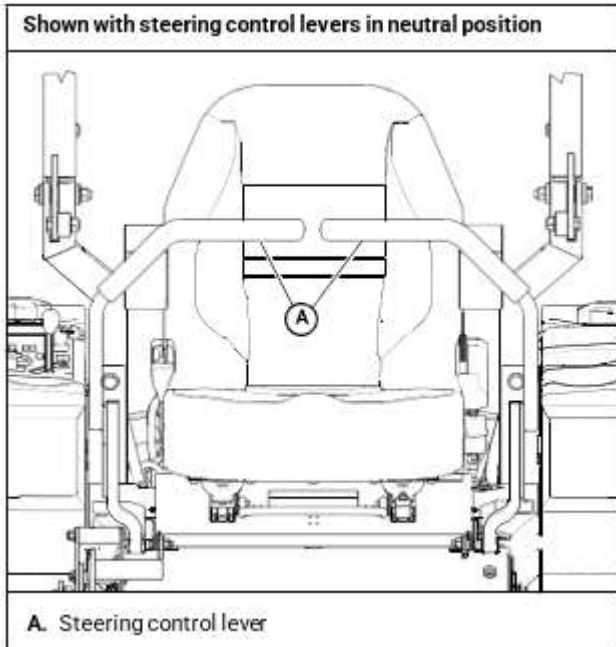


Figure 6



Figure 7

Steering Control Lever Adjustment

The steering control levers can be adjusted for operator comfort.

1. By loosening the cap screws that attach the upper steering control lever to the lower steering control lever the upper steering control lever can be pivoted to fit the operator's personal preference. [Figure 8]
2. The steering control levers should be adjusted so that they align vertically with each other when in the neutral position. [Figure 9]

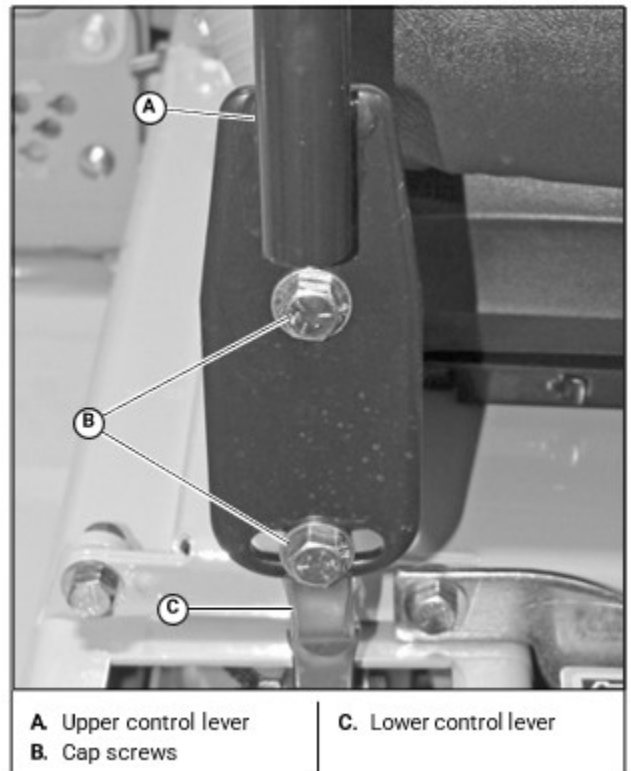


Figure 8

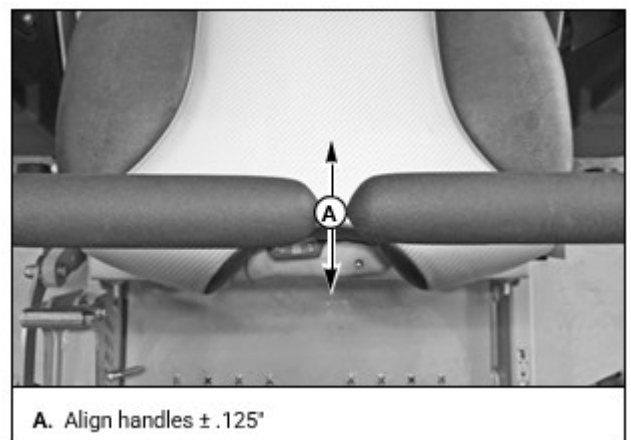


Figure 9

Park Brake Adjustment

1. Shut engine off, place steering control levers in the park brake position, disengage brush clutch, remove ignition switch key and disconnect negative battery cable before doing any adjustments.
2. Raise the rear of the unit and block with certified jack stands. The rear wheels need to be able to rotate freely and clear of all obstructions.
3. Chock the front tires.
4. Position the steering control levers in the neutral position.

NOTE: The front brake link is not to be adjusted.



Figure 10

5. Open the hydraulic pump's bypass valve, on the side that is being adjusted, by turning the bypass valve counter clockwise one-half to one revolution.

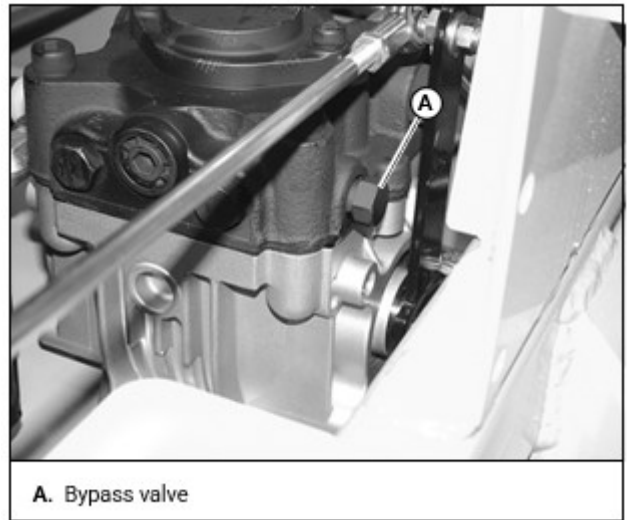


Figure 11

6. Try and rotate the tire by hand. The tire should rotate. Remember hydraulic oil resistance will prevent the tire from rotating freely even with the bypass valves open. There should be no resistance from the brakes at this point.
7. Move the steering control lever to where it is just inside (1/4" [6.35 mm]) the park brake slot.

[Figure 12]

NOTE: When the steering control lever is against the out- side edge of the slot, the brakes should not be engaged.

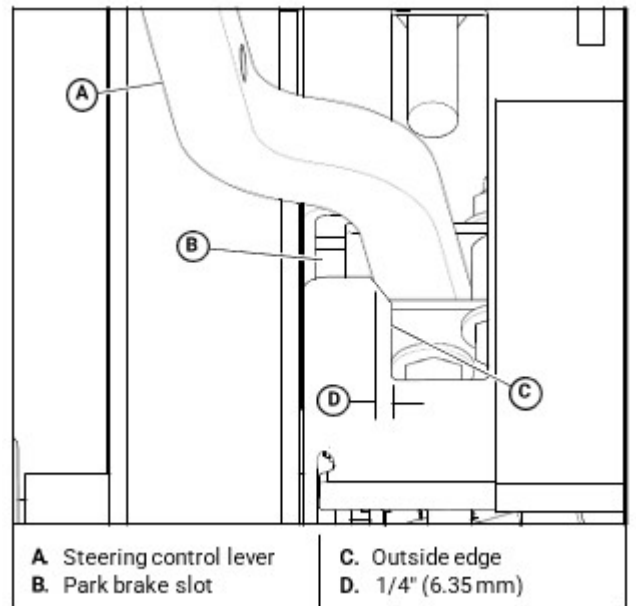


Figure 12

8. Rotate the tire. If the brake is adjusted properly the tire will still rotate but friction will start to

become noticeable here. However, if no brake resistance is noticed, the brake needs adjusted as follows:

- a. Loosen the brake linkage jam nuts. [Figure 13]
Rotate the tire and at the same time rotate the turnbuckle to shorten the length of the brake linkage to increase the brake pressure. When you feel the brake begin to engage, stop adjusting the turnbuckle. Re-tighten the jam nuts on the turnbuckle.
- b. Place the control lever in the park brake slot.
The tire should not rotate when the control lever is in the park brake position. [Figure 12]
- c. Place the control lever in the neutral position.
The tire should rotate freely.

9. Close the hydraulic pump's bypass valve.
[Figure 11]

10. Repeat steps 4 through 9 for the other side.

11. Check to make sure all tools or obstructions are removed from under the unit.

12. Raise the rear of the unit and remove the jack stands. Lower the unit.

13. Reconnect the negative battery cable.

14. Lower and secure the seat platform.

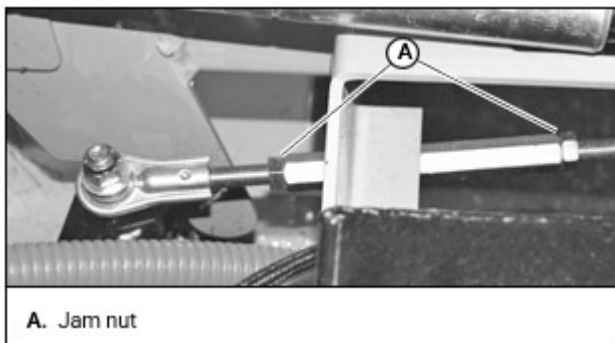


Figure 13



- Potential for serious injury!
- Never work under the machine or attachment unless it is safely supported with jack stands.
- Make certain machine is secure when it is raised and placed on the jack stands.
- **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
- Use in pairs only.
- Follow the instructions supplied with the jack stands.

- The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
- Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself.
To prevent injury, stay clear and exercise caution when rotating the wheels.
- To prevent injury, stay clear and exercise caution when rotating the wheels.

Belt

Inspect belts frequently for wear and serviceability.

Replace a belt that shows signs of:

- severe cuts
- tears
- separation
- weather checking
- cracking
- burns caused by slipping.

Slight raveling of belt covering does not indicate failure, trim ravelings with a sharp knife.

Inspect the belt pulley grooves and flanges for wear. A new belt, or one in good condition, should never run against the bottom of the groove. Replace the pulley when this is the case, otherwise, the belt will lose power and slip excessively.

Never pry a belt to get it on a pulley as this will cut or damage the fibers of the belt covering.

Keep oil and grease away from belts, and never use belt dressings. Any of these will destroy the belt composition in a very short time.

Hydraulic System

IMPORTANT: Never use hydraulic or automatic transmission fluid in this system; use only motor oil as specified. Remember, dirt is the primary enemy of any hydraulic system.



- Hydraulic fluid escaping under pressure may have sufficient force to penetrate skin and cause serious injury. Foreign fluid injected into the skin must be surgically removed within a few hours by a doctor, familiar with this form of injury, or gangrene may result.
- Before applying pressure to hydraulic system, make sure all connections are tight

and all hoses and lines are in good condition. To find a leak under pressure, use a piece of cardboard or wood — never use your hands.

- Relieve all pressure in the system before disconnecting or working on hydraulic lines.
- To relieve pressure, lower all attachments and shut off engine.

Check oil level in hydraulic system after every 50 hours of operation or weekly, whichever occurs first. Check more often if system appears to be leaking or otherwise malfunctioning. Fluid level should be 1" (25.4 mm) from top of reservoir.

Use only **15W50 synthetic oil** or **20W50 synthetic oil**. Full Synthetic 20W50 Hydrostatic Transmission Oil is recommended. [Figure 14]

NOTE: The reservoir will require approximately 3.0 U.S. gallons (11.35 liter) of **15W50 synthetic oil** or **20W50 synthetic oil** when replacing the oil after an oil and filter change. **Do not overfill the reservoir.**

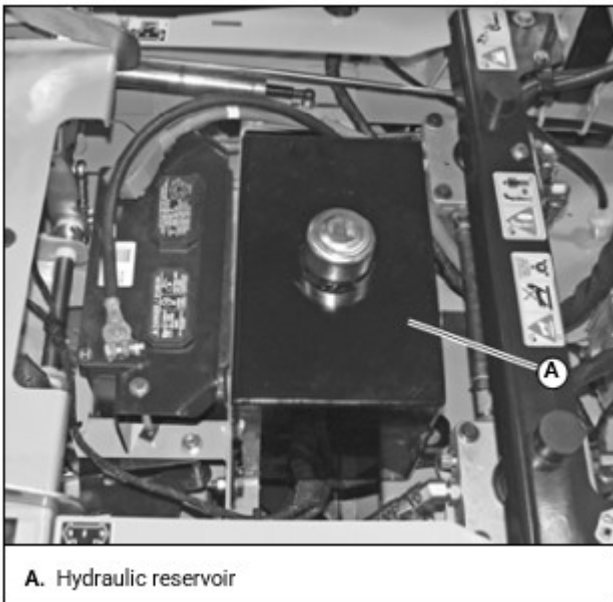


Figure 14

Initial system oil and filter change must be after the first 50 hours of operation. Thereafter, replace filter and oil in reservoir **annually or every 500 hours, whichever comes first.**

IMPORTANT: It is necessary to drain the system oil from the hydraulic reservoir, using the reservoir drain

plug, before removing the hydraulic filter. Replace the drain plug before adding system oil. [Figure 15] The system filter is located inside the hydraulic reservoir on the underneath side of the tank. When changing the filter use a 15/16" socket. The threads are right hand. [Figure 15]

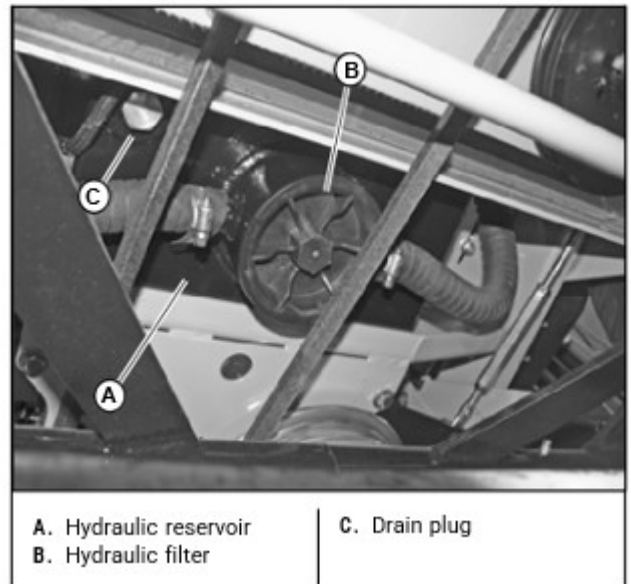


Figure 15

Hydraulic Oil Heat Exchanger

This unit is equipped with a hydraulic oil heat exchanger. The heat exchanger coils must be kept clean to ensure that the hydraulic oil is operating within the correct temperature range. Check and clean the heat exchanger daily and more often in dirty, dusty conditions. [Figure 16]

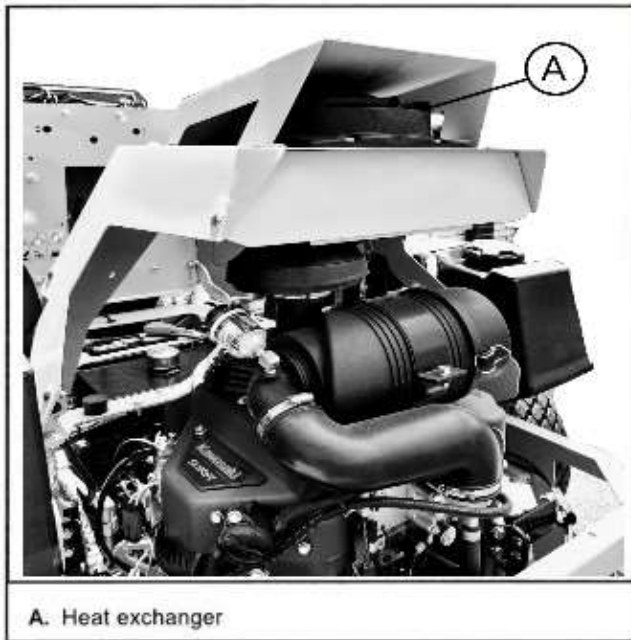


Figure 16

Test Procedure for DDC20 Pump

Equipment required:

Hustler® Pressure Test Gauge Kit, p/n 007898

- Potential for serious injury!
 - Never work under the machine or attachment unless it is safely supported with jack stands.
 - Make certain machine is secure when it is raised and placed on the jack stands.
 - **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
 - Use in pairs only.
 - Follow the instructions supplied with the jack stands.
 - The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
 - Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself.
- To prevent injury, stay clear and exercise caution when rotating the wheels.
- To prevent injury, stay clear and exercise caution when rotating the wheels.

WARNING

WARNING Untrained maintenance personnel should never attempt to make any adjustments or repairs to the drive system while the engine is running. **The following procedures should be performed by trained maintenance personnel only.**

Pump test procedure:

The drive system consists of two independent pump/motor combinations and will need to be tested separately. The oil supply (reservoir), filtering system (located in the bottom of the reservoir) and oil cooler are shared between the two independent systems. The testing sequence below is testing the hydrostatic pumps (only). If the test shows satisfactory results but performance is still deemed unacceptable, the motors, filtering, oil cooler and reservoir should be inspected.

1. Raise the rear of the unit and block with certified jack stands. The rear wheels need to be able to rotate freely and clear of all obstructions.
2. Chock the front tires.
3. Raise the seat platform and disconnect the harness from the seat switch harness. Bypass the seat switch by connecting the two (2) harness female spades together. [Figure 17]
4. Start the engine.
5. Remove the tire and wheel assembly.
6. Clean hydraulic oil lines connecting to motor thoroughly. (Contamination allowed to enter in the hydrostatic system can cause pump and motor failures).
7. After cleaning, remove oil supply lines from the motor and loosen supply lines at the pump. One wheel motor fitting may need to be removed to assist with test line installation. Cap the wheel motor ports or fittings.
8. Test procedures are the same for both the right and left sides.
9. Install Hustler® Pressure Test Gauge Kit as shown in Figure 19. Check the bypass valve (tow valve) to make sure it is fully seated. [Figure 20]
10. Recheck hose and fittings to ensure they are tight.
11. Check oil reservoir for proper oil level and make sure hydraulic filter is in good condition
12. Run engine at mid throttle for one or two minutes or until top of pump is warm to the touch.
13. Increase engine speed to full throttle.

14. Slowly move the steering control lever forward. You should easily get a 2600 PSI reading from one of the gauges. Return steering control lever to neutral. (Caution: do not hold steering control lever in forward position for more than 10 seconds as oil will become extremely hot).

Then, slowly move steering control lever in reverse. You should easily get a 2600 PSI reading from the other gauge.

(**Caution:** do not hold steering control lever in rearward position for more than 10 seconds as oil will become extremely hot).

If pressure is less than 2600 PSI, causes are either internal relief valve is faulty or internal pump parts are damaged.

NOTE: **Anytime a hydraulic pump is replaced the drive motor, hydraulic lines and oil cooler must be inspected and cleaned or replaced due to possible contamination.**

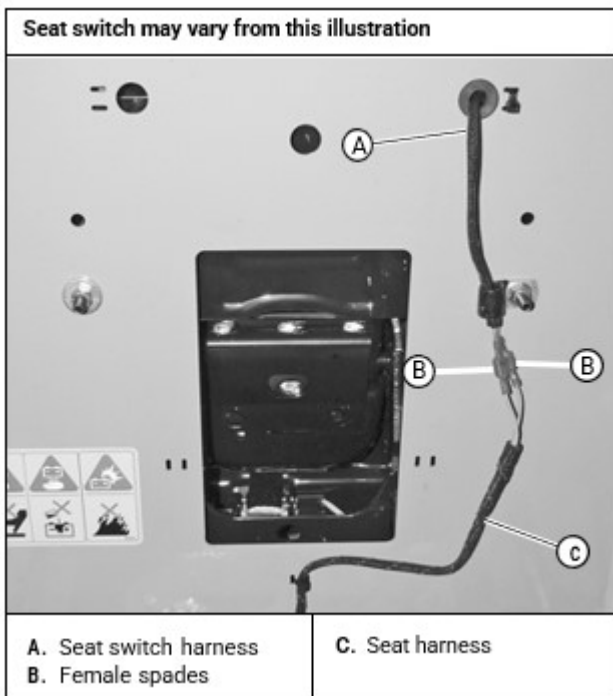


Figure 17



• Hydraulic fluid escaping under pressure may have sufficient force to penetrate skin and cause serious injury. Foreign fluid injected into the skin must be surgically removed within a few hours by a doctor, familiar with this form of injury, or gangrene may result.

- Before applying pressure to hydraulic system, make sure all connections are tight and all hoses and lines are in good condition. To find a leak under pressure, use a piece of cardboard or wood — never use your hands.
- Relieve all pressure in the system before disconnecting or working on hydraulic lines.
- To relieve pressure, lower all attachments and shut off engine.

After testing is concluded

1. **IMPORTANT:** With the engine off, disconnect the two female spade connectors from each other (from previous step #3) and reconnect them to the seat switch harness. This must be completed so that the safety circuit is functioning properly.
2. Remove the Hustler® Pressure Test Gauge Kit.
3. After all repairs are completed, check to make sure all tools and obstructions are removed from under the unit.
4. Raise the rear of the unit and remove the jack stands. Lower the unit.
5. Lower and secure the seat platform.



Do not operate without plugging the wiring harness into the seat switch harness. This switch is an important part of the safety start interlock system. Serious injury can result if the seat switch is not plugged into the wiring harness.



Never operate with a non-functioning seat switch. Always reconnect the seat switch harness to the harness.

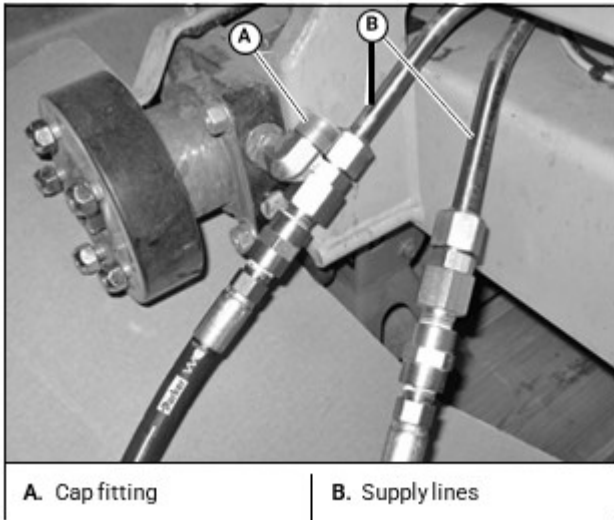


Figure 18

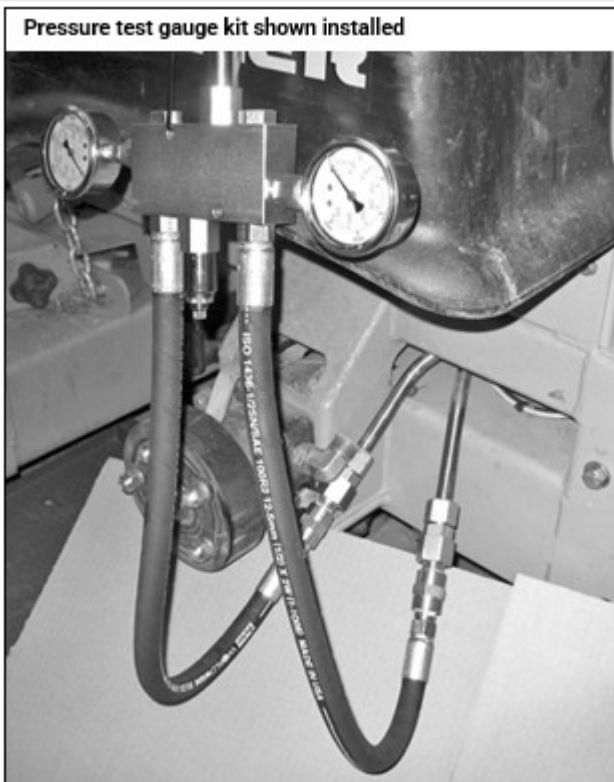


Figure 19

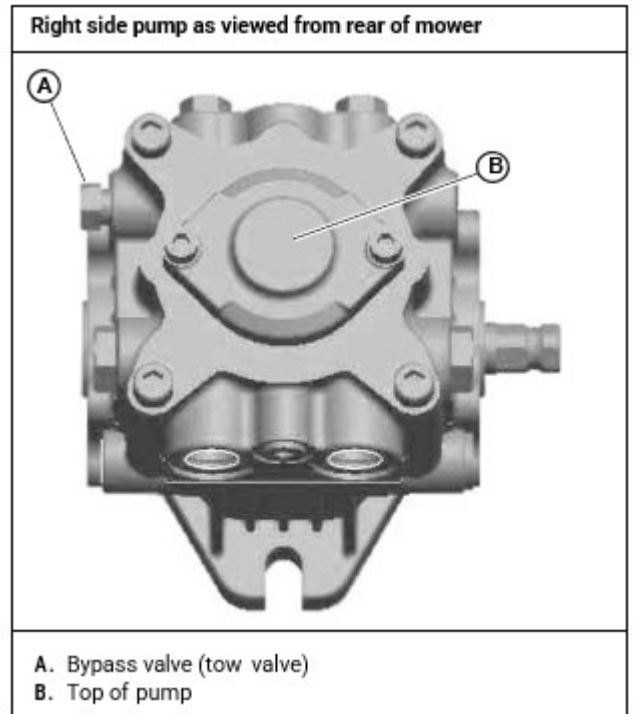


Figure 20

New or Rebuilt DDC20 Pump Startup Procedure

NOTE: Use this startup procedure any time a DDC20 pump has been removed for service or replaced.

WARNING

- Potential for serious injury!
 - Never work under the machine or attachment unless it is safely supported with jack stands.
 - Make certain machine is secure when it is raised and placed on the jack stands.
 - **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
 - Use in pairs only.
 - Follow the instructions supplied with the jack stands.
 - The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
 - Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself.
- To prevent injury, stay clear and exercise caution when rotating the wheels.
- To prevent injury, stay clear and exercise caution when rotating the wheels.



Do not attempt any adjustments with the engine running. Use extreme caution while working in or around all vehicle linkage! High temperatures can be generated. Follow all safety procedures outlined in the operator's manual!

Pump Replacement

1. Raise the rear of the unit and block with certified jack stands. The rear wheels need to be able to rotate freely and clear of all obstructions.
 2. Chock the front tires.
 3. Raise the seat platform and disconnect the harness from the seat switch harness. Bypass the seat switch by connecting the two (2) harness female spades together. [Figure 21]
 4. Before installing pump on machine, (either new or rebuilt) fill pump case with fresh, clean oil by removing case drain plug and adding 6 - 8 oz. of **15W50 synthetic oil or 20W50 synthetic oil** (Full Synthetic 20W50 Hydrostatic Transmission Oil is recommended), then install the hose fitting. [Figure 22]
 5. Install pump on machine and install lines.
 6. Check reservoir for contamination, metal particles, dirt, water, etc. and clean if necessary. Replace hydraulic filter and fill reservoir with oil until it is just below the reservoir neck.
 7. Do not open tow valves.
 8. Place the steering control levers in the neutral position.
 9. Set engine throttle to the half throttle position.
 10. Start engine. Run at idle for 30 seconds.
 11. Stroke steering control lever to the forward position.
- NOTE: If wheel motor does not rotate in 15 seconds, return steering control lever to neutral and shut off engine. Check hydraulic oil level and replenish if needed. Repeat steps 8 through 11.
12. After wheel motor starts to rotate, increase engine speed to half throttle and stroke the steering control lever forward and reverse several times until the wheel motor operates smoothly through the entire speed range.
 13. **IMPORTANT:** With the engine off, disconnect the two female spade connectors from each other (from step #3) and reconnect them to the seat switch harness. This must be completed so that

the safety circuit is functioning properly.

[Figure 21]

14. Check to make sure all tools or obstructions are removed from under the unit.
15. Raise the rear of the unit and remove the jack stands. Lower the unit.
16. Lower and secure the seat platform.

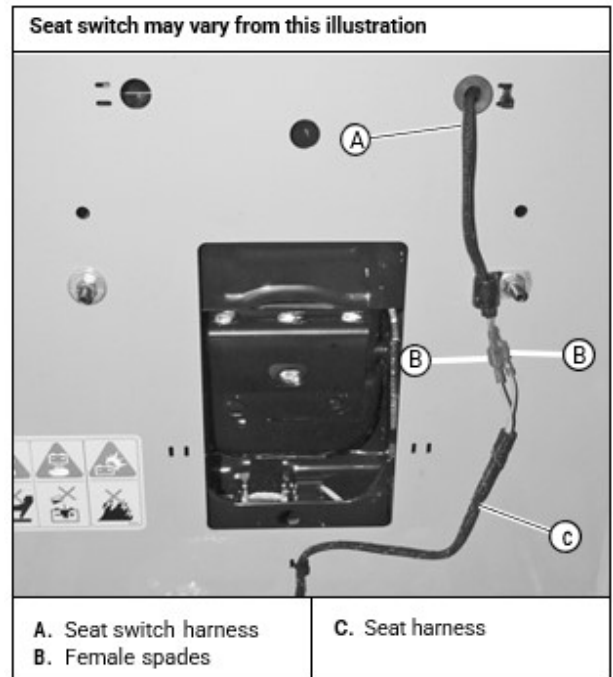


Figure 21

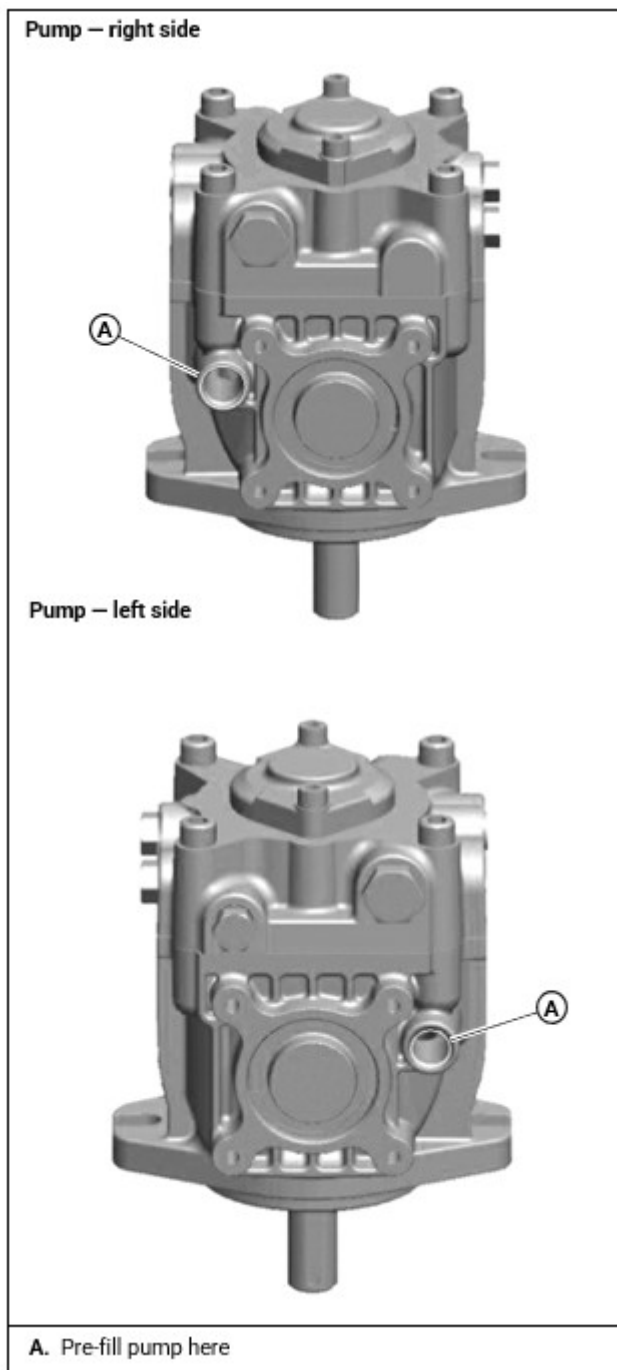


Figure 22

WARNING Do not operate without plugging the wiring harness into the seat switch harness. This switch is an important part of the safety start interlock system. Serious injury can result if the seat switch is not plugged into the wiring harness.

Purging Procedures

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that air is purged from the system.

These purge procedures should be implemented any time a hydrostatic system has been opened to facilitate maintenance or additional oil has been added to the system.

Air creates inefficiency because its compression and expansion rates are higher than that of oil.

Entrained air in the oil may cause the following symptoms:

1. Noisy operation.
2. Lack of power or drive after short term operation.
3. High operation temperature and excessive expansion of oil.

Before starting, make sure the reservoir is at the proper oil level. If it is not, fill to the vehicle manufacturer's specifications. The following procedures should be performed with the vehicle drive wheels off the ground, then repeated under normal operating conditions.

WARNING

- Potential for serious injury!
- Never work under the machine or attachment unless it is safely supported with jack stands.
- Make certain machine is secure when it is raised and placed on the jack stands.
- **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
- Use in pairs only.
- Follow the instructions supplied with the jack stands.
- The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
- Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself. To prevent injury, stay clear and exercise caution when rotating the wheels.
- To prevent injury, stay clear and exercise caution when rotating the wheels.

1. With the bypass valve open and the engine running, slowly move the directional control in both forward and reverse directions (5 or 6 times), as air is purged from the unit, the oil level will drop.
2. With the bypass valve closed and the engine running, slowly move the directional control in both forward and reverse directions (5 or 6 times). Check the oil level and add oil as required after stopping the engine.
3. It may be necessary to repeat Steps 1 and 2 until all the air is completely purged from the system. When the pumps operate smoothly forward and reverse at normal speeds, purging is complete.

Warner Clutch Re-gap Adjustment Procedures

The air gap is only adjustable on clutches that have a removable shim (see Figure 27).

When to remove shim:

When a clutch has worn to the extent that the existing air- gap is too large to allow for complete clutch engagement (clutch may engage easily when cold but has problems engaging when hot), the brake shim can be removed to reduce air gap and allow the clutch to continue to function.

After verifying that proper voltage and current are supplied to the clutch, follow the procedure outlined below.

NOTE: Before proceeding, the clutch must be installed on the engine crankshaft and the retaining bolt torqued to 45– 48 ft-lbs (61–65 N•m).

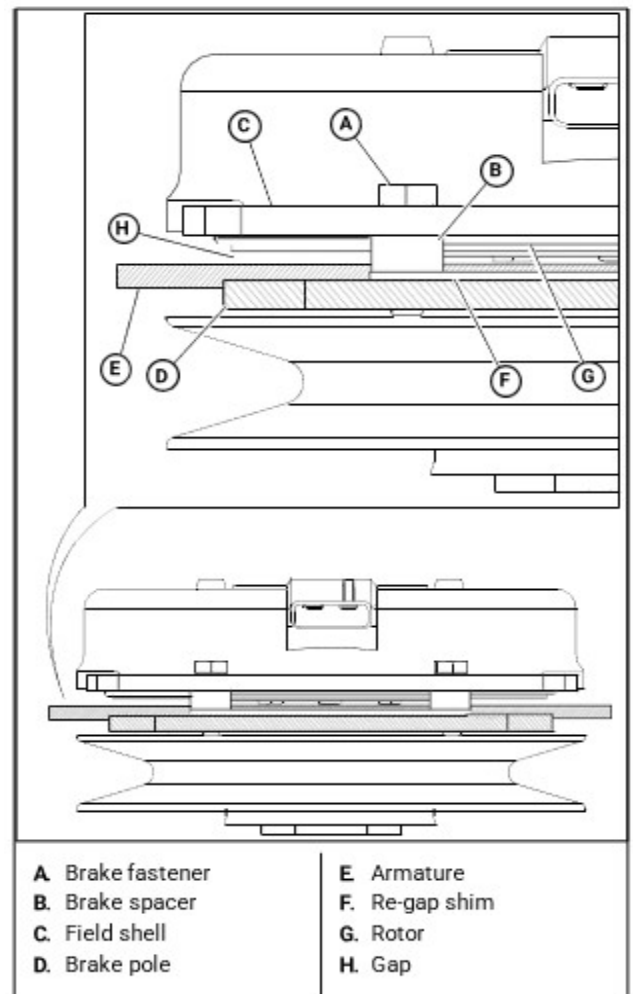


Figure 23



Always wear adequate eye protection when servicing.

Procedure:

With engine off, key removed and clutch disengaged and using a pneumatic line, blow out any debris from under the brake pole and around the aluminum spacers. [Figure 24]

Check the air gap between rotor & armature with feeler gage. If the gap is less than .070", then follow the trouble- shooting procedure outlined in Warner Electric P1177 installation troubleshooting guide available on Warner Electric's web site, www.warnerelectric.com. If the air gap is over 0.070", follow the procedure outlined below. [Figure 25]

1. Loosen both brake mounting bolts 1/2 to 1 full turn as shown in [Figure 26].
2. Using needle nose pliers, or by hand, take hold of the tab and remove shim (do not discard shim until proper clutch function has been confirmed). [Figure 27]

WARNING

Do not remove brake pole from field shell/armature. The brake pole tracks match with the clutch brake and need to continue to match after shim is removed to make sure of proper brake torque. Figure 23

3. Using a pneumatic line, blow out any debris from under the brake pole and around the aluminum spacers. [Figure 24]
4. Re-torque each bolt (M6 X 1) to 120 in.-lbs (13.5 N•m).
5. Using a .015" thick feeler gage, verify that a gap is present between the rotor and armature face on both ends of the brake pole as shown. [Figure 28] and [Figure 29]
 - a. If the gap is less than .015" the clutch must be replaced.
 - b. If sufficient gap is present, then proceed to safety check outlined below.

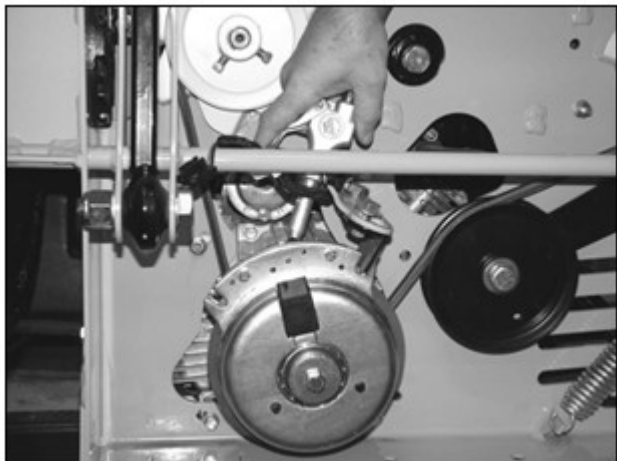


Figure 24

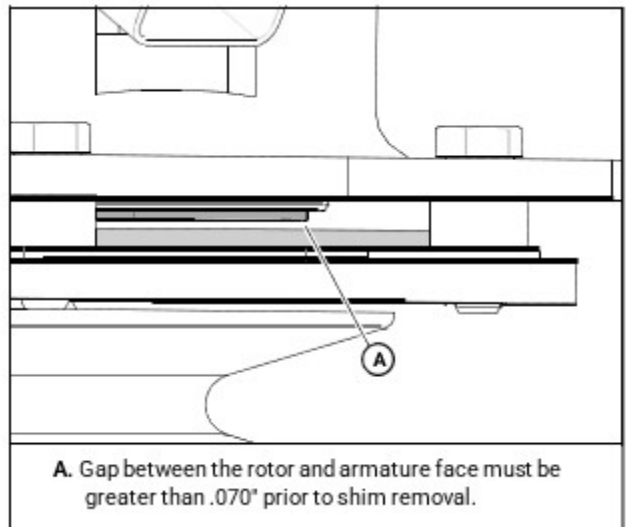
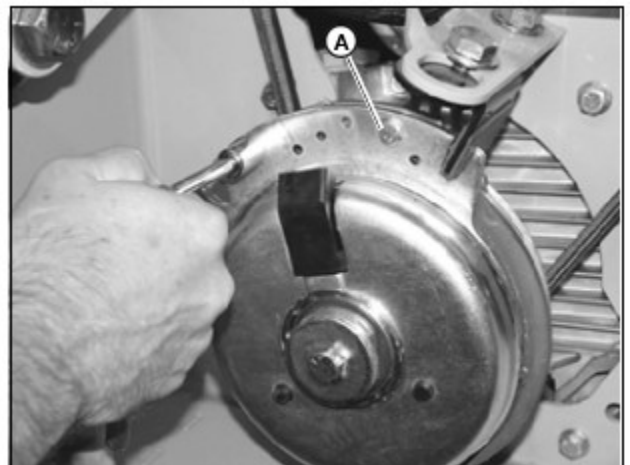


Figure 25



A. M6 x 1 bolt

Figure 26

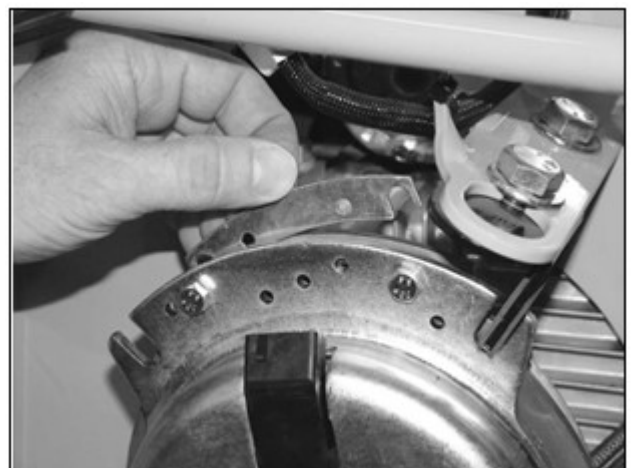


Figure 27

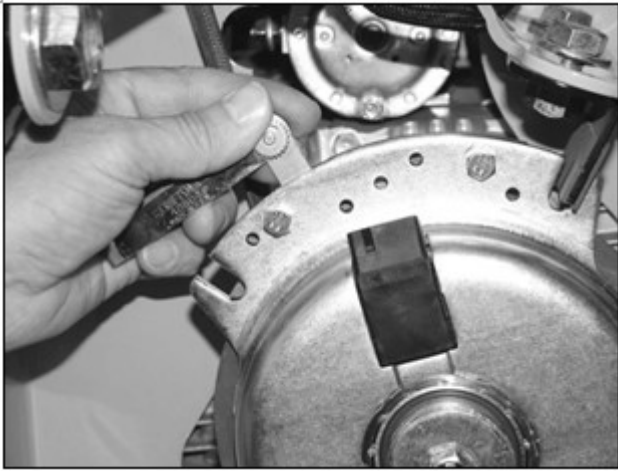


Figure 28

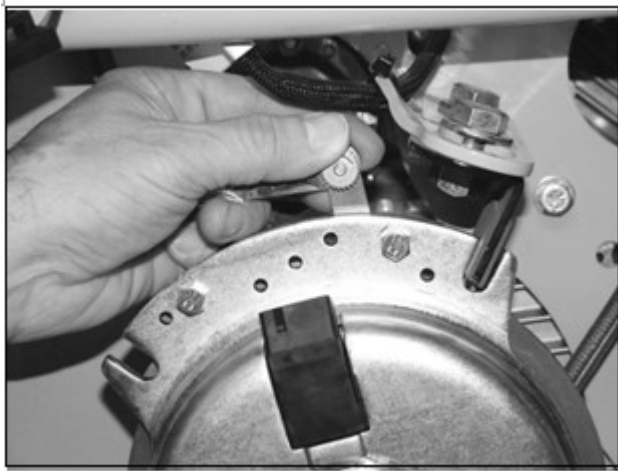


Figure 29

WARNING Observe brush operation from the operator's seat.

Perform Safety Check:

1. Start the engine and the brushes should not be engaged with the PTO switch "off" and clutch de-energized. Engage and disengage the PTO switch to ensure the proper function of the clutch.
2. If clutch still does not engage, then follow the trouble-shooting procedure outlined in Warner Electric P1177 installation troubleshooting guide available on Warner Electric's web site, www.warnerelectric.com and consult owner's manual.

Tires

It is important for level mowing that the tires have the same amount of air pressure. The recommended pressures are:

Drive wheels	29 - 32 psi (55–83 KPa)
Front wheels	25 - 28 psi (55–83 KPa)

If you wish to use non-pneumatic tires on your unit, the tire must be an approved tire. Warranty claims will be denied on any unit equipped with unapproved non-pneumatic tires.

Caster Fork Tapered Bearing Replacement

NOTE: A 1/4"–28 straight thread zerk fitting (not provided) is required for replacing the grease.

WARNING

- Potential for serious injury!
 - Never work under the machine or attachment unless it is safely supported with jack stands.
 - Make certain machine is secure when it is raised and placed on the jack stands.
 - **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
 - Use in pairs only.
 - Follow the instructions supplied with the jack stands.
 - The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
 - Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself.
- To prevent injury, stay clear and exercise caution when rotating the wheels.
- To prevent injury, stay clear and exercise caution when rotating the wheels.

Disassembly:

1. Raise the front of the unit enough to remove the caster wheel assembly.
2. Place unit securely on jack stands and do not allow unit to move. Chock the drive wheels.
3. Remove the top cap and the top lock nut. [Figure 30]

4. Remove the caster fork from the machine.
5. Remove and retain the cup washers.
6. Remove and discard the seal.
7. Remove and discard the tapered roller bearings and outer races.
8. Remove and retain the grease port plug.

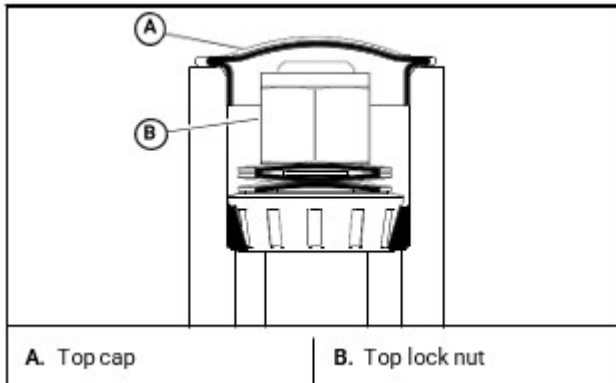


Figure 30

Assembly:

1. Insert the 1/4"–28 straight thread zerk fitting into the grease port and tighten.
 2. Apply a light coating of grease to the caster pocket before installing the outer bearing races.
 3. Use the Bearing Race Installation Kit (p/n 124351) to install the outer races into the caster pocket bore.
 4. Insert the Bearing Race Installation tool through the backing plate and the caster arm housing.
 5. Align a bearing outer race over the Bearing Race Installation tool and into the caster arm housing. Make sure that the race's thick edge is the leading edge going into the caster arm housing.
- IMPORTANT:** Do not use the bearings to press the races into place.
6. Install the pressing tool, washers and the nut, then slowly start to draw the race into the caster arm housing.
 7. Make sure the bearings outer race is correctly aligned before pressing the outer race into the fully-seated position against the caster pocket shoulder. [Figure 31]
 8. Disassemble and invert the Bearing Race Installation tool to install the other outer race.
 9. Install the bottom bearing and lower seal. Make sure that the lower seal lip is facing out and driven flush with the caster pocket. [Figure 32]
 10. Install the upper bearing. [Figure 33]

11. Install the caster fork assembly, taking care not to damage the lower seal lip. [Figure 32]

IMPORTANT: Stack the cup washers as shown in [Figure 34].

12. Torque the top nut to 40 ft-lbs (55 N•m), then back off 1/4 turn. Figure 34
13. Apply grease to the grease zerk until it is visible at the top bearing. Fill the top cavity with grease.
14. Make sure that the caster fork is free to rotate by spinning the fork one full revolution.
15. Remove the grease zerk, insert the plug into the grease port and tighten.
16. Install the top cap.
17. Remove the jack stands and wheel chocks.

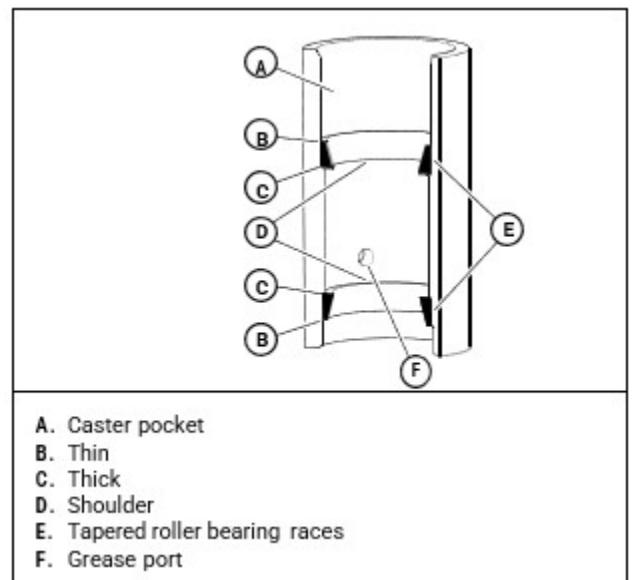


Figure 31

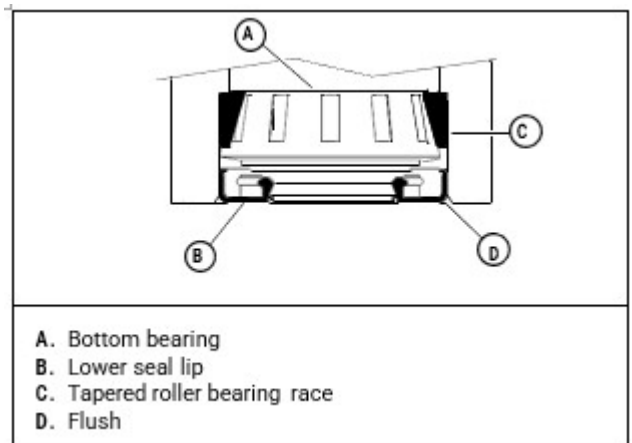


Figure 32

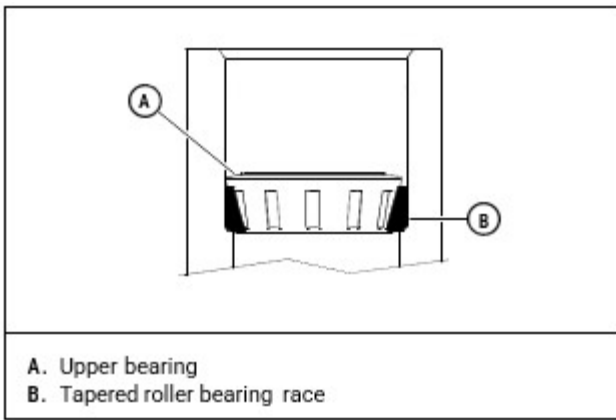


Figure 33

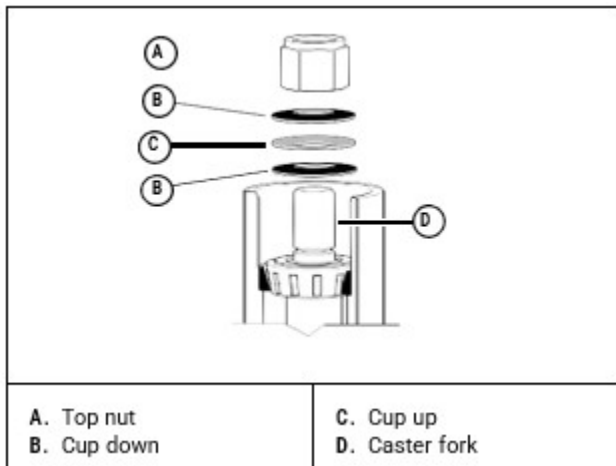


Figure 34

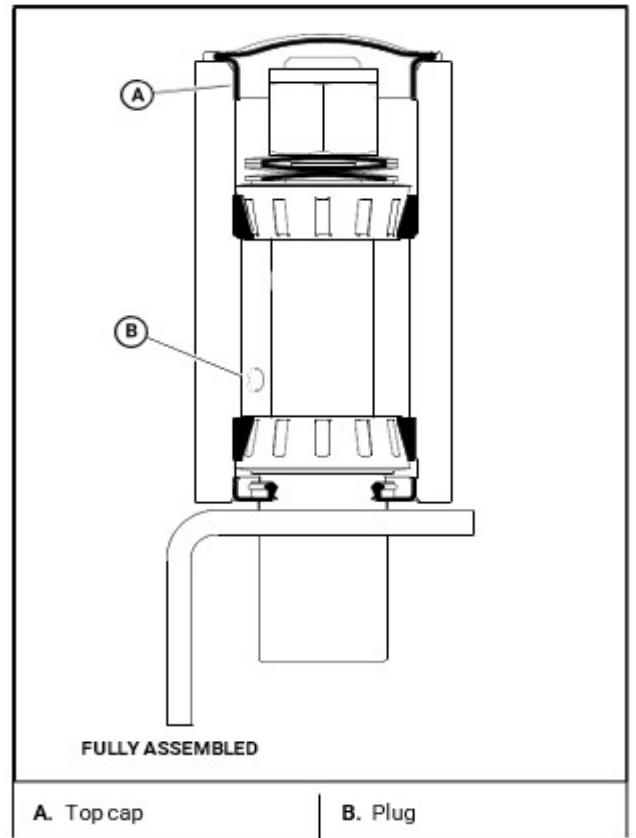


Figure 35

Tapered Wheel Bearing Replacement



- Potential for serious injury!
 - Never work under the machine or attachment unless it is safely supported with jack stands.
 - Make certain machine is secure when it is raised and placed on the jack stands.
 - **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 3000 pounds (1360 kg) to block the unit up.
 - Use in pairs only.
 - Follow the instructions supplied with the jack stands.
 - The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating.
 - Do not allow the wheels to come in contact with the floor or any object that would permit the unit to propel itself.
- To prevent injury, stay clear and exercise caution when rotating the wheels.
- To prevent injury, stay clear and exercise caution when rotating the wheels.

Disassembly:

1. Raise the front of the unit enough to remove the wheel assembly.
2. Place unit securely on jack stands and do not allow the unit to move. Chock the drive wheels.
3. Remove the wheel from the fork by removing the axle bolt, flat washers, and lock nut. [Figure 36]
4. Remove the dust caps and bushings from the wheel housing. Retain these parts. [Figure 37]
5. Remove and discard the seals. [Figure 37]
6. Remove and discard the tapered roller bearings and outer bearing races. [Figure 37]
7. To prevent contamination of the new tapered roller bearings remove the existing grease from the wheel housing.

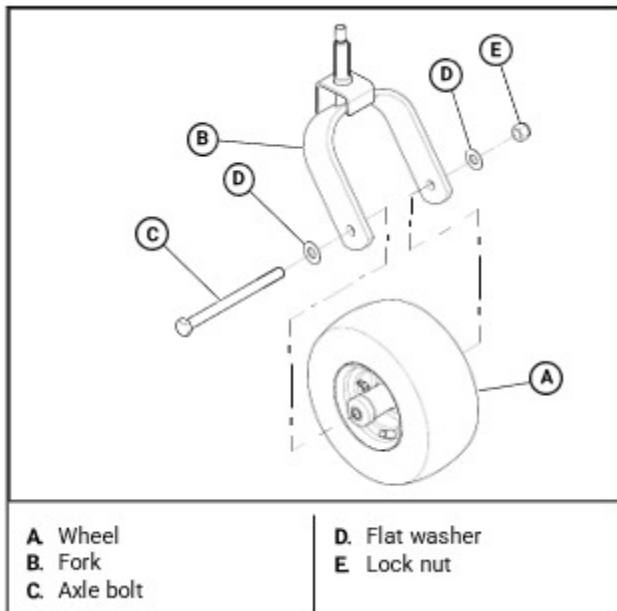


Figure 36

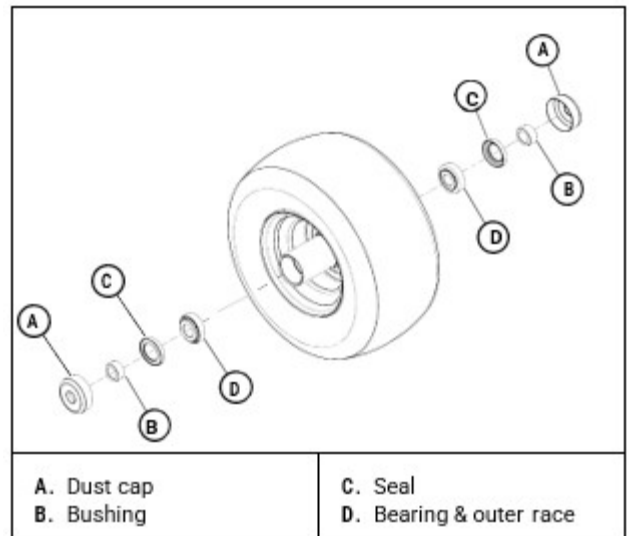


Figure 37

Assembly:

1. Press the new outer bearing races into the wheel housing until they are fully seated against the housing shoulder. [Figure 38]
 2. Thoroughly pack the tapered roller bearings with multi-purpose grease.
 3. Insert the new tapered roller bearings into the outer bearing race. [Figure 39]
 4. Insert the new seals into the wheel housing. Make sure that the flat side of the seal is flush with the outside edge of the wheel housing. [Figure 39]
 5. Insert the bushings through the seal openings and push them in until they contact the tapered roller bearings. [Figure 40]
 6. Push the dust caps onto the wheel housing. [Figure 40]
 7. Slide the wheel assembly between the caster fork legs and assemble to the fork using the axle bolt, flat washers, and lock nut. [Figure 41]
- NOTE: Make sure the head of the axle bolt is on the same side as the valve stem.
8. Screw the lock nut onto the axle bolt and tighten. Then, back the nut off until the wheel rotates freely.
 9. Using a grease gun, insert multi-purpose grease into the wheel housing until grease begins to seep from the dust caps.

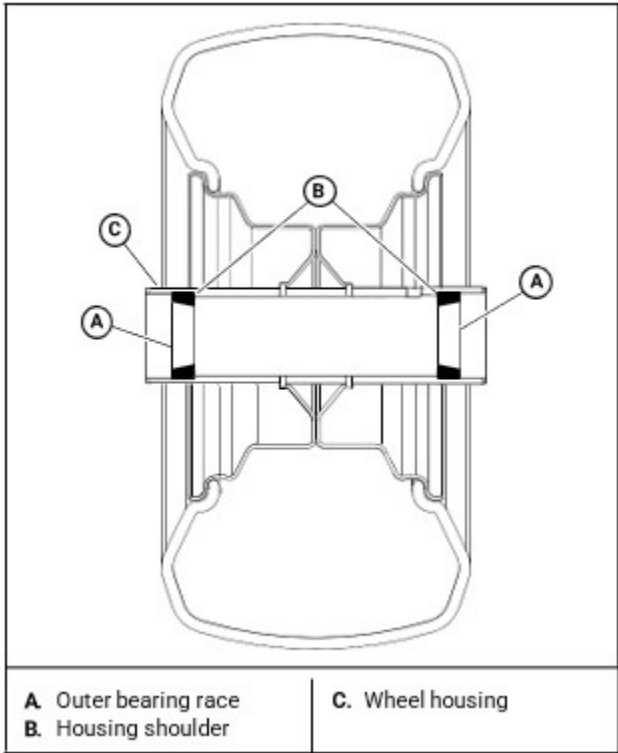


Figure 38

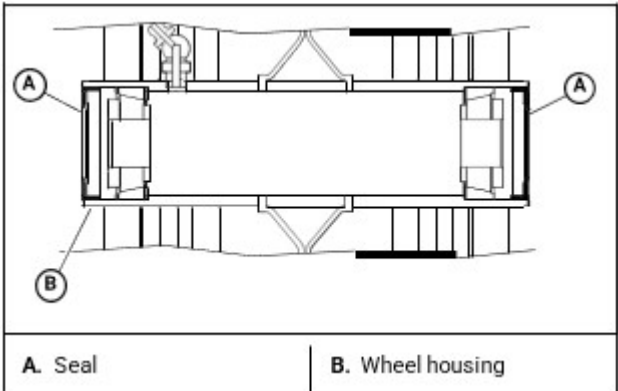


Figure 39

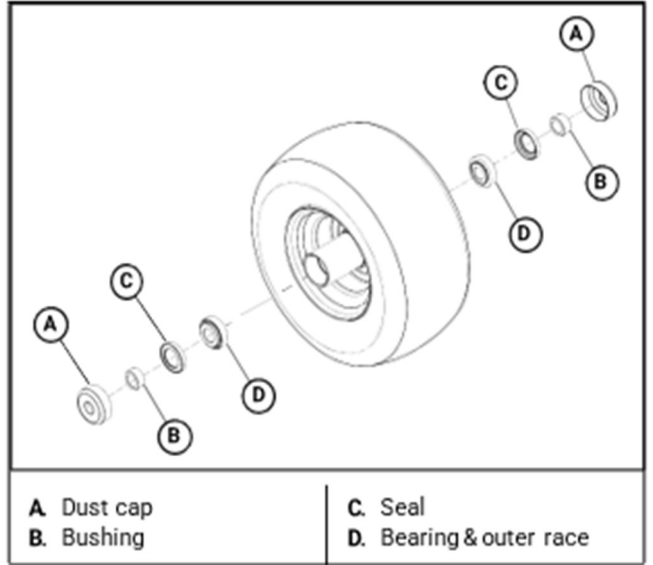


Figure 40

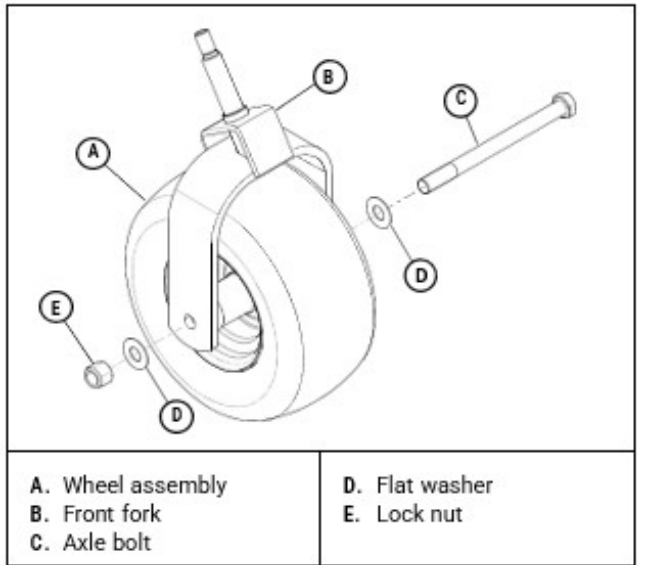


Figure 41

ENGINE MAINTENANCE

General Engine Maintenance

Detailed instructions and recommendations for break-in and regular maintenance are specified in the Engine Owner's Manual. Please refer to this manual for engine servicing, lubricating oil levels with quality and viscosity recommendations, bolt torques, etc. The engine warranty is backed by the engine manufacturer. Special attention should be paid to applicable data which will not be duplicated here.

Engine Oil and Filter



Allow the engine to cool before changing the engine oil. If the engine has been running, use caution when changing the engine oil as it will be very hot. You should wear the appropriate protective gear to avoid being burned or exposed to engine oil.

Check engine oil daily and after every 4 hours of operation. Machine must be setting level when checking oil. Refer to engine manual and maintenance schedule for oil recommendation and capacities.

Vanguard and Kawasaki Engines — Change the engine oil and filter after the first 5 hours of operation and per the engine manufacturer's recommendations after that. If unit is being operated in extremely dirty conditions, then it is recommended oil be changed more frequently. NOTE: Place a light film of oil on the filter's two O-rings before installing the new filter.

[Figure 42]

IMPORTANT: After the new oil filter has been installed, clean up any oil which may have spilled onto the engine plate, engine exhaust system, and muffler guard.

Vanguard and Kawasaki engines — *Draining the engine oil:*

1. Locate the oil drain valve on the engine. [Figure 43] & [Figure 44]
2. Position a suitable oil drain container under the machine below the oil drain valve.
3. Twist the valve counterclockwise to open the valve. Allow 10 minutes for engine oil to adequately drain.

4. After the oil is drained, close the valve by twisting it clockwise.

5. Once the valve is closed, clean up any spilled oil.

IMPORTANT: All oil drips or spills must be cleaned off of the engine plate, engine exhaust system, and muffler guard before operating the machine.

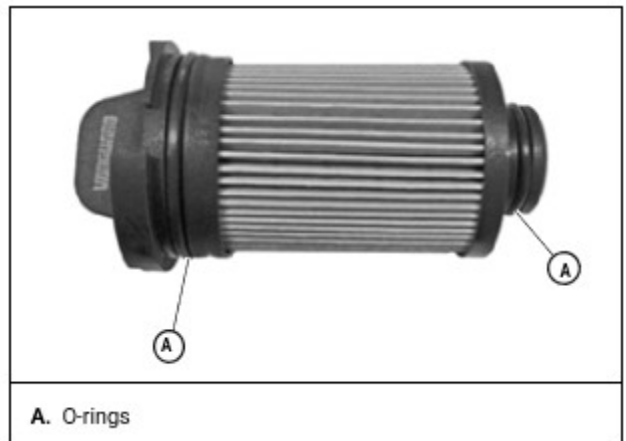


Figure 42

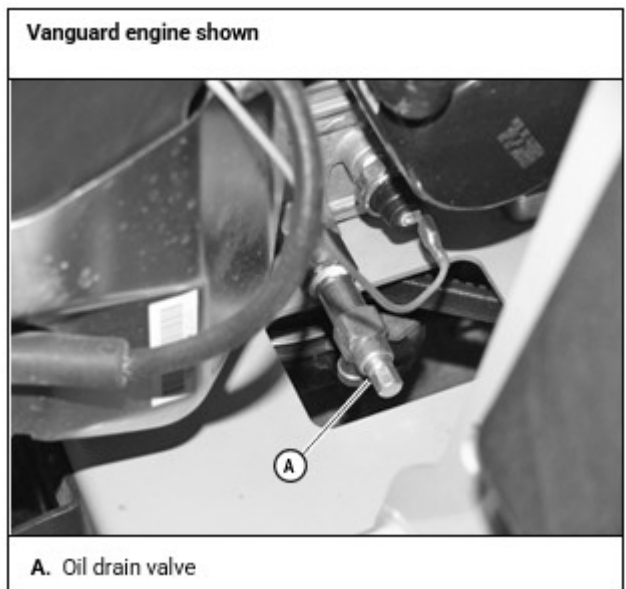


Figure 43

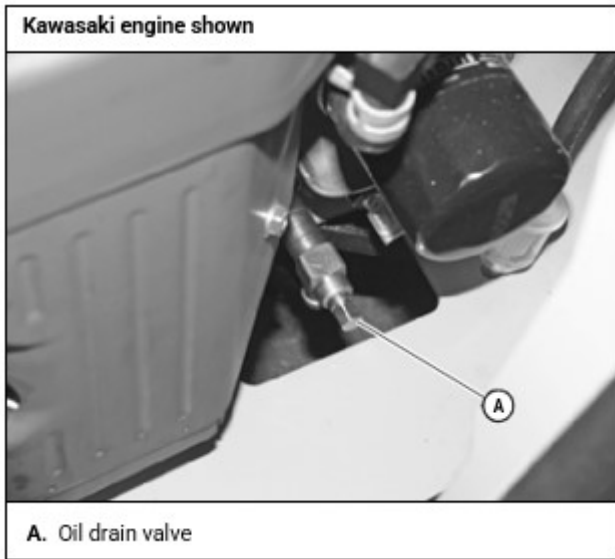


Figure 44

Engine Air Filter

Perform engine air filter maintenance per the Maintenance Schedule shown elsewhere in this manual.

A specially designed dry filter is standard equipment on these units and supplies clean combustion air to the engine. [Figure 45] & [Figure 46]

This unit is equipped with a safety filter. The filter element slides over the safety filter. [Figure 47]
The safety element does not require servicing unless it becomes contaminated with dirt or moisture.

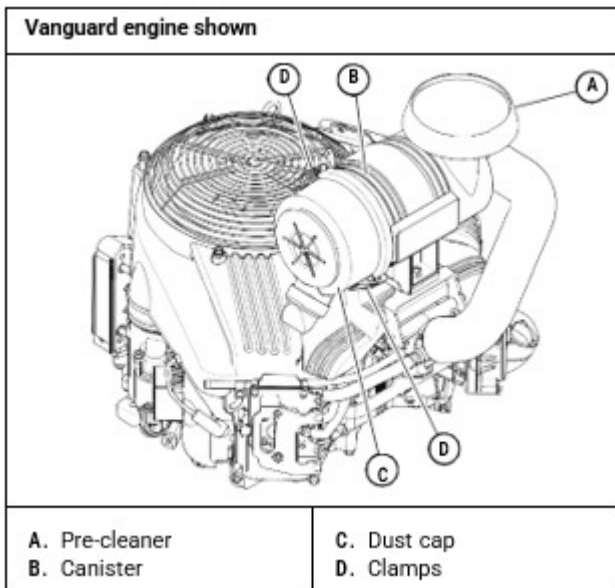


Figure 45

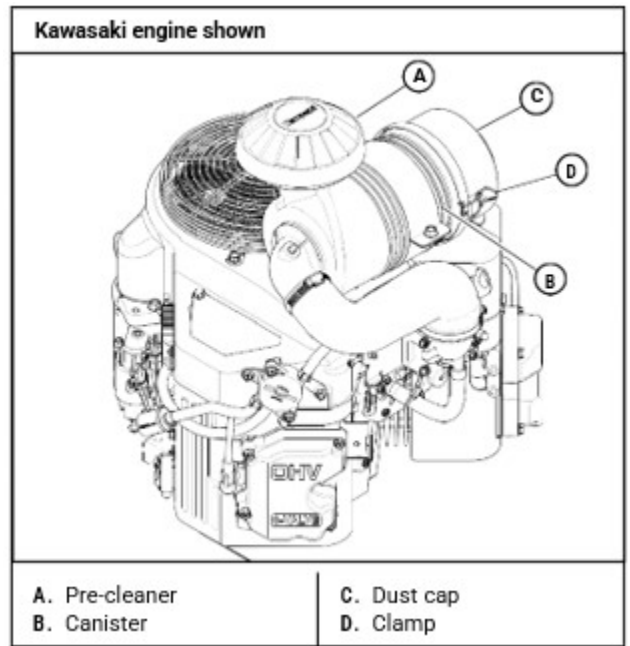


Figure 46

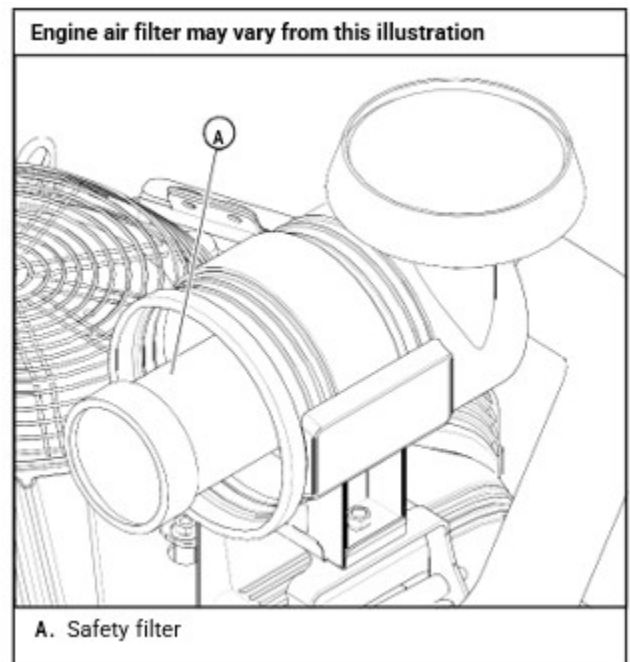


Figure 47

Recommended Service Procedure

1. Release clamps and remove element. Clean the air cleaner canister with a damp cloth.
2. Before installing a new element, inspect it by placing a bright light inside and rotating the element slowly, looking for any holes or tears in the paper. Also check gaskets for cuts or tears. Do not attempt to use a damaged element which will allow abrasive particles to enter the engine.

3. Reinstall the dust cap. Make sure it seals all the way around the air cleaner canister, then tighten the clamps. [Figure 45] & [Figure 46]
4. Check all fittings and clamps periodically for tightness and inspect hoses for holes or cracks.
5. Periodically check the intake hose for signs of ingested dust. Locate and repair the source of ingested dirt.
6. Never operate the machine without an air filter installed.

Overservicing

Overservicing occurs when an air filter element is removed for cleaning or replacement before it is necessary. Each time the filter is removed a small amount of dirt and dust could fall in the intake system. This accumulated dirt can cause a dusted engine. It only takes a few grams of ingested dirt over the normal service life of an engine to cause a dusted engine.

Do not clean the element, but replace with a new element only. Cleaning used air filter elements, through improper cleaning procedures, can get dust on the inside of the filter causing dirt ingestion and engine failure.

It is important to note that whenever an air filter element is cleaned by **any method**, the person or company performing the cleaning assumes responsibility for the integrity of the filter from then on. **The warranty for air filters expires upon cleaning or servicing in any manner because the condition of the filter after servicing is completely out of the filter manufacturer's control. Therefore, on a dust ingested engine failure, there will be no warranty consideration if the air filter element has been cleaned or serviced in any manner.**

A partially dirty air filter element works better than a new element. Therefore, a dirty filter element is not bad for the engine unless it is excessively restricting the air flow and engine performance is affected. The media in the filter must be porous to allow air to pass through it. When dirty air passes through the filter, the dirt plugs some of the holes in the media and actually acts as part of the filter media. When the next round of dirt enters, the first dirt helps filter out even smaller particles making the filter more efficient at stopping dirt from entering the engine. This is referred to as barrier filtration.

At some point the filter media becomes too clogged to allow air to pass.

The mowing conditions will determine the frequency of air filter element changing.

Air Restriction Indicator

These units have an air restriction indicator installed in the air cleaner. [Figure 48] & [Figure 49]

Replace the element whenever the restriction indicator reaches the change filter red line. Check the indicator daily and replace element as needed or annually whichever occurs first.

Reset the indicator by pushing in on the yellow button after each element change. [Figure 48] & [Figure 49]

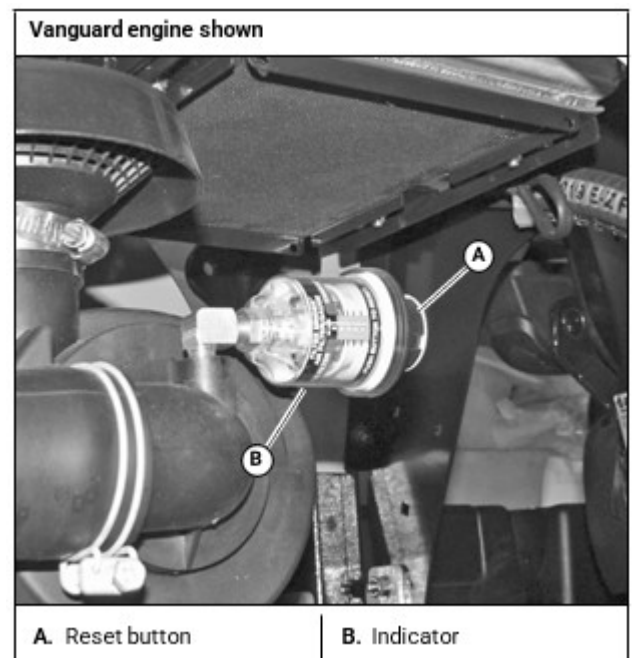


Figure 48



Figure 49

Fuel Evaporation System Filter

This unit has a fuel evaporation system filter. This filter must be checked and replaced every 500 hours or annually whichever comes first. [Figure 50]

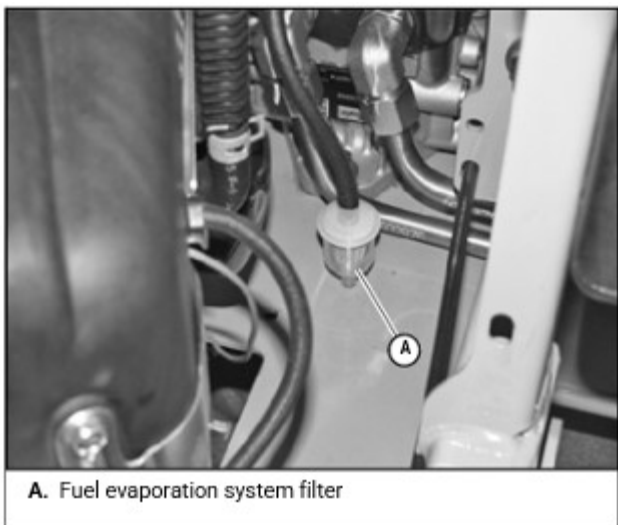


Figure 50

Fuel & Evaporative System Line Routings

There are two rubber hoses that are connected to the fuel tanks. One is the fuel hose that is part of the fuel system. The other is the vapor line that is part of the fuel evaporative system.

The fuel hose is connected to the fuel tank as shown. It connects the fuel tank to the fuel shutoff valve.

[Figure 51]

The vapor line is connected to the fuel tank as shown. It connects the fuel tank to the engine's vapor port.

[Figure 52]

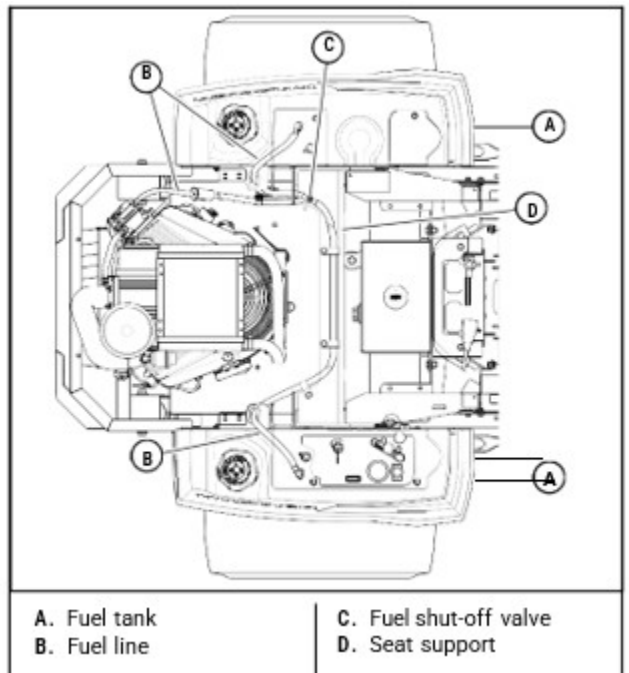


Figure 51

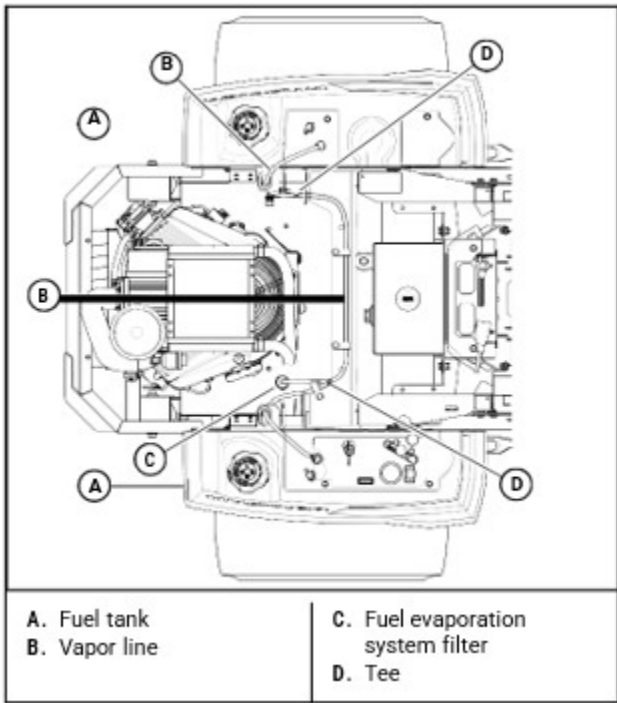


Figure 52

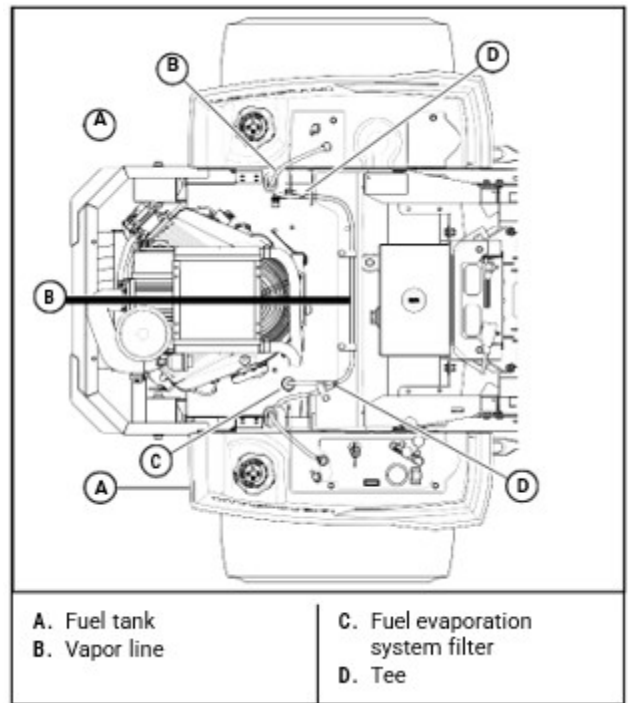


Figure 53

Engine RPM Settings

The engine RPMs are preset for maximum efficiency. Occasionally it may be necessary to check and adjust the settings. The high idle speeds, with no load, should be set as follows:

Kawasaki	
Model No.:	High idle
MODEL NO. FX1000V	3600 RPM
Vanguard	
Model No. ending with:	High idle
MODEL NO. M61	3600 RPM

Figure 54

ELECTRICAL

Electrical Schematic – Kawasaki

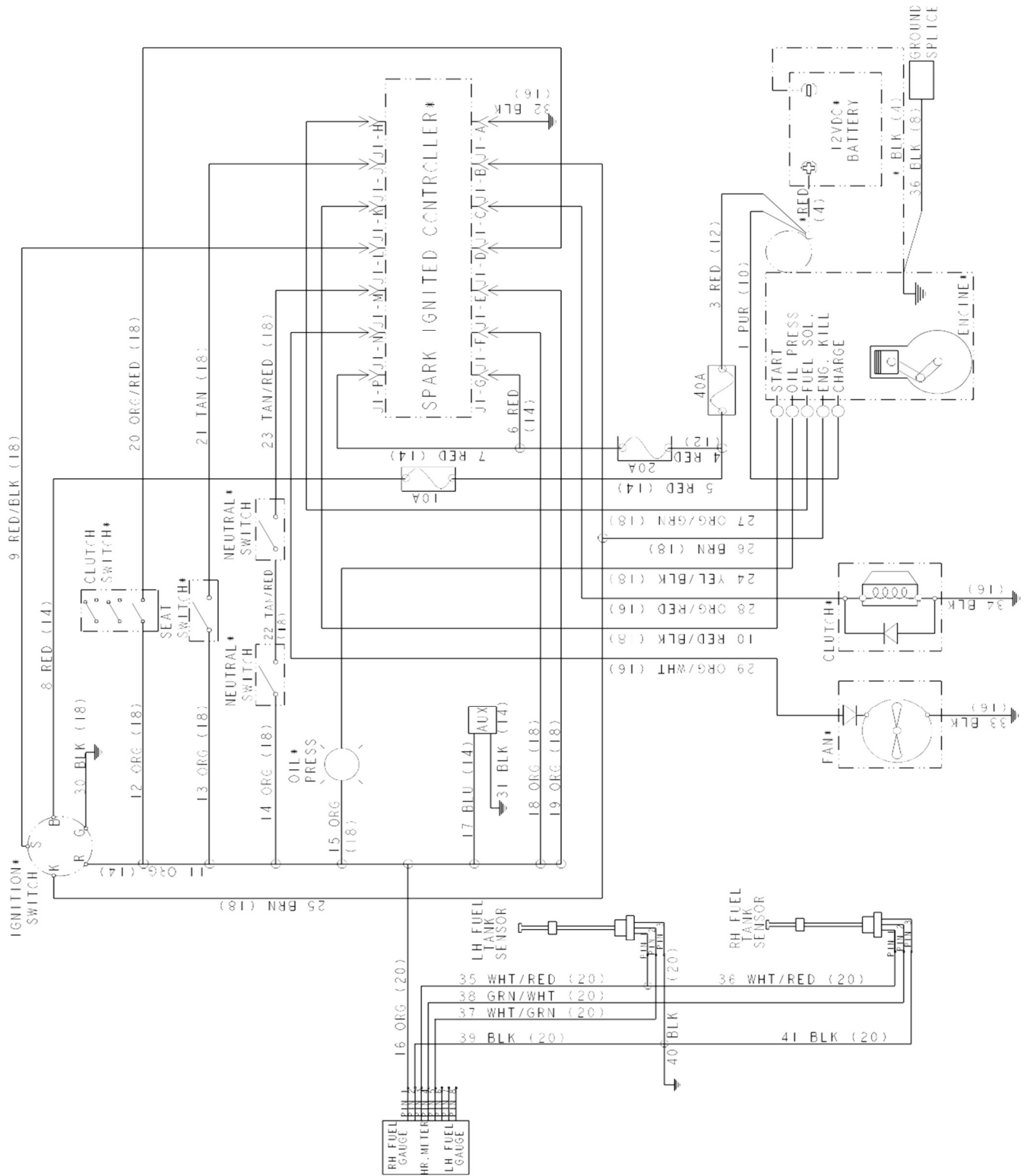


Figure 55

Electrical Schematic – Vanguard

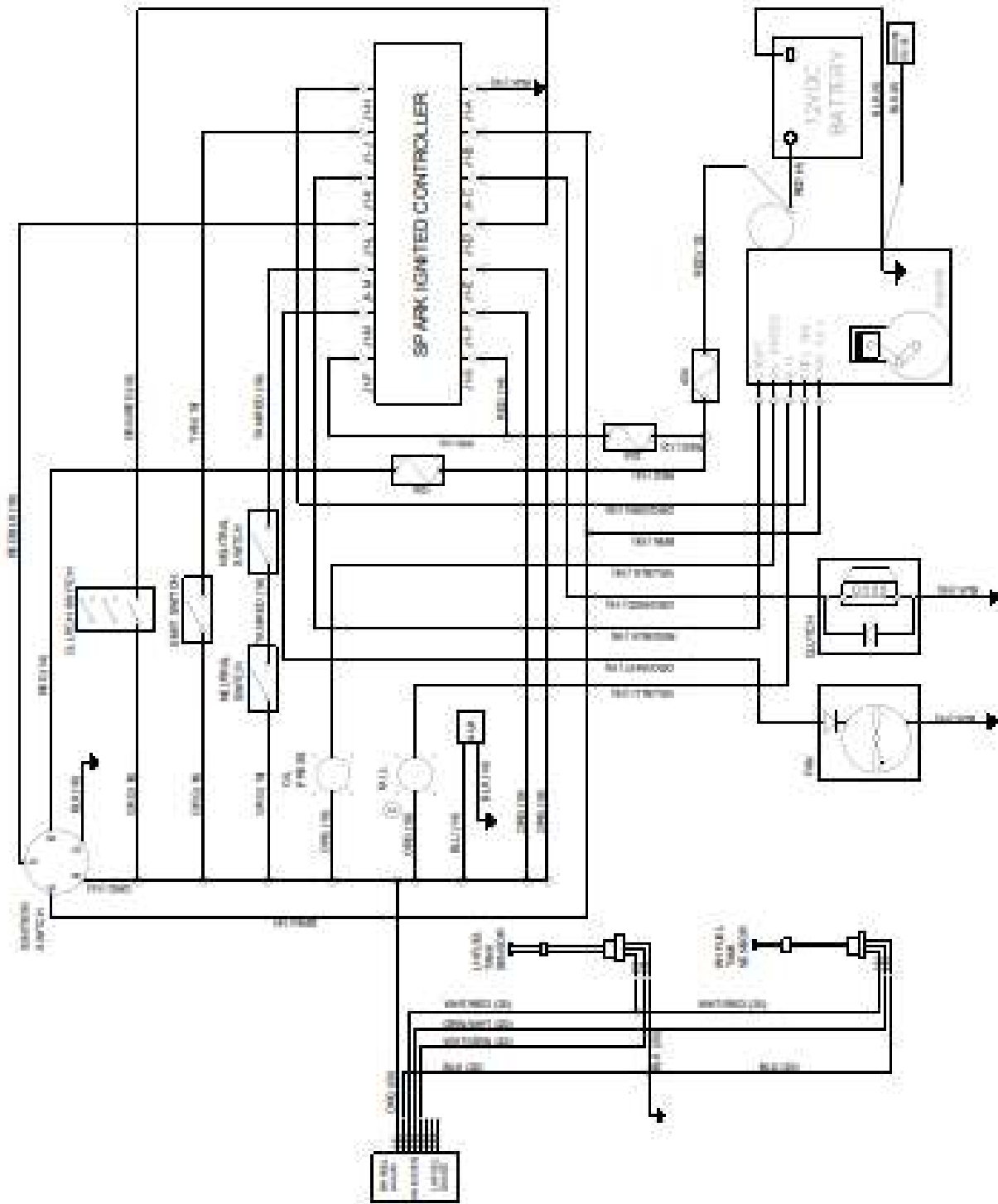


Figure 56

MAINTENANCE

Maintenance Schedule			
SERVICE AT INTERVALS INDICATED	WEEKLY OR 50 HOURS	MONTHLY OR 100 HOURS	* ANNUALLY OR 500 HOURS
Verify safety start interlock system	Prior to each use		
Visually inspect unit for loose hardware and/or damaged parts	Prior to each use		
Visually inspect tires	Prior to each use		
Check oil level, engine	Prior to each use or every 4 hours		
Clean oil heat exchanger (8)	Prior to each use or every 4 hours		
Check radiator screen (8)	Prior to each use or every 4 hours		
Clean air intake screen (8)	Prior to each use or every 4 hours		
Check fuel level	Prior to each use		
Clean engine and pump compartment	Daily		
Check air cleaner service indicator (8)	Daily		
Replace engine air cleaner element (5) (10)	As needed		
Caster fork tapered bearings (11)	Regular maintenance not required		
Change engine oil and filter (non EFI Oil Guard™ engines) (1) (4)	X		
Clean cylinder and head fins (10)	X		
Check battery connections	X		
Check tire pressure with a gauge	X		
Check hydraulic oil level	X		
Clean engine exterior (10)	X		
Grease pump idler (8)		X	
Grease front wheel bearings (8) (12)		X	
Clean & regap spark plugs (10)		X	
Check belt tension and condition (6)		X	
Check fuel system (7)		X	
Check hydraulic lines		X	
Check fuel valve (7)		X	
Check fuel tank grommets (7)		X	
Tighten lug nuts on wheels (2)		X	
Change engine oil and filter (EFI Oil Guard™ engines) (4) (13)			X
Change fuel filter (7)			X
Clean or replace hydraulic fill cap			X
Change hydraulic filter & oil (3)			X
Replace spark plugs (10)			X
Check ROPS mounting hardware (9)			X
Replace fuel evaporation system filter (8)			X

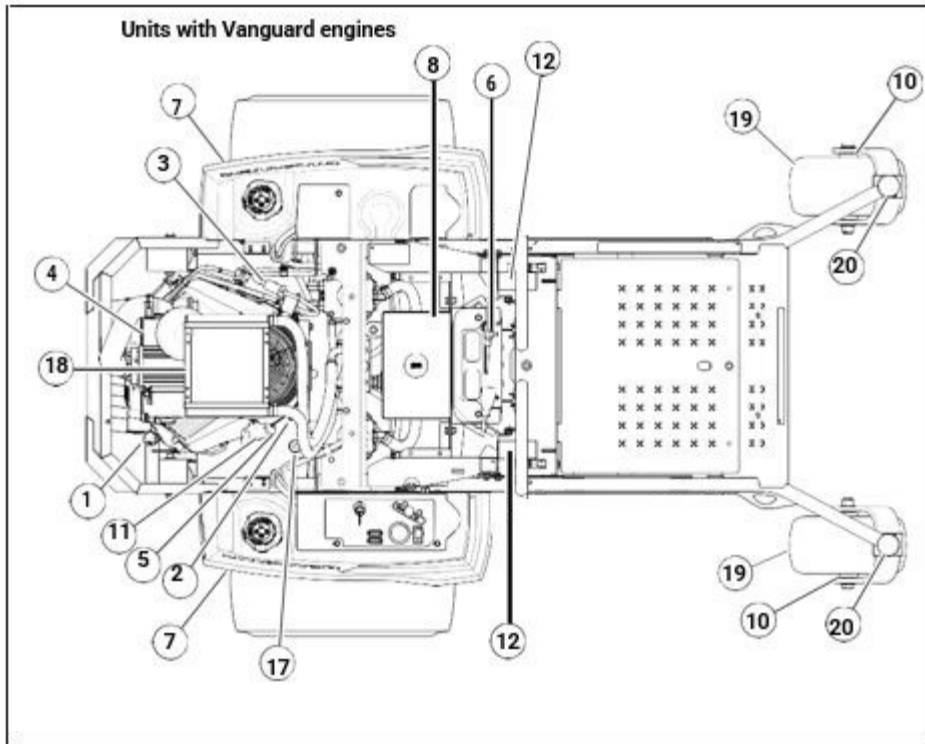
Figure 57

NOTES:

1. Initial engine oil change is after 5 hours of operation. Thereafter, change oil after every 40 hours operation. Change more often under dusty or dirty conditions and during hot weather periods.
2. Torque initially and after first 2 hours of operation.
3. Perform initial hydraulic oil and filter change after 50 hours (one week) of operation. Thereafter, change oil and filter annually or every 500 hours whichever comes first. Full Synthetic 20W50 Hydrostatic Transmission Oil is recommended.
4. Change engine oil filter per the engine manufacturer's recommendations. Refer to Engine Owner's Manual for recommendations and other maintenance items.
5. Service more often under dusty or dirty conditions. Use caution when servicing to prevent dust contamination in the engine. Do not clean filter element. Replace with a new one.
6. Pump drive belt only - Inspect belt every 100 hours and replace if worn or cracking is noticed. Check spring tension adjustment. Otherwise, replace belt every 400 hours or 2 years whichever comes first. Check and adjust spring tension after 50 hours of use as outlined in the Hydraulic Pump Belt Adjustment section of the General Service Manual (123934).
7. Check fuel system for any cracks or leaks including, but not limited to, fuel line hoses, fuel valve, vent line hoses, vent valve, vapor valve, carbon canister, and grommets. Replace as needed.
8. More often under dusty or dirty conditions and during hot weather.
9. Inspect ROPS after the first 20 hours of operation and then after every 500 hours of operation or yearly whichever comes first.
10. Refer to engine owner's manual for engine service information.
11. If caster fork tapered bearing seals leak, refer to the General Service Manual (P/N 123934) for repair procedures.
12. Refer to the General Service Manual (P/N 123934) to service or repair the tapered wheel bearings.
13. Initial oil change is after 500 hours of operation. Thereafter, change oil after every 500 hours operation. Change more often under dusty or dirty conditions.

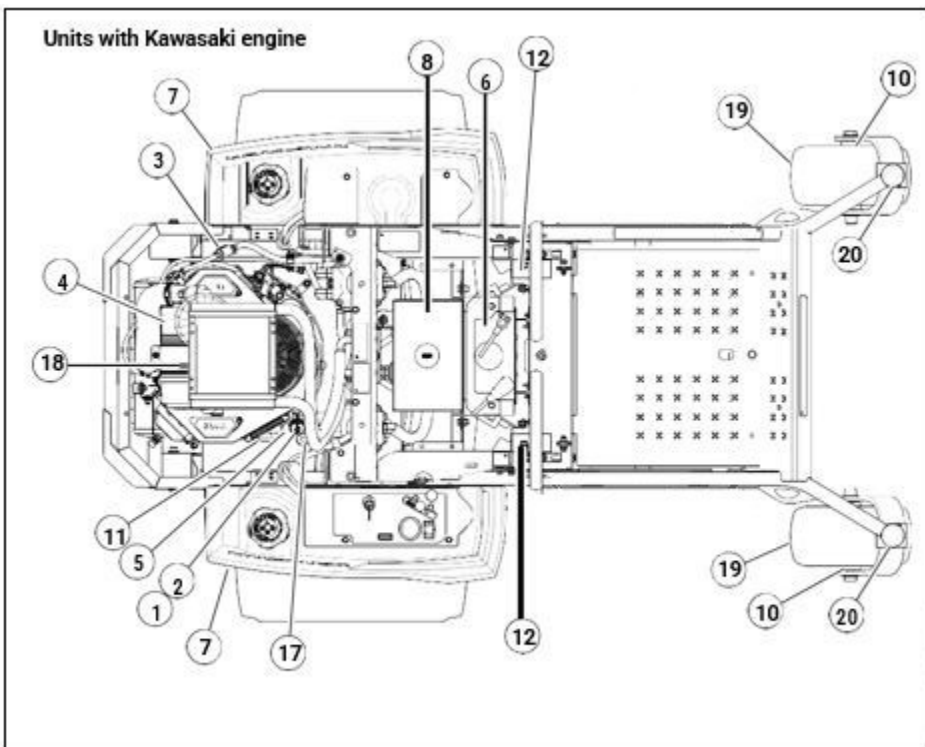
* After completing maintenance cycle (500 hours), repeat cycle

MAINTENANCE LOCATOR CHART



1. Engine Oil Fill
2. Engine Oil Dipstick
3. Fuel Filter
4. Engine Air Cleaner
5. Engine Oil Drain Plug
6. Battery
7. Fuel Tanks
8. Hydraulic Oil Reservoir
9. Hydraulic Oil Filter
10. Front Wheel Bearing Zerks (2)
11. Engine Oil Filter
12. Park Brake Switch
13. Drive Tires
14. Pump Idler Zerk (1)
15. Pump Belt
16. Spindle Housing Zerk (3)
17. Fuel Evaporation System Filter
18. Hydraulic Oil Heat Exchanger
19. Front Wheels Tires
20. Caster Fork Tapered Bearings

Figure 58



1. Engine Oil Fill
2. Engine Oil Dipstick
3. Fuel Filter
4. Engine Air Cleaner
5. Engine Oil Drain Plug
6. Battery
7. Fuel Tanks
8. Hydraulic Oil Reservoir
9. Hydraulic Oil Filter
10. Front Wheel Bearing Zerks (2)
11. Engine Oil Filter
12. Park Brake Switch
13. Drive Tires
14. Pump Idler Zerk (1)
15. Pump Belt
16. Spindle Housing Zerk (3)
17. Fuel Evaporation System Filter
18. Hydraulic Oil Heat Exchanger
19. Front Wheels Tires
20. Caster Fork Tapered Bearings

Figure 59

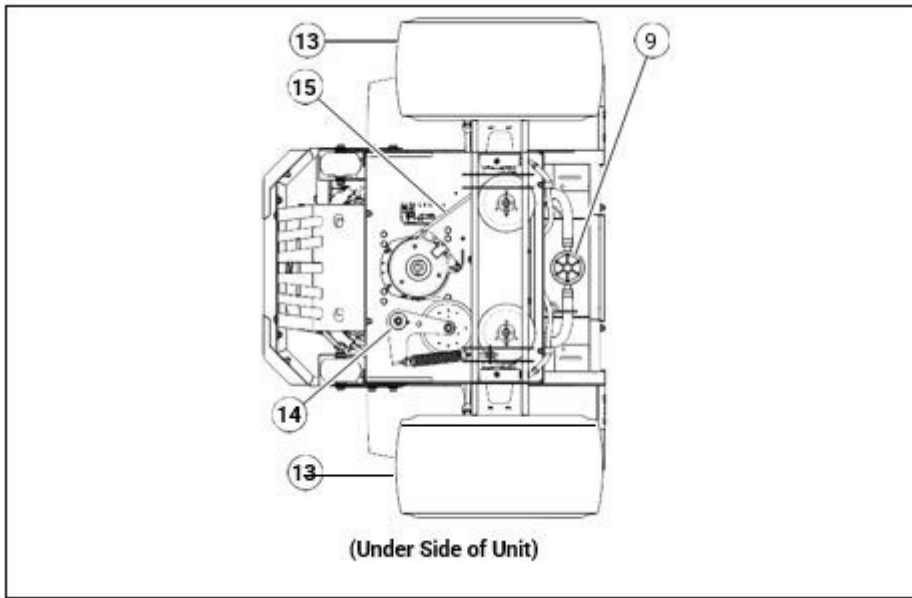


Figure 60

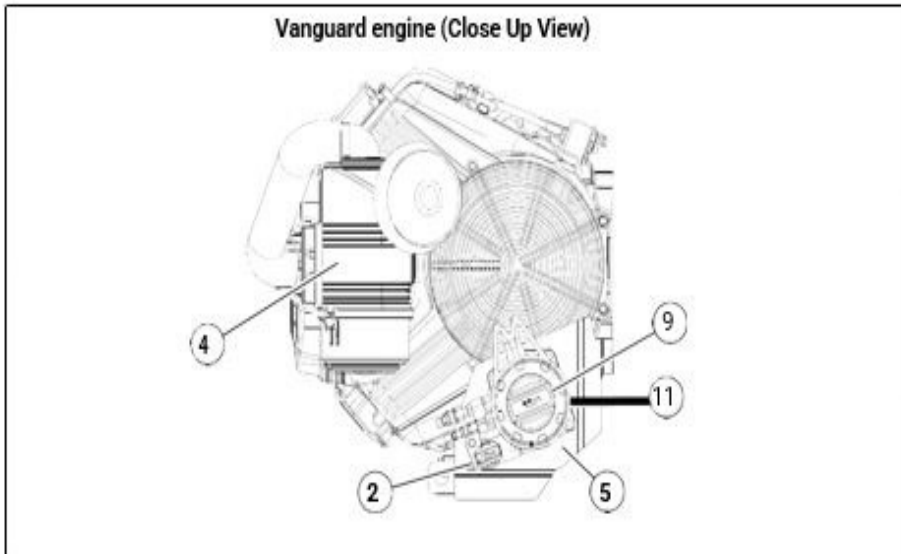


Figure 61

1. Engine Oil Fill
2. Engine Oil Dipstick
3. Fuel Filter
4. Engine Air Cleaner
5. Engine Oil Drain Plug
6. Battery
7. Fuel Tanks
8. Hydraulic Oil Reservoir
9. Hydraulic Oil Filter
10. Front Wheel Bearing Zerks (2)
11. Engine Oil Filter
12. Park Brake Switch
13. Drive Tires
14. Pump Idler Zerk (1)
15. Pump Belt
16. Spindle Housing Zerk (3)
17. Fuel Evaporation System Filter
18. Hydraulic Oil Heat Exchanger
19. Front Wheels Tires
20. Caster Fork Tapered Bearings

TROUBLESHOOTING

The majority of operating problems that occur with a system can be traced to improper adjustments or delayed service. A consistently applied preventative maintenance program, as outlined in the Maintenance section of this manual, will prevent many problems. The following chart is designed to help you locate a problem by suggesting probable causes and the recommended solutions.

SYMPTOMS	PROBABLE CAUSES	SUGGESTED REMEDIES
Starting motor does not crank	Steering control levers not in park brake position or switch not adjusted	Place steering control levers in park brake position or re-adjust switch
	Brush clutch switch engaged	Disengage clutch switch
	Weak or dead battery	Recharge or replace
	Electrical connections are corroded or loose	Check the electrical connections
	For additional causes	See engine manual
The engine will not start, starts hard or fails to keep running	No fuel or line plugged	Fill tank or replace line (See Fuel System section for more details)
	Fuel valve is turned off	Open the fuel valve
	There is incorrect fuel in the fuel system	Drain the tank and replace the fuel with the proper type
	There is dirt in the fuel filter	Replace the fuel filter
	Dirt, water or stale fuel in the fuel system	Contact your dealer
	The choke (if equipped) is not on	Move the choke lever to ON
	Numerous	See engine manual
Engine: Runs with continuous misfiring or engine runs unevenly or erratically	Numerous	See engine manual

SYMPTOMS	PROBABLE CAUSES	SUGGESTED REMEDIES
Loss of power or system will not operate in either direction	Restrictions in air cleaner	Service air cleaner
	Hydraulic line blockage	See your dealer
	Internal interference or leakage in wheel motor	See your dealer
	Insufficient hydraulic oil supply	Check level in reservoir
		Have dealer check hydraulic pump
	Poor compression	See your dealer
	Steering linkage needs adjustment	Adjust linkage
	Tow valve open	Close tow valve
	The traction drive belt is worn, loose or broken	Install a new traction drive belt
	Air in system	Check filter and fittings
For additional causes	See engine manual	
Air cooled engine over-heating	Air intake screen or cleaning fins clogged	Clean screen and fin
	For additional causes	See engine manual
Low engine oil pressure	Low oil level	Add oil
	Oil diluted or too light	Change oil and check for source of contamination
	Failed oil pump	Contact your dealer
High oil consumption	Numerous	Contact your dealer
Movement jerky when starting or operates in one direction only	Steering control linkage needs adjustment	Adjust linkage
	Pump or wheel motors faulty	Contact your dealer
	Tow valves not closed completely	Close tow valves

SYMPTOMS	PROBABLE CAUSES	SUGGESTED REMEDIES
Hydraulic system operates hot (oil in reservoir smells rancid)	Low hydraulic oil level	Fill reservoir
	Hydraulic pump faulty	Contact your dealer
	Hydraulic oil heat exchanger clogged	Clean oil heat exchanger core
Unit creeps when steering control levers are in neutral	Steering linkage needs adjustment	Adjust linkage
	Wheel motors faulty	Contact your dealer
Unit circles or veers in one direction	Steering linkage needs adjustment	Adjust linkage
	Wheel motors faulty	Contact your dealer
Unit creeps when steering control levers are in neutral	Tires improperly inflated	Adjust air pressure to 8–12 psi (55–83 KPa)
Unit circles or veers in one direction Unit creeps when parking brake engaged There is abnormal vibration	Hydraulic pump faulty	Contact your dealer
	Steering linkage out of adjustment	Adjust steering linkage
	Brakes need adjustment	Adjust parking brakes
	The engine mounting bolts are loose	Tighten the engine mounting bolts
Unit creeps when parking brake engaged	The engine pulley, idler pulley is loose	Tighten the appropriate pulley
	The engine pulley is damaged	Contact your dealer
	Spindle bearing is worn or loose	Replace or tighten spindle bearing
	The hydraulic belt is worn, loose or broken	Install a new hydraulic belt
	The hydraulic belt is off the pulley	Install the hydraulic belt and check for a reason
	Electric clutch is not engaging	Check and/or replace 10-amp fuse. Contact your dealer

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