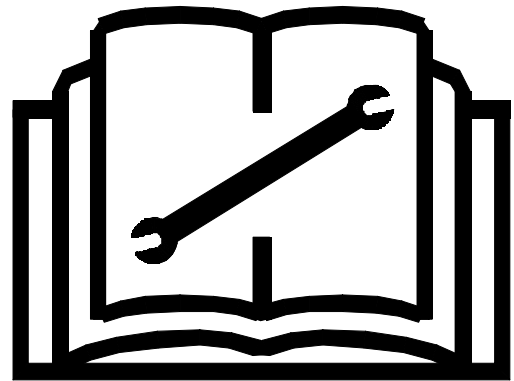


Vermeer®

***BC1230A
Brush Chipper***



Service Manual

BC1230A_S1_00
Serial No. 101 -
Order No. 105400Y13

This manual contains service requirements and procedures needed by an experienced service person to complete necessary service and repairs on the machine. Study and understand these requirements and procedures thoroughly before servicing or repairing the machine. There are also many components which are not user-serviceable. Do not attempt any service which you do not fully understand, nor any service that you cannot do adequately and safely with the tools and equipment available to you. Failure to do so could result in personal injury or equipment damage. If you encounter a problem that you do not understand or cannot solve, contact your Vermeer service representative.

The instructions, illustrations and specifications in this manual are based on the latest information available at the time of publication. Your machine may have product improvements and options not yet contained in this manual.

Vermeer Manufacturing Company reserves the right to make changes at any time without notice or obligation.

Additional copies of this manual are available. When ordering, use the part number on the front cover.

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1210 Vermeer Road East, P.O. Box 200
Pella, Iowa 50219-0200, USA**

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Chapter 1: General Information

USING THE MANUAL

This manual provides information and service procedures *based* upon current machine knowledge and configuration at the time the manual was written. The instructions, illustrations and specifications are based on the latest information available at the time of publication. Due to ongoing efforts to continuously improve the equipment, there may be changes on the machine not yet reflected in this manual.

Vermeer Manufacturing Company reserves the right to make changes at any time without notice or obligation.

Procedures given in this manual provide one method for completing a given task. Additional information may be available through Vermeer Service Support resources.

Additional copies of this manual are available through the Vermeer Parts Center. Use the reorder number on the front cover to order additional manuals.

Operating instructions are found in the *BC1230A Brush Chipper Operator's Manual*. Lubrication and maintenance procedures are found in the *BC1230A Brush Chipper Maintenance Manual*. Refer to "Reference Publications," for ordering information.

NOTE: Chapter titles located at the edge of the page aid in quickly locating information.

Reference Publications

Vermeer Publications	The following Vermeer Manufacturing Publications are necessary for reference: • BC1230A Brush Chipper Operator's Manual, order number 105400W95 • BC1230A Brush Chipper Maintenance Manual, order number 105400W97 • BC1230A Brush Chipper Parts Manual, order number 105400ZEW • Vermeer Industrial Dealerships Technician's Shop Manual, order number 105400V80 • Recommended Service Tools Users Guide, order number 105400T69 for special tools and test equipment.
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Contact the Vermeer Parts Center to order these publications.

Vendor Publications	The following vendor publications are optional reference materials: Contact the appropriate local dealer for this information. Vermeer Manufacturing Company does not verify the validity of vendor information within the context of the BC1230A machine configuration.
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WARRANTY CONSIDERATIONS

Vermeer Warranty

Vermeer 1 year Limited Warranty is printed inside the front cover of the Operator's Manual. The warranty requires that all service work be conducted by an authorized Vermeer representative or the warranty shall become void.

Caterpillar Engine Warranty

The Caterpillar engine is covered under the engine manufacturer's warranty.

Understand that only an authorized service facility may work on the engine while the warranty is in effect. Unauthorized service on the engine will void the warranty.

For the nearest Caterpillar authorized facility, consult the Yellow Pages of the phone directory or contact Caterpillar manufacturers Engine Warranty Service Dept.

SAFETY

General safety messages appear in this Safety section of the manual. Specific safety messages are located in the applicable sections of the manual where a potential hazard may occur if the instructions or procedures are not followed.

A signal word “**DANGER**”, “**WARNING**”, or “**CAUTION**” is used with the safety alert symbol.

Safety signs with signal word “**DANGER**”, “**WARNING**”, or “**CAUTION**” are located near specific hazards.

DANGER: Imminent hazards which, if not avoided, will result in serious personal injury or death.

WARNING: Potential hazards or unsafe practices which, if not avoided, could result in serious personal injury or death.

CAUTION: Potential hazards or unsafe practices which, if not avoided, could result in minor personal injury or product or property damage.

Do Not Modify Machine

Make no modifications to your equipment unless specifically recommended or requested by Vermeer Manufacturing Company.

Replace Shields

Be sure that all safety devices, including shields, are installed and functioning properly after servicing the machine.

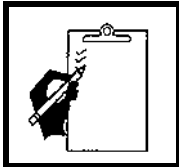
Safety Symbol Explanation



This is the safety alert symbol. This symbol is used in combination with an exclamation mark or other symbols to alert you to the potential for bodily injury or death.



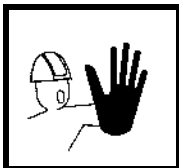
Read Operator's Manual and safety signs before operating machine. Allow only responsible, properly instructed individuals to operate and service the machine.



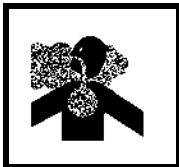
WARNING: Check machine before operating. Machine must be in good operating condition and all safety equipment installed and functioning properly.



Wear personal protective equipment. Wear close-fitting clothing and confine long hair. Avoid wearing jewelry such as rings, wristwatches, necklaces, or bracelets. Always wear a hard hat, safety glasses, and safety shoes.

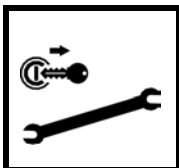


WARNING: Keep spectators away.



WARNING: Exhaust fumes can be fatal.

If operating in an enclosed area, remove the exhaust fumes with an exhaust pipe extension to the outside.

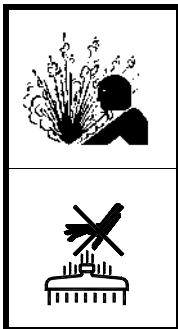


WARNING: Use Shutdown Procedure before servicing, cleaning, repairing, or transporting machine. Refer to "[Shutdown Procedure](#)," page [2-1](#) for instructions.

Continued on next page...



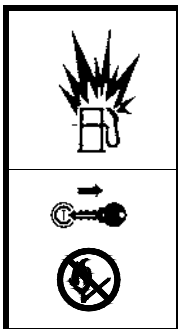
WARNING: Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible. Keep away from any suspected leak. Relieve pressure in the hydraulic system before searching for leaks, disconnecting hoses, or performing any other work on the system. If you must pressurize the system to find a suspected leak, use an object such as a piece of wood or cardboard rather than your hands. When loosening a fitting where some residual pressure may exist, slowly loosen the fitting until oil begins to leak. Wait for leaking to stop before disconnecting the fitting. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.



WARNING: Hot fluid under pressure can scald.



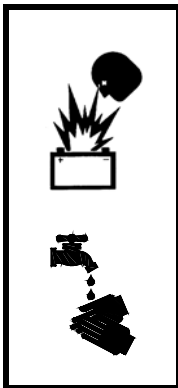
Allow engine to cool before opening radiator cap.



WARNING: Fuel and fumes can explode and burn.



Shut off engine before refueling. No flame. No smoking.

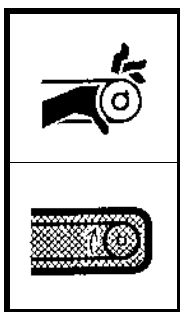


WARNING: Batteries produce an explosive gas when in use or being charged.

Wear protective clothing and face shield while working around batteries. Do not smoke, and keep flames and spark away from the battery area.

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.

Continued on next page...



WARNING: Moving parts can crush fingers.

Close all shields before starting.



WARNING: Failure to follow any of the preceding safety instructions or those that follow within this manual, could result in serious injury or death. This machine is to be used only for those purposes for which it was intended as explained in the Operator's Manual.

TERMINOLOGY

Circuit

An identifiable grouping of components that fill a specific role within a function.

Inputs and Outputs

Inputs and outputs are shown on functional diagrams by different line styles classified as hydraulic, electrical, pneumatic, and mechanical. Arrows on the end of the lines represent direction of electrical current flow, hydraulic oil flow, and air flow.

Reference Designators

Reference Designators are assigned to each component shown on schematic diagrams. A legend describing the reference designators, the symbols, and how they are used in the circuit diagrams and text is provided in chapter 2.

Each code-like designator identifies a specific component. The designator is comprised of an uppercase letter or letters followed by a number. The letters identify the type of component and the number specifies the exact component.

Diagrams and Schematics

Functional diagrams, schematics, wire harness connections, and hydraulic hose connections are located throughout the chapters. The diagrams represent function circuitry and components. Large format schematics and diagrams are located in the addendum section in the back of manual. See the following Chapter Organization information.

Chapter Organization

Other than the general and the machine information (chapters 1 and 2), the manual is divided up into chapters based on machine functions.

Each chapter will be divided into two sections. The first part of each chapter is devoted to theory/troubleshooting information and the last portion provides information on component repair.

Theory/ Troubleshooting	The theory/troubleshooting section is arranged starting with an overview of the function. The overview consists of a list of circuits and components, and a graphic depicting component locations. It also includes a description of what happens when the controls are activated, and how components that comprise that function work together to achieve the desired work. Illustrations, along with the text, will aid in understanding how the function works.
Component Repair	When it is determined through troubleshooting that components are malfunctioning, the “Component Repair” section of the chapter contains detailed instructions on how to repair or replace components and any special steps or procedures needed before returning the machine to service.
Addendum	Reference materials such as complete machine electrical and hydraulic schematics as well as wire harness diagrams too large to fit on standard pages, are located in the addendum in the back of this manual on 11 x 17” foldouts.

TROUBLESHOOTING GUIDELINES

Problem-Solving Analysis

First, look at the overall condition of the machine functions and determining whether a technical problem even exists.

Rule Out Operator Error	The operator may not be familiar with machine interlocks that must be in the appropriate position to allow a certain function to perform. In other words, the operator may not thoroughly understand the theory of operation. Ensure you are familiar with the interlocks (or refer to the BC1230A Brush Chipper Operator's Manual) and verify with the operator that all interlocks are satisfied, that any E-stop switches are closed and other simple items. Refer to "System Interlocks," page 2-11 to see the list of interlocks used on this machine.
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Define the Problem	Once operator error is ruled out, analysis begins by asking questions and making observations as follows: • Discuss the defect with the operator. Learn what function or actuator is not working and whether it is too slow, too fast or not working at all. • Ask if the operator has recently used all the other actuators and whether they seemed to be working normally. If not, ask the operator to try to use these actuators. If there are multiple problems, there could be a common cause to all of them.
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- If possible, inspect the machine. Verify that the problem is not something obvious, like low hydraulic fluid, broken lines or wires. If you cannot personally inspect the machine (such as when speaking over the phone), ask the operator to check for these simple problems. Many problems are solved this way.
- Ask other questions to further define the problem, such as:
 - Did the problem appear suddenly, or did machine performance deteriorate over time?
 - When was the problem first noticed, and had there been any changes made to the machine or the working conditions prior to the problem's appearance?
 - Were any odd smells, sounds or machine actions noticed at the same time as the problem?
 - Is the problem intermittent or continuous?
 - If intermittent, does it occur when the machine is cold, or fully warmed up?
 - Does it occur in cold weather, hot weather, dry weather, humid weather?
- Compare the problem with others from past experiences on this machine or machines similar to this one.
- Make an overall observation of the situation, noting symptoms and relevant changes.

Research the Machine

Familiarize yourself with the Service Manual by reading the General and Machine Information chapters.

These chapters, explain in detail how the machine is comprised of multiple functions and circuits as well as some components that may be used to activate more than one function.

If you are not familiar with, or have limited knowledge of the machine's functions, read the theory of operation for all or selected functions.

NOTE: Do not skip the analysis or research phase of troubleshooting. Simply replacing a component may solve the problem if you make a lucky guess, but it will waste time and money, as well as lessen your credibility with the customer if it does not solve the problem. Do the analysis, do the research and find the true cause of the problem.

If you are not familiar with this machine, read the Service Manual and refer to your notes describing the problem. This may give you insight that allows you to locate the true cause of the trouble.

Continued on next page...

Begin troubleshooting by doing the following:

- Describe and compare the problem situation with known operating conditions prior to breakdown.
- Describe all known differences such as symptoms, noises, and smells noticed when the failure occurred.
- Note which functions appear to behave normally and which do not.

Fault Charts

After doing the problem-solving analysis and noting the findings, use the observations to decide which function fault chart best applies to the problem to determine which circuits to investigate. Certain function chapters may include fault charts with troubleshooting information.

NOTE: The troubleshooting procedures in this manual cover the electrical and hydraulic circuits. First ensure a mechanical problem is not the cause of the failure before using the troubleshooting procedures.

Electrical Troubleshooting

Common Electrical Problems

Listed below are some common problems to consider when troubleshooting the electrical circuits:

- **Ground**

Characteristic of ground problems can be no circuit or component function or intermittent function. Ground problems can be blamed for about 50% of all electrical problems.

- **High Resistance**

A characteristic of high unwanted resistance is lower than normal circuit current. Higher than normal resistance in a circuit will result in a lower circuit current. This can be caused by loose, corroded, or oily terminals and connections on wire and cables, broken strands in wire, or a poor ground connection.

Measurements taken with a multimeter can be used to troubleshoot for unwanted resistance. Use the meter to test for lower than normal battery voltage (voltage drop) while moving to accessible points in the circuit wiring.

- **Open Circuit**

Characteristics of an open circuit are zero current, infinite resistance, and higher than normal voltage. An open circuit can be found either on the voltage side or the ground side of a circuit. If there is an open anywhere in the circuit, the current path is broken and current will cease to flow through the circuit.

An open circuit can occur when a component fails internally, a wire or cable is broken or burned through or becomes detached, or when pins inside a connector do not make contact.

In a normal working circuit, voltage is applied to the resistive load where it is dropped proportionately over each resistor in the circuit. The amount of voltage drop is dependent on the value of each resistor. Open circuits cannot drop voltage.

Although, troubleshooters may find full battery voltage all the way to the open part of circuit. Full battery voltage can also be found on the ground side of the circuit if the circuit is open near the battery negative terminal.

Measurements taken with a multimeter can be used to troubleshoot an open circuit. Use the meter to test for voltage while moving to accessible points in the circuit to find the open and isolate the failed component or wire harness section.

Continued on next page...

- **Short Circuit**

Characteristics of a short circuit are higher than normal current, and zero resistance. A short circuit can be caused by a component being subjected to heat, vibration, and so on as it ages. Over time this can cause abrasions in the insulation on coils and wires and such. Exposed wires can provide a short path for current, reducing the resistance that was designed into the circuit(s).

The resistance lowers causing the current to increase to a level higher than the circuit fuse was designed to handle, resulting in a blown fuse. The source of the short must be fixed or the fuse will continue to trip.

Hydraulic Troubleshooting

Leakage Path Analysis

The hydraulic troubleshooting procedures are based on leakage path analysis. Using these methods, components are tested under no-load and then full-load. The measurements taken from the test equipment are compared to the standard specifications and tolerances for that component.

The specifications and tolerances give values indicating the nominal, minimum, and maximum operating parameters.

High leakage will cause system overheating and/or a decline in actuator speed. The amount of leakage is influenced by four factors:

- pressure difference across clearances
- oil viscosity
- temperature
- size of clearances

NOTE: Clearance-related problems are generally viscosity sensitive. Increased leakage will be less obvious when the fluid temperature is low and will increase as the fluid temperature increases.

Pumps and Motors

All pumps and motors have internal clearances (internal leakage), but some design types have less leakage than others of the same displacement. Piston pumps or motors leak less than gear or gerotor pumps and motors.

The general rule used at Vermeer for expected leakages is:

Theoretical flow is equal to displacement times input shaft speed; i.e., CID X RPM.

Example: A pump with a 3.0 in³ displacement, turned at 2500 RPM, has a theoretical flow of 7500 in³/min.

- Piston pumps and piston motors are expected to lose about 3% of theoretical flow at normal working pressures. This is a 97% volumetric efficiency.
- Gear pumps and motors are expected to lose about 20% of theoretical flow at normal working pressures. This is an 80% volumetric efficiency. (This rises to 90% if the gear pump has pressure-compensated wear plates.)

Through normal wear over time, the clearances between the moving parts in the pump get larger, allowing more internal leakage. Eventually, the clearances are large enough that the pump or motor is worn-out.

The guideline used at Vermeer for determining a pump or motor is worn-out is:

- When volumetric efficiency for the pump or motor declines to 70% or less, the pump or motor should be replaced.

The most common symptoms associated with excessive pump/motor leakage are:

- A loss of actuator speed as the fluid temperature increases.
- A moderate to high increase in the operating temperature of the fluid.
- Actuator stalling at low pump or motor speed.
- An increase in case pressure which could result in shaft seal leakage.

Any increase in internal leakage will result in increased flow into case drain lines of externally drained pumps and motors. If case drain flow increases, case pressure will increase because of higher flow resistance through drain port in the housing and case drain lines. Excessive case pressure could result in shaft seal failure and case seal leakage.

The most common symptoms associated with excessive pump/motor case pressure are:

- Shaft seal leakage
- Catastrophic shaft seal failure
- Case seal leakage
- Moderate to high increase in the operating temperature of the fluid

Directional Control Valves

Directional control valves have radial clearances between the valve bore and spool of between 5 to 15 micrometers. If fluid is heavily contaminated with particles that are equal in size, the particles will cause abrasive wear. Abrasive wear will gradually increase the radial and diametrical clearances, resulting in increased cross-port leakage.

The most common symptoms associated with excessive directional control valve leakage are:

- Increased actuator drifting while directional control valve is in the NEUTRAL position.
- Moderate to high increase in the operating temperature of the fluid.
- Loss of precise position control.

Cylinders

Hydraulic cylinders consists of a moveable piston and rod assemblies. Pistons have seals to prevent leakage across the piston.

The most common symptoms associated with excessive cylinder leakage are:

- Cylinder fails to respond when directional control valve is actuated.
- Reduced cylinder rod velocity in one or both directions of travel.
- Moderate to high increase in the operating temperature of the oil.
- Cylinder rod speed reduction as the load increases.
- Actuator drifts when the directional control valve is in NEUTRAL position.
- Cylinder rod extends regardless of which port the oil enters.

Required Tools

- Digital multimeter—for performing voltage, current and resistance tests
- Calculator—for doing simple arithmetic quickly and accurately
- Pyrometer or thermometer with a magnetic base—for temperature readings
- Pressure gauges—for measuring system pressure
- Vacuum gauge—for measuring inlet pressure
- Flow meter—for measuring system flow
- Needle valve—for imposing an artificial load
- Combination flow meter/needle valve/pressure gauge—for measuring flow, pressure, and imposing artificial loads with one tool

Hydraulic Connections



WARNING: Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible. Keep away from any suspected leaks. Relieve pressure in the hydraulic system before searching for leaks, disconnecting hoses, or performing any other work on the system. If you must pressurize the system to find a suspected leak, use an object such as a piece of wood or cardboard rather than your hands. When loosening a fitting where some residual pressure may exist, slowly loosen the fitting until oil begins to leak. Wait for leaking to stop before disconnecting the fitting. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Avoid Trapped Pressure

Never disconnect hoses or lines unless the engine is shut down.

Avoid Oil Contamination

Warranty claims may be denied if damage is caused by contaminated hydraulic fluid.

Use care to avoid allowing dirt, dust or debris to enter the hydraulic system. Contaminated oil will ruin a pump in a short amount of time.

- Clean dirt from hose connections before loosening any connection.
- Use new, clean plugs to plug disconnected hoses. If clean plugs are not available, place plastic bags (such as sandwich bags) over the ends of hoses and hold them in place with rubber bands.
- When adding oil, use new oil filtered through a 10-micron absolute filter. (New oil is full of particles from metal storage containers and is not intended to be added directly to the hydraulic tank.)
- One source of contamination is dirt adhering to the cylinder rod and being drawn into the system when the rod is retracted. The wiper seals clean dirt from the rod as it retracts, but scratches in the rod will allow dirt past the wipers. Take care to avoid scratching the cylinder rods and regularly inspect rods for scratches. Draw your fingernail across any scratches. If the scratch is deep enough to catch the fingernail, the scratch should be polished out with fine emery cloth, or the rod should be replaced.

Connecting Flow Meters

Flow meters measure flow in one direction only. An arrow on the flow meter indicates the direction. The test setup instructions will state which way the flow arrow must point.

Often, adapters will be needed to plumb the flow meter into the line. It is important that the flow through the meter is not restricted (unintentionally) by using a flow meter or adapters that are of smaller diameter than the hose. Use a larger diameter flow meter if needed, and use adapters to connect the smaller diameter hose to the larger diameter flow meter.

Use a flow meter that is rated to safely withstand the pressure in the circuit.

Connecting a Needle Valve

Needle valves are used to impose artificial loads on pumps so the performance of the pump can be accurately measured. By slowly closing the needle valve while watching the pressure gauge, you can easily set the pressure as needed for the flow measurement.

As with flow meters, you can safely use a larger diameter needle valve, but you must not use smaller diameters.

NOTE: Do NOT attempt to use a ball valve in place of a needle valve. The ball valve is not precise and tends to snap closed by itself when higher pressures are reached. This will send a destructive pressure spike back through the system.

Connecting Pressure Gauges

Pressure gauges are selected according to the expected maximum pressure to be observed during the test. Since the gauge is most accurate at the middle of its range, read through the test to determine the expected maximum pressure and double that amount. Thus, if you expect to see 3000 psi as the greatest pressure during the test, select a 0–6000 psi gauge or a 0–7500 psi gauge.

IMPORTANT: If the gauge ever “pegs” (indicates pressure at the maximum reading), the gauge is ruined. Discard it immediately so that another technician does not use it and receive erroneous readings.

Thermometer or Pyrometer

The magnetic-base thermometer is placed on the oil tank to determine the temperature of the oil. Allow time for the thermometer to react before taking a temperature reading.

The pyrometer is a non-contact thermometer. Place the projected red dot on the surface and wait at least one second. The temperature of the surface is shown in the indicator window.

Several readings may be required during the same test. It is important to take the readings with the projected dot focused on the same spot on the surface.

Digital Multimeter

The multimeter is used to measure voltage, current, and resistance. It is also used to test wires for continuity.

Measuring Voltage

Voltage is defined as a difference in electrical potential between two points. Set the multimeter to measure volts DC in the appropriate range. If needed, see the instruction booklet for your multimeter to determine proper settings. Then do the following:

1. Turn off power to the circuit or device.
2. Connect positive (red) lead to the multimeter's voltage or $V\Omega$ port. Place the probe on the wire or contact delivering power to the device.
3. Connect negative (black) lead to the common or COM port. Place black probe on the wire or contact leading to ground for the device. In some cases you may place the black probe on the metal structure of the vehicle chassis (the multimeter is in parallel with the circuit).
4. Turn on power to the device.

The multimeter will indicate the voltage available to power the device.

Measuring Resistance

Resistance, measured in Ohms (Ω) is defined as the opposition to current flow. Set multimeter to measure resistance. If needed, see the instruction booklet for your multimeter to determine proper settings. Then do the following:

1. Turn off power to the circuit or device.
2. Connect the positive (red) lead in the multimeter's voltage or V Ω port. Place red probe on the wire or contact delivering power to the device.
3. Connect negative (black) lead in the common or COM port. Place black probe on the wire or contact leading to ground for the device (the multimeter is in parallel with the circuit).

The multimeter sends a small current through the device and indicates the amount of resistance encountered. Resistance (Ohms or Ω) greater than or less than published tolerances indicates the device is damaged and should be replaced.

Testing for Continuity

Continuity is defined as the presence of a complete pathway for the flow of current. With the multimeter set to test continuity, do the following:

1. Turn off power to the device or circuit.
2. Disconnect the section of harness in question.
3. Place one probe on one end of the wire or terminal of the device. Place the other probe on the other end of the same wire or opposite terminal of the same device.

An indication of zero or very low resistance (Ohms or Ω), indicates continuity (good wire or closed switch). High resistance or an indication of "OL" (overload) means there is no electrical contact between the two probes, i.e., the wire is broken or the switch is open. In this manual, the results of a continuity check are described as "continuity" or "open."

Some multimeters or continuity testers produce a beep or illuminate a bulb to indicate continuity.

Measuring Current

Current or amperage is defined as the flow of electrons. Set the multimeter to measure amps DC or milliamps DC. If needed, see the instruction booklet for your multimeter to determine proper settings.) This involves plugging the leads to the proper ports in the multimeter and setting the knobs and/or range switches correctly for measuring the expected amount of current (microamps, milliamps or amps). Then do the following:

1. Turn off power to the circuit or device.
2. Unplug the device from the wiring harness and install the proper breakout box.
3. Disconnect exposed connector for the desired wire.
4. Place red probe on one of the exposed connectors for the wire.
5. Place black probe on the other exposed connector for the wire. The multimeter is in series with the circuit.
6. Turn on power to the device.

The multimeter indicates the current in amps (A), milliamps (mA) or microamps (μ A).

REPAIR GUIDELINES**Safety Equipment**

Ensure all technicians have and use proper safety equipment, including steel-toed shoes, protective eyewear, gloves, and hearing protection.

Do not allow spectators or bystanders in your shop unless they are wearing adequate protective gear.

Ensure shop has proper fire prevention and fire-fighting equipment and that all technicians know how and when to use it.

Shop Requirements**Special Tools and Test Equipment**

To perform some tasks, special tools— available through Vermeer—may be required. These tools, are specified at the beginning of the procedure where they are needed.

Refer to the [Recommended Service Tools Users Guide](#) (Vermeer P/N 105400T69) for special tools and test equipment.

Personnel and Lifting Requirements

Review each task to determine the number of personnel needed for *safe* completion.

Determine if suitable lifting devices are needed to safely lift or lower the component.

Replacement Parts

Part Numbers/Hose Lengths/Fitting Orientation Refer to the most current *BC1230A Brush Chipper Parts Manual*, order number 105400ZEW, for part numbers, hose lengths, and fitting orientations.

Parts Ordering Contact the Vermeer Parts Center with part number information to order replacement components.

Torque Values

Repair procedures in this manual will list torque values for any part that needs to be tightened to an other-than-standard torque value. For (standard) torques on other parts, refer to the torque tables, given in the *Vermeer Industrial Dealerships Technician's Shop Manual*, order number 105400V80.

Chapter 2: System Information

SHUTDOWN PROCEDURE

IMPORTANT: For your safety and the safety of others, use the shutdown procedure before working on the machine for any reason, including servicing, cleaning, unclogging, inspecting, or transporting the chipper.

A variation of this procedure may be used if so instructed within this manual, or if an emergency requires it.

1. Return upper feed control bar to NEUTRAL.
2. Reduce engine speed to idle.
 - **Non-turbo:** Adjust throttle.
 - **Turbo:** Move throttle switch to LOW (1000 rpm).

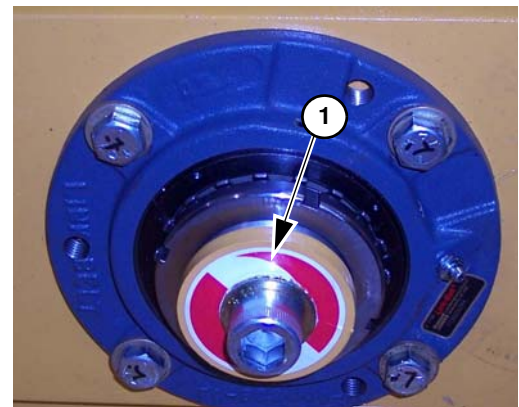
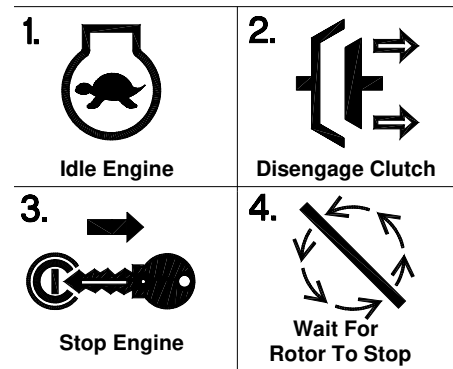
IMPORTANT: Whenever practical and consistent with good safety practice, run engine without load for a few minutes before shutting it off. This allows engine temperatures to decrease and equalize, which will increase engine life.

3. Fully disengage clutch.
4. Turn ignition key to OFF and remove key.
5. Wait for cutter disc to stop.

NOTE: Cutter disc rotation can be checked by looking at the end of the shaft (1) on the cutter disc housing.

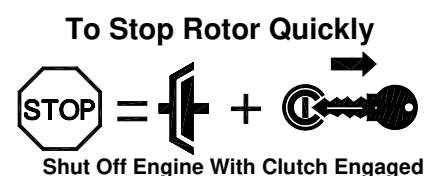
IMPORTANT: Cutter disc will continue to turn for a short time after engine has stopped.

6. Close and latch feed table.



Quick Stop Procedure

1. Turn ignition to OFF position with clutch engaged and remove key.
2. Wait for cutter disc to stop.
3. Disengage clutch.



INTENDED USE

Operations Overview

The BC1230A Brush Chipper is used to chip branches and limbs up to 12" (30 cm) in diameter. It is towed to the work site, then parked. The chipper may be unhitched from the towing vehicle during chipping operations, provided the machine is parked on a level surface, the tongue is supported by the tongue jack, and the wheels are chocked.

The operator adjusts the discharge chute to blow the chips in a safe direction.

Tongue Jack

If the chipper is unhitched, the operator levels the chipper using the manual jack, which is located on the tongue.

Engine

The operator starts the engine and engages the clutch to turn the cutter disc. Engine speed is controlled with the manual throttle control (non-turbo machines) or throttle switch (turbo machines).

There are two engine options for this machine:

- 83 hp Caterpillar 3054C non-turbo diesel engine
- 112 hp Caterpillar 3054ET turbo diesel engine

Cutter Disc

The engine output shaft is connected to an engine sheave. If the clutch is engaged, the drive belt turns the sheave connected to the cutter disc shaft. Knives bolted to the cutter disc pass close by a shear bar. The knives and shear bar work together to shave chips from the limb.

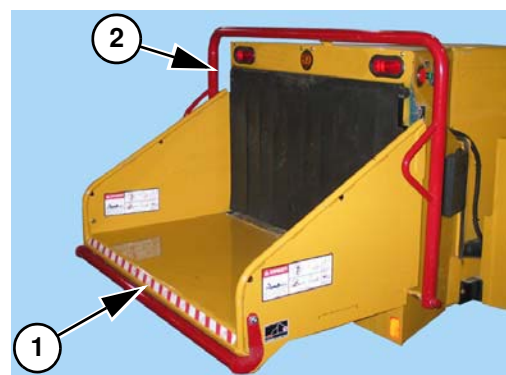
Feed Roller

Limbs, branches and other material are pushed large end first into the cutter disc by two vertically-mounted feed rollers. One of the feed rollers is mounted in a spring-loaded feed roller housing that maintains tension between the two rollers and allows it to move on a track. The other feed roller is stationary. Ridges on the rollers grip the limbs and branches and push them into contact with the cutter disc.

At engine start-up, the feed rollers are not turning. Before the feed roller controls are enabled:

- The clutch must be engaged.
- The engine speed must be at high RPM.
- The lower feed stop bar (1) must be in the correct position.
- Either the reset/hold-to-run button must be pressed and released, or the feed control bar must be pushed fully forward to the REVERSE/RESET position, and pulled back to the NEUTRAL position.

The operator then pulls the upper feed control bar (2) back into the FORWARD detent, and the rollers turn in the correct direction to pull in limbs and push them into the cutter drum. The operator and crew then feed branches, limbs and other material into the feed roller, large end first.



A safety feature is the lower feed stop bar, located at the end of the infeed table. If a crew member bumps it with enough force, it trips, turning off the feed rollers. The amount of force required to trip the stop feed bar can be set to NORMAL or REDUCED using the stop bar sensitivity switch. REDUCED sensitivity means it takes more force than NORMAL to trip the switch and stop the feed rollers.

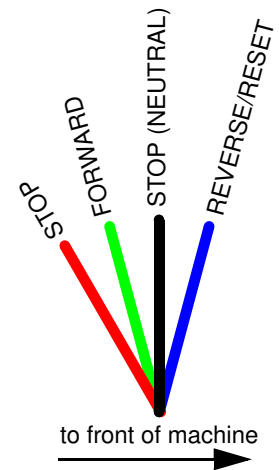
IMPORTANT: The NORMAL sensitivity setting provides the most protection of the operator since a leg is more likely to shut off feed in an emergency. Use NORMAL sensitivity whenever job site conditions permit. If the size and shape of limbs cause branches to strike the bar, resulting in an unacceptable frequency of feed stops, the REDUCED sensitivity setting may be temporarily selected. When these difficult conditions have passed, select the NORMAL setting to continue chipping.

Once stopped by the lower feed stop bar, the feed rollers will not turn again unless the lower feed stop bar is reset. To reset the lower feed stop bar, return it to its spring loaded position, then press the reset/hold-to-run button, or push the upper feed control bar fully forward to the REVERSE/RESET position.

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While the roller is turning, the operator uses the upper feed roller control bar to control the direction the rollers turn. The bar has four positions:

- **STOP (NEUTRAL)**—the feed roller control bar is vertical. The roller is stopped.
- **FORWARD**—bar is pulled rearwards to the first detent. The roller turns forward, feeding material into the cutter disc.
- **STOP**—bar is pulled fully rearward. The roller stops.
- **REVERSE/RESET**—bar is pushed forward beyond vertical. This is a spring-loaded position. Holding the bar forward will reverse the rollers, pushing material back out toward the feed table, away from the cutter drum. It also resets the SmartFeed controller to allow forward feeding again. Once released, the bar will spring back to the vertical NEUTRAL position.



SmartFeed

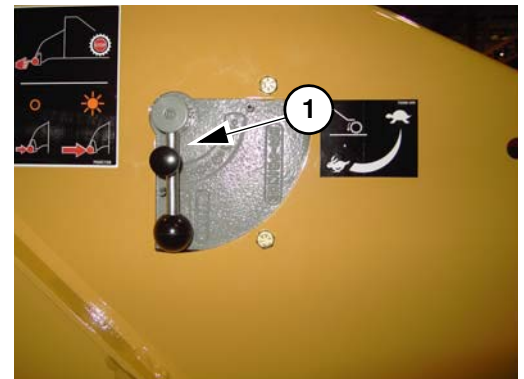
The direction of the feed rollers is controlled by the SmartFeed controller. It monitors the engine RPM—if engine speed pulls down, SmartFeed briefly stops, reverses, then restarts the feed rollers when the engine reaches full speed.

The feed rollers are driven by two hydraulic motors that receive flow from a gear pump, driven directly by the engine.

An electrically operated directional control valve controls the direction of the hydraulic motors. The SmartFeed controller controls this valve.

Manual Control of Feed Speed

For material that is denser and harder than normal to chip, a slower feed roller may be desired. The flow control valve (1) allows the operator to set the speed slower by diverting some pump flow away from the feed roller motors. Turning the valve control lever clockwise increases the feed roller speed, and turning it counterclockwise decreases the speed.



CHAPTER OVERVIEW

Other than the general and system information (Chapters 1 and 2), the manual is divided up into chapters based on machine functions. It includes the following chapters:

- Chapter 3

The Engine and Electrical Power Distribution chapter describes the electrical circuits and components necessary for engine starting, fuel control, and producing electrical power to keep the battery charged for machine operation. This chapter also includes the senders and gauges used for monitoring the engine during operation.
- Chapter 4

The Fluid Conditioning chapter describes the components that clean, store, and supply hydraulic fluid for the various system hydraulic circuits.
- Chapter 5

The Clutch and Cutter Disc chapter describes the components used to rotate the cutter disc, chip the wood, and deflect the expelled chips.
- Chapter 6

The Feed Roller and SmartFeed Control System chapter describes the circuits and hydraulic, mechanical, and electrical components used to rotate the feed rollers, including the SmartFeed controller.
- Chapter 7

The Trailer chapter describes the circuits and components used for the lights and brakes.

Components and Reference Designators

The following is a list of all designators used on this machine. The list is divided according to functional area.

Engine and Power Distribution:

- Battery BT1
- Fuel Tank RES1
- Fuel Gauge GA3
- Engine ENG1
- Alternator ALT1
- Oil Filter FL1
- Starter Solenoid L1
- Starter Motor M1
- Primary Fuel Filter FL2
- Secondary Fuel Filter FL3
- Fuel Lift Pump PMP2
- Air Filter FL4
- Air Restriction Indicator GA5
- Radiator HE1
- Glow Plug Relay K1
- 30-Amp Circuit Breaker CB1
- 50-Amp Circuit Breaker CB2
- Hourmeter GA1
- Voltmeter GA2
- Ignition Switch S1

Non-Turbo Engine Components

- Fuel Pump Relay K2
- 10-Amp SmartFeed Fuse F1
- 25-Amp Fuel System Fuse F2
- 30-Amp Cold Start Fuse F3
- Coolant Temperature Switch S13
- Oil Pressure Switch S14
- Coolant Temperature Switch S15 (for cold start)
- Cold Start Advance Solenoid L4
- Engine Fuel Solenoid L5

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Turbo Engine Components

- Throttle Switch S2
- Warning Light DS2
- Stop Light DS3
- Fuel Pump Relay K2
- Electric Lift Pump Relay K3
- 10-Amp SmartFeed Fuse F1
- 20-Amp Fuel Lift Pump Fuse F2
- 30-Amp Fuel Pump Fuse F3
- 10-Amp Engine Controller Fuse F4
- 3-Amp Indicator Lights/Relays Fuse F5
- Engine Control Module (ECM)

Fluid Conditioning:

- Hydraulic Tank RES2
- Hydraulic Return Filter FL5
- Strainer FL6
- Breather FL7

Clutch and Cutter Disc:

- Clutch Position Switch S3 (turbo model only)

Feed Roller and SmartFeed:

- SmartFeed Controller A1
- Hydraulic Pump PMP1
- Feed Roller Hydraulic Motors MH1 and MH2
- Flow Divider Manifold A3, containing:
 - Flow Control Valve FV1
- Feed Roller Directional Control Manifold A2, containing:
 - Directional Control Valve DV1
 - Solenoids L2 and L3
 - Flow Divider Valve FV2
 - Pressure Relief Valve PV1
 - Hydraulic Over-Pressure Switch S4
- Lower Feed Stop Bar Switches (2) S9 and S10
- Lower Feed Stop Bar Sensitivity Selector Switch S12

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- Sensitivity Selector Relay K4
- Reset/Hold-To-Run Switches (2) S5 and S6
- Feed Direction Emergency Stop Switch S11
- Feed Direction Forward Switch S7
- Feed Direction Reverse Switch S8
- Resistors (3) R4, R5, and R6
- Lower Indicator Diodes (2) D3 and D4
- Reverse Rotation Diode D5
- Information Lights DS1 and DS4
- Magnetic Speed Sensor B1

Trailer:

- Taillights DS5 and DS6
- License Plate Light DS7
- Marker Lights DS8 through DS12
- Breakaway Switch S14
- Brake Coils L6 and L7
- Brake Actuator CY1
- Brake Shoe Cylinders CY2 and CY3

BC1230A BRUSH CHIPPER SPECIFICATIONS

Machine Reference and Orientation

Left, right, front, and back of the machine are noted from facing the direction in which the machine is towed.



ENGINE SPECIFICATIONS

Model	3054C Non-Turbo	3054E Turbo
Specification	AR70428	AQ70398
Maximum power	83 hp (62 kW) @ 2400 rpm	112 hp (83 kW) @ 2400 rpm
Engine oil capacity	8.3 qt (7.9 L) with filter	8.3 qt (7.9 L) with filter
Fuel type and capacity	diesel, 25 gal (95 L)	diesel, 25 gal (95 L)
Cooling medium	liquid	liquid
System coolant capacity	14.2 qt (13.4 L)	14.2 qt (13.4 L)
Alternator	55 amp	55 amps
Maximum engine inclination	25° all directions	25° all directions
Battery	BCI group size 31 950 CAA (30 sec. -0°F/-18°C) 185 minutes of reserve capacity (25-amp output at 80°F/27°C)	BCI group size 31 950 CCA (30 sec. -0°F/-18°C) 185 minutes of reserve capacity (25-amp output at 80°F/27°C)
Hydraulic System		
Pump flow:	7.0 gpm (26.5 L/min)	7.2 gpm (27.3 L/min)
System pressure	2800 psi (193 bar) max.	2800 psi (193 bar) max.
Tank capacity	9 gal (34 L)	9 gal (34 L)

MACHINE SPECIFICATIONS

Model	3054C	3054E
Tire size	LT235/85 R16 load range E	LT235/85 R16 load range E
Tire pressure	80 psi (5.5 bar)	80 psi (5.5 bar)
Lug nut torque	90 ft-lb (122 Nm)	90 ft-lb (122 Nm)
Length	150" (381 cm)	150" (381 cm)
Width	79" (201 cm)	79" (201 cm)
Height	102" (259 cm)	102" (259 cm)
Total weight:	5340 lb (2567 kg)	5660 lb (2422 kg)
Tongue Weight:	450 lb (236 kg)	520 lb (204 kg)
Chipping Capacity		
Maximum log diameter	12" (30 cm)	12" (30 cm)

Fuel and Lubricants

Lubricant / Recommendation	Capacity	Specification / Notes
Engine oil with filter	Refer to the Engine Operation Manual.	An Engine Operation Manual is supplied with each machine. Refer to the manual for engine oil requirements. Engine must be level when checking engine oil.
Hydraulic Fluid <i>Vermeer Ultra VMF Hydraulic Fluid</i> NOTE: Use of any other hydraulic oil without written factory approval will jeopardize warranty.	9 gal (34 L)	Phillips: Type HG; ISO STD or equivalent If equipped with biodegradable hydraulic fluid, use Vermeer Biodegradable Hydraulic Fluid, Mobile EAL-224H, or equivalent. Use caution not to get dirt or other contaminants into the system(s) when connecting with a tractor, or when servicing. Filter all fluid through a 10-micron filter before adding. NOTE: Use of any other hydraulic oil without written factory approval will jeopardize warranty.
Grease <i>Vermeer Ultra LF Grease</i>	As required	EP: Grease: Shell Alvania EP2 or equivalent To minimize condensation in bearings, grease machine after it is shut down for the day. Fittings and grease applicator must be clean before applying grease. Replace all missing fittings.
General Lubricating Oil	As required	Vermeer Xtra Gold 10W30 or equivalent.

SYSTEM INTERLOCKS

Engine Speed Interlock

- Engine speed cannot be raised above idle unless clutch is engaged (turbo model only).

Feed Roller Reset

- The feed roller must be reset if turned off by setting the upper feed control bar to the Stop position or by bumping the lower feed stop bar with sufficient force.

MACHINE PERFORMANCE

The object of service work on a machine is to return it to normal. This section describes what speeds/behaviors will be seen on a normally operating machine. Perform the steps and look for the expected result. If the result is not the expected result, make a note of it, and continue the remaining system performance checks.

NOTE: If the machine performs as described below, a problem may still exist because the steps below do not place the machine under load. Engine problems and hydraulic internal leakage problems may only occur while the machine is under normal working loads.

Equipment Needed

- phototach and reflective paint or tape
- dry mark pen or other means to mark the feed rollers and feed table
- stopwatch
- calculator capable of simple arithmetic (add, subtract, multiply, divide)

Pre-Start Inspection

NOTE: If engine is hot, allow it to cool overnight.

1. Inspect the following items and correct them as needed. Refer to the [BC1230A Brush Chipper Maintenance Manual](#) for specifications.
 - Verify coolant level in radiator
 - Verify engine oil in crankcase
 - Verify sufficient fuel in fuel tank
 - Verify infeed table not in transport position (lowered)
 - Verify discharge chute pointed in safe direction
2. Remove five bolts holding toolbox cover in place and remove the cover.
3. Place a reflective mark on the side of the engine sheave and cutter disc sheave.
4. Place mark on the feed roller and on the floor of the feed table aligned with the mark on the feed roller.
5. Place clutch lever in the DISENGAGED position.
6. Place upper feed control bar in STOP (NEUTRAL) (vertical position).

Cutter Disc

1. Remove drive belt shield, as described on page 5-6.
1. Start engine. Allow to warm for 1–2 minutes at IDLE.
2. Engage clutch.
3. Set throttle to HIGH.

NOTE: If engine does not start or speed does not increase, troubleshoot engine as described in Chapter 3.

4. Use phototach to observe speed of engine sheave. Make a note of the speed.

Expected result: 2568 RPM, $\pm$ 75 RPM (non-turbo engine).
2640 RPM, $\pm$ 75 RPM (turbo engine).

5. Use phototach to observe speed of cutter disc sheave. Note the speed recorded.

Expected result: 961 RPM, $\pm$ 28 RPM (non-turbo engine).
988 RPM, $\pm$ 28 RPM (turbo engine).

6. If either engine sheave speed or cutter disc sheave speed is outside of these limits, multiply cutter disc sheave speed by 2.67. Answer should match engine speed.

If needed, troubleshoot the belt drive and cutter disc as described in Chapter 5.

7. Disengage clutch.

Feed Roller

1. Ensure engine speed is set to full throttle.
2. Pull upper feed control bar to the FORWARD feed position.
3. Verify feed roller speed control is in the FAST position (flow divider is fully open).
4. Observe feed roller as you push upper feed bar forward to the REVERSE position.

Expected result: Feed roller will turn in reverse. If not, troubleshoot feed roller, as described in Chapter 6.

5. Pull feed bar to FORWARD detent and allow feed roller to run for several minutes to warm the hydraulic fluid.

IMPORTANT: Before checking feed roller speed, ensure hydraulic oil is warmed to at least 100°F (38°C).

6. Pull feed bar back to STOP (NEUTRAL) position. Then pull it to the FORWARD detent. Use stopwatch and time ten revolutions. Push feed bar forward to STOP (NEUTRAL).

Expected result: Feed roller turns forward. Ten revolutions requires about twenty seconds. If not, troubleshoot feed roller, as described in Chapter 6.

7. Check lower feed stop bar by pulling upper feed bar to the FORWARD detent, then bumping lower feed stop bar.

Expected result: Feed roller will stop. If not, adjust lower feed stop bar as described in the [BC1230A Brush Chipper Maintenance Manual](#).

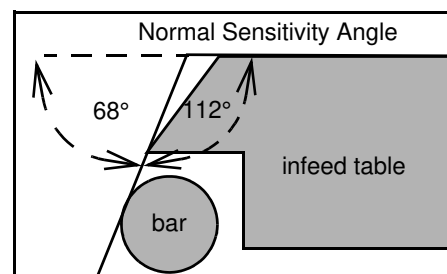
8. Push feed bar forward to the REVERSE/RESET position, then pull it back to the FORWARD detent. Observe roller speed as you move roller speed control handle to SLOW and back to FAST.

Expected result: Roller speed will change in accordance with the adjustment of the speed control handle. If not, troubleshoot feed roller circuits as described in Chapter 6.

SmartFeed Functions

1. Pull upper feed bar back to the FORWARD detent. Press lower feed stop bar. Use an angle finding protractor set to 112° to test the lower feed stop bar switch.

Expected result: When the protractor makes contact with the feed stop bar and the lip of the infeed table, the indicator light above the feed table will flash quickly. If not, troubleshoot the SmartFeed circuits beginning on page [6-16](#).



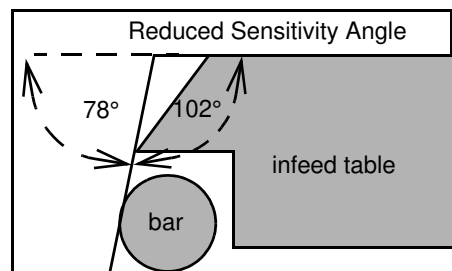
2. Move upper feed bar fully forward to the REVERSE/RESET position and pull it back to the forward position. Rollers will resume turning.

3. Set sensitivity selector switch to REDUCED sensitivity.

Expected result: The warning indicator light above the feed table will glow. If not, troubleshoot the SmartFeed circuits beginning on page [6-16](#).

4. Use an angle finding protractor set to 102° to test the lower feed stop bar switch.

Expected result: When the protractor makes contact with the feed stop bar and the lip of the infeed table the indicator light above the feed table will flash quickly. If not, troubleshoot SmartFeed circuits beginning on page [6-16](#).



5. Continue to press the lower feed stop bar. Observe rollers and quickly press and release the reset/hold-to-run button.

Expected result: Rollers will turn for approximately one second and stop. If not, troubleshoot SmartFeed circuits beginning on page [6-16](#).

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6. Observe and time rollers as you press and hold the reset/hold-to-run button.

Expected result: Rollers will turn for 30 seconds, then stop. If not, troubleshoot the SmartFeed circuits beginning on page [6-16](#).

7. Release lower feed stop bar, and press and release the reset/hold-to-run button. Observe roller speed as you move the roller speed control handle to SLOW and back to FAST.

Expected result: Roller speed will change in accordance with the adjustment of the speed control handle. If not, troubleshoot the feed roller circuits beginning on page [6-22](#).

NOTE: If the machine is located where it can be done safely, and an operator and limbs or branches are available, you can check the droop point setting function. Be sure to wear all protective gear required for the operator. See the [BC1230A Brush Chipper Operator's Manual](#) for required protective gear.

Trailer Circuits

Lights

1. Connect light harness to a towing vehicle.
2. Inspect operation of taillights, turn lights, brake lights and side marker lights.

Expected result: Turn signals and brake lights turn on and off in accordance with turn and signal lights on the towing vehicle. Taillights and side marker lights glow when taillights of towing vehicle are on. If not, replace faulty light. If problem continues with new lights, troubleshoot lights, as described in Chapter 7.

Brakes

1. Connect hitch to a towing vehicle that is equipped with a trailer brake controller.
2. Trip breakaway brake switch or lever by pulling forward briskly on the chain or cable attached to the breakaway switch. Tow machine forward far enough to determine that the brakes on the machine are set.

Expected result: Brakes are on. If not, troubleshoot brakes beginning on page [7-6](#).

3. Reset breakaway lever or push in the wedge that separates the contacts for the breakaway switch.
4. Tow machine forward slowly and apply the brakes.

Expected result: Electric brakes come on as the brake pedal is applied, hydraulic brakes come on when towing vehicle decelerates. Braking action is similar to that of towing vehicle alone. Machine does not “push” towing vehicle. If not, troubleshoot brakes, beginning on page [7-6](#).

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Chapter 3: Engine and Electrical Power Distribution

OVERVIEW

This chapter discusses the engine and the circuits and components needed to operate the engine. This chapter also includes the electrical circuits, interlocks, and components needed to produce and distribute operating current for the machine’s electrical functions.

This chapter discusses only those items provided by Vermeer needed to operate the engine. Troubleshooting and repair of the engine proper is beyond the scope of this manual. For engine service, see an authorized Caterpillar engine repair facility.

Circuits/Components

Circuits

The following circuits are used:

- Engine Shutdown Interlock
- Engine Speed Interlock (turbo only)
- Fuel
- Air
- Cooling
- On, Start, and Off
- Charging
- Glow Plugs
- Cold Start Advance (non-turbo only)

Components

Common Components

- Battery BT1
- Fuel Tank RES1
- Fuel Gauge GA3
- Engine ENG1
- Alternator ALT1
- Oil Filter FL1
- Starter Solenoid L1
- Starter Motor M1
- Primary Fuel Filter FL2
- Secondary Fuel Filter FL3
- Fuel Lift Pump PMP2
- Air Filter FL4
- Air Restriction Indicator GA5
- Radiator HE1
- Glow Plug Relay K1
- 30-Amp Circuit Breaker CB1
- 50-Amp Circuit Breaker CB2
- Hourmeter GA1
- Voltmeter GA2
- Ignition Switch S1

Non-Turbo Engine Components

- Fuel Pump Relay K2
- 10-Amp SmartFeed Fuse F1
- 25-Amp Fuel System Fuse F2
- 30-Amp Cold Start Fuse F3
- Coolant Temperature Switch S13
- Oil Pressure Switch S14
- Coolant Temperature Switch S15 (for cold start)
- Cold Start Advance Solenoid L4
- Engine Fuel Solenoid L5

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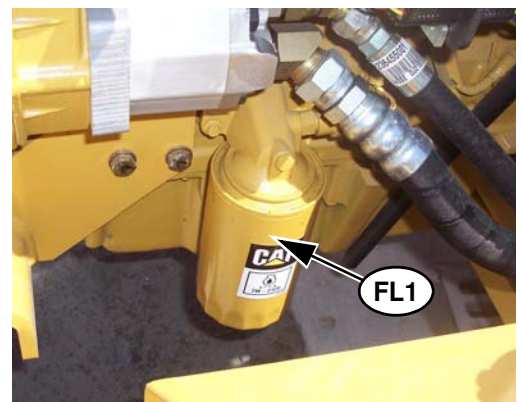
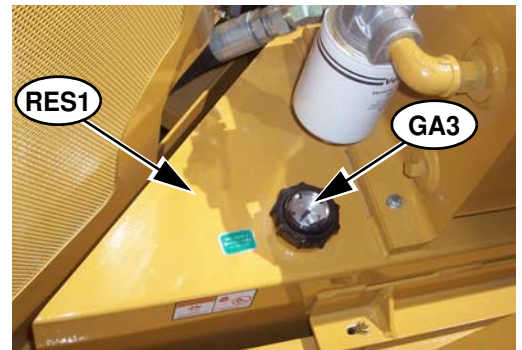
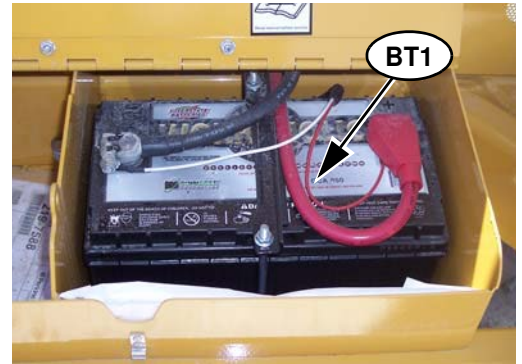
Turbo Engine Components

- Throttle Switch S2
- Clutch Switch S3
- Warning/Preheat Light DS2
- Stop Light DS3
- Fuel Pump Relay K2
- Electric Lift Pump Relay K3
- 10-Amp SmartFeed Fuse F1
- 20-Amp Fuel Lift Pump Fuse F2
- 30-Amp Fuel Pump Fuse F3
- 10-Amp Engine Controller Fuse F4
- 3-Amp Indicator Lights/Relays Fuse F5
- Engine Control Module (ECM)

Component Locations

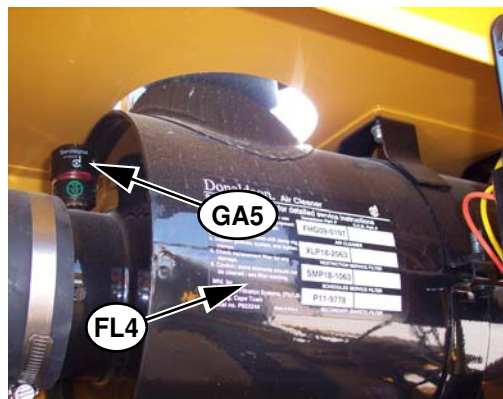
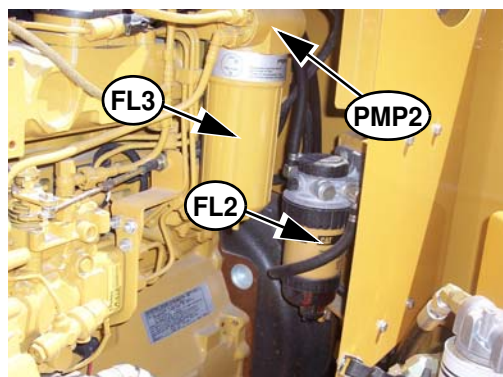
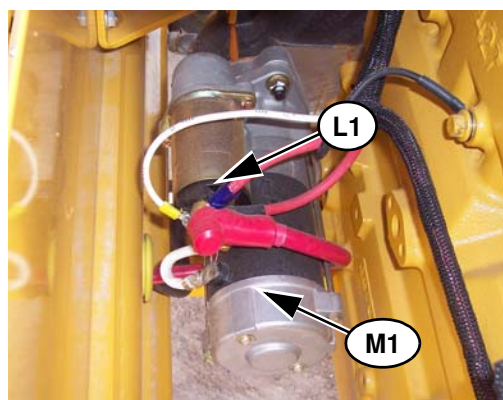
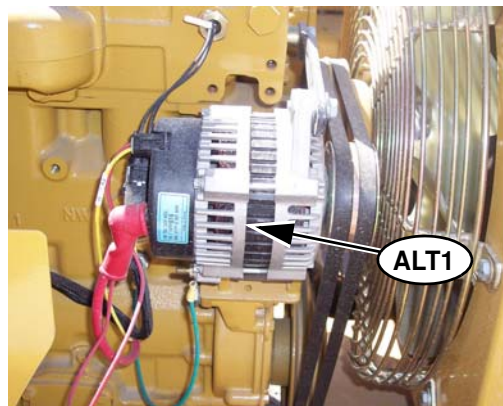
Common Components

- Battery BT1 located in battery compartment
- Fuel Tank RES1
- Fuel Gauge GA3
- Engine ENG1 is located inside engine hood
- Oil Filter FL1



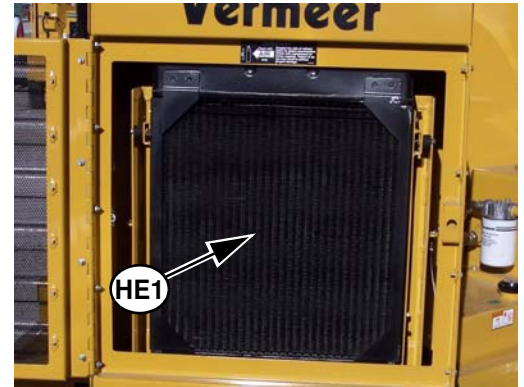
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- Alternator ALT1
- Starter Motor M1
- Starter Solenoid L1
- Primary Fuel Filter FL2
- Fuel Lift Pump PMP2
- Secondary Fuel Filter FL3
- Air Filter FL4
- Air Restriction Indicator GA5

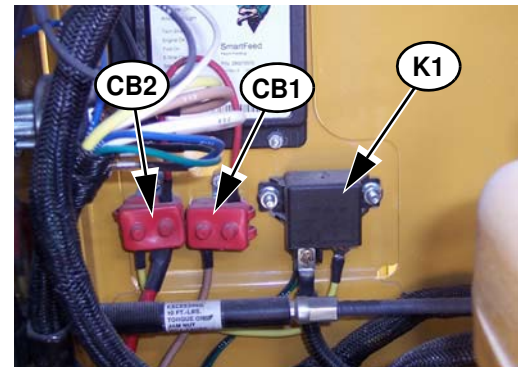


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- Radiator HE1

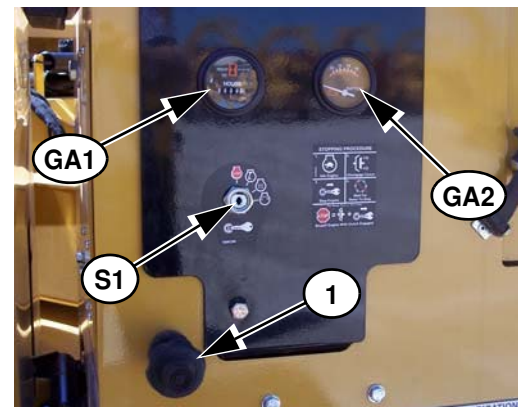


- Glow Plug Relay K1
- 30-Amp Circuit Breaker CB1
- 50-Amp Circuit Breaker CB2



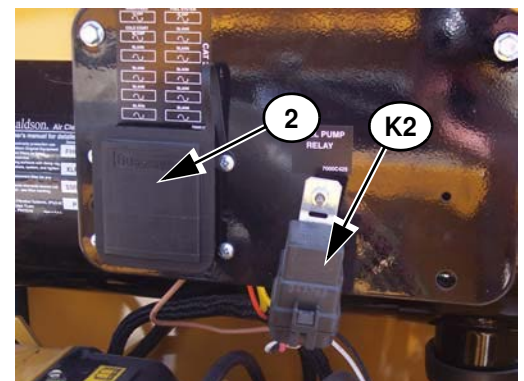
Non-Turbo Engine Components

- Hourmeter GA1
- Ignition Switch S1
- Throttle Control (1)
- Voltmeter GA2

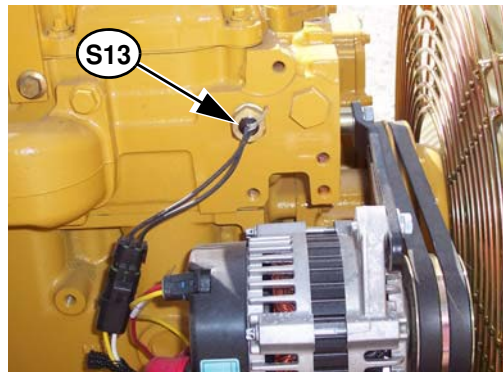


Standard Control Panel

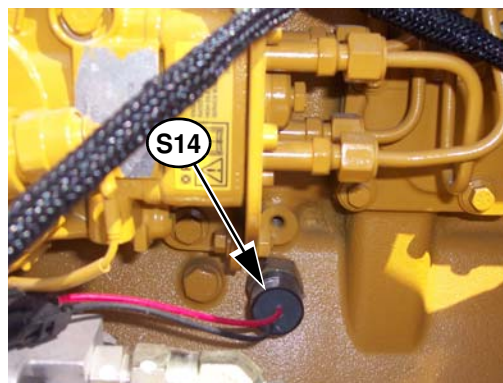
- Fusebox (2) containing:
 - 10-Amp SmartFeed Fuse F1
 - 25-Amp Fuel System Fuse F2
 - 30-Amp Cold Start Fuse F3
- Fuel Pump Relay K2



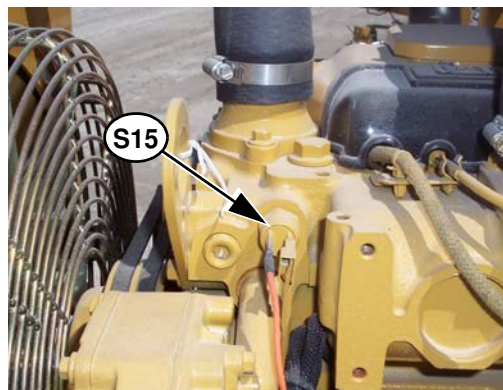
- Coolant Temperature Switch S13



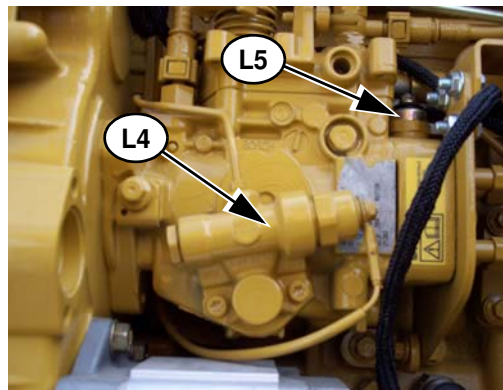
- Oil Pressure Switch S14



- Coolant Temperature Switch S15 (for cold start advance)



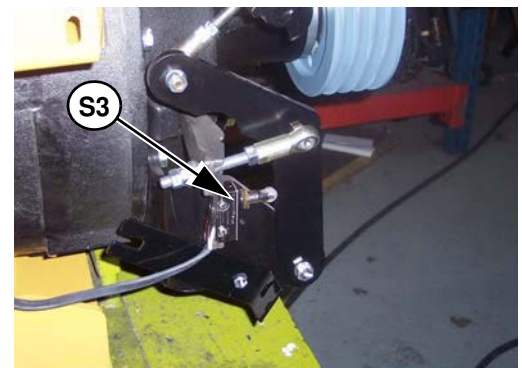
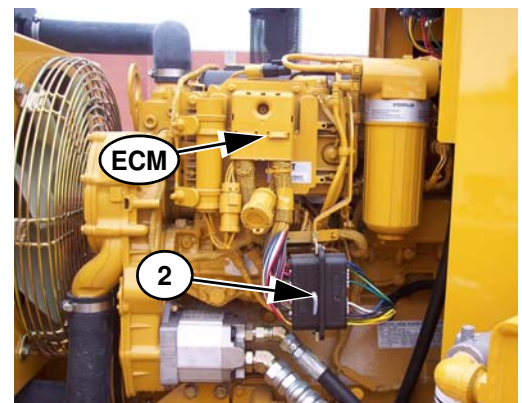
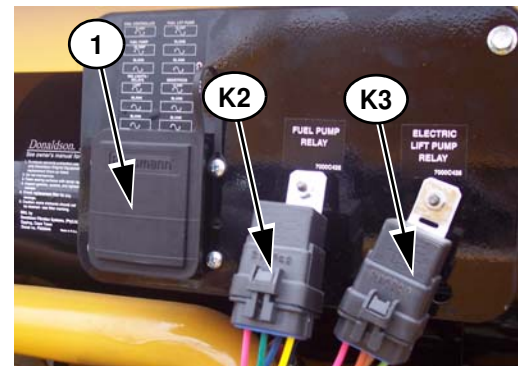
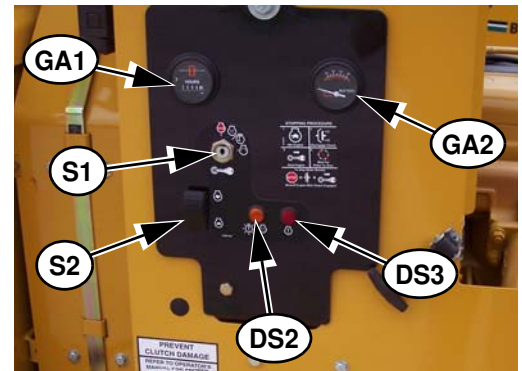
- Cold Start Advance Solenoid L4
- Engine Fuel Solenoid L5



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Turbo Engine Components

- Hourmeter GA1
- Ignition Switch S1
- Throttle Switch S2
- Warning/Preheat Light DS2
- Stop Engine Light DS3
- Voltmeter GA2
- Fuel Pump Relay K2
- Electric Lift Pump Relay K3
- Fusebox (1) containing:
 - 10-Amp SmartFeed Fuse F1
 - 20-Amp Fuel Lift Pump Fuse F2
 - 30-Amp Fuel Pump Fuse F3
 - 10-Amp Engine Controller Fuse F4
 - 3-Amp Indicator Lights/Relays Fuse F5
- Engine Control Module (ECM)
- Harness Connector to ECM (2)
- Clutch Switch S3 located on linkage on left side of clutch housing



Troubleshooting

Before performing any troubleshooting or testing on a electrical circuit or component, perform a pretest inspection of the machine (See below). Often problems can be solved by doing a walk-around inspection of the machine and looking for obvious problems.

Pretest Inspection

If a function fails to perform properly, do the following visual checks to inspect for obvious signs of failure before any exhaustive troubleshooting or testing is performed.

- Inspect for any mechanical failures.
- Ensure fuel, engine coolant, and oil levels are adequate.

Inspect electrical circuits for clues of the malfunction. Always check the following items before turning on switches or running the unit.

- Look for bare wires that could cause grounds or shorts.
- Look for broken, missing, corroded, or loose wires on the power wires that supply electrical circuit components.
- Check all ground connections on the machine and chassis for tight connections. Cleaning harness connections or ground connections can often correct what appears to be a malfunctioning component.
- Check for overheated components after the unit has been stopped for awhile. They will often smell like burned insulation.

Test Equipment Needed

To perform the troubleshooting procedures in this chapter, the following test equipment will be needed:

- Multimeter for continuity tests, voltage measurements, resistance measurements in the various electrical circuits.

Component Repair/Replace

If troubleshooting procedures determine a component is in need of repair or replacement, refer to the appropriate section at the end of this chapter for repair procedures for those components.

IMPORTANT: Most engine components are considered to be part of the Caterpillar engine and covered under Caterpillar's warranty. You can void this warranty by attempting to remove or repair these systems before the warranty has lapsed. If the warranty is still in effect, take the machine or engine to an authorized Caterpillar service facility.

ENGINE

The BC1230A brush chipper has two engine options:

- Caterpillar 3054C liquid cooled diesel engine that produces 83 hp (62 kW) @2400 rpm.
- Caterpillar 3054E turbocharged liquid-cooled diesel engine that produces 112 hp (83 kW) @ 2400 rpm.

This manual discusses only those items provided by Vermeer needed to operate the engine. Troubleshooting and repair of the engine proper is beyond the scope of this manual.

Engine Service

The Caterpillar engine is covered under Caterpillar's warranty. Warranty will become void if engine repair is attempted before warranty has lapsed. For information or service work involving the internal parts or engine overhaul, refer to the engine manual supplied with the machine, and/or contact an authorized Caterpillar engine repair facility.

Engine Maintenance

Refer to the [BC1230A Brush Chipper Maintenance Manual](#) for information on regular engine maintenance schedules and procedures.

ECM (Turbo Engine Only)

The engine ECM monitors current operating conditions and controls the response of the engine to these conditions. These conditions determine the precise control of the fuel injection by the ECM.

ENGINE SHUTDOWN INTERLOCKS

Turbo Engine Shutdown Interlocks

The ECM on the turbocharged engine is connected to sensors and transducers that monitor:

- coolant temperature
- engine oil pressure
- inlet manifold air temperature

The ECM processes the information from sensor inputs and directly controls the engine. If the ECM determines that the engine oil pressure is too low, the coolant temperature is too high, or the inlet air temperature is too high, it will turn the engine diagnostic lights on and shut down the engine via the fuel injection circuit.

- If the problem is coolant temperature, the coolant must cool down before the engine will restart.
- If the oil pressure is the problem, engine may restart, but will shut down again 30 seconds after restart if oil pressure remains low.

See page 3-13 for a description of the engine diagnostic light fault codes.

Troubleshooting the Turbo Engine Shutdown Interlocks

The ECM shuts down the engine if either of the following occur:

- Oil pressure falls too low. If too low at engine start, engine shuts down in 30 seconds.
- Coolant becomes too hot. If too hot at attempted engine start, ECU will prevent engine from starting.

When the ECU shuts down the engine for these reasons, the engine fault indicator DS1 turns on and stays on till the key switch S1 is turned to OFF.

Unless the diagnostic lights (see page 3-13) provide a diagnosis, problems with the shutdown interlock circuits cannot be diagnosed. Contact a Caterpillar service facility if you suspect problems with this circuit or the sensors used by this circuit.

Non-Turbo Engine Shutdown Interlocks

On non-turbo engines, the SmartFeed controller is connected to the following switches:

- coolant temperature switch S13
- engine oil pressure switch S14

If the SmartFeed controller determines that engine oil pressure is too low, or coolant temperature is too high, it shuts down the engine via engine fuel solenoid L5. The SmartFeed controller also flashes information light DS1 to indicate that an engine shutdown interlock has stopped the engine.

- If the problem is coolant temperature, the coolant must cool down before the engine will restart.
- If the oil pressure is the problem, engine may restart, but will shut down again 30 seconds after restart if oil pressure remains low.

Troubleshooting the Non-Turbo Engine Shutdown Interlocks

The SmartFeed controller shuts down the engine if:

- Oil pressure should fall too low. If too low at engine start, engine shuts down in 30 seconds.
- Coolant is too hot. If too hot at attempted engine start, SmartFeed will prevent engine from starting.

When the SmartFeed shuts down the engine for these reasons, check the engine oil level and the engine cooling system.

Engine Diagnostic Indicator Lights DS2 and DS3 (Turbo Engine Only)

Engine warning/preheat light DS2 and engine stop light DS3 located on the operator control panel display engine diagnostic information. The following table shows the possible conditions displayed by the indicator lights:

Engine Stop Light DS3	Engine Warning Light DS2	Conditions/Description
ON 	ON 	Lamp status before engine is cranked - bulb check: When ignition is turned on, the ECM illuminates each bulb for 2 seconds or until engine is cranked, unless cold start applies.
OFF 	then OFF  unless cold start	
OFF 	ON 	Lamp status before engine is cranked - cold start indication: Warning lamp is ON, then goes OFF when ready to crank.
OFF 	then OFF 	While start aid is operating Once engine is cranked or start aid operation is completed
OFF 	OFF 	Lamp status while engine is cranking: Lamps will only illuminate if a problem such as lack of oil pressure exists.
ON 	OFF 	No problems Lubrication oil pressure low (after delay exceeded)
OFF 	OFF 	Lamp status after engine cranking - if engine failed to start: No detected faults
OFF 	ON 	Electrical fault warning
Flashing 	OFF 	Stop engine fault detected that prevented engine from starting
OFF 	OFF 	Other lamp status: Lamp status that may be exhibited when engine is running or has shut down automatically.
ON 	OFF 	No detected faults Oil pressure low

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Engine Stop Light DS3	Engine Warning Light DS2	Conditions/Description
OFF 	Flashing 	Coolant temp is high or intake air temp is high, engine may be derating
Flashing 	OFF 	Stop engine fault detected or exceeding derate conditions
OFF 	ON 	Electrical fault warning
ON 	ON 	Oil pressure low and electrical fault warning
Flashing 	ON 	Stop engine fault detected or exceeding derate conditions and electrical fault warning
ON 	Flashing 	Oil pressure is low and coolant temp is high or intake air temp is high, engine may be derating

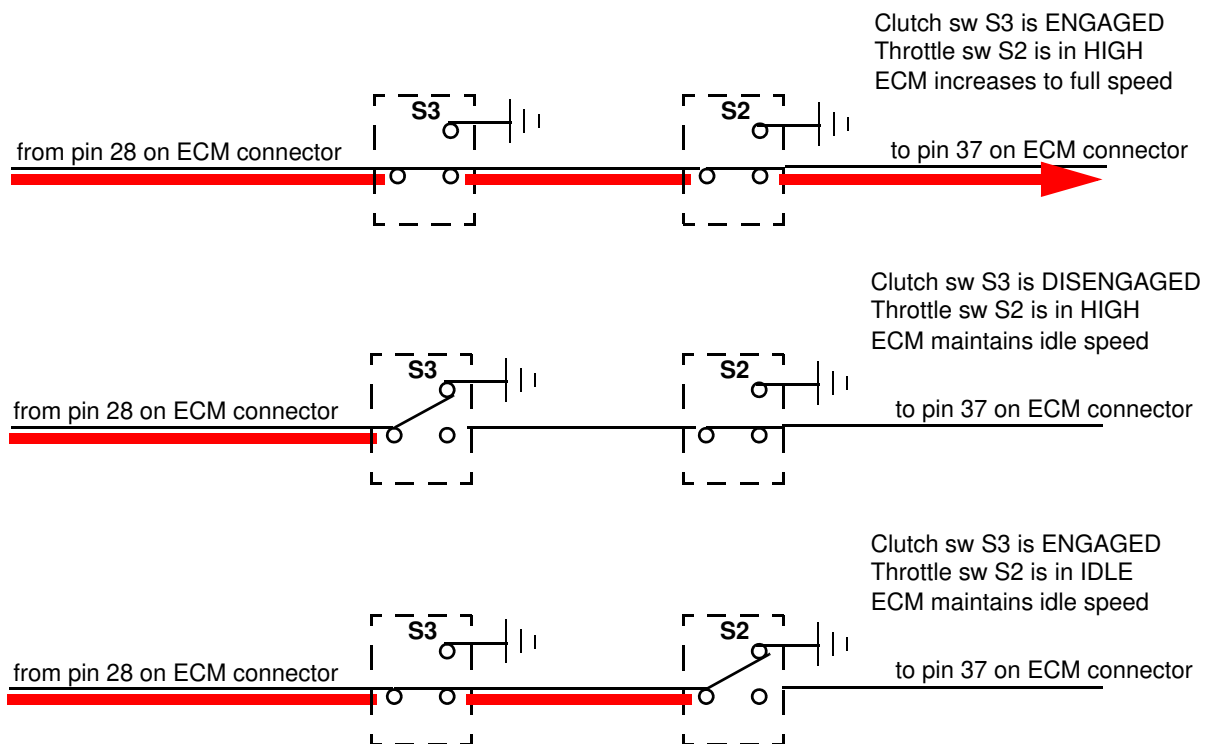
ENGINE SPEED INTERLOCK (TURBO ENGINE ONLY)

Refer to the engine schematic in the Addendum.

Since optimum chipping requires full engine speed, the ECM limits engine speed to two settings; idle (1000 rpm), and full operating speed (2568 rpm). The operator uses the throttle switch S2 to signal the ECM to go to full speed or to idle.

Since potential damage could result from engaging the clutch and cutter disc while at full speed, the ECM will not allow the engine to speed up unless the clutch switch S3 is in the ENGAGED position.

Clutch switch S3 and throttle switch S2 are wired in series from pin 28 to pin 37 of the ECM connector. The ECM sends out voltage at pin 28 of the connector. When the ECM detects voltage at pin 37, it sets the engine speed to high via the fuel injection system.



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Engine Speed Interlock Troubleshooting

If the throttle switch does not respond normally, test the switches and wires for continuity.

Throttle Switch S2

With switch disconnected and in the LOW position:

- Terminals B and A should have continuity.

With switch disconnected and in the HIGH position:

- Terminals B and C should have continuity.

If throttle switch is faulty, replace as described on page [3-55](#).

Clutch Switch S3

With switch disconnected and clutch DISENGAGED:

- Terminals A and B should have continuity.

With switch disconnected and clutch ENGAGED:

- Terminals A and C should have continuity.

If clutch switch is faulty, replace as described on page [3-55](#).

BATTERY BT1

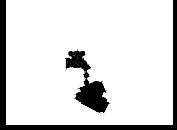
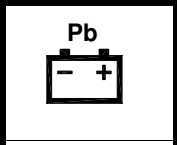
The standard battery system produces 12-volts, 475 cold cranking amps. Regardless of key position, battery power is always supplied to the 30-amp fuse F1. Power is also provided at the starter relay K1, but this component is discussed under the start circuit, page [3-35](#).

Battery Maintenance



WARNING: Battery fumes are flammable and can explode. Keep all burning materials away from battery. Battery explosion can blind. Acid can blind and burn. Tools and cable clamps can make sparks.

Do not smoke. Shield eyes and face. Read instructions.



WARNING: Battery post, 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.

Continued on next page...

Battery contains sulfuric acid, which can cause severe burns. Avoid contact with eyes, skin, and clothing.

In case of acid contact:

External: Flush with plenty of water. If eyes have been exposed, flush with water for 15 minutes and get prompt medical attention.

Internal: Drink large quantities of water or milk, follow with milk of magnesia, beaten egg, or vegetable oil. Call a physician immediately.

Before performing any troubleshooting on engine and power distribution components, ensure all connections and wires around battery are tight, in good condition with no corrosion or rotted insulation. Identify both (+) and (-) battery posts and visually inspect for corrosion around battery cable terminals.

A common cause of poor battery performance is loose or dirty cable connections.

1. Disconnect cables and clean terminals and cable ends with a mild solution of baking soda and water using a wire bristle brush.
2. Rinse all washed parts thoroughly with clean water.
3. Connect cables and ensure they are snug. Also check that frame end of the ground cable is securely connected to an unpainted surface.

NOTE: If the batteries are replaced, replacement batteries must meet standard battery specifications provided in the machine specifications in Chapter 2.

To check the electrolyte level in a serviceable battery, carefully remove caps to the cells and check the level of electrolyte. If needed, add distilled water to bring the electrolyte to the proper level.

Open Circuit Voltage Test

This test measures the battery's current state of charge and provides a reference voltage value for other tests done while troubleshooting the electrical circuits of the machine. It does not measure the battery's ability to deliver adequate cranking power.

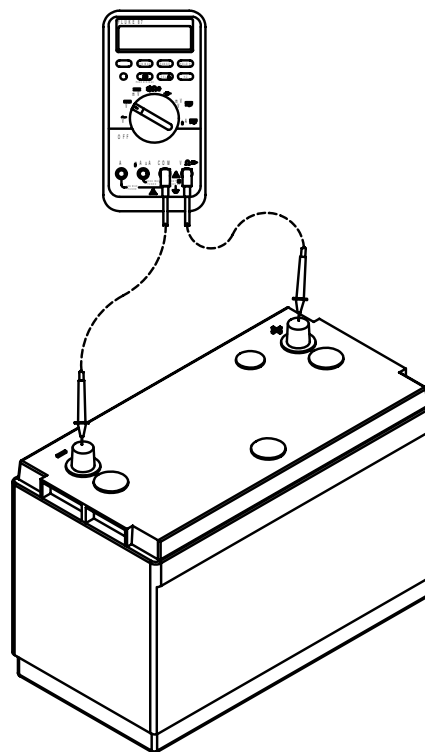
If the battery has just been charged, or if the machine has been running, it may have a surface charge that will throw off the results of the test. If the machine has sat overnight or longer without running, go ahead and test. Otherwise, turn the key to START to crank the engine to remove any surface charge. Shutdown the engine immediately if it starts.

1. Set multimeter to measure voltage in the 40 volt DC range.
2. Connect probes to battery, red to positive, black to negative.
3. Read and note voltage.

Expected result: Fully charged batteries will read 12.6 volts or slightly more.

Any reading less than 12.2 volts indicates the battery is 50% discharged. Recharge the battery before continuing troubleshooting on this machine.

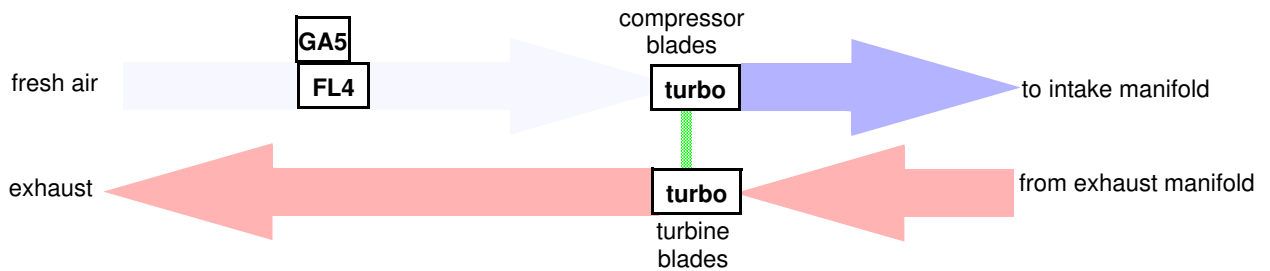
Expected result: If voltage is low, recharge battery. If it will not charge, replace the battery.



AIR CIRCUIT

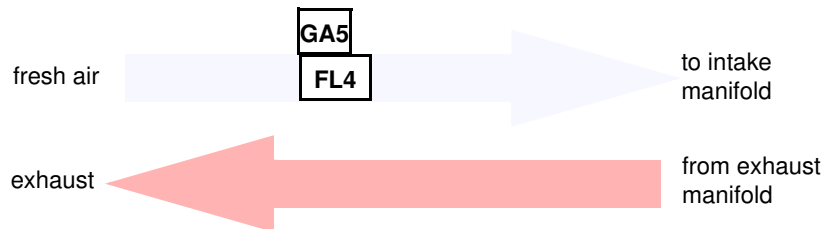
Turbo Engine Air Circuit

Outside air is pulled in through the air inlet and drawn through the primary and final elements of the air filter FL4. The filtered air is pulled into and compressed by the turbocharger and pushed to the intake manifold. The turbocharger is driven by the pressure of exhaust gases leaving the exhaust manifold. There is no aftercooler or intercooler used on this engine.



Non-Turbo Engine Air Circuit

Air used for fuel combustion is pulled through the air filter FL4, into the intake manifold. After combustion, the exhaust is expelled out the exhaust manifold.



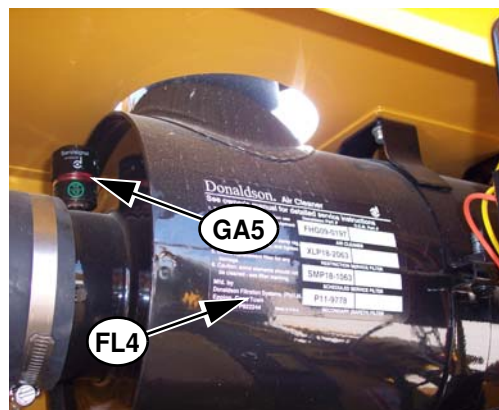
Air Circuit Troubleshooting

Troubleshooting the air circuit involves checking the air inlet restriction indicator GA5.

When the engine is running at full speed, check the air inlet restriction indicator.

- If the yellow ring is in the red zone, shut down and replace air filter elements, as described in the [BC1230A Brush Chipper Maintenance Manual](#).
- If the yellow ring is in the green zone, but above the bottom of the indicator, filters appear to be normal.
- If the yellow ring is resting on the bottom of the indicator, the filter may be torn or may not be sealed against the housing, allowing unfiltered air into the engine. Shut down engine. Remove and inspect air filter elements for damage. Replace element if damaged. If no damage is evident, carefully install the elements, making sure they seal properly in the housing. Also inspect housing for dents, holes or air leaks at duct joints.

Restart engine and recheck indicator. Replace filters if indicator is still at the bottom of the green zone.



FUEL CIRCUIT

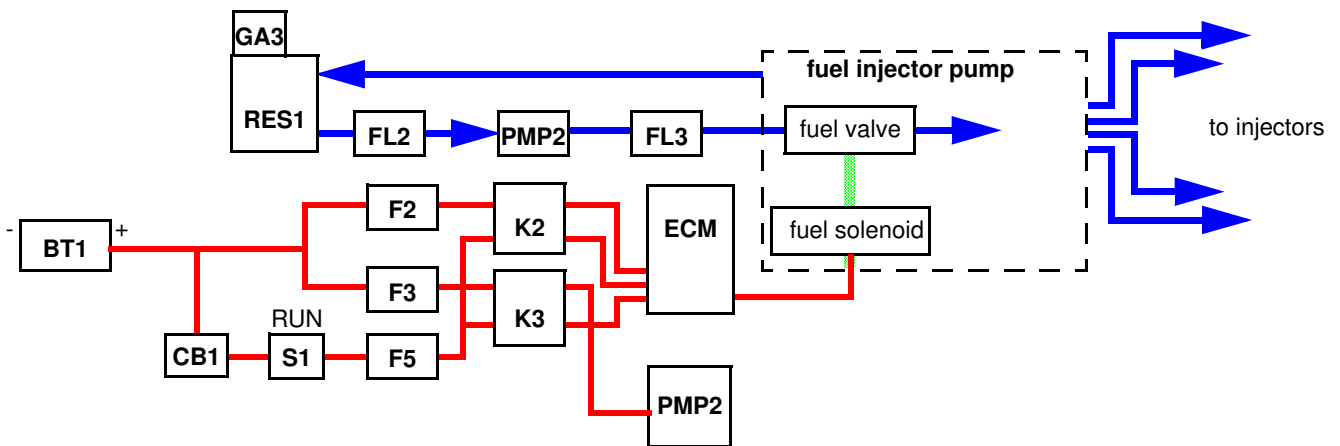
The fuel tank RES1 holds up to 25 gal (95 L) of diesel fuel. A simple spiral float-type gauge GA3 built into the fuel tank cap indicates the quantity of fuel in the tank.

Refer to the engine manual supplied with the machine to select the proper grade and blend of fuel for local conditions.

Turbo Engine Fuel Circuit

One hose carries fuel from the tank through fuel filter FL2 and then to the electric fuel lift pump PMP2 on the engine. The lift pump sends oil through fuel filter FL3 to the fuel injector pump. Another hose carries overflow from the fuel injector pump back to the fuel tank.

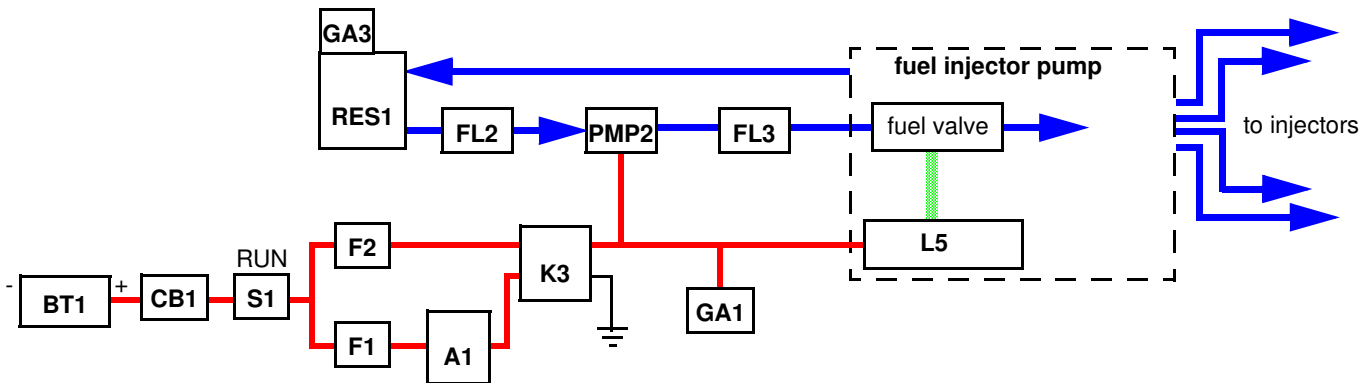
The fuel control electrical circuit includes fuses F2, F3, and F5, relays K2 and K3, and the ECM. Depending on the status of operator and sensor inputs, the ECM controls the amount of fuel that the fuel injector pump delivers to the cylinders from none, (to shut down the engine) to idle, to full speed. This is done by opening or closing the voltage paths for fuel pump relay K3 and fuel lift pump relay K2.



Non-Turbo Engine Fuel Circuit

One hose carries fuel from the tank through fuel filter FL2 and then to the electric fuel lift pump PMP2 on the engine. The lift pump sends oil through fuel filter FL3 to the fuel injector pump. Another hose carries overflow from the fuel injector pump back to the fuel tank.

The fuel control electrical circuit includes fuse F2, relays K2 engine fuel solenoid L5, and electric lift pump PMP2. The SmartFeed controller A1 controls the voltage used to open or close fuel relay K2. When closed, this relay supplies power for fuel lift pump PMP2, engine fuel solenoid L5, and hourmeter GA1.



Fuel Circuit Troubleshooting

If the engine will not run or performance is not adequate, resulting in a lack of power, investigate the fuel and air circuits. In order for the engine to start, the fuel solenoid must be energized.

If the fuel filters are clogged or partially clogged, the engine may run at idle, but stall when the throttle switch is turned to HIGH. A clogged filter will hinder fuel flow to the injector pump.

Troubleshooting the fuel circuit involves:

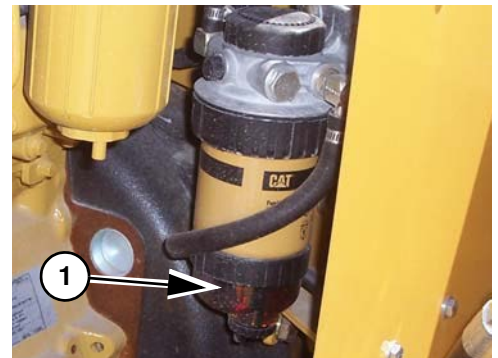
- inspecting fuel level
- inspecting fuel for water

If these items appear OK, replace primary fuel filter FL2 and secondary fuel filter FL3 as described in the engine manual supplied with the machine. If problem persists with a new filter, contact an authorized Caterpillar service facility.

Inspecting Fuel for Water

If water in the fuel is suspected:

1. Check clear fuel filter bowl (1) for water or debris. Drain water as needed based on visual inspection.
2. Open drain at bottom of primary fuel filter. Catch water in a suitable container and dispose of properly.
3. Close drain.
4. Replace the fuel filters as needed.



NOTE: The ECM, injector pump, and fuel injectors are considered to be part of the Caterpillar engine and are covered under Caterpillar's warranty. You can void this warranty by attempting to remove or repair this system before the warranty has lapsed. If the warranty is still in effect, take the machine to an authorized Caterpillar Service Facility.

Troubleshooting the Turbo Fuel Electrical Circuit

To troubleshoot the fuel electrical circuit for turbo engine machines, begin by checking fuses F2, F3, and F5. If these are OK, check continuity between the fuses and relays K2 and K3 (see engine electrical schematic in the Addendum). Also check continuity between the relays and the ECM connector.

Continued on next page...

**Troubleshooting the
Non-Turbo Fuel
Electrical Circuit**

To troubleshoot the fuel electrical circuit for non-turbo engine machines, check fuse F2 and ensure there is power at pin 1 of the SmartFeed controller A1 when the ignition switch is turned to the ON position. If these are OK, check continuity between pin 4 of the SmartFeed controller and pin 5 of the relay connector, and between fuse F2 and pin 1 of the relay connector (see engine electrical schematic in the Addendum). Also check continuity between pin 4 of the relay connector and engine fuel solenoid L5, fuel lift pump PMP2, and hourmeter GA1.

COOLING CIRCUIT

As the coolant in the engine's water jacket warms up to 180°F (82°C), the thermostat opens and the engine's water pump circulates coolant from the radiator through the water jacket.

The engine fan blows air through the fins of the radiator HE1 to remove heat from the coolant. The cap of the radiator will relieve pressure building inside the radiator at 7 psi (48 kPa) above the ambient air pressure.

Cooling Circuit Troubleshooting

Troubleshooting the cooling circuit involves inspecting the coolant level and the radiator fins as described in the [BC1230A Brush Chipper Maintenance Manual](#).

On turbo engine machines, a coolant temperature sensor delivers information to the ECM. If coolant temperature exceeds limits, the ECM shuts down the engine.

On non-turbo machines, coolant temperature sensor S13 delivers information to the SmartFeed controller. If coolant temperature exceeds limits, the controller shuts down the engine.

After shutdown, the engine will not restart until it cools down. If this happens, after the engine cools down, do the following:

- Inspect coolant level in the radiator. Add coolant as needed to bring level within 1/2" (13mm) of the filler neck. Refer to the engine manual supplied with the machine to determine the best coolant mixture to use for the local conditions.
- Inspect radiator fins for grease or dirt. Clean fins as needed. If fins are dry, compressed air will remove dust and dirt. If fins are greasy, use a spray bottle with a mixture of water and degreasing detergent to remove grease, and then use compressed air to dry the fins.

Do not start engine in a dusty environment until fins are dry. If the fan pulls dust onto wet fins, the dirt will stick and insulate the fins, reducing heat exchange.

IGNITION COMPONENT TESTS

Listed on the following pages are components used in the ignition circuits. The ignition switch positions and expected voltages that should be measured are listed. Continuity checks and resistance specifications are also given for some components.

NOTE: For information on the electronic control module (ECM) and other engine components refer to the Caterpillar engine manual.

Ignition Switch S1

Voltage Checks

With ignition switch S1 in OFF:

- Terminal 1 = 12 volts nominal

With ignition switch S1 in ON:

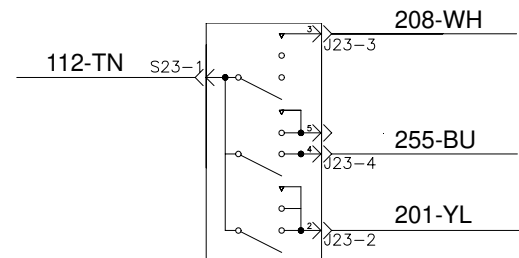
- Terminals 1, 2, & 4 = 12 volts nominal

With ignition switch S1 in PREHEAT (non-turbo only):

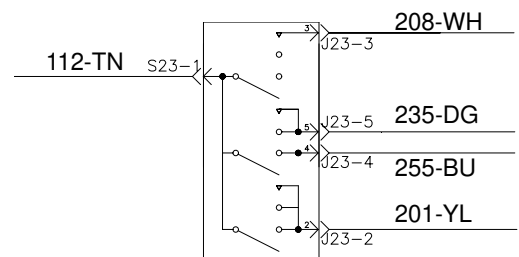
- Terminals 1, 2, & 5 = 12 volts nominal

With ignition switch S1 in START:

- Terminals 1, 2, & 3 = 12 volts nominal (turbo engine)
- Terminals 1, 2, 3, & 5 = 12 volts nominal (non-turbo engine)



Ignition Switch S1 (turbo engine)



Ignition Switch S1 (non-turbo engine)

Continued on next page...

Continuity Checks

Wires disconnected ignition switch S1 in ON:

- Terminals 1 & 2 and 1 & 4 should have continuity.

Wires disconnected ignition switch S1 in PREHEAT (non-turbo only):

- Terminals 1 & 2 and 1 & 5 should have continuity.

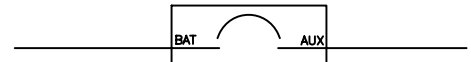
Wires disconnected ignition switch S1 in START:

- Terminals 1 & 2 and 1 & 3 should have continuity (turbo engine).
- Terminals 1 & 2, 1 & 3, and 1 & 5 should have continuity (non-turbo engine).

If faulty, replace ignition switch S1. Refer to page [3-55](#).

Circuit Breakers CB1 and CB2

Circuit breaker CB1 allows a maximum of 30 amps of current to flow to the ignition switch. Circuit breaker CB2 allows a maximum of 50 amps of current to flow to glow plug relay K1. If current draw is more than the rated amps, the breaker will heat causing it to trip. If the breaker trips and does not automatically reset in a few seconds, it has probably failed.



If CB1 fails, no electrical functions will be available through the ignition switch will be available. If CB2 fails, the glow plugs will not function.

Continuity Checks

With multimeter set to measure resistance (ohms), perform a continuity test. Check for continuity between the two battery and auxiliary terminals.

When checking continuity, if the meter displays OL (out of limits), no continuity, current cannot flow. If the test indicates no continuity between the terminals, replace breaker.

If faulty, replace circuit breaker. Refer to page [3-54](#).

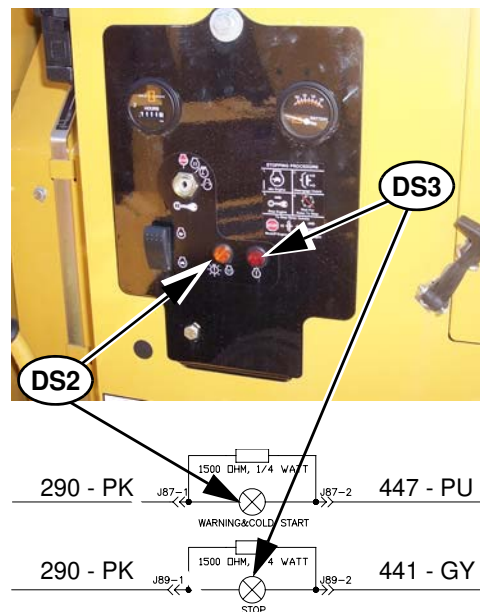
Indicator Lights DS2 and DS3 (Turbo Engines Only)

Voltage Checks

With ignition switch S1 in ON:

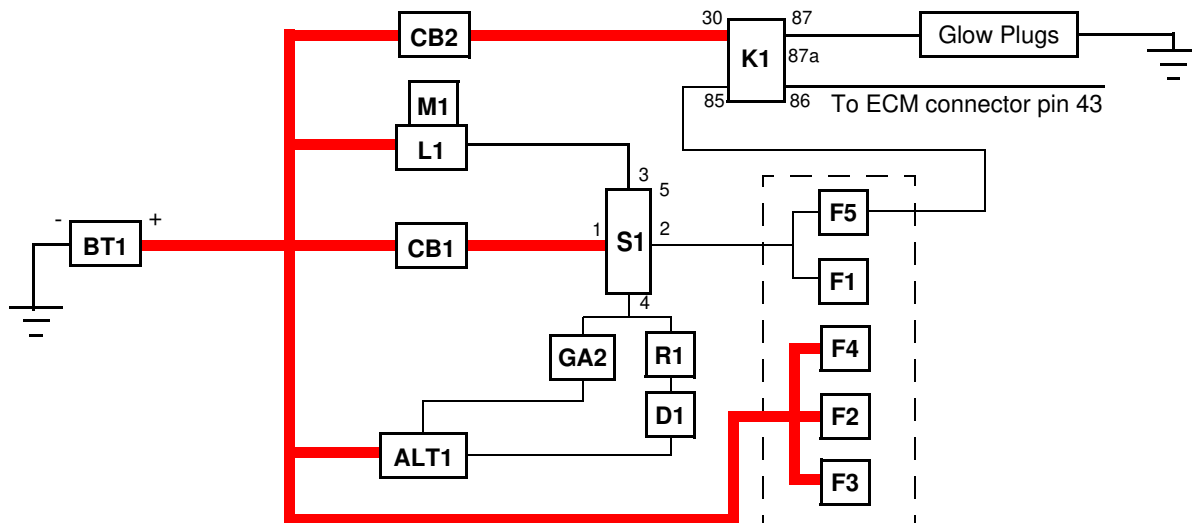
- Wires 290 - PK = 12 volts nominal.

If faulty, replace light. See page 3-56.



IGNITION OFF CIRCUIT

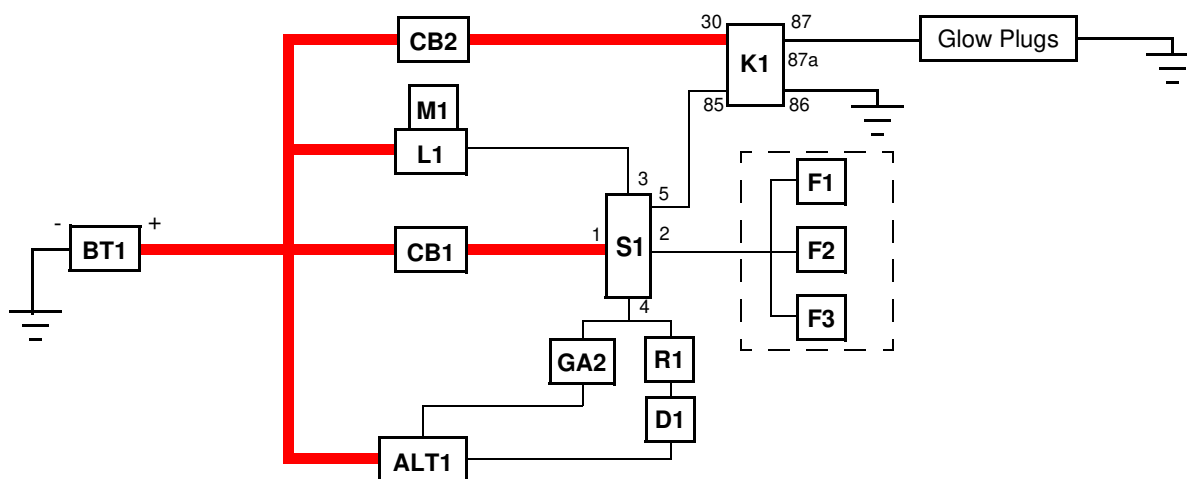
Turbo Engine Ignition OFF Circuit



Battery voltage is available at the following components at all times, including when ignition switch S1 is in the OFF position:

- 50-amp circuit breaker CB2, which provides power to glow plug relay K1
- Common terminal of starter solenoid L1
- 30-amp circuit breaker CB1, which provides power to ignition switch S1
- Alternator ALT1
- Fuses F4, F2, and F3, which provide power to the ECM connector, electric lift pump relay K2, and fuel pump relay K3 respectively.

Non-Turbo Engine Ignition OFF Circuit

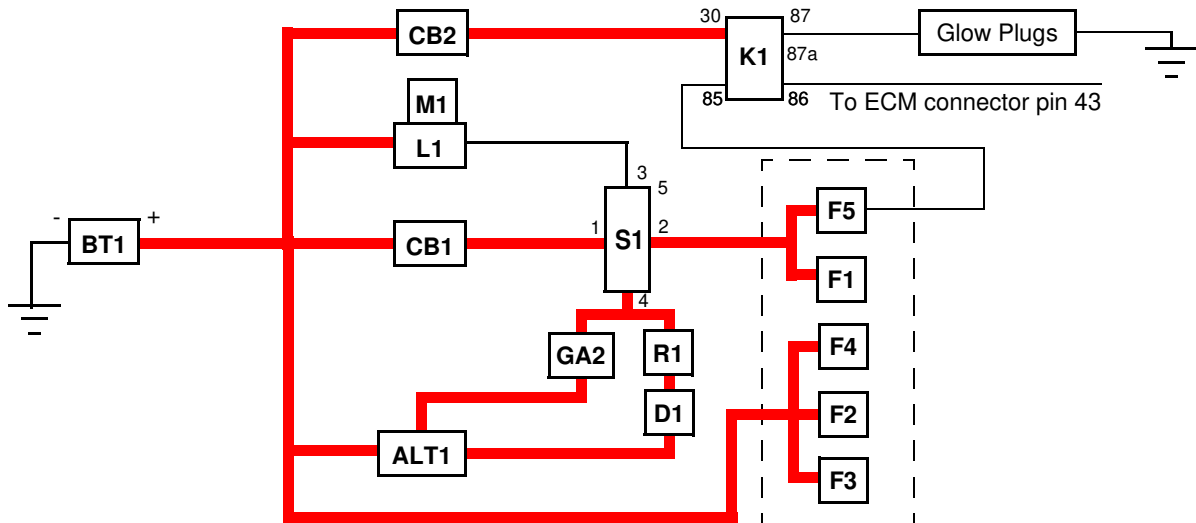


Battery voltage is available at the following components at all times, including when ignition switch S1 is in the OFF position:

- 50-amp circuit breaker CB2, which provides power to glow plug relay K1
- Common terminal of starter solenoid L1
- 30-amp circuit breaker CB1, which provides power to ignition switch S1
- Alternator ALT1

IGNITION ON CIRCUIT

Turbo Engine Ignition ON Circuit

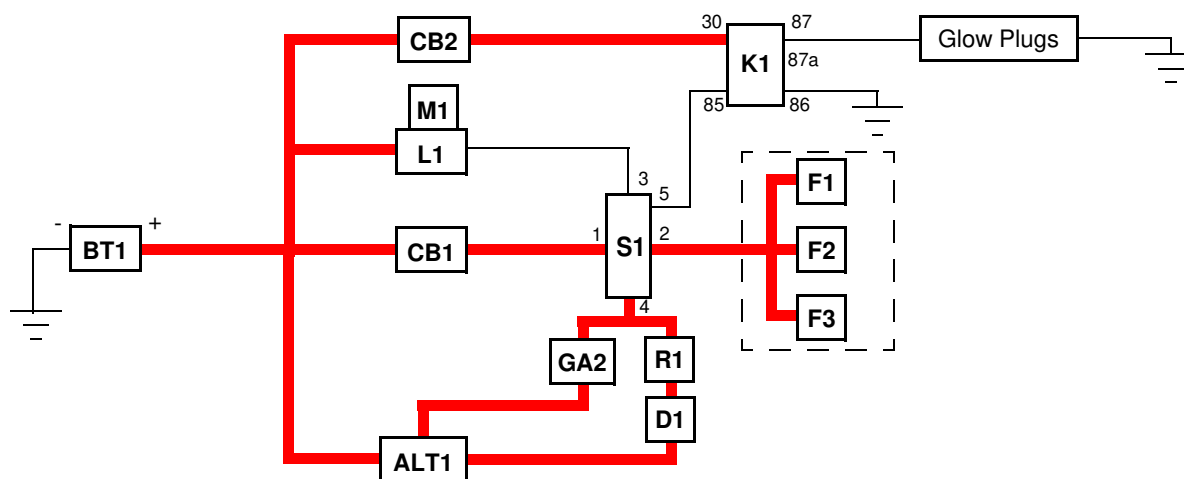


When ignition switch S1 is turned to the ON position, power flows through the switch to fuses F5 and F1. Power also flows through resistor R1 and diode D1 to the alternator and through voltmeter GA1.

The fuses F1–F5 distribute current to the machine electrical circuits. The fuses are rated from 3–30 amps, depending on the circuit(s) they protect:

- Fuse F1 (10 amp) provides current to SmartFeed controller A1, feed roller directional control, and lower feed stop bar circuits.
- Fuse F2 (20 amp) provides current to electric lift pump relay K2.
- Fuse F3 (30 amp) provides current to fuel pump relay K3.
- Fuse F4 (10 amp) provides current to the ECM.
- Fuse F5 (3 amp) provides current to glow plug relay K1, electric lift pump relay K2, fuel pump relay K3, and engine diagnostic lights DS2 and DS3.

Non-Turbo Engine Ignition ON Circuit



When ignition switch S1 is turned to the ON position, power flows through the switch to fuses F1–F3. Power also flows through resistor R1 and diode D1 to the alternator and through voltmeter GA1.

The fuses F1–F3 distribute current to the machine electrical circuits. The fuses are rated from 10–30 amps, depending on the circuit(s) they protect:

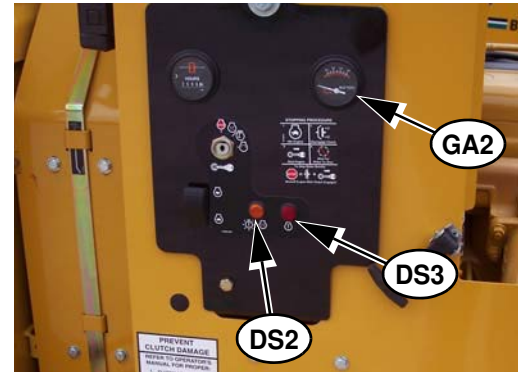
- Fuse F1 (10 amp) provides current to SmartFeed controller A1, feed roller directional control, and lower feed stop bar circuits.
- Fuse F2 (25 amp) provides current to the engine fuel system and hourmeter GA1.
- Fuse F3 (30 amp) provides current to the cold start advance circuit.

Ignition ON Circuit Troubleshooting

Troubleshooting the Turbo Engine Ignition ON Circuit

1. Turn key switch S1 from OFF to ON.

Expected result: The indicator lights DS2 and DS3 should light and voltmeter GA2 should register voltage. After a couple seconds, the indicator lights will go off. If the indicator lights are lit in the ON position, it indicates that power is available at the switch.



If indicator lights do not light, go to step 2.

NOTE: If turning key to ON in cold weather, indicator light DS2 may stay lit. See page 3-13 for more information on indicator light status.

2. If indicator lights do not light, check battery (page 3-17), 30-amp circuit breaker CB1 (page 3-28), indicator light (page 3-29) and ignition switch S1 (page 3-27). If these are OK and indicator lights still do not light, check continuity for the following:
 - red cable 100-RD from the positive terminal of the battery to the connector at starter motor M1
 - black cable 300-BK from the negative terminal of the battery to connector on the Engine ENG1
 - red wire 101-RD-6 from common terminal of starter solenoid L1 to circuit breaker CB2
 - red wire 105-RD-12 from circuit breaker CB2 to circuit breaker CB1
 - tan wire 112-TN-10 from circuit breaker CB1 to starter switch S1

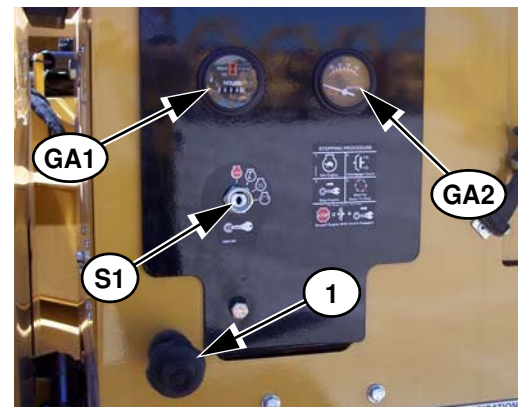
Troubleshooting the Non-Turbo Engine Ignition ON Circuit

1. Turn switch S1 from OFF to ON.

Expected result: Voltmeter GA2 should register voltage. If the voltmeter registers voltage, it indicates that power is available at the switch.

If voltmeter does not register voltage, go to step 2.

2. If voltmeter does not register voltage, check battery (page 3-17), 30-amp circuit breaker CB1 (page 3-28), and ignition switch S1 (page 3-27).



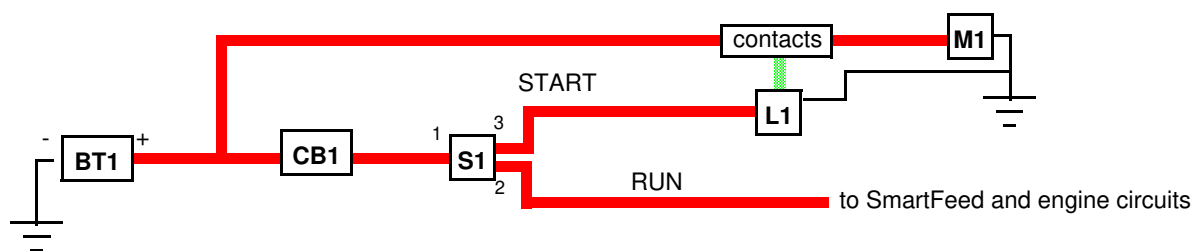
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If these are OK, and indicator lights still do not light, check continuity for the following:

- red cable 100-RD from the positive terminal of the battery to the connector at starter motor M1
- black cable 300-BK from the negative terminal of the battery to connector on the Engine ENG1
- red wire 101-RD-6 from common terminal of starter solenoid L1 to circuit breaker CB2
- red wire 105-RD-12 from circuit breaker CB2 to circuit breaker CB1
- tan wire 112-TN-10 from circuit breaker CB1 to starter switch S1

IGNITION START CIRCUIT

During Engine Start



When ignition switch S1 is turned and held to START, voltage at pin 3 goes to the coil of the starter solenoid L1, shifting the contacts of L1 to close. One of the contacts is connected to the battery terminal, the other is connected to the starter motor M1. The starter motor is grounded to the engine. The motor turns, starting the engine.

After the key is released, it returns to the ON position (pin 4). The alternator ALT1 is now turning and powering the system as discussed in *"Charging Circuit,"* page 3-39.

Ignition START Circuit Troubleshooting

Before performing the troubleshooting procedures, begin with the Pretest Inspection as described on page [3-9](#).

1. Turn and hold ignition switch S1 to START. Observe starter. If engine does not start within 30 seconds, release key. If engine starts, release key immediately.

Expected result: Starter motor will turn over the engine and engine will start. If so, continue below at step 2.

If starter motor does not turn, continue at *"Starter Motor Does Not Turn,"* page [3-37](#).

If starter turns but engine does not start, continue at *"Starter Motor Turns, but Engine Does Not Start,"* page [3-38](#).

2. Observe voltmeter gauge.

Expected result: After the engine runs a few moments, the SmartFeed power, engine start/run, cold start advance, and fault circuits are working and the gauge will be indicating normal parameters. If so, this indicates charge circuit is working.

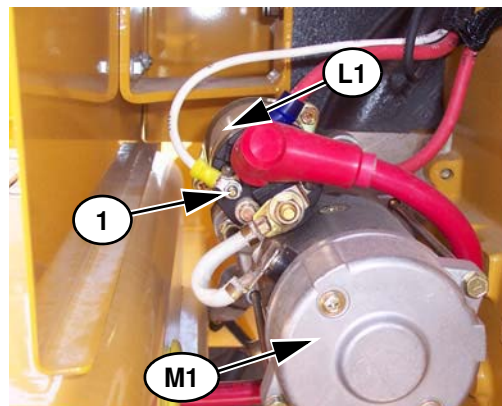
If not, go to *"Charging Circuit Troubleshooting,"* page [3-40](#).

Starter Motor Does Not Turn

1. Turn ignition switch S1 to OFF and inspect battery, terminals, connectors, and grounding points for corrosion. Also inspect opposite ends of battery cables at starter and at the grounding point on the frame. Check terminals and connectors, remove any corrosion and ensure cables are securely connected. Attempt to start engine again. If problem persists, continue below at step 2.
2. Troubleshoot ignition ON circuit (see page 3-32) to ensure power is available at the switch.

3. Turn ignition switch to START and check voltage of white wire 208-WH-10 at terminal 50 (1) of starter solenoid L1.

Expected result: Battery voltage. If so, contact an authorized Caterpillar Engine service facility. Starter M1 or solenoid L1 appears to be faulty. If not, continue below.



NOTE: The starter motor is considered to be part of the Caterpillar engine and may be covered under the engine warranty. You can void this warranty by attempting to remove or repair this system before the warranty has lapsed. If the warranty is still in effect, take the engine to an authorized Caterpillar engine service facility.

4. Turn ignition switch to OFF and test continuity of:
 - white wire 208-WH-10 from starter switch S1 to starter solenoid L1 on the starter motor M1

Expected result: Continuity. If the wire is open, repair or replace the faulty wire.

**Starter Motor Turns,
but Engine Does Not
Start**

Check these first:

- **Low Battery Voltage**—Is the engine turning over slowly? If the battery voltage is low, the starter motor may not have enough power to trigger combustion. See page [3-17](#).
- **Colder Weather Causing Harder Starting**—Did this problem arrive with colder weather? More starter motor torque is needed in cold weather because stiff engine oil and stiff hydraulic oil provide more resistance to engine and pump rotation.
- **Clogged Fuel Filter**— Change the primary and/or secondary fuel filters as discussed in the Caterpillar engine manual supplied with the machine.

If these items are ruled out as the problem, troubleshoot:

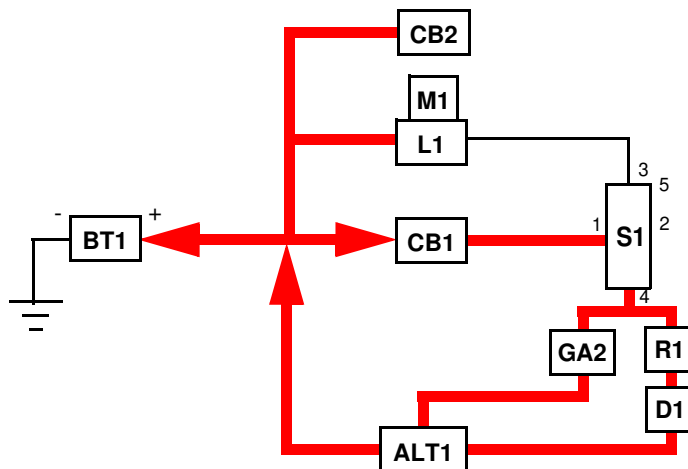
- *"Fuel Circuit,"* page [3-22](#)
- *"Air Circuit,"* page [3-20](#)
- *"Cooling Circuit,"* page [3-26](#)

If these circuits are OK, consult the engine manual that came with the machine, or contact a Caterpillar engine dealer for service.

CHARGING CIRCUIT

S1 in RUN after Engine Start

The spinning alternator supplies AC voltage, which is rectified to DC voltage by diodes inside the alternator. As soon as the alternator is producing more voltage than the battery, power from the alternator feeds back to the positive terminal of the battery and CB1. The voltmeter GA2 indicates how much DC voltage the alternator is generating.



Charging Circuit Troubleshooting

Problems encountered in keeping the battery charged can be due to the age or condition of the battery, to problems in the alternator, or to problems in the electrical paths between the alternator and battery.

1. Perform open circuit voltage test page 3-19, with key OFF. Note the indicated voltage of the battery.
2. Start engine, engage clutch, speed up engine to operating speed, and repeat open circuit voltage test and observe indicated voltage.

Expected result: Battery voltage in step 2 is at least 1/2 volt higher than in step 1. If so, alternator appears to be providing sufficient charge. Perform heavy load test on battery to ensure it is in good condition.

If not, perform ground circuit test (next step), and the charge circuit test (step 4). Then shut down and inspect alternator belt for proper tension. Tighten or replace alternator belt as needed.

3. With the engine running at operating speed, read voltage drop with the probes on the alternator housing and the negative terminal of the battery.

Expected result: Voltage drop of 0.10 volts or less. If so, engine and alternator appear to have a good ground path back to the battery. Continue at the next step.

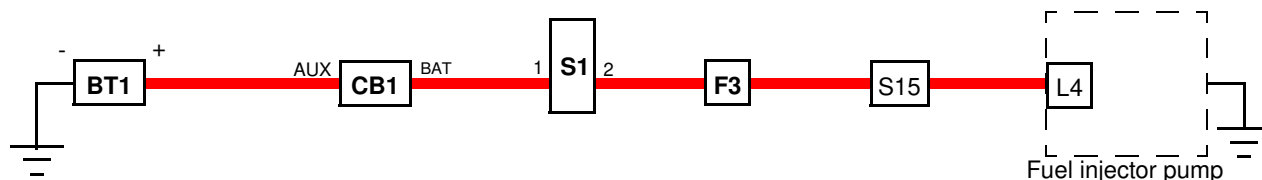
If not, look for corrosion at the ends of the ground cable the battery and the connection to the frame. 0.20 volts or more indicates significant resistance in the ground path. Inspect for and remove any corrosion. If needed, replace ground cable.

4. With the engine running at operating speed, read voltage drop with the probes on the alternator's positive post and the battery's positive post.

Expected result: Voltage drop of up to 0.20 volts is allowable due to the large diameter of the cables connecting the alternator and battery. Values above this indicate greater than desired resistance in the voltage path. Inspect for and remove any corrosion. If needed, replace cable.

If the charging problem persists and the battery has been verified to be in good condition, contact an authorized Caterpillar engine service facility about replacing the apparently faulty alternator.

COLD START ADVANCE CIRCUIT (NON-TURBO MACHINES ONLY)

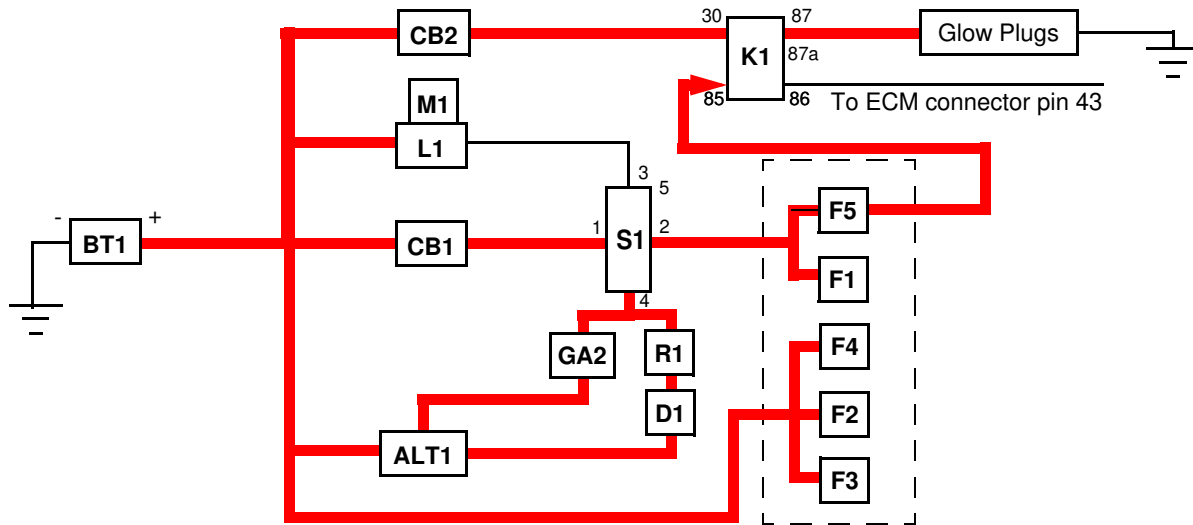


When ignition switch S1 is turned to the ON position, power flows through 30-amp circuit breaker CB1 to the fuse panel containing fuses F1–F3. Fuse F3 supplies power to a coolant temperature switch S15, which controls cold start solenoid L4 of the fuel injector pump. This switch is normally open, but closes during cold temperatures to complete the path to solenoid L4 and advance the timing of the fuel injector pump to control the amount of smoke at start-up.

When the engine reaches normal operating temperatures, switch S15 opens, breaking the voltage to L4 and returning the fuel injector pump timing to its normal setting.

GLow PLUGS CIRCUIT

Turbo Engine Glow Plugs Circuit

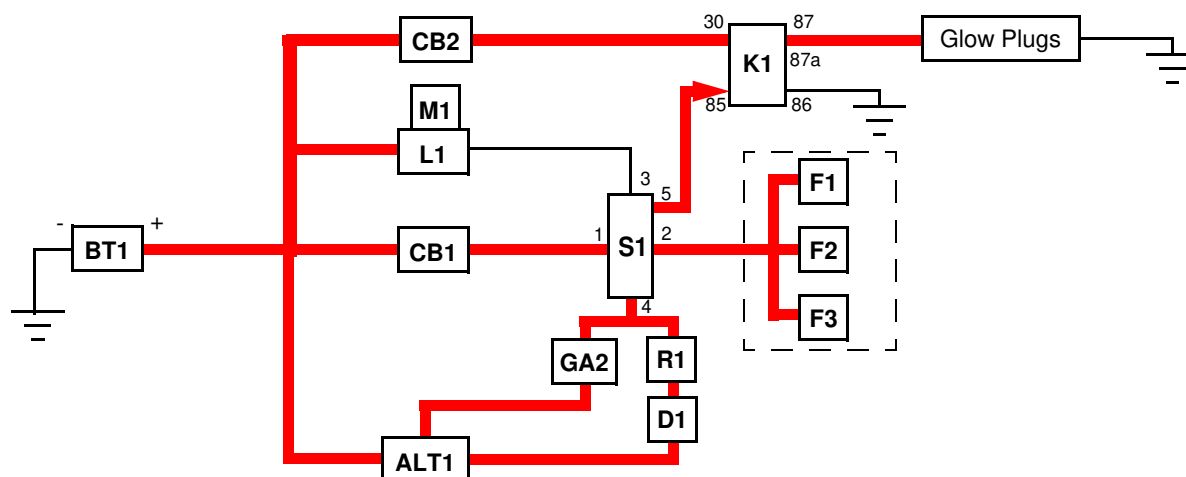


When ignition switch S1 is in the ON position, battery voltage through pin 2 of the key switch is sent through fuse F5 and then to pin 85 of the glow plug relay K1. In cold start conditions, the ECM completes the ground path for the relay at pin 43 of the ECM connector. The relay is then energized sending battery voltage from pin 87 to the glow plugs.

To indicate that the glow plugs are active, diagnostic indicator light DS2 remains lit when the ignition switch is turned to the ON position. Allow the glow plugs to stay on for 20 seconds before turning the key to START.

The glow plug relay is grounded internally to its mounting frame and the glow plugs are grounded internally to the engine.

Non-Turbo Engine Glow Plugs Circuit



When ignition switch S1 is in the GLOW PLUG position, battery voltage through pin 5 of the key switch is sent to pin 85 of the glow plug relay K1. The relay is then energized sending battery voltage from pin 87 to the glow plugs.

The glow plug relay is grounded internally to its mounting frame and the glow plugs are grounded internally to the engine.

Allow glow plugs to stay on for 20 seconds before turning the key to start.

ENGINE AND POWER DISTRIBUTION COMPONENT REPAIR

Remove/Replace Engine ENG1

Removing the Engine

NOTE: For locations of components listed below, refer to "*Component Locations*," page 3-4.

1. Follow "*Shutdown Procedure*," page 2-1.
2. Disconnect negative battery cable from battery.
3. Remove front engine shield:
 - Open the front engine shield and support it so the two retaining cables are slack.
 - Bend a fastener for each cable so the cables can be removed from the fastener.
 - Carefully lower the shield to the ground, then support the shield while removing the two pivot bolts and nuts connecting the shield to the machine.
 - Remove the shield.
4. Remove cutter disc drive belt shield and cutter disc drive belt, as described on page 5-20.
5. Disconnect both red and black battery cables from starter motor.
6. Disconnect and plug hydraulic hoses and cap fittings attached to hydraulic pump.
7. At primary fuel filter FL2, disconnect and plug fuel supply hose from fuel tank and hose to fuel lift pump.
8. Disconnect fuel return hose at fuel lift pump.
9. Disconnect air intake hose from air filter at engine turbocharger (turbo engine) or intake manifold (non-turbo engine).
10. Label and remove harness wiring at alternator, starter motor, and starter solenoid.
11. Disconnect plugs connecting harness to trailer harness.
12. Disconnect harness connections at engine for the following:
 - Speed Sensor B3 in flywheel housing
 - Engine Glow Plugs
 - Fuel Lift Pump

Continued on next page...

13. Disconnect harness connections at engine for the following:

Turbo engine

- Connector to ECM
- Clutch Position Switch S3

Non-turbo engine

- Coolant Temperature Switch S13
- Oil Pressure Switch S14
- Coolant Temperature Switch S14
- Engine Fuel Solenoid L5

For the non-turbo engine, also disconnect throttle control linkage at fuel injector.

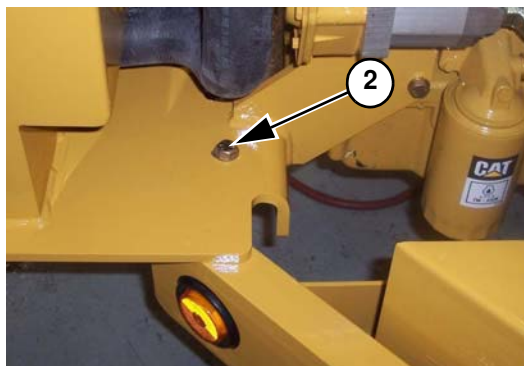
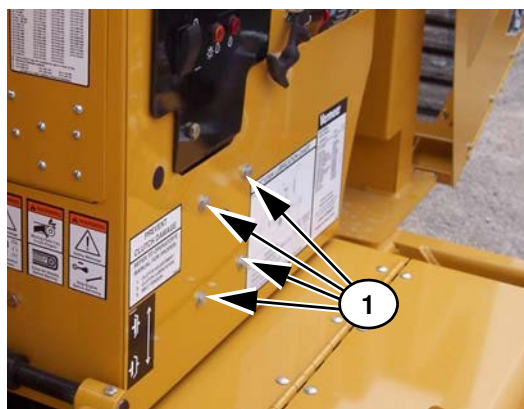
14. Attach a suitable lifting device to rear engine shield.

15. Remove four bolts (1) on each side of rear engine shield.

16. Remove rear engine shield.
Harness will be connected to electrical components on shield. Ensure that the harness is completely freed from all engine connections as the shield is removed.

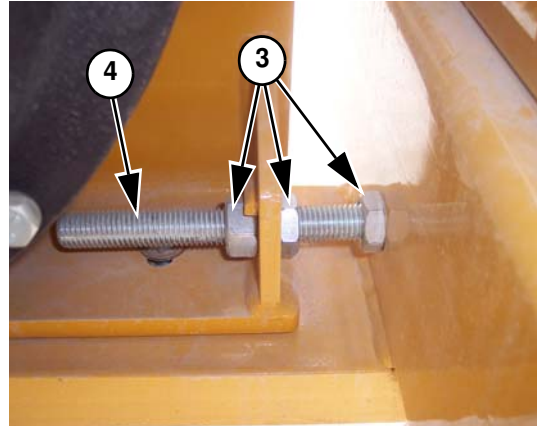
17. Attach hoist to lift rings on engine.

18. Remove four mounting bolts (2) attaching engine mounts to trailer frame. There are two bolts in front and two in back of engine.



Continued on next page...

19. Remove three jam nuts (3) and adjusting rod (4) from engine mounts. There are two adjusting rods in front and back of right side of engine.
20. Lift engine along with attached radiator assembly from machine.
21. If necessary, remove radiator assembly from engine by removing bolts on engine mount that attaches radiator assembly to engine.



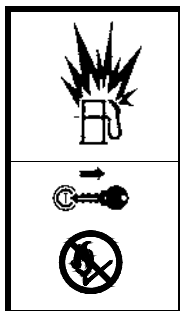
Installing the Engine

Reverse removal procedure to install the engine:

- Torque engine mounting bolts to 75 ft-lb (102 Nm)

Remove/Replace Fuel Tank RES2

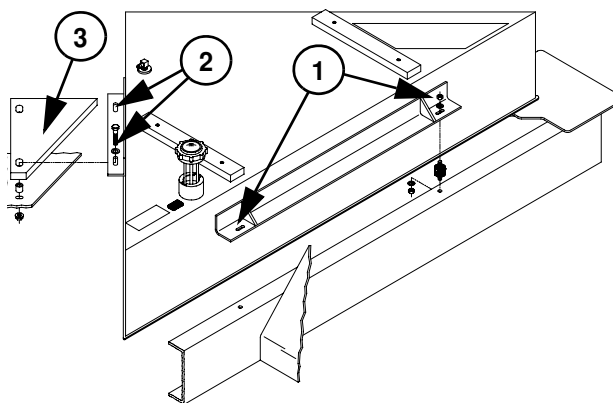
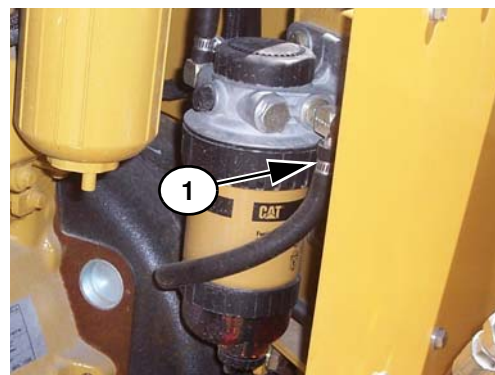
Removing the Fuel Tank



WARNING: Fuel and fumes can explode and burn.

Shut off engine before removing tank. No flame. No smoking.

1. Remove hydraulic tank RES2, as described on page 4-7.
2. Locate fuel supply line (1) where it attaches to primary fuel filter FL2.
3. Loosen hose clamp and pull fuel line from fitting. Place loose end in a suitable container and allow tank to drain. A full fuel tank holds 25 gal (95 L).
4. Loosen clamp on fuel supply hose attached to fitting on bottom of tank and pull hose off fitting.
5. Loosen hose clamp on fuel return line fitting on tank and pull hose off fitting. Raise loose end of hose above engine to prevent fuel from spilling.
6. Remove two nuts (1) from front mounting studs and two bolts and nuts (2) from rear mount. Ensure you retain mounting damper (3).
7. Lift fuel tank clear of the machine. Remove fitting on bottom of tank and drain remaining fuel into a suitable container.



NOTE: The fuel line fittings are each made up of a brass elbow and a barbed steel fitting that screws into it. If you must break them apart, clean the threads and apply oil to the threads. After reassembly, torque the barbed fitting to the brass fitting to 9 ft-lb (12 Nm).

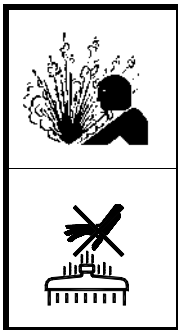
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8. Remove hose fittings and clean threads on the brass elbows. Apply Loctite 592 thread sealant to threads. Screw it into new tank until its hand-tight. Use a wrench to turn it at least 1 more revolution, and no more than 3-1/2 revolutions to point the fitting so that it points toward the direction of the engine when tank is installed.

Installing the Fuel Tank

1. Reverse steps 1 through 8 above to install new tank and attach fuel supply and return lines. Tighten nuts on mounting studs enough to visibly compress the rubber mount cushions.
2. Transfer fuel cap from old to new tank.
3. Apply new decals to new tank, if not installed.
4. Add fuel to tank. Check engine manual for instructions on priming fuel transfer pump.

Remove/Replace Radiator HE1

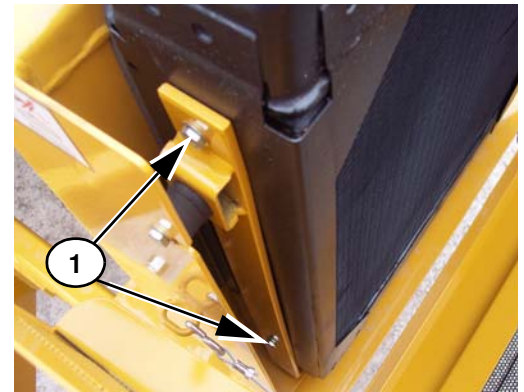


WARNING: Hot fluid under pressure can scald.

Allow engine to cool before opening radiator cap.

Removing the Radiator

1. Drain radiator into a suitable container by opening drain cock on bottom of radiator.
2. Unscrew clamps and remove upper and lower radiator hoses.
3. Remove two bolts on each side of radiator and remove radiator.



Installing the Radiator

Reverse removal procedure to install radiator. See the [BC1230A Brush Chipper Maintenance Manual](#) for information on coolant and capacity.

Charge or Replace Battery BT1

Safety Guidelines

Follow these general safety rules when working with batteries:

- Always wear safety glasses.
- Always connect battery cables correctly.
- Never short across battery posts or between post and vehicle frame for any reason. This can result in an explosion.
- Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes, and clothing.
- Store battery out of reach of children.
- Keep all burning material away from the battery and do not smoke.

Battery Explosion Avoid



WARNING: Battery fumes are flammable and can explode. Keep all burning materials away from battery. Battery explosion can blind. Acid can blind and burn. Tools and cable clamps can make sparks.

Do not smoke. Shield eyes and face. Read instructions.

- Batteries can generate an explosive mixture of hydrogen and oxygen gases. Vermeer ships machines with sealed (non-refillable) batteries but the operator may have replaced them with unsealed batteries or the seal may be broken. For this reason never smoke near the battery compartment or otherwise introduce flame to this area. A spark or flame near the battery could ignite the gases, rupturing the case and splattering acid on property, clothing, and eyes.
- If charging a battery, turn off or unplug the charger before connecting or disconnecting the clamps to the terminals to prevent sparking.
- If the air is still, explosive gases may linger near an unsealed (or improperly sealed) battery after charging. Blow away the gases before performing tests or work on the battery that may cause sparks.
- Do not break circuits near the top of the battery. A spark may cause an explosion.
- Batteries that have the proper level of electrolyte are less prone to explosion since less space is available in the cell to collect gases. Check the electrolyte (on unsealed batteries) frequently. If low, add distilled water.
- Use a flashlight to check electrolyte levels. Never use a match or lighter or other flame.
- Do not short across the battery terminals by placing a metal object between them. Keep plastic covers in place on the battery clamps. If the terminals are disconnected, use a plastic terminal cap to prevent metal contact.

Battery Acid Hazard

WARNING: Batteries contain sulfuric acid which can cause serious chemical burns.

Wear a face shield and rubber gloves when servicing the battery.

Electrolyte contains sulfuric acid—strong enough to eat holes in clothing, burn skin and internal tissue and cause blindness if splashed into the eyes. Work on batteries in a well-ventilated area to avoid breathing acid fumes.

- ***You must wear eye protection*** when checking electrolyte. If a cap is not vented, pulling the cap off the cell will create a vacuum, causing electrolyte to splash out.
- Rubber gloves and apron are recommended anytime you work with electrolyte. If you come in contact with electrolyte:
 - flush exposed skin with running water for several minutes. Apply baking soda or lime to neutralize the acid.
 - If acid gets in your eyes, force open the lids and flush with water for 15 to 30 minutes. Get medical help immediately.
 - If acid is swallowed, drink large amounts of milk or water to dilute the acid. Get medical help immediately.

First Aid

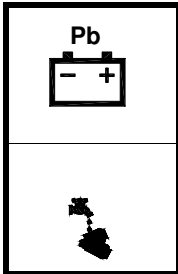
External: Flush with water. If eyes have been exposed, flush with water for 15 minutes and call a physician immediately.

Internal: Drink large quantities of water or milk; follow with milk of magnesia, beaten egg, or vegetable oil. Call a physician immediately.

Charging the Battery

- Follow instructions from the battery charger manufacturer.
- Provide good ventilation.
- Never attempt to charge a battery that has frozen electrolyte.
- Always confirm correct connection between battery and charger before turning on charger.

Performing Battery Maintenance

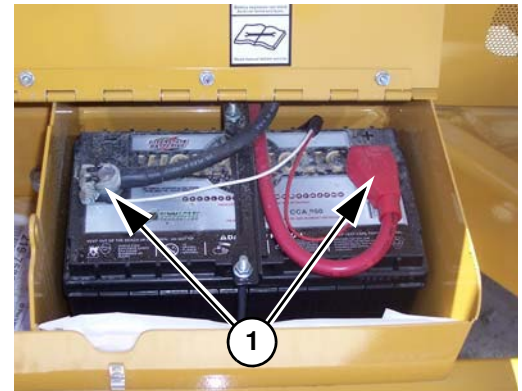


WARNING: Battery post, terminals, and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and reproductive harm.

Wash hands after handling.

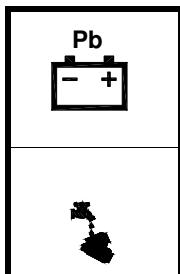
Inspect battery terminals **(1)** and connectors for corrosion. Also inspect opposite ends of battery cables at starter and at the grounding point on the frame. Check terminals and connectors, remove any corrosion and ensure cables are securely connected.

Batteries are perishable items that require periodic servicing. A properly maintained battery will give long and trouble free service.



- Keep top of the battery clean.
- Clean cable clamps when necessary. Replace any corroded or damaged parts. Red caps must remain installed over the positive cable clamps.
- Check electrical system if the battery repeatedly becomes discharged or low on electrolyte.
- If battery is not maintenance free periodically check electrolyte level and specific gravity.
- Use only distilled water to restore electrolyte level. Never add acid. In freezing weather, run the engine for a few minutes immediately after filling the battery to mix the water and the electrolyte.

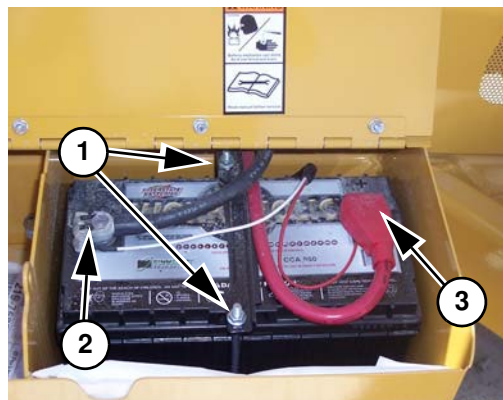
Replacing Battery BT1



WARNING: Battery post, 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.

1. Follow "*Shutdown Procedure*," page 2-1.
2. Unlatch and open door to battery compartment.
3. Remove two nuts (1) from holddown bracket.
4. Disconnect and remove negative battery cable (2) first.
5. Disconnect and remove positive cable (3).
6. Lift battery and remove from compartment.
7. Install new battery.
8. Apply a light coating of petroleum jelly around base of each terminal and connect cables. Torque retainer bolts to 25 ft-lb (34 Nm). Check that the red cap is over the positive cable clamp.
9. Reinstall holddown bracket.
10. Close and latch hood.

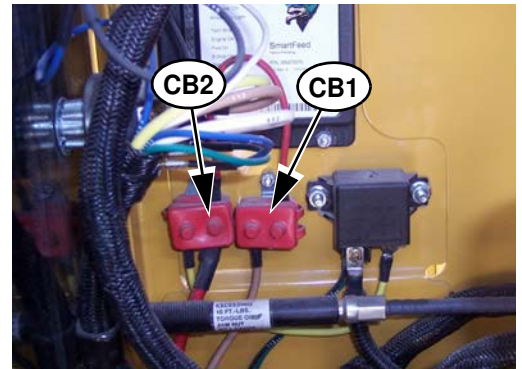
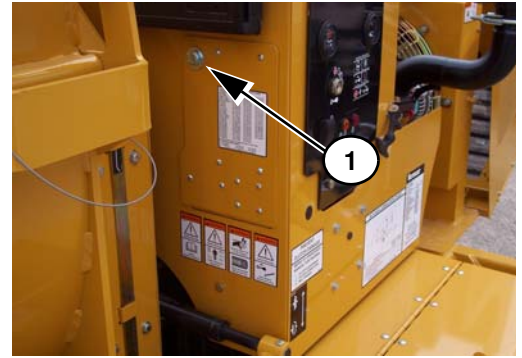


Replace Circuit Breakers CB1 and CB2

Circuit breaker CB1 and CB2 are located inside the access panel on the rear engine shield.

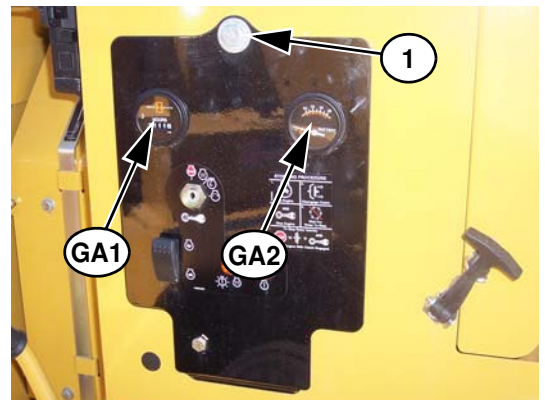
To replace either circuit breaker:

1. Remove bolt (1) to open access panel on rear engine shield.
2. Remove rubber cover over circuit breaker and remove wires from each side of breaker.
3. Remove two nuts and bolts connecting circuit breaker to panel.
4. Install new circuit breaker using existing hardware to reinstall wires.



Replace Hourmeter GA1 and Voltmeter GA2

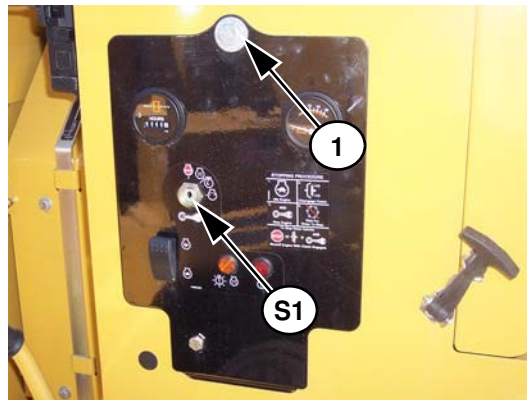
1. Remove bolt (1) to access back of control panel.
2. Remove wires from gauge terminals.
3. Remove mounting hardware from gauge and push gauge through panel.
4. Reverse procedure to install new gauge.



Replace Ignition Switch S1

To replace ignition switch S1:

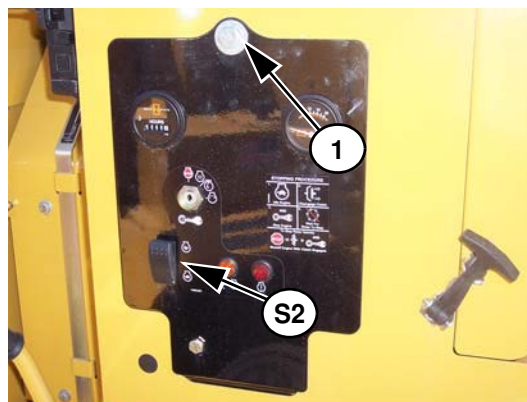
1. Remove bolt (1) to access back of control panel.
2. Remove wires from switch terminals.
3. On front side of control panel, unscrew retaining ring around barrel of switch. Pull switch out from back of panel.
4. Reverse procedure to install new switch. Refer to wiring diagrams in the Appendix to ensure that wires are connected to correct switch terminals.



Replace Throttle Switch S2 (Turbo Engine Only)

To replace throttle switch S2:

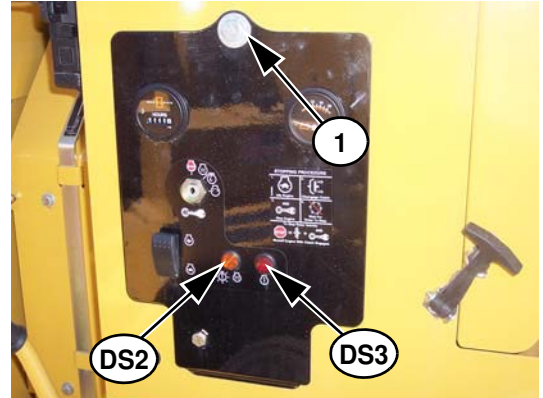
1. Remove bolt (1) to access back of control panel.
2. From behind panel, unplug harness connector from throttle switch S2.
3. Compare new switch with old switch and mark top of case of new switch.
4. Note plastic “ears” on switch case. Use a screwdriver blade or other method to force the ears down against case and work switch out through front of panel.
5. With marked side up, push new switch through cutout in the panel until ears pop up and retain switch.
6. Plug connector into new switch.



Replace Indicator Lights DS2 and DS3 (Turbo Engine Only)

To replace indicator lights DS2 and DS3:

1. Remove bolt (1) to access back of control panel.
2. From behind panel, unplug harness connector from indicator light.
3. Unscrew retaining nut fastening light to panel and remove light.
4. Plug connector into new light and reinstall light into panel with retaining nut.

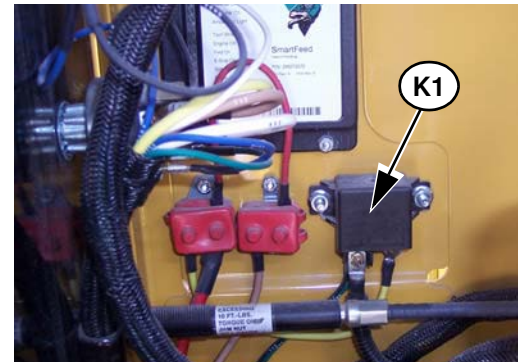
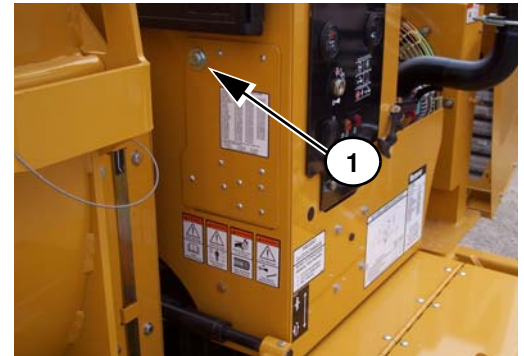


Replace Glow Plug Relay K1

Glow plug relay K1 is located inside the access panel on the rear engine shield.

To replace either circuit breaker:

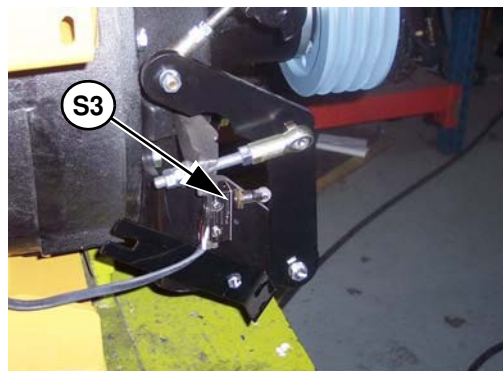
1. Remove bolt (1) to open access panel on rear engine shield.
2. Remove wires from the relay.
3. Remove two nuts and bolts connecting relay to panel.
4. Install new relay using existing hardware and reconnect wires.



Replace Clutch Switch S3 (Turbo Engine Only)

To replace clutch switch S3:

1. Locate switch and harness connection on left side of clutch housing.
2. Unplug harness connector from switch.
3. Remove two screws fastening switch to clutch linkage.
4. Plug connector into new switch and reinstall light into linkage with two screws. Ensure roller on switch aligns with linkage arm so the arm trips the switch when the clutch is engaged.



Replace Filters

For instructions on replacing the air filter element, refer to the [BC1230A Brush Chipper Maintenance Manual](#). For instructions on replacing oil filter FL1, primary fuel filter FL2 and secondary fuel filter FL3, refer to the Caterpillar engine manual.

Caterpillar Engine Components

The following items are considered part of the Caterpillar engine. Consult the engine manual that came with the machine, or an authorized Caterpillar engine repair facility to repair or replace these items:

- Starter Solenoid L1
- Starter Motor M1
- Alternator ALT1
- Fuel Lift Pump PMP2
- Engine Control Module (ECM)
- Coolant Temperature Switch S13
- Oil Pressure Switch S14
- Coolant Temperature Switch S15 (for cold start)
- Cold Start Advance Solenoid L4
- Engine Fuel Solenoid L5

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Chapter 4: Fluid Conditioning

OVERVIEW

Fluid Conditioning consists of hydraulic components that supply and condition oil required by the machine hydraulic circuits.

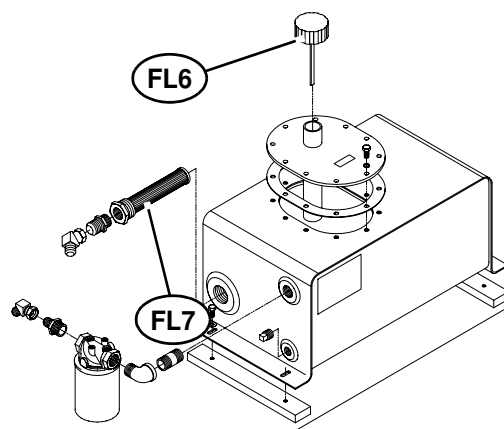
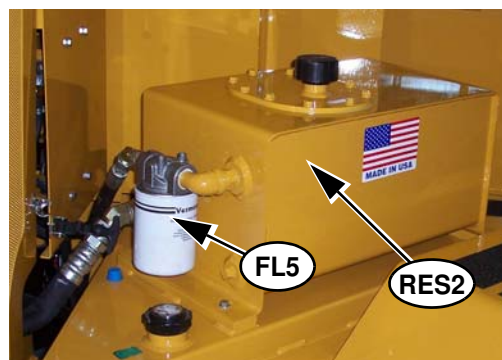
CIRCUITS/COMPONENTS

The following circuits and components are used for Fluid Conditioning:

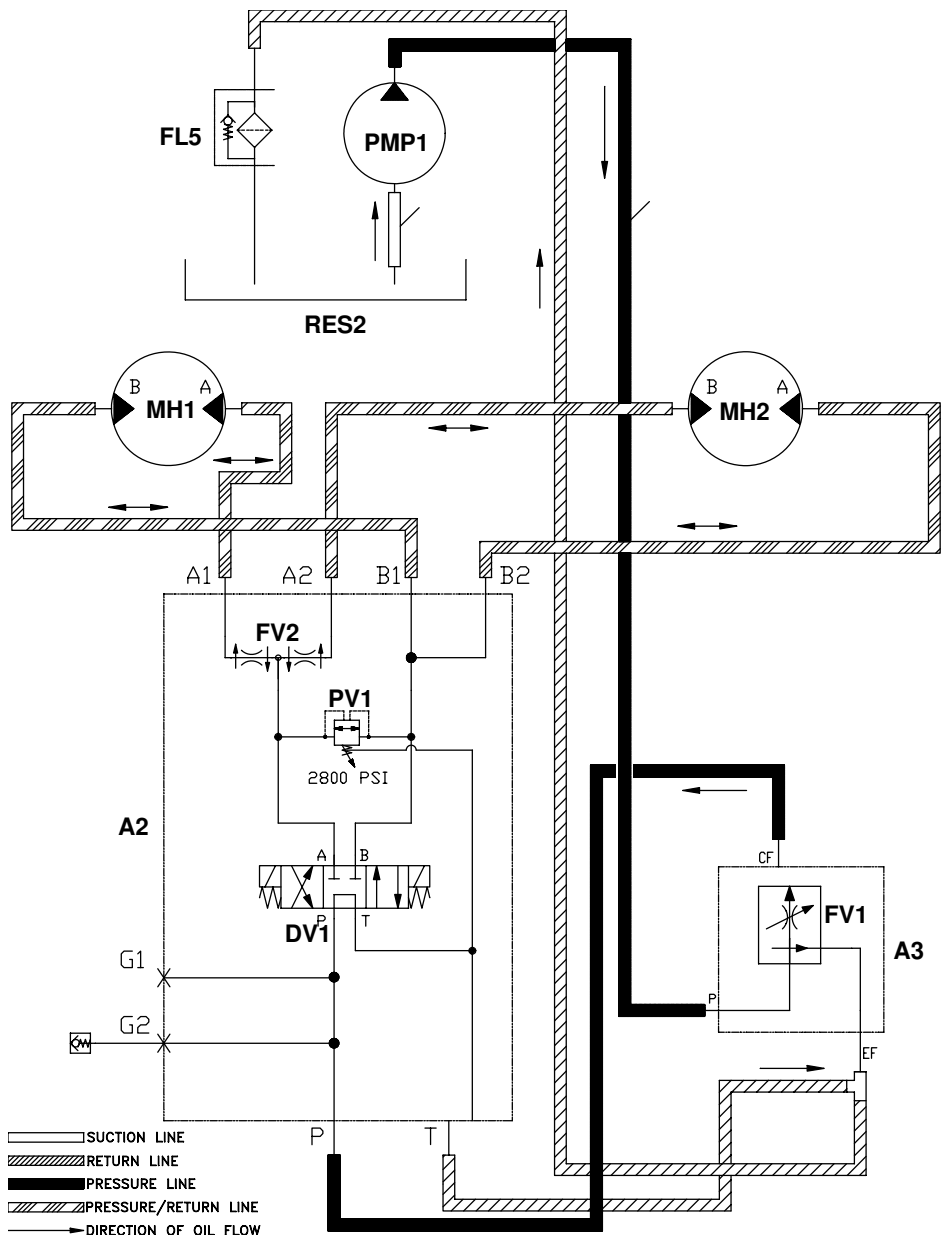
- Hydraulic Oil Supply and Return Circuit:
 - Hydraulic Tank RES2
 - Return Filter FL5
 - Strainer FL6
 - Breather FL7

Component Locations

- Hydraulic Tank RES2
- Hydraulic Return Filter FL5
- Breather FL6 is located in fill cap
- Strainer FL7 is located inside tank at supply hose fitting



HYDRAULIC HOSE CONNECTIONS

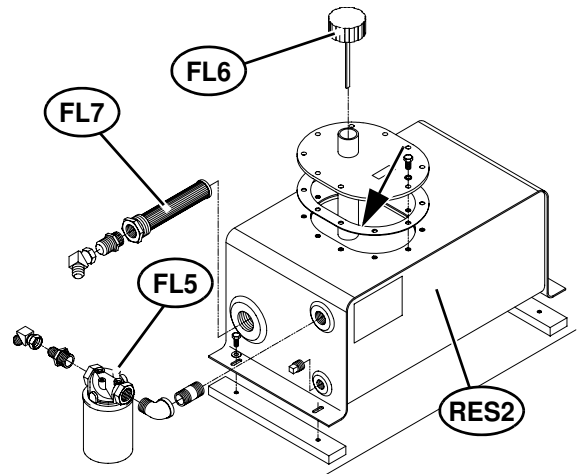


Fluid Conditioning

HYDRAULIC TANK RES2

The hydraulic tank RES2 holds 9 gal (34 L) of fluid and supplies and receives hydraulic oil necessary for operation of the machine hydraulic circuits. The fill cap (1) incorporates a 10-micron filter FL6 that allows air in and out of the tank while keeping contaminants out.

The hydraulic pump PMP1 supplies pressurized oil to the hydraulic implement circuits. As oil flows from the tank to the pump, it is filtered through a 100-mesh strainer FL7 that is located near the bottom of the tank.



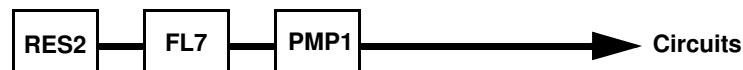
As oil returns to the tank, it is filtered through a beta 6 return filter FL5. A check valve in the filter head allows oil to bypass if the filter becomes dirty enough to restrict flow. When return line pressure exceeds 50 psi (3.5 bar), the check valve opens and oil bypasses the filter, flowing directly to the tank.

The time the fluid remains in the tank allows fluid that has returned from the circuits to cool. During this time contaminants begin settle out to the bottom of the tank, and air bubbles float to the surface to dissipate.

FLUID CONDITIONING CIRCUITS

Outgoing Fluid

As the gear pump PMP1 pulls fluid from the tank, the fluid passes through an inlet strainer FL7. The strainer is made of 100-mesh wire screen. It keeps large particles from entering the pump inlet.



Returning Fluid

As the fluid completes its circuit after moving through the pump, valves, and cylinders, it passes through return filter FL5 before it returns to the tank. This filter catches fine particles that may be pulled in past the gland seals of the cylinders.



FLUID CONDITIONING TROUBLESHOOTING

This section describes troubleshooting procedures for fluid conditioning. Before troubleshooting fluid conditioning, ensure that oil in the hydraulic tank is at the correct level. Check for damaged hoses or fittings that are leaking. Clean oil tank and surrounding area before working on affected components.

If machine performance indicates a problem in more than one circuit, components common to the problem circuits need to be investigated. Begin troubleshooting by looking at the hydraulic components shared by the faulty circuits.

Test Equipment Needed

- Pyrometer or magnetic or dial thermometer with magnetic base.

Hydraulic Oil

Observe Oil Condition

The fluid should appear clean, clear and amber in color. A milky haze or smoky appearance indicates there is water in the oil. The water should settle out in 24 hours. If not, replace the fluid. Refer to the [BC1230A Brush Chipper Maintenance Manual](#) for details.

- Low oil allows condensation to collect on the walls of the tank, adding water to the oil.
- When open loop systems are low on oil, cylinders and motors may move slowly or erratically.

Small quantities of water may not show up as a milky or smoky haze, but can be detected by placing a few drops of oil on a hot surface (about 250°F 121°C). If water is present, it quickly vaporizes and makes a crackling or popping sound.

- The oil level in the tank changes throughout the work cycle, so the air space above the oil also changes, unless the breather filter is clogged.
- Atmospheric pressure moves fluid into the inlet of the pump. A clogged breather filter may cause pumps to cavitate, which can severely damage the pump in a short time.

Observe Oil Odor

1. Remove cap and smell hydraulic oil. The oil should have a bland odor.

If the oil smells burnt or has a pungent odor, heat or oxidation has affected the quality of the oil.

2. Draw and inspect a sample of the oil and compare it to a sample of new oil.

Oil Sampling

If further testing is desired, send an oil sample to a qualified testing facility to determine:

- levels of acidity, alkalinity, water content, particles of dirt and metals

Oil Filtration

Return Filter

When a machine function is activated, return oil flows through filter FL5 and on to the tank. If the filter becomes restricted enough to raise the pressure to 50 psi (3.4 bar), a bypass valve in the filter head opens and allows unfiltered oil into the tank. Unfiltered oil will eventually damage system components.

Hydraulic Oil Temperature

1. Inspect area around hydraulic tank that may block air flow.
2. Use a pyrometer to measure the temperature of the oil in the hydraulic tank. If using a dial thermometer, ensure it is located below the level of the oil in tank.
3. Start engine. Advance throttle while listening to the pump.

IMPORTANT: If a pump is making a shrieking noise, the machine should be shut down immediately. This noise indicates that the pump may be cavitating (the pump is not receiving enough oil from the tank). Cavitation can ruin a pump in a short amount of time.

The temperature of the oil should not exceed 180°F (82°C) during normal work cycles. Rapid increases in temperature (from ambient to above maximum allowable) is usually caused by oil flowing through a restriction (such as an internal leak in a hydraulic component).

Internal leakage in components creates heat. In some cases it may be possible to use a pyrometer to follow hoses or drain lines upstream from the tank to the source of the heat. The pyrometer readings should increase or maintain temperature to the restriction, then decrease dramatically as it is moved upstream from the restriction.

FLUID CONDITIONING COMPONENT REPAIR

Remove/Replace Hydraulic Tank RES2

Removing Hydraulic Tank RES2

1. Follow *"Shutdown Procedure,"* page 2-1.

2. Allow hydraulic oil to cool.

3. Loosen fill cap (1).

4. Remove drain plug (2) and drain fluid into a suitable container (minimum capacity 10 gal/38 L).

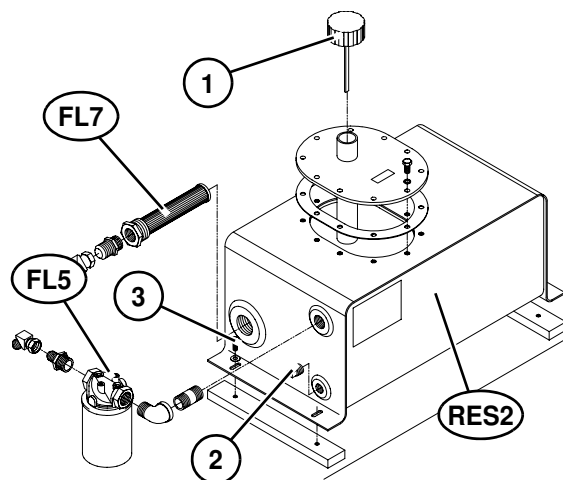
5. Disconnect and plug inlet hose going to return filter FL5 and outlet hose attached to strainer FL7.

6. Remove return filter FL5 and strainer FL7.

7. Remove bolt (3) from each corner of tank and remove tank.

8. Inspect interior for contaminants and remove when found. Clean tank interior with soapy water. Rinse and dry thoroughly.

IMPORTANT: Ensure that interior of tank is thoroughly dry after washing. Water left in the tank will cause oil contamination.



Installing Hydraulic Tank RES2

1. Reverse removal procedure to install tank.

2. Fill hydraulic fluid.

3. Install and tighten fill cap.

4. Start engine and operate hydraulic system.

5. Check hydraulic fluid level.

Replace Return Filter FL5

Refer to the *BC1230A Brush Chipper Maintenance Manual* for instructions on replacing hydraulic return filter FL5.

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Chapter 5: Clutch and Cutter Disc

OVERVIEW

This chapter contains instructions for adjusting, removing, and installing the components of the clutch and cutter disc assemblies. These assemblies also include the engine sheave, cutter disc sheave, drive belt, and discharge chute.

The cutter disc is driven mechanically by the engine and cutter disc sheaves and the drive belt. When the clutch is engaged, the engine torque is transmitted to the cutter disc sheave through the drive belt. The engine sheave is approximately twice the circumference of the cutter disc sheave, so the cutter disc turns at roughly half the RPM of the engine.

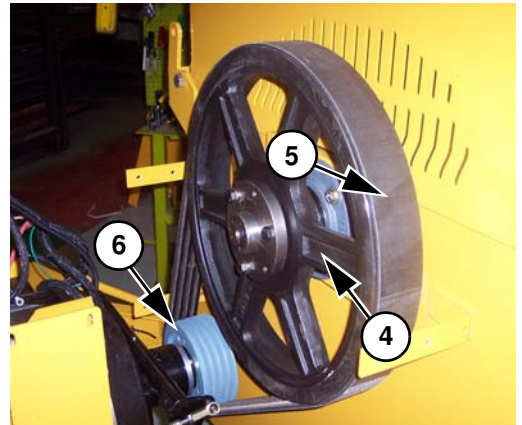
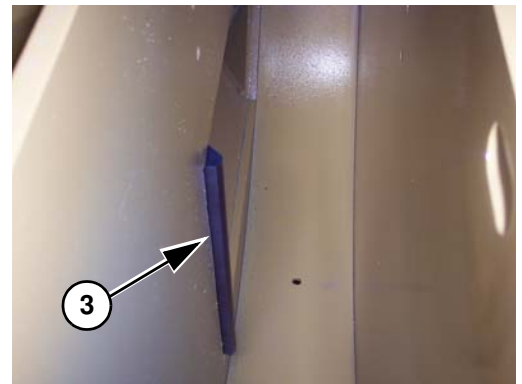
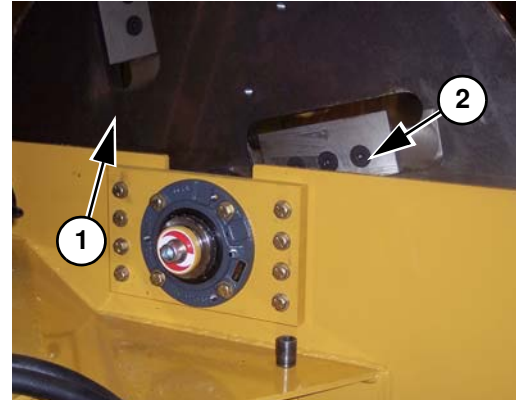
Circuits/Components

Components in this subsystem include:

- Cutter Disc
- Cutter Knives (4)
- Cutter Disc Lock Pin
- Shear Bar (Bedknife)
- Cutter Disc Drive Belt
- Cutter Disc Sheave
- Engine Sheave
- Clutch Assembly
- Clutch Lever
- Clutch Position Switch S3 (turbo model only)
- Discharge Chute and Deflector Assembly
- Discharge Chute Lock Pin

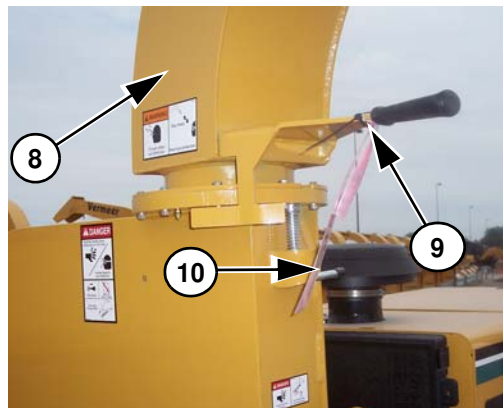
Component Locations

- Cutter Disc (1) as seen by opening top of cutter disc housing.
- One of four Cutter Knives (2)
- Shear Bar (3) as seen by looking down into cutter disc housing.
- Cutter Disc Sheave (4)
- Cutter Disc Drive Belt (5)
- Engine Sheave (6)
- Clutch Handle (7)

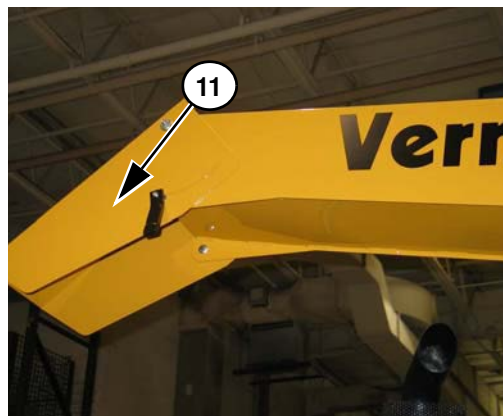


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- Discharge Chute (8)
- Chute Handle (9)
- Chute Lock Pin (10)



- Discharge Chute Deflector (11)



CLUTCH

The friction clutch is mounted to the end of the engine. The clutch is engaged and disengaged by the operator manually moving the clutch lever. When the clutch is engaged, the clutch shaft turns the clutch sheave.

On turbo models, clutch switch S3 opens and closes by moving the clutch lever. This switch is part of the engine's speed control interlock. For more information, see "[Engine Speed Interlock \(Turbo Engine Only\)](#)," page [3-15](#).

The clutch sheave is 7.9" (201 mm) in diameter and the cutter disc sheave is 21.1" (536 mm) in diameter. With that ratio, the torque at the cutter disc shaft is 2.67 times the torque at the clutch shaft. At 2400 rpm (operating speed), the cutter disc shaft turns at 899 rpm.

Clutch Troubleshooting

To obtain mechanical function of the cutter disc, the clutch must be engaged. Once engaged, the power of the engine is transferred to the cutter disc using the sheaves and belt. Every time the clutch is engaged, the components are subjected to considerable heat, friction, and wear.

The following list some problems that can occur with the clutch:

- slipping
- grabbing
- dragging
- abnormal noises

For information on adjusting or replacing the clutch to correct these problems, refer to page [5-31](#).

Slipping

As the clutch wears, free travel of the clutch linkage will increase, creating the need for adjustment.

Grease and oil on a clutch disc can also cause slippage. When this occurs, locate the leak and stop any leakage, thoroughly clean the clutch components and replace clutch disc.

Grabbing

A grabbing or chattering clutch will produce a severe vibration. This is caused by components inside the clutch housing (friction disc, flywheel, or pressure plate). Other reasons could be oil or grease on the disc facings, glazing, or loose disc facings. Broken parts, such as broken disc facings, broken facing springs, or broken pressure plate, will cause grabbing.

Dragging

Dragging is caused when a clutch disc does not completely disengage from the flywheel or pressure plate when clutch is disengaged. When this occurs, always check clutch adjustment first. If the problem is inside, it is generally a warped disc or pressure plate, oil or grease on the friction surface, rusted or damaged input shaft.

Abnormal Noises

Sounds produced from the clutch when the clutch is engaged are generally due to friction disc problems, such as a worn disc facing, which causes a metal-to-metal grinding sound. A rattling or a knocking sound may be produced by weak or broken clutch disc torsion springs.

CUTTER DISC AND SHEAR BAR

The cutter disc both chips the incoming material and creates air pressure to blow the chipped material up and out the chute. The disc has four (4) opposing staggered blades bolted to it on one side, and two paddles on the opposite side that move the chips out the discharge chute.

The blades of the cutter disc pass about 1/10" from the shear bar, also called a bedknife, mounted to the bottom of the feed roller housing. The close clearance ensures that even small diameter twigs and branches are chopped up by the blades and not pulled through. As the cutter disc blades wear and the shear bar wears, the clearance between them must be adjusted. A knife gauge is provided with each machine.

Openings in the cutter disc near the knife edges allow the chips to move to the other side of the cutter disc as they are cut. Paddles mounted on this side of the disc throw the chips up and out the chute, assisted by the flow of air caused by the paddles.

A cutter disc lock pin holds the disc from turning while cutter disc blades are removed or installed. Blade sharpening instructions are in the [BC1230A Brush Chipper Maintenance Manual](#).

Cutter Disc Troubleshooting

Anytime the belt is removed, take the opportunity to grab the sheave on the cutter disc shaft and attempt to shake it. If you feel any play in the cutter disc shaft bearings, replace them. Any radial play or axial play means the bearing is about to fail. The clearance between the disc housing walls and the disc, and more critically, between the cutter disc blades and the shear bar, do not allow for any movement of the cutter disc shaft.

Replacement of the disc bearings, blades and the shear bar is covered in "[Clutch and Cutter Disc Component Repair](#)," page **5-8**.

SHEAVES AND DRIVE BELT

When the clutch is engaged, the driving sheave on the engine output shaft rotates the sheave on the cutter disc. Tension is maintained on the drive belt by adjustment bolts on the engine mounts.

Sheave and Drive Belt Troubleshooting



WARNING: Moving parts can crush fingers.

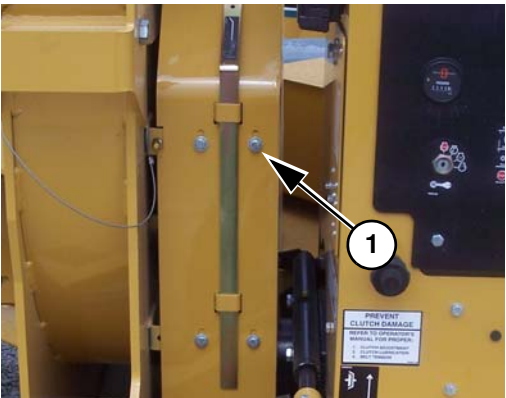
WARNING: Close all shields before starting.

If the belt is wearing out before its expected life, inspect the sheaves for wear, and proper alignment of the sheaves.

Removing the Belt Shield

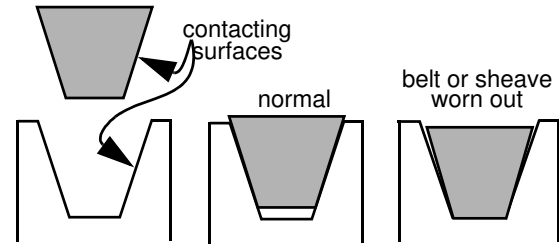
Removing the belt shield allows access to the cutter disc drive belt, drive belt sheave, and cutter disc sheave.

To remove the belt shield, remove four bolts from each side of the shield (1).

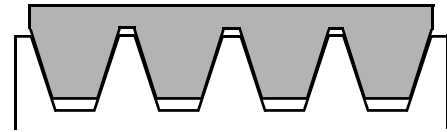


Belt/Sheave Wear

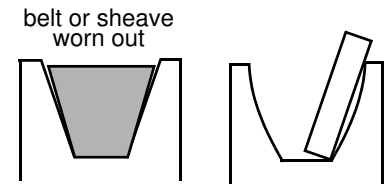
The sheaves and belt transmit power through friction of the sides of the vee of the belts with the sides of the vee in the sheave. The belt does not make contact with the bottom of the vee in the sheave.



On a relatively new belt and sheave in good condition, the walls of each vee in the sheave will be polished, but the bottom of the vee and the tops of the ridges between the vees will not be polished.



Since the chipper works in an environment with a lot of abrasive dust in the air, the walls of the vees on the sheaves may be subject to greater than normal wear. Always inspect the side of the vee with a straightedge. If the wall is dished out more than 1/32" (1 mm), replace the sheave.

**Aligning the Sheaves**

Ensure sheaves are aligned with each other. A straightedge or a string stretched along the two sheaves will confirm whether or not they are in-line. If not aligned, loosen or remove the sheaves and install them correctly.

NOTE: When aligning the sheaves, align the cutter disc sheave with the clutch sheave. See page [5-18](#).

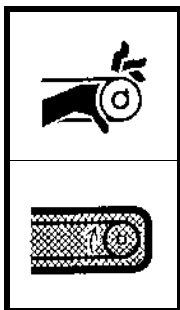
Ensure sheaves are mounted correctly on their shafts and do not wobble as the sheave rotates. Remove belt so you can turn the sheaves by hand.

Brace a ruler on the frame with the end about 1/4" (6 mm) from the edge of the sheave. Watch the gap as you rotate the sheave by hand. Any wobble will be plainly visible. This misalignment is usually due to uneven tightening of the bolts that hold the sheave to the hub. Disassemble and reassemble sheave to the hub.

DISCHARGE CHUTE

The discharge chute allows the operator to control the direction that chips are expelled from the chipper. A deflector at the top of the chute determines the downward deflection angle as the chips are expelled.

CLUTCH AND CUTTER DISC COMPONENT REPAIR



WARNING: Moving parts can crush fingers.

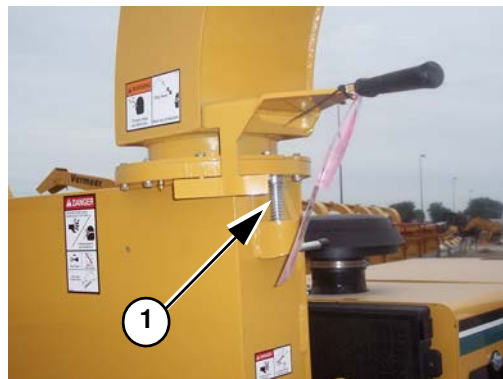
WARNING: Close all shields before starting.

Follow "*Shutdown Procedure*," page **2-1**, before working around the cutter disc components.

Cutter Disc

Removing the Cutter Disc

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Remove belt shield, as described on page 5-6.
3. Swing discharge chute over the right side of machine and secure with chute lock pin (1).



4. Remove two bolts (2) attaching cutter disc shield.



5. Remove cutter disc lock pin (3) from storage location.
6. Open cutter disc shield by carefully pulling down on discharge chute until spout deflector touches the ground.
7. Remove cutter disc drive belt, as described on.
8. Remove cutter disc sheave, as described on.

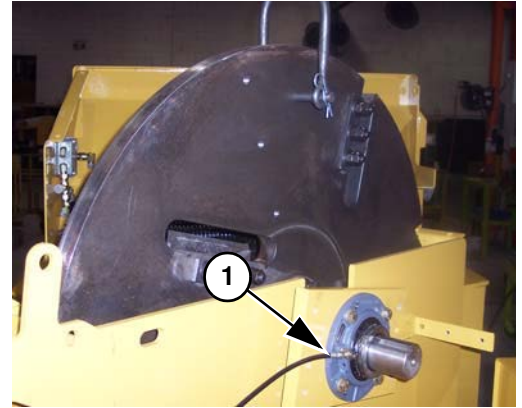


NOTE: Measure and record the distance from the bushing to the end of the shaft before removing the sheave and bushing. This will provide a good starting point for sheave placement during assembly.

Continued on next page...

9. Disconnect remote grease line (1).

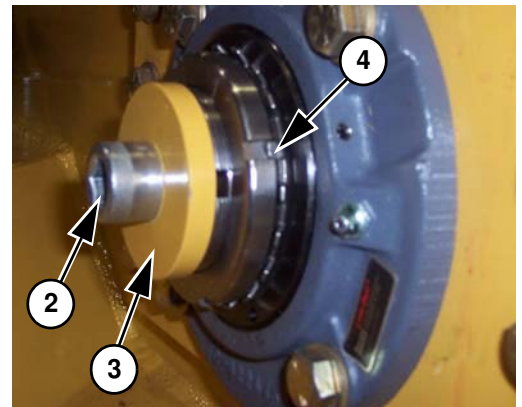
10. Attach a clevis and hoist to cutter disc as shown. Take up slack in chain.



11. Remove socket head cap screw (2), hardened washer, and end cap (3) from rear bearing assembly.

12. Bend tab (4) up in bearing locking ring slot so ring can turn freely.

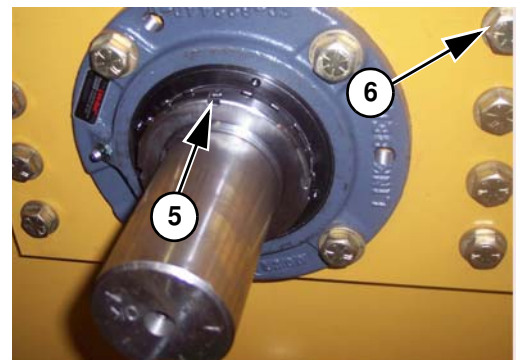
13. Use spanner tool to loosen rear bearing.



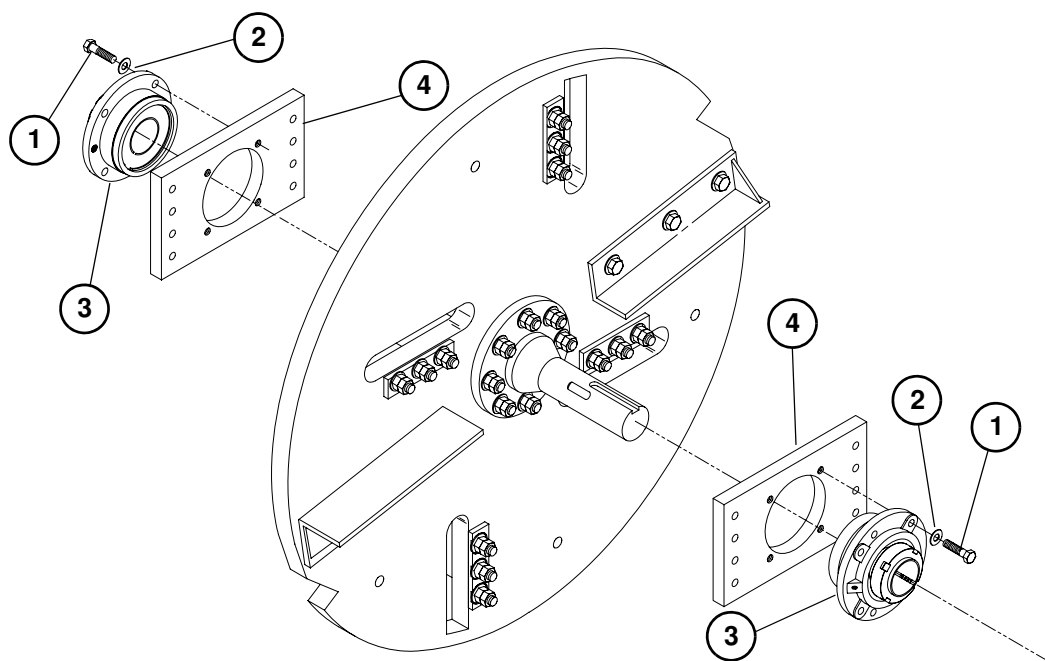
14. Bend tab (5) up in front bearing locking ring slot and use spanner tool to loosen front bearing.

15. Remove eight bolts and hardened washers (6) from front and rear bearing mounts.

16. Lift cutter disc assembly out of housing.

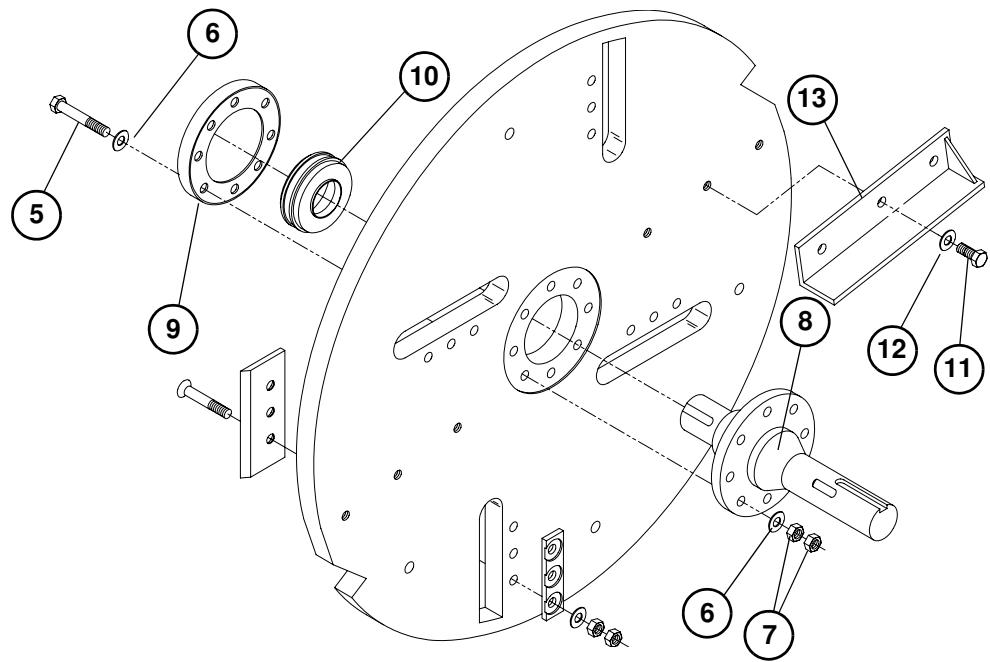


Disassembling the Cutter Disc



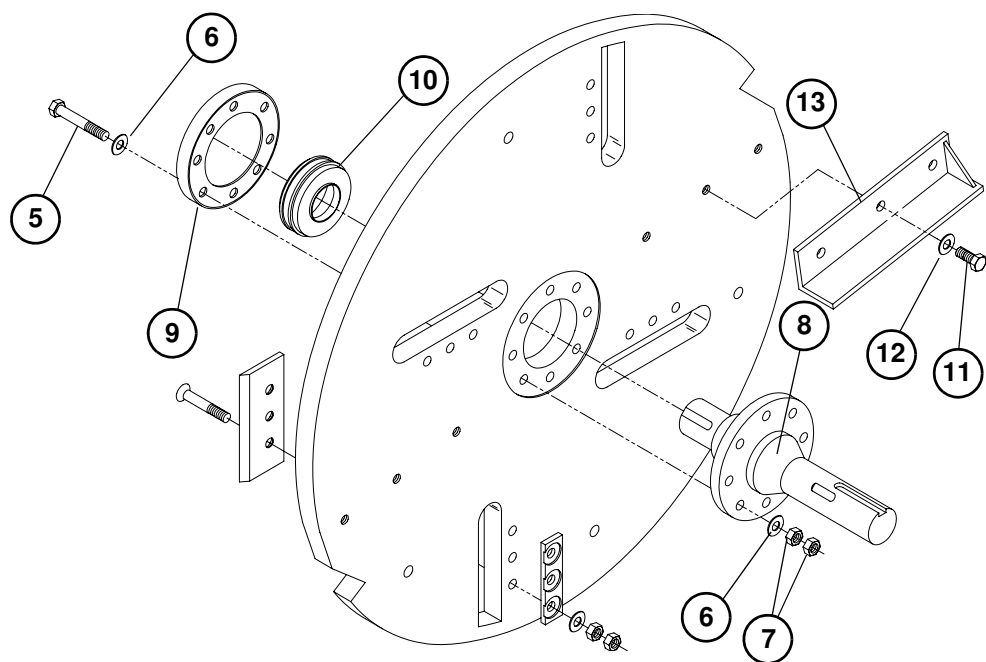
1. Remove bearing mount plates (4) and attached bearing assemblies (3) from cutter disc shaft.
2. Remove four bolts (1) and washers (2) from each bearing assembly (3) and remove bearing assemblies from bearing mounts (4).
3. Refer to *"Inspecting the Cutter Disc Knives,"* page 5-27 and inspect the knives. Sharpen or replace if needed.

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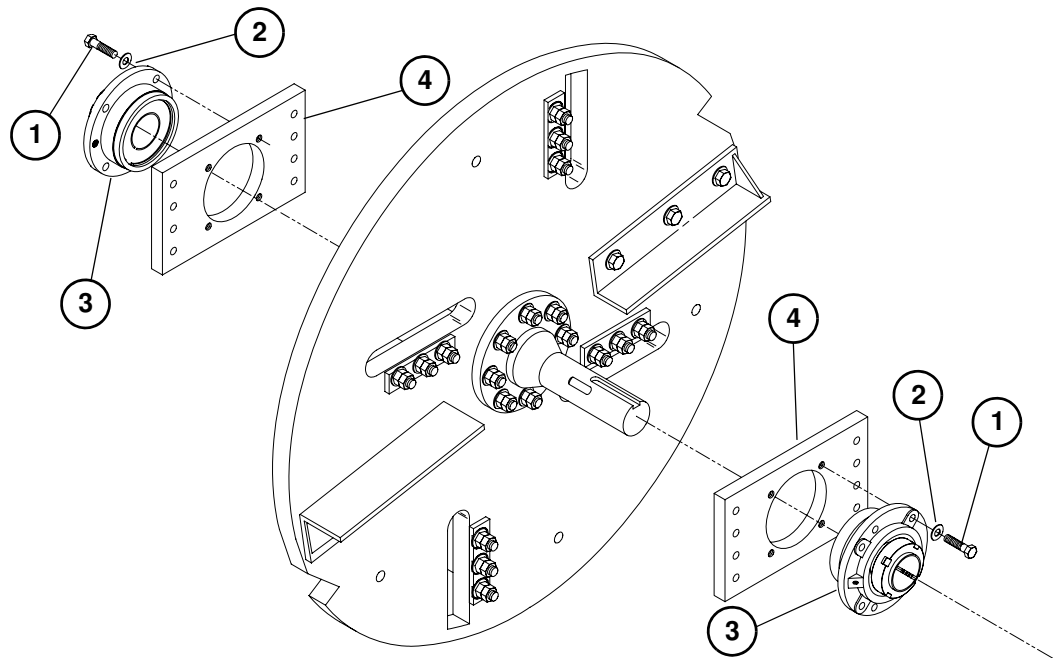
4. Remove bolts (5), washers (6), and nuts (7) from cutter disc shaft. Remove shaft (8), retaining ring (9), and spacer bearing (10).
5. If necessary, remove three bolts (11) and washers (12) from each paddle (13) and remove paddle.

Assembling the Cutter Disc



1. If the knives were removed, install sharpened or new knives according to the instructions in *"Installing Cutter Disc Knives,"* page 5-30.
2. Install cutter disc shaft (8) and retaining ring (9) with bolts (5), washers (6), and lock nuts (7). Torque inner nuts to 230 ft-lb (312 Nm) in a 1-5-2-6-3-7-4-8 sequence. Torque all outer nuts to 60 ft-lb (81 Nm).
3. Install spacer bearing (10) over short end of shaft.
4. If paddles (13) were removed, attach each paddle with three bolts (11) and washers (12) using Loctite 242. Torque bolts to 150 ft-lb (203 Nm).

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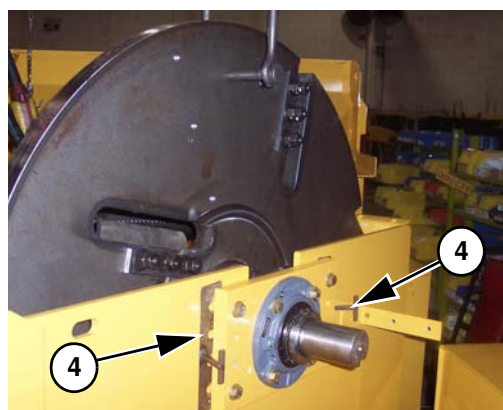
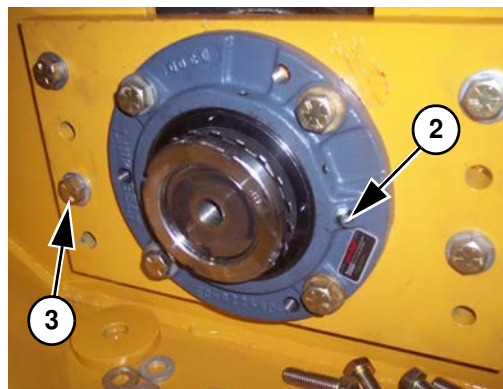
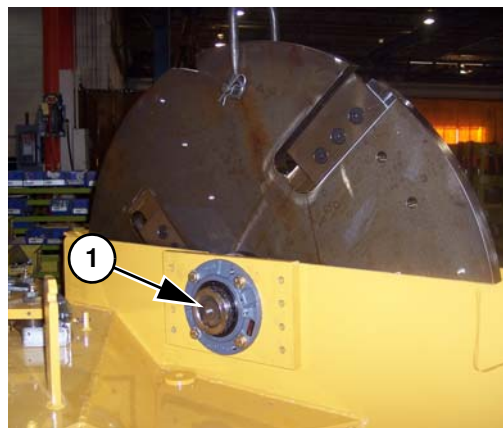
5. Remove locking rings from bearing assemblies (3).
6. Fit bearing assemblies into bearing mount plates (4) ensuring grease fitting on each assembly faces the bolt holes of the plate.
7. Apply Loctite 272 to bolts (1) and attach bearing assemblies to bearing mount plates using bolts (1) and washers (2). Torque bolts to 60 ft-lb (81 Nm).

Installing the Cutter Disc

1. Attach a hoist and clevis to cutter disc with a bolt and nut, or a hitch pin and retaining clip.
2. Apply a light coat of oil to the bearing contact areas of cutter disc shaft and slide bearing assemblies onto shaft.
3. Install locking ring on bearing assemblies and hand tighten so that bearing assembly is still able to slide on cutter wheel shaft.
4. Hoist cutter disc into housing with short shaft of disc (1) facing the rear of the machine as shown.

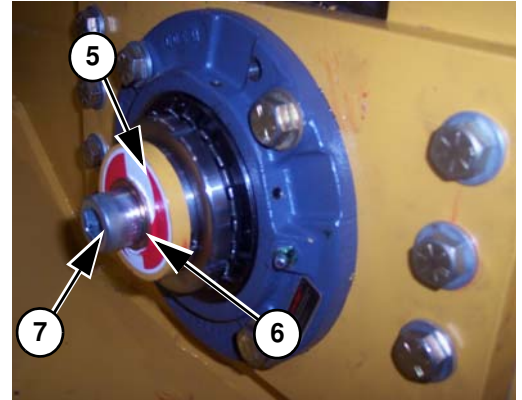
IMPORTANT: Keep cutter disc attached to hoist during the installation process to take load off the bearings.

5. Ensure grease fitting (2) on both bearing assemblies faces the right side of the machine.
6. Apply Loctite 272 to eight mounting bolts (3) and install them with a hardened washer into the rear bearing mounting plate. Torque to 60 ft-lb (81 Nm)
7. Install shims (4) behind each side of front bearing mounting plate and install mounting bolts (do not use Loctite) and washers to each corner of the mounting plate. Tighten bolts to snug.

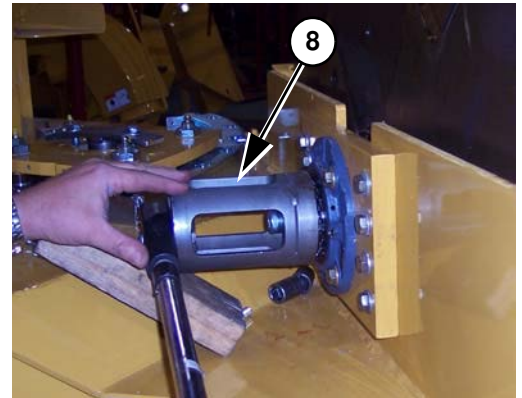


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8. Use pry bar to move cutter disc fully to the rear of the cutter disc housing. Secure in place by installing retaining washer (5), hardened washer (6), and socket head cap screw (7) finger tight.



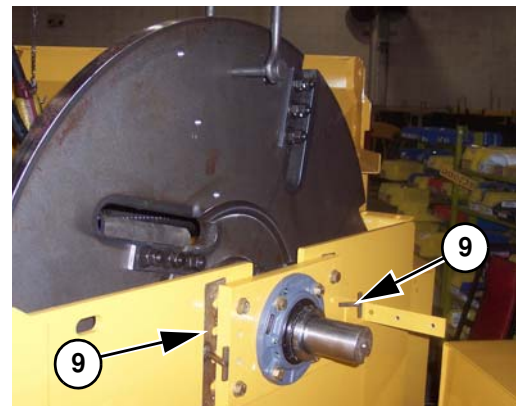
9. Using spanner tool (8), torque locking ring on rear bearing assembly to 200 ft-lb (271 Nm).
10. After tightening, use spanner tool to align a slot on the locking ring with one of the tabs on the lock washer and bend tab into slot to secure.



11. Remove socket head cap screw and retaining washer and apply Loctite 242 to cap screw. Reinstall retaining washer, hardened washer and cap screw and torque to 180 ft-lb (244 Nm).
12. Using spanner tool, torque locking ring on front bearing assembly to 200 ft-lb (271 Nm).
13. After tightening, use spanner tool to align a slot on the locking ring with one of the tabs on the lock washer and bend tab into slot to secure.

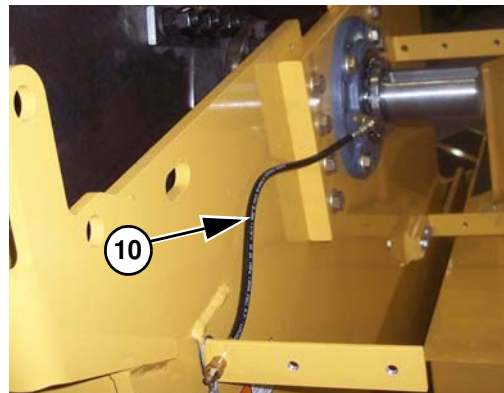
14. Loosen four bolts at corners of front bearing mount and use screwdriver as a wedge to release and remove the two shims (9).

15. Apply Loctite 272 to four remaining mounting plate bolts and install with hardened washer in center holes in mounting plate. Remove corner bolts and apply Loctite 272, and then reinstall with hardened washers. Torque all mounting plate bolts to 60 ft-lb (81 Nm).



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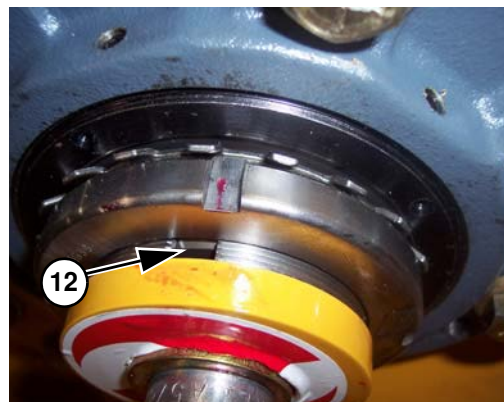
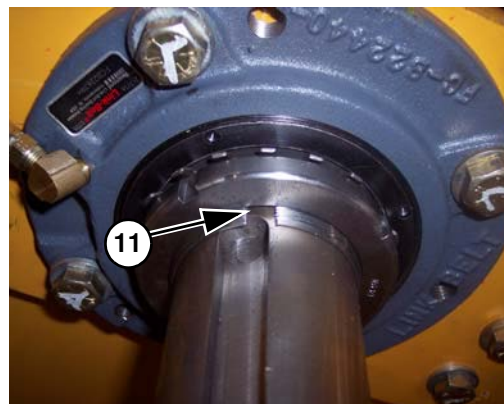
- 16.** Install grease hose (10) on front bearing assembly.



- 17.** Apply silicone sealant to slits in front (11) and rear (12) bearings.

- 18.** Install and align the cutter disc sheave as described on page 5-19.

- 19.** Adjust shear bar as described on page 5-22.



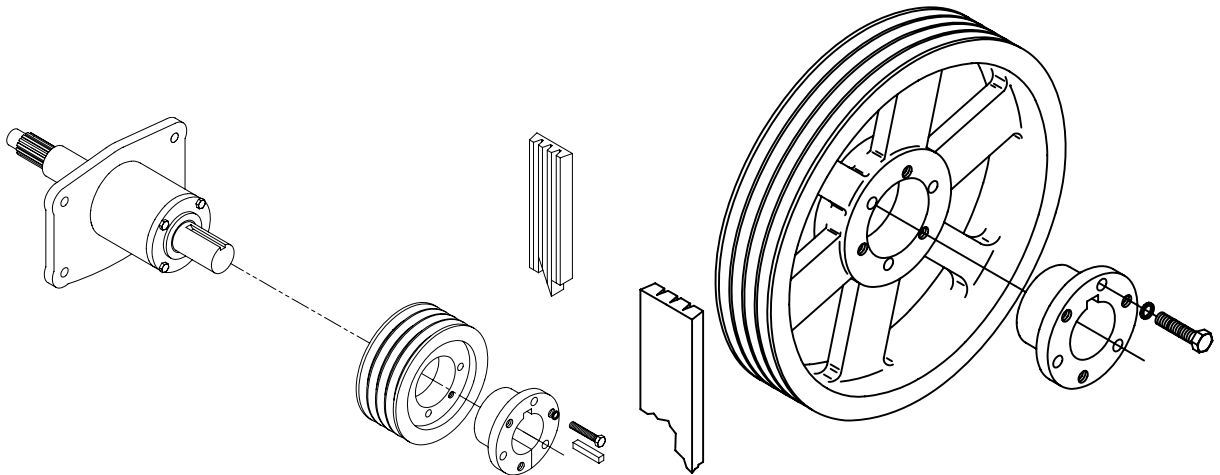
Sheaves and Hubs

Aligning Sheaves

The sheaves are attached to the shafts with tapered hubs, sometimes called tapered bushings. In the hub, half the holes are tapped (threaded) and the other half are drilled (unthreaded) to allow the bolts to reach through. When aligning the sheaves, you should loosen the cutter disc sheave and align it with the clutch sheave.

NOTE: Some hubs have an Allen screw to retain the key in the slot. If present, loosen the Allen screw first.

1. Remove belt from the sheaves. See page 5-20.
2. Turning them out evenly, remove bolts holding the hub to the cutter disc sheave.



IMPORTANT: Excessive or unequal pressure on the bolts can break the hub flange, making removal nearly impossible without destroying the sheave. Wedging a screwdriver into the slot on the hub can also break the hub.

NOTE: If lubricants such as penetrating oil are used to remove the bolts, thoroughly clean all lubricants off the threads in the holes and on the bolts before threading them into the threaded holes.

3. Start bolts in the threaded holes.
4. Starting with hole opposite from slot in hub, alternately tighten all the bolts evenly until sheave and hub begin to separate. The hub is now loose on the shaft.
5. Use a string or a straightedge to align sheaves.

Continued on next page...

6. Remove bolts from threaded holes in the hub, push them through the non-threaded holes into the threads in the holes in the sheave.

NOTE: Do not use lubricants on the bolts during assembly. Lubricants can cause the sheave to break.

7. Tighten the bolts evenly in a rotating sequence. Torque bolts to 60 ft-lb (81 Nm).
8. If present, tighten Allen screw used to retain the key.
9. Install belt and adjust belt tension See “Cutter Disc Drive Belt,” section below.

Removing Sheaves

To remove the clutch or cutter disc sheave, follow steps 1 through 4 above, but continue turning in the bolts until the hub and sheave separate. Note the orientation of the hub to the sheave.

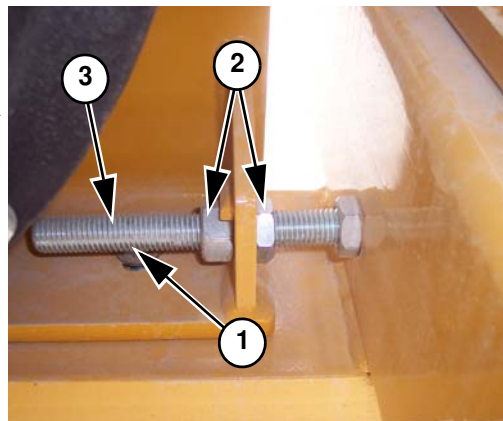
Ensure shaft and the hub mating surfaces are clean of dirt, rust, paint or lubricants. Slide new sheave onto the shaft, and insert the hub over the shaft and into the sheave.

Follows steps 5 through 9 above. Torque the bolts to 60 ft-lb (81 Nm) for both the clutch sheave and cutter disc sheave.

Cutter Disc Drive Belt

Adjusting Belt Tension

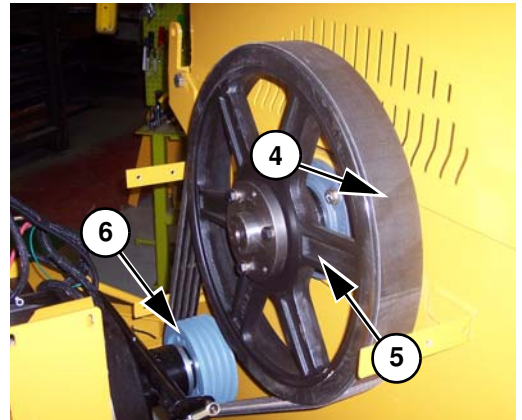
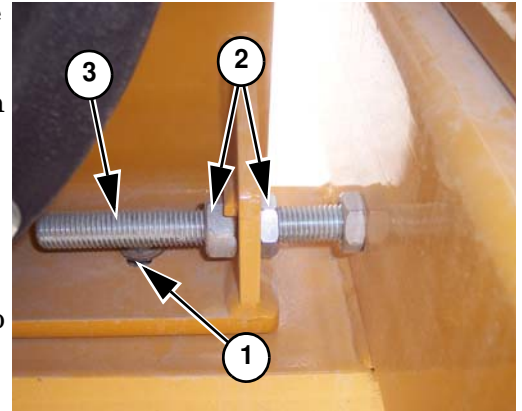
1. Follow *"Shutdown Procedure,"* page 2-1.
2. Remove belt shield, as described on page 5-6.
3. Loosen four engine mounting bolts (1), two in front and two in back, from under machine.
4. Loosen jam nuts (2) and tighten two adjusting rods (3) evenly. Use belt tension gauge to set tension to 700–900 lb (318–408 kg). Tighten jam nuts, using Loctite 242.
5. Tighten engine mounting bolts to 75 ft-lb (102 Nm).
6. Replace belt shield.



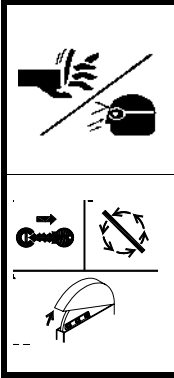
Replacing the Belt

If belt fails prematurely, use a straightedge to check the alignment of the sheaves. If out of line, adjust sheaves (see *"Aligning the Sheaves,"* page 5-7).

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Remove belt shield, as described on page 5-6.
3. Loosen four engine mounting bolts (1), two in front and two in back, from under machine.
4. Loosen jam nuts (2) and loosen two adjusting rods (3).
5. Slide engine over and remove belt (4) from cutter wheel sheave (5).
6. Remove belt from clutch sheave (6).
7. Install new belt.
8. Measure and record the outside circumference of the belt. The belt should measure approximately 91" (231 cm).
9. Tighten two adjustment bolts evenly until the circumference of the belt is .69" (17 mm) longer than the original measurement.
10. Tighten jam nuts.
11. Replace belt shield.

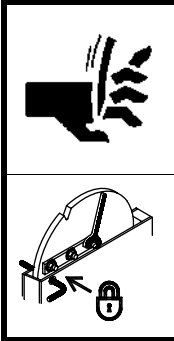


Shear Bar



WARNING: Rotating knives behind cover can cut off hand.
Thrown objects can strike you.

Stop engine, wait for disc to stop, then open access cover.



WARNING: Knives can cut off hand.

Lock disc before servicing knives or shear bar.



WARNING: Never start engine and engage cutter disc while cutter disc housing is open. Contact with the cutter disc will result in serious injury. Ejected material can cause injury and blindness.

Check shear bar on the brush chipper every time the disc knives are changed.

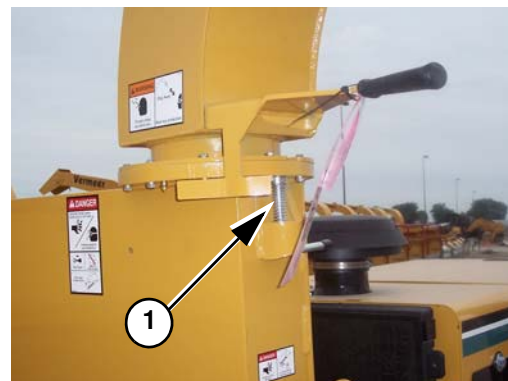
The shear bar is located on the front side of the cutter disc housing at the bottom of the housing.

Shear bar wear guidelines:

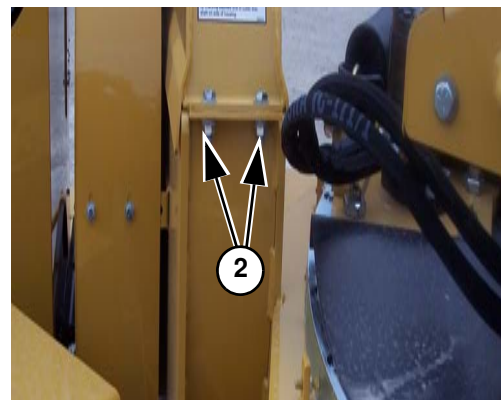
- It can be turned over and reversed, providing four working edges.
- It can be reground for additional life.
- Replace when there is no adjustment left to move shear bar toward knives on the cutter disc.

Adjusting the Shear Bar

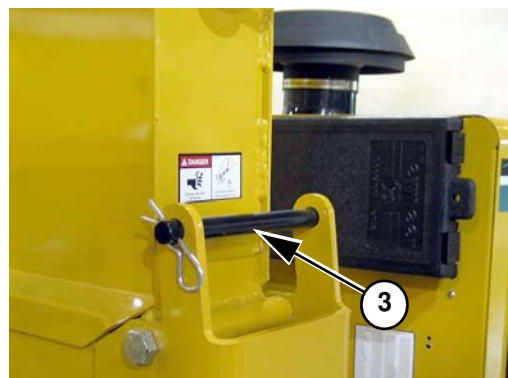
1. Follow "*Shutdown Procedure*," page 2-1.
2. Swing discharge chute over the right side of machine and secure with chute lock pin (1).



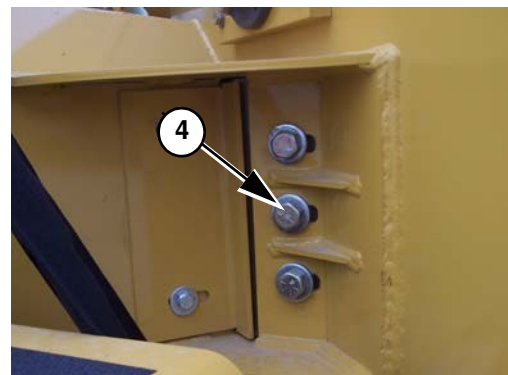
3. Remove two bolts (2) attaching cutter disc shield.



4. Remove cutter disc lock pin (3) from storage location.
5. Open cutter disc shield by carefully pulling down on discharge chute until spout deflector touches the ground.

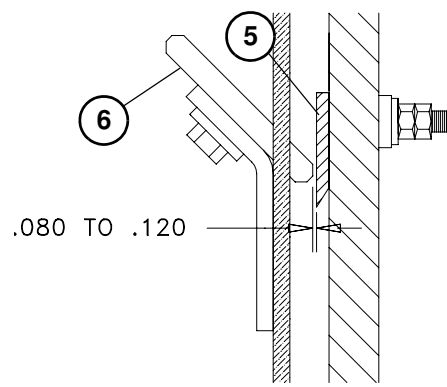


6. Loosen three shear bar mounting bolts (4).



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7. Turn rear bearing collar to rotate cutter wheel until a knife is near shear bar.
8. Remove knife gauge from belt shield and place it between shear bar and knife (5).
9. Move shear bar (6) against the gauge. Lightly tighten mounting bolts to hold shear bar.
10. Remove knife gauge. Rotate cutter wheel until another knife is near shear bar.
11. Check to ensure other knives miss the shear bar by 0.105–0.135" (2.6–3.4 mm).

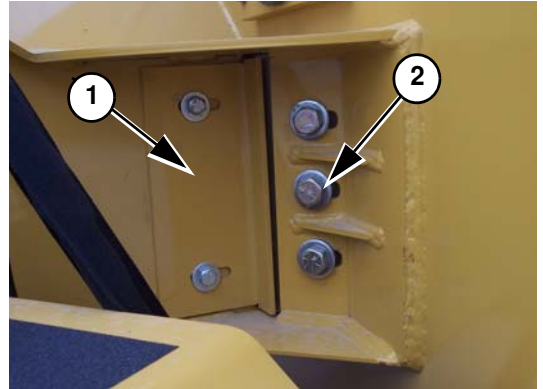


NOTE: The knife gauge is approximately 0.100" (2.5 mm) thick. Use it to estimate the proper clearance.

12. Tighten bolts.
 - Ensure only 3/4 x 1-3/4" grade 8 bolts are used.
 - Oil bolt threads and torque to 100 ft-lb (136 Nm) increments until reaching recommended torque of 300 ft-lb (407 Nm).
 - Start at center bolt and work out towards end bolts.
13. Recheck torque of all mounting bolts (4). Do not overtorque.
14. Recheck gap.
15. Close access cover, install bolts and disc lock pin.

Replacing the Shear Bar

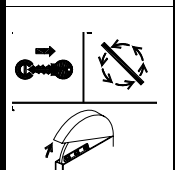
1. Remove two bolts and remove shield (1).
2. Remove three bolts (2). Remove shear bar.
3. Install and adjust shear bar (refer to *"Adjusting the Shear Bar,"* page 5-22).
4. Tighten bolts.
 - Ensure only 3/4-10 x 1-3/4" grade 8 bolts are used.
 - Oil bolt threads and torque to 100 ft-lb (136 Nm) increments until reaching recommended torque of 300 ft-lb (407 Nm).
 - Start at center bolt and work out towards end bolts.
5. Recheck torque of all mounting bolts. Do not overtorque.
6. Install shield.



Cutter Disc Knives



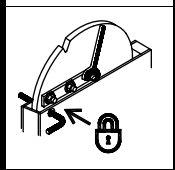
WARNING: Rotating knives behind cover can cut off hand. Thrown objects can strike you.



Stop engine, wait for disc to stop, then open access cover.



WARNING: Knives can cut off hand.



Lock disc before servicing knives or shear bar.



WARNING: Never start engine and engage cutter disc while cutter disc housing is open. Contact with the cutter disc will result in serious injury. Ejected material can cause injury and blindness.

Performing the following maintenance procedures will aid in reducing the possibility of the knives becoming loose, failing, and being ejected from the machine.

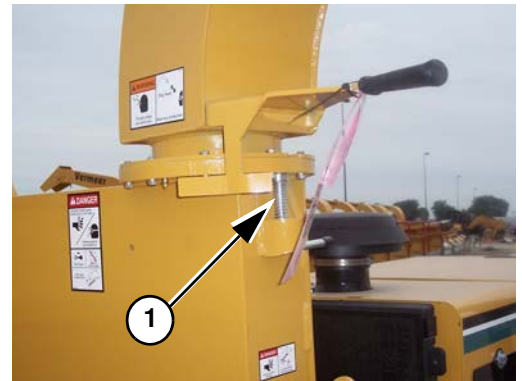
Removing the Cutter Disc Knives



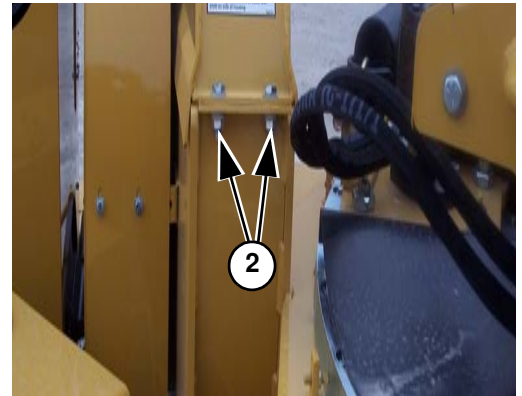
WARNING: Wear gloves when working with the cutter disc knives. Serious cutting injuries will result if contact is made with the knives while removing or installing them.

IMPORTANT: Always remove and replace knives as sets. Chipper balance can be affected if matched knives are not kept together.

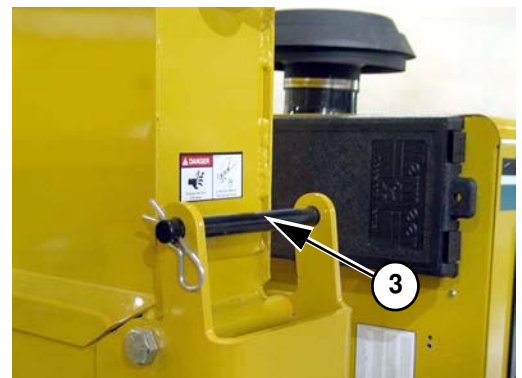
1. Follow *"Shutdown Procedure,"* page 2-1.
2. Swing discharge chute over the right side of machine and secure with chute lock pin (1).



3. Remove two bolts (2) attaching cutter disc shield.

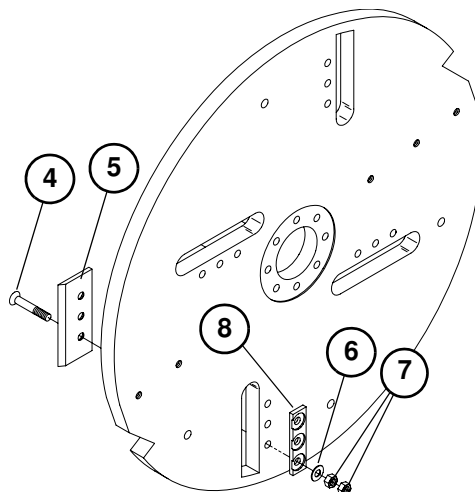


4. Remove cutter disc lock pin (3) from storage location.
5. Open cutter disc shield by carefully pulling down on discharge chute until spout deflector touches the ground.
6. Install disc lock pin (3) through cutter disc.



Continued on next page...

7. Remove cutter knives (5) and associated hardware from the cutter disc. Carefully examine nuts (7), washers (6), bolts (4), and backing plate (8), securing the knives to the disc.
8. Inspect bolts and washers for cracks or damaged threads. Replace as necessary.
9. Repeat Steps 7 and 8 to remove all four knives and spacers.



Inspecting the Cutter Disc Knives



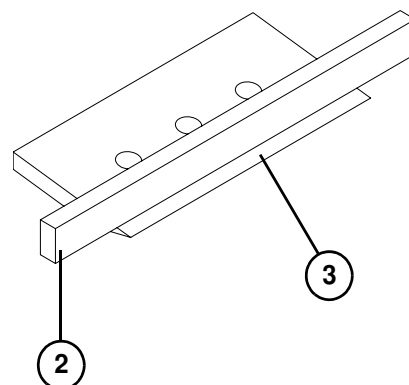
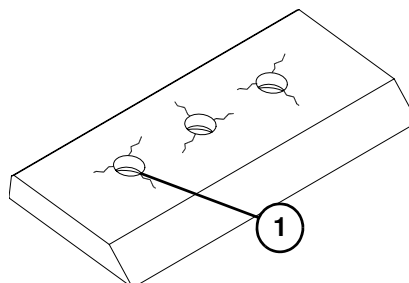
WARNING: Overtightened bolts can cause knife distortion, allowing wood to pack under the knife. Distorted knives can crack and fail resulting in death or serious injury, and machine damage. Use a straightedge and check all knives for distortion; discard any that are distorted.

Cracks — Thoroughly clean knives and inspect both sides of each knife for cracks (1). If any are found, discard knives and replace with new.

- Cracks that start at the mounting hole and progress outward result from the mounting bolts being improperly torqued.
- If cracked knives are reused, the cracks will extend across knife and the knife can separate from cutter disc.

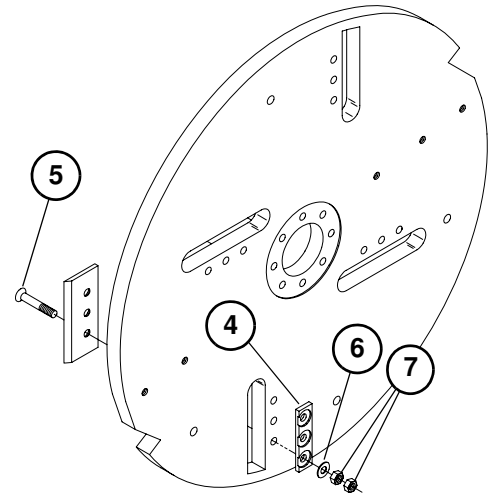
Distortion — Check the mounting side of knife for distortion. Bolting a distorted knife to cutter disc will add stresses in the knife and possibly cause knife cracking and failure.

1. Place a straightedge (2) on the mounting side of knife (3) and parallel to the mounting holes as shown.



Continued on next page...

2. Move straightedge slowly across knife surface, and inspect for any light that shows between knife and straightedge. If any light appears between the knife surface and the straightedge, this indicates that knife is distorted, and must be replaced.
3. Turn straightedge perpendicular to mounting holes and repeat Step 2.
4. Inspect backing plate (4) for cracks, worn surfaces, and distortion. If any are found, discard backing plate and replace with new.
5. Inspect bolts (5) for damaged threads, corrosion, and distortion. If any are found, discard and replace with new.
6. Inspect hardened washers (6) for cracks, worn surfaces, and distortion. If any are found, discard and replace with new.
7. Inspect nuts (7) for worn surfaces and damaged threads. If any are found, discard and replace with new.

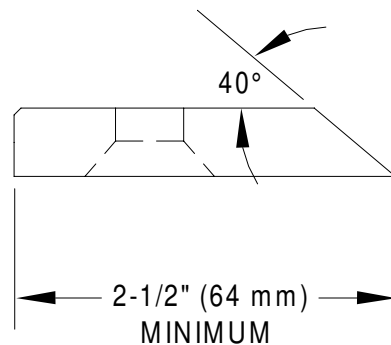


Sharpening the Cutter Disc Knives

It is very important to keep knives sharp and properly adjusted. If brush chipper does not feed properly or pulls the engine down, check knives first. Do not use a dull knife. A dull knife will require more power to drive knife through the wood. This will put extra force on the knife, creating heat, and possibly causing it to fail. Check knife clamp bolts weekly for proper torque of 180 ft-lb (244 Nm).

Recommended service interval for cutter knives is 50 service hours. However, the actual service hours interval before knife maintenance is required may be more or less, depending upon the wood being chipped and chipping conditions.

- Sharpen knives to a 40° angle as shown in the illustration.
- The grinding wheel should be a J grade grinding wheel with either 36 or 46 grit.
- Use adequate coolant while grinding.
- Do not overheat the knife when sharpening.
- Hone knives between sharpening with an oil honing stone.



IMPORTANT: Do not use a knife that has been sharpened to less than a width of 2.5" (64 mm).

Install sharpened knives as described in *"Installing Cutter Disc Knives,"* page 5-30.

Inspecting the Cutter Disc Knives Mounting Surface

When a cutting knife is removed from cutter disc, the knife-mounting surfaces on cutter disc must be thoroughly cleaned and inspected. Remove all wood chips and other material from the mounting pocket area.

IMPORTANT: Any debris left on the mounting surface can prevent knife from lying perfectly flat on its mating surface. This condition can lead to knife failure during operation.

Inspecting the Cutter Disc

Cutter disc must be free of any damage. Thoroughly clean and inspect cutter disc surface for cracks that may begin at the mounting holes and migrate outward.

If any cutter disc damage or cracks are found, contact an authorized independent Vermeer dealer.

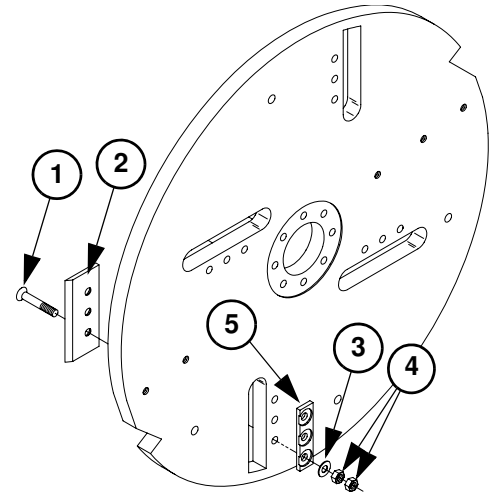
Inspecting Cutter Disc Knife Bolts

Inspect bolts for damaged threads, corrosion, and distortion. If **any** are found, discard the bolt and install a new one.

Installing Cutter Disc Knives

1. Lubricate threads of bolt (1) with oil. Install first knife (2) with the bolts (1), hardened washers (3), nuts (4), and backing plate (5).

NOTE: The backing plate is tapered to allow the hardened washers and nuts to seat flat on the backing plate. Be careful to install this plate correctly. If installed incorrectly, premature bolt failure will occur.



WARNING: Incorrect torquing of knife-mounting bolts can cause knives to become detached from cutter disc. Death or serious injury is possible if failed knives are ejected from machine and strike someone. Extensive and costly damage to cutter disc and machine will probably occur if knives become detached.

2. Lightly tighten the first nut on each bolt, making sure that all three bolt heads are centered in the knife holes and that the hardened washers and nuts seat flat on the backing bar. Torque nuts to 180 ft-lb (244 Nm) beginning with the center bolt. Recheck torque on all nuts after the last nut is tightened. Do not overtighten nuts.
3. Install second nut on each bolt and torque to 60 ft-lb (81 Nm). Recheck the torque of all three nuts after the last nut is tightened.

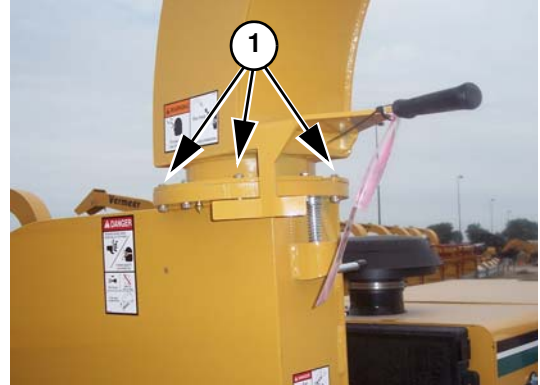
IMPORTANT: Do not tighten second nut beyond 60 ft-lb (81 Nm). Overtightening the nut could cause the bolt to fail.

4. Repeat steps 1–3 for the other knives.
5. After changing the knives, adjust shear bar. Refer to *"Adjusting the Shear Bar,"* page 5-22.

Discharge Chute

Removing the Discharge Chute

1. Support discharge chute with lifting strap and take up slack
2. Remove bolts (1) at base of chute.
3. Remove chute.



Installing the Discharge Chute

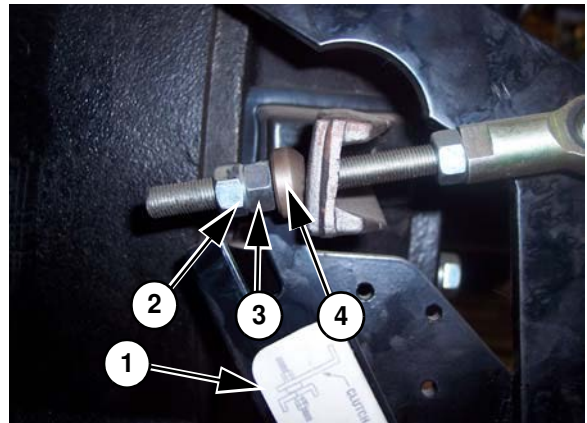
Reverse removal procedure to install chute.

Clutch

Adjusting the Clutch

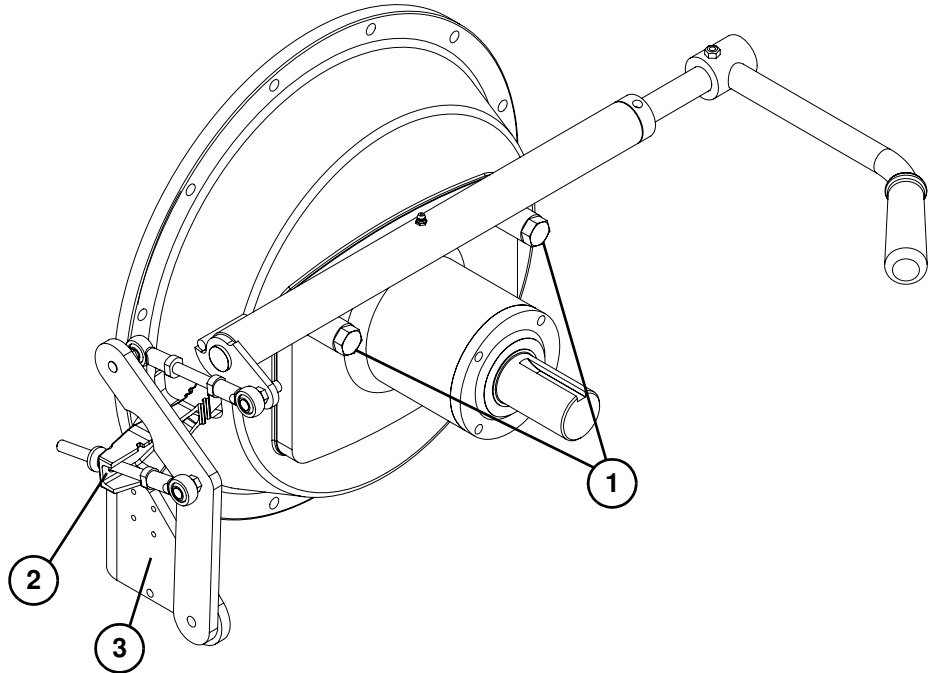
These machines come with a clutch gauge tool (1). The tool is fastened to the clutch bracket.

1. Move clutch lever to the ENGAGED position.
2. Loosen or remove lock nut (2). Loosen adjusting nut (3).
3. Pull end of the clutch arm forward enough to allow the clutch gauge tool to slip over the threads between the rocker ball (4) and the adjusting nut.
4. Turn adjusting nut up against the gauge tool until there is slight drag on the tool as it is pulled away.
5. Hold adjusting nut the same position and tight lock nut against the adjusting nut.
6. Move clutch lever to the DISENGAGED position. The belt drive and cutter wheel should turn freely.



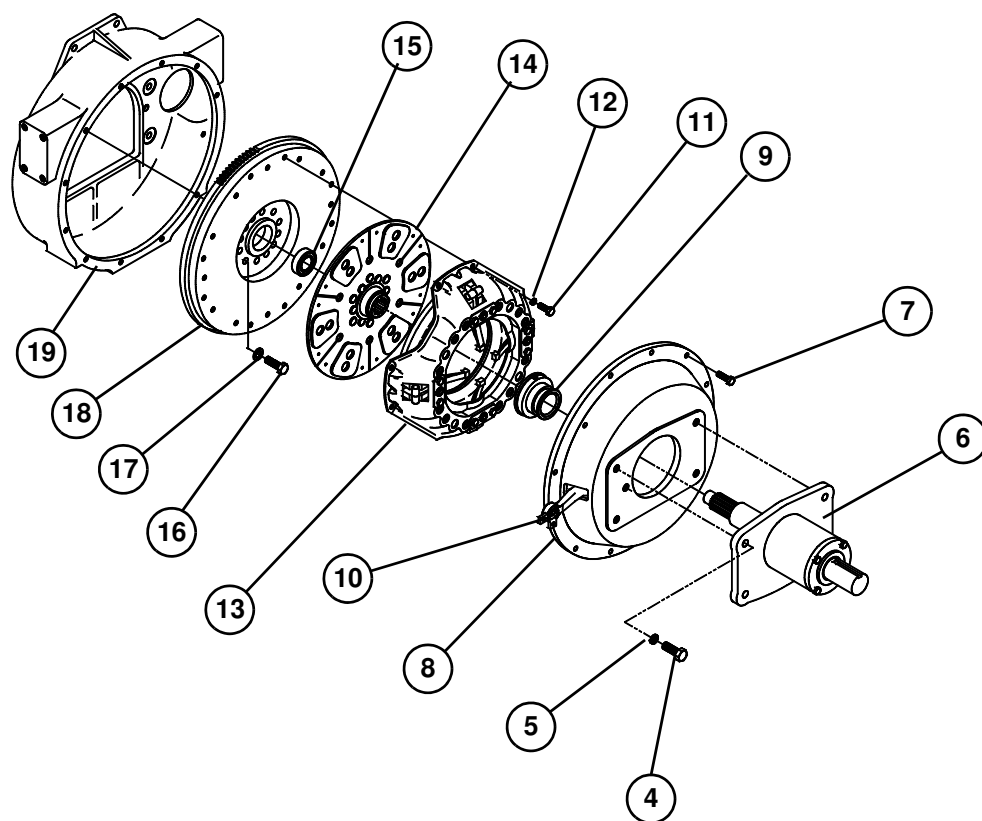
Removing the Clutch

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Remove drive belt and clutch sheave. Refer to page 5-19 and page 5-20.



3. Remove engine. Refer to *"Remove/Replace Engine ENG1,"* page 3-44
4. Engage clutch.
5. Remove two bolts (1) and washers.
6. Remove lock nut, adjusting nut, and rocker ball from attachment to clutch arm (2).
7. Remove two bolts attaching clutch handle bracket (3) to bell housing spring and remove clutch arm.

Continued on next page...



- 8.** Remove bolts (4), washers (5), and outboard bearing (6).
- 9.** Remove bolts (7) and clutch housing (8) from bell housing (19).
- 10.** Remove throwout bearing (9) from arm (10).
- 11.** Remove bolts (11), washers (12), clutch (13), and clutch disc (14).
- 12.** Remove bolts (16), washers (17), and flywheel (18).
- 13.** Check pilot bearing (15) for smooth operation and replace if necessary.

Installing the Clutch

Reverse removal procedures to install clutch.

- When replacing pilot bearing, press on outer race edge only.
- Use clutch alignment tool P/N 156335001 to align clutch and clutch disc to flywheel.
- Torque clutch to flywheel bolts and clutch housing to bell housing bolts to 47 ft-lb (63 Nm).

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Chapter 6: Feed Roller and SmartFeed Control System

OVERVIEW

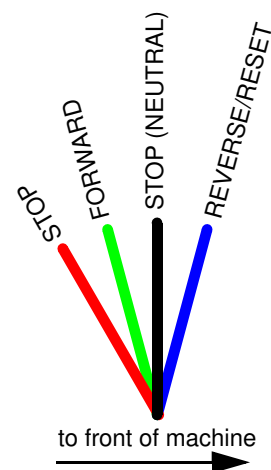
The feed control system consists of the hydraulic components that are involved in operating the feed rollers, as well as the SmartFeed controller used to regulate operation of the feed roller.

The feed rollers push material forward into contact with the cutter disc or pull material backward away from the cutter disc. The feed rollers are turned by hydraulic motors MH1 and MH2. The motors are powered by flow from the engine-mounted hydraulic pump PMP1. Pump flow passes through flow divider manifold A3 and directional control manifold A2. The operator sets the feed roller speed by adjusting the handle on A3.

The SmartFeed controller A1 controls whether the feed rollers turn forward, backward, or stop by energizing or de-energizing two solenoids on the feed roller directional control manifold A2. If solenoid L2 is energized, the rollers turn forward. If solenoid L3 is energized, the rollers turn backward. If neither solenoid is energized, the feed rollers stop.

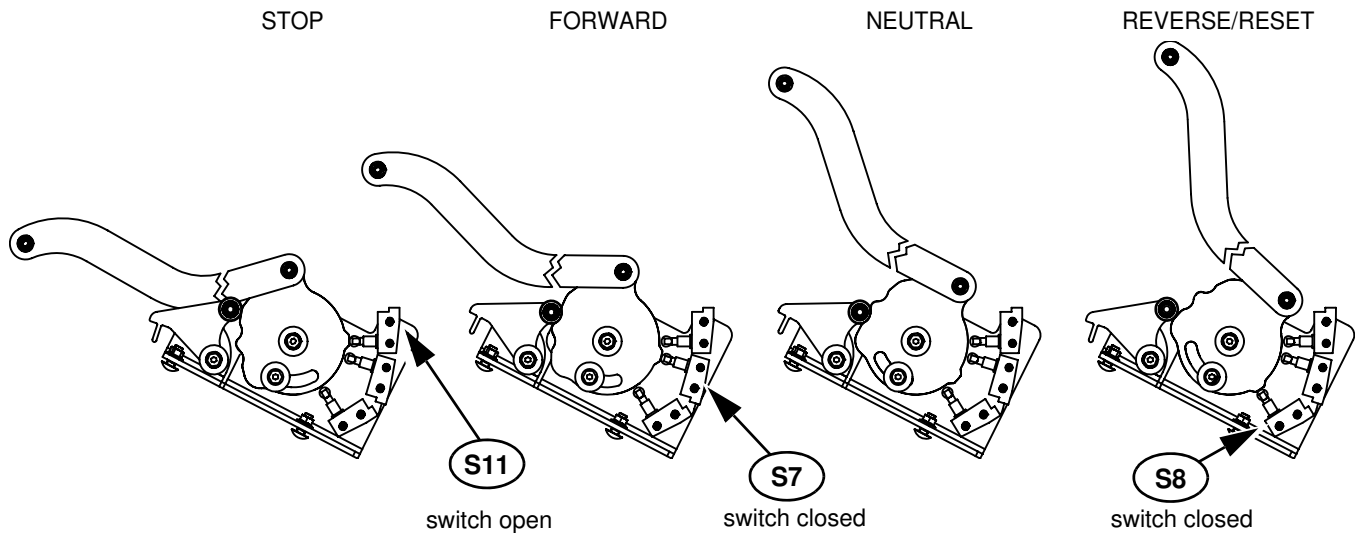
The operator uses the upper feed roller control bar to control the feed roller. The bar has four positions:

- **STOP (NEUTRAL)**—the upper feed control bar is vertical. The roller is stopped.
- **FORWARD**—bar is pulled rearwards to the first detent. The roller turns forward, feeding material into the cutter drum.
- **STOP**—bar is pulled fully rearward. The roller stops.
- **REVERSE**—bar is pushed forward beyond vertical. This is a spring-loaded position. Holding the bar forward will reverse the roller, pushing material back out toward the feed table, away from the cutter disc. Once released, the bar will spring back to the vertical STOP (NEUTRAL) position.



Continued on next page...

The upper feed bar operates three switches, S7, S8 and S11, that open and close depending on the position of the cam attached to the feed bar. The diagram below shows the switches and cam positions that open and close each switch.



The lower feed stop bar is also used to stop the feed roller. The amount of force required to trip the stop bar can be set by selecting NORMAL or REDUCED using the stop bar sensitivity switch S9. REDUCED means it takes more force than NORMAL to trip the stop bar and stop the feed roller.

Circuits/Components

Circuits

In addition to the important role played by the SmartFeed controller, this chapter discusses the normal operation of the following circuits:

- SmartFeed Controller Electrical Circuit
- SmartFeed Droop Point Circuit
- Feed Roller Forward Circuit
- Feed Roller Reverse Circuit
- Feed Roller Stop Circuit
- Lower Feed Stop Bar Sensitivity Circuit
- Lower Feed Stop Bar Reset Circuit
- SmartFeed Droop Point Circuit
- Feed Roller Jam Circuit

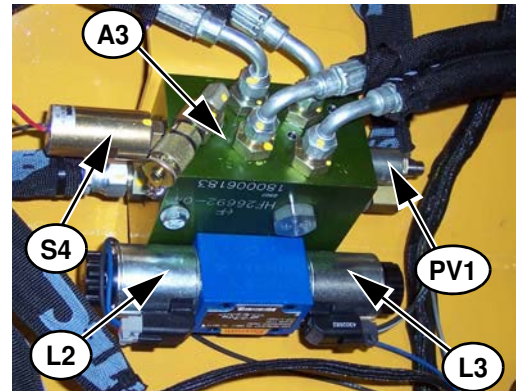
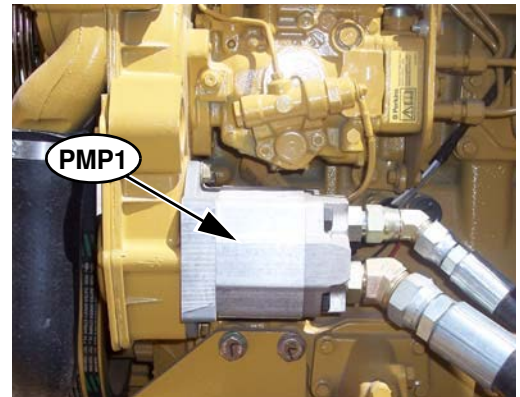
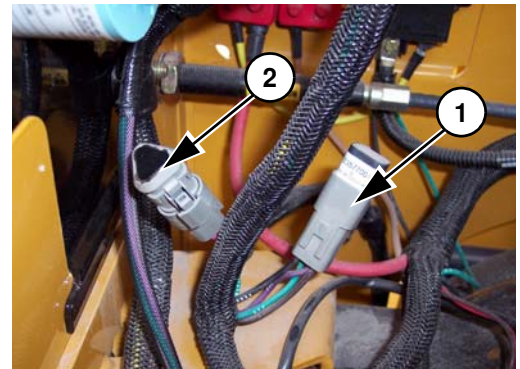
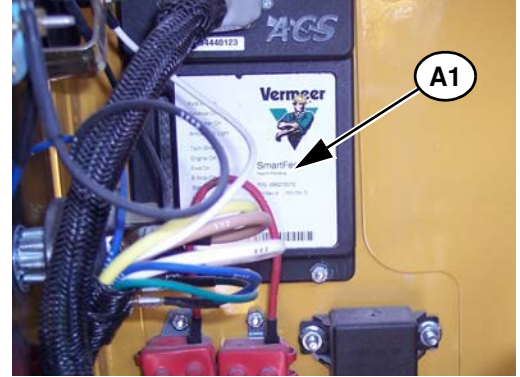
Components

These circuits include the following components:

- SmartFeed Controller A1
- Hydraulic Pump PMP1
- Feed Roller Hydraulic Motors MH1 and MH2
- Flow Divider Manifold A3, containing:
 - Flow Control Valve FV1
- Feed Roller Directional Control Manifold A2, containing:
 - Directional Control Valve DV1
 - Solenoids L2 and L3
 - Flow Divider Valve FV2
 - Pressure Relief Valve PV1
 - Hydraulic Over-Pressure Switch S4
- Lower Feed Stop Bar Switches (2) S9 and S10
- Lower Feed Stop Bar Sensitivity Selector Switch S12
- Sensitivity Selector Relay K4
- Reset/Hold-To-Run Switches (2) S5 and S6
- Feed Direction Emergency Stop Switch S11
- Feed Direction Forward Switch S7
- Feed Direction Reverse Switch S8
- Resistors (3) R4, R5, and R6
- Lower Indicator Diodes (2) D3 and D4
- Reverse Rotation Diode D5
- Information Lights DS1 and DS4
- Magnetic Speed Sensor B1

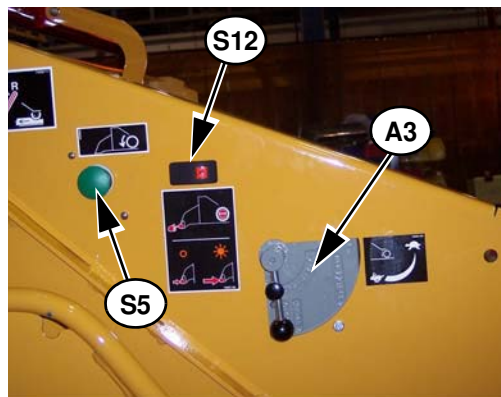
Component Locations

- SmartFeed Controller A1 — mounted to access panel on the inside back of engine enclosure.
- Resistor Pak (1) containing resistors R4, R5, and R6, and diode pak (2), containing diodes D3 and D4 — connected to engine harness near SmartFeed Controller.
- Pump PMP1 — mounted to an accessory pad on the engine
- Directional Control Manifold A2 containing:
 - Forward Feed Solenoid L2
 - Reverse Feed Solenoid L3
 - Hydraulic Over-Pressure Switch S4
 - Pressure Relief Valve PV1
 - Flow Divider Valve FV2
 - Directional Control Valve DV1

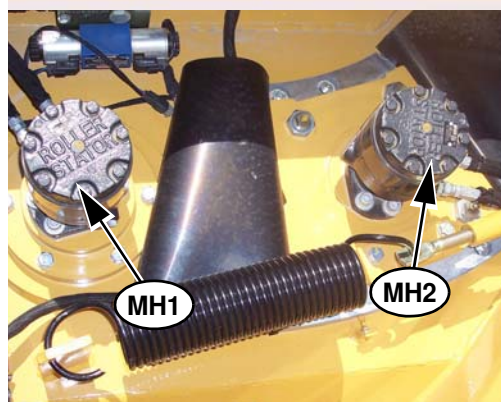


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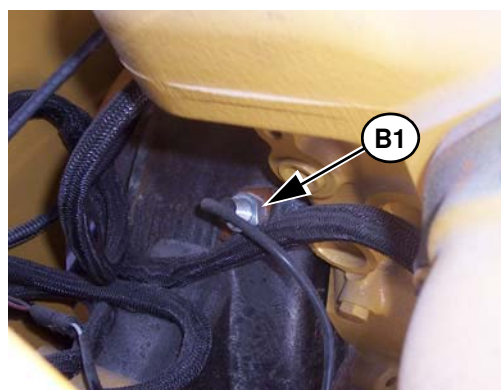
- Flow Divider Manifold A3, containing:
 - Flow Control Valve FV1
- Lower Feed Stop Bar Sensitivity Selector Switch S12, including:
 - Information Light DS4
- Right side—Reset/Hold-To-Run Switch S5 (S6 is on other side)



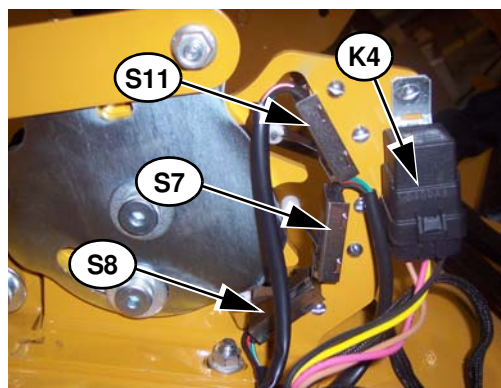
- Feed Roller Hydraulic Motors MH1 and MH2



- Magnetic Speed Sensor B1, located on bell housing



- Sensitivity Selector Relay K4
- Feed Direction Emergency Stop Switch S11
- Feed Direction Forward Switch S7
- Feed Direction Reverse Switch S8



- Amber Information Light DS1



Reference Diagrams

Schematic representations are shown along with the text to help explain the operation of the different functions of this chapter. Photographs are also shown in some situations to better represent components.

Large format 11 x 17" foldouts of the complete machine electric and hydraulic schematics are located in the Addendum section in the back of the manual to be used if needed.

Troubleshooting

Troubleshooting procedures are given in this chapter for every feed roller function. Each procedure begins by performing a pretest inspection of the machine (see below). If nothing obvious is found during the inspection, it may be necessary to operate all other functions of the machine to help further isolate a component problem.

Pretest Inspection

Perform the following visual checks to inspect for obvious signs of failure before exhaustive troubleshooting or testing is performed.

Electrical

Inspect electrical wiring for obvious problems. Always check the following items before turning on switches or running the unit.

- Look for bare wires that could cause grounds or shorts.
- Look for broken, missing, corroded, or loose wires on the power wires that supply electrical circuit components.
- Check all ground connections on the machine and chassis for tight connections. Cleaning harness connections or ground connections can often correct what appears to be a malfunctioning component.
- Check for overheated electrical components. They will often smell like burned insulation.
- Open engine hood and locate the LEDs on the SmartFeed controller. Wipe clean as needed so the LEDs and labels are visible. Observe them during machine operation. See ["SmartFeed Controller LEDs,"](#) page 6-15 for information on what the different LEDs mean.

Hydraulic

Check hydraulic components for any obvious problems such as:

- broken, kinked, loose, or leaking hoses and fittings on supply, pressure, and return to hydraulic components.
- Check level of hydraulic fluid in hydraulic tank. Low fluid can cause erratic behaviors in hydraulic circuits. Correct level is between the two lines on dipstick. If needed, add new fluid that has been filtered through a 10-micron filter.

Also review information in the General Information chapter under ["Troubleshooting Guidelines,"](#) page 1-8. Correct any problems found during the inspection. Operate machine to verify the problem is fixed.

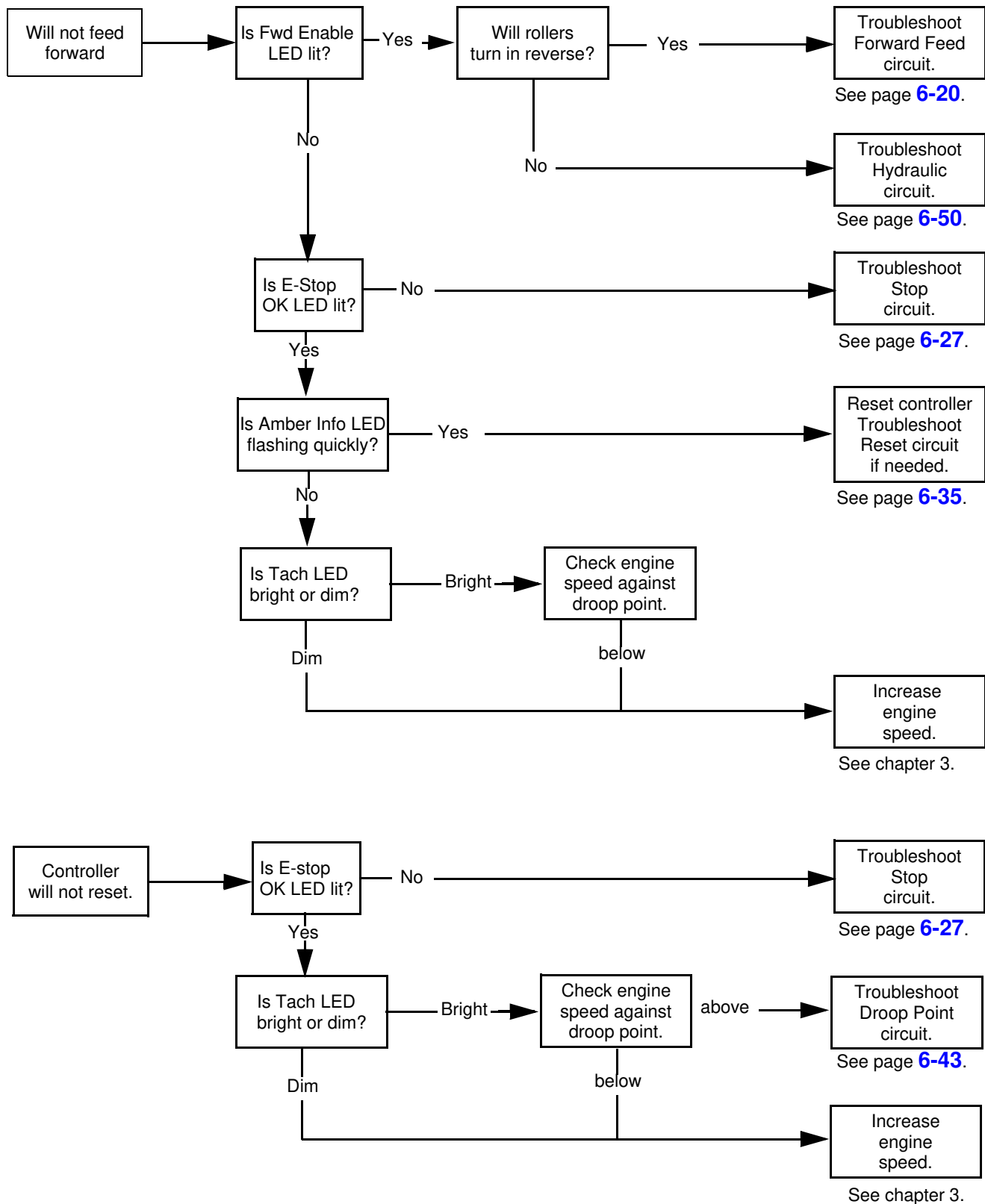
Test Equipment Needed

- multimeter for continuity tests, voltage measurements, resistance measurements
- phototach if optional tachometer not installed on this machine
- flow-pressure meter to measure hydraulic flow at varying pressures
- pressure test gauge
- porta-power to test directional control valves for leakage and check pressure relief valve
- hoses and fittings as needed to connect hydraulic test equipment to manifolds on machine

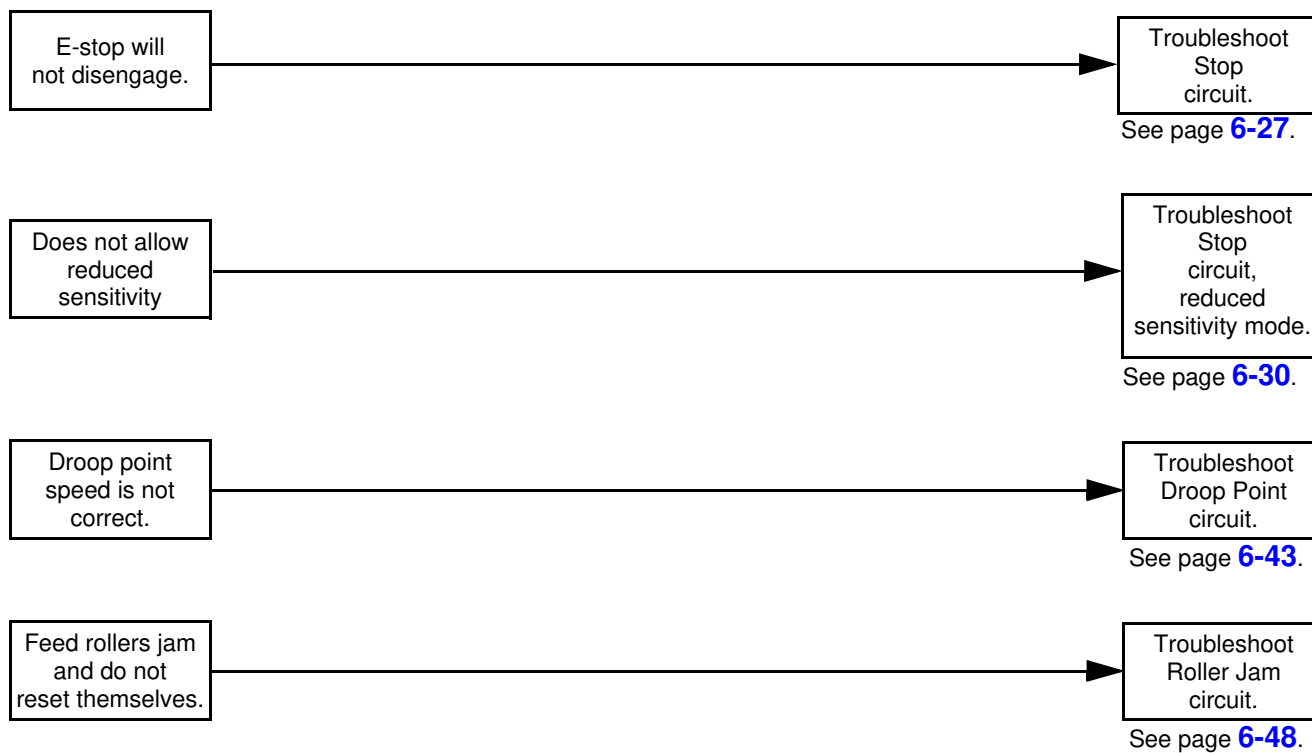
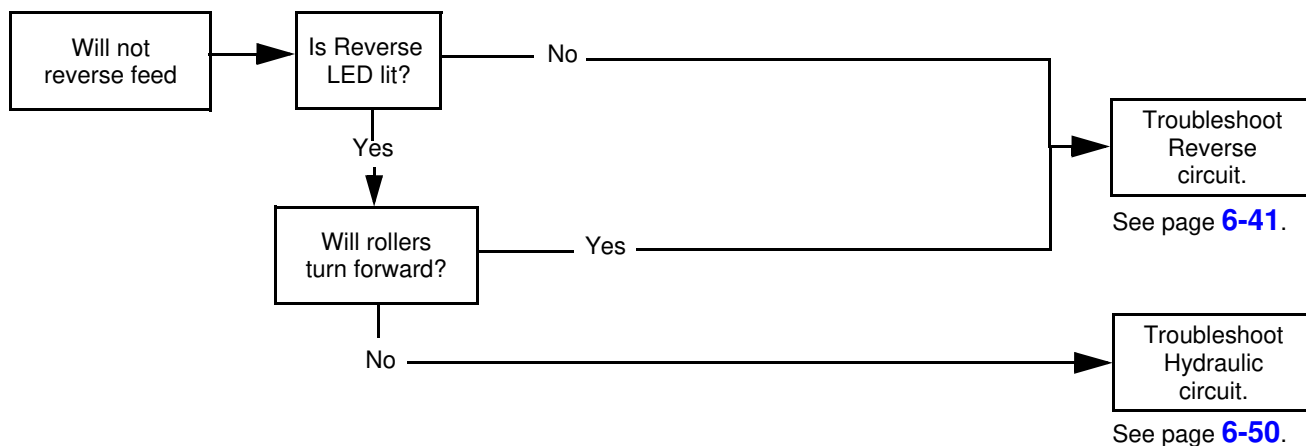
Component Repair/Replace

If troubleshooting procedures determine a component is in need of repair or replacement, refer to the appropriate procedures at the back of the chapter or other chapters where instructed. After repairs have been made to hydraulic components, refer to "[Hydraulic Fluid Sampling](#)," page **4-19** and follow instructions.

TROUBLESHOOTING FAULT CHARTS



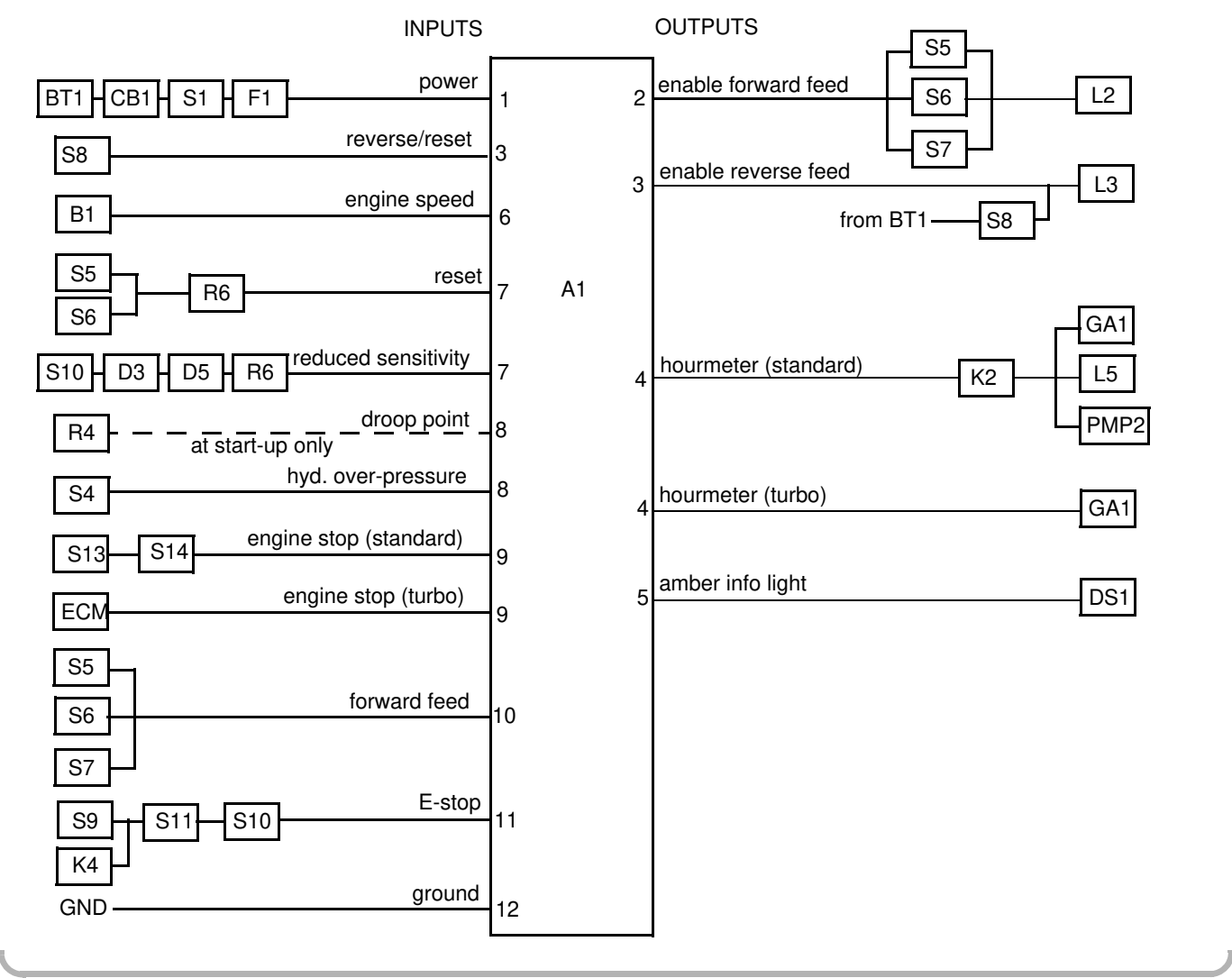
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SMARTFEED CONTROLLER A1

The SmartFeed controller A1 operates most of the functions performed by this subsystem. “SmartFeed” refers to the controller’s ability to forward feed or reverse feed material into the chipper cutter drum based on the engine speed. If the engine lugs down to a “droop point”, the controller backs the limb away from the cutter drum until the engine recovers speed, then it begins feeding in material again.

The following sections describe the inputs and outputs of the SmartFeed controller. As you read these sections, refer to the diagram below.



Inputs

Power to A1

Power and ground are supplied to A1 at pins 1 and 12 respectively.

Engine Speed, Engine Stop

Pin 6 receives engine speed information from the engine speed sensor B1. Pin 9 on the standard engine model receives warnings of low engine oil pressure or high engine coolant temperature from coolant temperature switch S13 and oil pressure switch S14. Pin 9 on the turbo engine model receives stop information directly from the Engine Control Module (ECM).

The controller will not enable forward feeding unless the engine speed is above the droop point.

If the engine is about to shut down, the controller will reverse the rollers for a few seconds to back any brush away from the cutter drum.

Droop Point

At start-up, the controller determines the droop point by determining the resistance of the droop point resistor pak installed. The pak contains resistor R4, connected to pin 8. Once the droop point is stored in memory, pin 8 is used for other inputs.

There are three droop point values available:

- 2290 rpm (9.09k resistor)
- 2215 rpm (3.92k resistor)
- 2140 rpm (1.47k resistor)

A different resistor pak is available for each droop point.

To change the droop point, shut down the engine and switch the resistor pak, and then restart the machine.

Reset Request

If the operator closes the reverse switch S8, pin 3 is energized. The controller interprets this as a request to reset.

If the operator presses either of the two reset/hold-to-run switches S5 or S6, 12 volts of current passes to resistor R6. R6 drops the voltage to 6 volts before the current reaches pin 7 of the controller. The controller interprets 6 volts at pin 7 as a request to reset.

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Before the controller resets, it checks that:

- There is power at pin 11, meaning that all the switches of the stop circuit are closed.
- The digital data coming in on pin 6 indicates the current engine speed is higher than the droop point.

If both conditions are true, the controller resets. Resetting means the controller illuminates the Forward (Fwd Enabled) LED and that forward feeding is enabled.

Forward Feed Status	If the forward feed solenoid L2 is energized, pin 10 on the controller is also energized.
Sensitivity Status	If the operator selects reduced sensitivity with switch S12, 12 volts from the battery is reduced to about 9 volts by the diodes D3 and D4. The 9 volts is further reduced to about 3 to 4 volts by passing through resistor R6 to pin 7. The SmartFeed controller shifts to reduced sensitivity mode when 3 to 4 volts is present at pin 7. When in reduced sensitivity mode, the controller illuminates the amber information light DS1 and also the Amber Info Light LED on the controller. The light DS4 on sensitivity switch S12 also illuminates.
Stop	Pin 11 must remain energized during forward feed. If it is de-energized, the controller will stop forward feeding and must be reset before forward feed is enabled again. In normal sensitivity mode, if any of switches S9, S10 or S11 opens, power to pin 11 stops. If the machine is in reduced sensitivity mode, power coming through relay K4 allows this circuit to ignore S9.

Outputs

Enable Forward Feed	All power to solenoid L2 that operates the feed roller in the forward direction comes from the controller. If the controller receives a Stop input, or a hydraulic over-pressure input, or reads an engine speed below the droop point, the controller shuts off power to pin 2. When pin 2 is energized, power is available at the forward switch S7, and at both reset/hold-to-run switches. If closed, these switches deliver power to solenoid L2.
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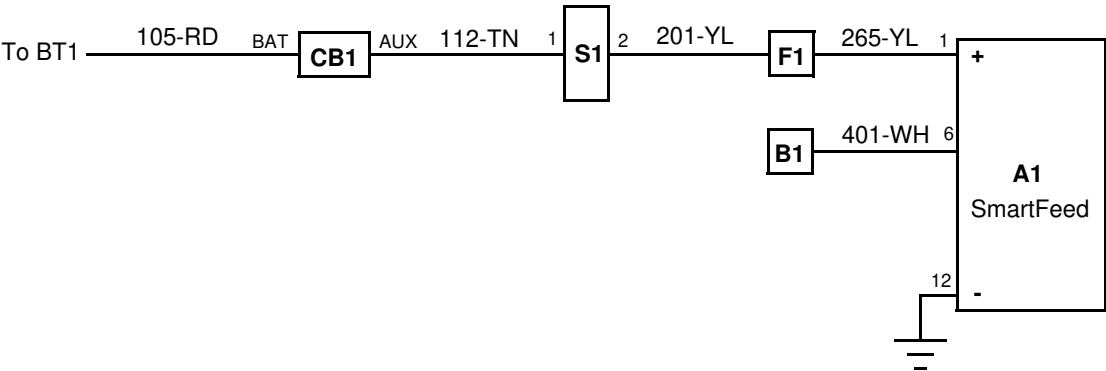
Reverse Feed	The solenoid L3 that operates the feed roller in the reverse direction can be energized either by the controller by output at pin 3, or by the operator closing the reverse switch S8. When the operator closes S8, it energizes L3 and also sends voltage back to pin 3 as an input to reset the controller, if it needs to be reset.
Hourmeter	Power is available at pin 4 whenever the controller reads a (engine speed sensor) tachometer input on pin 6. On the turbo engine model, Pin 4 powers hourmeter GA1. On the standard engine model, power at pin 4 shifts fuel pump relay K2, which powers hourmeter GA1, engine fuel solenoid L5, and fuel lift pump PMP2.
Amber Info Light	Pin 5 powers amber information light DS1. There are four modes for the light: • Off—indicating forward feed enabled in normal sensitivity mode • On—indicating forward feed enabled in reduced sensitivity mode • Fast Blink—indicating forward feed disabled, controller must be reset before forward feed is enabled again. • Slow Blink—stop engine condition, controller will back material out of the cutter disc and the machine will shut down.

SmartFeed Controller LEDs

On the face of the SmartFeed controller are ten light emitting diodes (LEDs). The following lists the functions of the LEDs from top to bottom by the label next to the LED:

- **Fwd Enable**—when lit, indicates that the controller is in the forward feed enabled mode. If switch S7 is closed, forward feed solenoid L2 will receive power.
- **Reverse On**—when lit, indicates that reverse feed solenoid L3 is energized.
- **Hr Meter On**—when lit, indicates the controller is sending voltage to hourmeter GA1.
- **Amber Info Light**—mirrors the amber info light DS1 found on the rear of the machine. The LED turns on and off at the same time and flashes at the same rate as DS1.
- **Tach Strength**—dark if the engine is not turning, dim at idle, bright at full speed.
- **Engine OK**—when lit, indicates the engine is not in a stop condition.
- **Fwd On**—when lit, indicates forward feed is enabled and forward feed switch S7 is closed, providing power to forward feed solenoid L2.
- **E-Stop OK**—when lit, indicates the switches in the stop circuit are closed. Must be lit before forward feed is enabled.
- **Status**—not used on this machine, remains dark.
- **Power On**—indicates that the controller has voltage and ground.

SmartFeed Controller Electrical Circuit.



When the engine is running (key switch S1 is turned to RUN position) power goes through the A pin of the switch to the clutch switch S2. If the clutch switch is in the engaged position, power then goes to the 5-amp fuse F2, then to the SmartFeed controller A1. A1 receives a signal from the magnetic sensor B1.

When the RPM drops below a certain threshold, A1 sends voltage to solenoid L2, which opens SmartFeed valve FV1 to divert the hydraulic flow to the tank and away from the boom swing cylinders.

SmartFeed Controller Electrical Circuit Troubleshooting

To check if controller A1 is getting voltage (at least 11.5v) from the ignition switch (ignition switch ON; engine not running):

1. Open engine hood and locate LEDs on controller A1. Start engine and look at Power LED.

Expected result: Glowing. If so, controller has power.

If not, check fuse F1, and then test continuity of wire 265-YL from fuse F1 to pin 1 at the controller and from negative post of battery to pin 12 at the controller. Repair or replace defective wires as needed.

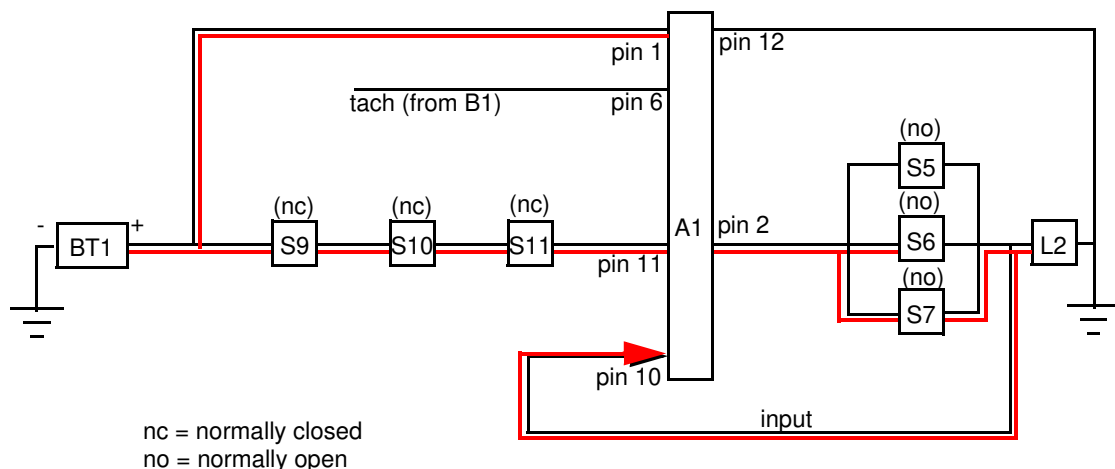
FORWARD FEED CIRCUIT

Forward Feed Enable

At start-up, the controller determines which droop point resistor pak is installed on this machine and stores the droop point in memory. The controller continually reads engine speed from magnetic speed sensor B1 on pin 6.

The forward circuit must be enabled by the controller. Before it is enabled, the controller verifies that:

- The stop circuit is closed, so power is present at pin 11. The E-Stop OK LED is lit if the stop circuit is closed.
- The machine does not need to be reset. The Amber Info Light LED flashes quickly if it needs to be reset.
- The engine is turning faster than droop point. The Tach Strength LED will be dim if engine is turning slowly and gets brighter as engine speed is increased.



If all these conditions are satisfied, the Fwd Enable LED is lit and the controller provides voltage at pin 2, which is wired to switches S5, S6 and S7.

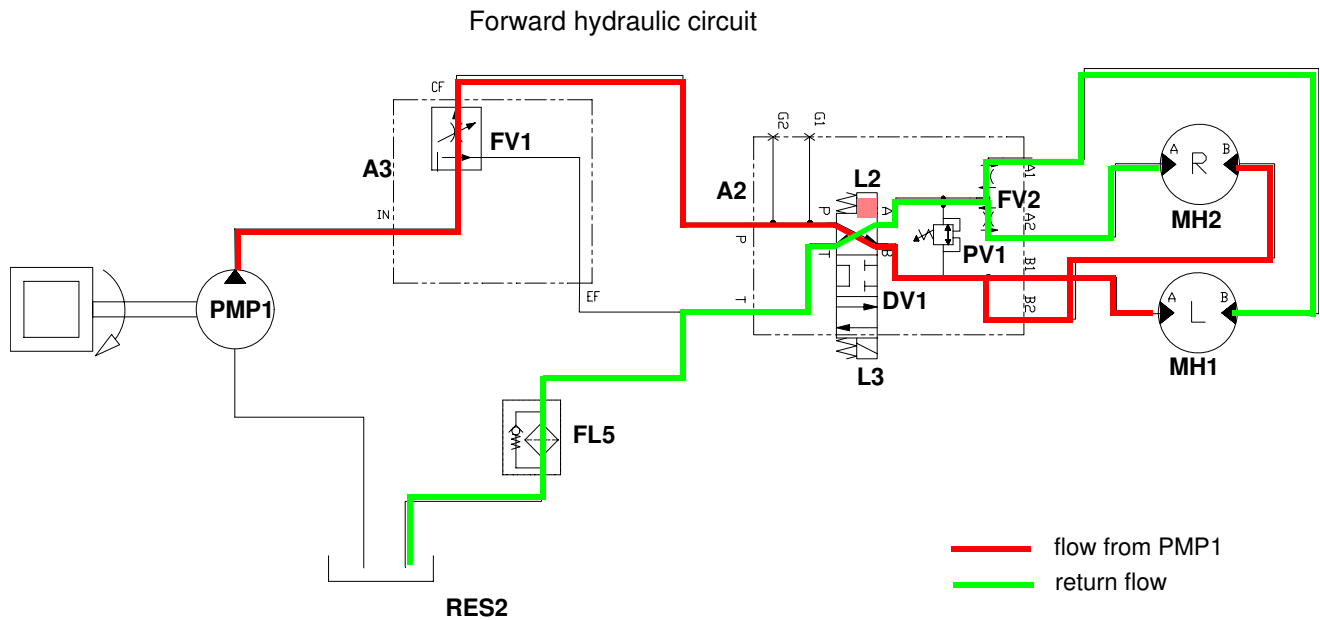
- Switches S5 and S6 are the reset/hold-to-run switches on either side of the machine.
- S7 is the forward feed switch closed by a cam on the feed bar when the operator pulls it back past NEUTRAL.

When any of these three switches close, it energizes L2. It also sends a voltage signal to the controller at pin 10. The controller “knows” when the feed roller is turning in the forward direction.

Continued on next page...

When solenoid L2 is energized, it shifts the directional control valve DV1 (on manifold A5) to the crossing position. Pump flow crosses DV1, splits and flows to motors MH1 and MH2. Flow always goes to opposite ports on the motors, since the motors always turn in opposite directions. Return flow from the motors combines at the flow divider combiner valve FV2, crosses DV1, and flows through return filter FL5 to the tank RES1

The following diagram shows the forward hydraulic circuit.



Feed Roller Speed

The speed of the roller motors MH1 and MH2 is controlled by the amount of flow they are receiving.

The 0.66 cid gear pump is driven by the engine at a 1:1 ratio to the engine speed. At the high idle speed of 2568 rpm, the pump produces a *theoretical* flow of 1864 in³/min, or 8.07 gpm (30.5 L/min).

Assuming that the control handle for the flow divider FV1 is in the full flow position, the 1864 in³/min pump flow is evenly divided between two gear motors, each with 28.30 cid displacement, for a total of 56.60 cid.

$$1864 \text{ in}^3/\text{min} \div 56.60 \text{ in}^3 = 32.93 \text{ rpm theoretical motor speed}$$

A gear pump and a gear motor are each expected to be 80% efficient when working against pressure. The other 20% is expected to be lost to internal leakage inside the pump or motor.

Adjusting both pump flow and motor speed by 80%:

$$1864 \text{ in}^3/\text{min} \times 0.80 = 1491 \text{ in}^3/\text{min} \text{ expected flow from the pump at working pressure}$$

$$1491 \text{ in}^3/\text{min} \div 56.60 \text{ in}^3 = 26.4 \text{ rpm}$$

$$26.4 \text{ rpm} \times 0.80 = 21 \text{ rpm expected from the motors.}$$

So, on a relatively new machine at 2568 engine rpm, feed roller speed can be expected to run a little less than 33 rpm when no material is feeding in, and as low as 21 rpm when the rollers are working hard to pull in material.

NOTE: Engine speed directly affects pump speed. If the engine pulls down when chipping tough material, pump speed will slow, so roller speed will also decrease. Likewise, when the machine is not chipping, the engine speeds up to 2568 rpm, increasing roller speed.

The flow entering the directional control manifold A2 is further divided into two equal parts by the flow divider/combiner valve FV2. The diagram below illustrates the roller speed control set to 1/2 full speed.

The diagram illustrates a hydraulic circuit with the following components and flow paths:

- Pump (PMP1):** Driven by an electric motor, it draws fluid from the reservoir (RES2) and pumps it into the system.
- Valves:**
 - FV1:** A 3/2-way valve with positions IN (normal) and CF (center). It is currently in the IN position, allowing full flow from the pump to the actuator.
 - FV2:** A 3/2-way valve with positions A1, A2 (normal), and B1, B2 (center). It is currently in the A1 position, allowing 1/2 flow from the pump to the actuator.
 - PV1:** A pressure-reducing valve (check valve) that limits the flow to the actuator.
 - FL5:** A flow control valve that regulates the flow rate to the reservoir.
- Actuators:**
 - MH1 (Cylinder):** A double-acting cylinder with ports A and B. It is currently in the retracted position (B is connected to the tank).
 - MH2 (Cylinder):** A double-acting cylinder with ports A and B. It is currently in the extended position (A is connected to the pump).
- Flow Paths (Legend):**
 - Red lines:** Indicate flow from the pump. The thickness of the red line represents the flow rate: thick red for full flow, medium red for 1/2 flow, and thin red for 1/4 flow.
 - Green lines:** Indicate return flow from the actuators back to the reservoir.

- First, check to see if the rollers will turn normally in the reverse direction. If not, the problem is most likely in the hydraulic components.
- Second, determine if the controller has enabled forward feeding. If it has, the Fwd Enable LED will glow on the controller LED panel. If the Fwd Enable LED is glowing, troubleshoot, as discussed in *"Troubleshooting the Forward Feed Circuit,"* page **6-22**. If not, continue below.

Preconditions to Enable Forward Feed

If the Fwd Enable LED is not glowing, verify that the controller is getting the needed inputs. Before it will enable forward feeding, the controller checks for the following:

- The stop circuit is closed. The E-Stop OK LED will glow if it is closed. If not, see *"Stop Feed Circuit Troubleshooting,"* page **6-27** to troubleshoot this problem.
- The machine does not need to be reset. The Amber Info LED flashes quickly if it needs to be reset. If it needs to be reset, press and release either of the reset/hold to run buttons, or move the upper feed control bar to the RESET position, and then to FORWARD. If this does not reset the machine, continue at *"Reset Circuit Troubleshooting,"* page **6-35** to troubleshoot this problem.
- The engine is turning faster than droop point—Tach Strength LED will be dim if the engine is turning too slowly. If needed, go to *"SmartFeed Droop Point Circuit Troubleshooting,"* page **6-43** to troubleshoot this problem.
- The hydraulic over-pressure switch S4 is open. Switch S4 closes at 2650 psi (183 bar). There is no LED for this switch. If the three items above are OK, and the Fwd On LED is dark, check this switch as described under *"Testing Hydraulic Pressure Switch S4,"* page **6-24**.

If the items above check out OK, contact the Vermeer brush chipper service department. The controller may need to be replaced.

Troubleshooting the Forward Feed Circuit

First, verify that the Fwd Enable LED is glowing on the controller A1. If not, see ["Preconditions to Enable Forward Feed,"](#) page 6-21. If so, continue below.

1. Observe rollers while pressing and holding either of the reset/hold-to-run switches S5 or S6.

Expected result: Rollers turn in the forward feed direction for 30 seconds or until switch is released.

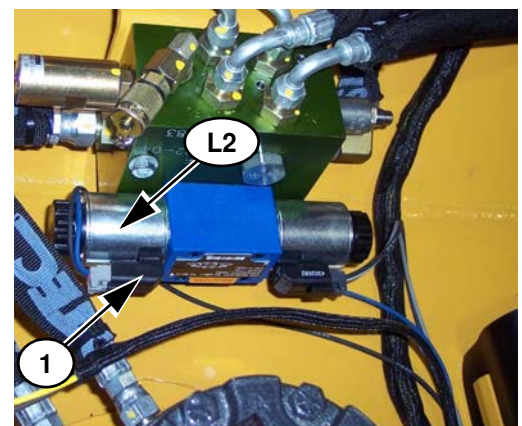
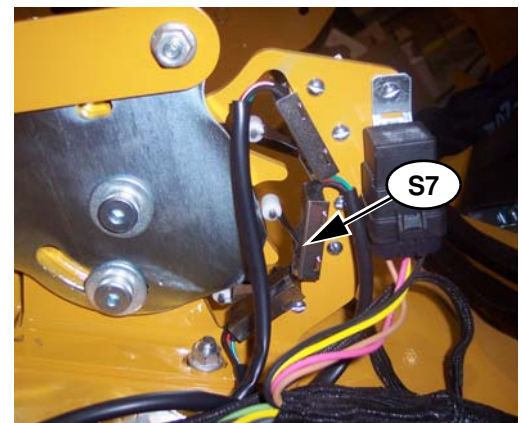
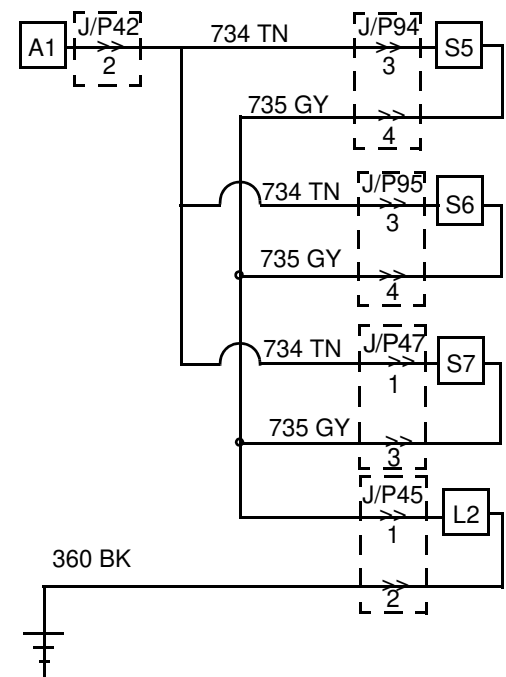
If so, fault lies in switch S7 on the upper feed control bar, or in the wires connected to this switch. Remove cover on top of feed chute and test continuity of switch in open and closed positions, and of wires to and from switch, and replace as needed.

If pressing and releasing either of the reset/hold to run switches S5 or S6 does not cause the rollers to turn, continue below.

2. Locate solenoid L2. The photo on the right shows the location of solenoid L2 on directional control manifold A2.
3. Disconnect L2 at J/P45 (1). Measure resistance across the solenoid.

Expected result: $5.4 \Omega \pm 0.5 \Omega$ If so, continue below.

If not, replace L2.



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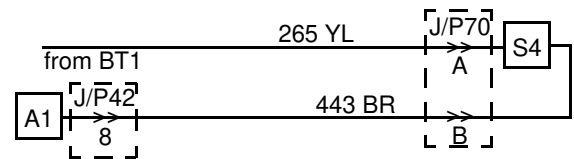
4. After ensuring that the forward feed circuit is enabled (see *"Preconditions to Enable Forward Feed,"* page 6-21), pull upper feed control bar back to the FORWARD position and measure voltage on connector J/P45 from pin 1 (power) to pin 2 (ground).

Expected result: 12 volts DC, $\pm$ 1.2 volts. If so, continue at *"Testing Pump Flow and Flow Divider,"* page 6-51. If not, continue below.

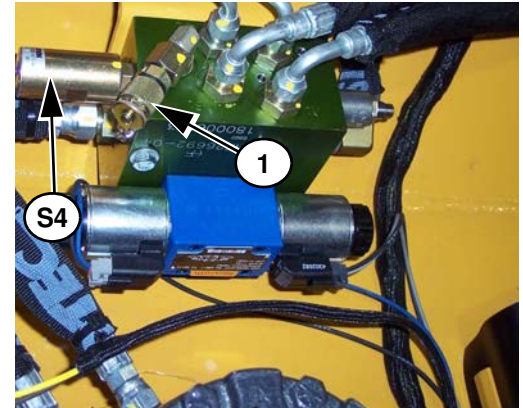
5. Test continuity of pin 2 to ground and pin 1 to switch S7. Repair or replace any faulty segment.

Testing Hydraulic Pressure Switch S4

When this switch closes, it delivers voltage to controller A1 on pin 8. A1 responds by shutting off power at pin 2, which disables forward feeding. S4 should close at 2650 psi (183 bar).



1. Follow *"Shutdown Procedure,"* page 2-1.
2. Connect a 5000 psi test gauge to diagnostic port (1) on manifold A2.
3. Unplug hydraulic pressure switch S4 from the harness at J/P 70.
4. After ensuring that the forward feed circuit is enabled (see *"Preconditions to Enable Forward Feed,"* page 6-21), pull upper feed control bar back to the FORWARD position. Test continuity across switch and note pressure on gauge when switch closes.



Expected result: Open, unless pressure reaches 2650 psi (183 bar), $\pm$ 125 psi (9 bar), when switch S4 closes. If so, continue at *"Testing Pump Flow and Flow Divider,"* page 6-51.

If S4 closes at less than 2650 psi (183 bar), $\pm$ 125 psi (9 bar), or failed to close at that pressure, replace switch S4, see page 6-77.

If pressure reached 2650 psi (183 bar), $\pm$ 125 psi (9 bar) when no limbs or branches were feeding (or jammed in the rollers), investigate what is restricting flow through the circuit, or causing the resistance to the rollers turning. Possibilities include:

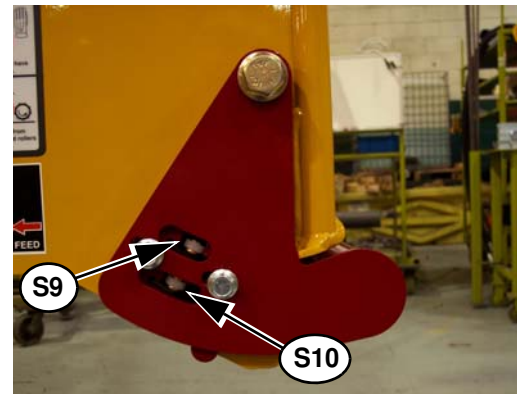
- shredded bark or other ropery material wrapped around axles of the feed rollers.
- material wedged between rollers and walls of the infeed throat
- seized bearing or other malfunctioning bearing on feed roller.
- partially obstructed fluid flow between P port of the directional valve DV1 and tank.

STOP FEED CIRCUIT

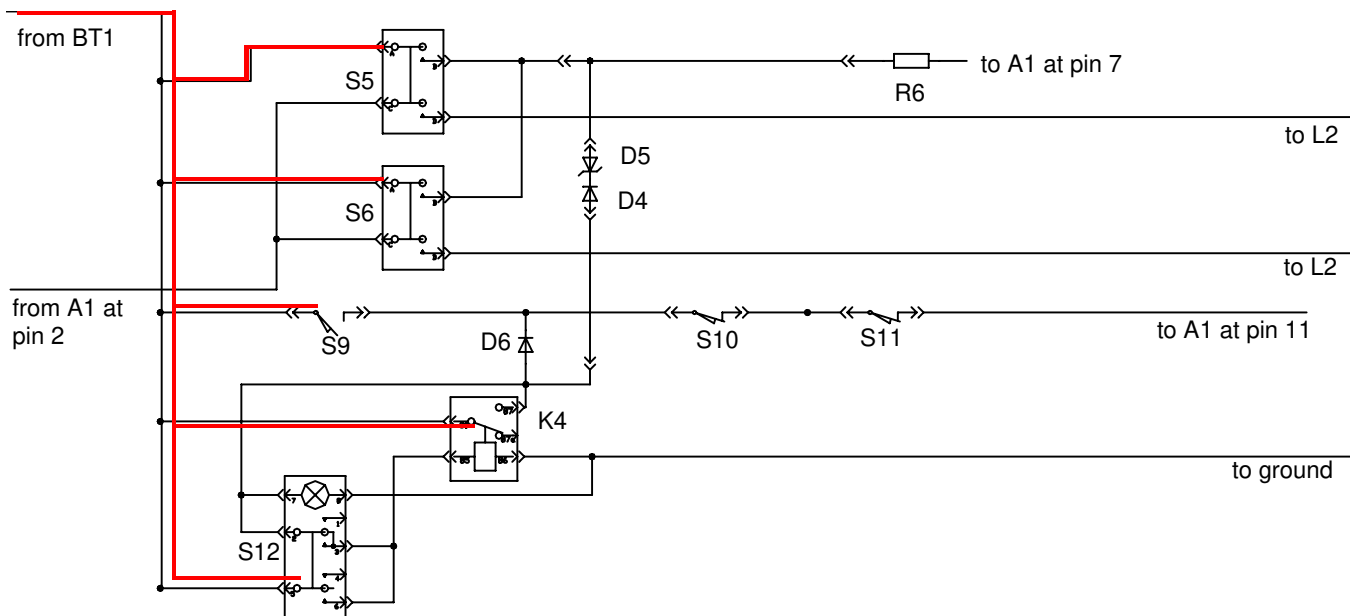
The SmartFeed controller A1 controls the voltage used by solenoid L2 to turn the rollers forward. A1 must receive voltage at pin 11 before it will send voltage to L2 (through switches S5, S6 or S7). Voltage to pin 11 can be interrupted by opening any of the three normally closed switches S9, S10 or S11.

S9 and S10 are mounted on the lower feed stop bar. S9 opens if moderate pressure is applied to the feed stop bar. S10 opens if more pressure is applied to the feed stop bar. S11 opens if the operator shoves the upper feed bar fully forward to the emergency stop position.

The stop feed circuit has two different modes of operation, depending on the position of sensitivity selector switch S12. When S12 is in normal sensitivity mode, switches S9, S10, and S11 must all be closed to complete the stop circuit. When S12 is in reduced sensitivity mode, switch S9 is bypassed and only switches S10 and S11 must be closed to complete the stop circuit.



Normal Sensitivity



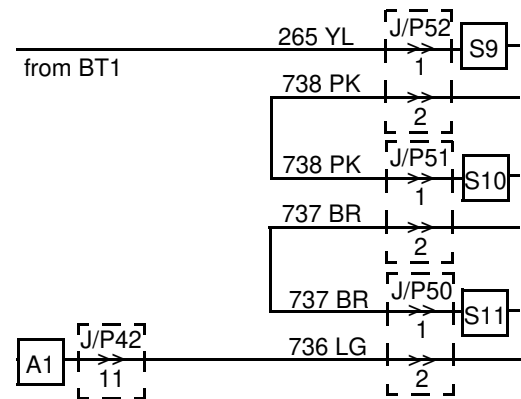
Stop Feed Circuit Troubleshooting

Problems with the stop circuit most often can be traced to defective lower feed stop bar switches S9 or S10, so it is best to begin by testing these. Testing this circuit involves simple voltage checks and continuity checks of the circuit with the switches in their open and closed positions. The following sections describe how to test the stop circuit in both normal sensitivity and reduced sensitivity modes.

Before beginning troubleshooting of the stop circuit, ensure power is available at the controller, as described in "[SmartFeed Controller Electrical Circuit.](#)," page 6-16.

Troubleshooting Normal Sensitivity Mode

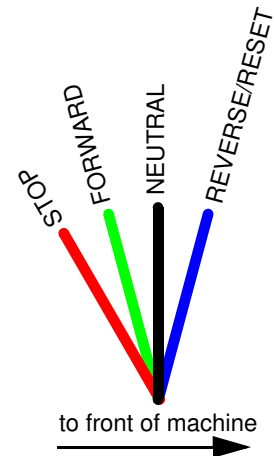
In normal sensitivity mode, the stop circuit is interrupted by opening switch S9 with a slight movement of the lower feed stop bar, or by opening switch S10 by pulling the upper feed control bar fully back to the STOP position.



1. Pull lower feed stop bar out to ensure that switches S9 and S10 are in their normal position, and put upper feed control bar in the NEUTRAL detent to ensure stop switch S11 is in its closed position.
2. With engine off, and ignition switch S1 in the RUN position, ensure sensitivity selector switch S12 is in normal sensitivity mode (the light on the switch is off when in normal sensitivity mode).

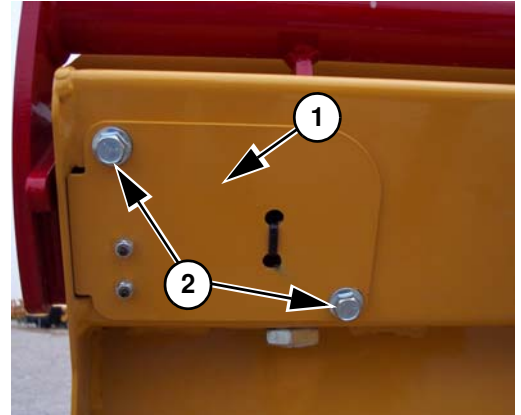
Expected result: The E-Stop OK LED on the controller should be lit. If so, switches S9, S10, and S11 and the wires between them appear to be working properly.

If LED is not lit, one or more of the switches in the stop circuit may not be closing, or the wires between them may be broken. Continue below to test the switches and wires.

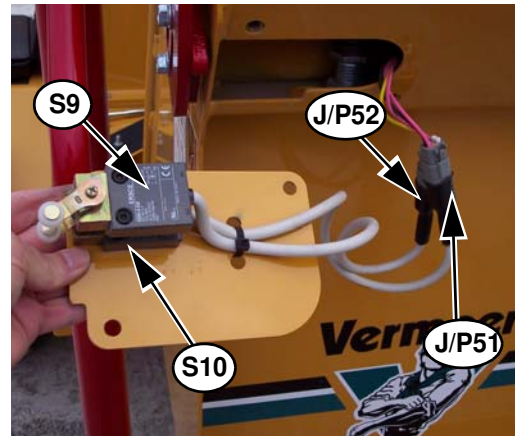


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3. With infeed table folded up into transport position, remove two bolts (2) from switch access plate (1) to reveal switches S9 and S10.



4. Pull switch wires out to access connectors J/P51 and J/P52



5. Test continuity across switch S10 from P51-1 to P51-2 with lower feed stop bar released, and fully pressed.

Expected result: Continuity with feed stop bar released, open when bar is fully depressed. If so, S10 is working normally.

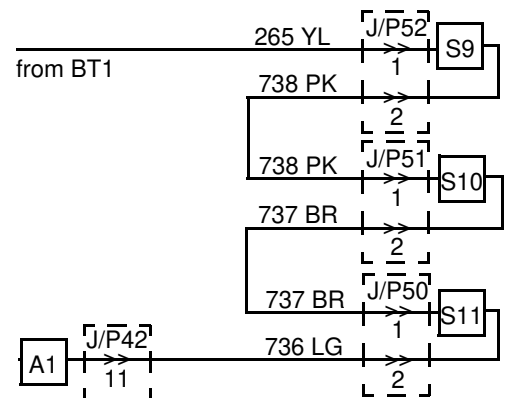
If not, replace S10. See page 6-81.

6. Test continuity of wire 738 PK from J51-1 to J52-2. Repair or replace wire or harness segment if open.

7. Test continuity across switch S9 from P52-1 to P52-2 with lower feed stop bar released, and slightly pressed.

Expected result: Continuity with feed stop bar released, open when bar is pressed. If so, S9 is working normally. Continue below.

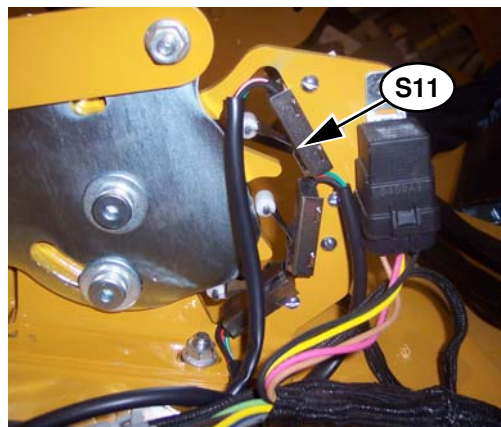
If not, replace S9. See page 6-81.



Continued on next page...

8. Remove shield on top of feed chute, and locate switch S11 and follow the lead to connector J/P50.
9. Disconnect J/P50 and test voltage across S11 from P50-1 to P50-2 with upper feed control bar in the STOP position, and in FORWARD, NEUTRAL, and REVERSE/RESET.

Expected result: Open in STOP, continuity in the other positions. If so, continue below.



If not, replace S11 see page [6-81](#).

10. Ensure lower feed stop bar is pulled out and upper feed control bar is in the NEUTRAL position, then disconnect J/P42 at controller A1 and test continuity of the following wires:
 - wire 736 LG from P50-2 to P42-11
 - wire 737 BR from J50-1 to J51-2.
 - wire 738 PK from J51-1 to J52-2

Expected result: Continuity. Repair or replace any open wire or harness segment.

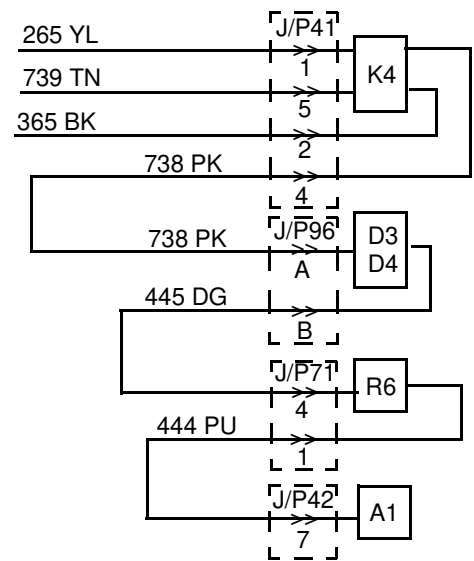
If all switches and harness segments appear to be working, consult Vermeer Service Department. There may be a fault in controller A1.

Troubleshooting Reduced Sensitivity Mode

In reduced sensitivity mode, the switch S9 on the lower feed stop bar is ignored. It takes more movement of the lower feed stop bar to open the stop circuit in this mode.

When controller A1 reads 3 to 4 volts on pin 7, it turns on information light DS2 on the rear of the machine and the Amber Info Light LED on the controller. The lights glow, but do not flash.

In addition, the sensitivity selector switch S12 has an indicator light DS4 that glows when reduced sensitivity is selected.

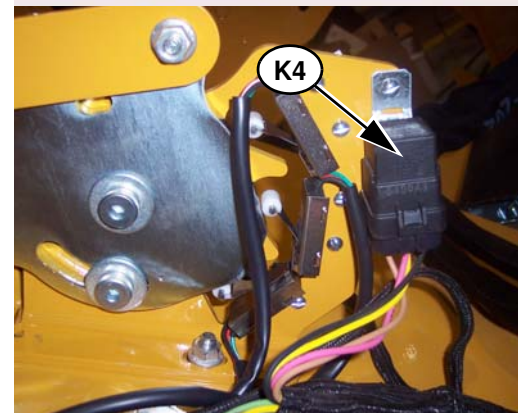
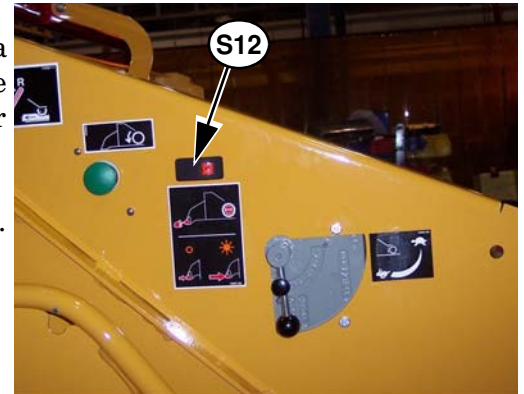


Information Lights Dark, Switch S12 Glows

If the light on switch S12 glows, but the information lights do not, there is a fault in the electrical path between the relay K4, at J/P41-4 and the controller at J/P 42-7.

1. Remove shield on top of feed chute. Locate relay K4.
2. Continuity checks of the segments will reveal the faulty harness segment. Repair or replace any open segment.

Refer to *"Component Locations,"* page 6-4 to find the components and their connectors.

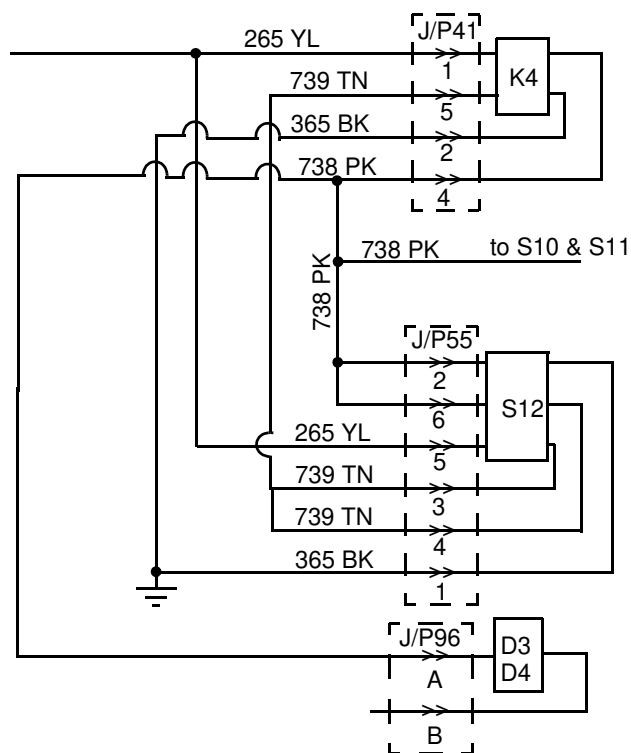


Neither Amber Information Light nor S10 Glow

1. Remove shield on top of feed chute. Locate relay K1.
2. Unplug relay K4 at J/P41 and switch S12 at J/P55.
3. With the key turned to RUN, verify voltage to the switch. Ground the black probe of multimeter to the frame, and measure voltage to pin P55-5.

Also, verify voltage to the relay. Ground the black probe of multimeter to the frame, and measure voltage to pin P41-1.

Expected result: 12 volts
DC, ± 1.2 volts. If so,
continue below. If not,
test continuity to positive post of the battery. Repair or replace the faulty
wire or harness segment.



4. Verify continuity to ground for the relay at pin J41-2. If open, repair or replace faulty harness segment.
5. While pressing switch S12, test continuity across the switch from:
 - J55-5 to J55-4
 - J55-2 to J55-3

Expected result: Continuity. If so, continue below. If not, replace the switch. See page 6-82.

- 6.** Release switch S12 and test continuity from pin J55-2 to J55-3.

Expected result: Continuity. If so, continue below. If not, the switch will not “latch.” Replace switch. See page [6-82](#).

7. Plug connector into switch S12. Check voltage to relay K4 at P41-5, with the black probe on P41-2.

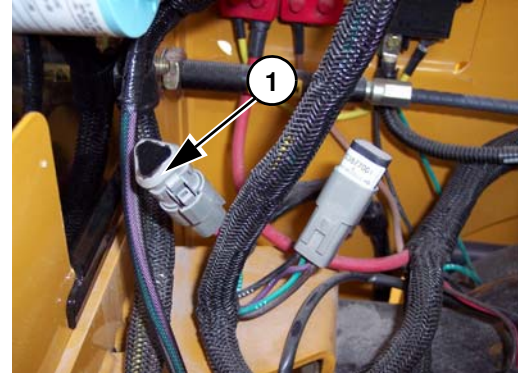
Expected result: 12 volts DC, ± 1.2 volts. If so, continue below. If not, test continuity from S12 to K4 on wire 739 TN and repair or replace if open.

Continued on next page...

8. Open engine cover and remove diode pak (1) containing D3 and D4 from connector J/P96. Plug relay K4 into its connector.

With the black probe grounded to frame, measure voltage to diode connector at pin A.

Expected result: 12 volts DC, $\pm$ 1.2 volts. If so, relay appears to be working.



If not, test continuity of wire 738 PK. If continuous, replace relay. If open, repair or replace harness segment.

If problem persists, check resistor pak, as discussed on page [6-46](#).

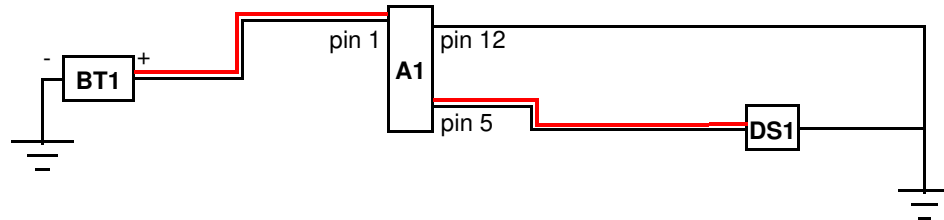
In Reduced Sensitivity, Forward Feed Stops in 30 Seconds

The zener diode D3 has failed in the closed position, so it does not reduce the voltage to R6. Pin 7 reads the incoming voltage as a request to hold-to-run from the reset switches S5 and S6.

Replace diode pak for D3 and D4. (See page [6-80](#)).

STOP BAR RESET CIRCUIT

If the lower feed stop bar switches are tripped, or the upper feed control bar is moved to the STOP position, the controller will begin flashing info light DS1, located above the feed table. The controller will not allow the feed rollers to forward feed until the machine is reset.

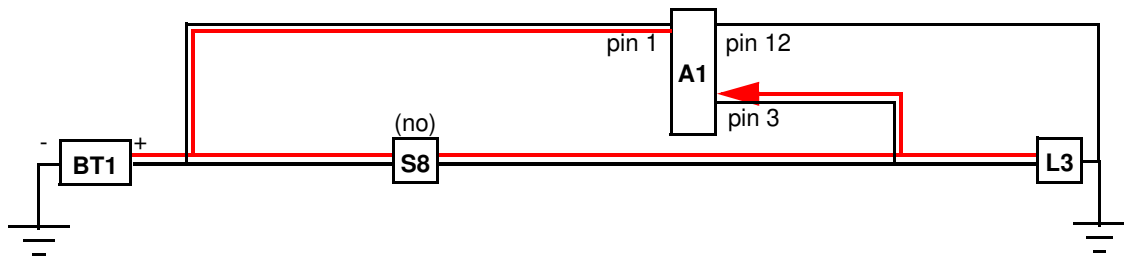


After the lower feed stop bar and/or the upper feed control bar are returned to the normal or NEUTRAL position, there are two ways to reset the system.

- Method One: Push the upper feed control bar fully forward to the Reverse/Reset position.
- Method Two: Press either of the two reset/hold-to-run switches S5 or S6 on either side of the machine.

Method One

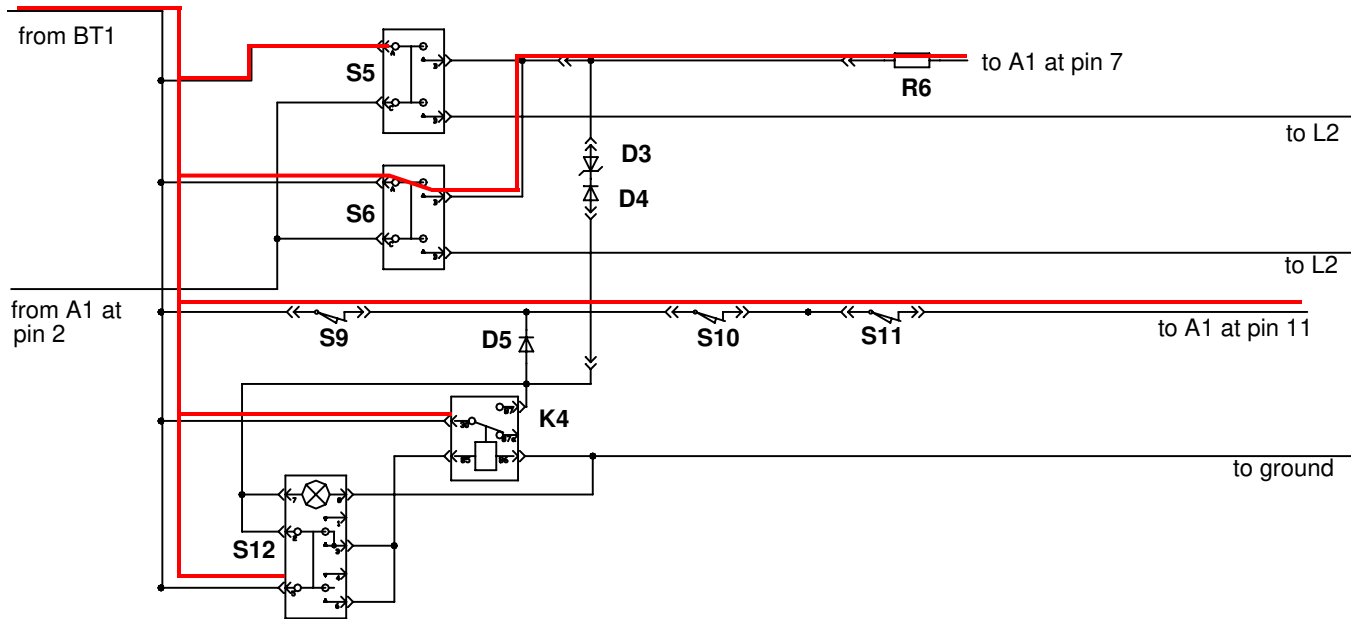
Pushing the bar fully forward to the Reverse/Reset position sends voltage to solenoid L3 from switch S8. It also sends an input to the controller at pin 3. The controller notes voltage at the pin and resets to allow forward feed.



Method Two

Pressing S5 or S6 sends 12 volts through resistor R6, to pin 7 on the controller. The resistor decreases the voltage to some value between 8 and 5 volts.

The controller measures the voltage to distinguish between this signal and a signal from the sensitivity selector switch and relay K4, which delivers less than 5 volts to the same pin on the controller.



Reset Circuit Troubleshooting

Anytime the stop circuit opens, the machine needs to be reset before forward feed is enabled again. When the stop circuit opens, the info light DS1 on the back of the machine flashes quickly. The Amber Info Light LED on the controller also flashes at the same rate as DS1.

If the following condition is satisfied, the machine can be reset:

- The stop circuit must be closed. The E-Stop OK LED glows when this circuit is closed. (The Amber Info Light LED will continue to flash until the machine is reset.) If moving the upper feed control bar out of STOP and jiggling the lower feed stop bar does not cause the E-Stop OK LED to glow, see ["Stop Feed Circuit Troubleshooting,"](#) page 6-27.

Once this condition exists, the machine can be reset by two methods:

- Press and release reset/hold-to-run switch S6 or S7. This sends 12 volts through resistor R4, and 6 volts reaches pin 7.
- Push upper feed control bar forward to the reverse/reset position. This sends 12 volts to pin 3.

Once the machine is reset, the Amber Info Light LED stops flashing and the Fwd Enable LED glows.

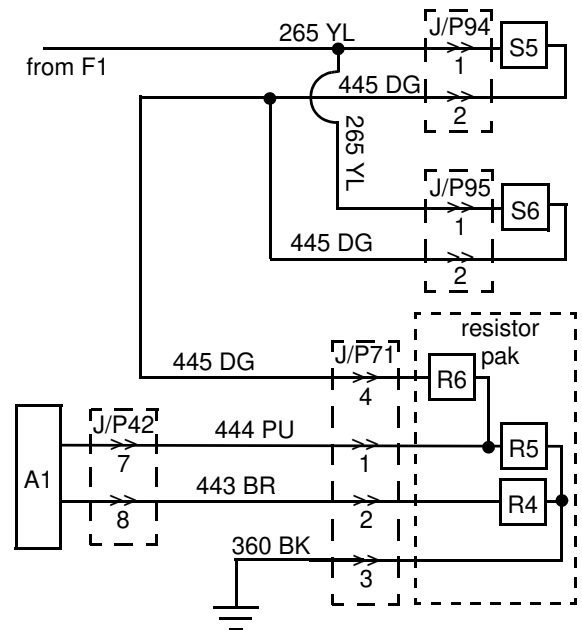
NOTE: If the machine is set to reduced sensitivity, the Amber Info Light LED and DS1 glow. If the machine is about to shut down due to engine problems, the Info LED and DS1 flash slowly.

Reset/Hold-to-Run Switch Does Not Reset

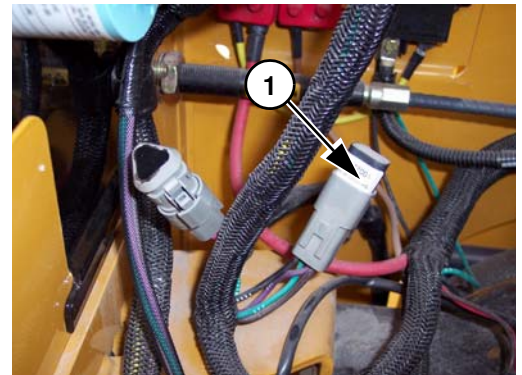
1. Remove shield on top of feed chute to access the connectors for S5 and S6. Test continuity across the switches from pin 1 to pin 2 with the switch pressed and released.

Expected result: Continuity when pressed, open when released. If not, replace switch as described on page 6-80.

If so, continue below.



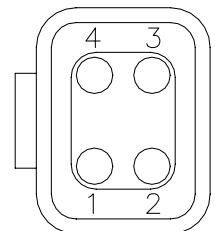
2. Locate resistor pak (1) for R4, R5 and R6. It is plugged into the four sided jack J71 that is connected to the harness, near controller A1.



3. Remove and orient the pak as shown at the right. Measure resistance of:

- R6 between sockets 1 and 4
- R5 between sockets 1 and 3

Depending on the thickness of the probes used with your multimeter, you may need to insert a short stiff wire, such as a paper clip, into the socket to get electrical contact.



Expected result: $0.51\text{ K}\Omega \pm 0.05\text{ K}\Omega$ for both resistors. If so, continue below. If not, replace resistor pak.

Continued on next page...

4. Test continuity of wires:

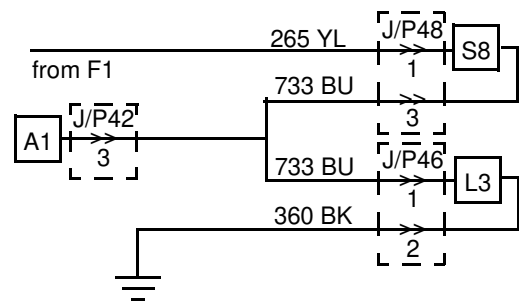
- 445 DG from J94-2 to P71-4 at the resistor pak
- 445 DG from J95-2 to P71-4 at the resistor pak
- 444 PU from J71-1 to P42-7 at the controller.

Expected result: Continuity. If so, contact Vermeer Service department about a possible fault in the controller.

If not, repair or replace wire or harness segment.

Reverse Does Not Reset

Switch S8 closes when the upper feed control bar is pushed fully forward. This sends voltage to the reverse solenoid L3, and to pin 3 on the controller.



1. Remove shield on top of feed chute. Locate switch S8 and follow the lead to connector J/P48.
2. Disconnect J/P48 and test continuity across S8 with the upper feed control bar in the STOP position, and in FORWARD, NEUTRAL, and REVERSE/RESET.

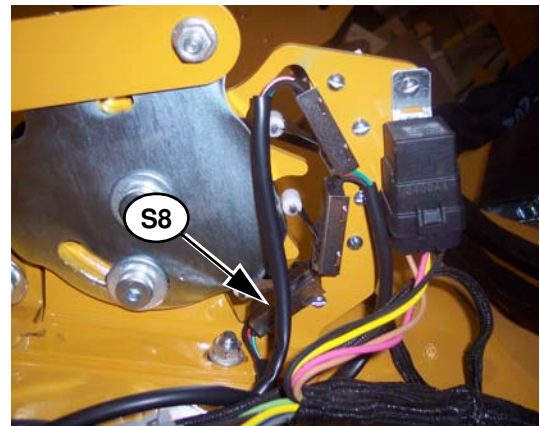
Expected result: Closed in REVERSE/RESET, open in the other positions. If so, continue below.

If not, replace switch S8. See page [6-81](#).

3. Test continuity of the following harness segments:

- wire 265 YL from fuse F1 to J48-1
- wire 733 BU from P48-3 to the controller A1 at J42-3

Expected result: Continuity. Repair or replace any open harness segment.



HOLD-TO-RUN CIRCUIT

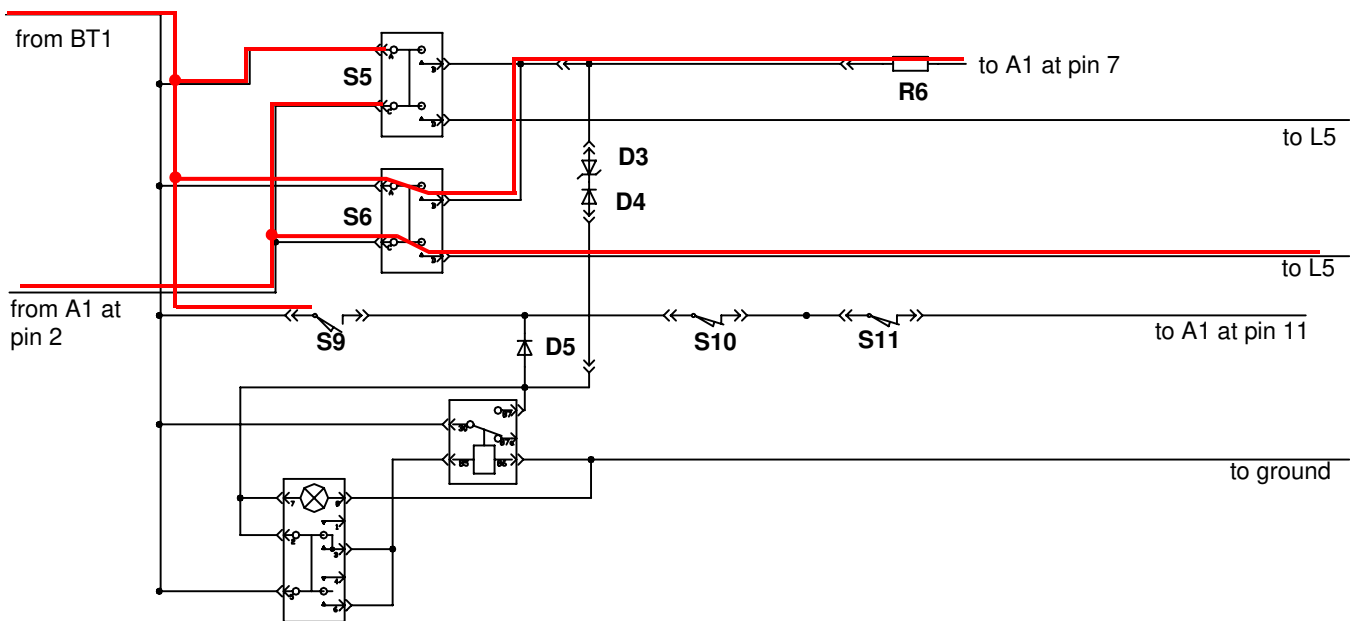
The reset/hold-to-run switches S5 and S6 allow the operator to resume chipping quickly when it has stopped due to the following:

- tripping the lower feed stop bar
- pushing or pulling the upper feed control bar out of the FORWARD position

Provided that the feed control bar is not in FORWARD, and the lower feed stop bar is not tripped, then the following will occur:

- If the operator presses and releases S5 or S6, the feed rollers will feed for 1 second.
- If the operator holds S5 or S6, the feed rollers will run for up to 30 seconds.

If the operator releases the button in less than 30 seconds, the rollers will continue to feed if the spring-loaded lower feed stop bar has returned to its normal position and the upper feed control bar is in FORWARD position. If held longer than 30 seconds, feeding will stop. The operator must release and repress S5 or S6 to continue feeding.



Continued on next page...

Switches S5 and S6 are double pole momentary switches. When pressed, voltage passes across the switch from A to B to A1 at pin 7 through resistor R6.

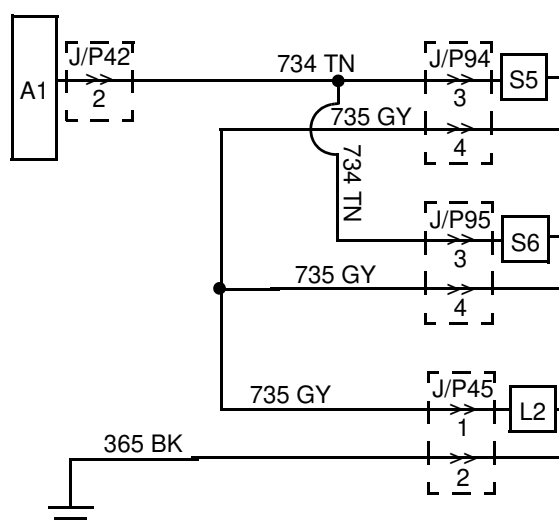
Pin 7 is an analog port on A1, so the amount of voltage can be distinguished from the amount of voltage delivered to pin 7 through the diode D3 when the sensitivity switch is used.

A1 responds to the voltage at pin 7 by energizing pin 2 for at least 1 second, and up to 30 seconds. From pin 2 on A1, voltage crosses the hold-to-run switch from pins 3 to 4 and energizes the forward feed solenoid L2.

Hold-to-Run Circuit Troubleshooting

When pressed, switch S5 or S6 sends an input to pin 7 of controller A1. A1 responds by sending an output from pin 2, which crosses the other pole of the double pole switch S5 or S6 to solenoid L2.

The input is the same one used to reset the controller from these switches. Refer to "*Reset/ Hold-to-Run Switch Does Not Reset,*" page **6-36** to troubleshoot the input from switches S5 and S6 to controller A1.

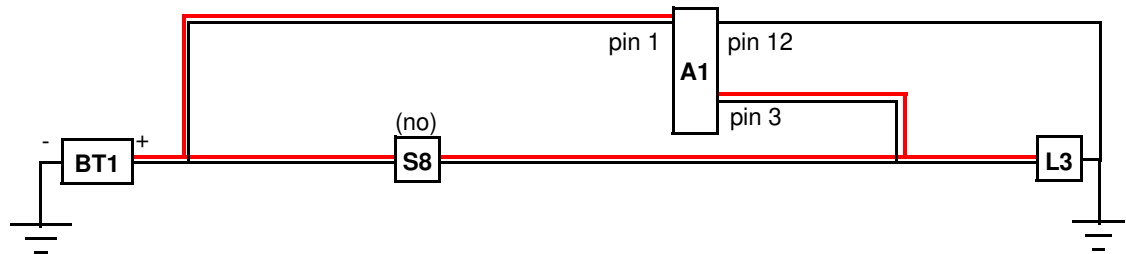


To troubleshoot the output, perform continuity checks across switches S5 and S6 (when pressing the switch), and on the other harness segments shown in the diagram. Replace any faulty switch or wire. See page 6-80 to replace S5 or S6.

If the wires and switches are OK, contact the Vermeer service department. There may be a fault in the controller that prevents it from sending the output on pin 2.

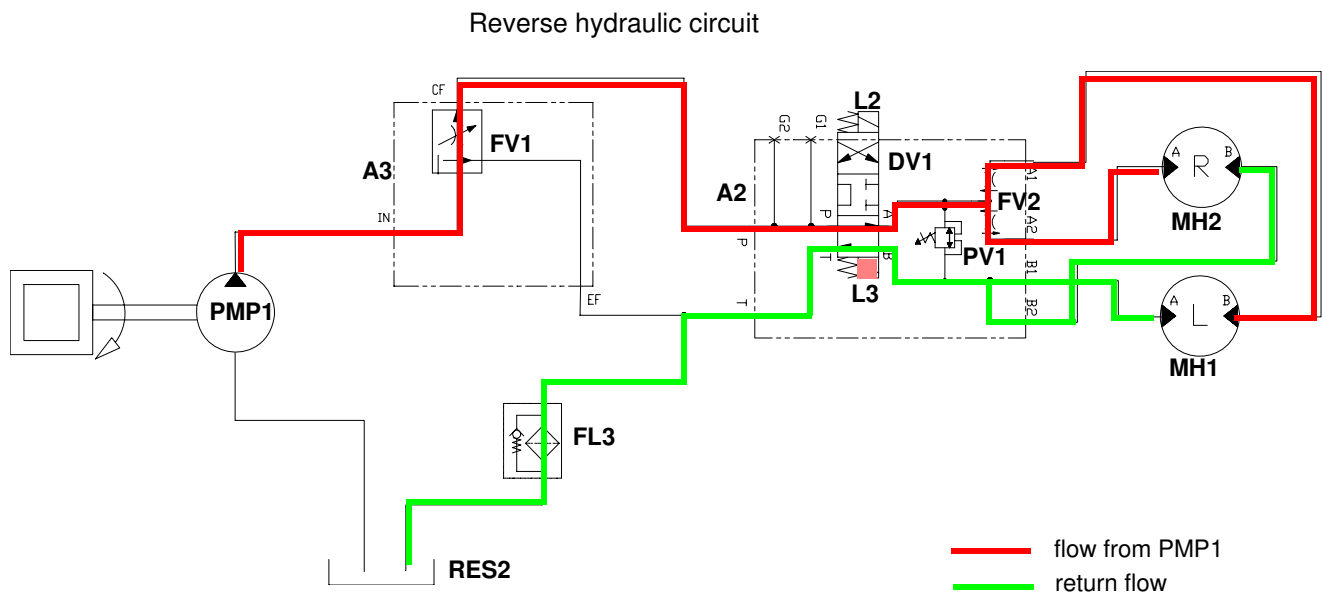
REVERSE CIRCUIT

Either the SmartFeed controller A1 or the operator using switch S8 (the upper feed control bar) can send voltage to solenoid L3 to turn the rollers in reverse.



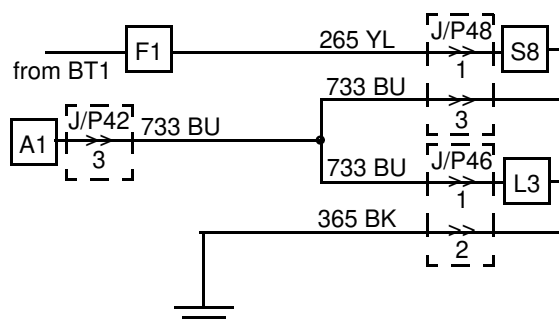
When solenoid L3 is energized, it shifts the directional control valve DV1 (on manifold A2) to the straight-across position. Pump flow crosses DV1, and splits to two paths at the flow divider combiner valve FV2. Flow to motors MH1 and MH2 always goes to opposite ports and the motors always turn in opposite directions. On the return path, flow from each motor combines and crosses DV1, flows through the return filter FL3 to the tank RES1.

The following diagram shows the reverse hydraulic circuit.



Reverse Feed Circuit Troubleshooting

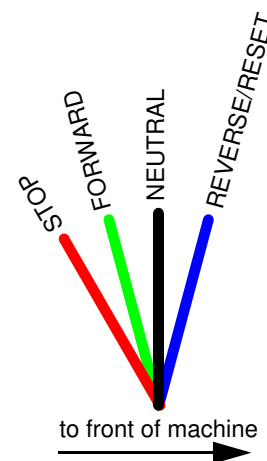
Reverse feed can be turned on by the operator pushing the bar into the REVERSE position, or by the controller.



1. With engine off, and ignition switch S1 in the RUN position, look at the Reverse On LED on controller A1 while an assistant moves the upper feed control bar from NEUTRAL to REVERSE/RESET.

Expected result: Dark in NEUTRAL, glowing in REVERSE/RESET. If so, switch S8 and the wiring between the battery, fuse F1, the switch, and the controller appear to be working. Continue below.

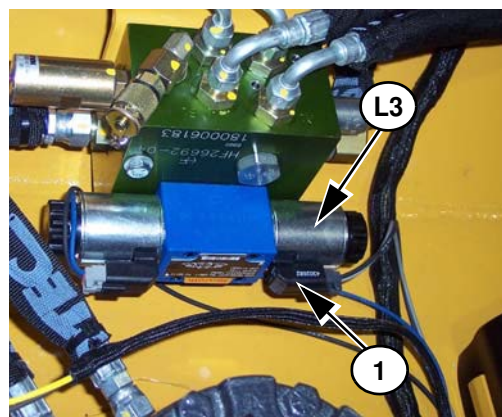
If not, continue as described under *"Reverse Does Not Reset,"* page 6-37.



2. Locate solenoid L3. The photo on the right shows the location of solenoid L3 and its jumper connection (1) on directional control manifold A2.
3. Disconnect L3 at J/P 46 (1). Measure resistance across the solenoid.

Expected result: $5.4 \, \Omega \pm 0.5 \, \Omega$ If so, continue below.

If not, replace L3.



4. With ignition switch S1 at RUN, measure voltage at pins J/P46-1 and J/P46-2 while an assistant holds upper feed control bar in REVERSE/RESET position.

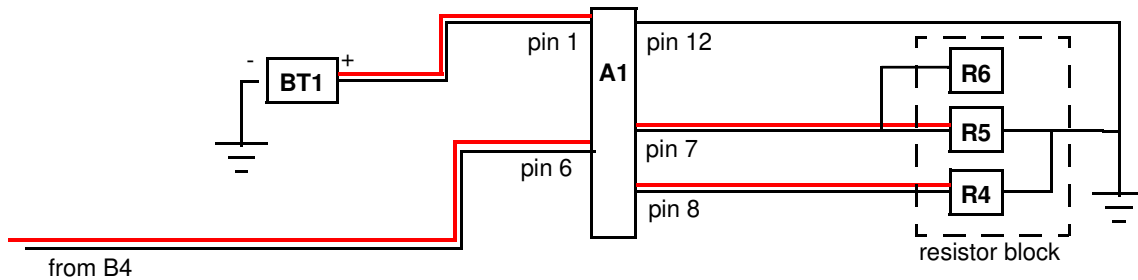
Expected result: 12 volts DC, ± 1.2 volts. If so, the problem appears to in the hydraulics. See *"Hydraulic System Troubleshooting,"* page 6-50.

If not, test continuity from J/P46-2 to ground and J/P46-1 to J/P42-3 at the controller. Repair or replace faulty wire or harness segment.

SMARTFEED DROOP POINT CIRCUIT

While the feed rollers are turning forward, the SmartFeed controller A1 monitors the engine RPM signal from the engine speed sensor B4 on pin 6.

During machine start-up, the controller sends out a small voltage on the two analog pins 7 and 8. It measures the amperage of these signals and determines the resistance of the two resistors R4 and R5. These two resistors are built into the droop point resistor block along with resistor R6. From this, the controller determines whether the droop point is 2140 rpm, 2215 rpm or 2290 rpm.



During chipping, if the engine slows to the droop point, the controller stops the feed roller, reverses a moment to pull material away from the cutter drum and stops again until the engine speed recovers. Then the controller begins feeding material to the cutter drum again.

After start-up, the analog pins become input pins. Pin 7 is used to determine (from the incoming voltage) whether the one of the reset/hold-to-run switches S5 or S6 is closed, or whether the sensitivity switch S12 is set to reduced sensitivity. (See *"Forward Feed Circuit,"* page 6-17, and *"Stop Bar Reset Circuit,"* page 6-33.)

SmartFeed Droop Point Circuit Troubleshooting

Troubleshooting this circuit involves:

- Determining what droop point pak is currently installed on the machine. See page [6-43](#).
- Reading actual engine speed while the machine operates under load. See page [6-44](#).
- Testing the magnetic speed sensor B1. See
- Testing the resistor pak. See page [6-46](#).
- Testing for continuity problems between the controller and the resistor pak. See page [6-47](#).

If the resistor pak is good and continuity is good, but the machine is not reversing the feed rollers at the installed droop point speed, contact the Vermeer Service department. There may be a fault in the controller.

Determining Droop Point of Pak Installed

1. Open engine cover and locate resistor pak (1) for R4, R5 and R6. It is plugged into the 4-sided jack J71 that is connected to the harness near controller A1.
2. To determine the correct droop point for this machine, look at the part number label on the resistor pak. On some machines you must pull the pak out of the jack to see the label.
 - P/N 153576-001 gives a droop point of 2140 rpm.
 - P/N 153577-001 gives a droop point of 2215 rpm.
 - P/N 153578-001 gives a droop point of 2290 rpm.



Measuring Engine Speed Under Load

This procedure must be done in a location where the machine can safely chip brush. The limbs used must be large enough to load the machine enough to cause the SmartFeed feature to operate.

1. Follow "[Shutdown Procedure](#)," page [2-1](#).
2. Remove shield over the cutter disc drive belt and sheaves. The shield remains off during this test, so keep away from the belts and sheaves after engine start.
3. Use reflective paint to mark a spot on the clutch sheave.
4. Wear full protective gear, as required of the operator, as described in the [BC1230A Brush Chipper Operator's Manual](#).
5. Set feed roller speed control lever to full speed.
6. Have a qualified operator start the machine and throttle up to working speed. Use a phototach focused on the clutch sheave to observe the engine speed as the operator feeds in brush.

Note the speed at which the feed rollers stop and reverse momentarily in reaction to the slowing engine speed. This is the droop point speed.

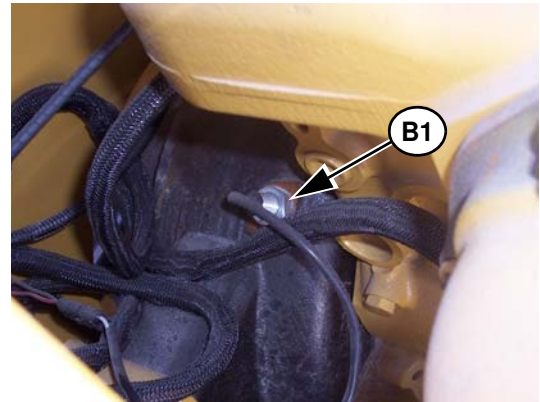
Expected result: The demonstrated droop point will be within 100 rpm of the droop point for the resistor pak installed. If so, the feature appears to operate as designed. Continue with testing the magnetic RPM sensor B1 on page [6-45](#).

If not, test resistor pak (see page [6-46](#)) and continuity between the controller and the resistor pak (page [6-47](#)).

7. Shut down engine.

Testing Magnetic RPM Sensor B1

Magnetic sensor B1 provides engine RPM information to the SmartFeed controller. The sensor is installed into the flywheel housing and aligns with the starter ring gear on the flywheel. It generates a small AC voltage spike whenever a flywheel tooth passes it. The SmartFeed controller counts the number (frequency) of voltage spikes per second. The following shows the high no load RPM and corresponding hertz reading from magnetic sensor B1 for the standard and turbo engines.



	Standard	Turbo
High No Load RPM	2568	2640
High No Load Hertz	5393	5544

The following test uses a multimeter to measure the frequency from B1. This test follows the test to measure engine speed under load on page 6-44. You should have the phototach ready to measure engine RPM at the same time as you are measuring frequency from B1. This test is performed under no-load, so make sure all brush has been expelled from the chipper.

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Disconnect the connector between the sensor and harness.
3. Have a qualified operator start the machine and throttle up to working speed. Do not start feed rollers.
4. Use a phototach focused on the clutch sheave to observe the engine speed. The speed should reach the no load RPM shown in the table above.
5. Push Hz button on the multimeter.
6. Measure hertz across terminals A (white/sensor) and B (black/ground) of sensor connector.

The sensor frequency should be correct for the corresponding engine rpm. If the frequency is either too high or too low, the controller will not function correctly.

If frequency is not correct:

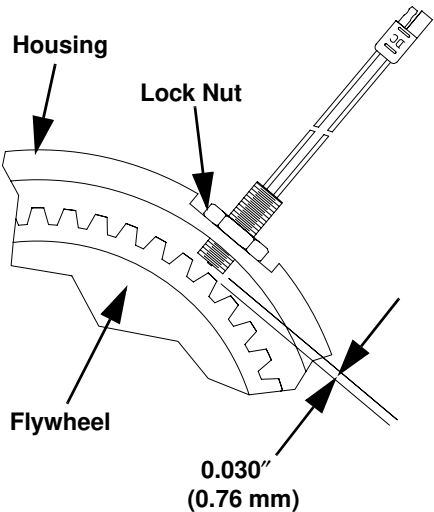
7. The magnetic pickup could be out of adjustment. See following section for adjustment procedure.

Adjusting Sensor B1

For proper operation of the magnetic sensor, there should be a 0.030" (0.76 mm) gap between the flywheel teeth and the tip of the pickup.

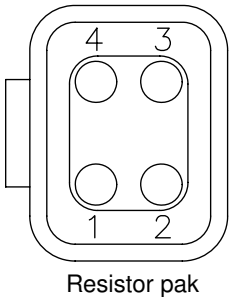
NOTE: When installing magnetic pickup, clean threads then apply Loctite 242 to the threads.

- 1. Back off lock nut.
- 2. Tighten by hand until sensor contacts flywheel.
- 3. Back off 1/2 turn.
- 4. Hold the pickup to keep it from turning, and then tighten lock nut.



Testing Resistor Pak

- 1. Remove resistor pak. Orient pak as shown at the right.
- 2. Depending on the thicknesses of the probes used with your multimeter, you may need two short stiff pieces of wire that can reach into the sockets to make electrical contact. Common paper clips work well.



Measure resistance of each resistor in the pak by measuring between the pins as listed in the table below.

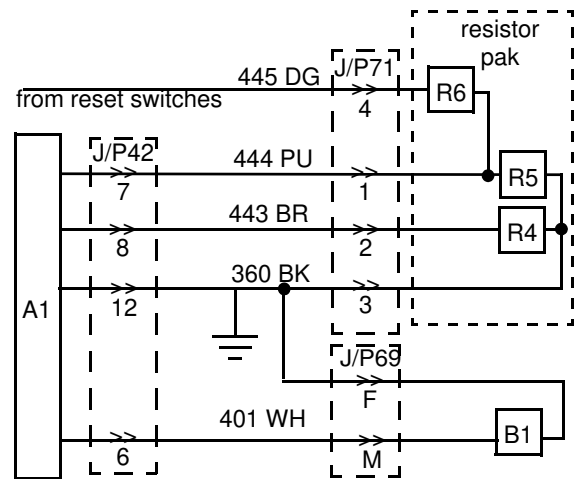
Part Number and Droop Point	Probes contacting socket numbers (resistor)	Expected Result
153576-001 2140 rpm	4 to 1 (R4)	0.51 K Ω
	1 to 3 (R5)	0.51 K Ω
	2 to 3 (R6)	1.47 K Ω
153577-001 2215 rpm	4 to 1 (R4)	0.51 K Ω
	1 to 3 (R5)	0.51 K Ω
	2 to 3 (R6)	3.92 K Ω
153578-001 2290 rpm	4 to 1 (R4)	0.51 K Ω
	1 to 3 (R5)	0.51 K Ω
	2 to 3 (R6)	9.09 K Ω

Expected result: Results will match the table, $\pm$ 10%. If so, continue below. If not, replace the resistor pak.

Testing Continuity of Droop Point Circuit

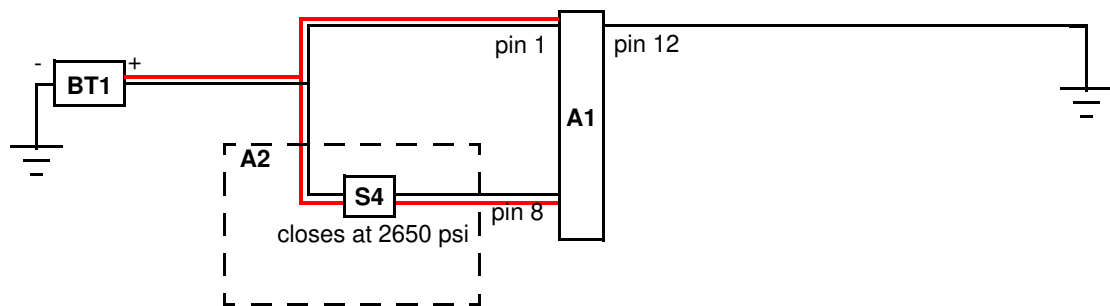
1. Disconnect controller from the harness at J/P42.
2. Remove resistor pak from jack J71.
3. Test continuity between:
 - P42-8 and J71-2
 - P42-12 and J71-3
 - P42-6 and J96-M
 - J96-F and P42-12

Expected result: Continuity. If not, repair or replace the faulty wire or harness segment.



ROLLER JAM CIRCUIT

Mounted on directional control manifold A2 is hydraulic over-pressure switch S4. If the feed rollers jam and stop turning while flow is going to them, the pressure in the line will rise. At 2650 psi (183 bar), the switch closes, sending 12 volts to controller A1 at pin 8.



A1 responds by stopping and reversing the rollers for a short interval, then feeding material again. If S4 closes again, A1 responds by reversing the rollers for a little longer interval.

- first time S4 closes—reverses rollers for 0.5 seconds
- second time—reverses for 0.7 seconds
- third time—reverses for 0.9 seconds
- fourth time—reverses for 1.1 seconds

On the fifth time, it starts the sequence over at 0.5 seconds.

Continued on next page...

If the jam clears, and S4 remains open for at least 2 or 3 seconds, the sequence resets and starts over at 0.5 seconds at the next jam.

If the hydraulic over-pressure switch S4 fails to work and the rollers jam, the rollers will remain stationary as the hydraulic flow from the pump flows over the 2500 psi pressure relief valve. Symptoms of this problem include:

- Operator is forced to clear jams by shoving the upper feed control bar to the REVERSE position before continuing with forward feeding.
- The hydraulic fluid heats up quickly.

Roller Jam Circuit Troubleshooting

If feed rollers are jamming, but not reversing:

1. Verify reverse circuit is working properly by manually pushing the upper feed control bar to the REVERSE position and observing the feed rollers.

Expected result: Rollers turn in the reverse direction. If so, continue below. If not, see "[Reverse Feed Circuit Troubleshooting](#)," page [6-41](#).

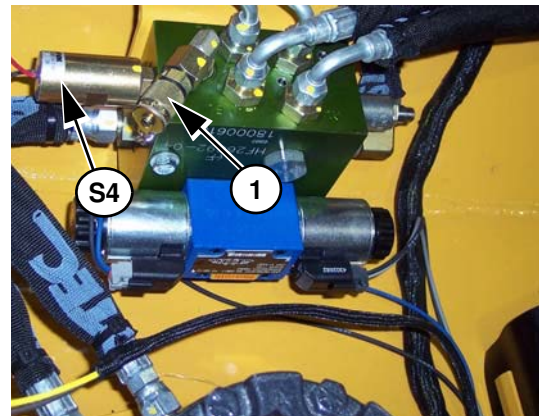
2. Follow "[Shutdown Procedure](#)," page [2-1](#).

3. Locate directional control manifold A2.

4. Unplug hydraulic pressure switch S4 from the harness at J/P 70.

5. Turn key switch S1 to RUN and measure voltage from J70-A to J70-B.

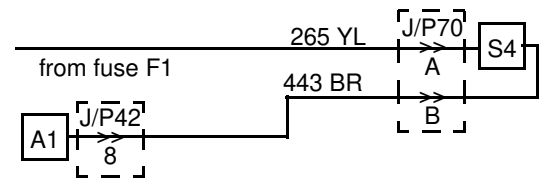
Expected result: 12 volts DC, $\pm$ 1.2 volts. If so, continue below at step 5.



If not, test continuity of 265 YL from J70-A to fuse F1, and of 443 BR from J70-B to controller A1 at J42-8. Repair or replace the faulty wire or harness segment

Continued on next page...

6. Start machine, activate forward feeding and have an assistant observe rollers as you use a jumper wire to connect J70-A to J70-B.



Expected result: Rollers will stop forward feeding and reverse momentarily, then switch between feeding in forward and reverse. If so, controller is responding normally to a hydraulic power pressure input. Continue below.

If not, contact Vermeer Service. There may be a fault in the controller.

7. Shut down engine. Locate diagnostic port (1) shown in photo on previous page. Connect a 5000 psi (350 bar) pressure test gauge to the diagnostic port.

Place machine in a location where you can chip safely. Obtain a limb large enough to jam the feed rollers. Wear all protective gear required for an operator, as described in the [BC1230A Brush Chipper Operator's Manual](#).

8. Remove jumper wire and reconnect switch S4 to the harness.
9. Have a qualified operator start and run the chipper as you observe the pressure gauge. Note indicated pressure when the operator jams the feed rollers.

Expected result: 2650 psi, $\pm$ 120 psi.

If indicated pressure is less than 2650 psi, valves are relieving before the switch can close. Adjust pressure relief valve PV1 and repeat test. See page [6-64](#).

If indicated pressure is above 2800 psi, replace pressure switch and adjust pressure relief valve PV1.

HYDRAULIC SYSTEM TROUBLESHOOTING

Pretest Inspection



WARNING: Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible. Keep away from any suspected leak. Relieve pressure in the hydraulic system before searching for leaks, disconnecting hoses, or performing any other work on the system. If you must pressurize the system to find a suspected leak, use an object such as a piece of wood or cardboard rather than your hands. When loosening a fitting where some residual pressure may exist, slowly loosen the fitting until oil begins to leak. Wait for leaking to stop before disconnecting the fitting. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Before servicing hydraulically operated items, take the following precautions:

1. Check level of hydraulic fluid in hydraulic tank. Low fluid can cause erratic behaviors in hydraulic circuits. If needed, add new fluid that has been filtered through a 10-micron filter.
2. Relieve all hydraulic system pressure before disconnecting lines or performing other work. Ensure all connections are tight and hoses and lines are in good condition before applying pressure to the system.
3. Follow "*Shutdown Procedure*," page 2-1.
4. Loosen hose fitting to release any remaining line pressure BEFORE removing the hose.

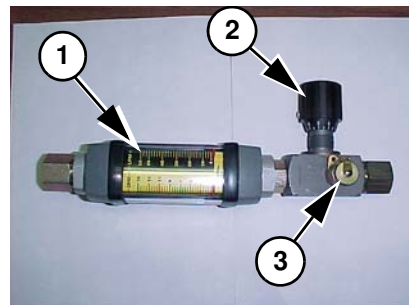
NOTE: Remove all lines as though there is hydraulic pressure in the line.

Testing Pump Flow and Flow Divider

This test will measure the output of the pump against pressure, at a known engine speed.

Equipment needed:

- pump flow test device, consisting of a flow meter (1) capable of handling at least 8 gpm, with a needle valve (2), and a diagnostic port (3) to accept a pressure test gauge
- fittings and hoses as need to connect the pump flow test device to the circuit
- a 5000 psi pressure test gauge (attach it to the pump flow test device)
- pen or pencil and a photocopy of the worksheet on page 6-53
- calculator for simple arithmetic
- phototach, if machine does not have optional tachometer installed



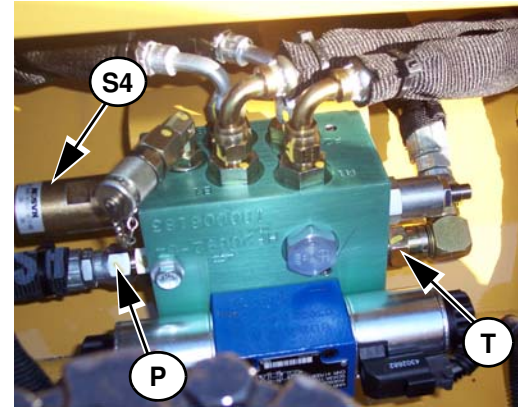
Preparation for Test

The engine must be shut down for steps 1 through 7 below. See "[Shutdown Procedure](#)," page 2-1.

1. Remove shield over the drive belt (see page 5-6). Use reflective paint to mark a spot on the clutch sheave.

The shield remains off during the test, so keep away from the belts and pulleys after engine start.

2. At directional control manifold A2, label, then disconnect the hose leading to the T port. Adding fittings as needed, connect hose to the outlet end of the flow meter. Refer to the flow arrow on the flow meter to determine the outlet end.



IMPORTANT: When connecting a flow meter to a circuit, do not restrict flow unintentionally by using hoses or fittings smaller than those normally installed in the circuit. Smaller diameter hoses will restrict flow and alter the results of the test.

3. At A2, label, then disconnect hose from the P port. Adding fittings and hoses as needed, connect hose to the inlet end of the flow meter.
4. Attach a 5000 psi pressure test gauge to the diagnostic fitting on the flow meter.
5. Verify needle valve is fully open. (Turning the handle counterclockwise opens the valve.)
6. Unplug hydraulic pressure switch S4 from the harness at J/P 70.
7. Verify feed roller speed control handle on flow divider manifold A3 is in the HIGH SPEED position as shown in the photo at right.
8. Start engine. Examine all hydraulic connections for leaks. If found, shut down and correct leaks.
9. Engage clutch and run engine at full operating speed.



IMPORTANT: The fluid must be at 90–100°F (32–37°C) to conduct the test. Feel surface of the flow meter. Allow engine to run and the fluid to circulate until the fittings at the flow meter are no longer cool to the touch.

Continued on next page...

Worksheet—Testing Pump Flow and Flow Divider for BC1230A

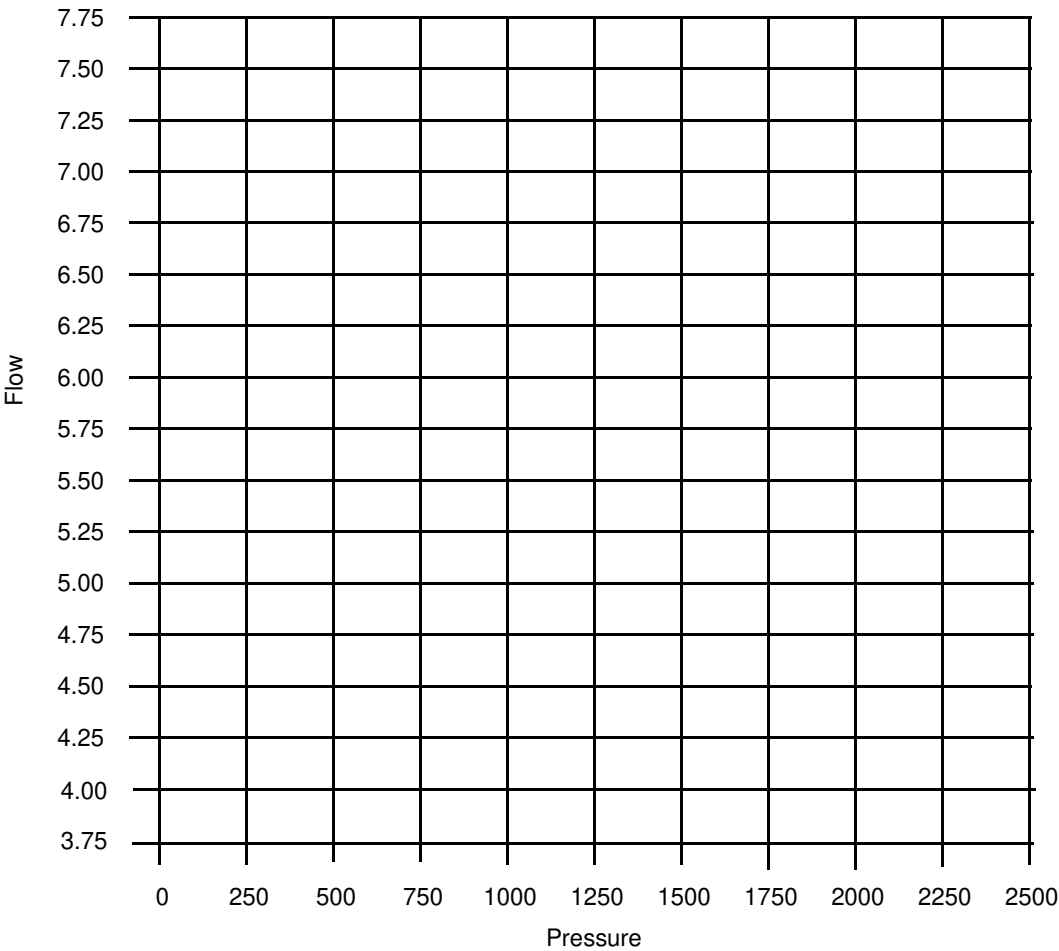
Make a photocopy of this page. DO NOT make marks on the original.

Beginning Engine RPM: _____
Beginning Indicated Pressure: _____
Beginning Indicated Flow: _____

Ending Engine RPM: _____
Ending Indicated Pressure: _____
Ending Indicated Flow: _____

Beginning theoretical flow (BTF): _____
BEF (BTF X 0.80): _____
BWF (BTF X 0.70): _____

Ending theoretical flow (ETF): _____
EEF (ETF X 0.80): _____
EWF (ETF X 0.70): _____



Indicated pressure when flow drops to nearly zero: _____

Flow at 1/3 speed mark at 500 psi: _____
Flow at SLOW speed at 500 psi: _____

Flow at 1/3 speed mark at 1500 psi: _____
Flow at SLOW speed at 1500 psi: _____

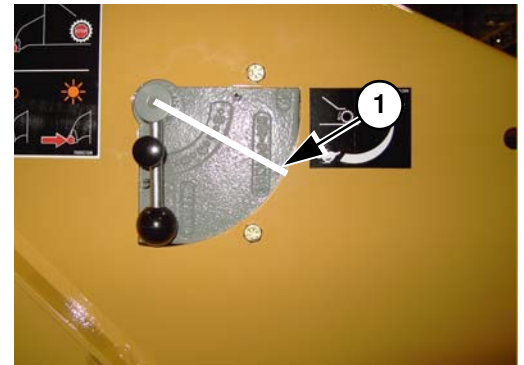
Continued on next page...

Conducting the Test

1. On a photocopy of the worksheet, record the Beginning Engine RPM, Beginning Indicated Pressure and Beginning Indicated Flow
2. Place a mark on the graph to indicate the displayed pressure and flow.
3. Watch displayed pressure as you screw in the knob on the needle valve of the pressure/flow test device. When indicated pressure matches the value for the next vertical line, stop and read pressure and flow, and mark it on the graph.

Repeat until pressure refuses to rise, or upon reaching 2800 psi (193 bar). Do not exceed 2800 psi.

4. Record Ending Engine RPM, Ending Indicated Pressure and Ending Indicated Flow
5. Use tape or some other mark to mark the arc of the feed roller speed control handle at the 1/3 speed location (1).



6. Fully open needle valve to allow full flow through the flow meter.

Slowly turn in the handle of the needle valve until 500 psi is indicated on the pressure test gauge.

7. Move feed roller speed control handle from HIGH to the 1/3 speed mark. Observe and record the flow on the line labeled "Flow at 1/3 speed at 500 psi."
8. Move feed roller speed control handle from the 1/3 mark to SLOW. Record flow at the line labeled "Flow at SLOW speed at 500 psi."
9. Move handle back to HIGH. Tighten needle valve until 1500 psi is indicated. Observe and record the flow on the line labeled "Flow at 1/3 speed at 1500 psi."
10. Move feed roller speed control handle from the 1/3 mark to SLOW. Record flow at the line labeled "Flow at SLOW speed at 1500 psi."
11. Shut down engine, and analyze results of the test, as discussed below. Do not remove test equipment until any needed adjustments are complete.

Continued on next page...

Analyzing the Test Results

This test is designed to tell you the following:

- Demonstrate whether the flow divider FV1 is working properly.
- Measure internal leakage to determine whether the pump PMP1 is worn beyond useful life.

Flow Divider Test Results

Look at the information at the bottom of the graph. The flow divider in manifold A3 is pressure-compensated. This means that the difference in flow at 1/3 speed and 500 psi and at 1500 psi should be very little—within 10%. The same is true for SLOW speed settings.

If the difference is greater than 10%, replace flow divider FV1. See page [6-73](#).

NOTE: A faulty flow divider can affect the readings taken in the other parts of the test. If the flow divider must be replaced, and the results of the pump test indicate it is worn-out, replace flow divider and run test again before deciding to replace the pump.

PMP1 Pressure v. Flow Results

Internal leakage is leakage through the clearances between the moving parts of the pump. As the pump creates suction on the inlet side, and the load on the circuit creates pressure on the outlet side, some fluid is pulled back through the clearances to the inlet side. As the pump wears, and the clearances become larger, more internal leakage occurs.

Beyond a certain point of wear, the pump cannot produce enough flow at working pressures to fulfill the function of the subsystem.

1. Multiply beginning engine RPM by 0.66 and divide the result by 231. This is the theoretical flow for PMP1 at that speed. Plot this point on the graph and mark it BTF (beginning theoretical flow).
2. Multiply ending engine RPM by 0.66 and divide the result by 231. This is the theoretical flow for PMP1 at that speed. Plot this point on the graph and mark it ETF (ending theoretical flow).
3. Draw a straight line to connect points BTF and ETF. This is the "theoretical line."

An example worksheet is provided on page 6-57.

Pump PMP1 is a gear pump, so its expected flow at working pressure is 80% of its theoretical flow.

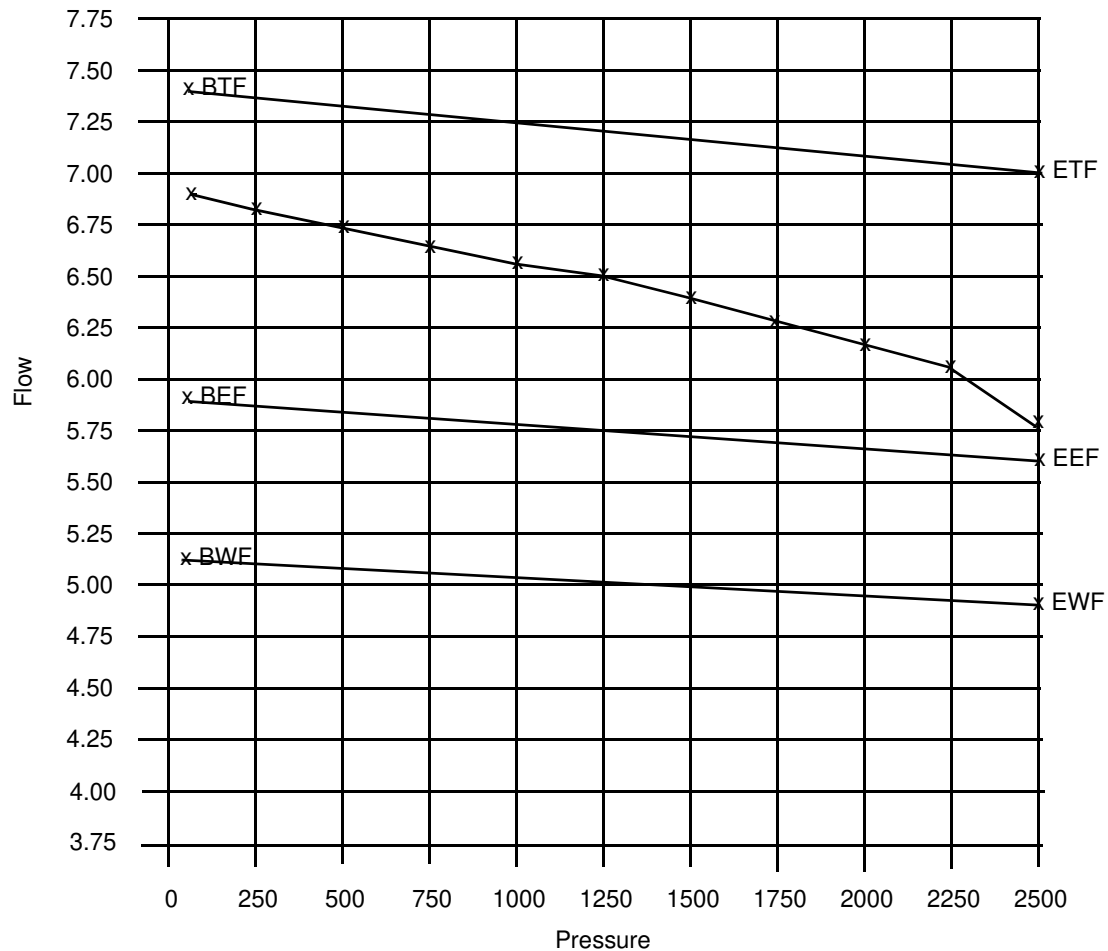
4. Multiply BTF value by 0.80. Plot this point on the graph and mark it BEF (beginning expected flow).
5. Multiply ETF value by 0.80. Plot this point on the graph and mark it EEF (ending expected flow).
6. Draw a straight line to connect points BEF and EEF. This is the "expected line."

A pump is considered worn beyond its useful life when it produces only 70% of its theoretical flow against working pressure.

7. Multiply BTF value by 0.70. Plot this point on the graph and mark it BWF (beginning worn-out flow).
8. Multiply ETF value by 0.70. Plot this point on the graph and mark it EWF (ending worn-out flow). This is the "worn-out line."
9. Join data points plotted on the graph during the test. Examine the path of the plotted line and the worn-out line.

If the plotted line extends below the expected line, but is above the worn-out line, the pump is wearing, but has useful life remaining. If it comes within 0.25 gpm of the worn-out line, advise the owner/operator that he have the pump re-tested during the next "off-season" to assess whether to replace it then, rather than have it fail during an upcoming busy season.

If the plotted line leads below the worn-out line, the pump is worn beyond limits now and needs to be replaced.

Example Worksheet For testing pump flow and flow divider for BC1230A.Beginning Engine RPM: 2568 rpmBeginning Indicated Pressure: 50 psiBeginning Indicated Flow: 5.21 gpmEnding Engine RPM: 2450 rpmEnding Indicated Pressure: 2500 psiEnding Indicated Flow: 4.02 gpmBeginning theoretical flow (BTF): 7.34BEF (BTF X 0.80): 5.87BWF (BTF X 0.70): 5.14Ending theoretical flow (ETF): 7.00EEF (ETF X 0.80): 5.60EWF (ETF X 0.70): 4.90Indicated pressure when flow drops dramatically: 2775 psiFlow at 1/3 speed mark at 500 psi: 5.2 gpmFlow at SLOW speed at 500 psi: 1 gpmFlow at 1/3 speed mark at 1500 psi: 5.1 gpmFlow at SLOW speed at 1500 psi: 1 gpm

Testing Components of Feed Roller Manifold A2

Testing DV1 for Internal Leakage

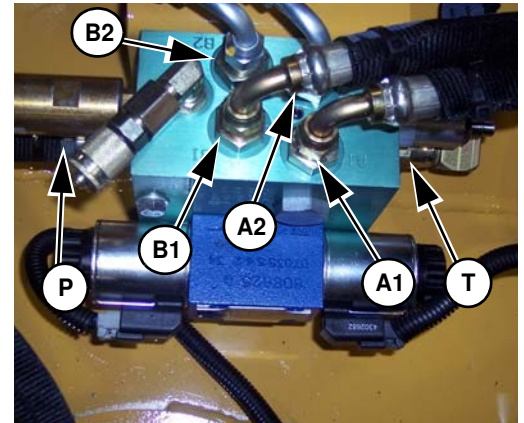
Since the spool of the directional control valve must be able to slide back and forth in the bore, there are internal clearances. When under pressure, these clearances allow some leakage from the high pressure side to the low pressure side of the lands on the spool. If contaminants in the fluid are approximately the same size as the clearances, they will be trapped in the clearances, and motion of the spool will cause abrasion, which increases the clearances and the internal leakage.

This test determines if the internal leakage in the spool is excessive and whether the valve DV1 needs to be replaced. It is also used to verify the setting of the crossover relief valve PV1

Equipment needed:

- porta-power equipped with a pressure gauge for minimum 3000 psi (207 bar) with adapter to connect to port B2 of directional control manifold A2.
- plugs needed to plug ports P, T, both of the A ports and one of the B ports of manifold A2 - refer to parts book for plug sizes
- containers to catch oil from hoses, towels to wipe up dripped oil.

The engine remains shut down throughout this test.



1. Locate manifold A2.
2. Remove hoses from ports P and T. Leave them open for the first part of the test.
3. Remove hoses from both B ports and plug one of them.
4. Remove hoses from both A ports and plug one of them.
5. Connect porta-power to the unplugged B port.

Continued on next page...

6. Open valve on porta-power and watch pressure gauge and the open ports as you stroke the handle. Pump until the pressure reaches 2800 psi. At 2800 psi (193 bar), count to five while watching the pressure gauge. Note the pressure at the end of the five count.

Expected result: Pressure will reach 2800 psi (193 bar). A little fluid will seep from the open ports. As soon as pumping stops, pressure decreases, rapidly at first, then slower. Pressure is at least 200 psi (13.8 bar) at the end of the five count. If so, cross-port leakage in DV1 appears to be acceptable. Continue at step 7.

If the amount of fluid emitting from the open ports could better be described as a stream, but you can pump the valve up to 2800 psi (193 bar), the valve may be leaking excessively. If the motors are stalling once the fluid becomes warm, this may be the cause. Check the setting of PV1 (step 7) before deciding to replace this valve.

If the fluid leaks through so quickly you cannot pump the valve up to 2800 psi (193 bar) with the porta-power, replace valve DV1. See page [6-77](#).

7. Open valve on the porta-power to relieve the pressure trapped in the valve. Remove plug from one of the A ports. Install plugs in ports P and T.
8. Close valve on the porta-power and stroke the pump handle steadily. Observe pressure gauge.

Expected result: Pressure will rise steadily to the cracking pressure of the crossover relief valve PV1, at which point the valve will vent off a little pressure, and fluid will emit from the open A port. The cracking pressure will be at least 2800 psi (193 bar), and no higher than 2875 psi (198 bar).

If so, PV1 appears properly adjusted for when the motors are turning in the forward feed direction. Continue below to check the valve for the reverse feed direction.

If not, the valve may be out of adjustment, or faulty. Continue below.

9. Open valve on porta-power to relieve pressure trapped in the valve. Disconnect porta-power from the B port and connect it to the A port.

Continued on next page...

10. Close valve on the porta-power and stroke pump handle steadily. Observe pressure gauge.

Expected result: Again pressure will rise steadily to a cracking pressure within 80 psi of that observed in step 8. That pressure will be from 2800 to 2875 psi.

If so, PV1 appears to be in good condition, and properly set.

If the cracking pressure in this step is within 80 psi (5.5 bar) of that seen in step 8, but it is not in the range of 2800 to 2875 (193–198 bar), the valve needs to be adjusted. See page [6-64](#).

If the cracking pressure in this step is more than 80 psi (5.5 bar) from that seen in step 8, the valve appears to be faulty. Replace PV1. See page [6-78](#).

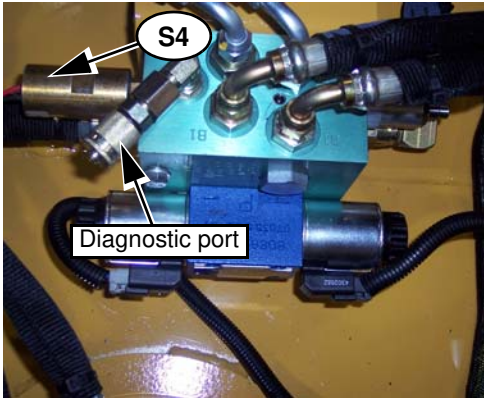
Testing PV1

Equipment needed:

- 5000 psi pressure test gauge
- piece of lumber 4 x 4" (10 x 10 cm) or larger, at least 7 feet (2 m) long
- log chain 12 feet (3.5 m) long or longer
- paper and pencil for making notes
- short section (2 to 3 inches) of wire for jumper (for turbo engines only)

IMPORTANT: This test is conducted with the clutch disengaged and the throttle set to HIGH (full throttle). On turbo models, clutch switch S3 must be closed (clutch engaged) before throttle switch S2 can be set to HIGH. Since this test must be conducted with the clutch disengaged, you will need to bypass the switch. To do this, unplug the switch from the harness and insert a short jumper wire into the sockets on the harness plug that are connected to the blue and tan wires.

1. Locate directional control manifold A2 and disconnect hydraulic over-pressure switch S4 from the harness.
2. With engine shut down, connect 5000 psi (345 bar) pressure test gauge to the diagnostic port on A2.
3. Start engine and throttle up to full speed (do not engage clutch). Reset system by moving upper feed control bar fully FORWARD.



Ensure feed roller speed control handle is in the HIGH SPEED position.

4. Prepare a small chart similar to the table below, or photocopy the page and note pressures on the photocopy.

	Indicated pressure while feed control bar held to:		
	FORWARD	NEUTRAL	REVERSE
Free to Turn			
Jammed			

5. On the Free to Turn line, observe and note the pressure indicated while upper feed bar is held in FORWARD, NEUTRAL and REVERSE/RESET while there is no material being fed into the machine. (Feed rollers can turn freely.)

Continued on next page...

6. Shift feed control bar to FORWARD and feed in the piece of lumber. The feed rollers will shove it up to the stationary cutter disc and the feed rollers will jam. Note the indicated pressure on the Jammed line, under FORWARD.
7. Shift control to NEUTRAL. Attach one end of the log chain to the trailer tongue. Run chain under the machine and use the other end to restrain the lumber from being pushed back out of the rollers.
8. Shift feed control bar to REVERSE. When the chain is taut and the rollers jam, note the indicated pressure on the jammed line, under REVERSE.
9. Shut down machine, remove chain and lumber. Analyze the results as discussed below.

After taking any needed corrective action, remove test gauge. On turbo models, remove jumper wire and reconnect clutch switch S3 to harness.

**Analyzing Test
Results of Manifold
A2 Components**

On a normally operating machine, pressures indicated in the Free to Turn line will be:

- lowest for NEUTRAL
- slightly higher for FORWARD and REVERSE than NEUTRAL, but almost identical to each other

If the motors did not turn in either forward, or in reverse, or both, *and the pressure indicated for the non-turning direction matches the neutral pressure*, valve DV1 may not be shifting in that direction. DV1 could fail because:

- Dirt or debris between the spool and the bore may cause it to “stick” and the coil is not strong enough to shift it.
- The coil used to shift it that direction is faulty. Try switching the coils. If the problem switches to the other direction, replace the faulty coil. If not, the valve appears to be sticking.

If the motors did not turn in one direction, *and the pressure indicated in the non-turning direction was a little higher than NEUTRAL, but not as high as the working direction*, one port of the crossover relief valve may be relieving at too low a pressure. Data supplied in the Jammed line can verify this diagnosis.

On a normally operating machine, pressures indicated in the Jammed line will be:

- FORWARD—2800 psi, ± 100 psi (193 bar ± 7 bar)
- REVERSE—same as for FORWARD, ± 150 psi (7 bar)
- NEUTRAL—same as for NEUTRAL in the Free to Turn line

If the values for FORWARD and REVERSE are more than 150 psi (10 bar) apart, relief valve PV1 is apparently faulty.

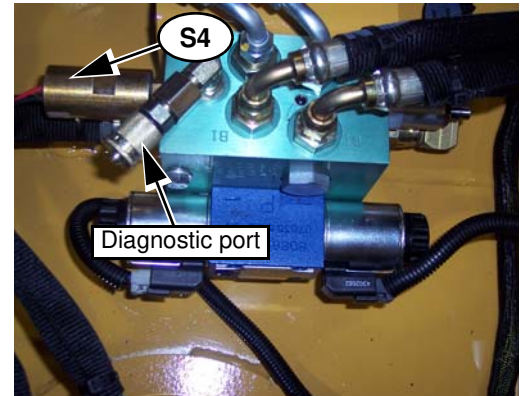
If the motors will turn forward, but not in reverse (or vice versa) and the values for FORWARD and REVERSE are dramatically different, replace PV1 instead of replacing DV1.

If the values for FORWARD and REVERSE are within 150 psi (10 bar) of each other, but not within 100 psi of 2800 psi (within 7 bar of 193 bar), adjust PV1 as discussed on page [6-64](#).

Adjusting PV1

IMPORTANT: Adjusting PV1 is done with the clutch disengaged and the throttle set to HIGH (full throttle). On turbo models, clutch switch S3 must be closed (clutch engaged) before throttle switch S2 can be set to HIGH. Since this test must be conducted with the clutch disengaged, you will need to bypass the switch. To do this, unplug switch from the harness and insert a short jumper wire into the sockets on the harness plug that are connected to the blue and tan wires.

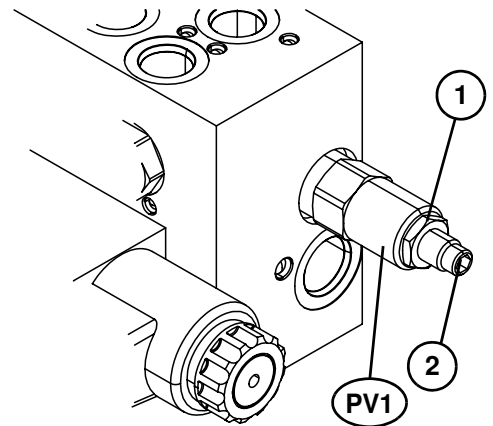
1. Locate directional control manifold A2 and disconnect hydraulic over-pressure switch S4 from the harness.
2. With engine shut down, connect 5000 psi (345 bar) pressure test gauge to the diagnostic port on A2.



3. Loosen jam nut (1).
4. Start engine and throttle up to full speed (do not engage clutch). Reset system by moving upper feed control bar fully forward to the REVERSE/RESET position.

Ensure feed roller speed control handle is in the HIGH SPEED position.

5. Put upper feed bar into the FORWARD detent. Feed in a 4 x4" piece of lumber. The feed rollers will shove it up to the stationary cutter disc and the feed rollers will jam.
6. Observe pressure gauge. Using an Allen wrench, turn hex screw (2) clockwise to increase pressure, or counterclockwise to decrease pressure. Adjust it to 2800 psi (193 bar). Tighten jam nut.
7. Shut down. If no further adjustments or work is required:
 - Remove lumber.
 - Remove test gauge.
 - Remove jumper wire and reconnect clutch switch to harness (turbo engine only).



One Motor Slower Than the Other

If this is suspected, first determine how much difference in speed there is.

1. Use pieces of black tape to mark both rollers with corresponding marks on the floor of the infeed table.
2. Start them turning forward and count 20 turns and stop.

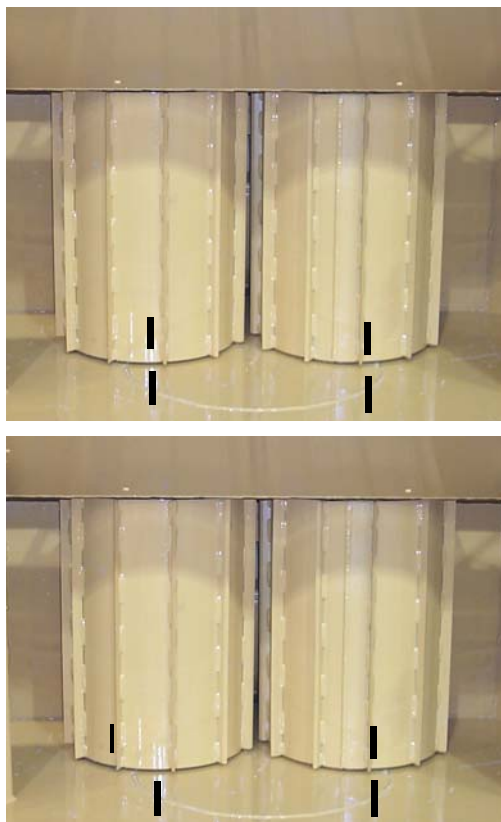
Expected result: On new machines, it is normal for the mark on one roller to be one quarter revolution ahead or behind the other roller after 20 revolutions.

If one roller is one half a revolution or more ahead of the other, do the following:

1. Look for sources of drag on the slower roller.
 - Inspect for material wrapped around shaft.
 - Remove hoses and turn by hand. Listen for bad bearings.
2. Look for evidence of higher internal leakage. Starting with a machine that has cooled for at least 4 hours, start and operate the machine in normal use. Every ten minutes, feel the motor cases.

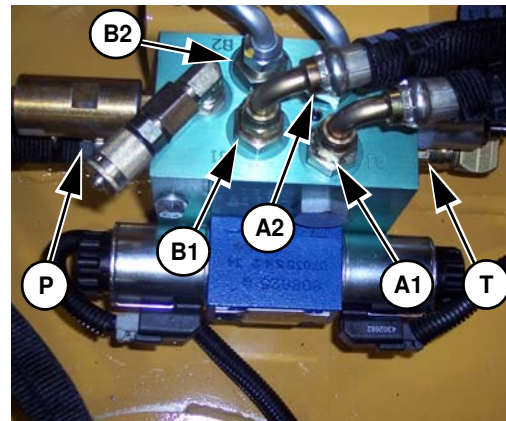
Expected result: Motor cases will warm up at about the same rate.

If one case heats quickly compared to the other, it suggests that it is leaking more through its internal clearances than the other.



Continued on next page...

3. At manifold A2, reverse the hoses coming from the motors to the manifold to see if the other motor now becomes the slow motor.
4. Do the following:
 - Disconnect hose from A1 port and connect it to A2 port.
 - Connect remaining hose to A1 port.
 - Operate feed rollers in forward direction for 20 revolutions and refer to tape marks.



Expected result: Opposite motor is now the slower motor. If so, replace flow combiner divider valve FV2 in A2. See page [6-78](#).

If not, conduct a leakage test on both motors. See "[Feed Roller Motor Leakage Test](#)," page [6-67](#).

IMPORTANT: Return hoses to their original locations before conducting further tests, or making repairs.

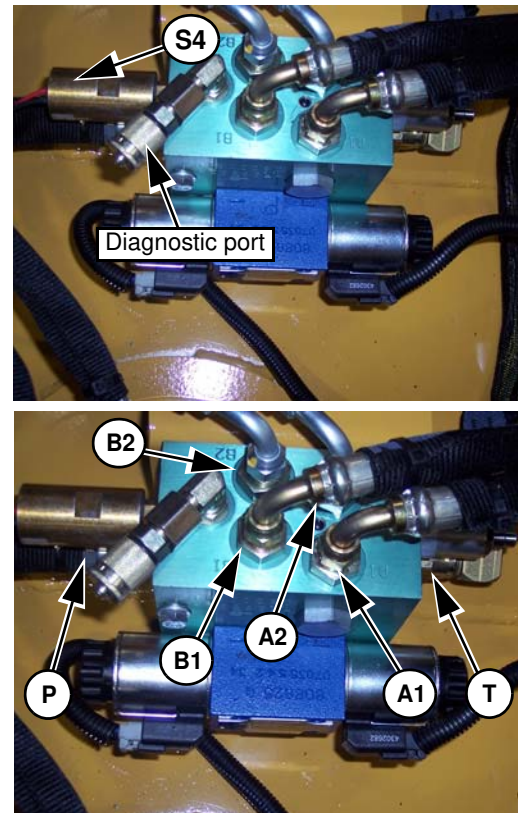
Feed Roller Motor Leakage Test

Equipment needed:

- 5 gpm flow meter—1 at minimum, 2 preferred
- 5000 psi pressure test gauge
- 4 x 4" (10 x 10 cm) or similar sized piece of lumber
- calculator
- pen and paper for recording pressures and flows
- 2 to 3" (5–7.5 cm) section of wire for jumper

IMPORTANT: This test is done with the clutch disengaged and the throttle set to HIGH (full throttle). On turbo models, clutch switch S3 must be closed (clutch engaged) before throttle switch S2 can be set to HIGH. Since this test must be conducted with the clutch disengaged, you will need to bypass the switch. To do this, unplug the switch from the harness and insert a short jumper wire into the sockets on the harness plug that are connected to the blue and tan wires.

1. Locate directional control manifold A2 and disconnect hydraulic over-pressure switch S4 from the harness.
2. With engine shut down, connect 5000 psi (345 bar) pressure test gauge to the diagnostic port on A2.
3. At the right feed roller motor MH2, disconnect hose leading from port B1 of manifold A2 and connect a 5 gpm flow meter with the flow arrow pointed to the motor. Connect a hose from the outlet of the flow meter to the right feed roller motor MH2.
4. If only one 5 gpm flow meter is available, continue below at step 5.



If another 5 gpm flow meter is available, disconnect hose leading from B2 of A2 to the left feed roller motor MH1, and connect flow meter in series to the motor, with the flow arrow pointed to the motor.

Continued on next page...

5. Ensure feed roller speed control handle on manifold A3 is in the HIGH position.

IMPORTANT: If the flow meter is equipped with a needle valve, ensure needle valve is fully open throughout this test.

6. Start engine and throttle up to full speed (do not engage clutch). Reset system by moving upper feed control bar fully forward to the REVERSE/RESET position.
7. Pull upper feed control bar back to the FORWARD position. Inspect connections for leaks. If found, shut down and tighten connections to eliminate leakage.
8. Observe and record flow on the flow meter(s) when the rollers are turning freely. Observe and record pressure indicated on the pressure gauge.
9. Stall motors by inserting a 4 x 4 between the rollers. It will hit the stationary cutter drum and stop, stalling the feed roller motors
10. With the motors stalled, observe and record the flow indicated on the meter(s). Observe and record pressure indicated on the pressure gauge.
11. Shut down engine. Remove 4 x 4 from between the rollers.

If the test was conducted with 2 flow meters, continue below at *"Analyzing the Results of Feed Roller Motor Leakage Test,"* page 6-69.

If only one flow meter was used, remove from MH2, and connect it as described in step 4, and repeat steps 5 through 11. Then remove the test equipment and continue at *"Analyzing the Results of Feed Roller Motor Leakage Test,"* page 6-69.

Analyzing the Results of Feed Roller Motor Leakage Test

When the feed rollers are turning freely, pressure indicated will be low, and the combined flows to the motors will be high.

When the feed rollers are stalled, the pressure shown on the gauge indicates the current setting of the crossover relief valve PV1. This should be 2800 psi, ± 50 psi. If not, adjust the crossover relief valve PV1 as discussed on page 6-64 and repeat the test.

When the feed rollers are stalled, most of the pump flow will pass over the crossover relief to the tank. The flow indicated on the flow meters will be the amount leaking past the internal clearances of the motor.

Since these are gear motors, expected leakage is 20% of full flow leakage. As the motors wear, the internal clearances enlarge, and leakage increases. Eventually, leakage becomes too great and the motor cannot efficiently perform the work intended. For gear motors, this occurs when leakage exceeds 30% of full flow.

A typical symptom of excessive internal leakage is that the feed rollers appear to operate well when the hydraulic fluid is cool, but that performance deteriorates as the fluid gets warm. Also, the fluid heats quickly as soon as the feed rollers are under load.

1. Refer to your notes to determine the flow for each motor when the rollers were turning freely.
2. Multiply this value by 0.30.
3. Compare result with the flow for the motor when it was stalled.
 - If the stalled flow was higher than the result, this motor should be replaced. (See page 6-72.)
 - If the stalled flow was less than the result, the motor appears to have useful life remaining.

FEED ROLLER AND SMARTFEED COMPONENT REPAIR

Releasing Hydraulic Pressure



WARNING: Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible. Keep away from any suspected leak. Relieve pressure in the hydraulic system before searching for leaks, disconnecting hoses, or performing any other work on the system. If you must pressurize the system to find a suspected leak, use an object such as a piece of wood or cardboard rather than your hands. When loosening a fitting where some residual pressure may exist, slowly loosen the fitting until oil begins to leak. Wait for leaking to stop before disconnecting the fitting. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Before servicing hydraulically operated items, take the following precautions:

Relieve all hydraulic system pressure before disconnecting lines, or performing other work. Ensure all connections are tight, and that hoses and lines are in good condition before applying pressure to the system.

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Loosen hose fitting to release any remaining line pressure BEFORE removing the hose.

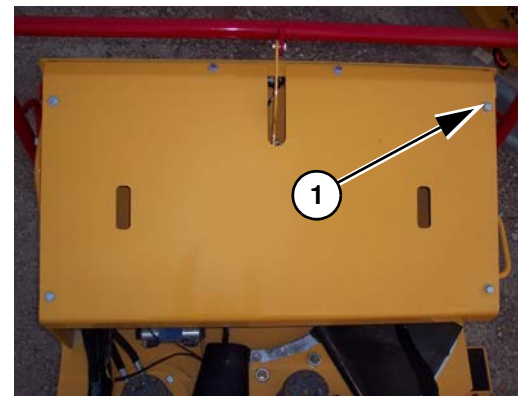
NOTE: Remove all lines as though there is hydraulic pressure in the line.

Removing the Detent Shields

Removing the detent shields allows access to the upper feed roller control bar switches, reset/hold-to-run switches, flow divider manifold A3, sensitivity relay K4, and sensitivity selector switch S12.

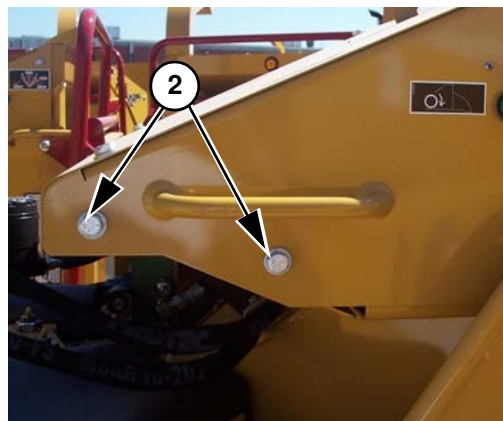
To remove the shields:

1. Remove six bolts and washers (1) from upper shield.
2. Remove upper shield.



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3. Remove two bolts and washers (2) from left side of machine (shown) and single bolt and washer from right side of machine.
4. Remove lower shield.

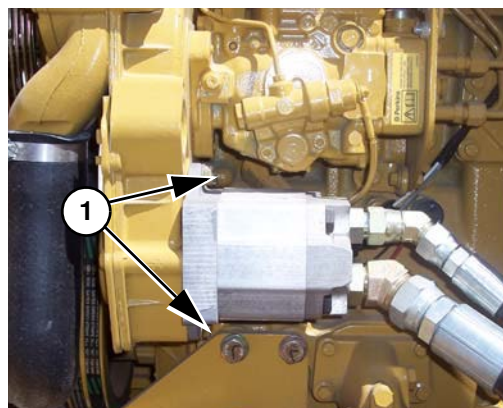


Remove/Replace Hydraulic Pump PMP1

Removing Hydraulic Pump PMP1

The pump requires no special maintenance. If the hydraulic system is losing power, the pump may not be receiving enough hydraulic fluid or it may be worn. Before checking system pressure or replacing the pump, refer to *"Hydraulic System Troubleshooting,"* page 6-50, for possible problems.

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Open engine cover to access pump.
3. Label hoses on pump.
4. Refer to *"Releasing Hydraulic Pressure,"* page 6-70. Disconnect and cap hoses at fittings.
5. Plug ports on pump.
6. Remove bolts (1), washers, pump, and gasket.



Installing Hydraulic Pump PMP1

Reverse removal procedure to install pump.

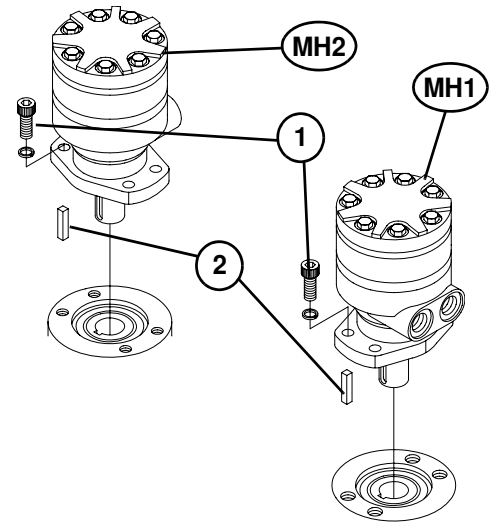
IMPORTANT: Install new gasket between engine block and pump when replacing pump.

Apply Loctite #242 or equivalent to bolt threads prior to installation. Torque bolts to 23 ft-lb (31 Nm).

Remove/Replace Feed Roller Motors MH1 and MH2

Removing Feed Roller Motors MH1 and MH2

1. Follow *"Shutdown Procedure,"* page [2-1](#).
2. Clean motor, hoses, and surrounding area.
3. Refer to *"Releasing Hydraulic Pressure,"* page [6-70](#).
4. Label and disconnect hoses from motors. Cap hoses and plug fittings.
5. Remove bolts (1) and washers.
6. Slide motor out of roller shaft and remove key (2).



Installing Feed Roller Motors MH1 and MH2

Reverse removal procedures to install motor.

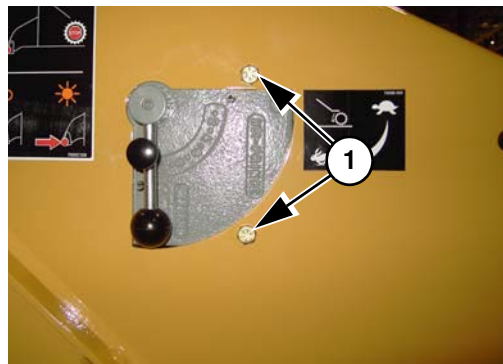
- Apply anti-seize compound to hydraulic motor shaft before installing.
- Apply Loctite #271 to threads and torque hydraulic motor bolts (1) to 60 ft-lb (81 Nm).
- Remove fittings from old motor, oil the threads and install fittings in new motor. Torque all fittings to 46 ft-lb (62 Nm). Torque hoses to 18 ft-lb (24 Nm).

Remove/Replace Flow Divider Manifold A3

The flow divider manifold A3 can be replaced as a complete unit or repaired with replaceable components.

Removing Manifold A3

1. Follow *"Shutdown Procedure,"* page **2-1**.
2. Refer to *"Releasing Hydraulic Pressure,"* page **6-70**.
3. Remove upper detent shield as described in *"Removing the Detent Shields,"* page **6-70**.
4. Label hoses to aid reassembly. Cap hoses and plug fittings.
5. Remove two bolts (1) holding the manifold to frame.
6. Place new manifold in a vise. Remove fittings from old manifold, oil the threads and install fittings in new manifold. Torque all fittings to 21 ft-lb (28 Nm).



Installing Manifold A3

Reverse removal procedure to install new valve.

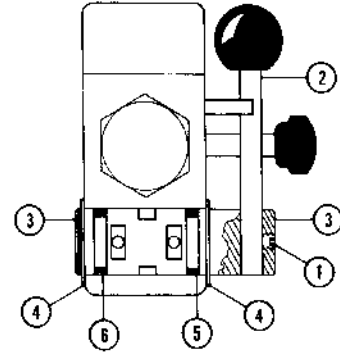
- Torque mounting bolts (2) to 10 ft-lb (14 Nm).
- Connect hoses and torque as follows:
 - hose at P port—48 ft-lb (65 Nm)
 - all other hoses—40 ft-lb (54 Nm)

For information on manifold component replacement, see the following page.

**Rebuilding Manifold
A3**

IMPORTANT: If fittings are removed from valve, inspect O-rings and replace if necessary. Apply a light coating of oil to O-rings before installing.

1. Loosen set screw (1) and remove control handle (2).
2. Clean all dirt and paint from ends of spool (3).
3. Remove snap rings (4) on each end of spool.
4. Push spool out toward control handle side far enough to expose O-ring (5). Remove O-ring and replace it with a new one.



NOTE: Do not rotate the spool during servicing. It will not function properly when installed.

5. Lubricate new O-ring with oil and carefully slide spool back into housing just far enough to expose O-ring (6). Remove this O-ring and install a new one.
6. Lubricate new O-ring and push spool back to the normal position.
7. Install snap rings (4).
8. Install control handle (2) and tighten set screw (1).
9. Install and check for normal operation.

Remove/Replace Directional Control Manifold A2

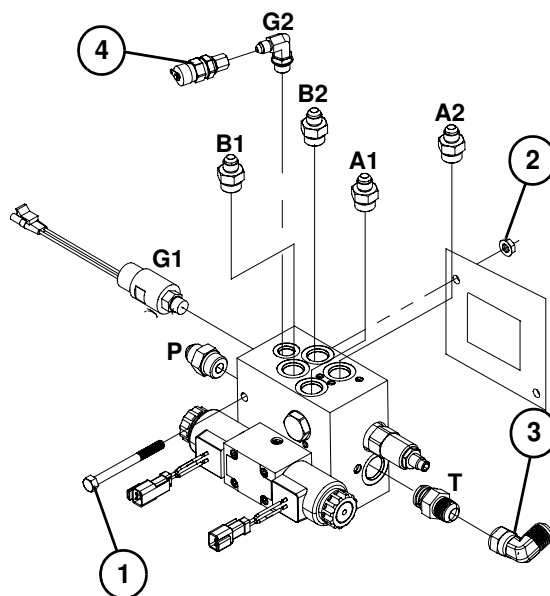
The directional control manifold can be replaced as a complete unit or repaired with replacement components.

Removing Manifold A2

To remove the complete unit:

1. Follow *"Shutdown Procedure,"* page **2-1**.
2. Refer to *"Releasing Hydraulic Pressure,"* page **6-70**.
3. Label hoses to aid reassembly. Plug the hoses and cap the fittings.
4. Remove two bolts (1) and two nuts (2) securing manifold A2 to the frame.
5. Place new manifold in a vise. Remove fittings from old manifold, oil the threads and install fittings in new manifold. Torque fittings as follows:

- Ports P & T fittings—36 ft-lb (49 Nm)
- Ports A1, A2, B1, B2 fittings—30 ft-lb (41 Nm)
- Port G1 switch—18 ft-lb (20 Nm)
- Port G2 fitting—21 ft-lb (20 Nm)
- Fitting (3)—40 ft-lb (54 Nm)
- Diagnostic Fitting (4)—18 ft-lb (20 Nm)

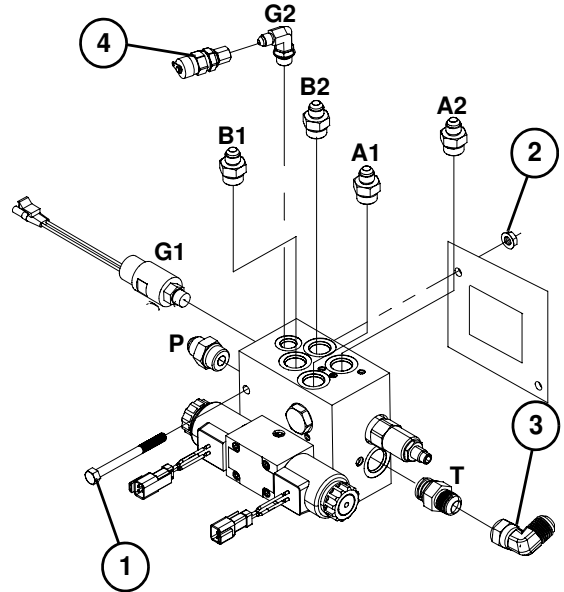


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Installing Manifold A2

Reverse removal procedure to install new valve.

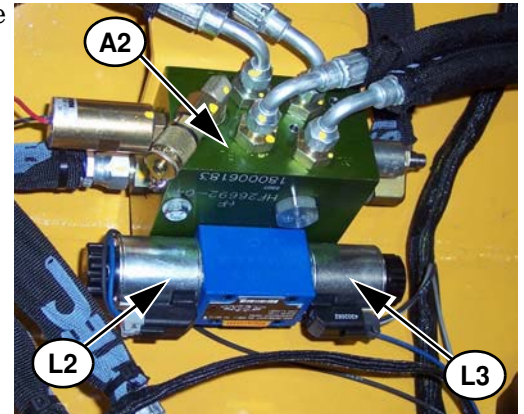
- Torque mounting bolts (1) to 20 ft-lb (27 Nm).
- Connect hoses and torque as follows:
 - hoses at ports A1, A2, B1, B2—18 ft-lb (24 Nm)
 - hose at port P—30 ft-lb (41 Nm)
 - hose at fitting (3)—40 ft-lb (54 Nm)



Remove/Replace Solenoids L2 and L3

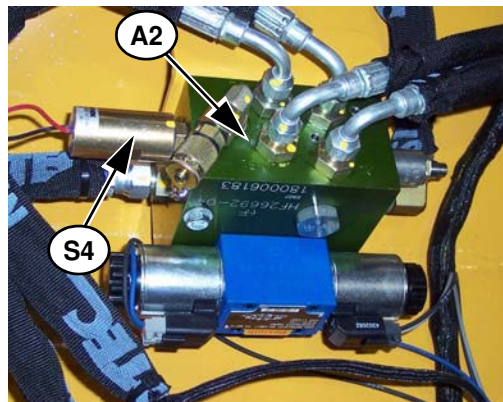
If replacing both, replace one at a time to avoid connecting them to the wrong harness connectors.

1. Disconnect solenoid from the harness.
2. Unscrew plastic retaining nut.
3. Slide solenoid off its cartridge. Watch for the O-ring while removing solenoid.
4. Slide new solenoid in place and install O-ring.
5. Screw on plastic retaining nut.
6. Connect solenoid to the harness.

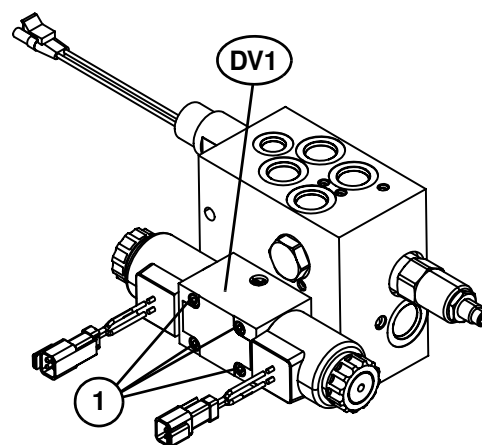


Remove/Replace Hydraulic Over-Pressure Switch S4

1. Disconnect switch S4 from the harness.
2. Refer to *"Releasing Hydraulic Pressure,"* page 6-70.
3. Screw out old switch.
4. Screw in new switch and torque to 18 ft-lb (20 Nm).
5. Connect new switch to harness.

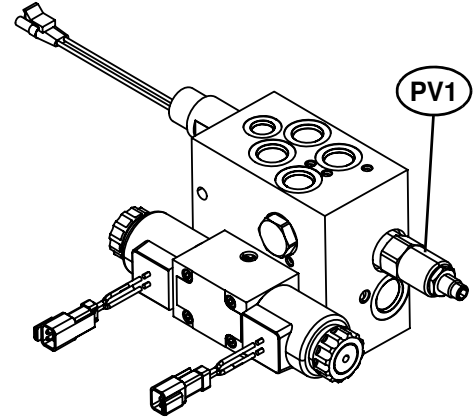
**Remove/Replace Valve DV1**

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Remove solenoids L2 and L3.
3. Refer to *"Releasing Hydraulic Pressure,"* page 6-70.
4. Remove four screws (1) holding valve to the manifold. Remove valve. Observe location of the four O-rings.
5. Apply a light coating of oil to new O-rings and install new O-rings.
6. Install four screws to hold valve to the manifold and torque them to 65 in-lb (7.3 Nm).
7. Install solenoids.

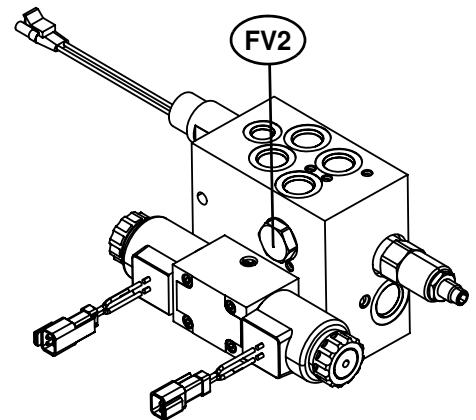


**Remove/Replace
Pressure Relief
Valve Cartridge PV1**

1. Follow "*Shutdown Procedure*," page **2-1**.
2. Refer to "*Releasing Hydraulic Pressure*," page **6-70**.
3. Unscrew cartridge. Observe location of O-rings and backup rings.
4. Apply a light coat of oil to new O-rings and backup rings and install them on new cartridge.
5. Screw new cartridge into manifold and torque to 20 ft-lb (27 Nm).

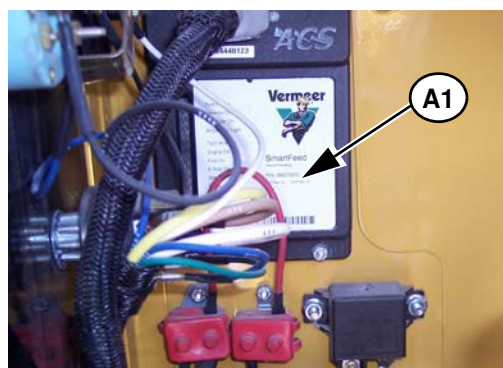
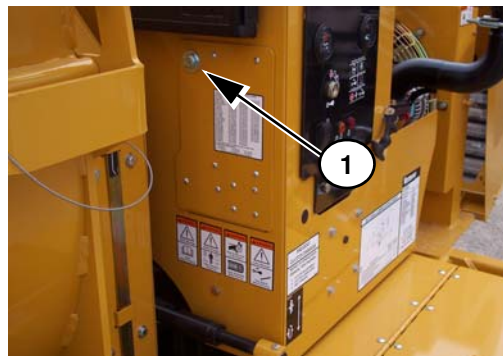
**Remove/Replace
Cartridge FV2**

1. Follow "*Shutdown Procedure*," page **2-1**.
2. Refer to "*Releasing Hydraulic Pressure*," page **6-70**.
3. Unscrew cartridge. Observe location of O-rings and backup rings.
4. Apply a light coat of oil to new O-rings and backup rings and install them on new cartridge.
5. Screw new cartridge into manifold and torque to 25 ft-lb (34 Nm).



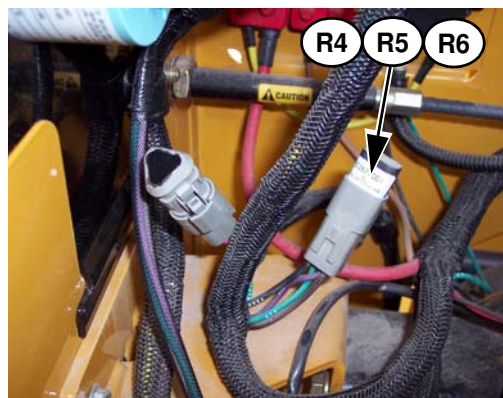
Replace SmartFeed Controller A1

1. Remove bolt (1) to open access panel on rear engine shield.
2. Disconnect controller from harness.
3. Remove nuts from two stove bolts that fasten controller to access panel.
4. Install new controller and connect it to harness.
5. Reinstall access panel.



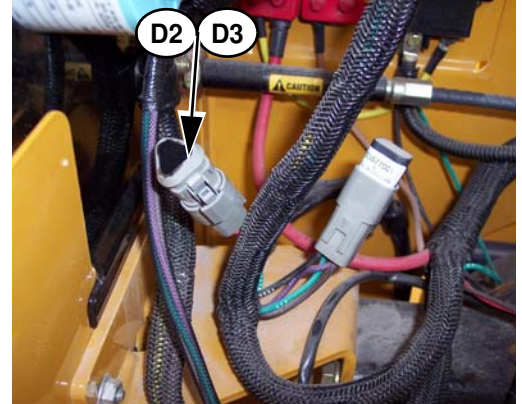
Replace Resistor Pack for R4, R5 and R6

This resistor pack simply unplugs from the harness like any other Deutsch connector on the harness. Remove the old pack, install the new pack.



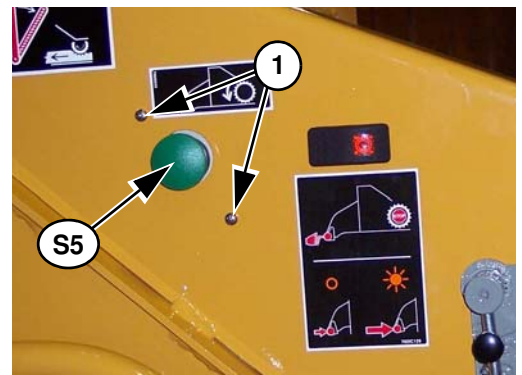
Replace Diode Pak for D3 and D4

This diode pak simply unplugs from the harness like any other Deutsch connector on the harness. Remove the old block, install the new block.



Replace Reset/Hold-to-Run Switches S5 and S6

1. Remove upper detent shield as described in *"Removing the Detent Shields,"* page 6-70.
2. Unplug switch S5 or S6 from the harness.
3. Remove two screws (1).
4. Reverse instructions above to install new switch.



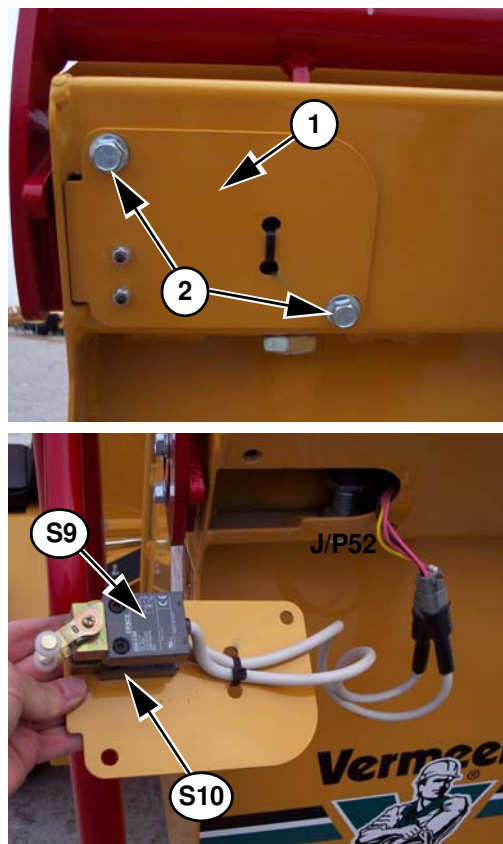
Replace Amber Information Light DS1

1. Remove upper detent shield as described in *"Removing the Detent Shields,"* page 6-70.
2. Unplug bulb from the harness.
3. From inside the compartment, push out on bulb and lens to pop them out of the rubber grommet.
4. Reverse steps above to install new bulb/lens.



Replace Lower Feed Stop Bar Switches S9 and S10

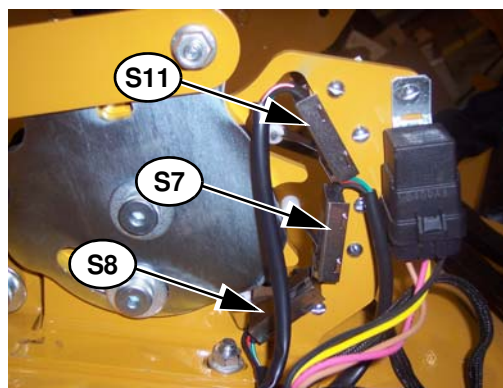
1. Fold up tailgate.
2. Remove two bolts (2) to remove mounting panel (1) for the switches.
3. Pull out harness and disconnect switch.
4. Clip ny-tie. Remove nuts and bolts to separate switches from panel.
5. Reverse steps above to install new switch.



Replace Feed Control Bar Switches S7, S8, and S11

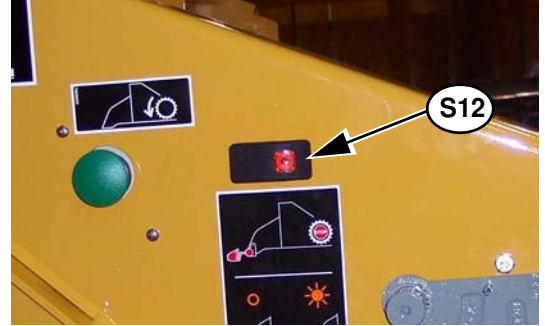
NOTE: If replacing more than one switch, replace them one at a time to avoid connecting a switch to the wrong harness connector.

1. Remove upper detent shield as described in *"Removing the Detent Shields,"* page 6-70.
2. Unplug switch from harness.
3. Remove nuts from the two stove bolts that hold the switch to the cam mount.
4. Reverse steps above to install.



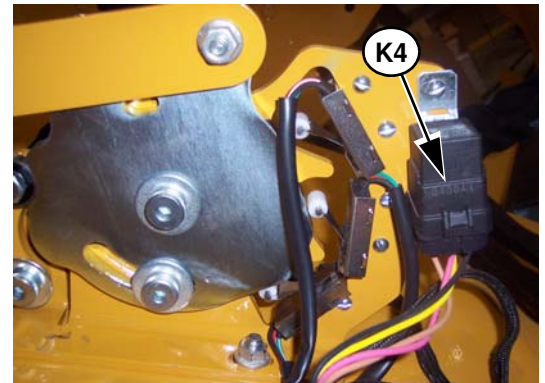
Replace Sensitivity Selector Switch S12

1. Remove upper detent shield as described in *"Removing the Detent Shields,"* page 6-70.
2. Unplug harness connector from sensitivity switch.
3. Compare new switch with old switch and mark the top of the case of the new switch.
4. Note plastic "ears" on the case of the switch. Use a screwdriver blade or other method to force the ears down against the case of the switch and work the switch outward through the compartment wall.
5. With the marked side up, push new switch through the cutout in the wall until the ears pop up and retain the switch.
6. Plug connector into the new switch.



Replace Sensitivity Relay K4

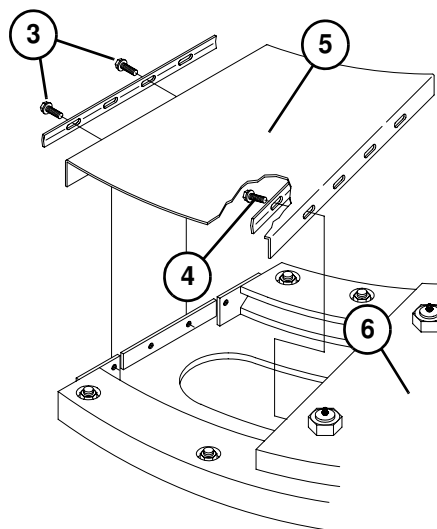
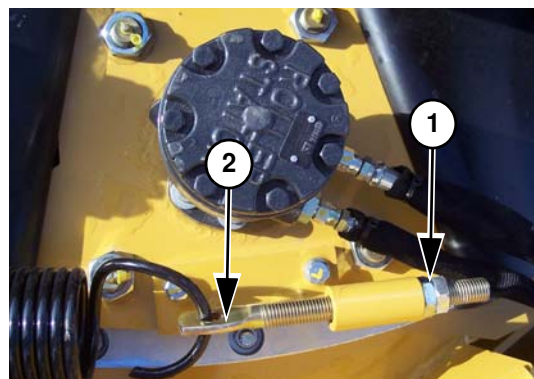
1. Remove upper detent shield as described in *"Removing the Detent Shields,"* page 6-70.
2. Unplug relay from the harness.
3. Remove stove bolt and nut (1) and remove relay.
4. Reverse steps above to install new relay.



Feed Roller Bearings

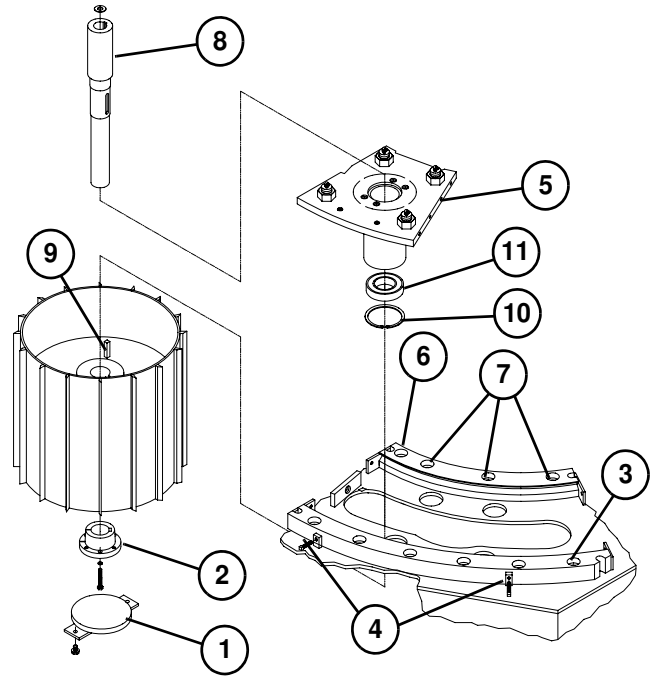
Removing Left Feed Roller Bearing

1. Follow *"Shutdown Procedure,"* page 2-1.
2. Loosen two jam nuts (1) enough to remove spring from spade bolt (2).
3. Remove feed roller motor MH1. See *"Remove/Replace Feed Roller Motors MH1 and MH2,"* page 6-72.
4. Lay motor to the side.
5. Remove four bolts (3) fastening the two rubber feed roller shields (5) to feed roller guides and four bolts (4) attaching the shield to the sides of feed roller motor mount (6).



Continued on next page...

6. Support feed roller by placing 1/4" (6 mm) spacers on the infeed floor beneath the feed roller.
7. From below the machine, remove two bolts securing access cover (1).
8. Remove hub (2) that attaches the shaft to the feed roller. This is a tapered hub. Remove all bolts from hub and thread them into the threaded holes. Evenly tighten the bolts to force apart the tapered hub from feed roller. Remove hub.

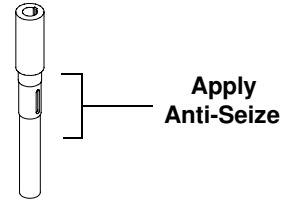


9. Loosen six nuts (3) securing long feed roller guide.
10. Loosen jam nuts (4) to allow guide to move away from feed roller motor mount (5).
11. Loosen nut (6), then remove three nuts and bolts (7) from short feed roller guide. Swing guide away from feed roller motor mount (5) to free mount from guides.
12. Use a suitable prying device to lift feed roller motor mount (5) and attached feed roller shaft (8) out of machine.
13. Remove key (9) and feed roller shaft (8) from motor mount (5). Remove snap ring (10), and feed roller bearing (11) from motor mount.

Installing Left Feed Roller Bearing

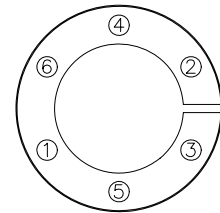
Reverse removal procedures to install.

1. Use hydraulic press to install feed roller bearing. Ensure bearing is being pressed on the outer race when installing.
2. Apply anti-seize compound to shaft in area shown and inside diameter of feed roller bearing.
3. Install key in shaft.
4. Install motor mount and shaft into feed roller, aligning key with slot in feed roller. Shaft should be recessed 1 1/4" (32 mm) below top surface of motor mount.
5. Install hub:
 - a. Ensure all contact surfaces are clean. Remove dirt, paint, metal chips, and lubricants.
 - b. Align the drilled holes in the hub with the tapped holes in the feed roller. Insert bolts and tighten 2 or 3 threads.



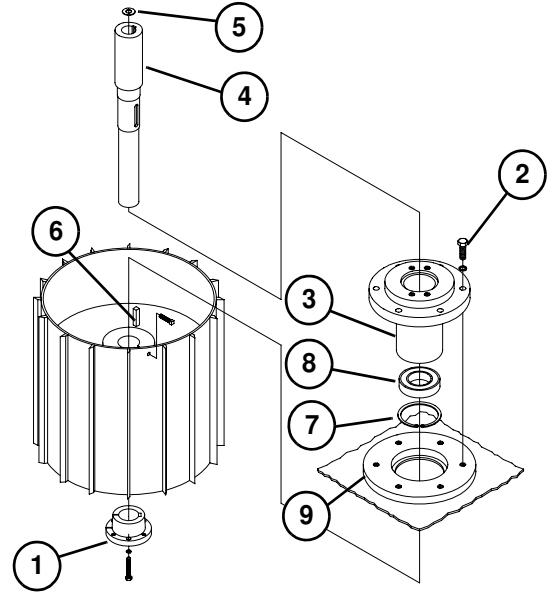
NOTE: Do not use lubricants during assembly. Lubricants can cause sheave breakage.

- c. Refer to the sequence diagram on the right and tighten bolts in small equal amounts until tapers are seated (at approximately half the recommended torque).
 - d. Alternately tighten bolts in small equal increments until 13 ft-lb (18 Nm) is achieved.
 - e. Install access cover and torque two bolts to 25 ft-lb (34 Nm).
6. Install three bolts in short feed roller guide and tighten all four nuts.
7. Ensure rollers on feed roller motor mount are centered in guide grooves and tighten six nuts on long feed roller guide so rollers have a maximum of .06" of clearance with guides. Tighten jam nuts to hold long guide in place.
8. Install rubber feed roller shields and tighten bolts to 13 ft-lb (18 Nm).
9. Remove 1/4" (6 mm) spacers on the infeed floor beneath the feed roller.
10. Install motor. Refer to *"Remove/Replace Feed Roller Motors MH1 and MH2,"* page 6-72.



Removing Right Feed Roller Bearing

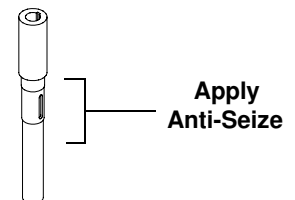
1. Follow *"Shutdown Procedure,"* page 2-1.
2. Remove feed roller motor MH2. Note direction that the holes for motor mount align with machine mounting plate (9). See *"Remove/Replace Feed Roller Motors MH1 and MH2,"* page 6-72.
3. Lay motor to the side.
4. Support feed roller by placing 1/4" (6 mm) spacers on infeed floor beneath the feed roller.
5. From below the machine, locate access opening to feed roller hub.
6. Remove hub (1) that attaches shaft to feed roller. This is a tapered hub. Remove all bolts from hub and thread them into threaded holes. Evenly tighten bolts to force apart the tapered hub from feed roller. Remove hub.
7. Remove six bolts (2) attaching feed roller motor mount (3) to machine mounting plate (9).
8. Use a suitable prying device to lift feed roller motor mount (3) and attached feed roller shaft (4) out of machine.
9. Remove two washers (5), key (6), and feed roller shaft (4) from motor mount (3). Remove snap ring (7), and feed roller bearing (8) from motor mount.



Installing Right Feed Roller Bearing

Reverse removal procedures to install.

1. Use hydraulic press to install feed roller bearing. Ensure bearing is being pressed on the outer race when installing.
2. Apply anti-seize compound to shaft in area shown and inside diameter of feed roller bearing.
3. Install key in shaft.

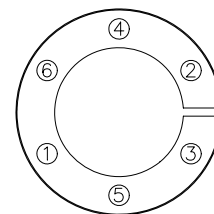


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4. Install motor mount and shaft into feed roller, aligning key with slot in feed roller and holes in motor mount with holes in machine mount. Insert a punch through matching holes in motor mount and machine mounting plate to ensure that the holes for attaching motor to motor mount are aligned correctly.
5. Hammer motor mount assembly into housing and shaft into feed roller. Shaft should be recessed 7/8" (22 mm) below top surface of motor mount.
6. Install two washers into end of shaft.
7. Install six bolts and washers in feed roller mount. Tighten in star pattern to 60 ft-lb (81 Nm).
8. Install hub:
 - a. Ensure all contact surfaces are clean. Remove dirt, paint, metal chips, and lubricants.
 - b. Align the drilled holes in the hub with the tapped holes in the feed roller. Insert bolts and tighten 2 or 3 threads.

NOTE: Do not use lubricants during assembly. Lubricants can cause sheave breakage.

- c. Refer to the sequence diagram on the right and tighten bolts in small equal amounts until tapers are seated (at approximately half the recommended torque).
 - d. Alternately tighten bolts in small equal increments until 13 ft-lb (18 Nm) is achieved.
9. Remove 1/4" (6 mm) spacers on the infeed floor beneath the feed roller.
10. Install motor. Refer to *"Remove/Replace Feed Roller Motors MH1 and MH2,"* page 6-72.



Adjust Upper Feed Control Bar Force

For instructions on adjusting the force needed to move the upper feed control bar, refer to the *BC1230A Brush Chipper Maintenance Manual*.

Adjust Lower Feed Stop Bar Switch

For instructions on adjusting the force needed to trip the lower feed stop bar switch, refer to the *BC1230A Brush Chipper Maintenance Manual*.

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Chapter 7: Trailer

OVERVIEW

This chapter contains information describing the function, location, and service procedures associated with the trailer electrical and brake systems. This consists of the electrical circuits and devices used to provide brakes to the trailer wheels, safety breakaway switch, and all the running light functions.

Circuits/Components

Circuits The circuits covered in this chapter include:

- Lights
- Brakes

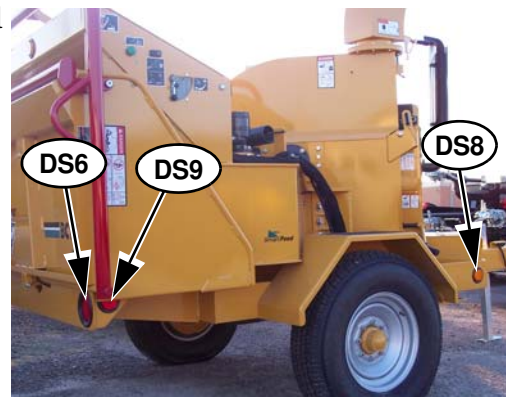
Components The components in these circuits include:

- Taillights DS5 and DS6
- License Plate Light DS7
- Marker Lights DS8 through DS12
- Breakaway Switch S14
- Brake Coils L6 and L7
- Brake Actuator CY1
- Brake Shoe Cylinders CY2 and CY3

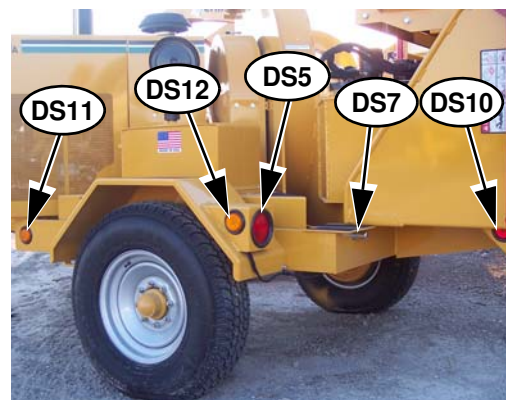
Component Locations

Lights

- Right Side Marker Lights DS8 and DS9
- Right Taillight DS6

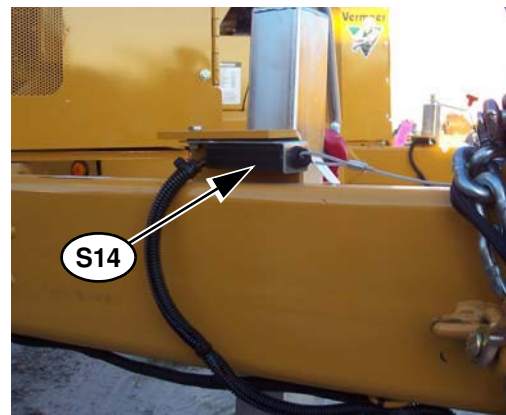


- Left Side Marker Lights DS10, DS11, and DS12
- Left Taillight DS6
- License Plate Light DS7

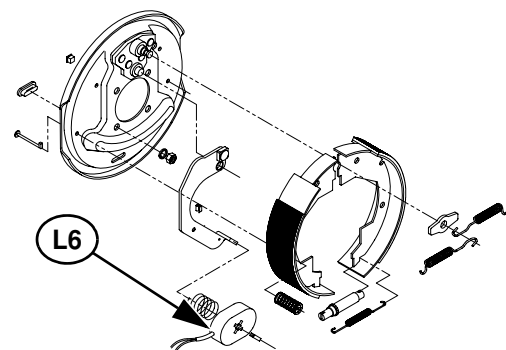


Brakes

- Breakaway Switch S14 for electric brakes

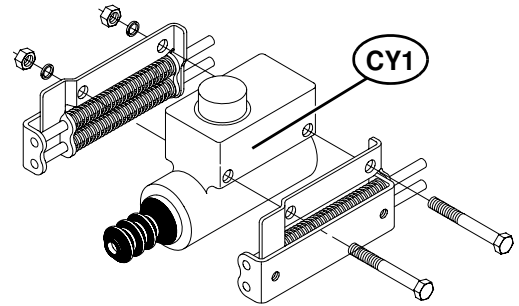


- Electric Brake Coil L6 for electric brakes (L7 is in opposite wheel)

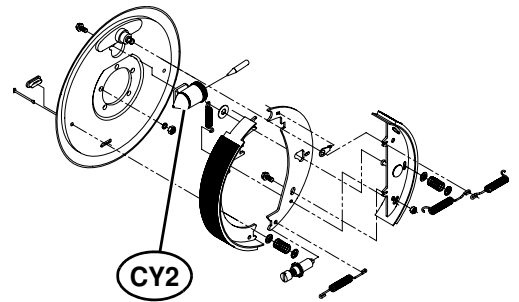


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- Brake Master Cylinder CY1 for hydraulic brakes

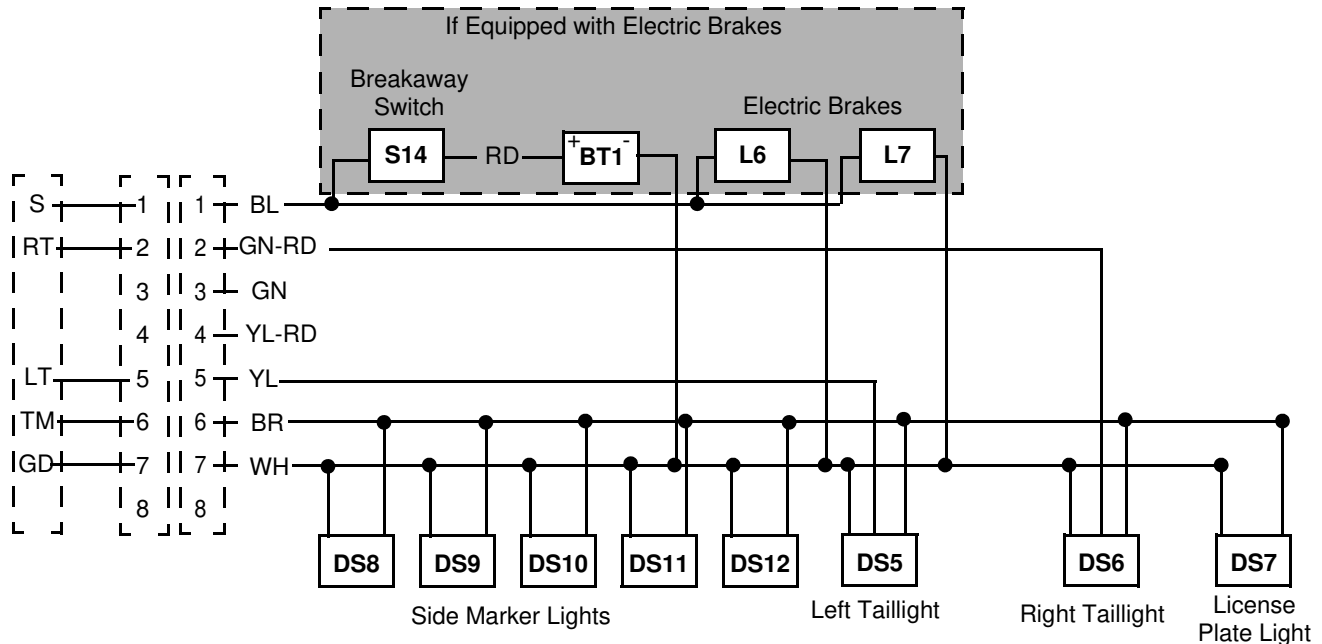


- Brake Shoe Cylinder CY2 for hydraulic brakes (CY3 is in opposite wheel)



LIGHTS

The machine has five side marker lights, a left taillight, a right taillight, and a license plate light.



Lights Troubleshooting

Each of the lights requires power from terminal TM (brown wire) and ground from Terminal G (white wire) in the trailer harness.

Remove the non-functioning light, test for battery voltage at the light receptacle. If present, replace the light. If not, test continuity and track down and replace or repair the faulty wire.

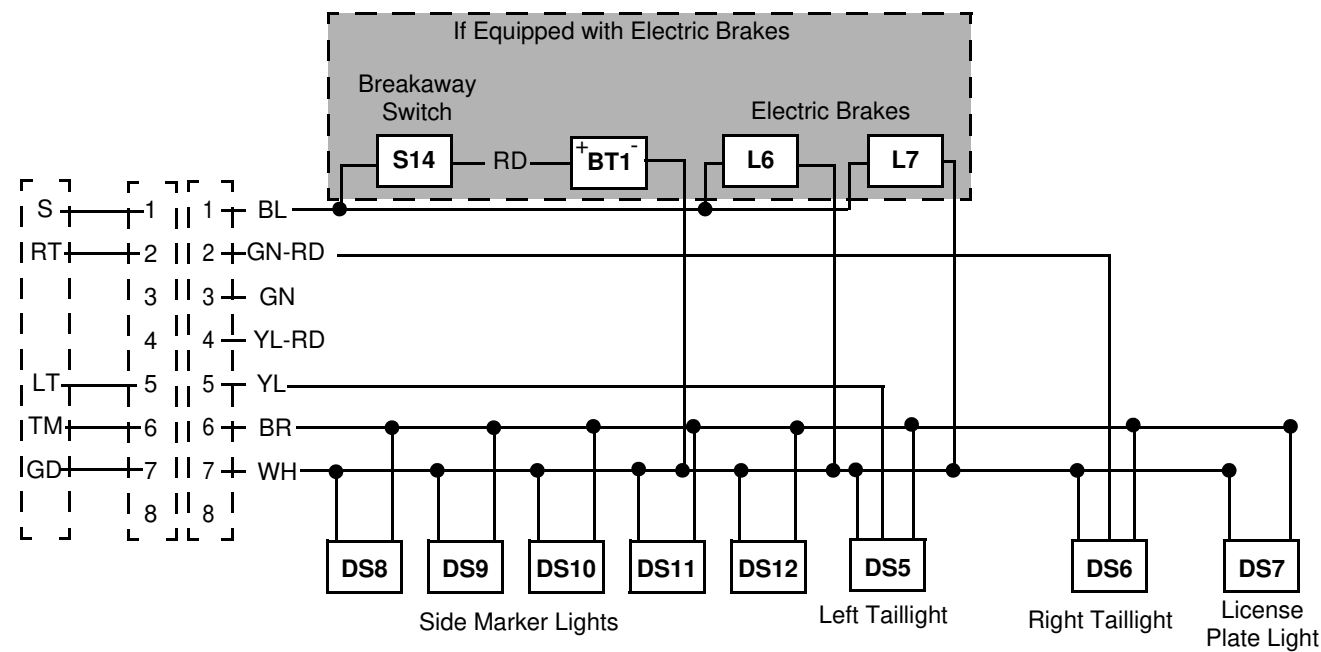
If multiple lights fail, but not all, suspect a broken wire. Remove lights and test continuity between sockets to track down the location of the break.

If all lights fail, verify proper voltage at the connector on the tow vehicle. If present, test continuity of pigtail harness (from vehicle to first Deutsch connector on the tongue).

ELECTRIC BRAKES

On machines with electric brakes, solenoids L6 and L7 are energized when the S terminal in the tow vehicle harness receives power. This occurs when the driver steps on the brakes. The solenoids expand the shoes of the brakes against the brake drums. A spring pulls the brake shoes away from the drum when the solenoids de-energize

The breakaway switch S14 is normally open. It closes if a tether to the towing vehicle is pulled, as in the case of the hitch failing while the chipper is being towed. If the breakaway switch is closed, power from the battery is applied to solenoids L6 and L7 to stop the vehicle.



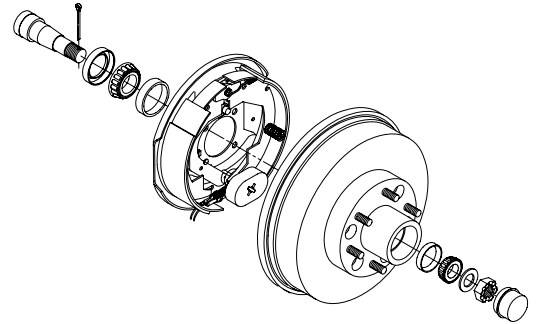
Trailer

Electric Brake Troubleshooting

Begin by attempting to adjust the brakes, then inspect the brakes, then continue with electric brake troubleshooting below.

1. Refer to the [BC1230A Brush Chipper Maintenance Manual](#) for information on adjustments.
2. Jack up machine to raise wheels off the ground. Support machine with suitable blocking.
3. Remove dust cap from hub of the wheel, remove cotter pin from the castle nut. Unscrew castle nut. Remove wheel to expose brakes.

NOTE: Note location and orientation of wheel bearings to aid correct reassembly.



4. Inspect brakes, looking for:
 - bent or broken parts
 - worn-out brake linings or magnets
 - seized lever arms or shoes
 - scored drums
 - loose parts
5. Inspect brake linings. Replace brake shoes if lining is:
 - worn to within 1/16" or less
 - contaminated with grease or oil
 - abnormally scored or gouged

To retain the balance of the brakes, if one brake shoe requires replacement, replace both shoes on both wheels.

6. With electrical plug disconnected from tow vehicle, measure resistance in ohms (Ω), between S and GD terminals.
 - If it is approximately 1.3Ω the brake coils L6 and L7 and wiring are good. Each coil has a nominal resistance of 2.6Ω and are wired in a parallel circuit; therefore, total resistance is 1/2 the resistance of one coil.
 - If it is approximately 2.6Ω resistance, one coil may be disconnected or burned out. Check the wiring to each coil. It may be necessary to pull the hubs off to find which coil is not working.

Continued on next page...

- If meter displays OL (overload) or infinite resistance, a wire could be broken, or both coils could be burned out. Check plug wiring and harness wiring.
 - If it is approximately 0, there is a short to ground in the wiring. Another symptom of a short would be blowing fuses to the brake actuator.
7. Check brake actuator and tow vehicle wiring.

HYDRAULIC BRAKES

If not equipped with electric brakes, the brush chipper is equipped with hydraulic surge brakes. A master cylinder CY1 in the tongue is compressed when the towing vehicle slows and the inertia of the brush chipper presses forward against the towing vehicle.

Fluid forced out of the master cylinder goes to the brake cylinders CY2 and CY3 in either wheel. The brake cylinders expand, forcing the brake shoes against the brake drum.

NOTE: Two oleo-type dampers are used to prevent minor decelerations of the towing vehicle from compressing the master cylinder.

When the brush chipper trailer slows to the speed of the towing vehicle, springs on the brake shoes pull the shoes away from the drum and force back the brake cylinder pistons. The oil in the brake cylinders returns to the master cylinder.

On this type of brake, if the trailer uncouples from the tow vehicle while being transported, a chain attached to the tow vehicle pulls the breakaway lever from vertical to horizontal. The lever presses against the piston of the master cylinder, sending fluid to extend the brake cylinders and stop the machine.

Hydraulic Brake Troubleshooting

Problems involving the hydraulic brakes usually involve a leaking line, pinched line, or mechanical problems with the surge brake actuator on the tongue, or the brake shoes and operating components inside the brake drum.

1. Inspect for leaks in lines and fittings. Tighten leaky connections if loose. Replace if tightening does not stop leak.
2. Inspect lines for pinched points. Replace line if found.
3. Check fluid level of brake reservoir on tongue, as discussed in the [BC1230A Brush Chipper Maintenance Manual](#).
4. Remove wheel and hub, inspect brake components in brake drum, as described on page [7-6](#).

TRAILER COMPONENT REPAIR

Replace Marker Lights

The marker lights used on the machine consist of a single unit bulb and lens sitting in a rubber grommet.

1. Gain access to backside of grommet and press lens outward. The lens will pop out of grommet.
2. Disconnect light from the harness.
3. Connect new light to the harness.
4. Press new light into grommet from the outside.

Replace Taillights

The taillights consist of a single unit bulb and lens. The lens is attached to the light with four screws.

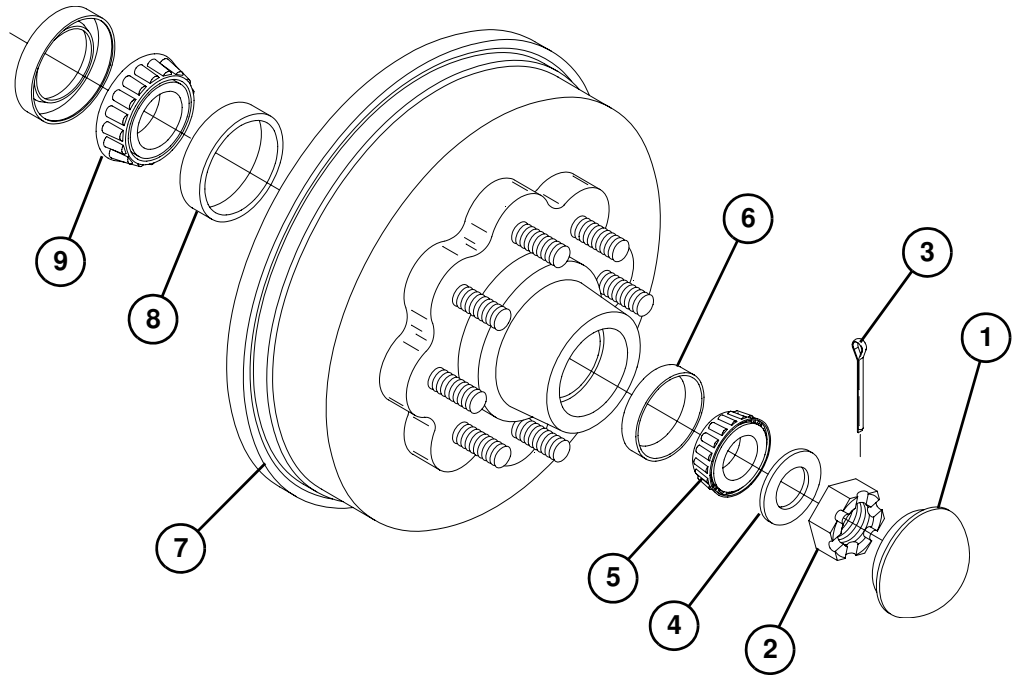
1. Remove the four screws from the lens.
2. Replace bulb.
3. Replace screws.

Replace License Plate Light/Rear Clearance Light

1. Look at wiring inside frame for ny-tie used to remove slack from harness. Clip ny-tie.
2. Remove screws holding clearance light or license plate light.
3. Pull light assembly from trailer to expose the plug and jack. Disconnect plug and jack.
4. Reverse steps above to install new light.

Replace/Repack Wheel Bearings

1. Follow "*Shutdown Procedure*," page 2-1.
2. If attached to vehicle, raise machine and support with suitable blocking. If unattached, chock both sides of opposite wheel and support tongue with blocking. Raise machine and support with suitable blocking.
3. Remove wheel and tire.

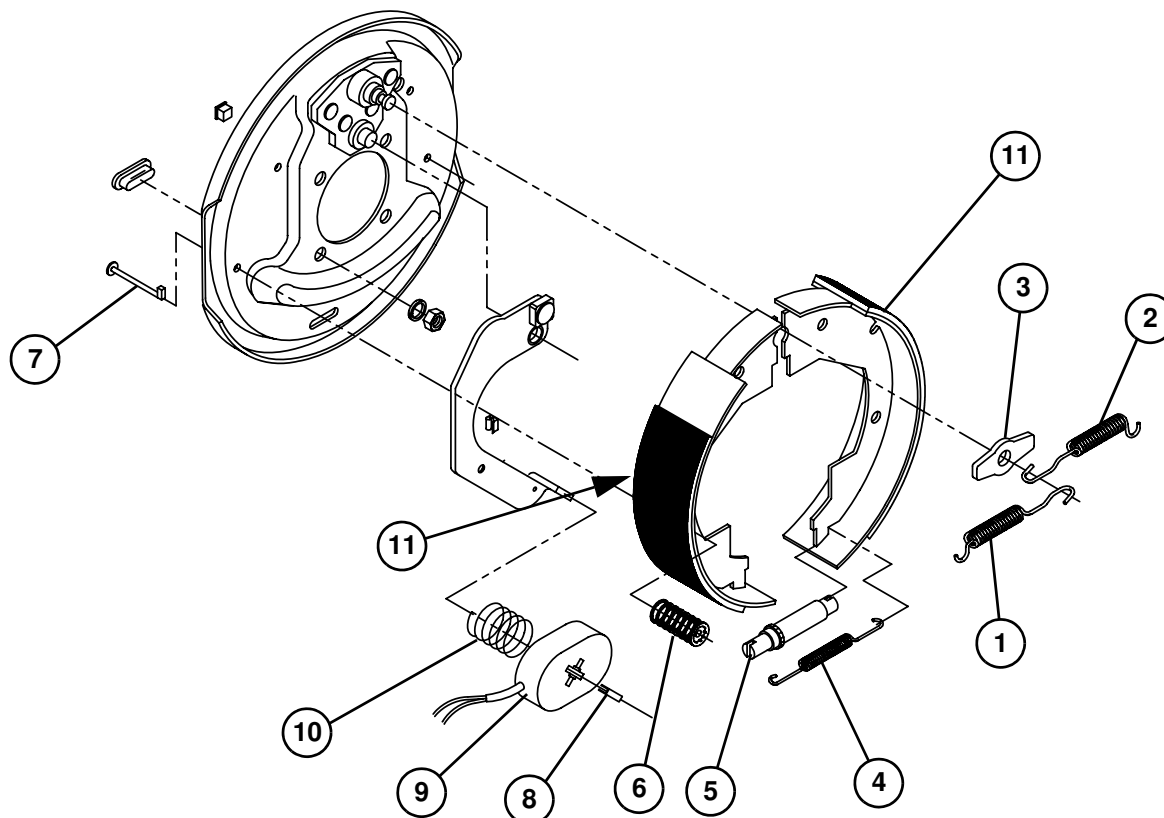


4. Remove bearing cap (1) from brake drum (7).
5. Straighten cotter pin (3) and remove.
6. Remove nut (2) and washer (4).
7. Support drum and remove outer bearing (5).
8. Slide brake drum (7) off axle.
9. Remove inner bearing (9) and inner (8) and outer (6) bearing race.
10. Clean and inspect seals, bearings, and race surfaces for wear or damage and replace if necessary.
11. Install components in reverse of removal.
12. Grease bearings with Vermeer LF Ultra, Shell Alvania EP2 or similar grease.
13. When installing hub on spindle, rotate wheel while tightening nut until drag is felt on the wheel. Back off nut one notch and install cotter pin.

Electric Brakes

Replacing Brake Shoes

1. If attached to tow vehicle, raise machine and support with suitable blocking. If unattached, chock both sides of opposite wheel and support tongue with blocking. Raise machine and support with suitable blocking.



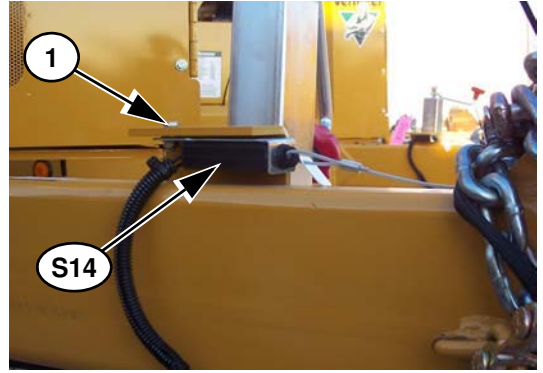
2. Remove wheel and tire assembly.
3. Remove springs (1) and (2), and brake washer (3).
4. Remove adjuster spring (4) and adjuster assembly (5).
5. Remove brake shoe springs (6) and pins (7) by compressing spring and turning 90°.
6. Remove magnet retainer clip (8), magnet (9), and spring (10).
7. Remove brake shoes (11).
8. Reverse removal procedures to install brake components.

NOTE: Refer to the [BC1230A Brush Chipper Maintenance Manual](#) for brake adjustment procedures.

9. Torque wheel nuts to 175–225 ft-lb (237–305 Nm).

Replacing Breakaway Switch S14

1. Remove bolt (1) and remove old switch from tongue.
1. Remove bolt and remove old switch. Pull off or clip off old connectors if attached to trailer harness.
2. Strip wires as needed. The wires each need 1/4" of bare wire exposed.
3. Cut two sleeves of insulation approximately twice as long as the crimp connectors. Slide one sleeve piece onto each wire on the switch.
4. Slide connectors onto exposed wire ends from switch and from harness and crimp connectors.
5. Slide insulation sleeves over crimped connectors.
6. Apply heat from a heat gun to shrink insulation sleeves down over connectors and seal out moisture.
7. Bolt switch onto tongue. Torque nut onto bolt to 6 ft-lb (8 Nm).
8. If new switch is not equipped with new cable and wedge, install wedge and cable from old switch into new switch (the wedge forces the two contacts apart inside the body of the switch).

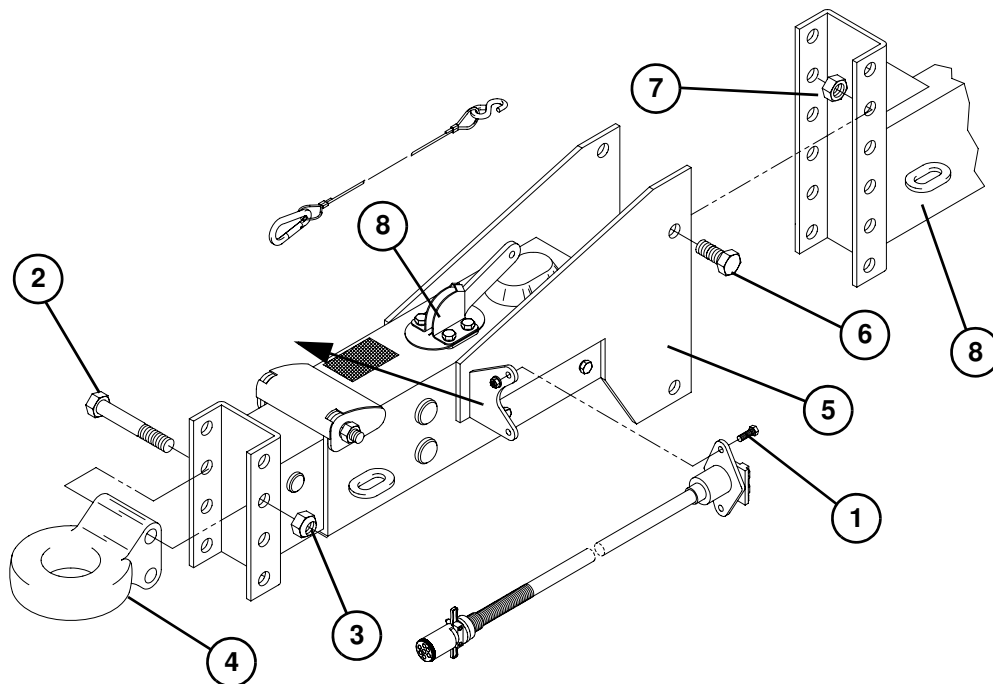


NOTE: Breakaway switch is not intended to be used as a trailer park brake. Rapid battery discharge will occur when switch plunger is pulled out of switch.

Hydraulic Brakes

Removing Surge Brake Actuator

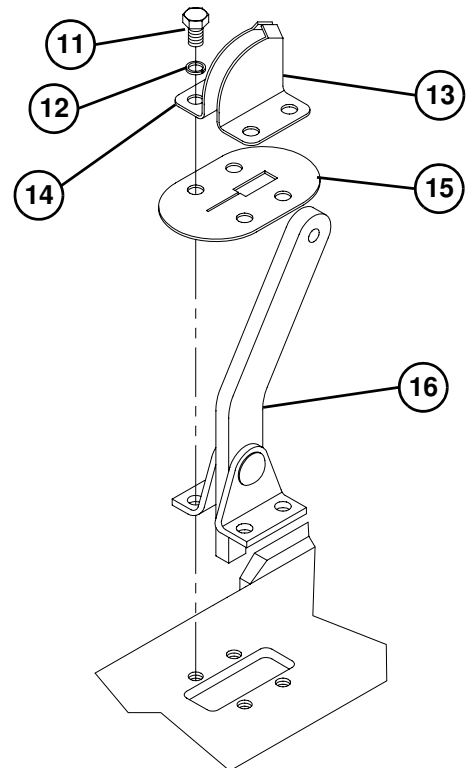
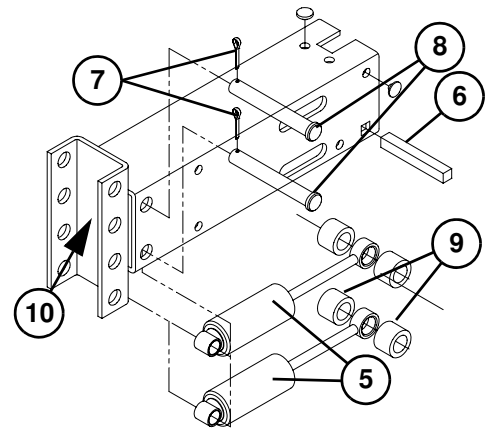
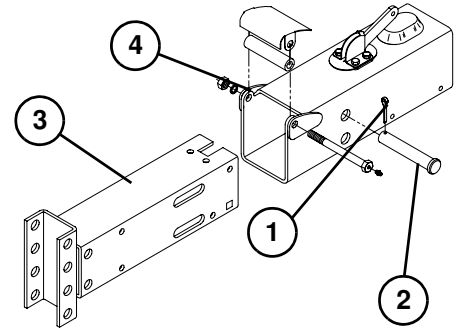
1. Chock in front and back of both wheels.
2. Raise and support tongue.
3. Disconnect brake hose from master cylinder.
4. Remove two bolts (1) to remove harness plug.
5. Remove bolts (2) and nuts (3) that attach hitch (4) to front of brake actuator (5).



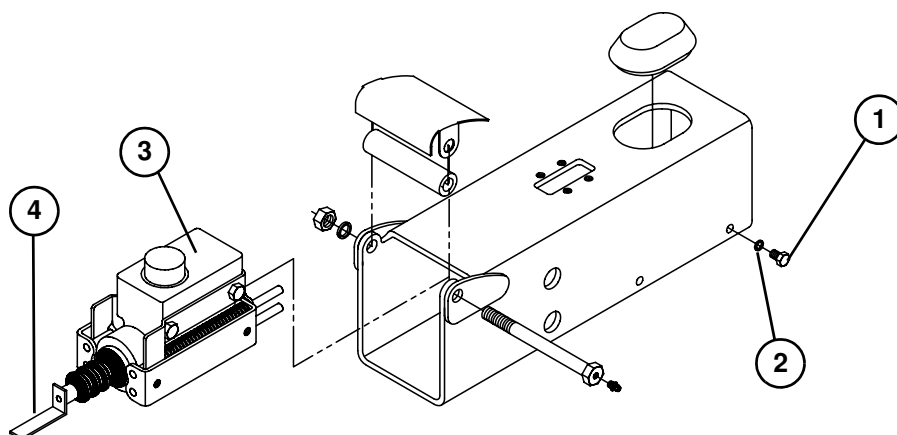
6. Support surge brake actuator (5) and remove bolts (6) and nuts (7) that attach surge brake actuator to tongue (8).
7. Reverse removal procedures to install surge brake actuator. Torque tongue and hitch mounting bolts to 180–200 ft-lb (244–271 Nm).

Disassembling Surge Break Actuator

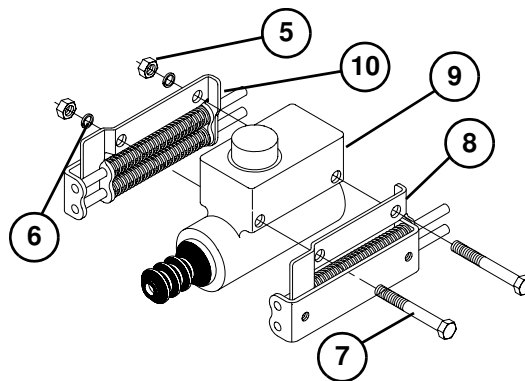
1. Remove actuator from brush chipper, as described in previous section.
2. Remove cotter pins (1) and pins (2).
3. Slide front half of actuator (3) out of rear half (4).
4. If dampers (5) are to be replaced, remove push rod stock (6), cotter pins (7), pins (8), rollers (9) and dampers (5) from front half of actuator (10).
5. If master cylinder is to be replaced, remove bolts (11), lock washers (12), left breakaway lever lock (13), right breakaway lever lock (14), weather seal (15), safety lever and chain (16).



Continued on next page...



6. Remove four bolts (1), and washers (2) that hold master cylinder in outer case (3). Slide master cylinder forward and remove.
7. Remove push rod assembly (4) from master cylinder (3).
8. Remove nuts (5), washers (6), and bolts (7) and remove left (8) and right (10) cylinder bracket assemblies to master cylinder (9).



Installing Surge Brake Actuator

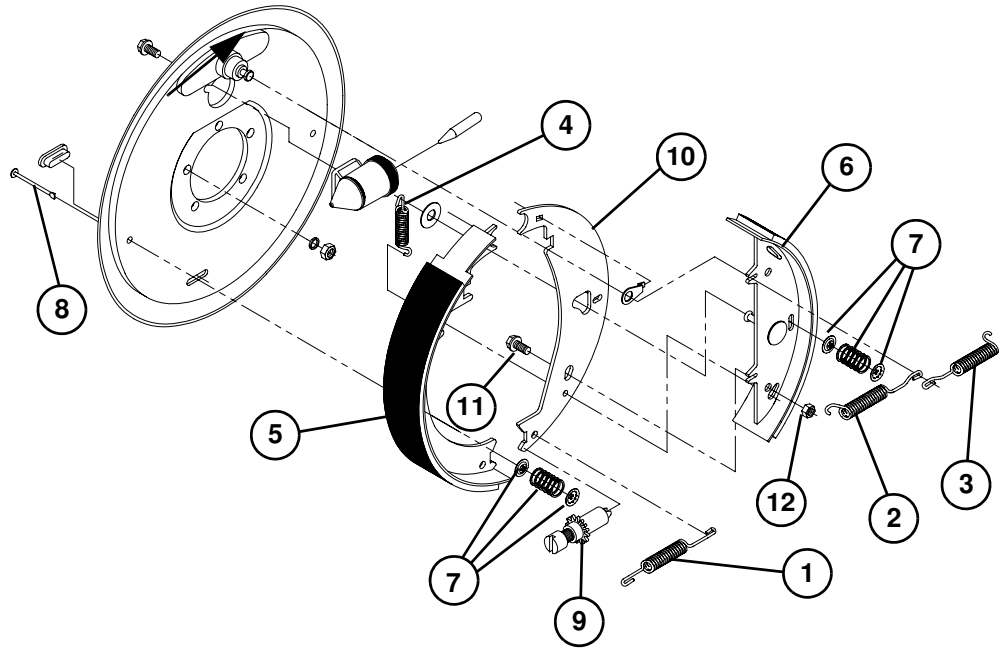
Reverse removal procedures to install master cylinder and reassemble surge brake actuator.

Refer to the [BC1230A Brush Chipper Maintenance Manual](#) for bleeding and adjustment procedures.

Replacing Hydraulic Brake Shoes

1. If attached to tow vehicle, raise machine and support with suitable blocking.

If unattached, chock both sides of opposite wheel and support tongue with blocking. Raise machine and support with suitable blocking.



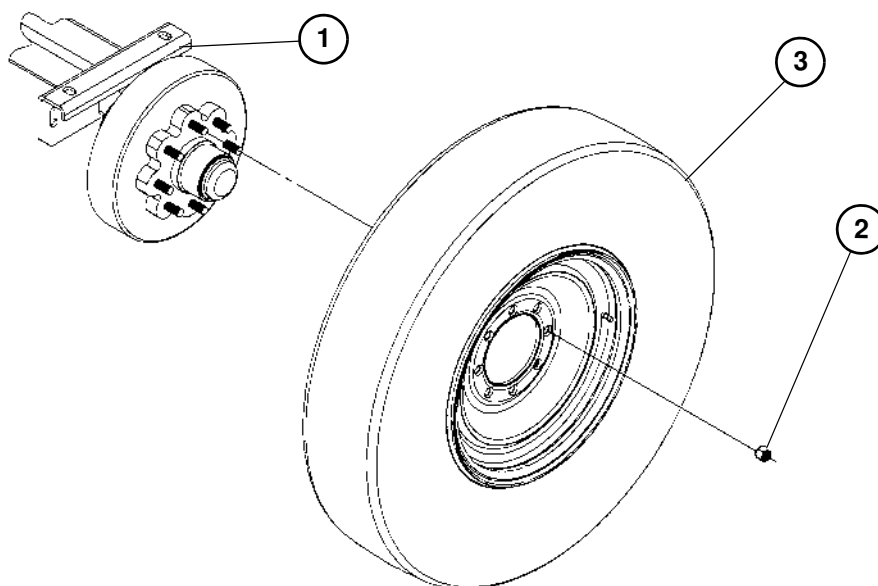
2. Remove wheel and tire assembly.
3. Remove springs (1), (2), (3), and (4) from left (5) and right (6) brake shoes.
4. Remove shoe hold-down springs and washers (7) and pins (8).
5. Spread shoes and remove adjuster assembly (8). Right shoe (6) is attached to shoe lever (10).
6. Remove left brake shoes (5) and right brake shoe (6) and shoe lever (10).
7. Remove bolt (11) and nut (12) to separate right brake shoe from shoe lever.
8. Reverse steps above to assemble and install brakes.

NOTE: Refer to [BC1230A Brush Chipper Maintenance Manual](#) for bleeding and adjustment procedures.

9. Torque wheel nuts to 175–225 ft-lb (237–305 Nm).

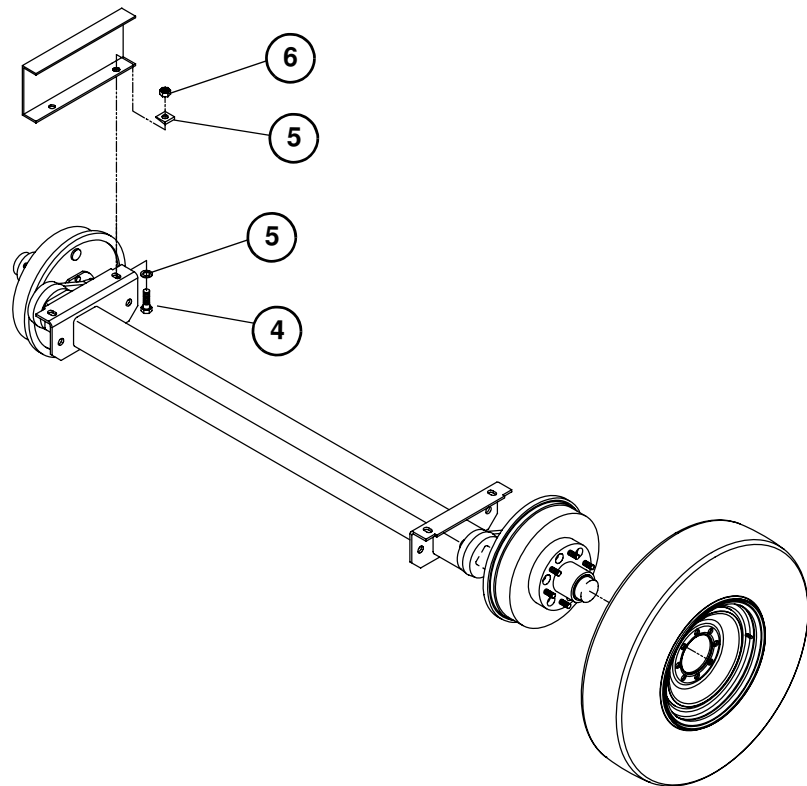
Replace Axle

The brush chipper trailer is mounted on a torsion arm type suspension system axle, which is completely self-contained within the axle tube. If the axle is damaged, it must be replaced as a single unit.



1. Using a suitable lifting device, raise machine off the ground to allow adequate room to remove axle (1).
2. Place blocking under trailer frame and remove lifting device.
3. Loosen and remove eight nuts (2) and remove wheel assembly (3) from each side of machine.

Continued on next page...



4. For machines with electric brakes, disconnect electric brake connectors (not shown) on each brake hub from wiring harness.
5. For machines with hydraulic brakes, disconnect hydraulic brake line (not shown) from each brake hub.
6. Support axle, then loosen and remove four bolts (4), eight washers (5), and four nuts (6).
7. Lower axle to the ground and remove from under trailer.
8. Reverse removal procedures to install axle.
9. Torque axle bolts to 180 ft-lb (244 Nm).
10. Torque wheel nuts to 175–225 ft-lb (237–305 Nm).

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Diagrams and Schematics

LEGEND FOR FUNCTIONAL DIAGRAMS

Functional diagrams display inputs and outputs involved in system operation.

Different line weights and types are used to display electric, hydraulic, mechanical and airborne inputs and outputs. Dash-dot lines indicate that devices within are included in a larger assembly.

The diagrams read (generally) from left to right, with inputs starting on the left and outputs traveling to the right. In special cases, arrowheads are used to indicate an input “flowing” contrary to normal left-to-right flow.

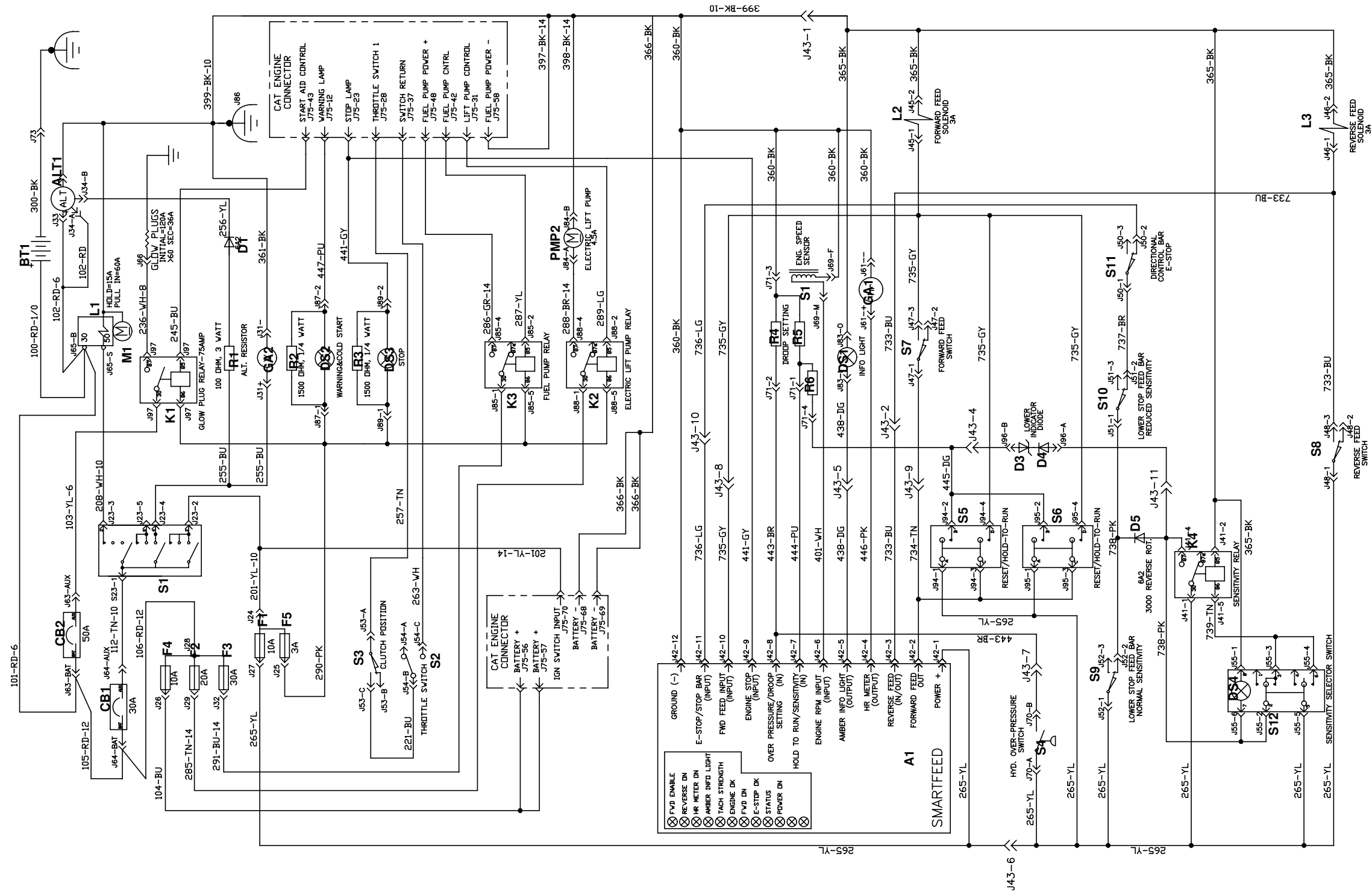
Reference designator codes are used to identify the types of the devices, the number after the letter code identifies the specific device.

- A—assembly of multiple devices. Can also indicate a module that is replaced as a single unit
- ACC—accumulator
- AD—audible device; horn, buzzer, or speaker
- ALT—alternator
- B—sender or transducer, pulse pickup
- BT—battery
- C—Capacitor
- CB—circuit breaker, maximum capacity is listed near the circuit breaker
- CP—coupler, quick coupler
- CV—check valve
- CY—cylinder
- D—diode
- DV—directional control valve
- DS—lamp or indicating device, such as a low oil pressure light
- E—antenna, arrester

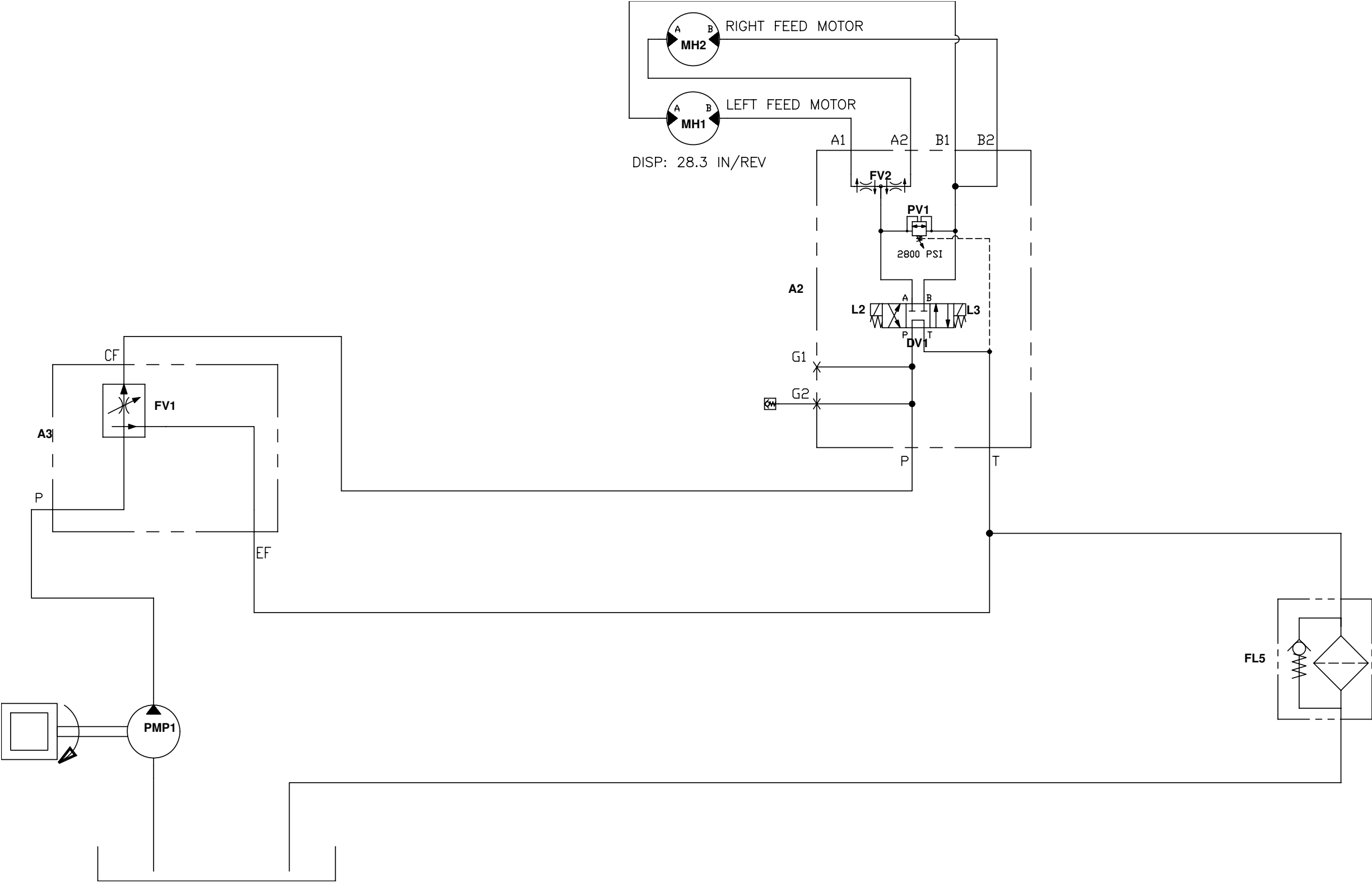
- ENG—engine
- F—fuse, maximum capacity is listed near the fuse
- FV—flow control valve such as needle valve, orifice, or flow divider.
- FL—filter
- G—diagnostic port, gauge port, or oil sampling port.
- GA—gauge
- H—hose
- HE—heat exchanger, radiator, oil cooler, intercooler
- J—jack, pins on jacks identified by number, so that “J1-7” is pin 7 on jack 1
- K—relay, may be shown divided into coil and contacts
- L—solenoid, coil, electric displacement control (EDC).
- M—electric motor
- MH—hydraulic motor
- MP—mechanical part, brakes, clutch, etc.
- P—plug, pins on plugs identified by number, so that “P1-16” is pin 16 on plug 1
- PMP—pump
- PV—pressure control valve, such as a relief valve, reducing valve, counterbalance valve, sequence valve, or unloading valve.
- Q—transistor
- R—resistor, rheostat, potentiometer
- RES—reservoir or tank
- S—switch, in the case of temperature and pressure switches, the temperature or

- pressure needed to activate it is given near the switch
- SR—strainer
- SV—shuttle valve
- T—transformer
- TB—terminal board
- W—wiring harness
- (nc)—indicates switch that is “normally closed”
- (no)—indicates switch that is “normally open”
- (nnp)—indicates valve that is “normally non-passing”
- (np)—indicates valve that is “normally passing”

Add-3



MACHINE HYDRAULIC SCHEMATIC



Revision History

[illegible]



WARNING

The Engine Exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.