3033R, 3038R, 3039R, 3045R and 3046R Compact Utility Tractors Diagnostic and Repair Manual (September 2014)

TECHNICAL MANUAL

Compact Utility models 3045R, 3038R, 3046R, 3039R, 3033R

TM130619 17 SEP 14 (ENGLISH)

For complete service information also see:

3TNV86, 4TNV86, 3TNV88, and 4TNV88 Diesel Engines(Final Tier 4/Stage IV platform)	CTM120419

John Deere Agriculture
Pinted by Belgreen

TM130619

Table of contents

Foreword

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

□ This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Technical manuals are divided in two parts: repair and operation and tests. Repair sections tell how to repair the components. Operation and tests sections help you identify the majority of routine failures quickly.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, service parts kits, specifications, wear tolerances, and torque values.

Technical Manuals are concise guides for specific machines. They are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes.

Section 10 - GENERAL INFORMATION

Table of contents

Group 05 - Safety

Recognize Safety Information

Safety-alert symbol

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.

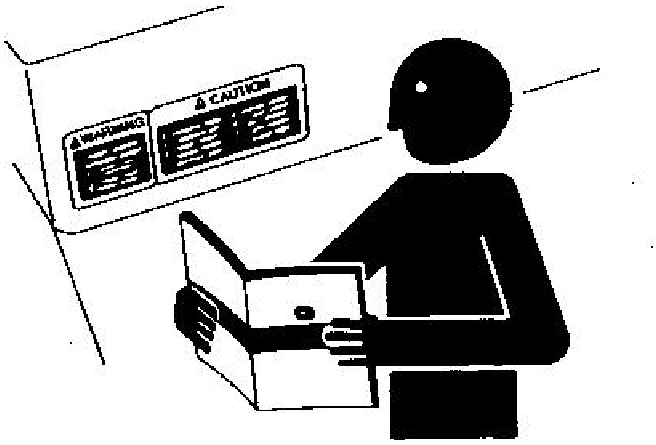
Understand Signal Words

Signal Words

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

Follow Safety Instructions



Safety Messages

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

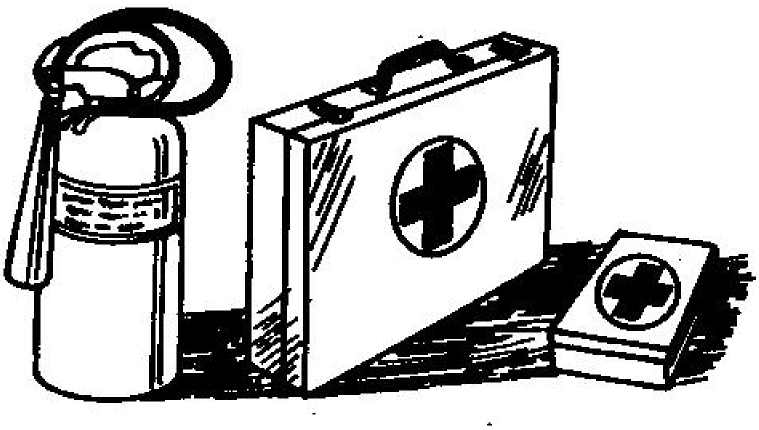
There can be additional safety information contained on parts and components sourced from suppliers that is not reproduced in this operator′s manual.

Learn how to operate the machine and how to use controls properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.

If you do not understand any part of this manual and need assistance, contact your John Deere dealer.

Prepare for Emergencies



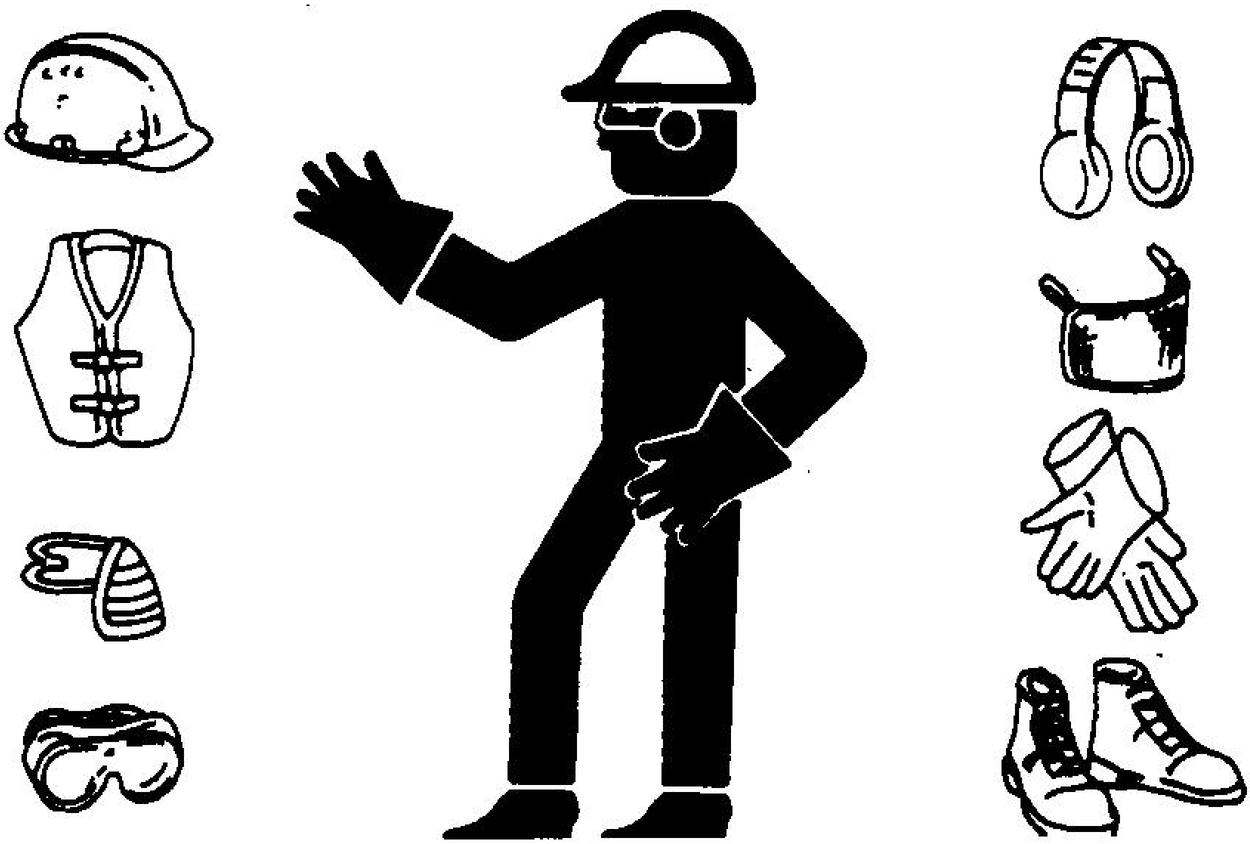
First Aid Kit

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

Wear Protective Clothing

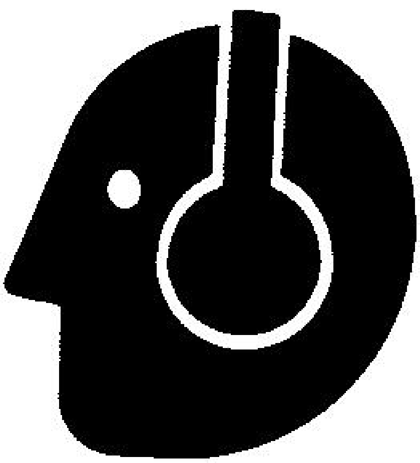


Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

Protect Against Noise



Noise Exposure

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Handle Fuel Safely—Avoid Fires

Avoid Fires

Handle fuel with care: it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks.

Always stop engine before refueling machine. Fill fuel tank outdoors.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris. Always clean up spilled fuel.

Use only an approved fuel container for transporting flammable liquids.

Never fill fuel container in pickup truck with plastic bed liner. Always place fuel container on ground before refueling. Touch fuel container with fuel dispenser nozzle before removing can lid. Keep fuel dispenser nozzle in contact with fuel container inlet when filling.

Do not store fuel container where there is an open flame, spark, or pilot light such as within a water heater or other appliance.

Handle Starting Fluid Safely

Store Safely

Starting fluid is highly flammable.

Keep all sparks and flame away when using it. Keep starting fluid away from batteries and cables.

To prevent accidental discharge when storing the pressurized can, keep the cap on the container, and store in a cool, protected location.

Do not incinerate or puncture a starting fluid container.

Fire Prevention

To reduce the risk of fire, your tractor should be regularly inspected and cleaned.

- Birds and other animals may build nests or bring other flammable materials into the engine compartment or onto the exhaust system. The tractor should be inspected and cleaned prior to the first use each day.
- A build up of grass, crop material and other debris may occur during normal operation. This is especially true when operating in very dry conditions or conditions where airborne crop material or crop dust is present. Any such build up must be removed to ensure proper machine function and to reduce the risk of fire. The tractor must be inspected and

cleaned periodically throughout the day.

- Regular and thorough cleaning of the tractor combined with other routine maintenance procedures listed in the Operator’s Manual greatly reduce the risk of fire and the chance of costly downtime.
- Do not store fuel container where there is an open flame, spark, or pilot light such as within a water heater or other appliance.
- Check fuel lines, tank, cap, and fittings frequently for damage, cracks or leaks. Replace if necessary.

Follow all operational and safety procedures posted on the machine and the Operator’s Manual. Be careful of hot engine and exhaust components during inspection and cleaning. Before carrying out any inspection or cleaning, always shut OFF the engine, place the transmission in PARK or set parking brake, and remove the key. Removal of the key will prevent others from starting the tractor during inspection and cleaning.

In Case of Fire

Flames

CAUTION:

Avoid personal injury.

Stop machine immediately at the first sign of fire. Fire may be identified by the smell of smoke or sight of flames. Because fire grows and spreads rapidly, get off the machine immediately and move safely away from the fire. Do not return to the machine! The number one priority is safety.

Call the fire department. A portable fire extinguisher can put out a small fire or contain it until the fire department arrives; but portable extinguishers have limitations. Always put the safety of the operator and bystanders first. If attempting to extinguish a fire, keep your back to the wind with an unobstructed escape path so you can move away quickly if the fire cannot be extinguished.

Read the fire extinguisher instructions and become familiar with their location, parts, and operation before a fire starts. Local fire departments or fire equipment distributors may offer fire extinguisher training and recommendations.

If your extinguisher does not have instructions, follow these general guidelines:

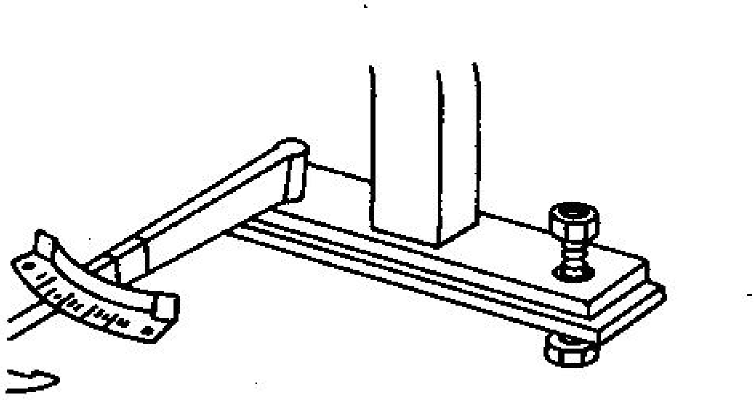
[1] - Pull the pin. Hold the extinguisher with the nozzle pointing away from you, and release the locking mechanism.

[2] - Aim low. Point the extinguisher at the base of the fire.

[3] - Squeeze the lever slowly and evenly.

[4] - Sweep the nozzle from side-to-side.

Keep ROPS Installed Properly



Roll-Over Protective Structure

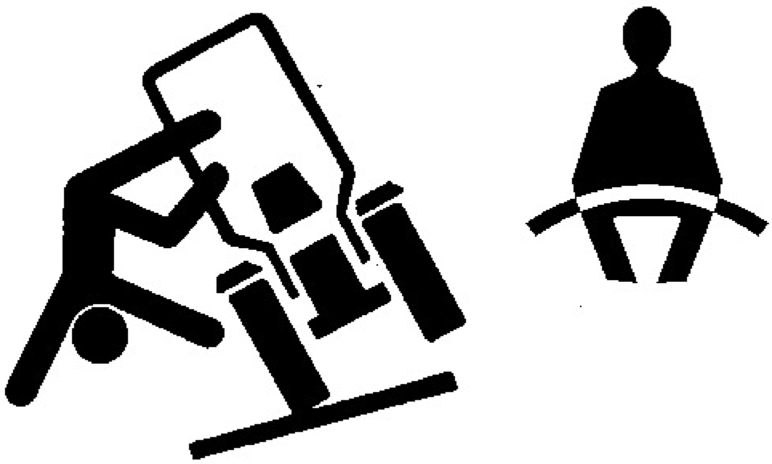
Make certain all parts are reinstalled correctly if the roll-over protective structure (ROPS) is loosened or removed for any reason. Tighten mounting bolts to proper torque.

The protection offered by ROPS will be impaired if ROPS is subjected to structural damage, is involved in an overturn incident, or is in any way altered by welding, bending, drilling, or cutting. A damaged ROPS should be replaced, not reused.

The seat is part of the ROPS safety zone. Replace only with John Deere seat approved for your tractor.

Any alteration of the ROPS must be approved by the manufacturer.

Use Foldable ROPS and Seat Belt Properly



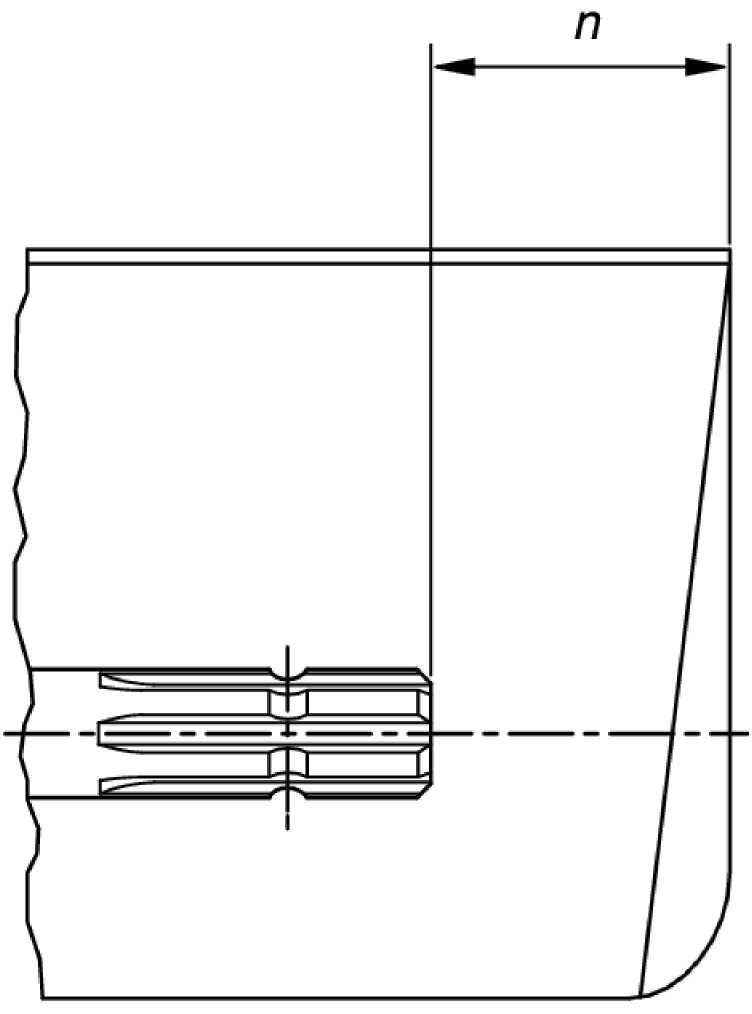
Fasten Your Seat Belt

Avoid crushing injury or death during rollover.

- If this machine is equipped with a foldable rollover protective structure (ROPS), keep the ROPS in the fully extended and locked position. USE a seat belt when you operate with a ROPS in the fully extended position.
    - Hold the latch and pull the seat belt across the body.
    - Insert the latch into the buckle. Listen for a click.
    - Tug on the seat belt to make sure that the belt is securely fastened.
    - Snug the seat belt across the hips.
- If this machine is operated with the ROPS folded (for example, to enter a low building), drive with extreme caution. DO NOT USE a seat belt with the ROPS folded.
- Return the ROPS to the raised, fully extended position as soon as the machine is operated under normal conditions.

Stay Clear of Rotating Drivelines

Rotating Drivelines



Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep tractor master shield and driveline shields in place at all times. Make sure rotating shields turn freely.

Wear close fitting clothing. Stop the engine and be sure that PTO driveline is stopped before making adjustments, connections, or cleaning out PTO driven equipment.

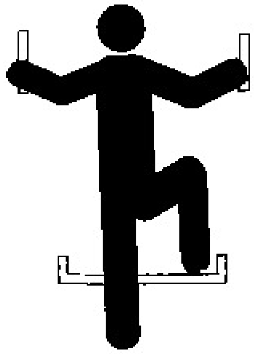
Do not install any adapter device between the tractor and the primary implement PTO drive shaft that will allow a 1000 rpm tractor shaft to power a 540 rpm implement at speeds higher than 540 rpm.

Do not install any adapter device that results in a portion of the rotating implement shaft, tractor shaft, or the adapter to be unguarded. The tractor master shield shall overlap the end of the splined shaft and the added adaptor device as outlined in the table.

Stay Clear of Rotating Drivelines

PTO Type	Diameter	Splines	n ± 5 mm (0.20 in.)
1	35 mm (1.378 in.)	6	85 mm (3.35 in.)
2	35 mm (1.378 in.)	21	85 mm (3.35 in.)
3	45 mm (1.772 in.)	20	100 mm (4.00 in.)

Use Steps and Handholds Correctly



Use Handholds and Steps

Prevent falls by facing the machine when getting on and off. Maintain 3-point contact with steps, handholds, and handrails.

Use extra care when mud, snow, or moisture present slippery conditions. Keep steps clean and free of grease or oil. Never jump when exiting machine. Never mount or dismount a moving machine.

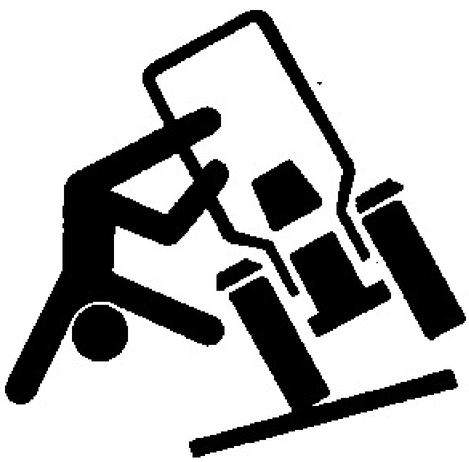
Read Operator Manuals for ISOBUS Implements

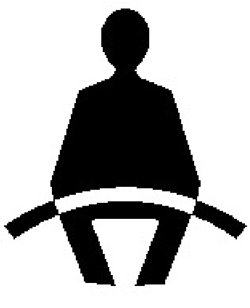
In addition to GreenStar Applications, this display can be used as a display device for any implement that meets ISO 11783 standard. This includes capability to control ISOBUS implements. When used in this manner, information and implement control functions placed on the display are provided by the implement and are the responsibility of the implement manufacturer. Some of these implement functions could provide a hazard either to the Operator or a bystander. Read the operator manual provided by the implement manufacturer and observe all safety messages in manual and on implement prior to use.

→NOTE:

ISOBUS refers to the ISO Standard 11783

Use Seat Belt Properly





Fasten Your Seat Belt

Avoid crushing injury or death during rollover.

This machine is equipped with a rollover protective structure (ROPS). USE a seat belt when you operate with a ROPS.

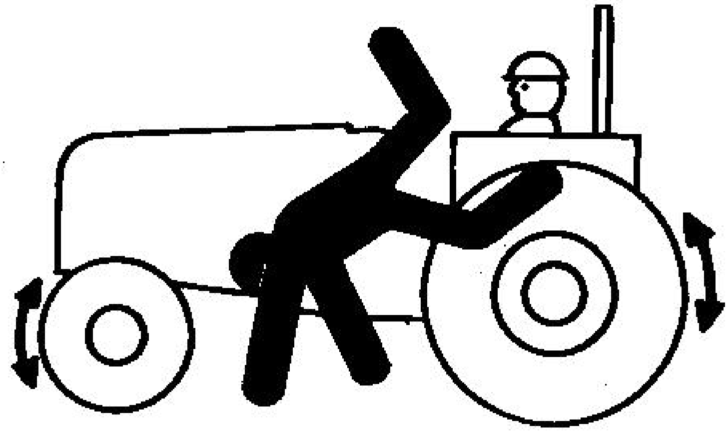
- Hold the latch and pull the seat belt across the body.

- Insert the latch into the buckle. Listen for a click.
- Tug on the seat belt latch to make sure that the belt is securely fastened.
- Snug the seat belt across the hips.

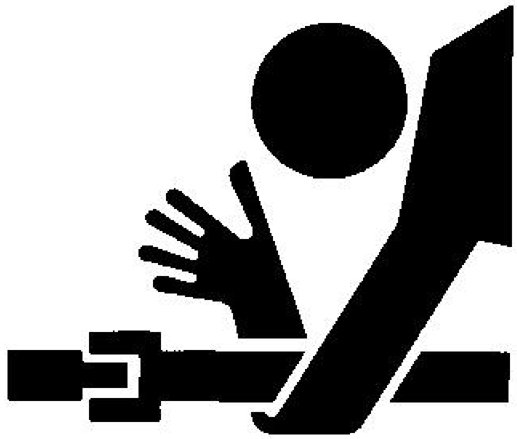
Replace entire seat belt if mounting hardware, buckle, belt, or retractor show signs of damage.

Inspect seat belt and mounting hardware at least once a year. Look for signs of loose hardware or belt damage, such as cuts, fraying, extreme or unusual wear, discoloration, or abrasion. Replace only with replacement parts approved for your machine. See your John Deere dealer.

Operating the Tractor Safely



Safety—Fall Off Tractor



Safety—PTO

You can reduce the risk of accidents by following these simple precautions:

- Use your tractor only for jobs it was designed to perform, for example, pushing, pulling, towing, actuating, and carrying a variety of interchangeable equipment designed to conduct agricultural work.
- This tractor is not intended to be used as a recreational vehicle.
- Read this operator's manual before operating the tractor and follow operating and safety instructions in the manual and on the tractor.
- Follow operation and ballasting instructions found in the operator's manual for your implements/attachments, such as front loaders
- Make sure that everyone is clear of machine, attached equipment, and work area before starting engine or operation.
- Keep hands, feet, and clothing away from power-driven parts

Driving Concerns

- Never get on or off a moving tractor.
- Keep all children and nonessential personnel off tractors and all equipment.
- Never ride on a tractor unless seated on a John Deere approved seat with seat belt.
- Keep all shields/guards in place.
- Use appropriate visual and audible signals when operating on public roads.
- Move to side of road before stopping.
- Reduce speed when turning, applying individual brakes, or operating around hazards on rough ground or steep slopes.
- Couple brake pedals together for road travel.
- Pump brakes when stopping on slippery surfaces.

Towing Loads

- Be careful when towing and stopping heavy loads. Stopping distance increases with speed and weight of towed loads, and

on slopes. Towed loads with or without brakes that are too heavy for the tractor or are towed too fast can cause loss of control.
- Consider the total weight of the equipment and its load.
- Hitch towed loads only to approved couplings to avoid rearward upset.

Parking and Leaving the Tractor

- Before dismounting, shut off SCVs, disengage PTO, stop engine, lower implements/attachments to ground and securely engage park mechanism, including the park pawl and park brake. In addition, if tractor is left unattended, remove key.
- Leaving transmission in gear with engine off will NOT prevent the tractor from moving.
- Never go near an operating PTO or an operating implement.
- Wait for all movement to stop before servicing machinery.

Common Accidents

Unsafe operation or misuse of the tractor can result in accidents. Be alert to hazards of tractor operation.

The most common accidents involving tractors:

- Tractor rollover
- Collisions with motor vehicles
- Improper starting procedures
- Entanglement in PTO shafts
- Falling from tractor
- Crushing and pinching during hitching

Avoid Backover Accidents

Avoid Backover Accidents

Before moving machine, be sure that all persons are clear of machine path. Turn around and look directly for best visibility. Use a signal person when backing if view is obstructed or when in close quarters.

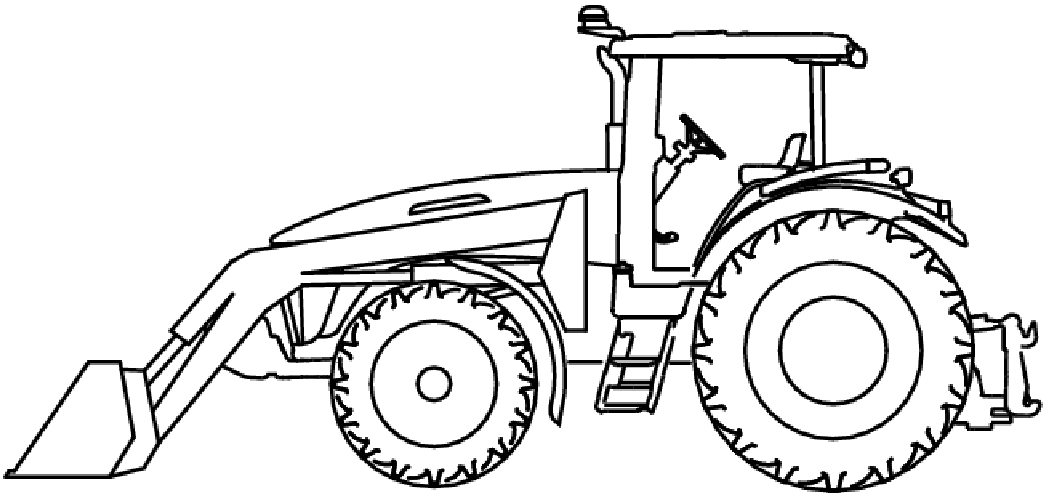
Do not rely on a camera to determine if personnel or obstacles are behind the machine. The system can be limited by many factors including maintenance practices, environmental conditions, and operating range.

Limited Use in Forestry Operation

The intended use of John Deere tractors when used in forestry operations is limited to tractor-specific applications like transport, stationary work such as log splitting, propulsion, or operating implements with PTO, hydraulic, or electrical systems.

These are applications where normal operation does not present a risk of falling or penetrating objects. Any forestry applications beyond these applications, such as forwarding and loading, requires fitment of application-specific components including Falling Object Protective Structure (FOPS) and/or Operative Protective Structures (OPS). Contact John Deere dealer for special components.

Operating the Loader Tractor Safely



Loader Tractor

When operating a machine with a loader application, reduce speed as required to ensure good tractor and loader stability.

To avoid tractor rollover and damage to front tires and tractor, do not carry load with your loader at a speed over 10 km/h (6 mph).

To avoid tractor damage do not use a front loader or a sprayer tank if the tractor is equipped with a 3 Meter Front Axle.

Never allow anyone to walk or work under a raised loader.

Do not use loader as a work platform.

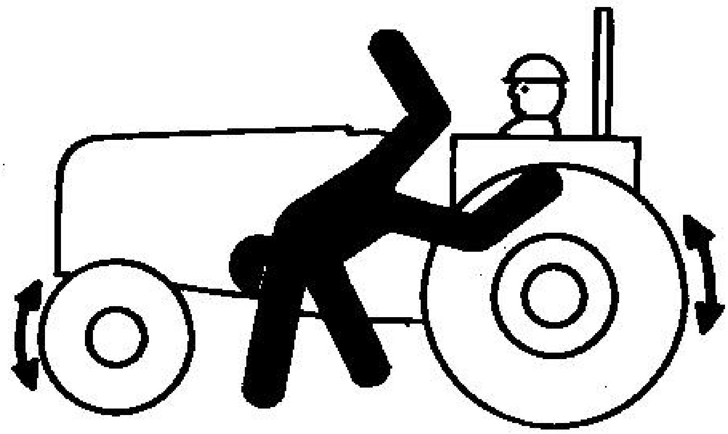
Do not lift or carry anyone on loader, in bucket, or on implement or attachment.

Lower loader to ground before leaving operators station.

The Rollover Protective Structure (ROPS) or cab roof, if equipped, may not provide sufficient protection from load falling onto the operators station. To prevent loads from falling onto the operators station, always use appropriate implements for specific applications (that is, manure forks, round bale forks, round bale grippers, and clampers).

Ballast tractor in accordance to Ballast Recommendations in PREPARE TRACTOR section.

Keep Riders Off Machine

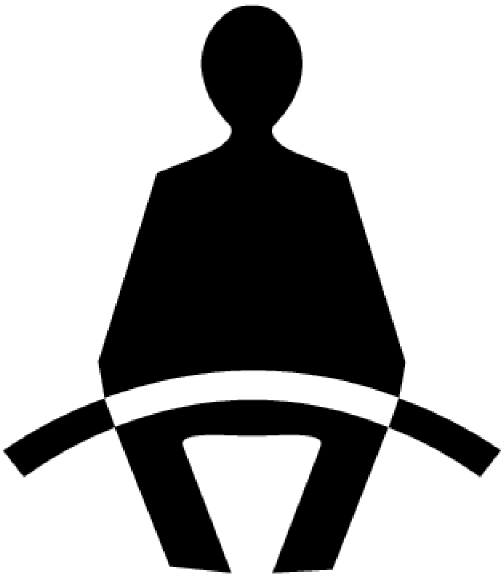


Keep Riders Off

Only allow the operator on the machine. Keep riders off.

Riders on machine are subject to injury such as being struck by foreign objects and being thrown off of the machine. Riders also obstruct the operator’s view resulting in the machine being operated in an unsafe manner.

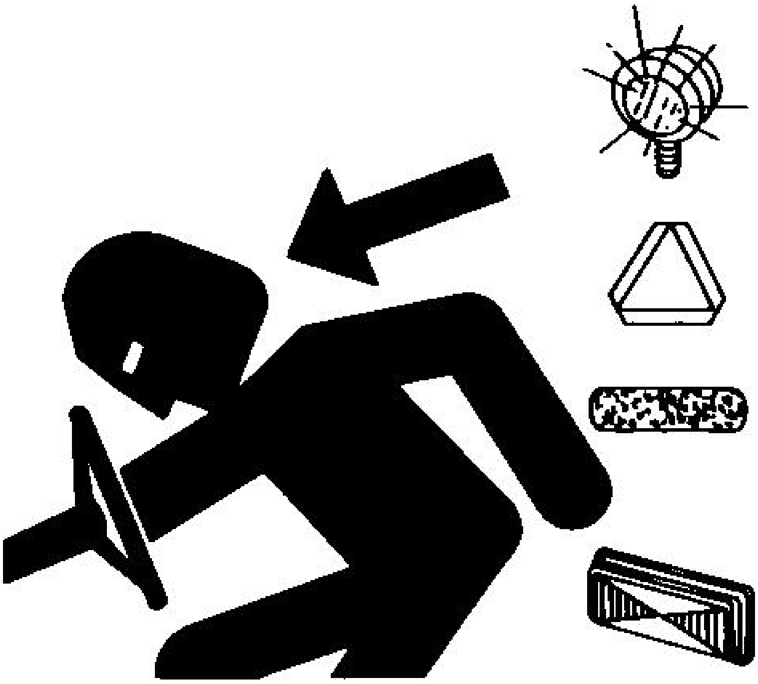
Instructional Seat



Use Seat Belt

The instructional seat, if so equipped, has been provided only for training operators or diagnosing machine problems.

Use Safety Lights and Devices

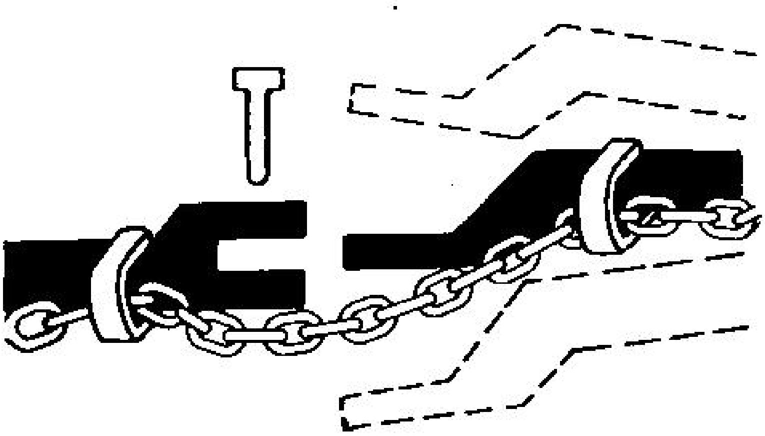


Prevent Collisions

Prevent collisions between other road users, slow moving tractors with attachments or towed equipment, and self-propelled machines on public roads. Frequently check for traffic from the rear, especially in turns, and use turn signal lights.

Use headlights, flashing warning lights, and turn signals day and night. Follow local regulations for equipment lighting and marking. Keep lighting and marking visible, clean, and in good working order. Replace or repair lighting and marking that has been damaged or lost. An implement safety lighting kit is available from your John Deere dealer.

Use a Safety Chain



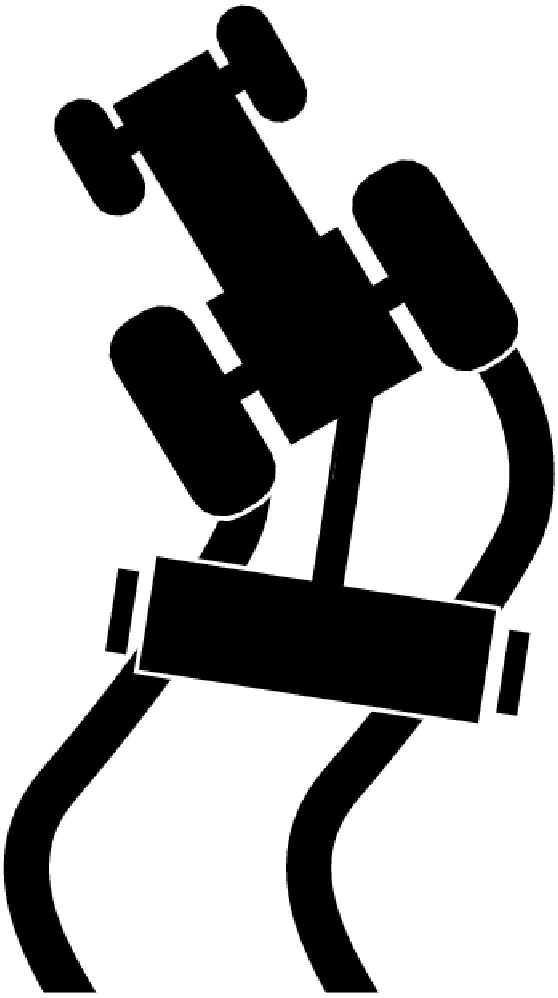
Safety Chain

A safety chain will help control drawn equipment should it accidentally separate from the drawbar.

Using the appropriate adapter parts, attach the chain to the tractor drawbar support or other specified anchor location. Provide only enough slack in the chain to permit turning.

See your John Deere dealer for a chain with a strength rating equal to or greater than the gross weight of the towed machine. Do not use safety chain for towing.

Transport Towed Equipment at Safe Speeds



Tractor

Do not exceed the maximum transport speed. This tractor is capable of operating at transport speeds that exceed the maximum allowable transport speed for most towed implements.

Before transporting a towed implement, determine from signs on the implement or information provided in the implement′s operator manual the maximum transport speed. Never transport at speeds that exceed the implement′s maximum transport speed. Exceeding the implement′s maximum transport speed can result in:

- Loss of control of the tractor/implement combination
- Reduced or no ability to stop during braking
- Implement tire failure
- Damage to the implement structure or its components

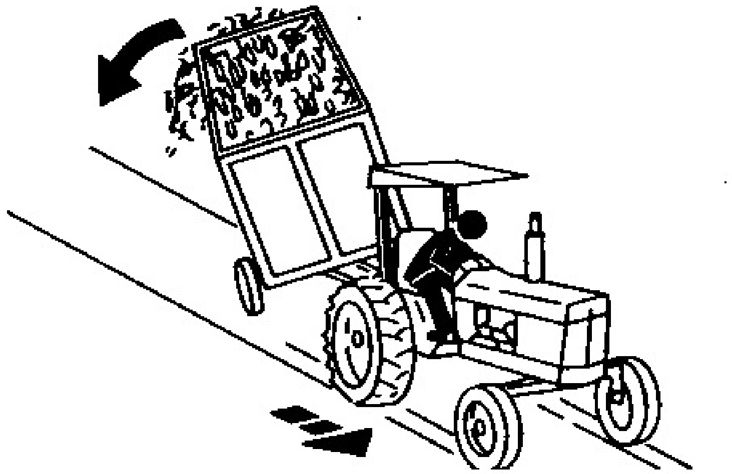
Implements without brakes:

- Do not transport at speeds greater than 32 km/h (20 mph).
- Must weigh less than 1.5 times the tractor weight and less than 1.5 t (3300 lb) when fully loaded.

Implements with brakes:

- If the manufacturer does not specify a maximum transport speed, do not tow at speeds greater than 40 km/h (25 mph).
- When transporting at speeds up to 40 km/h (25 mph) the fully loaded implement must weigh less than 4.5 times the tractor weight.
- When transporting at speeds between 40—50 km/h (25—31 mph) the fully loaded implement must weigh less than 3.0 times the tractor weight.

Towing Trailers/Implements Safely (Mass)



Towing trailers/implements safely (mass)

Stopping distance increases with speed and mass of trailer/implement, and when transporting on slopes. Towed mass with or without brakes that is too heavy for the tractor or is towed too fast can cause loss of control. Consider the total weight of the equipment and its load.

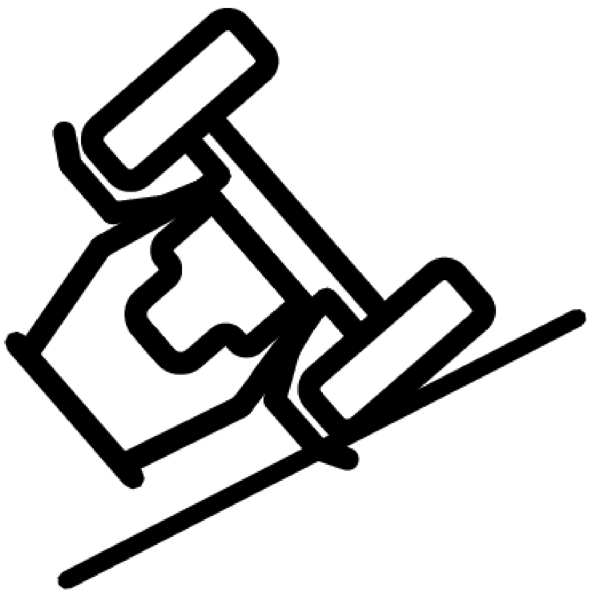
Tow Towed Mass Safely

Trailer/implement brake system	Top speed
- unbraked	25 km/h (15.5 mph)
- independent	25 km/h (15.5 mph)
- overrun brake	25 km/h (15.5 mph)
- hydraulic brake	25 km/h (15.5 mph)
- single-line air brake	25 km/h (15.5 mph)
- dual-line air brake	Maximum design speed

There may be legal limits in force that restrict travel speeds to figures lower than those quoted here.

Use additional caution when towing loads under adverse surface conditions, when turning, and on inclines.

Use Caution On Slopes and Uneven Terrain



Slopes

Avoid holes, ditches, and obstructions which cause the tractor to tip, especially on slopes. Avoid sharp uphill turns.

Driving forward out of a ditch, mired condition, or up a steep slope could cause tractor to tip over rearward. Back out of these situations if possible.

Danger of overturn increases greatly with narrow tread setting, at high speed.

Not all conditions that can cause a tractor to overturn are listed. Be alert for any situation in which stability may be compromised.

Slopes are a major factor related to loss-of-control and tip-over accidents, which can result in severe injury or death. Operation on all slopes requires extra caution

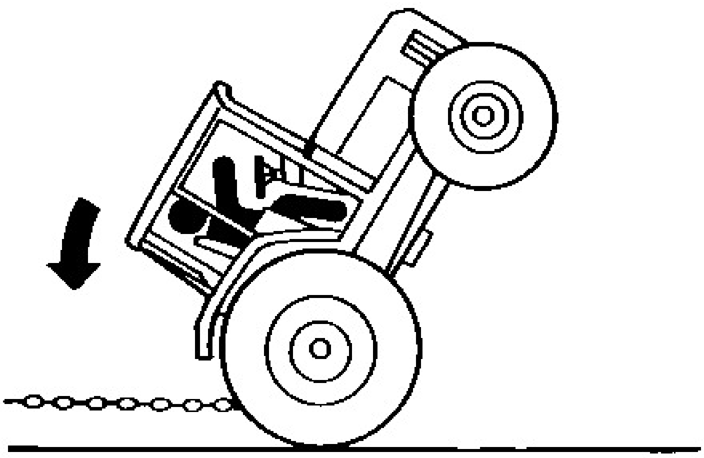
Never drive near the edge of a gully, drop-off, ditch, steep embankment, or a body of water. The machine could suddenly roll over if a wheel goes over the edge or the ground caves in

Choose a low ground speed so you will not have to stop or shift while on a slope.

Avoid starting, stopping or turning on a slope. If the tires lose traction, disengage the PTO and proceed slowly, straight down the slope.

Keep all movement on slopes slow and gradual. Do not make sudden changes in speed or direction, which could cause the machine to roll over.

Freeing a Mired Machine



Tractor Tipping

Cable Recoiling

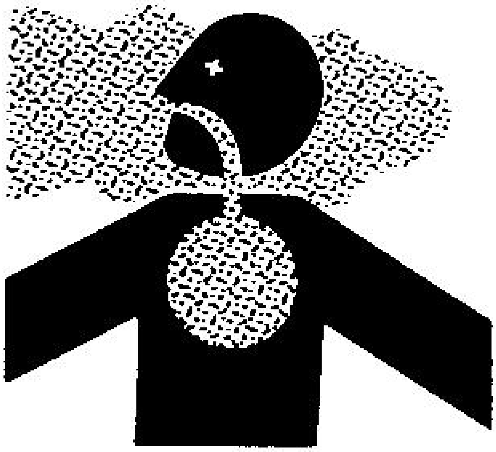
Attempting to free a mired machine can involve safety hazards such as the mired tractor tipping rearward, the towing tractor overturning, and the tow chain or tow bar (a cable is not recommended) failing and recoiling from its stretched condition.

Back your tractor out if it gets mired down in mud. Unhitch any towed implements. Dig mud from behind the rear wheels. Place boards behind the wheels to provide a solid base and try to back out slowly. If necessary, dig mud from the front of all wheels and drive slowly ahead.

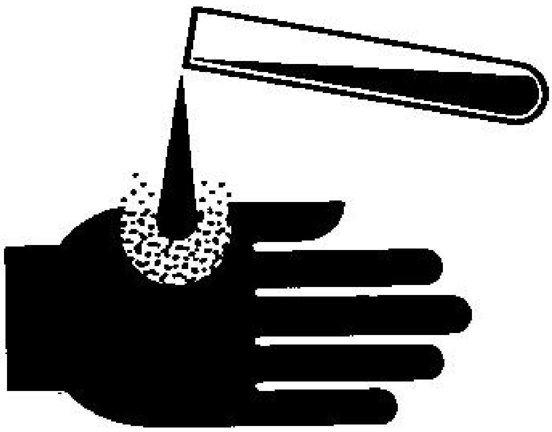
If necessary to tow with another unit, use a tow bar or a long chain (a cable is not recommended). Inspect the chain for flaws. Make sure all parts of towing devices are of adequate size and strong enough to handle the load.

Always hitch to the drawbar of the towing unit. Do not hitch to the front pushbar attachment point. Before moving, clear the area of people. Apply power smoothly to take up the slack: a sudden pull could snap any towing device causing it to whip or recoil dangerously.

Avoid Contact with Agricultural Chemicals



Harmful Pesticides



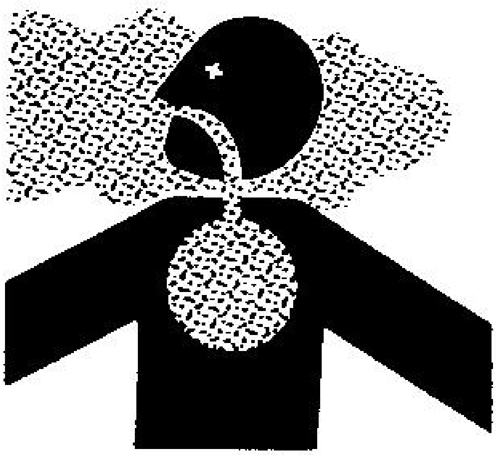
Pesticide Use

This enclosed cab does not protect against inhaling vapor, aerosol or dust. If pesticide use instructions require respiratory protection, wear an appropriate respirator inside the cab.

Before leaving the cab, wear personal protective equipment as required by the pesticide use instructions. When re-entering the cab, remove protective equipment and store either outside the cab in a closed box or some other type of sealable container or inside the cab in a pesticide resistant container, such as a plastic bag.

Clean your shoes or boots to remove soil or other contaminated particles prior to entering the cab.

Handle Agricultural Chemicals Safely



Safety

A34471

Safety

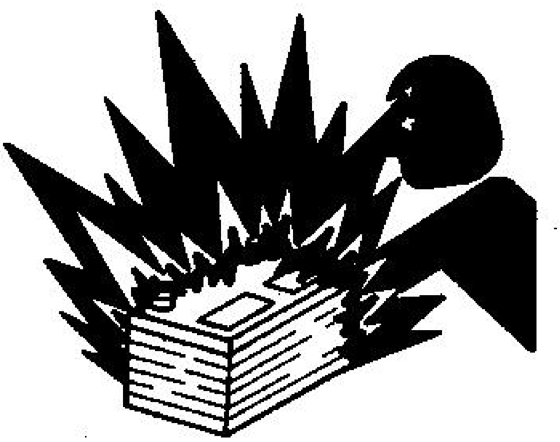
Chemicals used in agricultural applications such as fungicides, herbicides, insecticides, pesticides, rodenticides, and fertilizers can be harmful to your health or the environment if not used carefully.

Always follow all label directions for effective, safe, and legal use of agricultural chemicals.

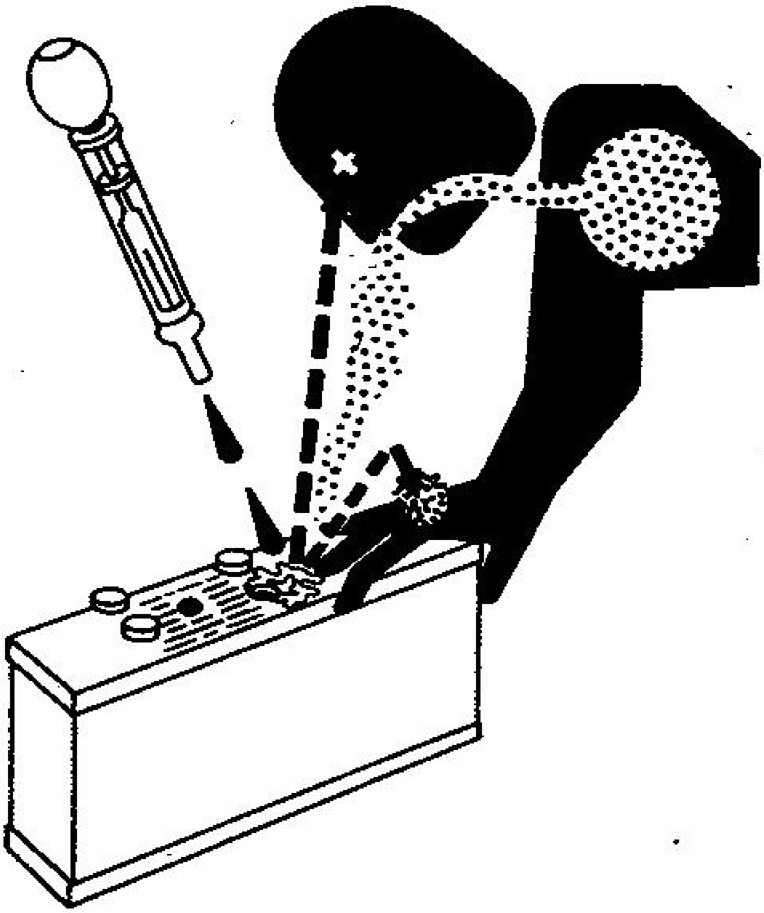
Reduce risk of exposure and injury:

- Wear appropriate personal protective equipment as recommended by the manufacturer. In the absence of manufacturer′s instructions, follow these general guidelines:
    - Chemicals labeled ′**Danger**′ : Most toxic. Generally require use of goggles, respirator, gloves, and skin protection.
    - Chemicals labeled ′**Warning**′ : Less toxic. Generally require use of goggles, gloves, and skin protections.
    - Chemicals labeled ′**Caution**′ : Least toxic. Generally require use of gloves and skin protection.
- Avoid inhaling vapor, aerosol or dust.
- Always have soap, water, and towel available when working with chemicals. If chemical contacts skin, hands, or face, wash immediately with soap and water. If chemical gets into eyes, flush immediately with water.
- Wash hands and face after using chemicals and before eating, drinking, smoking, or urination.
- Do not smoke or eat while applying chemicals.
- After handling chemicals, always bathe or shower and change clothes. Wash clothing before wearing again.
- Seek medical attention immediately if illness occurs during or shortly after use of chemicals.
- Keep chemicals in original containers. Do not transfer chemicals to unmarked containers or to containers used for food or drink.
- Store chemicals in a secure, locked area away from human or livestock food. Keep children away.
- Always dispose of containers properly. Triple rinse empty containers and puncture or crush containers and dispose of properly.

Handling Batteries Safely



Caution



Caution

Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (-) battery clamp first and replace grounded clamp last.

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

Avoid hazards by:

- Filling batteries in a well-ventilated area
- Wearing eye protection and rubber gloves
- Avoiding use of air pressure to clean batteries
- Avoiding breathing fumes when electrolyte is added
- Avoiding spilling or dripping electrolyte
- Using correct battery booster or charger procedure.

If acid is spilled on skin or in eyes:

1. Flush skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 qt.).
3. Get medical attention immediately.

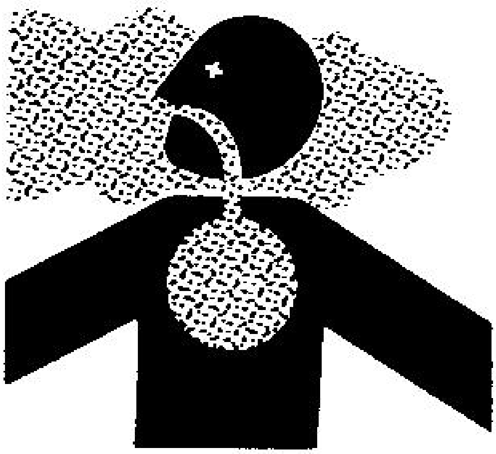
WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

Avoid Heating Near Pressurized Fluid Lines

Flammable Spray

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when heat goes beyond the immediate flame area.

Remove Paint Before Welding or Heating



Toxic Fumes

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 100 mm (4 in.) from area to be affected by heating. If paint cannot be removed, wear an approved respirator before heating or welding.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper

containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do not use a chlorinated solvent in areas where welding will take place.

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

Handle Electronic Components and Brackets Safely

falling hazard

Falling while installing or removing electronic components mounted on equipment can cause serious injury. Use a ladder or platform to easily reach each mounting location. Use sturdy and secure footholds and handholds. Do not install or remove components in wet or icy conditions.

If installing or servicing a RTK base station on a tower or other tall structure, use a certified climber.

If installing or servicing a global positioning receiver mast used on an implement, use proper lifting techniques and wear proper protective equipment. The mast is heavy and can be awkward to handle. Two people are required when mounting locations are not accessible from the ground or from a service platform.

Practice Safe Maintenance

Keep Area Clean

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet , and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

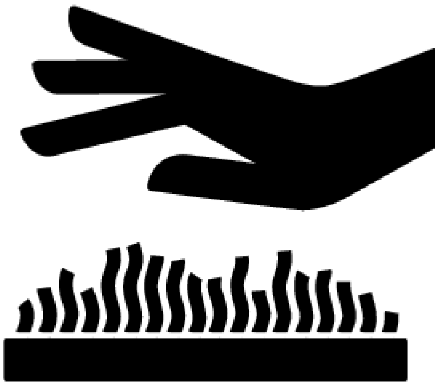
Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.

Avoid Hot Exhaust



Safety—Hot Parts

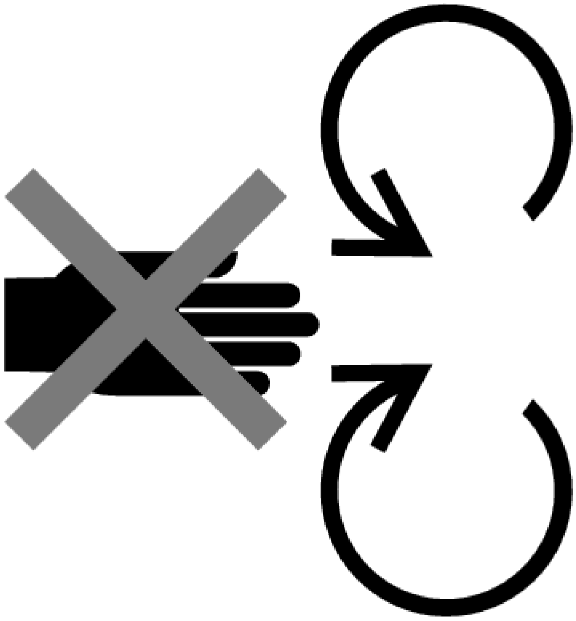
Servicing machine or attachments with engine running can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

Exhaust parts and streams become very hot during operation. Exhaust gases and components reach temperatures hot enough to burn people, ignite, or melt common materials.

Clean Exhaust Filter Safely

Fire Safety

Hand Over Flame



Moving Parts

Stop

During exhaust filter cleaning operations, the engine may run at elevated idle and hot temperatures for an extended period of time. Exhaust gases and exhaust filter components reach temperatures hot enough to burn people, or ignite or melt common materials.

Keep machine away from people, animals, or structures which may be susceptible to harm or damage from hot exhaust gases or components. Avoid potential fire or explosion hazards from flammable materials and vapors near the exhaust. Keep exhaust outlet away from people and anything that can melt, burn, or explode.

Closely monitor machine and surrounding area for smoldering debris during and after exhaust filter cleaning.

Adding fuel while an engine is running can create a fire or explosion hazard. Always stop engine before refueling machine and clean up any spilled fuel.

Always make sure that engine is stopped while hauling machine on a truck or trailer.

Contact with exhaust components while still hot can result in serious personal injury.

Avoid contact with these components until cooled to safe temperatures.

If service procedure requires engine to be running:

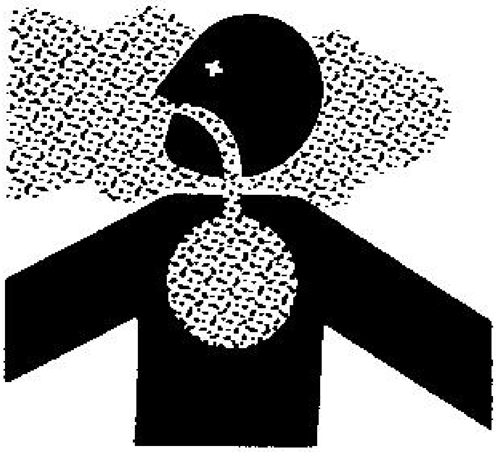
- Only engage power-driven parts required by service procedure
- Ensure that other people are clear of operator station and machine

Keep hands, feet, and clothing away from power-driven parts.

Always disable movement (neutral), set the parking brake or mechanism and disconnect power to attachments or tools before leaving the operator’s station.

Shut off engine and remove key (if equipped) before leaving the machine unattended.

Work In Ventilated Area

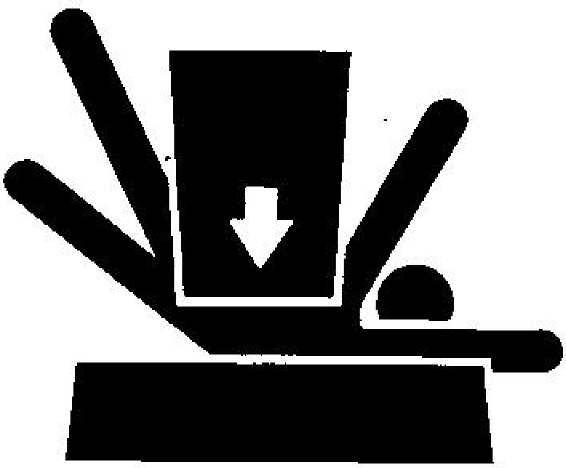


Engine exhaust fumes

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

Support Machine Properly



Support Properly

Always lower the attachment or implement to the ground before you work on the machine. If the work requires that the machine or attachment be lifted, provide secure support for them. If left in a raised position, hydraulically supported devices can settle or leak down.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

When implements or attachments are used with a machine, always follow safety precautions listed in the implement or attachment operator′s manual.

Prevent Machine Runaway

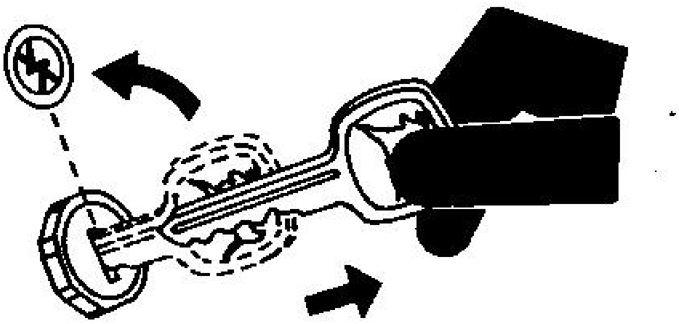
Machinery Runaway

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start engine only from operator’s seat, with transmission in neutral or park.

Park Machine Safely

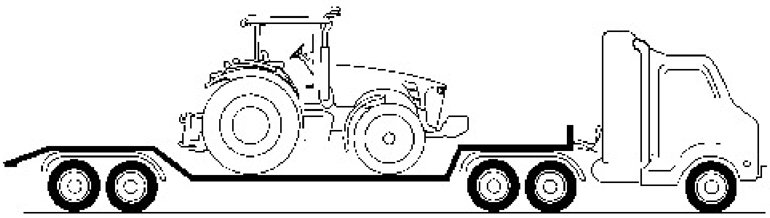


Remove the Key

Before working on the machine:

- Lower all equipment to the ground.
- Stop the engine and remove the key.
- Disconnect the battery ground strap.
- Hang a "DO NOT OPERATE" tag in operator station.

Transport Tractor Safely



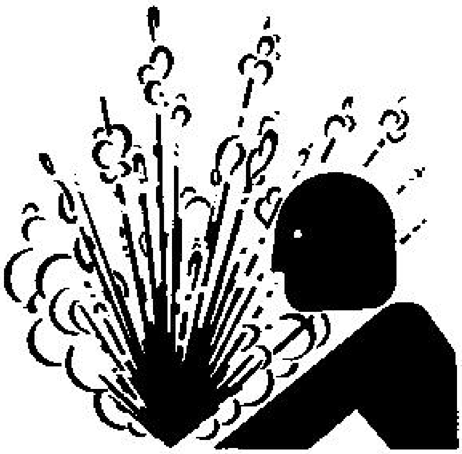
Transport Tractor Safely

A disabled tractor is best transported on a flatbed carrier. Use chains to secure the tractor to the carrier. The axles and tractor frame are suitable attachment points.

Before transporting the tractor on a low-loader truck or flatbed rail wagon, make sure that the hood is secured over the tractor engine and that doors, roof hatch (if equipped) and windows are properly closed.

Never tow a tractor at a speed greater than 10 km/h (6 mph). An operator must steer and brake the tractor under tow.

Service Cooling System Safely

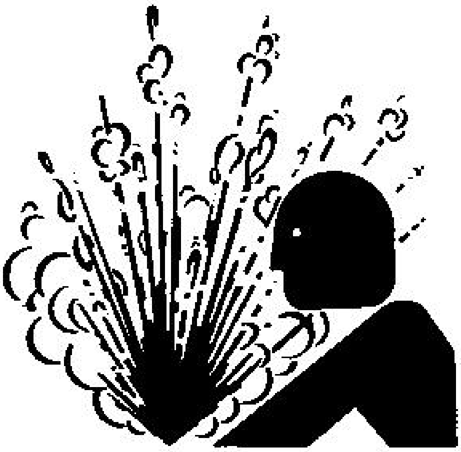


Cooling System

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

Service Accumulator Systems Safely



Hydraulic Accumulator

Escaping fluid or gas from systems with pressurized accumulators that are used in air conditioning, hydraulic, and air brake systems can cause serious injury. Extreme heat can cause the accumulator to burst, and pressurized lines can be accidentally cut. Do not weld or use a torch near a pressurized accumulator or pressurized line.

Relieve pressure from the pressurized system before removing accumulator.

Relieve pressure from the hydraulic system before removing accumulator. Never attempt to relieve hydraulic system or accumulator pressure by loosening a fitting.

Accumulators cannot be repaired.

Service Tires Safely

Explosive Tire and Rim Parts

Explosive separation of a tire and rim parts can cause serious injury or death.

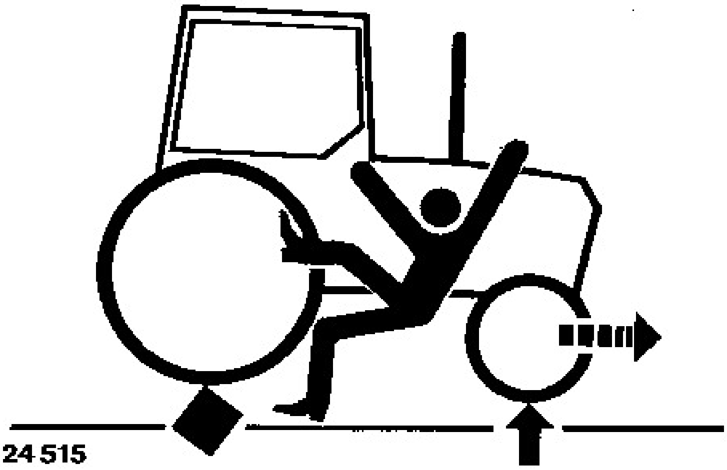
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and NOT in front of or over the tire assembly. Use a safety cage if available.

Check wheels for low pressure, cuts, bubbles, damaged rims, or missing lug bolts and nuts.

Service Front-Wheel Drive Tractor Safely

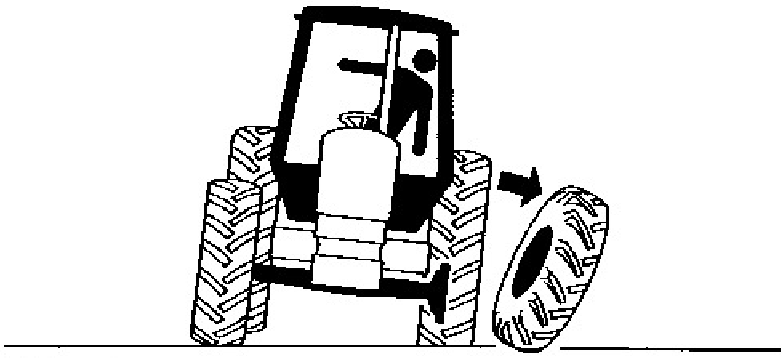


L124 515

SafetyTractor Rolling Forward

When servicing front-wheel drive tractor with the rear wheels supported off the ground and rotating wheels by engine power, always support front wheels in a similar manner. Loss of electrical power or transmission hydraulic system pressure will engage the front driving wheels, pulling the rear wheels off the support if front wheels are not raised. Under these conditions, front drive wheels can engage even with switch in disengaged position.

Tightening Wheel Retaining Bolts/Nuts

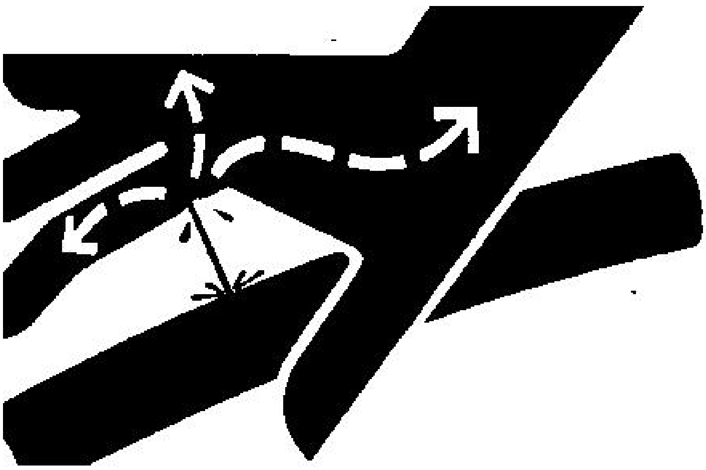


L124 516

Torque

Torque wheel retaining bolts/nuts at the intervals specified in section Break-In Period and Service.

Avoid High-Pressure Fluids



High Pressure

Inspect hydraulic hoses periodically – at least once per year – for leakage, kinking, cuts, cracks, abrasion, blisters, corrosion, exposed wire braid or any other signs of wear or damage.

Replace worn or damaged hose assemblies immediately with John Deere approved replacement parts.

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available in English from Deere & Company Medical Department in Moline, Illinois, U.S.A., by calling 1-800-822-8262 or +1 309-748-5636.

Do Not Open High-Pressure Fuel System

High-Pressure Fuel Lines

High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt repair of fuel lines, sensors, or any other components between the high-pressure fuel pump and nozzles on engines with High Pressure Common Rail (HPCR) fuel system.

Only technicians familiar with this type of system can perform repairs. (See your John Deere dealer.)

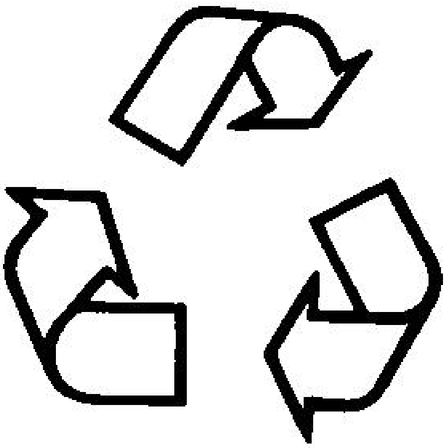
Store Attachments Safely

Stored Attachments

Stored attachments such as dual wheels, cage wheels, and loaders can fall and cause serious injury or death.

Securely store attachments and implements to prevent falling. Keep playing children and bystanders away from storage area.

Dispose of Waste Properly



Recycle Waste

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth’s atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

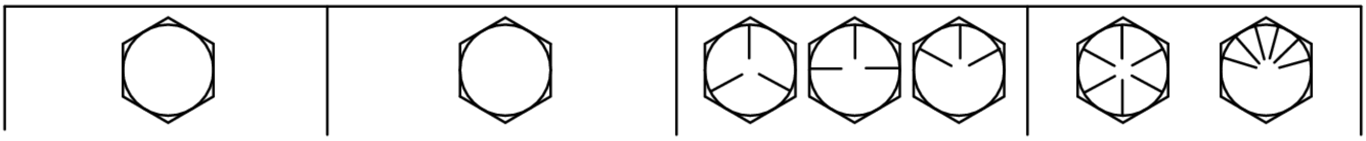
Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.

Section 20 - SPECIFICATIONS AND INFORMATION

Table of contents

Group 05 - General Specifications

Unified Inch Bolt and Screw Torque Values

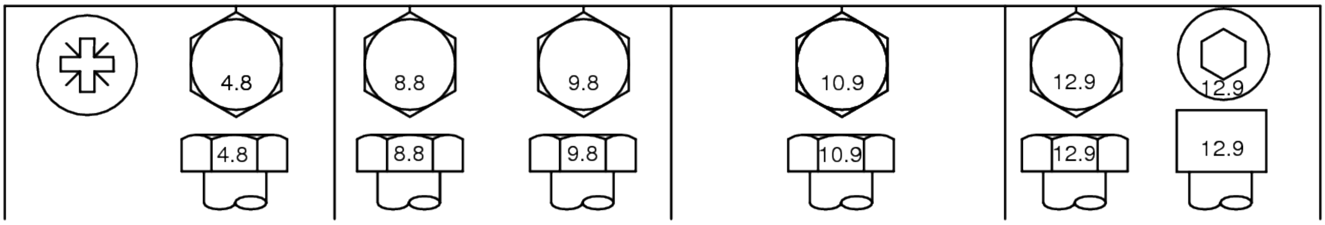


Unified Inch Bolt and Screw

Unified Inch Bolt and Screw Torque Values

Bolt or Screw Size	SAE Grade 1				SAE Grade 2 [Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
	Lubricated ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		Dry ["Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B, F13E or F13H zinc flake coating.]		Lubricated ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		Dry ["Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B, F13E or F13H zinc flake coating.]		Lubricated ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		Dry ["Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B, F13E or F13H zinc flake coating.]		Lubricated ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		Dry ["Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B, F13E or F13H zinc flake coating.]	
	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N·m	lb.-ft.	N·m	lb.-ft.
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N·m	lb.-ft.	N·m	lb.-ft.				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N·m	lb.-ft.														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350
Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.									Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.							

Metric Bolt and Screw Torque Values



Metric Bolt and Screw

Metric Torque Values

Bolt or Screw Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		**Dry** ["Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B, F13E or F13H zinc flake coating.]		**Lubricated** ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		**Dry** ["Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B, F13E or F13H zinc flake coating.]		**Lubricated** ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		**Dry** ["Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B, F13E or F13H zinc flake coating.]		**Lubricated** ["Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.]		**Dry** ["Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B, F13E or F13H zinc flake coating.]	
	N·m	**lb.-in.**	**N·m**	**lb.-in.**	**N·m**	**lb.-in.**	**N·m**	**lb.-in.**	**N·m**	**lb.-in.**	**N·m**	**lb.-in.**	**N·m**	**lb.-in.**	**N·m**	**lb.-in.**
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N·m	**lb.-ft.**	**N·m**	**lb.-ft.**	**N·m**	**lb.-ft.**	**N·m**	**lb.-ft.**
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N·m	**lb.-ft.**	**N·m**	**lb.-ft.**	**N·m**	**lb.-ft.**								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N·m	**lb.-ft.**														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

Metric Cap Screw Torque Values—Grade 7

→NOTE:

When bolting aluminum parts, tighten to 80% of torque specified in table.

Metric Cap Screw Torque Values—Grade 7

Size	N˙m	(lb-ft)
M6	9.5—12.2	(7—9)
M8	20.3—27.1	(15—20)
M10	47.5—54.2	(35—40)
M12	81.4—94.9	(60—70)
M14	128.8—146.4	(95—108)
M16	210.2—240	(155—177)

Gasket Sealant Application

Cleaning— Clean both surfaces that will be joined using 100% isopropyl alcohol. Wipe excess off with a clean cloth. Cleaner/degreaser can be substituted for isopropyl alcohol.

How to Dispense, Apply, and Assemble Gasket Sealants— Dispence approximately 1 to 2 oz. of flexible form-in-place gasket on a clean sheet or table top. Avoid using excess amounts that may be exposed for long periods of time. This will help prevent contamination from surrounding atmosphere such as dust with metal content.

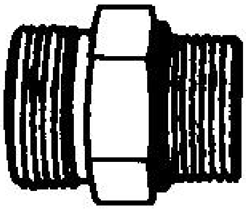
Using an ink roller or similar device, apply to one surface of the joint by loading the roller from a plastic sheet and transferring the material in a thin film to the joint. The application should be the thinnest film possible, but providing complete coverage. This can be judged by the appearance of the joint once it is put together. Excessive amounts of material will cause incorrect bearing end play, extend cure time, and will cause runoff of the material. A small bead or buildup at the joint is permissible and indicates good dispersion through the joint. Excess can be wiped from the joint. Joining should take place within three minutes after sealant application.

Apply proper cap screw torque and sequence as applicable. Allow a minimum of 30 minutes before air test or adding oil for test stand usage.

Disassembly— Cured material can be removed with a wire brush or scraper. Chemical cleaners are available for use, should they be deemed necessary.

Service Recommendations for O-Ring Boss Fittings

Straight Fitting



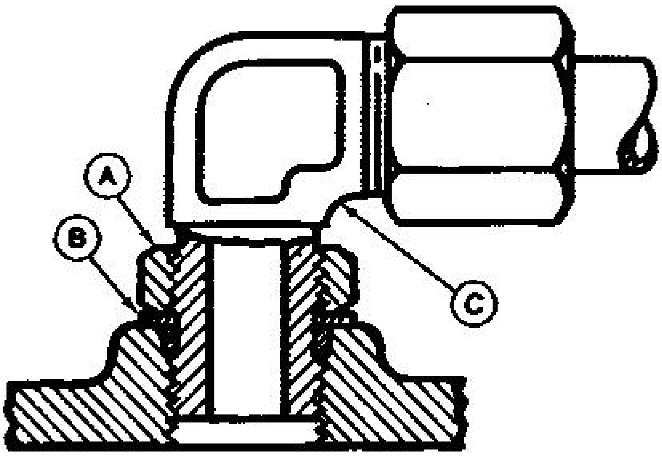
Straight Fitting

[1] - Inspect O-ring boss seat for dirt or defects.

[2] - Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.

[3] - Tighten fitting to torque value shown on chart.

Angle Fitting



Angle Fitting

[1] - Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.

[2] - Turn fitting into threaded boss until back-up washer contacts face of boss.

[3] - Turn fitting head-end counterclockwise to proper index (maximum of one turn).

[4] -

→NOTE:

Do not allow hoses to twist when tightening fittings.

Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.

Straight Fitting or Special Nut Torque Chart

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART		
Thread Size	**N˙m**	**lb-ft**
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160

→NOTE:

Torque tolerance is ± 10%.

Service Recommendations for Flat Face O-Ring Seal Fittings

[1] - Inspect the fitting sealing surfaces and O-ring. They must be free of dirt or defects.

[2] - Lubricate O-rings and install into groove using petroleum jelly to hold in place.

[3] - Index angle fittings and tighten by hand, pressing joint together to ensure O-ring remains in place.

[4] - Tighten fitting or nut to torque value shown on the chart. Do not allow hoses to twist when tightening fittings; use back-up wrench on straight hose couplings.

IMPORTANT:

Tighten fittings to 150% of listed torque value if indexing is necessary or if fitting is attached to an actuating device.

Tighten fittings to 50% of listed torque value if used in aluminum housing.

O-ring Seal Fitting Torque

FLAT FACE O-RING SEAL FITTING TORQUE*						
Nomial Tube OD		**Thread Size**	**Swivel Nut**		**Bulkhead Nut**	
mm	**in.**	**in.**	**N˙m**	**lb.-ft.**	**N˙m**	**lb.-ft.**
6.35	0.250	9/16-18	16	12	12	9
9.52	0.375	11/16-16	24	18	24	18
12.70	0.500	13/16-16	50	37	46	34
15.88	0.625	1-14	69	51	62	46
19.05	0.750	1-3/16-12	102	75	102	75
22.22	0.875	1-3/16-12	102	75	102	75
25.40	1.000	1-7/16-12	142	105	142	105
31.75	1.250	1-11/16-12	190	140	190	140
38.10	1.500	2-12	217	160	217	160
*Torque tolerance is +15 -20% unless otherwise specified.						

Stud End O-Ring Seal Torque for Straight and Adjustable Fittings*				
Thread Size	**Straight Hex Size**	**Lock Nut Hex Size**	**Straight Fitting or Lock Nut Toque**	
Inch	**Inch**	**Inch**	**N˙m**	**lb.-ft.**
3/8-24	5/8	9/16	12	9
7/16-20	5/8	5/8	21	15
1/2-20	3/4	11/16	26	19
9/16-18	3/4	3/4	34	25
3/4-16	7/8	15/16	73	55
7/8-14	1-1/16	1-1/16	104	76
1-1/16-12	1-1/4	1-3/8	176	130
1-3/16-12	1-3/8	1-1/2	230	170
1-5/16-12	1-1/2	1-5/8	285	210
*Torque tolerance is +15 -20% unless otherwise specified.				

Group 10 - Fuel and Lubricants

Diesel Fuel

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended. Renewable diesel fuel produced by hydrotreating animal fats and vegetable oils is basically identical to petroleum diesel fuel. Renewable diesel that meets EN 590 or ASTM D975 is acceptable for use at all percentage mixture levels.

Required Fuel Properties

In all cases, the fuel shall meet the following properties:

Cetane number of 43 minimum. Cetane number greater than 47 is preferred, especially for temperatures below –20 °C (–4 °F) or elevations above 1500 m (5000 ft.).

Cold Filter Plugging Point (CFPP) should be at least 5 °C (9 °F) below the expected lowest temperature or **Cloud Point** below the expected lowest ambient temperature.

Fuel lubricity should pass a maximum scar diameter of 0.52 mm as measured by ASTM D6079 or ISO 12156-1. A maximum scar diameter of 0.45 mm is preferred.

Diesel fuel quality and sulfur content must comply with all existing emissions regulations for the area in which the engine operates. DO NOT use diesel fuel with sulfur content greater than 10000 mg/kg (10000 ppm).

Sulfur content for Interim Tier 4, Final Tier 4, Stage III B, and Stage IV Engines

- Use ONLY ultra low sulfur diesel (ULSD) fuel with a maximum of 15 mg/kg (15 ppm) sulfur content.

Sulfur Content for Tier 3 and Stage III A Engines

- Use of diesel fuel with sulfur content less than 1000 mg/kg (1000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 1000—2000 mg/kg (1000—2000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 2000 mg/kg (2000 ppm), contact your John Deere dealer.

Sulfur Content for Tier 2 and Stage II Engines

- Use of diesel fuel with sulfur content less than 2000 mg/kg (2000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 2000—5000 mg/kg (2000—5000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm), contact your John Deere dealer.

Sulfur Content for Other Engines

- Use of diesel fuel with sulfur content less than 5000 mg/kg (5000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm) REDUCES the oil and filter change interval.

IMPORTANT:

Do not mix used diesel engine oil or any other type of lubricating oil with diesel fuel.

Improper fuel additive usage may cause damage on fuel injection equipment of diesel engines.

Handling and Storing Diesel Fuel

CAUTION:

Reduce the risk of fire. Handle fuel carefully. DO NOT fill the fuel tank when engine is running. DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

Keep all storage tanks as full as practicable to minimize condensation.

Ensure that all fuel tank caps and covers are installed properly to prevent moisture from entering. Monitor water content of the fuel regularly.

When using BioDiesel fuel, the fuel filter may require more frequent replacement due to premature plugging.

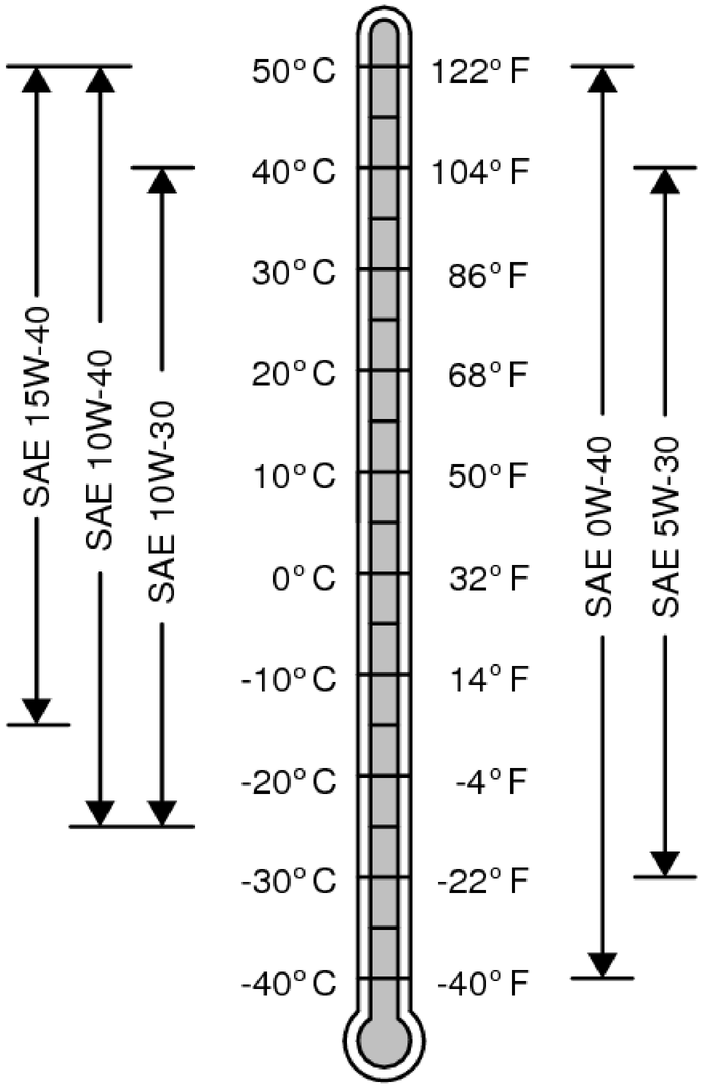
Check engine oil level daily prior to starting engine. A rising oil level may indicate fuel dilution of the engine oil.

IMPORTANT:

The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and prevent water condensation. Contact your fuel supplier or John Deere dealer for recommendations.

Engine Oil



Oil Viscosities for Air Temperature Ranges

Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following John Deere oils are preferred:

- PLUS-50™ II
- TORQ-GARD SUPREME™

Other oils may be used if above John Deere oils are not available, provided they meet the following specification:

3033R, 3039R, and 3046R (Models with aftertreatment device)

- API Service Classification CJ-4
- ACEA Specification E6 or E9
- JASO Specification DH-2

3033R, 3038R, and 3045R (Models without aftertreatment device)

- API Service Classification CD, CF, CF-4, CI-4 or CJ-4
- ACEA Specification E-3, E-4, E-5 or E-6
- JASO Specification DH-1 or DH-2

Diesel fuel quality and fuel sulfur content must comply with all existing emissions regulations for the area in which the engine operates.

Alternative and Synthetic Lubricants

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual.

Some John Deere brand coolants and lubricants may not be available in your location.

Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements as shown in this manual.

The temperature limits and service intervals shown in this manual apply to both conventional and synthetic lubricants.

Re-refined base stock products may be used if the finished lubricant meets the performance requirements.

Lubricant Storage

Your equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

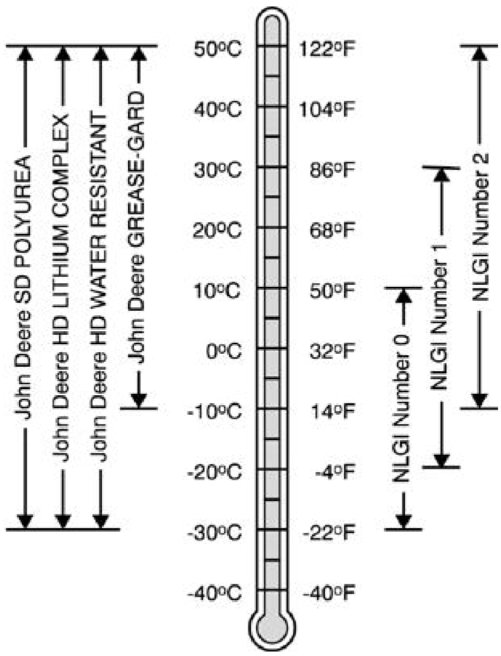
Mixing of Lubricants

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere dealer to obtain specific information and recommendations.

Grease



Greases for Air Temperature Ranges

Use grease based on NLGI consistency numbers and the expected air temperature range during the service interval.

John Deere SD Polyurea Grease is preferred.

The following greases are also recommended:

- John Deere HD Lithium Complex Grease
- John Deere HD Water Resistant Grease
- John Deere GREASE-GARD ™

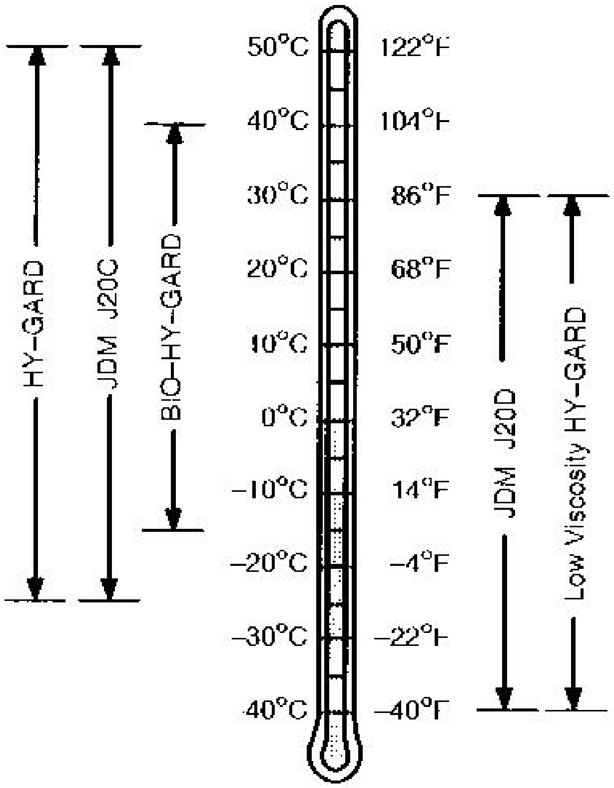
Other greases may be used if they meet the following:

- NLGI Performance Classification GC-LB

IMPORTANT:

Some types of grease thickeners are not compatible with others. Consult your grease supplier before mixing different types of grease.

Transmission and Hydraulic Oil



Transmission and Hydraulic Oil

Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following oils are preferred:

- John Deere HY-GARD ™
- John Deere Low Viscosity HY-GARD ™

Other oils may be used if they meet one of the following:

- John Deere Standard JDM J20C
- John Deere Standard JDM J20D

Use the following oil when a biodegradable fluid is required:

- John Deere
  [meets or exceeds the minimum biodegradability of 80% within 21 days according to CEC-L-33-T-82 test method. BIO-HY-GARD should not be mixed with mineral oils because this reduces the biodegradability and makes proper oil recycling impossible.]
  BIO-HY-GARD ™

Diesel Engine Coolant (engine with wet sleeve cylinder liners)

Preferred Coolants

The following pre-mix engine coolants are preferred:

- **John Deere COOL-GARD ™ II**
- **John Deere COOL-GARD II PG**

COOL-GARD II pre-mix coolant is available in several concentrations with different freeze protection limits as shown in the following table.

COOL-GARD II Pre-Mix—Freeze Protection Limit

COOL-GARD II pre-mix	Freeze Protection Limit
COOL-GARD II 20/80	-9 °C (16 °F)
COOL-GARD II 30/70	-16 °C (3 °F)
COOL-GARD II 50/50	-37 °C (-34 °F)
COOL-GARD II 55/45	-45 °C (-49 °F)
COOL-GARD II PG 60/40	-49 °C (-56 °F)
COOL-GARD II 60/40	-52 °C (-62 °F)

Not all COOL-GARD II pre-mix products are available in all countries.

Use COOL-GARD II PG when a non-toxic coolant formulation is required.

Additional Recommended Coolants

The following engine coolant is also recommended:

- John Deere COOL-GARD II Concentrate in a 40—60% mixture of concentrate with quality water.

IMPORTANT:

When mixing coolant concentrate with water, do not use less than 40% or greater than 60% concentration of coolant. Less than 40% gives inadequate additives for corrosion protection. Greater than 60% can result in coolant gelation and cooling system problems.

Other Coolants

Other ethylene glycol or propylene glycol base coolants may be used if they meet the following specification:

- Pre-mix coolant meeting ASTM D6210 requirements
- Coolant concentrate meeting ASTM D6210 requirements in a 40—60% mixture of concentrate with quality water

If coolant meeting one of these specifications is unavailable, use a coolant concentrate or pre-mix coolant that has a minimum of the following chemical and physical properties:

- Provides cylinder liner cavitation protection according to either the John Deere Cavitation Test Method or a fleet study run at or above 60% load capacity
- Is formulated with a nitrite-free additive package
- Protects the cooling system metals (cast iron, aluminum alloys, and copper alloys such as brass) from corrosion

Water Quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

Coolant Drain Intervals

Drain and flush the cooling system and refill with fresh coolant at the indicated interval, which varies with the coolant used.

When COOL-GARD II or COOL-GARD II PG is used, the drain interval is 6 years or 6000 hours of operation.

If a coolant other than COOL-GARD II or COOL-GARD II PG is used, reduce the drain interval to 2 years or 2000 hours of operation.

IMPORTANT:

Do not use cooling system sealing additives or antifreeze that contains sealing additives.

Do not mix ethylene glycol and propylene glycol base coolants.

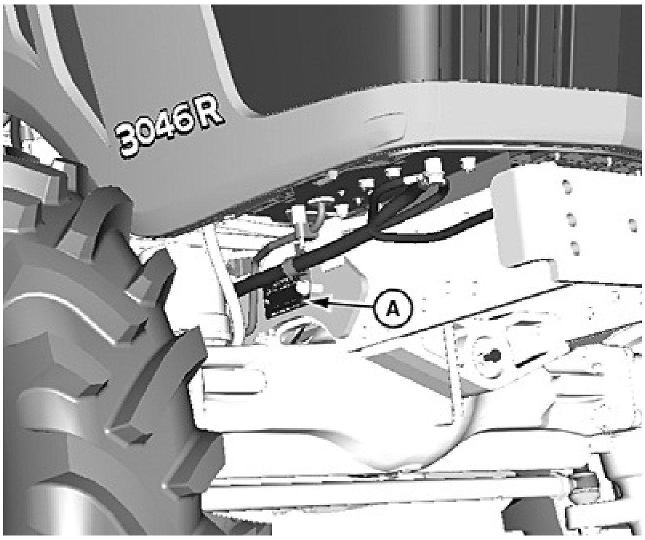
Do not use coolants that contain nitrites.

Group 15 - Serial Number Locations

Serial Numbers

When ordering parts or submitting a warranty claim, it is IMPORTANT that the machine product identification number (PIN) and component serial numbers are included. The location of the PIN, engine, and turbocharger serial numbers are provided below.

Machine Product Identification Number

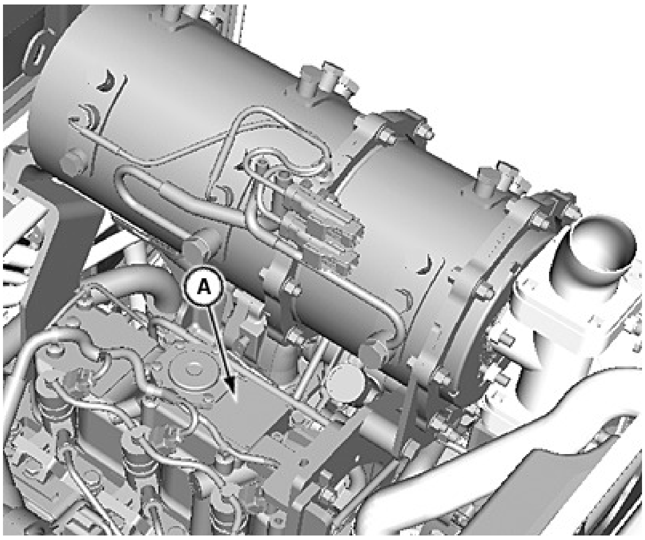


LEGEND:
A Machine Product Identification Number

Machine Serial Number

The machine’s product identification number plate is located on the right side of frame.

Engine Serial Number



LEGEND:
A Engine Serial Number

Engine Serial Number

The engine serial number plate is located on the top of the engine.

Section 25 - DIAGNOSTIC TROUBLE CODES

Table of contents

Group 05 - General References

Diagnostic Trouble Codes Overview

SPN.FMI Codes

Diagnostic Trouble Codes (DTC) are based on the CAN ISO and J1939 SAE Standards. These are worldwide standards for automotive and off-highway vehicles and are controlled by an ISO industry committee. There are two main parts that make up a DTC:

SPN - 'Suspect Parameter Number' - this is intended to identify where the problem exists. An example is '94' which the standard defines as "Fuel Delivery System". Any vehicles using the '94' in the DTC will therefore be defining a problem with the fuel delivery system. The list of possible SPNs is too large to provide here, but basically, codes in the lower numbers (at this time, below 5000) are 'assigned' numbers that are set standards. SPNs that contain 6 digits, such as 524255 are called 'proprietary', and are set up in blocks. An example would be 520000 – 540000 which might be assigned to John Deere Waterloo to use for parameters that are not already defined. At some point, if these proprietary numbers are approved by SAE and the CAN committee, they may be assigned a lower number and become available industry-wide.

FMI - ′Failure Mode Indicator′ - this is a standard set of numbers that defines how the SPN failed. FMIs are defined by the J1939 standard.

By combining the SPN and FMI, the code 000094.03 would mean the Fuel Delivery System input voltage is high. With the universal standard, this would apply to any CAN based vehicle.

Failure Modes:

Failure Modes

FMI	Condition
00	Data valid but above normal operating range- most severe level
01	Data valid but below normal operational range - most severe level
02	Data erratic, intermittent or incorrect
03	Voltage above normal, or shorted to high source
04	Voltage below normal, or shorted to low source
05	Current below normal or open circuit
06	Current above normal or grounded circuit
07	Mechanical system not responding or out of adjustment
08	Abnormal frequency or pulse width or period
09	Abnormal update rate
10	Abnormal rate of change
11	Root cause not known
12	Bad intelligent device or component
13	Out of calibration
14	Special instructions
15	Data valid but above normal operating range - least severe level
16	Data valid but above normal operating range - moderately severe level
17	Data valid but below normal operating range - least severe level
18	Data valid but below normal operating range - moderately severe level
19	Received network data in error
20	Data drifted high
21	Data drifted low
22-30	Reserved for SAE assignment
31	Not available or condition exists

Recall, Record, and Clear Codes

Codes are displayed as warning/alarm:

Stop (red Stop Sign): Vehicle/control unit detects a serious malfunction which requires immediate operator action. If vehicle is damaged, stop the system or engine immediately.

Service Alert (yellow Exclamation Point Sign): Vehicle/control unit detects a problem which requires operator action. Vehicle will be damaged or experience significant performance reduction if not serviced, repaired, or operated differently.

→NOTE:

When a diagnostic trouble code occurs, operational information is also recorded. Clearing the code, erases the operational information that could be used for diagnostic purposes. Always record code information before clearing from the control units.

Diagnostic trouble codes (DTC) can be accessed by the following methods:

- Service ADVISOR™
- Instrument Cluster Control (ICC)
- Performance Monitor

Service ADVISOR™—Recall, Record, and Clear Codes

Recall diagnostic trouble codes (DTC) through the "Diagnostics" panel. See Service ADVISOR™ Machine Connection Information (CTM441).

Instrument Cluster Control (ICC)—Recall, Record, and Clear Codes

Stored Diagnostic Trouble Codes (DTC) can be accessed with through the Instrument Cluster Control (ICC) screen. See Entering Diagnostic and Calibration Modes for more information on viewing DTC through the ICC.

If no code is present, NONE will appear on the screen.

If codes are present:

1. Record the code information.
2. Clear the DTCs from the controllers.
3. Operate machine and attempt to recreate code/problem based on conditions.

Performance Monitor—Recall, Record, and Clear Codes

LEGEND:

A	Performance Monitor
B	Test Harness
C	Service ADVISOR Connector

Connect Performance Monitor

1. Connect test harness (B) to performance monitor (A).
2. Turn key switch to ON position.

    →NOTE: The performance monitor automatically performs a self test and a bulb check (which takes about 2 seconds) once connected to the Service ADVISOR™ connector.
    →NOTE: The performance monitor receives its power via the Service ADVISOR™ connector from the battery positive terminal, not via the key switch.

   Connect test harness (B) to the Service ADVISOR™ connector (C).

4. There are two different entry modes into diagnostic mode: operator mode and technician mode. All diagnostic trouble codes can be accessed with the engine on or off and with the tractor in park or in motion. **Operator Mode:** The key switch must be on before connecting the performance monitor to the Service ADVISOR™ connector.Connect the performance monitor to the Service ADVISOR™ connector and wait a minimum of 5 seconds before pressing the service button. Hold the service button until the display changes to DIA.**Technician Mode:** Turn the key switch to OFF position.Turn the key switch back to ON before connecting the performance monitor to the Service ADVISOR™ connector.

    →NOTE: If the service button is not pressed within 5 seconds, the operator mode is automatically selected.

   Connect the performance monitor to the Service ADVISOR™ connector and within 5 seconds press and hold the service button.Hold the service button until the display changes to DIA.

5. Press the up button (A) or the down button (D) to scroll through the list of control units. Press the set/save button (C) once the desired control unit is displayed.

LEGEND:

A	Up Button
B	Next Button
C	Set/Save Button
D	Down Button
E	Clear Button
F	Service Button

Performance Monitor

6. Momentarily press the up button (A) or the down button (D) until address 001 is displayed.
7. If ”CODE” displays, press the set/save button (C) to enter the address to view stored codes. Go to step 8.If ”NONE” displays, there are currently no stored codes to display. Press the clear button (E) to return to the address list and press it again to return to the control unit list. Go back to step 5.
8. Momentarily press the up button (A) or the down button (D) to cycle through and record stored code information.

LEGEND:

A	Controller ID (when viewing DTCs) or Address Number (when scrolling through the list of addresses)
B	First Three Figures of Displayed Information (if the displayed information contains more than 5 characters)
C	Displayed Information

Performance Monitor Screen

9. Once all codes for this control unit have been scrolled through, ”clr” displays on the screen. Press the set/save button (C) to clear stored codes for this control unit. Any codes remaining are considered to be active codes and do not clear until they are diagnosed.

Erroneous Diagnostic Trouble Codes

On occasion, a DTC may appear or be recorded due to various anomalies such as electromagnetic interference, voltage or current spikes, lightning, or other similar but temporary conditions. These factors should be taken into account when performing diagnostic procedures.

A snapshot of the DTC in question can be analyzed in Service ADVISOR ™ to aid in the determination as to whether the code is erroneous or not.

Often times, these codes will be “missing or erratic data” or “abnormal update rate” types. These can also be caused by excessive CAN bus traffic that prevent lower priority messages from being transmitted.

A component on the machine or attachment may cause a false DTC as well. Commonly, false DTCs occur when a component in a circuit is switched on or off. These may consist of:

- Glow plugs
- Blower motors
- A/C compressors
- Horn
- Strobe/beacon lights
- Electric PTO clutches
- Electric solenoids

Gather as much information as possible about the operating conditions at the time the suspect code became active. If a component is suspect, cycle the component on and off several times to see if the DTC reoccurs.

Group 10 - Power Train Hydrostatic (PTH) Control Unit Diagnostic Trouble Codes

PTH 000084.08- MFWD Speed Abnormal Frequency

462

Code Cause: The MFWD speed is missing or signal is out of operating range while cruise control is not engaged.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 21. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is reading above 1000?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Check for the following conditions. Are they present?

- 5V at MFWD speed sensor
- Continuity between MFWD speed sensor and ground

Result:

YES: Go to next step.

NO: Troubleshoot power circuit.

(3) Step 3

Action:

Check MFWD speed sensor.

Does MFWD speed sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace MFWD sensor.

PTH 000084.31- MFWD Speed Not Available or Condition Exists

462

Code Cause: The MFWD speed is missing or signal is out of operating range while cruise control is engaged.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 20. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is reading above 0.5 or below?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Check for the following conditions. Are they present?

- 5V at MFWD speed sensor
- Continuity between MFWD speed sensor and ground

Result:

YES: Go to next step.

NO: Troubleshoot power circuit.

(3) Step 3

Action:

Check MFWD speed sensor.

Does MFWD speed sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace MFWD sensor.

PTH 000091.03- Throttle Sensor Input Voltage Above Normal, or Shorted to High Source

462

Code Cause: Hand throttle sensor input is short to power.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 28. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is voltage between 4.8 or higher?

Result:

YES: Go to next step.

NO: Test forward pedal sensor.

(2) Step 2

Action:

Perform Throttle Position Sensor Test and Adjustment .

Does throttle sensor test good?

Result:

YES: Go to next step.

NO: Replace throttle position sensor.

(3) Step 3

Action:

Disconnect the P03 throttle position sensor.

Measure sensor output voltage at pin B on throttle position sensor connector.

Is voltage between 5V or higher?

Result:

YES: Check for a short to power or short to another sensor wire. Repair wire or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000091.04- Throttle Sensor Input Voltage Below Normal, or Shorted to Low Source

462

Code Cause: Hand throttle sensor input is short to ground or open circuit.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 28. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is voltage present?

Result:

YES: Test forward pedal sensor.

NO: Go to next step.

(2) Step 2

Action:

Perform Throttle Position Sensor Test and Adjustment .

Does throttle sensor test good?

Result:

YES: Go to next step.

NO: Replace hand throttle sensor and perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

(3) Step 3

Action:

Disconnect the P03 throttle position sensor.

Check for continuity between pin B on throttle position sensor connector and ground.

Is continuity indicated?

Result:

YES: Check for a short to ground on harness. Repair wire or replace harness.

NO: Go to next step.

(4) Step 4

Action:

Disconnect the PTH connector.

Check for continuity between pin B on throttle position sensor connector and pin C3 on PTH connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Check for an open circuit on harness. Repair wire or replace harness.

PTH 000091.09- Throttle Sensor Abnormal Update Rate

462

Code Cause: Hand throttle sensor CAN data is missing.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 28 while moving lever through full range of motion. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is voltage present during the full motion?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Go to next step.

(2) Step 2

Action:

Perform Throttle Position Sensor Test and Adjustment .

Does throttle sensor test good?

Result:

YES: Go to next step.

NO: Replace hand throttle sensor and perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

(3) Step 3

Action:

Check for the following conditions, are they present?

- 5V at hand throttle sensor
- Continuity between hand throttle sensor and ground

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Troubleshoot power circuit.

PTH 000091.13- Throttle Sensor Out of Calibration

462

Code Cause: Hand throttle sensor is out of calibration.

Procedure:

(1) Step 1

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 000091.13 still present after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000091.15- Throttle Sensor Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: Hand throttle sensor input is above the normal operating range.

Procedure:

(1) Step 1

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 000091.13 still present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(2) Step 2

Action:

Check hand throttle sensor. See Throttle Position Sensor Test and Adjustment .

Does hand throttle position sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace hand throttle sensor and perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

PTH 000091.16- Throttle Sensor Data Valid but Above Normal Operating Range - Moderately Severe Level

462

Code Cause: Hand throttle sensor input is above the normal operating range.

Procedure:

(1) Step 1

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 000091.16 still present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(2) Step 2

Action:

Are there any other missing or abnormal update rate codes from other controllers?

Result:

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Check for the following conditions, are they present?.

- 5V at hand throttle sensor
- Continuity between hand throttle sensor and ground

Result:

YES: Go to next step.

NO: Troubleshoot power circuit.

(4) Step 4

Action:

Check hand throttle sensor. See Throttle Position Sensor Test and Adjustment .

Does hand throttle position sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace hand throttle sensor and perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

PTH 000091.17- Throttle Sensor Data Valid but Below Normal Operating Range - Least Severe Level

462

Code Cause: Hand throttle sensor input is below the normal operating range.

Procedure:

(1) Step 1

Action:

Check hand throttle rod adjustment.

Does hand throttle rod test good?

Result:

YES: Go to next step.

NO: Adjust hand throttle and Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

(2) Step 2

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 000091.17 still present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(3) Step 3

Action:

Check for the following conditions, are they present?

- 5V at hand throttle sensor
- Continuity between hand throttle sensor and ground

Result:

YES: Go to next step.

NO: Troubleshoot power circuit.

(4) Step 4

Action:

Check hand throttle sensor. See Throttle Position Sensor Test and Adjustment .

Does hand throttle position sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace hand throttle sensor and perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

PTH 000091.18- Throttle Sensor Data Valid but Below Normal Operating Range - Moderately Severe Level

462

Code Cause: Hand throttle sensor input is below the normal operating range.

Procedure:

(1) Step 1

Action:

Check hand throttle rod adjustment.

Does hand throttle rod test good?

Result:

YES: Go to next step.

NO: Adjust hand throttle and Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

(2) Step 2

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 000091.17 still present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(3) Step 3

Action:

Check for the following conditions, are they present?

- 5V at hand throttle sensor
- Continuity between hand throttle sensor and ground

Result:

YES: Go to next step.

NO: Troubleshoot power circuit.

(4) Step 4

Action:

Check hand throttle sensor. See Throttle Position Sensor Test and Adjustment .

Does hand throttle position sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace hand throttle sensor and perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

PTH 000158.00- Switch Battery Potential Data Valid but Above Normal Operation Range - Most Severe Level

462

Code Cause: Switched power is above normal operation range.

Procedure:

(1) Step 1

Action:

Perform Alternator Test .

Does alternator test good?

Result:

YES: Go to next step.

NO: Replace alternator.

(2) Step 2

Action:

Key switch ON, check for voltage at pin G1 at the transmission control unit connector?

Is voltage greater that 16V?

Result:

YES: Troubleshoot and repair short to power on power circuit.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000158.01- Switched Power Valid but Below Normal Operation Range - Most Severe Level

462

Code Cause: Switched power is below normal operation range.

Procedure:

(1) Step 1

Action:

Key switch ON, check for voltage at pin 5 on the key switch?

Is voltage below 9V?

Result:

YES: Troubleshoot and repair power circuit.

NO: Go to next step.

(2) Step 2

Action:

Key switch ON, check for voltage at pin H1 at the transmission control unit connector?

Is voltage below 9V?

Result:

YES: Troubleshoot and repair power circuit.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000168.00- Supply Power Valid but Above Normal Operational Range - Most Severe Level

462

Code Cause: Unswitched power is above normal operation range.

Procedure:

(1) Step 1

Action:

Check for voltage at pin L1 at the transmission control unit connector?

Is voltage greater than 16V?

Result:

YES: Troubleshoot and repair power circuit.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000168.01- Supply Power Valid but Below Normal Operation Range - Most Severe Level

462

Code Cause: Supply power is below normal operation range.

Procedure:

(1) Step 1

Action:

Check for voltage at pin L1 at the transmission control unit connector?

Is voltage below 10V?

Result:

YES: Troubleshoot and repair power circuit.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000190.09- Engine Speed Abnormal Update Rate

462

Code Cause: Engine speed data is missing or abnormal update rate over CAN network.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU crank and/or cam sensor codes present, troubleshoot sensor(s).

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to PTH?

Result:

YES: Check ECU to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 000190.09 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000190.15- Engine Speed Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: Engine speed data is out of range high.

Procedure:

(1) Step 1

Action:

Are engine speed codes present in the engine control unit (ECU)?

Result:

YES: Diagnose and resolve ECU codes.

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU crank and/or cam sensor codes present, troubleshoot sensor(s).

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to PTH?

Result:

YES: Check ECU to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 000190.15 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000190.16- Engine Speed Data Valid but Above Normal Operating Range - Moderately Severe Level

462

Code Cause: Engine speed data is out of range high.

Procedure:

(1) Step 1

Action:

Are engine speed codes present in the engine control unit (ECU)?

Result:

YES: Diagnose and resolve ECU codes.

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU crank and/or cam sensor codes present, troubleshoot sensor(s).

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to PTH?

Result:

YES: Check ECU to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 000190.16 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000190.17- Engine Speed Data Valid but Below Normal Operating Range - Least Severe Level

462

Code Cause: Low-idle engine speed is below the normal operating range.

Procedure:

(1) Step 1

Action:

Are engine speed codes present in the engine control unit (ECU)?

Result:

YES: Diagnose and resolve ECU codes.

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU crank and/or cam sensor codes present, troubleshoot sensor(s).

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to PTH?

Result:

YES: Check ECU to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 000190.17 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000190.18- Engine Speed Data Valid but Below Normal Operating Range - Moderately Severe Level

462

Code Cause: High-idle engine speed is below the normal operating range.

Procedure:

(1) Step 1

Action:

Are engine speed codes present in the engine control unit (ECU)?

Result:

YES: Diagnose and resolve ECU codes.

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU crank and/or cam sensor codes present, troubleshoot sensor(s).

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to PTH?

Result:

YES: Check ECU to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 000190.18 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000191.00- Transmission Output Shaft Speed Data Valid but Above Normal Operational Range - Most Severe Level

462

Code Cause: Transmission output shaft speed is above the acceptable range while in hitch assist mode.

Procedure:

(1) Step 1

Action:

Perform MFWD Speed Sensor Test ?

Does sensor test good?

Result:

YES: Go to next step.

NO: Replace sensor.

(2) Step 2

Action:

Check the following circuits at B33 MFWD speed sensing switch.

- Key switch ON: 5V at pin A of sensor
- Ground present at pin C of connector
- Continuity between pin B of sensor connector and M4 of controller

Do the circuits test good?

Result:

YES: Go to next step.

NO: Repair circuits or replace harness.

(3) Step 3

Action:

Check park brake linkage. See Parking Brake Adjustment .

Does linkage test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Adjust park brake linkage.

PTH 000596.31- Cruise Control Enable Switch Not Available or Condition Exists

462

Code Cause: Both cruise control enable switch and max speed are active.

Procedure:

(1) Step 1

Action:

Are max speed and cruise control switches both engaged?

Result:

YES: Disengage switches, only one at a time can be active.

NO: Go to next step.

(2) Step 2

Action:

Check for battery voltage at pin 3 on cruise enable switch.

Is battery voltage present at enable switch?

Result:

YES: Test cruise control switch.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000599.03- Cruise Control Enable Switch Voltage Above Normal, or Shorted to High Source

462

Code Cause: Cruise control switch is stuck in the ON position or short to power.

Procedure:

(1) Step 1

Action:

Is cruise control switch stuck in the momentary position?

Result:

YES: Replace switch.

NO: Go to next step.

(2) Step 2

Action:

Check for battery voltage at pin 6 on cruise enable switch.

Is battery voltage present at enable switch?

Result:

YES: Test cruise control switch.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000599.31- Resume Enable Switch Not Available or Condition Exists

462

Code Cause: The PTH detects both the cruise ON signal and resume signal.

Procedure:

(1) Step 1

Action:

Check for battery voltage at pin 6 and pin 3 on cruise enable switch.

Is battery voltage present at both pins?

Result:

YES: Test cruise control switch.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000601.03- Resume Enable Switch Voltage Above Normal, or Shorted to High Source

462

Code Cause: The cruise control resume switch is stuck in the ON position or short to power.

Procedure:

(1) Step 1

Action:

Observe reading at address PTH 3. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is value shown as 1 or 2?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Disconnect S46 cruise control module.

Check for battery voltage at pin M on module.

Is battery voltage present?

Result:

YES: Check wire to PTH for a short to power or short to another sensor wire.

NO: Go to next step.

(3) Step 3

Action:

Disconnect PTH connector.

Check for battery voltage at pin D4 on PTH connector.

Is battery voltage present?

Result:

YES: Check wire to PTH for a short to power or short to another sensor wire.

NO: Replace cruise control module.

PTH 000628.02- Program Memory Data Erratic, Intermittent or Incorrect

462

Code Cause: The PTH EOL parameters are missing or are not valid for the current configuration.

Procedure:

(1) Step 1

Action:

Program PTH. See Programming Control Units .

Is PTH 000628.02 still present after programming?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000628.12- Program Memory Bad Intelligent Device or Component

462

Code Cause: The PTH software has failed or does not exist on PTH.

Procedure:

(1) Step 1

Action:

Program PTH. See Programming Control Units .

Is PTH 000628.02 still present after programming?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace transmission control unit.

PTH 000630.14- Calibration Memory Special Instructions

462

Code Cause: Application software has found invalid EEPROM parameters on PTH.

Procedure:

(1) Step 1

Action:

Program PTH. See Programming Control Units .

Is PTH 000628.02 still present after programming?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace transmission control unit.

PTH 000752.15- Transmission Secondary Shift Selector Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: Motion Match switch voltage is above normal or short to power.

Procedure:

(1) Step 1

Action:

Key ON.

Disconnect S46 cruise control module.

Check for battery voltage at pin E on module.

Is 4.75V or more present on input circuit?

Result:

YES: Check wire to PTH for a short to power or short to another sensor wire.

NO: Go to next step.

(2) Step 2

Action:

Key switch ON.

Disconnect PTH connector.

Check for battery voltage at pin J2 on PTH connector.

Is 4.75V or more present on input circuit?

Result:

YES: Troubleshoot power circuit.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000752.17- Transmission Secondary Shift Selector Data Valid but Below Normal Operating Range - Least Severe Level

462

Code Cause: Motion Match switch voltage is below normal operating conditions or open circuit.

Procedure:

(1) Step 1

Action:

Key ON.

Disconnect S46 cruise control module.

Disconnect PTH connector.

Check continuity between pin E on module and pin J2 on PTH connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Open circuit on harness. Repair or replace harness.

PTH 000767.03- Transmission Hitch Assist Switch Voltage Above Normal, or Shorted to High Source

462

Code Cause: Hitch assist switch voltage above normal or short to power.

Procedure:

(1) Step 1

Action:

Check hitch assist for continuity between pins 5 and 6 while in the OFF position.

Is continuity indicated?

Result:

YES: Replace switch.

NO: Go to next step.

(2) Step 2

Action:

Key switch ON, hitch assist OFF.

Check hitch assist PTH input circuit for voltage?

Is voltage present?

Result:

YES: Troubleshoot input circuit for short to power.

NO: Perform Troubleshooting Unresolved Problems .

PTH 000810.14- Hitch Assist Speed Sensor Integrity is out of Range

462

Code Cause: Hitch assist speed sensor integrity is out of range.

Procedure:

(1) Step 1

Action:

Are there any MFWD or speed sensor DTCs present?

Result:

YES: Diagnose and resolve any active PTH code first.

NO: Go to next step.

(2) Step 2

Action:

Check and adjust park brake.

Is code PTH 000810.14 present after adjustment?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 000903.03- Hitch Assist Direction Switch Voltage Above Normal

45

Code Cause: Hitch assist forward direction switch voltage above normal.

Procedure:

(1) Step 1

Action:

Disconnect the hitch assist module.

Key ON.

Check for voltage at pins 2 and 3 of hitch assist connector.

Is battery voltage present?

Result:

YES: Repair short to power on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 001504.31- Operator Seat Switch Not Available or Condition Exists

462

Code Cause: The seat switch is open while either of the pedals are depressed. Operator in the seat before depressing a pedal.

Procedure:

(1) Step 1

Action:

Access address PTH 8 (Operator presence switch) or measure for battery voltage (operator present) at PTH . Is a “1” displayed or voltage present?

Result:

YES: Go to next step.

YES: Check seat switch wires for short to battery voltage.

(2) Step 2

Action:

Perform Seat Switch Test .

Does switch test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace seat switch.

PTH 002017.09- Source Address 17 Abnormal Update Rate

462

Code Cause: ICC CAN Transmission enable signal abnormal update rate or lost.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 000190.09 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 003509.00- Sensor Supply Voltage Data Valid but Above Normal Operational Range - Most Severe Level

462

Code Cause: The sensor supply voltage (5V) is above normal or short to power.

Procedure:

(1) Step 1

Action:

Observe status at address PTH 28. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is 5.15V or more present?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Disconnect P02 reverse pedal sensor, P01 forward pedal sensor, or P03 hand throttle sensor.

Check for voltage at the following pins:

- Pins 3 and 6 on P01 forward pedal sensor.
- Pins 3 and 6 on P02 reverse pedal sensor.
- Pin C on hand throttle sensor.

Is 5.15V or more present?

Result:

YES: Repair short to battery voltage on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems.

PTH 003509.00- Sensor Supply Voltage Data Valid but Above Normal Operational Range - Most Severe Level

462

Code Cause: The sensor supply voltage (5V) is above normal or short to power.

Procedure:

(1) Step 1

Action:

Observe status at address PTH 28. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller.

Is 5.15V or more present?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems.

(2) Step 2

Action:

Disconnect P02 reverse pedal sensor, P01 forward pedal sensor, or P03 hand throttle sensor.

Check for voltage at the following pins:

- Pins 3 and 6 on P01 forward pedal sensor.
- Pins 3 and 6 on P02 reverse pedal sensor.
- Pin C on hand throttle sensor.

Is 5.15V or more present?

Result:

YES: Repair short to battery voltage on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems.

PTH 003509.01- Sensor Supply Voltage Data Valid but Below Normal Operational Range - Most Severe Level

462

Code Cause: The sensor supply voltage (5V) is below normal or shorted to ground.

(0) Step 1

Action:

Disconnect P03 hand throttle sensor.

Check for voltage at pin C on hand throttle sensor.

Is 4.85V or less present?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Go to next step.

(1) Step 2

Action:

Disconnect PTH connector.

Check for continuity between pin K2 on PTH connector and ground.

Is continuity present?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Go to next step.

(2) Step 3

Action:

Disconnect P03 hand throttle sensor and PTH connector.

Check for continuity between pin C of throttle P03 and pin K2 on PTH connector?

Is continuity present?

Result:

YES: Repair open on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems.

PTH 521991.00- Controller Temperature Data Valid but Above Normal Operational Range - Most Severe Level

462

Code Cause: PTH Temperature is severely high.

Procedure:

(1) Step 1

Action:

Are there any external heat sources near the PTH or has the PTH been subjected to extreme ambient temperature?

Result:

YES: Remove PTH from heat source.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does code return?

Result:

YES: Replace controller.

NO: Diagnosis complete.

PTH 521991.01- Controller Temperature Data Valid but Below Normal Operational Range - Most Severe Level

462

Code Cause: PTH Temperature is severely low.

Procedure:

(1) Step 1

Action:

Has the PTH been exposed to severe cold ambient temperatures?

Result:

YES: Remove the PTH from cold temperatures.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does code return?

Result:

YES: Replace controller.

NO: Diagnosis complete.

PTH 521991.15- Controller Temperature Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: PTH Temperature is slightly high.

Procedure:

(1) Step 1

Action:

Are there any external heat sources near the PTH or has the PTH been subjected to extreme ambient temperatures?

Result:

YES: Remove PTH from heat source.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does code return?

Result:

YES: Replace controller.

NO: Diagnosis complete.

PTH 521991.16- Controller Temperature Data Valid but Above Normal Operating Range - Moderately Severe Level

462

Code Cause: PTH Temperature is moderately high.

Procedure:

(1) Step 1

Action:

Are there any external heat sources near the PTH or has the PTH been subjected to extreme ambient temperatures?

Result:

YES: Remove PTH from heat source.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does code return?

Result:

YES: Replace controller.

NO: Diagnosis complete.

PTH 521991.17- Controller Temperature Data Valid but Below Normal Operating Range - Least Severe Level

462

Code Cause: PTH Temperature is slightly low.

Procedure:

(1) Step 1

Action:

Has the PTH been exposed to severe cold ambient temperatures?

Result:

YES: Remove the PTH from cold temperatures.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does code return?

Result:

YES: Replace controller.

NO: Diagnosis complete.

PTH 521991.18- Controller Temperature Data Valid but Below Normal Operating Range - Moderately Severe Level

462

Code Cause: PTH Temperature is moderately low.

Procedure:

(1) Step 1

Action:

Has the PTH been exposed to severe cold ambient temperatures?

Result:

YES: Remove the PTH from cold temperatures.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does code return?

Result:

YES: Replace controller.

NO: Diagnosis complete.

PTH 522019.04- ELX2 State Voltage Below Normal, or Shorted to Low Source

462

Code Cause: The ELX transmission enable pin is incorrectly in a low state.

Procedure:

(1) Step 1

Action:

Remove fuse F14 and check fuse for continuity.

Is continuity indicated?

Result:

YES: Go to next step.

NO: Replace fuse.

(2) Step 2

Action:

Perform Key Switch Test .

Does switch test good?

Result:

YES: Go to next step.

NO: Replace key switch.

(3) Step 3

Action:

Replace fuse F14.

Disconnect the PTH connector and the key switch.

Check for continuity between pin 4 on the key switch and pin M1 on the PTH connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair open on harness or replace harness.

PTH 523498.03- Hitch Assist Voltage Above Normal or Shorted to High Source

462

Code Cause: Hitch assist enable direction switch voltage above normal.

Procedure:

(1) Step 1

Action:

Disconnect the hitch assist module.

Key ON.

Check for voltage at pin 4 of hitch assist connector.

Is battery voltage present?

Result:

YES: Repair short to power on harness or replace harness.

NO: Replace hitch assist module.

PTH 523590.03- Machine Drive Forward Pedal Voltage Above Normal, or Shorted to High Source

462

Code Cause: Forward pedal sensor is above normal operating range or short to power.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 32 and 35. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is 100% value present on either channel?

Result:

YES: Go to next step.

NO: Test forward pedal sensor. See Forward and Reverse Pedal Sensor Test and Adjustment .

(2) Step 2

Action:

Disconnect the P01 forward pedal sensor.

Measure sensor output voltage at pins 2 and 5 on forward pedal sensor connector.

Is voltage between 5V or higher?

Result:

YES: Check for a short to power or short to another sensor wire. Repair wire or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 523590.04- Machine Drive Forward Pedal Voltage Below Normal, or Shorted to Low Source

462

Code Cause: Forward pedal sensor input is below normal operating range or short to ground.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 32 and 35. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is 0% value present on either channel?

Result:

YES: Go to next step.

NO: Test forward pedal sensor. See Forward and Reverse Pedal Sensor Test and Adjustment .

(2) Step 2

Action:

Disconnect the P01 forward pedal sensor.

Check for continuity to ground on pins 2 and 5 on forward pedal sensor connector.

Is continuity indicated?

Result:

YES: Check for a short to ground or short to another sensor wire.

NO: Go to next step.

(3) Step 2

Action:

Disconnect the PTH connector.

Check for continuity between the following pins:

- Pin 2 on forward pedal sensor and pin F3 of PTH connector.
- Pin 5 on forward pedal sensor and pin H3 of PTH connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Check for a an open circuit were continuity was not indicated. Repair wire or replace harness.

PTH 523590.08- Machine Drive Forward Pedal Abnormal Frequency or Pulse Width or Period

462

Code Cause: Forward pedal channel signal has an abnormal frequency or pulse width.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P01 forward pedal sensor.

PTH 523590.13- Machine Drive Forward Pedal Out of Calibration

462

Code Cause: Forward pedal sensor is out of calibration.

Procedure:

(1) Step 1

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 523590.13 present after calibration?

Result:

YES: Repeat calibration procedure. If code returns, go to next step.

NO: End of tests.

(2) **Step 2**

Action:

Are other non calibration related codes still present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 523590.14- Machine Drive Forward Pedal Special Instructions

462

Code Cause: Forward pedal sensor connectors plugged into wrong location.

Procedure:

(1) **Step 1**

Action:

Is PTH 523591.14 present?

Result:

YES:P01 forward pedal sensor and P02 reverse pedal sensor are reversed. Swap connector locations. .

NO: Go to next step.

(2) **Step 2**

Action:

Verify the following circuit are in the correct locations:

- Circuit 4014— pin 2 on P01 connector and pin F3 on PTH connector.
- Circuit 4625— pin 5 on P01 connector and pin H3 on PTH connector.

Are circuits in the correct pins?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Remove pins and orient in the correct location.

PTH 523590.16- Machine Drive Forward Pedal Data Valid but Above Normal Operating Range - Moderately Severe Level

462

Code Cause: Forward pedal sensor full depressed values out of range high.

(0) **Step 1**

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P01 forward pedal sensor.

PTH 523590.18- Machine Drive Forward Pedal Data Valid but Below Normal Operating Range - Moderately Severe Level

462

Code Cause: Forward pedal sensor Neutral Position values out of calibration range.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P01 forward pedal sensor.

PTH 53590.31- Machine Drive Forward Pedal Not Available or Condition Exists

462

Code Cause: Both forward and reverse pedals are depressed simultaneously.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P01 forward pedal sensor.

PTH 523591.03- Machine Drive Reverse Pedal Voltage Above Normal, or Shorted to High Source

462

Code Cause: Reverse pedal sensor is above normal operating range or short to power.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 39 and 42. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is 100% value present on either channel?

Result:

YES: Go to next step.

NO: Test reverse pedal sensor. See Forward and Reverse Pedal Sensor Test and Adjustment .

(2) Step 2

Action:

Disconnect the P02 reverse pedal sensor.

Measure sensor output voltage at pins 2 and 5 on reverse pedal sensor connector.

Is voltage between 5V or higher?

Result:

YES: Check wire to PTH for a short to power or short to another sensor wire.

NO: Perform Troubleshooting Unresolved Problems .

PTH 523591.04- Machine Drive Reverse Pedal Voltage Below Normal, or Shorted to Low Source

462

Code Cause: Reverse pedal sensor input is below normal operating range or short to ground.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTH 39 and 42. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is 0% value present on either channel?

Result:

YES: Go to next step.

NO: Test forward pedal sensor. See Forward and Reverse Pedal Sensor Test and Adjustment .

(2) Step 2

Action:

Disconnect the P02 reverse pedal sensor.

Check for continuity to ground on pins 2 and 5 on reverse pedal sensor connector.

Is continuity indicated?

Result:

YES: Check for a short to ground or short to another sensor wire.

NO: Go to next step.

(3) Step 2

Action:

Disconnect the PTH connector.

Check for continuity between the following pins:

- Pin 2 on reverse pedal sensor and pin E3 of PTH connector.
- Pin 5 on reverse pedal sensor and pin G4 of PTH connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Check for a an open circuit were continuity was not indicated. Repair wire or replace harness.

PTH 523591.08- Machine Drive Reverse Pedal Abnormal Frequency or Pulse Width or Period

462

Code Cause: Reverse pedal channel signal is missing or abnormal update rate.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P02 reverse pedal sensor.

PTH 523591.13- Machine Drive Reverse Pedal Out of Calibration

462

Code Cause: Reverse pedal sensor input is out of calibration.

Procedure:

(1) Step 1

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 523591.13 present after calibration?

Result:

YES: Repeat calibration procedure. If code returns, go to next step.

NO: End of tests.

(2) Step 2

Action:

Are other non calibration related codes still present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 523591.14- Machine Drive Reverse Pedal Special Instructions

462

Code Cause: Reverse pedal sensor connectors plugged into wrong locations.

Procedure:

(1) Step 1

Action:

Is PTH 523590.14 present?

Result:

YES:P01 forward pedal sensor and P02 reverse pedal sensor are reversed. Swap connector locations. .

NO: Go to next step.

(2) Step 2

Action:

Verify the following circuit are in the correct locations:

- Circuit 4166— pin 2 on P02 connector and pin E3 on PTH connector.
- Circuit 4677— pin 5 on P02 connector and pin G4 on PTH connector.

Are circuits in the correct pins?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Remove pins and orient in the correct location.

PTH 523591.16- Machine Drive Reverse Pedal Data Valid but Above Normal Operating Range - Moderately Severe Level

462

Code Cause: Reverse pedal sensor full depressed values out of calibration range.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P02 reverse pedal sensor.

PTH 523591.18- Machine Drive Reverse Pedal Data Valid but Below Normal Operating Range - Moderately Severe Level

462

Code Cause: Reverse pedal sensor Neutral Position values out of calibration range.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P02 reverse pedal sensor.

PTH 523591.31- Machine Drive Reverse Pedal Not Available or Condition Exists

462

Code Cause: Reverse pedal sensor signal channels are no longer accurate.

Procedure:

(1) Step 1

Action:

Perform Forward and Reverse Pedal Sensor Test and Adjustment

Does the pedal test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace P02 reverse pedal sensor.

PTH 523655.31- Forward & Reverse inputs both active Not Available or Condition Exists

462

Code Cause: Both the forward and reverse pedals are depressed simultaneously. Release both the pedals. Depress one pedal at a time.

Procedure:

(1) Step 1

Action:

Are there any PTH codes present?

Result:

YES: Diagnose and resolve any active PTH code first.

NO: See Forward and Reverse Pedal Sensor Test and Adjustment .

PTH 523735.03- Clutch Driver Power Voltage Above Normal, or Shorted to High Source

462

Code Cause: The HST solenoid power supply voltage is above normal or short to power.

Procedure:

(1) Step 1

Action:

Disconnect Y06 reverse proportional or Y05 forward proportional Solenoid and test. See Proportional Drive Solenoid Test .

Do solenoids test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Check for voltage at pin 1 of solenoid Y6 or Y5?

Is 5.0V or more present?

Result:

YES: Repair short to battery voltage on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 523735.05- Clutch Driver Power Current Below Normal or Open Circuit

462

Code Cause: HST Solenoid power supply current below normal.

Procedure:

(1) Step 1

Action:

Disconnect Y06 reverse proportional or Y05 forward proportional Solenoid and test. See Proportional Drive Solenoid Test .

Doe solenoids test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect PTH connector.

Disconnect Y06 reverse proportional or Y05 forward proportional Solenoid.

Check for continuity between pin B2 on PTH connector and pin 1 of solenoid Y6 or Y5.

Is continuity present?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 523735.06- Clutch Driver Power Current Above Normal or Grounded Circuit

462

Code Cause: HST Solenoid power supply current above normal.

Procedure:

(1) Step 1

Action:

Disconnect Y06 reverse proportional or Y05 forward proportional Solenoid and test. See Proportional Drive Solenoid Test .

Doe solenoids test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect PTH connector.

Check for continuity between the pin B2 on PTH connector and ground

Is continuity present?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 523966.31- Come-Home Mode Procedure Detected

462

Code Cause: The Come-Home fuse was detected at startup.

Procedure:

(1) Step 1

Action:

Remove the load center cover.

Is there a fuse in the F3 service port in the load center?

Result:

YES: Remove fuse from service port.

NO: Go to next step.

(2) Step 2

Action:

Disconnect PTH connector.

Check for battery voltage at pin G1 on PTH connector.

Is battery voltage present?

Result:

YES: Repair short to power on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524061.03- Transmission Enable Command Voltage Above Normal, or Shorted to High Source

462

Code Cause: ICC is communicating vehicle motion is allowed when PTH never requested it.

Procedure:

(1) Step 1

Action:

Transmission in park, ignition ON.

Observe voltage at address PTH 56 5-5. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is value shown as 2?

Result:

YES: Repair short to power on circuit 4034 between pins J1 on PTH connector and pin 3H on ICC connector.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524061.04- Transmission Enable Command Voltage Below Normal, or Shorted to Low Source

462

Code Cause: PTH is requesting trans enable and the ICC is not responding to the request.

Procedure:

(1) Step 1

Action:

Transmission in park, ignition ON.

Observe voltage at address PTH 56 5-5. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is value shown as 2?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Disconnect PTH connector and ICC connector.

Check for continuity between the pin J1 on PTH connector and pin 3H on ICC connector.

Is continuity present?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524061.31- Transmission Enable Command Not Available or Condition Exists

462

Code Cause: The ICC is reporting a park-recoverable fault.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the PTH?

Result:

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from PTH to ICC?

Result:

YES: Check ICC to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 524061.31 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 524069.03- Machine Drive Valve Reverse Voltage Above Normal, or Shorted to High Source

462

Code Cause: The reverse valve solenoid voltage is above normal or short to power.

Procedure:

(1) Step 1

Action:

Test Y06 reverse solenoid. See Proportional Drive Solenoid Test .

Does solenoid test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect Y06 reverse proportional solenoid?

Key ON.

Check for voltage at pin 2 of solenoid Y6?

Is battery voltage present?

Result:

YES: Repair short to battery voltage on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524069.05- Machine Drive Valve Reverse Current Below Normal or Open Circuit

462

Code Cause: The reverse valve coil calculated resistance is below normal or open.

Procedure:

(1) Step 1

Action:

Test Y06 reverse solenoid. See Proportional Drive Solenoid Test .

Does solenoid test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect Y06 reverse proportional solenoid?

Check for continuity between pin 2 of solenoid Y6 and ground?

Is continuity indicated?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Go to next step.

(3) Step 3

Action:

Disconnect PTH connector?

Check for continuity between pin 2 of solenoid Y6 and pin K4 on PTH connector?

Is continuity indicated?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524069.13- Machine Drive Valve Reverse Out of Calibration

462

Code Cause: Reverse valve coil not calibrated.

Procedure:

(1) Step 1

Action:

Test Y06 reverse solenoid. See Proportional Drive Solenoid Test .

Is 524069.13 present after calibration?

Result:

YES: Go to next step.

NO: End of tests.

(2) Step 2

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 524069.13 present after calibration?

Result:

YES: Repeat calibration procedure. If code returns, go to next step.

NO: End of tests.

(3) Step 3

Action:

Are other non calibration related codes present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 524069.15- Machine Drive Valve Reverse Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: The reverse valve solenoid current is above the normal operating range.

→NOTE:

The machine park brake or service brakes must not be applied during the calibration procedure. Verify that there are no objects around the machine that will prevent machine movement during calibration.

Procedure:

(1) Step 1

Action:

Verify that the machine is movable during the calibration procedure.

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 524069.15 present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(2) Step 2

Action:

Are other non calibration related codes present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 524069.17- Machine Drive Valve Reverse Data Valid but Below Normal Operating Range - Least Severe Level

462

Code Cause: The reverse valve solenoid current is below the normal operating range.

> **→NOTE:**
>
> **The machine must in gear and on a level surface during calibration. Premature machine movement of the machine during calibration will cause the PTH to terminate the calibration and log PTH 524069.17.**

Procedure:

(1) Step 1

Action:

Verify that the machine is in gear and on a level surface during the calibration procedure.

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 524069.17 present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(2) Step 2

Action:

Are other non calibration related codes present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 524071.03- Machine Drive Valve Forward Voltage Above Normal, or Shorted to High Source

462

Code Cause: The forward valve solenoid voltage is above normal or short to power.

Procedure:

(1) Step 1

Action:

Test Y05 forward solenoid. See Proportional Drive Solenoid Test .

Does solenoid test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect Y05 forward proportional solenoid?

Key ON.

Check for voltage at pin 2 of solenoid Y05?

Is battery voltage present?

Result:

YES: Repair short to battery voltage on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524071.05- Machine Drive Valve Forward Current Below Normal or Open Circuit

462

Code Cause: The forward valve coil calculated resistance is below normal or open

Procedure:

(1) Step 1

Action:

Test Y05 forward solenoid. See Proportional Drive Solenoid Test .

Does solenoid test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect Y05 forward proportional solenoid?

Check for continuity between pin 2 of solenoid Y05 and ground?

Is continuity indicated?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Go to next step.

(3) Step 3

Action:

Disconnect PTH connector?

Check for continuity between pin 2 of solenoid Y05 and pin B2 on PTH connector?

Is continuity indicated?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524071.13- Machine Drive Valve Forward Out of Calibration

462

Code Cause: Forward valve coil not calibrated.

Procedure:

(1) Step 1

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 524071.13 present after calibration?

Result:

YES: Go to next step.

NO: End of tests.

(2) Step 2

Action:

Are other non calibration related codes present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 524071.15- Machine Drive Valve Forward Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: The forward valve solenoid current is above the normal operating range.

> **→NOTE:**
>
> **The machine park brake or service brakes must not be applied during the calibration procedure. Verify that there are no objects around the machine that will prevent machine movement during calibration.**

Procedure:

(1) Step 1

Action:

Verify that the machine is movable during the calibration procedure.

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 524071.15 present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(2) Step 2

Action:

Are other non calibration related codes present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 524071.17- Machine Drive Valve Forward Data Valid but Below Normal Operating Range - Least Severe Level - Least Severe Level

462

Code Cause: The forward valve solenoid current is above the normal operating range.

→NOTE:

The machine must in gear and on a level surface during calibration. Premature machine movement of the machine during calibration will cause the PTH to terminate the calibration and log PTH 524069.17.

Procedure:

(1) Step 1

Action:

Verify that the machine is in gear and on a level surface during the calibration procedure.

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is PTH 524071.17 present after calibration?

Result:

YES: Go to next step.

NO: Checks complete.

(2) Step 2

Action:

Are other non calibration related codes present?

Result:

YES: Troubleshoot other codes and repeat calibration procedure.

NO: Replace PTH.

PTH 524254.03- Transmission Enable Output Voltage Above Normal, or Shorted to High Source

462

Code Cause: PTH Trans enable pin is incorrectly in a high state.

(0) Step 1

Action:

Transmission in park, ignition ON.

Observe voltage at address PTH 56. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is value shown as 2?

Result:

YES: Repair short to power on circuit 4034 between pins J1 on PTH connector and pin 3H on ICC connector.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524254.04- Transmission Enable Output Voltage Below Normal, or Shorted to Low Source

462

Code Cause: PTH Trans enable pin is incorrectly in a low state.

Procedure:

(1) Step 1

Action:

Transmission in park, ignition ON.

Observe voltage at address PTH 56. See Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller .

Is value shown as 2?

Result:

YES: Go to next step.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Disconnect PTH connector and ICC connector.

Check for continuity between the pin J1 on PTH connector and pin 3H on ICC connector.

Is continuity present?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

PTH 524254.15- Transmission Enable Output Data Valid but Above Normal Operating Range - Least Severe Level

462

Code Cause: ICC CAN message is incorrectly communicating open state.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the PTH?

Result:

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from PTH to ICC?

Result:

YES: Check ICC to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 524254.15 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

PTH 524254.17- Transmission Enable Output Data Valid but Below Normal Operating Range - Least Severe Level

462

Code Cause: ICC CAN message is incorrectly communicating closed state.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the PTH?

Result:

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from PTH to ICC?

Result:

YES: Check ICC to PTH physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(4) Step 4

Action:

Perform Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Is 524254.17 active after calibration?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

Group 15 - Instrument Cluster Control (ICC) Diagnostic Trouble Codes

ICC 000096.03- Fuel Sender Voltage Above Normal, or Shorted to High Source

378

Code Cause: Fuel sender output voltage is above normal operating range, indicating an open circuit.

Procedure:

(1) Step 1

Action:

Disconnect the B01 fuel sender.

Measure sensor output voltage at pin 2 on B01 fuel sender connector.

Is voltage 5V or higher?

Result:

YES: Check for a short to power or short to another sensor wire. Repair wire or replace harness.

NO: Go to next step.

(2) Step 2

Action:

Disconnect instrument control cluster connector.

Is battery voltage present at pin 4G on ICC connector?

Result:

YES: Check wires for short to battery voltage.

NO: Perform Troubleshooting Unresolved Problems .

ICC 000096.03- Fuel Sender Voltage Above Normal, or Shorted to High Source

378

Code Cause: Fuel sender output voltage is above normal operating range, indicating an open circuit.

Procedure:

(1) Step 1

Action:

Disconnect the B01 fuel sender.

Measure sensor output voltage at pin 2 on B01 fuel sender connector.

Is voltage 5V or higher?

Result:

YES: Check for a short to power or short to another sensor wire. Repair wire or replace harness.

NO: Go to next step.

(2) Step 2

Action:

Disconnect instrument control cluster connector.

Is battery voltage present at pin 4G on ICC connector? .

Result:

YES: Check wires for short to battery voltage.

NO: Perform Troubleshooting Unresolved Problems .

ICC 000110.00- Engine Coolant Temperature Data Valid But Above Normal Operating Range

378
Code Cause: Engine coolant temperature is in the red zone.

Procedure:

(1) Step 1

Action:

Observe voltage at address PTR 40.

Is temperature above 110° C?

Result:

YES: Test coolant temperature sensor. If sensor test good, Go to Step 2.

NO: Go to step 3.

(2) Step 2

Action:

Check for the following conditions:

- Coolant Level Low
- Coolant Leaks
- Contaminated Coolant
- Obstructions in radiator Cooler Fins

Are any conditions present?

Result:

YES: Repair condition and retest.

NO: Go to Next Step.

(3) Step 3

Action:

Check coolant temperature sensor and connector for the following conditions:

- Proper connection (seated on sensor and clipped tight)
- Connector damage
- Corrosion on terminals
- Terminals making a tight connection on sensor pins
- Terminals seated securely in connector body

Does the sensor and connector check good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair or replace connector or sensor.

ICC 000110.04- Engine Coolant Temperature Voltage Below Normal, or Shorted to Low Source
378
Code Cause: The coolant temperature sensor has a short circuit or grounded.

Procedure:

(1) Step 1

Action:

Observe voltage at address ICC 40.

Is voltage present?

Result:

YES: Test coolant temperature sensor.

NO: Go to next step.

(2) Step 2

Action:

Disconnect the engine coolant temperature sensor.

Check for continuity between pin on temperature sensor connector and ground.

Is continuity indicated?

Result:

YES: Check for a short to ground on harness. Repair wire or replace harness.

NO: Go to next step.

(3) Step 3

Action:

Disconnect instrument control cluster connector.

Check for continuity between pin on engine coolant temperature sensor connector and pin 2F on ICC connector.

Is continuity indicated?

Result:

YES: Go to next step.

NO: Check for an open circuit on harness. Repair wire or replace harness.

(4) Step 4

Action:

Check engine coolant temperature sensor.

Does engine coolant temperature sensor test good?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Replace engine coolant temperature sensor.

ICC 000110.09- Engine Coolant Temperature Abnormal Update Rate

378

Code Cause: Coolant temperature data is missing or abnormal update rate over CAN network.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are other missing or abnormal data codes present from only from ECU to ICC?

Result:

YES: Check ECU to ICC physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(3) Step 3

Action:

Program ICC. See Programming Control Units .

Is 000110.09 active after programing?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

ICC 000190.09- Engine Speed Abnormal Update Rate

378

Code Cause: Engine speed data is missing or abnormal update rate over CAN network.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are other missing or abnormal data codes present from only from ECU to ICC?

Result:

YES: Check ECU to ICC physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(3) Step 3

Action:

Program ICC. See Programming Control Units .

Is 000190.09 active after programing?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

ICC 000247.09- Engine Total Hours of Operation, Abnormal Update Rate

378
Code Cause: Engine hour meter data is missing or abnormal update rate over CAN network.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are other missing or abnormal data codes present from only from ECU to ICC?

Result:

YES: Check ECU to ICC physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(3) Step 3

Action:

Program ICC. See Programming Control Units .

Is 000247.09 active after programing?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

ICC 000628.02- Light Bulb Output Driver Data erratic, intermittent or incorrect
378
Code Cause: Instrument Cluster Control (ICC) unit detects that light bulb output driver is out of calibration.

Procedure:

(1) Step 1

Action:

Are other active ICC codes present?

Result:

YES: Troubleshoot other ICC codes first.

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does problem return?

Result:

YES: Go to next step.

NO: Diagnosis complete.

(3) Step 3

Action:

Program ICC. See Programming Control Units .

Is 000628.02 active after programing?

Result:

YES: Replace ICC.

NO: Checks complete.

ICC 000628.12- Program Memory, Bad Intelligent Device or Component

378

Code Cause: ICC not programmed or programmed incorrectly.

Procedure:

(1) Step 1

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does problem return?

Result:

YES: Go to next step.

NO: Diagnosis complete.

(2) Step 2

Action:

Program ICC. See Programming Control Units .

Is 000628.12 active after programing?

Result:

YES: Replace ICC.

NO: Checks complete.

ICC 000630.13- Program Memory Out of Calibration

378

Code Cause: Light output not calibrated.

Procedure:

(1) Step 1

Action:

Perform Recall, Record, and Clear Codes for this control unit.

Does problem return?

Result:

YES: Go to next step.

NO: Diagnosis complete.

(2) Step 2

Action:

Program ICC. See Programming Control Units .

Is 000628.13 active after programing?

Result:

YES: Replace ICC.

NO: Checks complete.

ICC 000632.05- Engine Fuel Shutoff Current Below Normal or Open Circuit

378

Code Cause: The hold-in coil output circuit open.

Procedure:

(1) Step 1

Action:

Test Y09 Fuel Solenoid.

Does solenoid test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect the fuel solenoid.

Disconnect ICC connector.

Check for continuity between pin A fuel solenoid and pin 3A on ICC connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair open in harness or replace harness.

ICC 000632.06- Engine Fuel Shutoff Current Above Normal or Grounded Circuit

378

Code Cause: Hold-in coil output is shorted to battery or open circuit.

Procedure:

(1) Step 1

Action:

Test Y09 Fuel Solenoid.

Does solenoid test good?

Result:

YES: Go to next step.

NO: Replace solenoid.

(2) Step 2

Action:

Disconnect the fuel solenoid.

Check for continuity between pin A fuel solenoid and ground.

Is continuity indicated?

Result:

YES: Repair short to ground in harness or replace harness.

NO: Go to next step.

(3) Step 3

Action:

Disconnect ICC connector.

Check for continuity between pin 3A on ICC connector and ground.

Is continuity indicated?

Result:

YES: Repair short to ground in harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 000677.05- Engine Starter Motor Relay Current Below Normal or Open Circuit

378

Code Cause: Starter output is shorted to battery or open circuit.

Procedure:

(1) Step 1

Action:

Disconnect K01 or K02 starter relay and test. See Relay Test .

Does relay test good?

Result:

YES: Go to next step.

NO: Replace relay.

(2) Step 2

Action:

Disconnect instrument control cluster connector.

Disconnect K01 or K02 starter relay.

Check for continuity between pin 3N on ICC connector and pin 86 of starter relay.

Is continuity present?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 000677.06- Engine Starter Motor Relay Current Above Normal or Grounded Circuit

378

Code Cause: Starter output is shorted to ground.

Procedure:

(1) Step 1

Action:

Disconnect K01 or K02 starter relay and test. See Relay Test .

Does relay test good?

Result:

YES: Go to next step.

NO: Replace relay.

(2) Step 2

Action:

Disconnect instrument control cluster connector.

Check for continuity between the pin 3N on ICC connector and ground

Is continuity present?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 002000.09- Source Address 0 Abnormal Update Rate

378

Code Cause: ECU not responding.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are other missing or abnormal data codes present from only from ECU to ICC?

Result:

YES: Check ECU to ICC physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(3) Step 3

Action:

Program ICC. See Programming Control Units .

Is 002000.09 active after programing?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

ICC 002003.09- Source Address 3 Abnormal Update Rate

378

Code Cause: TCU not responding.

Procedure:

(1) Step 1

Action:

Are other missing or abnormal update rate codes present from other controllers?

Result:

YES: If data is missing from other controllers/sensors, troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks

YES: Test CAN terminator. See CAN Bus Terminator Test .

NO: Go to next step.

(2) Step 2

Action:

Are other missing or abnormal data codes present from only from TCU to ICC?

Result:

YES: Check TCU to ICC physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Go to next step.

(3) Step 3

Action:

Program ICC. See Programming Control Units .

Is 002003.09 active after programing?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

ICC 002368.05- Left Turn Signal Lights Current Below Normal or Open Circuit

378

Code Cause: Left turn output low or open circuit.

(0) Step 1

Action:

Remove E03 left turn light bulb and test.

Does left turn light bulb test good?

Result:

YES: Go to next step.

NO: Replace bulb.

(1) Step 2

Action:

Disconnect instrument control cluster connector.

Disconnect E03 left turn light.

Check for continuity between pin 2S on ICC connector and pin A of left turn light connector.

Is continuity present?

Result:

YES: Go to next step.

NO: Repair open circuit on harness or replace harness.

(2) Step 3

Action:

Check for continuity between pin B of left turn light connector and ground.

Is continuity present?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair open circuit on harness or replace harness.

ICC 002368.06- Left Turn Signal Lights Current Above Normal or Grounded Circuit

378

Code Cause: Left turn output shorted to ground.

(3) Step 1

Action:

Remove E03 left turn light bulb and test.

Does left turn light bulb test good?

Result:

YES: Go to next step.

NO: Replace bulb.

(4) Step 2

Action:

Disconnect E03 left turn light.

Check for continuity between pin A of left turn light connector and ground.

Is continuity present?

Result:

YES: Repair short circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 002370.05- Right Turn Signal Lights Current Below Normal or Open Circuit

378

Code Cause: Right turn output shorted to battery or open circuit.

(5) Step 1

Action:

Remove E08 right turn light bulb and test.

Does right turn light bulb test good?

Result:

YES: Go to next step.

NO: Replace bulb.

(6) Step 2

Action:

Disconnect instrument control cluster connector.

Disconnect E08 right turn light.

Check for continuity between pin 2R on ICC connector and pin A of right turn light connector.

Is continuity present?

Result:

YES: Go to next step.

NO: Repair open circuit on harness or replace harness.

(7) Step 3

Action:

Check for continuity between pin B of right turn light connector and ground.

Is continuity present?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair open circuit on harness or replace harness.

ICC 002370.06- Right Turn Signal Lights Current Above Normal or Grounded Circuit

378

Code Cause: Right turn output shorted to ground.

(8) Step 1

Action:

Remove E08 right turn light bulb and test.

Does right turn light bulb test good?

Result:

YES: Go to next step.

NO: Replace bulb.

(9) Step 2

Action:

Disconnect E08 right turn light.

Check for continuity between pin A of right turn light connector and ground.

Is continuity present?

Result:

YES: Repair short circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 002392.05- Alarm Horn Current Below Normal or Open Circuit

378

Code Cause: Audible Alarm current too low or open circuit

(10) Step 1

Action:

Disconnect audible alarm H01 or H04 and test alarm.

Does the audible alarm test good?

Result:

YES: Go to next step.

NO: Replace alarm horn.

(11) **Step 2**

Action:

Disconnect instrument control cluster connector.

Check for continuity between pin 2E on ICC connector and pin A of audible alarm connector.

Is continuity present?

Result:

YES: Go to next step.

NO: Repair open circuit on harness or replace harness.

(12) **Step 3**

Action:

Check for continuity between pin B of audible alarm connector and ground.

Is continuity present?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair open circuit on harness or replace harness.

ICC 002807.05- Engine Fuel Shutoff 2 Control Current Below Normal or Open Circuit

378

Code Cause: The fuel shutoff pull-in coil output circuit is open.

Procedure:

(1) **Step 1**

Action:

Disconnect K03 or K15 fuel shutoff relay and test. See Relay Test .

Does relay test good?

Result:

YES: Go to next step.

NO: Replace relay.

(2) **Step 2**

Action:

Disconnect instrument control cluster connector.

Disconnect K03 or K15 fuel shutoff relay.

Check for continuity between pin 3M on ICC connector and pin 86 of fuel shutoff relay.

Is continuity present?

Result:

YES: Repair open circuit on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 002807.06- Engine Fuel Shutoff 2 Control Current Above Normal or Grounded Circuit

378

Code Cause: Pull-in coil output is shorted to ground.

Procedure:

(1) Step 1

Action:

Disconnect K03 or K15 fuel shutoff relay and test. See Relay Test .

Does relay test good?

Result:

YES: Go to next step.

NO: Replace relay.

(2) Step 2

Action:

Disconnect ICC connector.

Check for continuity between pin 3M on ICC connector and ground.

Is continuity indicated?

Result:

YES: Repair short to ground in harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 002808.03- Keypad Voltage Above Normal, or Shorted to High Source

378

Code Cause: Display mode switch is stuck on - switch used to navigate user menus is defective.

Displayed Text:

2803.3

Control Unit Response:

Function disabled (OFF)

Diagnosis:

(0) Step 1

Action:

Disconnect the S02 light pod.

Check for voltage at pin E on the light pod connector.

Is voltage indicated?

Result:

YES: Repair short to power in harness or replace harness.

NO: Go to next step.

(1) Step 2

Action:

Disconnect ICC connector.

Check for voltage at pin 1J on the ICC connector.

Is voltage indicated?

Result:

YES: Repair short to power in harness or replace harness.

NO: Replace S02 light pod.

ICC 003352.07- Engine Exhaust Pressure Regulator Vent Valve Position Not Responding or Out of Adjustment

378

Code Cause: Hybrid Exhaust Actuator not able to reach the intended position.

Procedure:

(1) Step 1

Action:

Perform Exhaust Valve Actuator Rod Adjustment .

Is ICC 003352.07 still active after adjustment?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

(2) Step 2

Action:

Check for the following conditions at the exhaust valve actuator, are they present?

- 24V at pin C on actuator connector
- Continuity between pin E actuator connector and ground
- 5V at pin A on actuator connector when regen is requested
- Continuity between pin D on actuator connector and pin 3L on TCU connector

Result:

YES: Replace actuator motor.

NO: Repair or replace circuit were conditions were not met.

ICC 003695.03- Diesel Particulate Filter Regeneration Inhibit Switch Voltage above normal, or shorted to high source

378

Code Cause: Regen inhibit switch stuck on or short to power.

Procedure:

(1) Step 1

Action:

Has the regen interrupt switch been active for more that 2 minutes or is the switch stuck in the ON position?

Result:

YES: If active for more than two minutes, turn off switch.

YES: If stuck in the ON position, replace control module switch.

NO: Go to next step.

(2) Step 2

Action:

Check for battery voltage at pin C on S02 control module?

Is battery voltage present?

Result:

YES: Repair short to power in harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

(3) Step 3

Action:

Disconnect instrument control cluster connector.

Check for battery voltage at pin 1E on ICC connector?

Is battery voltage present?

Result:

YES: Repair short to power in harness or replace harness.

NO: Replace S02 control module.

ICC 003719.09- Particulate Trap #1 Soot Load Percent Abnormal Update Rate

378

Code Cause: Soot Load Percent Request to ECU Timed out.

Procedure:

(1) Step 1

Action:

Are there any other missing or abnormal update rate codes from other control units?

Result:

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU regeneration codes present, troubleshoot first.

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to ICC?

Result:

YES: Check ECU to ICC physical portion of CAN wiring harness for kinks, worn insulation, or breaks.

NO: Perform Troubleshooting Unresolved Problems .

ICC 003721.09- Particulate Trap #1 Time Since Last Active Regeneration Abnormal Update Rate

378
Code Cause: Hours Since Last Active Regen Request to ECU Timed out.

Procedure:

(1) Step 1

Action:

Are there any other missing or abnormal update rate codes from other controllers?

Result:

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If ECU regeneration codes present, troubleshoot first.

YES: Troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from ECU to ICC?

Result:

YES: Check ECU to ICC physical portion of CAN wiring harness for kinks, worn insulation, breaks, etc.

NO: Perform Troubleshooting Unresolved Problems .

ICC 522011.02- TCU is Not Responding, Data Erratic, Intermittent or Incorrect
378
Code Cause: The transmission has defaulted to neutral.

Procedure:

(1) Step 1

Action:

Are there any other missing or abnormal update rate codes from other control units?

Result:

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Are multiple missing or abnormal update rate codes present from the ECU?

Result:

YES: If TCU regeneration codes present, troubleshoot first.

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(3) Step 3

Action:

Are other missing or abnormal data codes present from only from TCU to ICC?

Result:

YES: Check TCU to ICC physical portion of CAN wiring harness for kinks, worn insulation, or breaks.

NO: Perform Troubleshooting Unresolved Problems .

ICC 523905.05- Front PTO Driver Current Below Normal or Open Circuit

378

Code Cause: The front PTO coil current is too low or open circuit.

Procedure:

(1) Step 1

Action:

Disconnect the PTO jumper harness X13.

Disconnect ICC connector.

Check continuity between pin 3 on jumper harness connector and 2N at ICC connector.

Is continuity indicated?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Repair open circuit on harness or replace harness.

ICC 523905.06- Front PTO Driver Current Above Normal or Short to Ground

378

Code Cause: The front PTO coil current is too high or short to ground.

Procedure:

(1) Step 1

Action:

Disconnect the PTO jumper harness X13.

Check continuity between pin 3 on jumper harness connector and ground.

Is continuity indicated?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

(2) Step 2

Action:

Disconnect ICC connector.

Check continuity between pin 2N on ICC connector and ground.

Is continuity indicated?

Result:

YES: Repair short to ground on harness or replace harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 524254.06- Transmission Enable Output Current Above Normal or Grounded Circuit

378

Code Cause: Trans Enable current too high or short to Ground.

Procedure:

(1) Step 1

Action:

Are there any active TCU codes present?

Result:

YES: Diagnose TCU codes.

NO: Go to next step.

(2) Step 2

Action:

Disconnect instrument control cluster connector.

Check for continuity between pin 3H and ground.

Is continuity indicated?

Result:

YES: Repair short to ground on chassis harness.

NO: Perform Troubleshooting Unresolved Problems .

ICC 524264.31- Checksum Error Not Available or Condition Exists

378

Code Cause: EEPROM checksum failure - data invalid.

Procedure:

(1) Step 1

Action:

Are there any other missing or abnormal update rate codes from other control units?

Result:

YES: Troubleshoot CAN Bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Program ICC. See Programming Control Units .

Is 000110.09 active after programing?

Result:

YES: Perform Troubleshooting Unresolved Problems .

NO: Checks complete.

Group 20 - Engine Control Unit (ECU) Diagnostic Trouble Codes

ECU- Non-Tractor ECU Codes

17

→NOTE:

See relevant engine CTM for diagnostic procedure.

- Component Technical Manual 3TNV86, 4TNV86, 3TNV88, and 4TNV88 Diesel Engines (Final Tier 4/Stage IV Platform)

Non-Tractor ECU Code List

Non-Tractor ECU Code List	
ECU 000028.00	Accelerator Pedal #3 Position Data Valid but Above Normal Operational Range
ECU 000028.01	Accelerator Pedal #3 Position Data Valid but Below Normal Operational Range
ECU 000028.03	Accelerator Pedal #3 Position Voltage Above Normal or Shorted to High Source
ECU 000028.04	Accelerator Pedal #3 Position Voltage Below Normal or Shorted to Low Source
ECU 000029.03	Accelerator Pedal #2 Position Voltage Above Normal or Shorted to High Source
ECU 000029.04	Accelerator Pedal #2 Position Voltage Below Normal or Shorted to Low Source
ECU 000029.08	Accelerator Pedal #2 Position Voltage Abnormal Frequency or Pulse Width or Period
ECU 000051.03	Engine Throttle Valve Position Voltage Above Normal or Shorted to High Source
ECU 000051.04	Engine Throttle Valve Position Voltage Below Normal or Shorted to Low Source
ECU 000091.03	Accelerator Pedal Position Voltage Above Normal or Shorted to High Source
ECU 000091.04	Accelerator Pedal Position Voltage Below Normal or Shorted to Low Source
ECU 000100.01	Engine Oil Pressure Data Valid but Below Normal Operational Range
ECU 000100.04	Engine Oil Pressure Voltage Below Normal, or Shorted to Low Source
ECU 000102.03	Engine Intake Manifold #1 Pressure Voltage Above Normal or Shorted to High Source
ECU 000102.04	Engine Intake Manifold #1 Pressure Voltage Below Normal or Shorted to Low Source
ECU 000102.13	Engine Intake Manifold #1 Pressure Out of Calibration
ECU 000105.03	Engine Intake Manifold 1 Temperature Voltage Above Normal or Shorted to High Source
ECU 000105.04	Engine Intake Manifold 1 Temperature Voltage Below Normal or Shorted to Low Source
ECU 000108.03	Barometric Pressure Voltage Above Normal or Shorted to High Source
ECU 000108.04	Barometric Pressure Voltage Below Normal or Shorted to Low Source
ECU 000108.10	Barometric Pressure Voltage Abnormal Rate of Change
ECU 000110.00	Engine Coolant Temperature Data Valid but Above Normal Operational Range
ECU 000110.03	Engine Coolant Temperature Voltage Above Normal or Shorted to High Source
ECU 000110.04	Engine Coolant Temperature Voltage Below Normal or Shorted to Low Source
ECU 000157.00	Engine Injector Metering Rail 1 Pressure Data Valid but Above Normal Operational Range
ECU 000157.03	Engine Injector Metering Rail 1 Pressure Voltage Above Normal or Shorted to High Source
ECU 000157.04	Engine Injector Metering Rail 1 Pressure Voltage Below Normal or Shorted to Low Source
ECU 000157.15	Engine Injector Metering Rail 1 Pressure Data Valid but Above Normal Operating Range
ECU 000157.16	Engine Injector Metering Rail 1 Pressure Data Valid but Above Normal Operating Range
ECU 000157.18	Engine Injector Metering Rail 1 Pressure Data Valid but Below Normal Operating Range
ECU 000167.01	Alternator Potential Data Valid but Below Normal Operational Range
ECU 000167.05	Alternator Potential Current Below Normal or Open Circuit
ECU 000172.03	Engine Air Intake Temperature Voltage Above Normal or Shorted to High Source
ECU 000172.04	Engine Air Intake Temperature Voltage Below Normal or Shorted to Low Source
ECU 000173.03	Engine Exhaust Gas Temperature Voltage Above Normal or Shorted to High Source
ECU 000173.04	Engine Exhaust Gas Temperature Voltage Below Normal or Shorted to Low Source
ECU 000174.00	Engine Fuel Temperature Data Valid but Above Normal Operational Range
ECU 000174.03	Engine Fuel Temperature Voltage Above Normal or Shorted to High Source
ECU 000174.04	Engine Fuel Temperature Voltage Below Normal or Shorted to Low Source

Non-Tractor ECU Code List	
ECU 000190.00	Engine Speed Data Valid but Above Normal Operational Range
ECU 000237.13	Vehicle Identification Number Out of Calibration
ECU 000237.31	Vehicle Identification Not Available or Condition Exists
ECU 000412.03	Engine Exhaust Gas Recirculation Temperature Voltage Above Normal or Shorted to High Source
ECU 000412.04	Engine Exhaust Gas Recirculation Temperature Voltage Below Normal or Shorted to Low Source
ECU 000630.12	Calibration Memory Bad Intelligent Device or Component
ECU 000633.03	Engine Fuel Actuator 1 Control Command Voltage Above Normal or Shorted to High Source
ECU 000633.05	Engine Fuel Actuator 1 Control Command Current Below Normal or Open Circuit
ECU 000633.06	Engine Fuel Actuator 1 Control Command Current Above Normal or Grounded Circuit
ECU 000651.03	Engine Injector Cylinder #01 Voltage Above Normal or Shorted to High Source
ECU 000651.05	Engine Injector Cylinder #01 Current Below Normal or Open Circuit
ECU 000651.06	Engine Injector Cylinder #01 Current Above Normal or Grounded Circuit
ECU 000652.03	Engine Injector Cylinder #02 Voltage Above Normal or Shorted to High Source
ECU 000652.05	Engine Injector Cylinder #02 Current Below Normal or Open Circuit
ECU 000652.06	Engine Injector Cylinder #02 Current Above Normal or Grounded Circuit
ECU 000653.03	Engine Injector Cylinder #03 Voltage Above Normal or Shorted to High Source
ECU 000653.05	Engine Injector Cylinder #03 Current Below Normal or Open Circuit
ECU 000653.06	Engine Injector Cylinder #03 Current Above Normal or Grounded Circuit
ECU 000654.03	Engine Injector Cylinder #04 Voltage Above Normal or Shorted to High Source
ECU 000654.05	Engine Injector Cylinder #04 Current Below Normal or Open Circuit
ECU 000654.06	Engine Injector Cylinder #04 Current Above Normal or Grounded Circuit
ECU 001202.02	Anti-theft Password Representation Data Erratic, Intermittent or Incorrect
ECU 001209.03	Engine Exhaust Gas Pressure Voltage Above Normal or Shorted to High Source
ECU 001209.04	Engine Exhaust Gas Pressure Voltage Below Normal or Shorted to Low Source
ECU 001209.13	Engine Exhaust Gas Pressure Out of Calibration
ECU 001485.02	ECU Main Relay Data Erratic, Intermittent or Incorrect
ECU 001485.07	ECU Main Relay Mechanical System not Responding or Out of Adjustment
ECU 002791.00	Engine Exhaust Gas Recirculation (EGR) Valve Control Data Valid but Above Normal Operational Range
ECU 002791.01	Engine Exhaust Gas Recirculation (EGR) Valve Control Data Valid but Below Normal Operational Range
ECU 002791.07	Engine Exhaust Gas Recirculation (EGR) Valve Control Mechanical System not Responding or Out of Adjustment
ECU 002791.09	Engine Exhaust Gas Recirculation (EGR) Valve Control Abnormal Update Rate
ECU 002791.12	Engine Exhaust Gas Recirculation (EGR) Valve Control Bad Intelligent Device or Component
ECU 002797.06	Engine Injector Group 1 Current Above Normal or Grounded Circuit
ECU 002798.06	Engine Injector Group 2 Current Above Normal or Grounded Circuit
ECU 002950.03	Engine Intake Valve Actuator Voltage Above Normal or Shorted to High Source
ECU 002950.04	Engine Intake Valve Actuator Voltage Below Normal or Shorted to Low Source
ECU 002950.05	Engine Intake Valve Actuator Current Below Normal or Open Circuit
ECU 002950.06	Engine Intake Valve Actuator Current Above Normal or Grounded Circuit
ECU 002951.03	Engine Intake Valve Actuator #2 Voltage Above Normal or Shorted to High Source
ECU 002951.04	Engine Intake Valve Actuator #2 Voltage Below Normal or Shorted to Low Source
ECU 003242.00	Aftertreatment Diesel Particulate Filter Intake Gas Temperature Data Valid but Above Normal Operational Range
ECU 003242.03	Aftertreatment Diesel Particulate Filter Intake Gas Temperature Voltage Above Normal or Shorted to High Source
ECU 003242.04	Aftertreatment Diesel Particulate Filter Intake Gas Temperature Voltage Below Normal or Shorted to Low Source
ECU 003250.00	Aftertreatment Diesel Particulate Filter Intermediate Gas Temperature Data Valid but Above Normal Operational Range
ECU 003250.01	Aftertreatment Diesel Particulate Filter Intermediate Gas Temperature Data Valid but Below Normal Operational Range
ECU 003250.03	Aftertreatment Diesel Particulate Filter Intermediate Gas Temperature Voltage Above Normal or Shorted to High Source
ECU 003250.04	Aftertreatment Diesel Particulate Filter Intermediate Gas Temperature Voltage Below Normal or Shorted to Low Source

Non-Tractor ECU Code List	
ECU 003251.00	Aftertreatment Diesel Particulate Filter Differential Pressure Data Valid but Above Normal Operational Range
ECU 003251.03	Aftertreatment Diesel Particulate Filter Differential Pressure Voltage Above Normal or Shorted to High Source
ECU 003251.04	Aftertreatment Diesel Particulate Filter Differential Pressure Voltage Below Normal or Shorted to Low Source
ECU 003251.13	Aftertreatment Diesel Particulate Filter Differential Pressure Out of Calibration
ECU 003609.03	Diesel Particulate Filter Intake Pressure Voltage Above Normal or Shorted to High Source
ECU 003609.04	Diesel Particulate Filter Intake Pressure Voltage Below Normal or Shorted to Low Source
ECU 003695.14	Diesel Particulate Filter Regeneration Inhibit Switch Special Instructions
ECU 003719.00	Particulate Trap #1 Soot Load Percent Data Valid but Above Normal Operational Range
ECU 003719.07	Particulate Trap #1 Soot Load Percent Mechanical System not Responding or Out of Adjustment
ECU 003719.09	Particulate Trap #1 Soot Load Percent Abnormal Update Rate
ECU 003719.16	Particulate Trap #1 Soot Load Percent Data Valid but Above Normal Operating Range
ECU 003720.00	Particulate Trap #1 Ash Load Percent Data Valid but Above Normal Operational Range
ECU 003720.16	Particulate Trap #1 Ash Load Percent Data Valid but Above Normal Operating Range
ECU 004257.12	Engine Injector Group #3 Bad Intelligent Device or Component
ECU 522243.05	Spray Nozzle Actuator #16 Current Below Normal or Open Circuit
ECU 522243.05	Spray Nozzle Actuator #16 Current Above Normal or Grounded Circuit
ECU 522323.00	Row Clutch Actuator #27 Data Valid but Above Normal Operational Range - Most Severe Level
ECU 522329.00	Row Clutch Actuator #23 Data Valid but Above Normal Operational Range
ECU 522400.02	Machine Network Controller Membership - Do Not Use, Temporary Mirage Data Erratic, Intermittent or Incorrect
ECU 522400.05	Machine Network Controller Membership - Do Not Use, Temporary Mirage Current Below Normal or Open Circuit
ECU 522401.02	N/A
ECU 522401.05	N/A
ECU 522401.07	N/A
ECU 522571.03	Oper Ctrl B1 Cmd Byte 8 Bit Quad 5-8 Voltage Above Normal or Shorted to High Source
ECU 522571.06	Oper Ctrl B1 Cmd Byte 8 Bit Quad 5-8 Current Above Normal or Grounded Circuit
ECU 522572.06	Oper Ctrl B1 Cmd Byte 7 Bit Quad 1-4 Current Above Normal or Grounded Circuit
ECU 522572.11	Oper Ctrl B1 Cmd Byte 7 Bit Quad 1-4 Root Cause not Known
ECU 522573.00	Oper Ctrl B1 Cmd Byte 7 Bit Quad 5-8 Data Valid but Above Normal Operational Range
ECU 522574.00	Oper Ctrl B1 Cmd Byte 6 Bit Quad 1-4 Data Valid but Above Normal Operational Range
ECU 522575.07	Oper Ctrl B1 Cmd Byte 6 Bit Quad 5-8 Mechanical System not Responding or Out of Adjustment
ECU 522576.12	Oper Ctrl B1 Cmd Byte 5 Bit Quad 1-4 Bad Intelligent Device or Component
ECU 522577.11	Oper Ctrl B1 Cmd Byte 5 Bit Quad 5-8 Root Cause not Known
ECU 522578.12	Oper Ctrl B1 Cmd Byte 4 Bit Quad 1-4 Bad Intelligent Device or Component
ECU 522579.12	Oper Ctrl B1 Cmd Byte 4 Bit Quad 5-8 Bad Intelligent Device or Component
ECU 522580.12	Oper Ctrl B1 Cmd Byte 3 Bit Quad 1-4 Bad Intelligent Device or Component
ECU 522581.07	Oper Ctrl B1 Cmd Byte 3 Bit Quad 5-8 anical System not Responding or Out of Adjustment
ECU 522582.07	Oper Ctrl A1 Rsp Byte 8 Bit Quad 1-4 Mechanical System not Responding or Out of Adjustment
ECU 522583.01	Oper Ctrl A1 Rsp Byte 8 Bit Quad 5-8 Data Valid but Below Normal Operational Range
ECU 522584.01	Oper Ctrl A1 Rsp Byte 7 Bit Quad 1-4 Data Valid but Below Normal Operational Range
ECU 522585.12	Oper Ctrl A1 Rsp Byte 7 Bit Quad 5-8 Bad Intelligent Device or Component
ECU 522588.12	Oper Ctrl A1 Rsp Byte 6 Bit Pair 5-6 Bad Intelligent Device or Component
ECU 522589.12	Oper Ctrl A1 Rsp Byte 6 Bit Pair 7-8 Bad Intelligent Device or Component
ECU 522590.12	Oper Ctrl A1 Rsp Byte 5 Bit Pair 1-2 Bad Intelligent Device or Component
ECU 522591.12	Oper Ctrl A1 Rsp Byte 5 Bit Pair 3-4 Bad Intelligent Device or Component
ECU 522592.12	Oper Ctrl A1 Rsp Byte 5 Bit Pair 5-6 Bad Intelligent Device or Component
ECU 522596.09	Oper Ctrl A1 Rsp Byte 4 Bit Pair 5-6 Abnormal Update Rate
ECU 522597.09	Oper Ctrl A1 Rsp Byte 4 Bit Pair 7-8 Abnormal Update Rate
ECU 522599.09	Oper Ctrl A1 Rsp Byte 3 Bit Pair 3-4 Abnormal Update Rate

Non-Tractor ECU Code List	
ECU 522600.09	Oper Ctrl A1 Rsp Byte 3 Bit Pair 5-6 Abnormal Update Rate
ECU 522601.09	Oper Ctrl A1 Rsp Byte 3 Bit Pair 7-8 Abnormal Update Rate
ECU 522603.09	Oper Ctrl A1 Cmd Byte 8 Bit Quad 5-8 Abnormal Update Rate
ECU 522609.09	Oper Ctrl A1 Cmd Byte 6 Bit Pair 5-6 Abnormal Update Rate
ECU 522610.09	Oper Ctrl A1 Cmd Byte 6 Bit Pair 7-8 Abnormal Update Rate
ECU 522611.09	Oper Ctrl A1 Cmd Byte 5 Bit Pair 1-2 Abnormal Update Rate
ECU 522617.12	Oper Ctrl A1 Cmd Byte 4 Bit Pair 5-6 Bad Intelligent Device or Component
ECU 522618.09	Oper Ctrl D1 Rsp Byte 8 Bit Pair 1-2 Abnormal Update Rate
ECU 522619.09	Oper Ctrl D1 Rsp Byte 8 Bit Pair 3-4 Abnormal Update Rate
ECU 522623.07	Oper Ctrl D1 Rsp Byte 7 Bit Pair 1-2 Mechanical System not Responding or Out of Adjustment
ECU 522624.07	Oper Ctrl D1 Rsp Byte 7 Bit Pair 3-4 Mechanical System not Responding or Out of Adjustment
ECU 522730.12	Oper Ctrl C1 Rsp Byte 3 Bit Pair 1-2 Bad Intelligent Device or Component
ECU 522744.04	N/A
ECU 522746.12	Beater Rolls Control Bad Intelligent Device or Component
ECU 522747.12	Bale Control Actuator Controls Bad Intelligent Device or Component
ECU 522748.12	Bale Handler Control Bad Intelligent Device or Component
ECU 522749.12	Lower Rear Feedroll Right Hand Bearing Bad Intelligent Device or Component
ECU 522750.12	Lower Rear Feedroll Left Hand Bearing Bad Intelligent Device or Component
ECU 522751.19	Lower Rear Feedroll Received Network Data in Error
ECU 522994.04	Product Flow Sensor #174 Voltage Below Normal, or Shorted to Low Source
ECU 523249.05	Kernel Processor Upper Left Hand Roller Bearing Current Below Normal or Open Circuit
ECU 523460.07	Boom Roll Lock Out Sensor Mechanical System not Responding or Out of Adjustment
ECU 523462.13	Boom Roll Lock Out Mode Out of Calibration
ECU 523463.13	Boom Roll Bias Left Mode Out of Calibration
ECU 523464.13	Boom Roll Bias Right Mode Out of Calibration
ECU 523465.13	Left Outer Boom Unfold Mode Out of Calibration
ECU 523468.09	Left Inner Boom Unfold Mode Abnormal Update Rate
ECU 523469.00	Right Inner Boom Unfold Mode Data Valid but Above Normal Operational Range
ECU 523470.00	Right Inner Boom Fold Mode Data Valid but Above Normal Operational Range
ECU 523471.06	Right Outer Boom Fold Mode Current Above Normal or Grounded Circuit
ECU 523473.12	Right Break-away Boom Unfold Mode Bad Intelligent Device or Component
ECU 523474.12	Right Break-away Boom Fold Mode Bad Intelligent Device or Component
ECU 523475.12	Left Break-away Boom Fold Mode Bad Intelligent Device or Component
ECU 523476.12	Left Break-away Boom Unfold Mode Bad Intelligent Device or Component
ECU 523477.12	Center Frame Lower Mode Bad Intelligent Device or Component
ECU 523478.12	Center Frame Raise Mode Bad Intelligent Device or Component
ECU 523479.12	Left Boom Tilt Down Mode Bad Intelligent Device or Component
ECU 523480.12	Right Boom Tilt Down Mode Bad Intelligent Device or Component
ECU 523481.12	Left Boom Tilt Up Mode Bad Intelligent Device or Component
ECU 523482.12	Right Boom Tilt Up ModeBad Intelligent Device or Component
ECU 523483.12	4 Wheel Steer Jog Mode Request Bad Intelligent Device or Component
ECU 523484.12	Four Wheel Steer Crab Bad Intelligent Device or Component
ECU 523485.12	Transport Lock Bad Intelligent Device or Component
ECU 523486.12	Wheel Steer Priority Change Bad Intelligent Device or Component
ECU 523487.12	4 Wheel Steer Mode Bad Intelligent Device or Component
ECU 523488.00	4 Wheel Steer Requested Mode Data Valid but Above Normal Operational Range
ECU 523489.00	Engine Service/Work Lights Data Valid but Above Normal Operational Range
ECU 523491.00	Engine Mid Idle State Data Valid but Above Normal Operational Range

ECU 000237.13- VIN Option Code Security Data Conflict

17

Code Caused By: Vehicle Identification option code is not valid.

Displayed Text:

000237.13

Procedure:

(1) Step 1

Action:

Are there any other CAN communication or abnormal update rate codes from other controllers?

Result:

YES:CAN communication codes present - diagnose and resolve all CAN communication codes and retest.

YES: Abnormal update codes present - troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Does the VIN number in the controller match the VIN number of the machine?

Result:

YES: Go to next step.

NO: Program ECU. See Programming Control Units .

(3) Step 3

Action:

Perform Recall, Record, and Clear Codes .

Is ECU 000237.13 still present?

Result:

YES: Diagnosis complete.

NO: Perform Troubleshooting Unresolved Problems .

ECU 000237.31- VIN Security Data Missing

17

Code Caused By: Vehicle Identification Number (VIN) not received from other control units.

Displayed Text:

000237.31

Procedure:

(1) Step 1

Action:

Are there any other CAN communication or abnormal update rate codes from other controllers?

Result:

YES:CAN communication codes present - diagnose and resolve all CAN communication codes and retest.

YES: Abnormal update codes present - troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Does the VIN number in the controller match the VIN number of the machine?

Result:

YES: Go to next step.

NO: Program ECU. See Programming Control Units .

(3) Step 3

Action:

Perform Recall, Record, and Clear Codes .

Is ECU 000237.31 still present?

Result:

YES: Diagnosis complete.

NO: Perform Troubleshooting Unresolved Problems .

ECU 003695.14- Diesel Particulate Filter Regeneration Special Instructions

17

Code Caused By: DPF regeneration is required, but inhibit switch is active.

Displayed Text:

003695.14

Procedure:

(1) Step 1

Action:

Are there any other CAN communication or abnormal update rate codes from other controllers?

Result:

YES:CAN communication codes present - diagnose and resolve all CAN communication codes and retest.

YES: Abnormal update codes present - troubleshoot CAN bus. See CAN Network Voltage Checks and CAN Communication Fault Checks .

NO: Go to next step.

(2) Step 2

Action:

Perform Recall, Record, and Clear Codes .

Is ECU 003695.14 still present?

Result:

YES: Replace S02 control module.

NO: Perform Troubleshooting Unresolved Problems .

Section 30 - ENGINE—DIESEL

Table of contents

Group 05 - Specifications

Engine Information

Engine Component Technical Manuals

This technical manual has only engine information which is specific to the interim tier 4 engine models.

Use this manual in conjunction with CTM120419 for final tier 4 engine models.

Engine Information (interim tier 4)

Machine Model	Engine Model
3033R	3TNV88
3038R	3TNV84T
3045R	3TNV84HT

Engine Information (final tier 4)

Machine Model	Engine Model
3033R	3TNV88C
3039R	3TNV86CT
3046R	3TNV86CHT

General Specifications

Item	Measurement	Specification
General Specifications		
Engine Make		Yanmar
Engine Type		4-Cycle Diesel
Engine Model		3TNV88 (3033R)
		3TNV84T (3038R)
		3TNV84HT (3045R)
Number of Cylinders		3
Firing Order (number 1 cylinder on flywheel side)		1 - 3 - 2
Compression Ratio		19:1
Direction of Rotation		Counterclockwise (viewed from flywheel)
Combustion System		Direct Injection Type
Oil Capacity (with filter)	Capacity	Approximately 4.3 L
		4.5 qt.
Bore and Stroke		
3TNV88	Diameter (bore)	88 mm
		3.46 in.
	Distance (stroke)	90 mm
		3.54 in.
3TNV84T	Diameter (bore)	84 mm
		3.31 in.
	Distance (stroke)	90 mm
		3.54 in.
3TNV84HT	Diameter (bore)	84 mm
		3.31 in.
	Distance (stroke)	90 mm
		3.54 in.
Displacement		
3TNV88	Displacement	1.642 L
		100.2 cu. in.
3TNV84T	Displacement	1.496 L
		91.3 cu. in.
3TNV84HT	Displacement	1.496 L
		91.3 cu. in.
Cooling		
3TNV88	Type	Liquid
	Capacity	Approximately 4.2 L
		4.4 qt.
3TNV84T	Type	Liquid
	Capacity	Approximately 4.2 L
		4.4 qt.
3TNV84HT	Type	Liquid
	Capacity	Approximately 4.2 L
		4.4 qt.
Radiator Cap	Pressure	90 kPa
		0.9 bar
		13 psi
Engine Speed		
All Engines	Governor	Centrifugal
	Low Idle Speed	950 ± 25 rpm
	High Idle Speed	2775 ± 50 rpm

Item	Measurement	Specification
	Rated Speed	2600 ± 10 rpm
	Operating Range	950 ± 25—2775 rpm

Engine Torque

3TNV88	Net Torque (at 2600 rpm)	83.5 N·m
		61.6 lb.-ft.
	Maximum Torque (at 1560 rpm)	100.2 N·m
		73.9 lb.-ft.
3TNV84T	Net Torque (at 2600 rpm)	96.4 N·m
		71.1 lb.-ft.
	Maximum Torque (at 1560 rpm)	115.7 N·m
		85.4 lb.-ft.
3TNV84HT	Net Torque (at 2600 rpm)	114.3 N·m
		84.3 lb.-ft.
	Maximum Torque (at 1560 rpm)	137.1 N·m
		101.1 lb.-ft.

Repair Specifications

Item	Measurement	Specification
Valve Train:		
Rocker Arm Shaft	OD	15.966—15.984 mm (0.6285—0.6295 in.)
Rocker Arm Shaft Wear Limit	Measurement	15.94 mm (0.6275 in.)
Rocker Arm and Shaft Support Bushing	ID	16.00—16.02 mm (0.630—0.631 in.)
Wear Limit	Measurement	16.09 mm (0.633 in.)
Oil Clearance	Clearance	0.02—0.05 mm (0.001—0.002 in.)
Wear Limit	Measurement	0.15 mm (0.006 in.)
Push Rod Bend	Out-of-Round	0.0—0.03 mm (0.0—0.001 in.)

Item	Measurement	Specification
Cylinder Head and Valves:		
Cylinder Head Distortion	Measurement	0.0—0.05 mm (0.0—0.002 in.)
Cylinder Head Distortion Wear Limit	Measurement	0.15 mm (0.006 in.)
Intake Valve Seat	Width	1.07—1.24 mm (0.042—0.049 in.)
Intake Valve Seat—Wear Limit	Width	1.74 mm (0.069 in.)
Exhaust Valve Seat	Width	1.24 mm—1.45 mm (0.042—0.049 in.)
Exhaust Valve Seat—Wear Limit	Width	1.94 mm (0.076 in.)
Intake Valve Stem	OD	7.96—7.98 mm (0.313—0.314 in.)
Intake Valve Stem—Wear Limit	OD	7.9 mm (0.311 in.)
Exhaust Valve Stem	OD	7.96—7.97 mm (0.313—0.314 in.)
Exhaust Valve Stem—Wear Limit	OD	7.9 mm (0.311 in.)
Valve Head—Intake Valve	Thickness	1.24—1.44 mm (0.049—0.057 in.)
Valve Head—Exhaust Valve	Thickness	1.35—1.55 mm (0.053—0.061 in.)
Wear Limit	Measurement	0.50 mm (0.020 in.)
Intake Valve	Recess	0.31—0.51 mm (0.012—0.020 in.)
Intake Valve—Wear Limit	Recess	1.00 mm (0.039 in.)
Exhaust Valve	Recess	0.3—0.5 mm (0.012—0.020 in.)
Exhaust Valve Wear Limit	Measurement	1.00 mm (0.039 in.)

Item	**Measurement**	**Specification**
Valve Guide Stem-to-Guide Oil		
Intake	Clearance	0.04—0.07 mm (0.001—0.003 in.)
Exhaust	Measurement	0.05—0.08 mm (0.002—0.003 in.)
Exhaust—Wear Limit	Measurement	0.20 mm (0.008 in.)
Valve Guide	ID	8.01—8.03 mm (0.315—0.316 in.)
Valve Guide—Wear Limit	ID	8.10 mm (0.319 in.)
Valve Guide Projection	Measurement	15 mm (0.591 in.)
Valve Spring Free Length	Length	42.0 mm (1.654 in.)
Maximum Spring Inclination	Measurement	1.10 mm (0.044 in.)
Valve Spring Tension (Measured With Spring Compressed 1.0 mm (0.039 in.)	Tension	2.36—3.10 kg (5.20—6.83 lb.)
Valve Seat Surface—Exhaust Valve	Angle	45°
Intake Valve	Angle	30°
Valve Timing—Intake Valve Opens	Position	10—20° BTDC
Intake Valve Closes	Position	40—50° ABDC
Exhaust Valve Opens	Position	51—61° BBDC
Exhaust Valve Closes	Position	13—23° ATDC
Piston-to-Cylinder Head Clearance	Clearance	0.66—0.78 mm (0.026—0.031 in.)

Item	**Measurement**	**Specification**
Connecting Rod:		
Large End Bearing	ID	51.00—51.01 mm (2.008—2.008 in.)
Large End Bearing Thickness	Thickness	1.49—1.50 mm (0.059—0.059 in.)
Oversize	Thickness	1.625 mm (0.064 in.)
Oil Clearance	Clearance	0.02—0.05 mm (0.001—0.002 in.)
Oil Clearance—Wear Limit	Clearance	0.13 mm (0.005 in.)
Connecting Rod Side Play	Play	0.2—0.4 mm (0.008—0.016 in.)

Item	**Measurement**	**Specification**
Piston Rings:		
First Compression Piston Ring Groove—3TNV84	Width	2.065—2.080 mm (0.081—0.082 in.)
First Compression Piston Ring Groove—3TNV88	Width	2.060—2.075 mm (0.081—0.082 in.)
First Compression Piston Ring—All	Width	1.97—1.99 mm (0.078—0.078 in.)
First Compression Ring Minimum Side—3TNV84	Clearance	0.075—0.110 mm (0.003—0.004 in.)
First Compression Ring Minimum Side—3TNV88	Clearance	0.070—0.105 mm

Item	Measurement	Specification
		(0.003—0.004 in.)
Second Compression Piston Ring Groove—3TNV84	Width	2.035—2.050 mm
		(0.080—0.081 in.)
Second Compression Piston Ring Groove—3TNV88	Width	2.025—2.040 mm
		(0.080—0.080 in.)
Second Compression Piston Ring Width—All	Width	1.97—1.99 mm
		(0.078—0.078 in.)
Second Compression Piston Ring Minimum Side—3TNV84	Clearance	0.035—0.070 mm
		(0.001—0.003 in.)
Second Compression Piston Ring Minimum Side—3TNV88	Clearance	0.045—0.080 mm
		(0.002—0.003 in.)
Oil Control Piston Ring Groove	Width	4.015—4.030 mm
		(0.158—0.159 in.)
Oil Control Piston Ring	Width	3.97—3.99 mm
		(0.156—0.157 in.)
Oil Control Piston Ring Minimum Side	Clearance	0.025—0.060 mm
		(0.001—0.002 in.)
Piston Ring End	Gap	0.20—0.40 mm
		(0.008—0.016 in.)
Wear Limit	Measurement	1.50 mm
		(0.059 in.)

Item	Measurement	Specification
Piston Pin:		
Piston Pin	OD	25.99—26.00 mm
		(1.023—1.024 in.)
Piston Pin—Wear Limit	OD	25.90 mm
		(1.020 in.)
Piston Pin Bushing	ID	23.025—23.038 mm
		(0.906—0.907 in.)
Piston Pin Bushing—Wear Limit	ID	23.10 mm
		(0.909 in.)
Piston Pin-to-Rod Bore Oil	Clearance	0.025—0.047 mm
		(0.001—0.002 in.)
Piston Pin-to-Rod Bore Oil—Wear Limit	Clearance	0.2 mm
		(0.008 in.)
Piston Pin Bore—In Piston	ID	26.000—26.009 mm
		(1.023—1.024 in.)
Piston Pin Bore—Wear Limit	ID	26.02 mm
		(1.024 in.)
Piston Pin-to-Piston Oil	Clearance	0.000—0.022 mm
		(0.0—0.0009 in.)
Piston Pin-to-Piston Oil—Wear Limit	Clearance	0.12 mm
		(0.005 in.)

Item	Measurement	Specification
Piston:		
Standard Piston—3TNV84	OD	83.95—83.98 mm
		(3.305—3.306 in.)
Standard Piston Wear Limit—3TNV84	OD	83.90 mm
		(3.303 in.)
Standard Piston—3TNV88	OD	87.95—87.98 mm
		(3.462—3.464 in.)
Standard Piston Wear Limit—3TNV88	OD	87.90 mm

Item	Measurement	Specification
		(3.461 in.)
Oversize Piston—3TNV84	OD	84.20—84.23 mm (3.315—3.316 in.)
Oversize Piston Wear Limit—3TNV84	OD	84.10 mm (3.311 in.)
Oversize Piston—3TNV88	OD	88.20—88.23 mm (3.472—3.474 in.)
Oversize Piston Wear Limit—3TNV88		88.10 mm (3.469 in.)

Item	Measurement	Specification
Cylinder Bore Inner Diameter:		
Cylinder Bore—3TNV84	ID	84.00—84.03 mm (3.307—3.308 in.)
Cylinder Bore Wear Limit—3TNV84	ID	84.20 mm (3.315 in.)
Cylinder Bore—3TNV88	ID	88.00—88.03 mm (3.465—3.466 in.)
Cylinder Bore Wear Limit—3TNV88	ID	88.20 mm (3.472 in.)
Oversize Bore—3TNV84	ID	84.25—84.28 mm (3.317—3.318 in.)
Oversize Bore—3TNV88	ID	88.25—88.28 mm (3.474—3.476 in.)
Piston-to-Cylinder Clearance		0.040—0.070 mm (0.0016—0.0027 in.)
Cylinder Roundness	Out-of-Round	0.01—0.03 mm (0.000—0.001 in.)
Cylinder Roundness—Wear Limit	Out-of-Round	0.03 mm (0.001 in.)
Cylinder Taper	Taper	0.00—0.01 mm (0.0000—0.0004 in.)
Cylinder Taper—Wear Limit	Taper	0.03 mm (0.001 in.)
Cylinder—Deglazing	Surface Finish	30—40° crosshatch pattern
Cylinder—Deboring	Surface Finish	30—40° crosshatch pattern

Item	Measurement	Specification
Crankshaft and Main Bearings:		
Connecting Rod Crankshaft Journal	OD	47.95—47.96 mm (1.888—1.888 in.)
Connecting Rod Crankshaft Journal—Wear Limit	OD	47.91 mm (1.886 in.)
Main Bearing Journal	OD	53.95—53.96 mm (2.124—2.124 in.)
Main Bearing Journal—Wear Limit	OD	53.91 mm (2.122 in.)
Main Bearing Oil Clearance	Clearance	0.04—0.07 mm (0.002—0.003 in.)
Main Bearing Oil Clearance—Wear Limit	Clearance	0.16 mm (0.006 in.)
Crankshaft Bend (Maximum)	Bend	0.02 mm (0.001 in.)
Crankshaft	End Play	0.13—0.23 mm

Item	Measurement	Specification
		(0.005—0.009 in.)

Item	Measurement	Specification
Camshaft:		
Camshaft	End Play	0.05—0.20 mm (0.002—0.008 in.)
Camshaft Bend	Bend	0—0.02 mm (0—0.001 in.)
Camshaft—Wear Limit		0.05 mm (0.002 in.)
Camshaft Side Gap	Gap	0.05—0.25 mm (0.002—0.010 in.)
Lobe Height—Intake and Exhaust	Height	38.64—38.77 mm (1.521—1.526 in.)
Lobe Height Wear Limit—Intake and Exhaust	Height	38.40 mm (1.512 in.)
Bearing Journal— Flywheel Side and Gear Side	OD	44.93—44.95 mm (1.769—1.770 in.)
Intermediate Journal	OD	44.91—44.94 mm (1.768—1.769 in.)
Intermediate Journal—Wear Limit	OD	44.85 mm (1.766 in.)
Oil Clearance (Gear and Flywheel Ends)	Clearance	0.04—0.13 mm (0.002—0.005 in.)
Oil Clearance—Intermediate	Clearance	0.07—0.12 mm (0.003—0.005 in.)

Item	Measurement	Specification
Camshaft Follower:		
Camshaft Follower Stem	OD	11.98—11.99 mm (0.471—0.472 in.)
Camshaft Follower Stem—Wear Limit		11.93 mm (0.470 in.)
Camshaft Bore	ID	12.00—12.02 mm (0.472—0.473 in.)
Camshaft Bore—Wear Limit		12.05 mm (0.474 in.)
Oil Clearance	Clearance	0.01—0.04 mm (0.0004—0.0016 in.)
Oil Clearance—Wear Limit		0.12 mm (0.005 in.)

Item	Measurement	Specification
Idler Gear:		
Idler Gear Shaft	OD	45.95—45.98 mm (1.809—1.810 in.)
Idler Gear Shaft—Wear Limit	OD	45.93 mm (1.808 in.)
Idler Gear Shaft Bushing	ID	46.00—46.03 mm (1.811—1.812 in.)
Idler Gear Shaft Bushing—Wear Limit	ID	46.08 mm (1.814 in.)
Idler Gear Shaft Bushing	Clearance	0.15 mm (0.006 in.)

Item	Measurement	Specification
Oil Pump:		
Rotor Shaft Outer Diameter-to-Side Cover Hole Inner Diameter	Clearance	0.01—0.04 mm (0.001—0.002 in.)
Rotor Shaft Outer Diameter-to-Side Cover Hole Inner Diameter—Wear Limit	Clearance	0.20 mm (0.08 in.)
Inner Rotor and Outer Rotor-to-Pump Body Side	Clearance	0.03—0.09 mm (0.001—0.004 in.)
Inner Rotor and Outer Rotor-to-Pump Body Side—Wear Limit	Clearance	0.15 mm (0.006 in.)
Outer Rotor-to-Pump Body	Clearance	0.10—0.16 mm (0.004—0.006 in.)
Outer Rotor-to-Pump Body—Wear Limit	Clearance	0.25 mm (0.010 in.)
Inner Rotor-to-Outer Rotor—Wear Limit	Clearance	0.15 mm (0.006 in.)

Item	Measurement	Specification
Turbocharger:		
Turbocharger	Model	RHB31
Turbine Shaft Journal	OD	6.257—6.263 mm (0.246—0.247 in.)
Turbine Shaft Journal—Wear Limit	OD	6.25 mm (0.246 in.)
Turbine Shaft Seal Ring Groove	Width	1.038—1.062 mm (0.0408—0.0418 in.)
Turbine Shaft Seal Ring Groove—Wear Limit	Width	1.07 mm (0.042 in.)
Compressor Side Seal Ring Groove (G1)	Width	1.02—1.03 mm (0.040—0.041 in.)
Compressor Side Seal Ring Groove (G1)—Wear Limit	Width	1.04 mm (0.041 in.)
Compressor Side Seal Ring Groove (G2)	Width	0.82—0.83 mm (0.246—0.247 in.)
Compressor Side Seal Ring Groove (G2)—Wear Limit	Width	0.84 mm (0.003 in.)
Turbine Shaft	Radial Runout	0.002 mm (0.001 in.)
Turbine Shaft—Wear Limit	Radial Runout	0.005 mm (0.001 in.)
Journal Bearing	ID	6.257—6.285 mm (0.246—0.247 in.)
Journal Bearing—Wear Limit	ID	6.29 mm (0.248 in.)
Journal Bearing	OD	9.940—9.946 mm (0.391—0.392 in.)
Journal Bearing—Wear Limit	OD	9.93 mm (0.391 in.)
Journal Bearing Housing	ID	9.995—10.005 mm (0.394—0.394 in.)
Journal Bearing Housing—Wear Limit	ID	10.01 mm (0.394 in.)
Thrust Bearing	Width	3.59—3.61 mm (0.141—0.142 in.)
Thrust Bearing—Wear Limit	Width	3.58 mm

Item	Measurement	Specification
		(0.141 in.)
Thrust Bushing Groove	Width	3.632—3.642 mm
		(0.143—0.143 in.)
Thrust Bushing Groove (Wear Limit)	Width	3.65 mm
		(0.144 in.)
Seal Ring Fixing Area (Turbine Side)	Width	11.00011.018 mm
		(0.433—0.434 in.)
Seal Ring Fixing Area (Turbine Side)—Wear Limit	Width	11.03 mm
		(0.434 in.)
Seal Ring Fixing Area (Compressor Side—S1)	Width	9.987—10.025 mm
		(0.394—0.395 in.)
Seal Ring Fixing Area (Compressor Side—S1)—Wear Limit	Width	10.04 mm
		(0.395 in.)
Seal Ring Fixing Area (Compressor Side—S2)	Width	7.968—8.000 mm
		(0.314—0.315 in.)
Seal Ring Fixing Area (Compressor Side—S2)—Wear Limit	Width	8.01 mm
		(0.314—0.315 in.)

Tests and Adjustment Specifications

Item	Measurement	Specification
Specifications:		
Valve	Clearance	0.15—0.25 mm (0.006—0.010 in.)
Connecting Rod Side Play	Play	0.2—0.4 mm (0.008—0.016 in.)
Connecting Rod Bearing	Clearance	0.04—0.07 mm (0.002—0.003 in.)
Crankshaft	End Play	0.09—0.27 mm (0.004—0.011 in.)
Crankshaft Main Bearing	Clearance	0.04—0.07 mm (0.001—1.003 in.)
Camshaft	End Play	0.05—0.25 mm (0.002—0.010 in.)
Timing Gear Backlash—All Except Hydraulic Pump Gear	Backlash	0.07—0.15 mm (0.003—0.005 in.)
Hydraulic Pump Gear	Backlash	0.11—0.19 mm (0.004—0.008 in.)
Fuel Injection Nozzle—Opening Pressure	Pressure	19 600 + 1000 kPa (196 ± 1 bar) (2843 + 145 psi)
Leakage at 11 032 kPa (110 bar) (1600 psi)	Leakage	None for a minimum of 10 seconds
Chatter and Spray Pattern at 19 600 ± 1000 kPa (196 bar) (2843 ± 145 psi)—Slow Hand Lever Movement	Pressure	Fine Stream; Chatter Sound
Chatter and Spray Pattern at 19 600 ± 1000 kPa (196 bar) (2843 ± 145 psi)—Fast Hand Lever Movement	Pressure	Fine Atomized Spray; 150° Spray Pattern
Alternator Drive Belt Deflection	Deflection	10—15 mm (0.4—0.6 in.)
Fuel Injection Pump Timing	Position	11° ± 1° BTDC
Turbocharger Rotor Play in Axial Direction	Play	0.022—0.053 mm (0.001—0.002 in.)
Turbocharger Rotor Play in Axial Direction—Wear Limit	Play	0.07 mm (0.007 in.)
Turbocharger Rotor Play in Radial Direction	Play	0.061—0.093 mm (0.002—0.004 in.)
Turbocharger Rotor Play in Radial Direction—Wear Limit	Play	0.12 mm (0.005 in.)

Operational Tests

Item	Measurement	Specification
Operational Tests		
Cooling System—Test	Pressure	88 ± 15 kPa
		(0.88 ± 0.15 bar)
		(12.8 ± 2.2 psi)
Thermostat Temperature—Opening	Temperature	107—113°C
		(224—235°F)
Minimum Lift Height above 85°C (185°F)	Height	8.0 mm
		(0.135 in.)
Radiator Cap—Opening	Pressure	88 ± 15 kPa
		(0.88 ± 0.15 bar)
		(12.8 ± 2.2 psi)
Cylinder Compression—3TNV84T (@ 250 rpm)	Pressure	2940 ± 100 kPa
		(29.4 ± 1.0 (bar)
		(426 ± 14.5 psi)
Cylinder Compression—3TNV84T (@ 250 rpm (minimum))	Pressure	2450 ± 100 kPa
		(24.5 ± 1.0 bar)
		(355 ± 14.5 psi)
Cylinder Compression—3TNV88 (@ 250 rpm)	Pressure	3430 ± 100 kPa
		(34.3 ± 1.0 bar)
		(497.0 ± 14.5 psi)
Cylinder Compression—3TNV88 (@ 250 rpm (minimum))	Pressure	2750 ± 100 kPa
		(27.5 ± 1.0 bar)
		(399.0 ± 14.5 psi)
Cylinder Compression—Difference Between Cylinders	Pressure	200—300 kPa
		(2—3 bar)
		(29—43 psi)
Oil Pressure—Rated Speed		294—392 kPa
		(2.94—3.92 bar)
		(42.6—56.8 psi)
Oil Pressure—Slow Idle (Minimum)	Pressure	58.8 kPa
		(0.59 bar)
		(8.5 psi)
Oil Relief Valve—Opening	Pressure	294—392 kPa
		(2.94—3.92 bar)
		(43—57 psi)
Oil Pressure Switch—Opening	Pressure	49.0 ± 9.8 kPa
		(0.49 ± 0.098 bar)
		(7.1 ± 1.4 psi)

Torque Values, Non-Standard Fasteners

Item	Measurement	Specification
Torque Specifications:		
Starting Motor Cable Nut	Torque	10 ± 2 N·m
		(7.4 ± 1.5 lb.-ft.)
Starting Motor Cap Screw	Torque	88 N·m
		(65 lb.-ft.)
Cylinder Head Cap Screws (lubricating oil applied)	Torque	85—91 N·m
		63—67 lb.-ft.
Connecting Rod Cap Screws (lubricating oil applied)	Torque	44—54 N·m
		33—40 lb.-ft.
Damper Cap Screws	Torque	48—50 N·m
		35—37 lb.-ft.
Flywheel Mounting Cap Screws (lubricating oil applied)	Torque	83—88 N·m
		62—65 lb.-ft.
Main Bearing Cap Screws (lubricating oil applied)	Torque	96—100 N·m
		71—74 lb.-ft.
Crankshaft Pulley Cap Screw (lubricating oil applied)	Torque	113—122 N·m
		83—90 lb.-ft.
Fuel Injector Nozzle Nut	Torque	6.8—8.8 N·m
		60—78 lb.-in.
Governor Weight Support Nut	Torque	44—49 N·m
		33—36 lb.-ft.
Rocker Arm Mounting Cap Screw and Nut	Torque	26 N·m
		19 lb.-ft.
Oil Pump Mounting Cap Screw	Torque	25 N·m
		18 lb.-ft.
Starting Motor Mounting Cap Screw	Torque	47 N·m
		35 lb.-ft.
Turbocharger Waste Gate Actuator Set Cap Screw	Torque	3.9—4.9 N·m
		34.5—43.4 lb.-in.
Turbocharger Blower Impeller Set Nut (left-hand thread)	Torque	0.9—1.19 N·m
		8.0—10.5 lb.-in.
Lock Plate Set Cap Screw		11.8—12.8 N·m
		104.4—113.3 lb.-in.
Thrust Bearing Set Screw	Torque	1.2—1.4 N·m
		10.6—12.4 lb.-in.
Seal Plate Set Screw	Torque	1.2—1.4 N·m
		10.6—12.4 lb.-in.
Glow Plug (if equipped)	Torque	15—20 N·m
		133—177 lb.-in.
Glow Plug Connector Nut	Torque	1—1.5 N·m
		9—13 lb.-in.

Service Equipment and Tools

→NOTE:

Order tools according to information given in the U.S. SERVICEGARD ™ Catalog or in the European Microfiche Tool Catalog (MTC).

Dial Indicator

(English, in.) D17526CI or (Metric, mm) D17527CI

Use with JDG451 to measure valve recess.

Spring Compression Tester

D01168AA

Test valve spring compression.

Valve Inspection Center

D05058ST

Check valves for out-of-round.

End Brush

D17024BR

Clean valve seat and bores.

Compression Test Adapter

JDG1687

To check cylinder compression pressure on diesel engines.

Universal Pressure Test Kit

JT05470 (D15027NU or FKM10002)

Used to check engine oil pressure.

Cooling System Pressure Pump

D05104ST

Used to pressure test radiator cap and cooling system.

Magnetic Follower Holder Kit

D15001NU

Hold cam followers when removing and installing camshaft.

Nozzle Cleaning Kit

JDF13

Use to clean fuel injection nozzles.

Valve Guide Knurl Kit

JT05949 or D-20019WI

Knurl valve guides.

Valve Guide Driver

JDE118

Use to remove and install valve guides in cylinder head.

Valve Guide Reamer

D-20021WI

Use to ream out valve guides.

Turbocharger Shield

JDG576

Cover turbocharger inlet when testing engine with air filter system removed.

Manifold Pressure Tester

JDE147 or FKM10002

Used to test intake manifold pressure on turbocharged engines.

Pressure Gauge 0—200 kPa (0—2 bar) (0—30 psi), Hose and Fittings.

JT05470

Measure transfer pump pressure in rotary injection pump systems. Assemble test equipment from JT05470 Universal Pressure Test Kit or any other suitable equipment.

Noncontact Temperature Measuring Gun

JT07254

Spots heat problems early in your electrical and mechanical systems.

Air Regulator with Gauge

Pressurize waste gate actuator to test operation of waste gate.

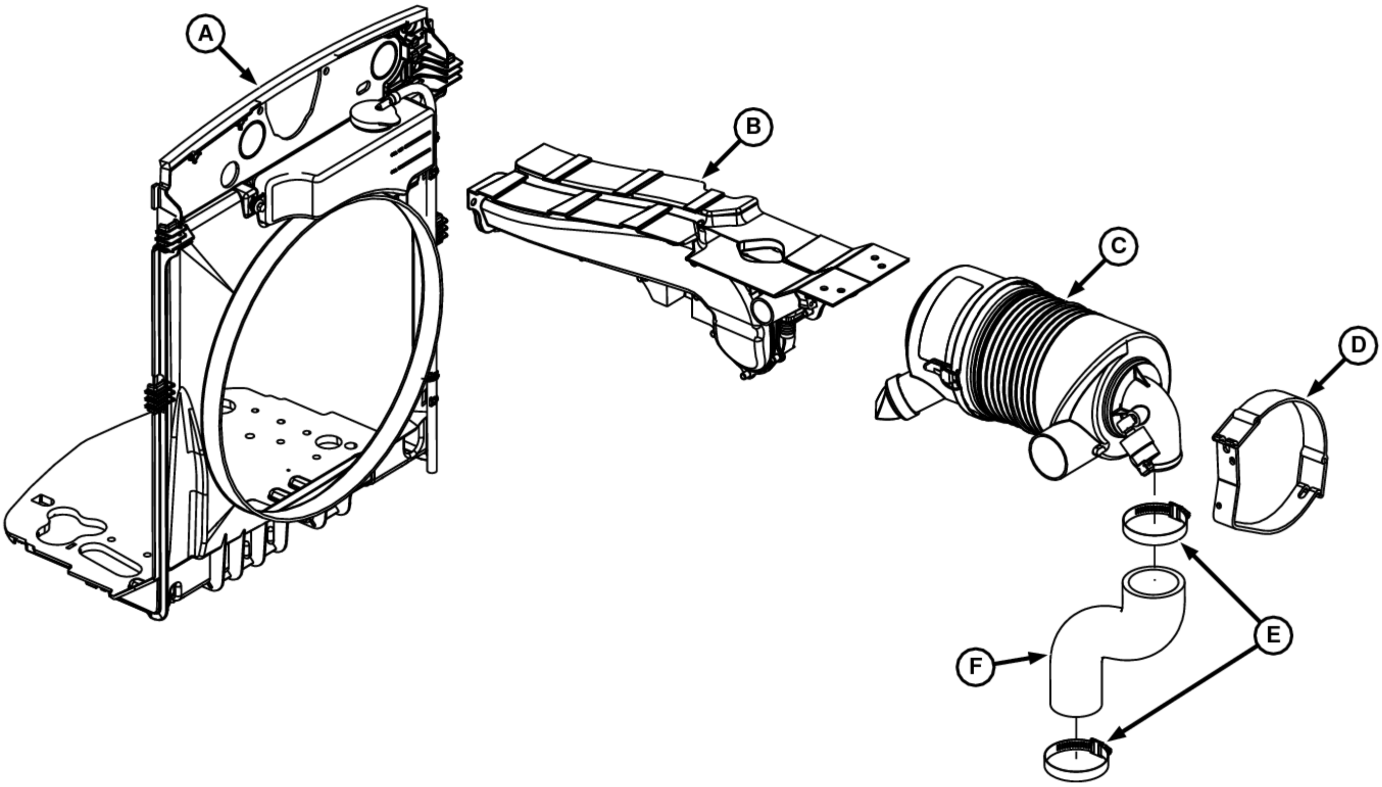
Other Materials

Number	Name	Use
• (us)	Brake clean or Ignition Cleaner	Remove sealant from crankshaft flange.
• (us)	Plastigage ™	Check main bearing-to-crankshaft journal oil clearance.
• TY15130 Loctite ™ (us)	John Deere Form-In-Place Gasket	Seals rear oil seal case and flywheel housing to engine block. Seals oil pan to timing gear housing and engine block.
• TY9370 Loctite® No. 242 (us)	Thread Lock and Sealer (Medium Strength)	Apply to threads of crankshaft pulley cap screw.
• AR44402 (us)	Valve Stem Lubricant	Lubricate valve stems.
• PT569 (us)	NEVER-SEEZ ™ Compound	Turbocharger-to-exhaust manifold cap screws.

Group 10 - Component Location

Air Cleaner and Intake Components

3033R Air Cleaner and Intake Components

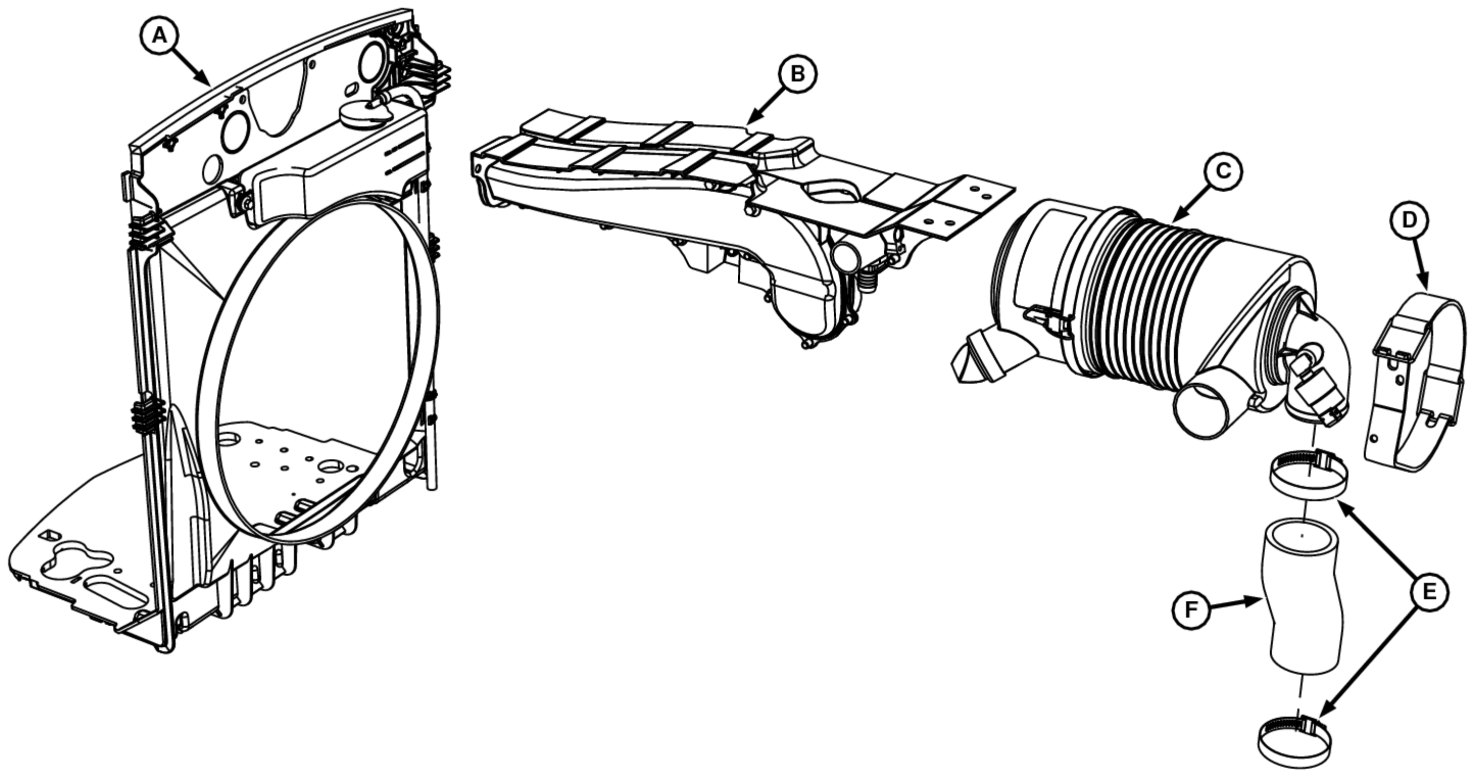


Engine with Aftertreatment Device

LEGEND:

A	Fan Shroud
B	Center Intake
C	Air Filter Assembly
D	Air Cleaner Bracket
E	Hose Clamp (2 used)
F	Air Intake Hose

3033R Air Cleaner and Intake Components

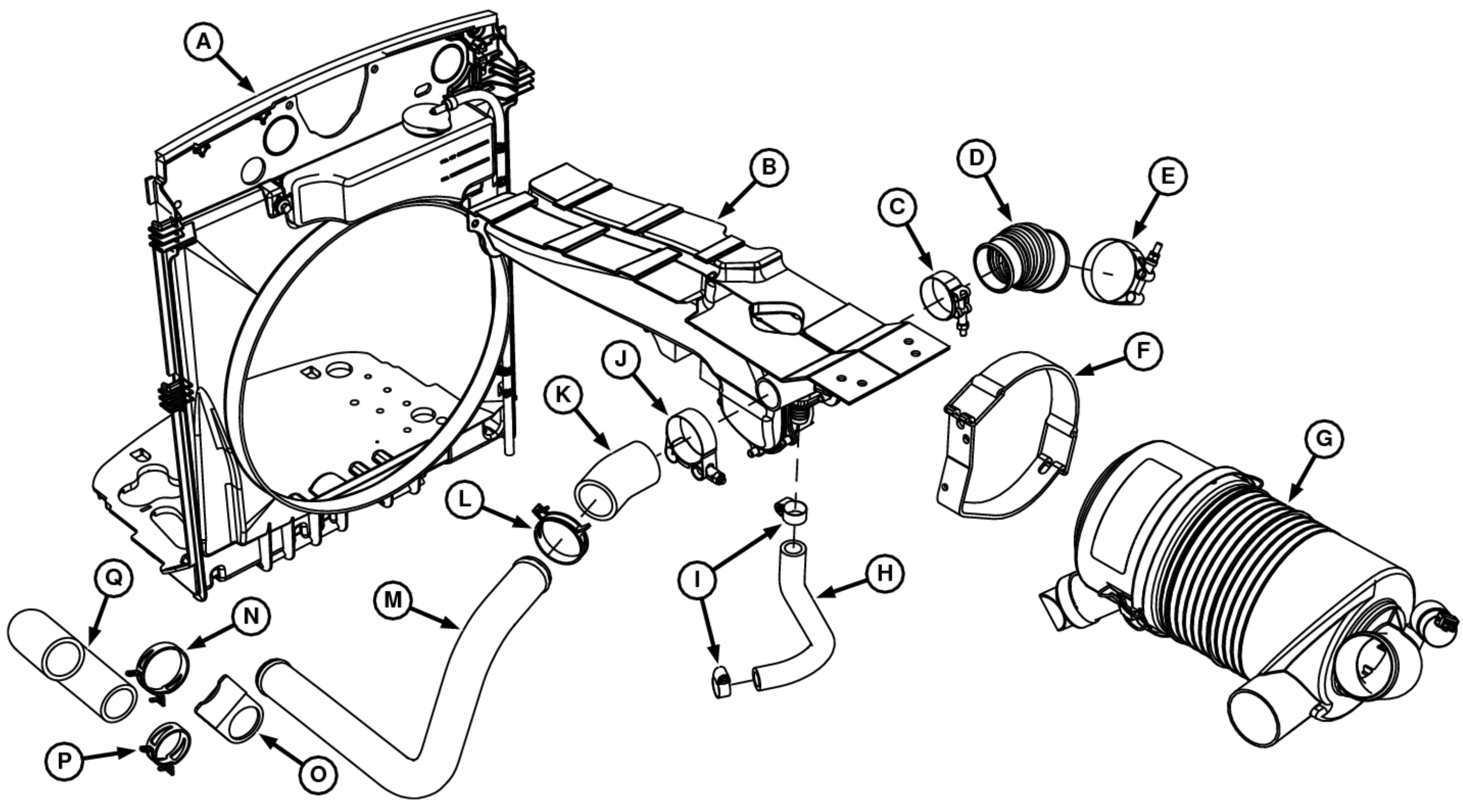


Engine without Aftertreatment Device

LEGEND:

A	Fan Shroud
B	Center Intake
C	Air Cleaner Assembly
D	Air Cleaner Bracket
E	Hose Clamp (2 used)
F	Air Intake Hose

3038R Air Cleaner and Intake Components

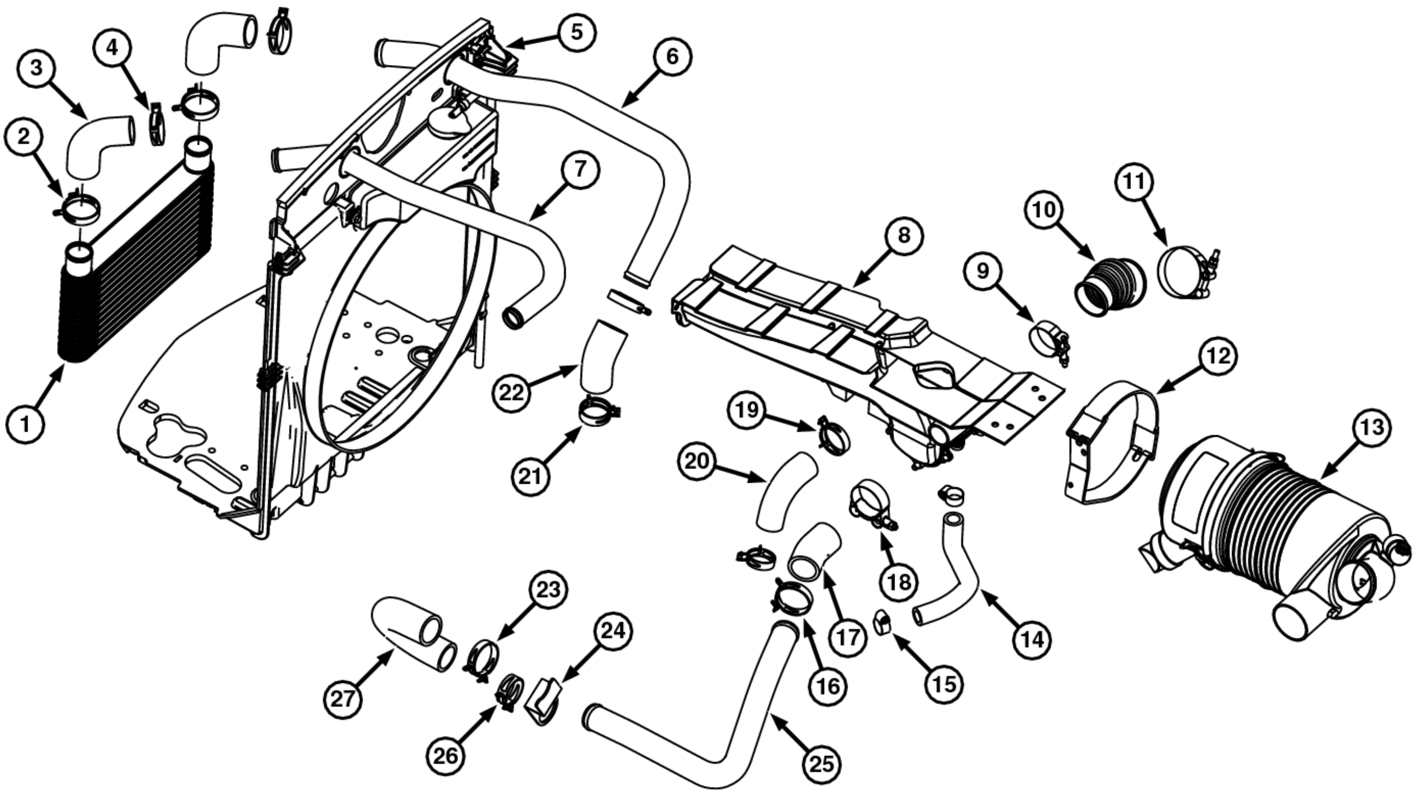


Engine with Aftertreatment Device

LEGEND:

A	Fan Shroud
B	Center Intake
C	Clamp
D	Boot
E	Clamp
F	Air Cleaner Bracket
G	Air Cleaner Assembly
H	EGR Hose
I	Clamp (2 used)
J	Clamp
K	Hose
L	Clamp
M	Tube
N	Clamp
O	Bracket
P	Clamp
Q	Tube

3045R Air Cleaner and Intake Components



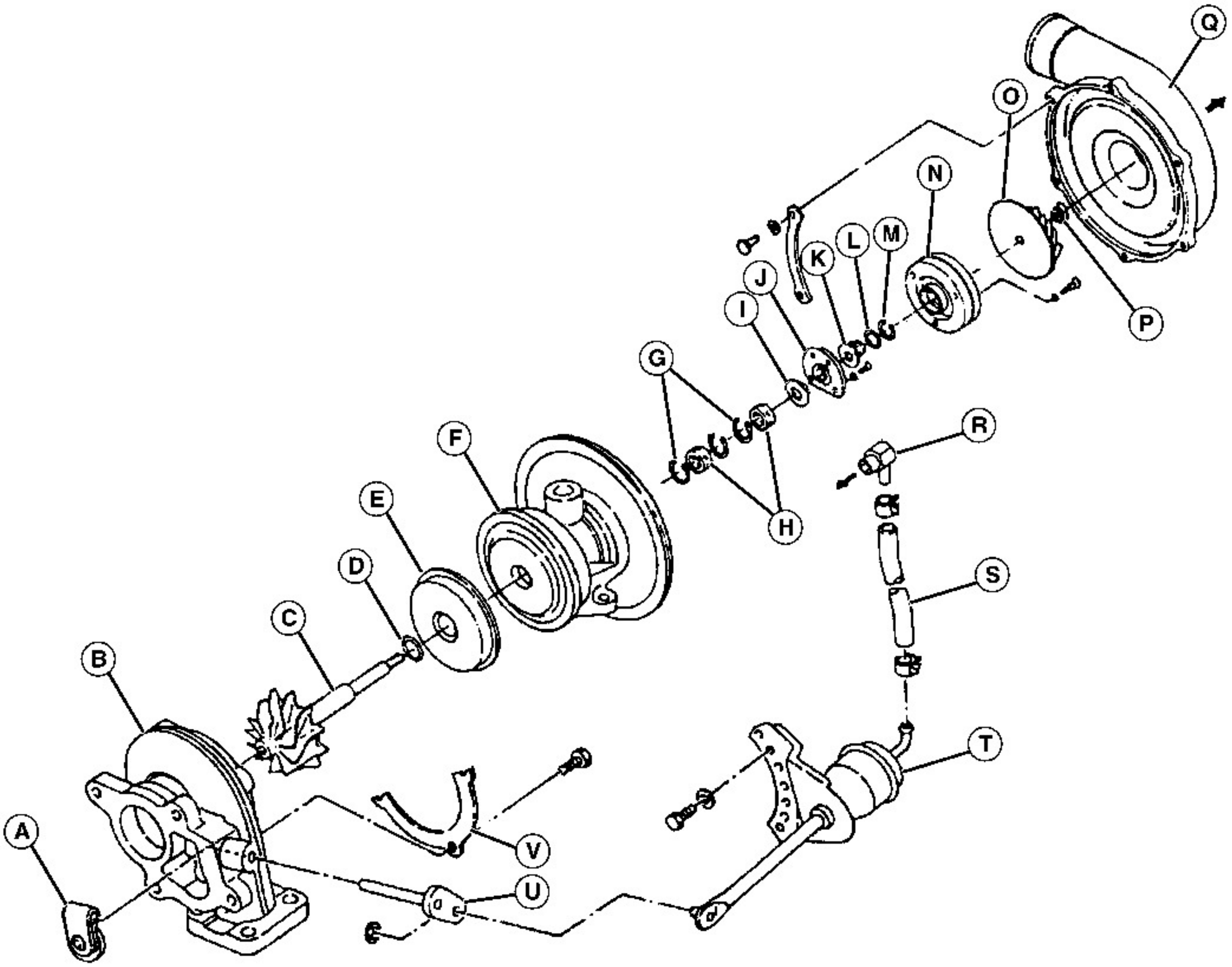
Engine with Aftertreatment Device

LEGEND:

1	Charge Air Cooler
2	Clamp (2 used)
3	Hose (2 used)
4	Clamp (2 used)
5	Fan Shroud
6	Tube
7	Tube
8	Center Intake
9	Clamp
10	Boot
11	Clamp
12	Air Cleaner Bracket
13	Air Cleaner Assembly
14	EGR Hose
15	Clamp (2 used)
16	Clamp
17	Hose
18	Clamp

19	Clamp (2 used)
20	Hose
21	Clamp (2 used)
22	Hose
23	Clamp
24	Bracket
25	Tube
26	Clamp
27	Tube

Turbocharge Components



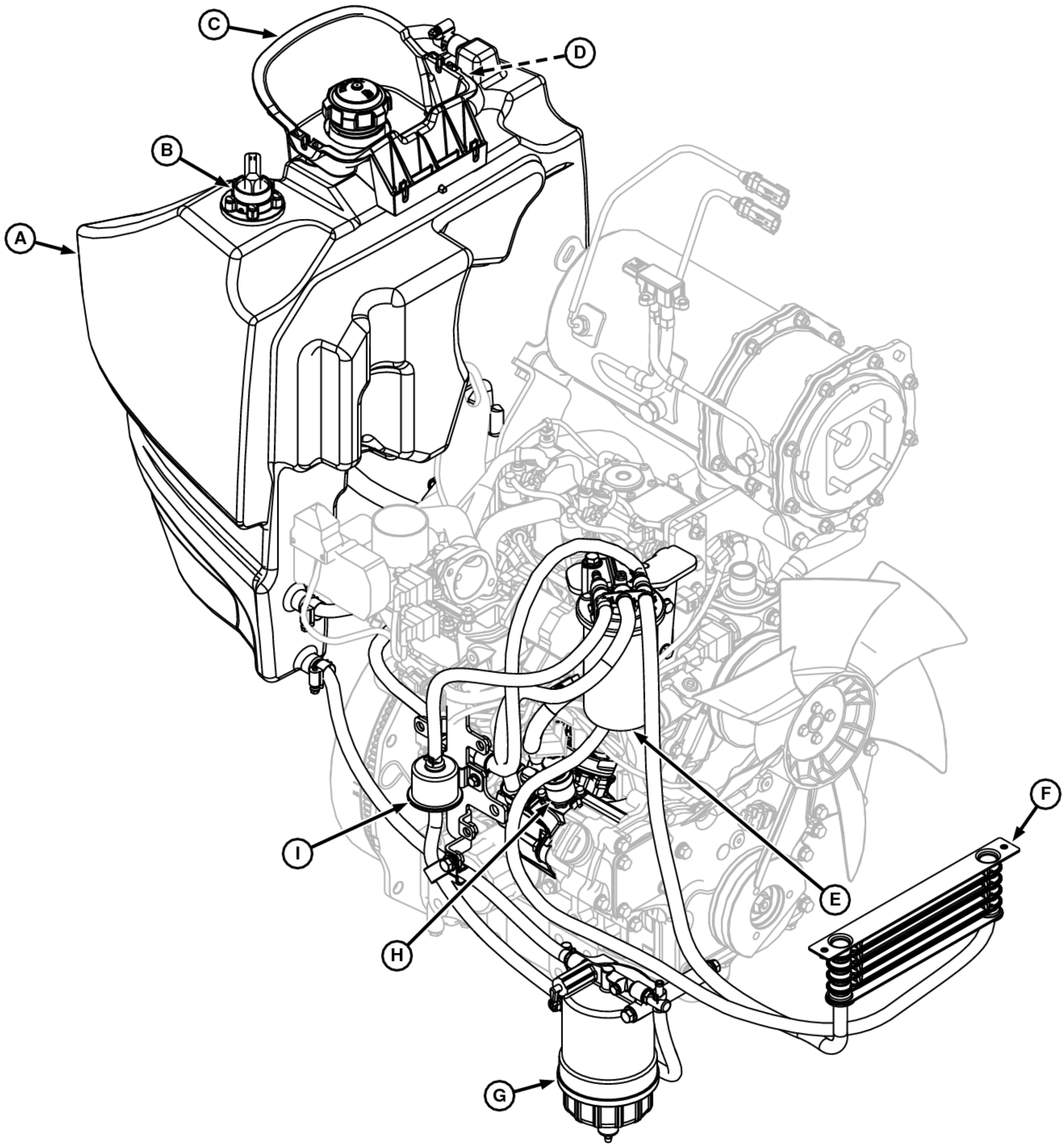
Turbocharger Components

LEGEND:

A	Waste Gate Valve
B	Turbine Housing
C	Turbine Shaft
D	Seal Ring (Turbine Side)
E	Heat Shield
F	Bearing (Center) Housing
G	Retaining Ring
H	Journal Bearing
I	Thrust Bushing
J	Thrust Bearing
K	Oil Thrower
L	Seal Ring
M	Seal Ring
N	Seal Plate
O	Impeller
P	Lock Nut (left-hand thread)
Q	Compressor Housing
R	Fitting (To Intake Manifold)
S	Hose
T	Waste Gate Actuator
U	Waste Gate Link Plate
V	Lock Plate

Fuel Supply Components

Fuel Supply Components (Open Station)

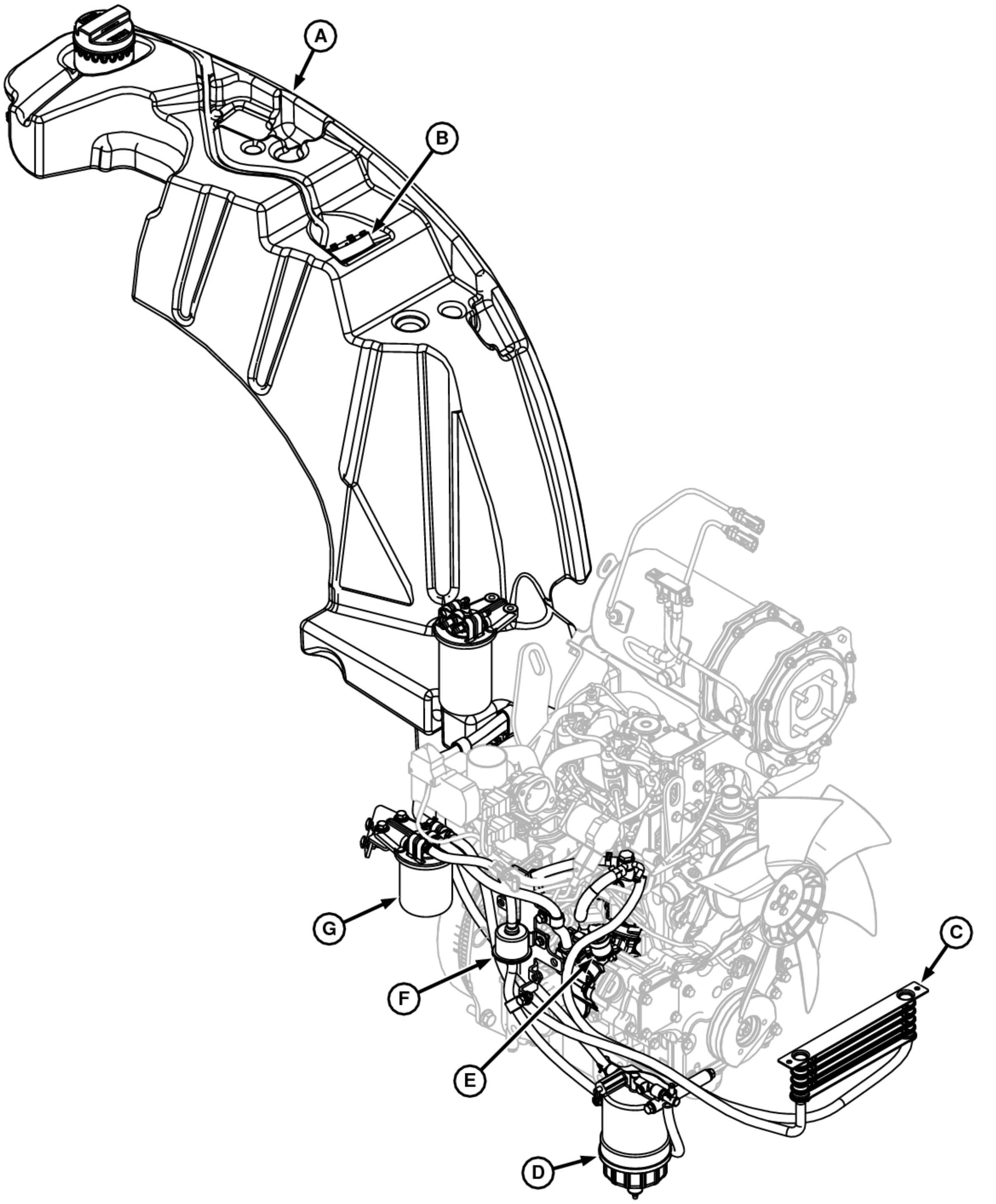


Engine with Aftertreatment Device

LEGEND:

A	Fuel Tank
B	Fuel Level Sender
C	Fuel Overflow Bowl
D	Fuel Overflow Drain Hose
E	Secondary Fuel Filter
F	Fuel Cooler
G	Primary Fuel Filter/Water Separator
H	Injector Pump
I	Electrical Fuel Pump

Fuel Supply Components (Cab)

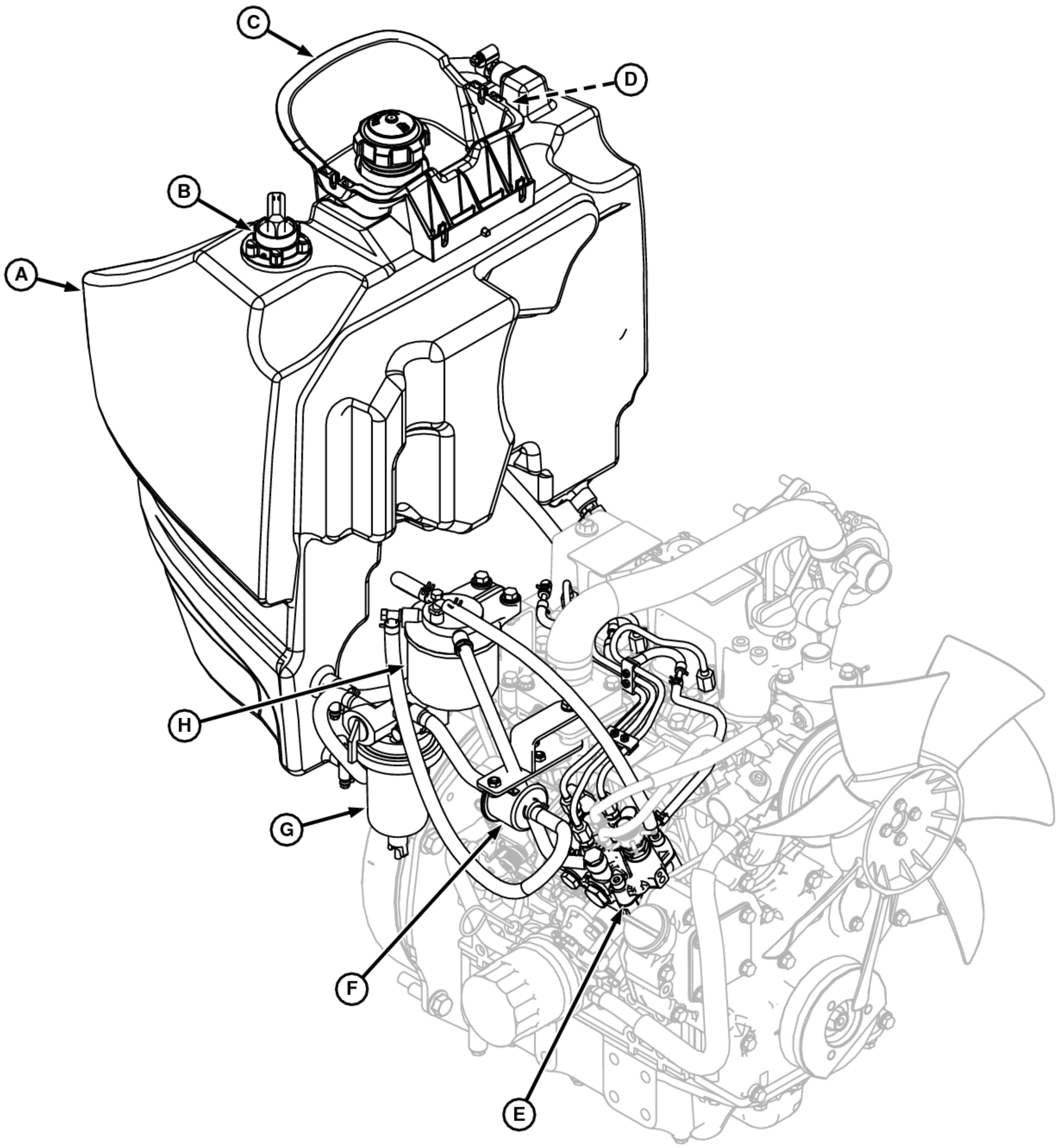


Engine with Aftertreatment Device

LEGEND:

A	Fuel Tank
B	Fuel Level Sender
C	Fuel Cooler
D	Primary Fuel Filter/Water Separator
E	Injector Pump
F	Electrical Fuel Pump
G	Secondary Fuel Filter

Fuel Supply Components (Open Station)

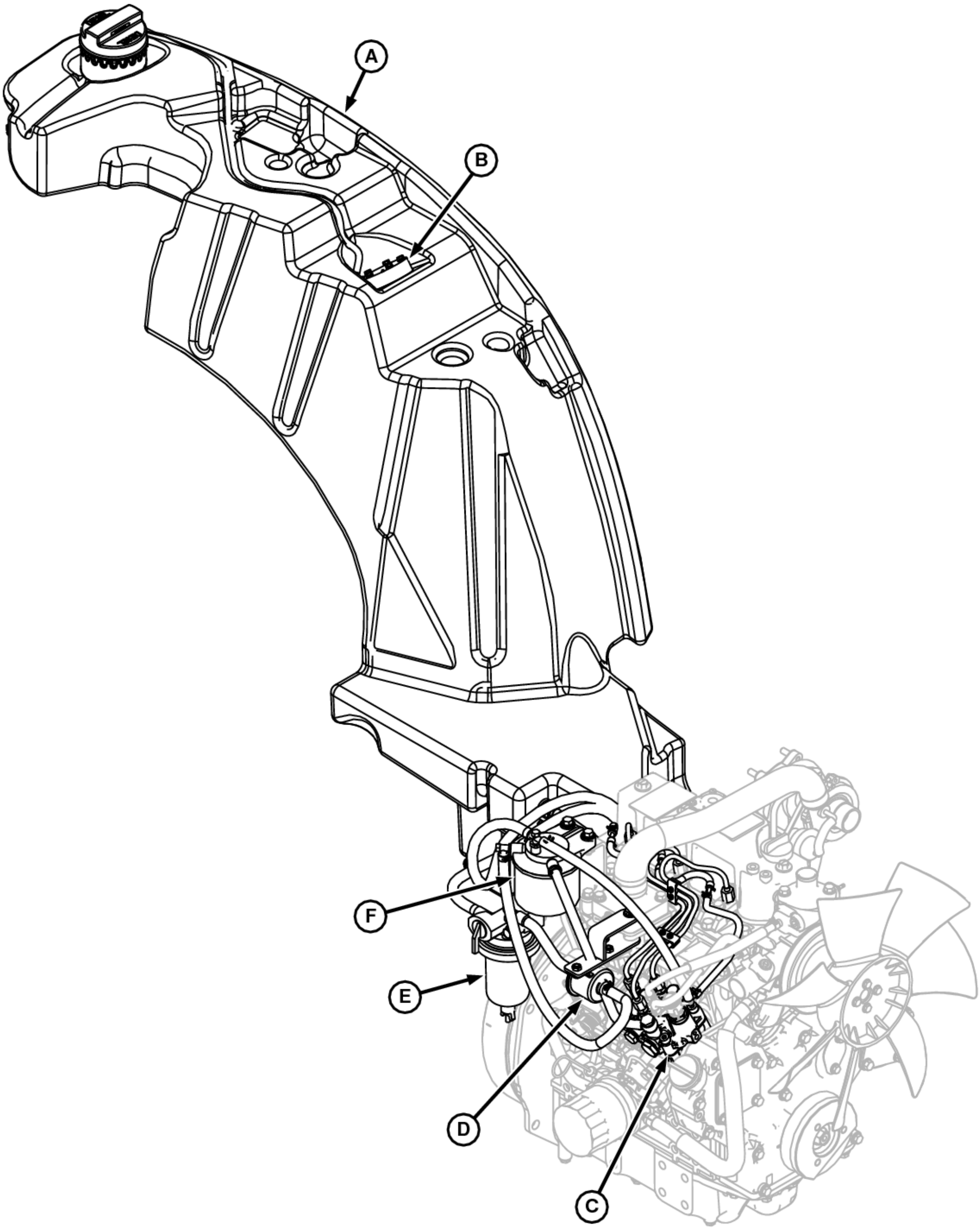


Engine without Aftertreatment Device

LEGEND:

A	Fuel Tank
B	Fuel Level Sender
C	Fuel Overflow Bowl
D	Fuel Overflow Drain Hose
E	Injector Pump
F	Electrical Fuel Pump
G	Primary Fuel Filter/Water Separator
H	Secondary Fuel Filter

Fuel Supply Components (Cab)



Engine without Aftertreatment Device

LEGEND:

A	Fuel Tank
B	Fuel Level Sender
C	Injector Pump
D	Electrical Fuel Pump
E	Primary Fuel Filter/Water Separator
F	Secondary Fuel Filter

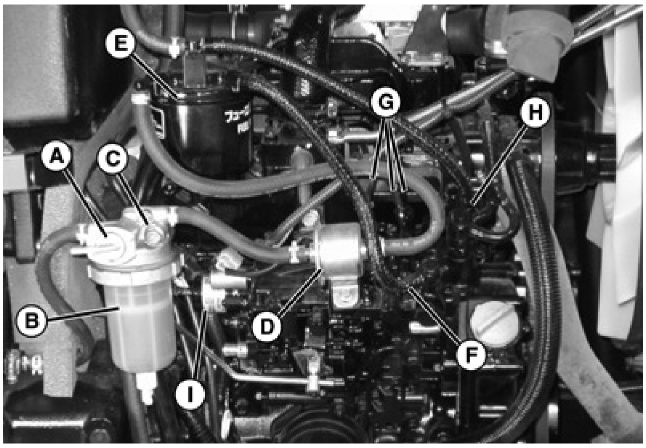
Group 15 - Theory of Operation

Fuel System Operation

Function:

Fuel system supplies fuel to the injection nozzles.

Theory of Operation:



LEGEND:

A	Fuel Shutoff Valve
B	Primary Fuel Filter/Water Separator
C	Air Bleed Screw
D	Fuel Transfer Pump
E	Secondary Fuel Filter
F	Fuel Injector Pump Inlet
G	Injector Lines
H	Junction Fitting
I	Fuel Shutoff Solenoid

Cab model shown.

Fuel System:

Fuel from the fuel tank flows to the fuel shutoff valve (A) in the top of the primary fuel filter/water separator (B). An air bleed screw (C) in the top of the housing is used for bleeding air out of the primary fuel filter/water separator when tractor has run out of fuel or fuel filters are serviced. An electric fuel transfer pump (D) pumps low-pressure fuel to the secondary fuel filter (E) and then to the fuel injection pump inlet (F). The injection pump then directs high-pressure fuel through the injector lines (G) to the fuel injector nozzles for combustion. Excess fuel from the injection pump is combined with leak off fuel from the injectors, through a junction fitting (H) and is routed through the top of the secondary filter base, back to the fuel tank.

If the machine runs out of fuel, or after servicing fuel strainer/water separator, air must be bled from the fuel strainer/water separator. Make sure that fuel shutoff valve is ON. Open bleed screw (C) two or three turns and observe bleed screw. When a steady stream of fuel with no bubbles is observed, close bleed screw. Turn the key switch ON. Let the electric fuel transfer pump run (you should hear clicking sound) for 30 seconds to purge the air from the fuel system.

The engine speed is controlled by the throttle lever and rod or the foot accelerator. The rod is connected to the injection pump governor control lever. The fuel shutoff solenoid (I) controls the injection pump shutoff shaft. When the solenoid is retracted (key in the START or ON position), the engine can be started. When the key is turned off, return springs on the shutoff shaft extend the solenoid, moving the shutoff linkage to the shutoff position. The solenoid also closes if the machine is operated in an unsafe condition. See Electrical section.

The injection pump meters fuel as determined by the governor and delivers it at high pressure to the injection nozzles.

The injection nozzle prevents flow until high pressure is reached, then opening the valve and spraying atomized fuel into the combustion chamber. Injection lines contain trapped fuel whenever injection is not taking place.

A small amount of fuel leaks past the nozzle valve to lubricate the fuel injection nozzle. This leakage combines with excess fuel from the injection pump and is returned to tank. Any air in the fuel system is bled out with return fuel to the fuel tank.

A fuel level sensor mounted in the fuel tank informs the operator of the fuel level.

Cooling System Operation

Function:

The coolant pump circulates the coolant through the cooling system, drawing hot coolant from the engine block, circulating it through the radiator to cool.

Theory of Operation:

The pressurized cooling system includes the radiator, water pump, fan, and thermostat.

During warm-up the thermostat remains closed and the impeller type coolant pump draws coolant from the bypass tube. Coolant from the pump flows to the cylinder block water jacket and up through the cylinder head providing a fast warm-up.

Once the engine has reached operating temperature, the thermostat opens and coolant is pumped from the bottom of the radiator via the lower radiator hose into the cylinder block. Here it circulates through the block and around the cylinders.

From the block, coolant is then directed through the cylinder head, and into thermostat housing. With the thermostat open; warm engine coolant passes through the housing into the top of the radiator where it is circulated to dissipate heat.

Item	Measurement	Specification
Cooling System Thermostat—Start to Open	Temperature	69.5—72.5 °C (157—163 °F)
Cooling System Thermostat—Fully Open	Temperature	85 °C (185 °F)

When coolant system pressure exceeds **48 kPa (7 psi)** , a valve in the radiator cap opens to allow coolant to discharge into the coolant recovery tank.

When temperature is reduced, a vacuum is produced in the radiator and coolant is drawn back out of the coolant recovery tank through a valve in the radiator cap.

A coolant temperature sensor informs the operator of the engine coolant temperature and warns of overheating by lighting a lamp.

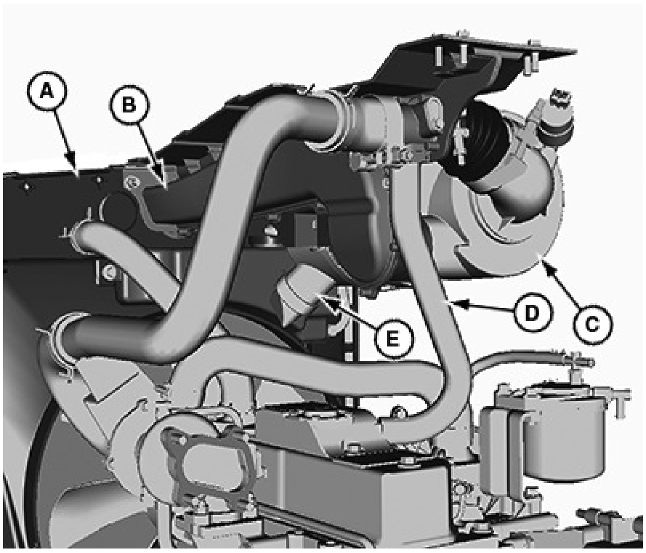
On the TNV engines there are small coolant lines between the water pump and the cold start advance unit on the fuel injection pump. The water pump circulates engine block coolant through the fuel injection pump. While the engine is cold, the fuel injection pump timing is advanced from normal operation which aids in cold starting. When warm water circulates through the fuel injection pump the timing is retarded to provide a cleaner burning of fuel.

Air Intake System

Function:

The air intake system filters and supplies air for combustion. The new closed crankcase ventilation system is routed to intake system to burn crankcase gasses, reducing engine emissions.

Theory of Operation:



LEGEND:
A Radiator Shroud
B Center Intake
C Air Cleaner Housing
D Hose
E Unloader Valve

3TNV84T Engine Shown

Air enters the center intake (B) through the radiator shroud (A) and is directed into the air cleaner housing (C). The air is directed to a baffle which starts a high-speed centrifugal motion of air that continues around the element until it reaches the far end of the air cleaner housing.

Most of the dust is separated from the air by centrifugal force which causes heavy dust particles to enter the opening at the top of the unloader valve (E). The air flows through the primary air filter element, which filters the larger dirt particles before the air enters the secondary air filter element. The finer dirt particles are filtered out by the secondary air filter before the air enters the intake manifold.

The dirt that is deposited in the unloader valve is removed through the rubber diaphragm at the base of the air cleaner. When the engine is running, a pulsing action is created in the intake system by each intake stroke of the engine. This pulsing action causes the rubber diaphragm to open and close, thus emptying the unloader valve. The operator can squeeze the valve to let out the large particles.

Crankcase and engine gases are routed through hose (D) to a tee in the intake hose to help reduce engine emissions.

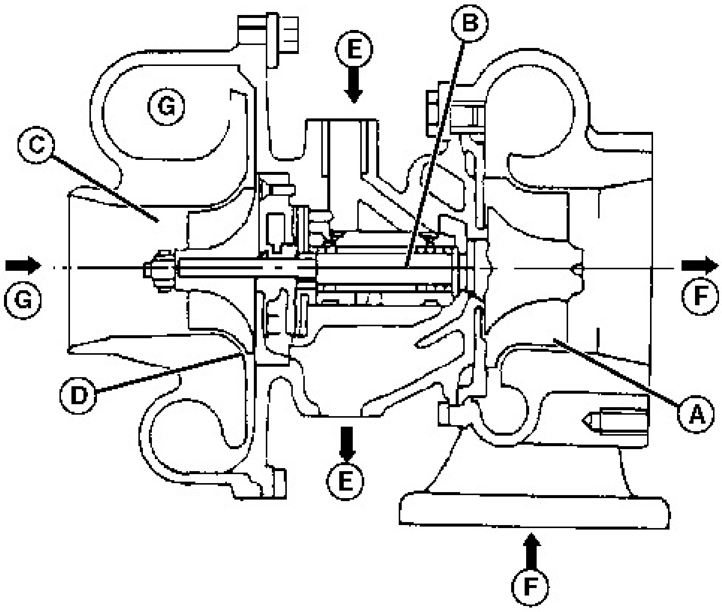
Turbocharger Operation

Function:

The turbocharger supplies pressurized air to the air intake manifold of the engine.

Theory of Operation:

The turbocharger, which is an air pump that is driven by exhaust gases, allows the engine to produce added power without increasing displacement.



LEGEND:

A	Turbine Impeller
B	Turbine Shaft
C	Compressor Impeller
D	Seal Plate
E	Center Housing
F	Air Exhaust
G	Air Inlet

Turbocharger Operation

Exhaust gas from the engine is blown onto the turbine impeller (A) in the turbocharger turbine housing to rotate the turbine shaft (B). The turbine impeller and shaft are referred to as the turbine.

The compressor impeller (C) installed on the turbine shaft rotates with the shaft to draw in filtered air and discharge the compressed air into the intake manifold, where it is then delivered to the engine combustion chambers. The compressor impeller and housing are referred to as the blower or compressor.

To prevent the intake air and oil from leaking, a seal ring and a seal plate (D) are provided to form a double wall structure on the rear side of the compressor impeller.

A waste gate assembly is installed on the turbocharger to prevent it from overspeeding and maintain constant manifold intake pressure. When the blower side pressure (intake pressure) exceeds a specified level, the exhaust gas at the turbine inlet is partially bypassed to the discharge side to control the turbine rpm. This improves response to load variations in the low to medium speed range and minimizes black exhaust smoke.

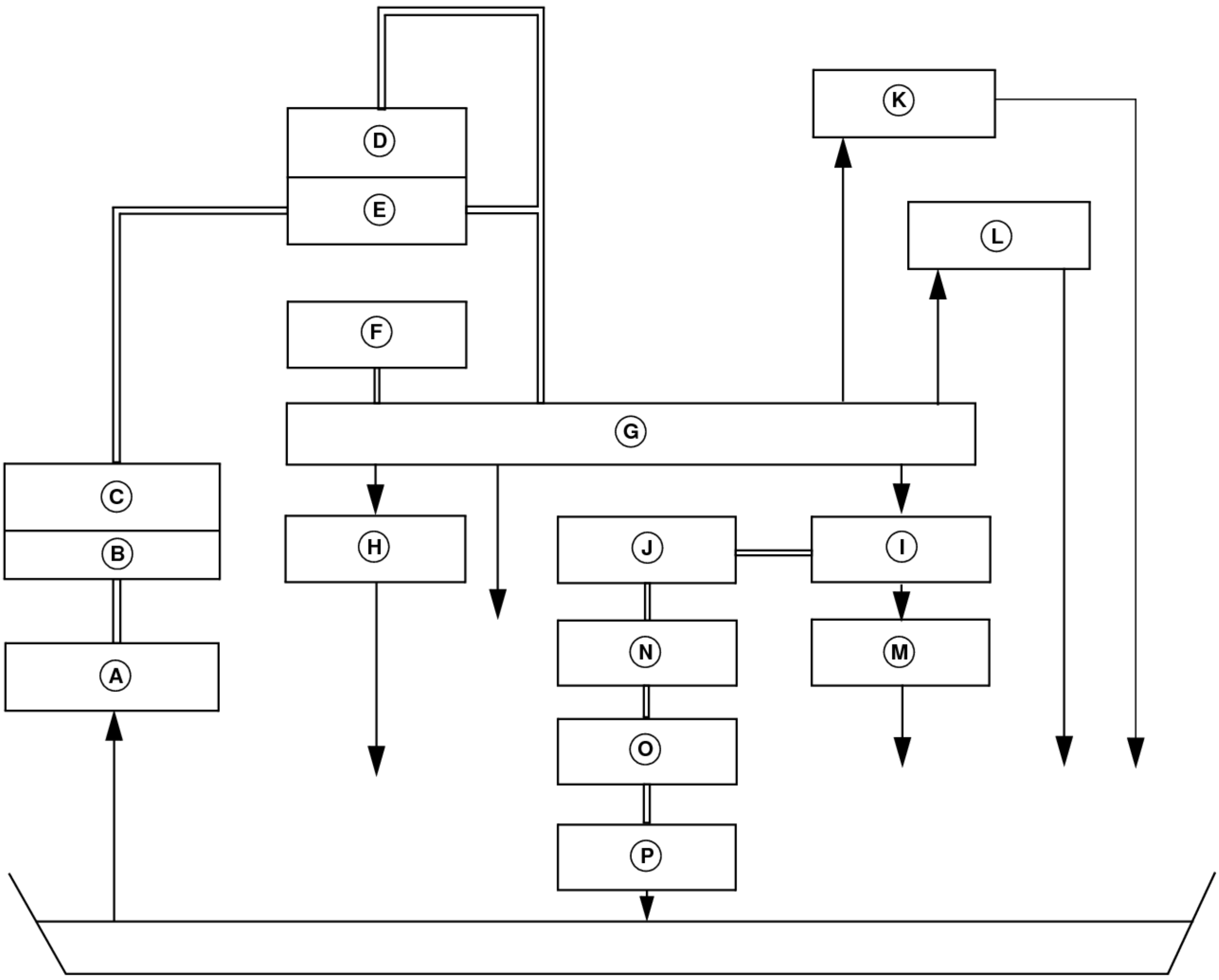
The waste gate consists of a control assembly separated from the turbocharger and a valve assembly installed in the turbine impeller chamber.

Engine oil (E), under pressure from the engine lubricating system, is provided to the turbocharger center housing to lubricate and cool the shaft and bearings.

Engine oil, under pressure from the lubricating system, is pumped through a passage in the bearing housing and directed to the bearings, thrust plate, and thrust sleeve. Oil is sealed from the compressor and turbine at both ends of the bearing (center) housing.

Engine oil then drains through the bottom of the center housing, through a tube and hose, into the back of the timing gear housing and returns to crankcase.

Lubrication System Operation



Lubrication System

LEGEND:

A	Oil Suction Pipe (Strainer)
B	Oil Pump
C	Regulator Valve
D	Oil Filter
E	Bypass Valve
F	Pressure Switch
G	Engine Block Main Oil Galley
H	Intermediate Gear Shaft
I	Crank Journal
J	Camshaft Bearing
K	Turbocharger Housing
L	Fuel Injection Pump
M	Crank Pin
N	Rocker Arm Bearings
O	Rocker Arm
P	Tappet Cam Face

Function:

A full pressure system lubricates engine parts with filtered oil.

Theory of Operation:

The pressure lubrication system consists of an oil strainer (A), positive displacement oil pump (B), oil pressure regulating valve (C), full flow oil filter (D), bypass valve (E), and an electrical pressure warning switch (F).

The pump draws lubrication oil from the oil pan through a strainer and a suction tube. The oil is then pumped through an oil passage to the oil filter and through the engine block main oil galley (G).

From the main oil gallery, oil is forwarded under pressure to the intermediate gear shaft (H) and crankshaft main bearing journals (I). Drilled cross-passages in the crankshaft distribute the oil from the main bearings to connecting rod bearings.

Lube oil holes in main bearing oil grooves direct oil to the camshaft bearings (J).

A drilled passage from the rear camshaft bearing through the cylinder block and cylinder head supplies lubricating oil to the rocker arm bearings. The hollow shaft distributes oil to the rocker arms, cam followers, and valves.

Lubrication oil is supplied to the fuel injection pump (J) and turbocharger bearing housing (K) from the main oil galley through external oil lines.

An oil pressure switch (F) activates an indicator light to alert the operator if oil pressure drops below specification.

Group 20 - Diagnostics

Engine Troubleshooting

CAUTION:

Avoid Injury! Engine radiator fluid is hot during operation.

CAUTION:

Avoid Injury! The engine may start to rotate at any time. Keep hands away from all moving parts when testing.

Engine Oil Diagnostics

Symptom	Problem	Solution
Crankcase Contamination	Fuel in crankcase.	Broken or seized piston ring—replace rings and check cylinder.
		Seized intake/exhaust valve—replace valve and check valve guide.
		Piston ring, piston, or cylinder worn—bore or hone cylinder and replace piston.
	Water in crankcase.	Leaking cylinder head gasket—replace head gasket.
		Cracked water jacket—repair or replace water jacket.

Symptom	Problem	Solution
Low Oil Pressure	Oil level low.	Add oil.
	Oil filter clogged.	Replace Oil Filter.
	Incorrect viscosity	Check oil for too low viscosity, or coolant-or-fuel-diluted engine oil.
		Change engine oil.
	External oil leaks	Repair as necessary
	Oil pressure relief valve worn.	Clean, adjust, or replace relief valve.
	Oil pump defective.	Remove and inspect oil pump. (See Oil Pump (Engines 3TNV8x-BJT, -BMJT, -BXJT) in Section 30, Group 30.)
	Coolant in oil.	(See Coolant in Oil or Oil in Coolant in Section 20, Group 20.)
	Fuel in oil.	Broken or seized piston ring. Replace rings and check cylinder.
		Seized intake or exhaust valve. Check valve guides and stems.
		Piston ring, piston, or cylinder worn. Bore or hone cylinder and replace piston.
	Oil pump screen clogged or pick-up tube cracked.	Remove oil pan and clean screen. Replace pick-up tube. (See Oil Pan and Crankcase Housing Extension in Section 30, Group 30.)
	Intake/Exhaust valves worn.	Check valve guides and stems.
	Crankshaft pin or bearing worn.	Regrind crank and replace bearings.
	Connecting rod bolt loose.	Check for damage and torque bolts.
	Excessive volume of fuel injected.	Check fuel injection pump and injectors.
	Broken or seized piston ring.	Replace rings and check cylinder.
	Excessive main or connecting rod bearing clearance.	Determine bearing clearance. (See Connecting Rod Bearing Clearance Check in Section 30, Group 25.)
	Piston ring, piston, or cylinder worn.	Bore or hone cylinder and replace piston.
	Piston ring end gaps not correct.	Stagger piston ring gaps.
	Piston rings installed incorrectly.	Install piston rings correctly.
	Excessive fumes or dripping oil; appears to becaused by turbocharger boost pressure.	Check the turbocharger, repair/replace as needed. (See Turbocharger Failure Analysis in Section 30, Group 20.)
	Excessive fumes or dripping oil observed; does not appear to becaused by turbocharger boost pressure.	Excessive blow-by, not caused by boost pressure is most likely caused by faulty piston rings/cylinder bores not providing an adequate combustion seal. Perform a compression test to verify this is the case. (See Cylinder Compression Test in Section 30, Group 25.)
	Check for turbocharger oil seal leaks. Signs of oil leakage present.	Investigate problems associated with oil leakage as outlined in the test procedure, perform necessary repairs, and retest. (See Turbocharger Oil Seal Leak Check in Section 30, Group 25.)
High Oil Pressure	High Oil Pressure	Improper engine oil viscosity/type—replace engine oil and filter.
		Oil pressure relief valve failed. Inspect oil pressure relief valve. (See Oil Pump (Engines 3TNV8x-BJT, -BMJT, -BXJT) in Section 30, Group 30.)

Excessive Fuel Consumption

Symptom	Problem	Solution
Excessive Fuel Consumption	Compression leakage from valve seat.	Grind valve seat; regrind valves.
	Engine running too cool.	Check thermostat.
	Excessive volume of fuel injected.	Check fuel injection pump and injectors.
	Poor fuel injection pattern.	Clean or replace fuel injector nozzles.

Incorrect Manifold Pressure

Symptom	Problem	Solution
Low Manifold Pressure	Improper intake or exhaust valve clearance.	Adjust valve clearance.

	Compression leakage from valve seat	Grind valve seat; regrind valves.
	Seized intake/exhaust valve.	Replace valve and check valve guide.
	Clogged air filter.	Clean or replace air filter.
	Engine at high altitude/temperature.	Use higher output engine.
High Manifold Pressure	Excessive volume of fuel injected.	Check fuel injection pump and injectors.

Low Engine Compression

Symptom	Problem	Solution
Low Engine Compression	Oil filter clogged.	Replace oil filter.
	Improper engine oil viscosity/type.	Replace engine oil and filter.
	Excessive volume of fuel injected.	Check fuel injection pump and injectors.
	Compression leakage from valve seat.	Grind valve seat; regrind valves.
	Seized intake/exhaust valve.	Replace valve and check valve guide.
	Broken or seized piston ring.	Replace rings and check cylinder.
	Piston ring, piston, or cylinder worn.	Bore or hone cylinder and replace piston.
	Crankshaft pin or bearing seized.	Regrind crank and replace bearings.
	Piston ring end gaps not correct.	Stagger piston ring gaps.
	Piston rings installed incorrectly.	Install piston rings correctly.
	Foreign matter in combustion chamber.	Remove head and inspect for damage.
	Intake/Exhaust valves worn.	Check valve guides and stems.

Engine Starting Problem

Symptom	Problem	Solution
Engine Does Not Start	Battery voltage low.	Recharge battery.
	Starting motor defective.	Repair or replace starting motor.
	Alternator defective.	Repair or replace alternator.
	Open circuit in wiring.	Repair wiring.
	Faulty fuel shutoff solenoid circuit or fuel shutoff solenoid.	Test electrical circuit, replace fuel shutoff solenoid.
	Fuel filter clogged.	Replace fuel filter.
	Clogged or cracked fuel lines.	Clean or replace fuel lines.
	Fuel volume to injection pump low.	Check or replace fuel transfer pump.
	Water in fuel.	Check and repair.
	Improper intake or exhaust valve clearance.	Adjust valve clearance.
	Improper timing between injection pump, intake, and exhaust valves.	Adjust valve clearance. Check valve timing.
	Seized intake/exhaust valve.	Replace valve and check valve guide.
	Broken or seized piston ring.	Replace rings and check cylinder.
	Piston ring, piston, or cylinder worn.	Bore or hone cylinder and replace piston.
	Crankshaft pin or bearing seized.	Regrind crank and replace bearings.
	Air entering fuel system.	Check and repair fuel supply system.

Symptom	Problem	Solution
Engine Starts But Does Not Continue Running—Exhaust Smoke Absent	Fuel filter clogged.	Replace fuel filter.
	Clogged or cracked fuel lines.	Clean or replace fuel lines.
	Water in fuel.	Check and repair.
	Air entering fuel system.	Check and repair fuel supply system.
	Fuel volume to injection pump low.	Check or replace fuel transfer pump.
	Improper engine oil viscosity/type.	Replace engine oil and filter.
	Improper intake or exhaust valve clearance.	Adjust valve clearance.
	Crankshaft pin or bearing seized.	Regrind crank and replace bearings.
	Piston ring end gaps not correct.	Stagger piston ring gaps.
	Governor not functioning properly.	Repair or replace governor.
	Improper intake or exhaust valve clearance.	Adjust valve clearance.

Symptom	Problem	Solution
Engine Starts But Does Not Continue Running—Excess Exhaust Smoke	Clogged air filter.	Clean or replace air filter.
	Seized intake/exhaust valve.	Replace valve and check valve guide.
	Broken or seized piston ring.	Replace rings and check cylinder.
	Piston ring, piston, or cylinder worn.	Bore or hone cylinder and replace piston.

Engine Operation Poor

Symptom	Problem	Solution
Low Engine Output—Exhaust Color Normal	Fuel filter clogged.	Replace fuel filter.
	Air entering fuel system.	Check and repair fuel supply system.
	Clogged or cracked fuel lines.	Clean or replace fuel lines.
	Improper intake or exhaust valve clearance.	Adjust valve clearance.
	Compression leakage from valve seat.	Grind valve seat; regrind valves.
	Seized intake/exhaust valve.	Replace valve and check valve guide.
	Leaking cylinder head gasket.	Replace head gasket.
	Crankshaft pin or bearing worn.	Regrind crank and replace bearings.
	Improper engine oil viscosity/type.	Replace engine oil and filter.
	Wrong type of fuel.	Drain and replace fuel.
	Fuel volume to injection pump low.	Check or replace fuel transfer pump.
Low Engine Output—Exhaust Color White	Water in fuel.	Check and repair.
	Wrong type of fuel.	Drain and replace fuel.
	Poor fuel injection pattern.	Clean or replace fuel injector nozzles.
	Incorrect injection pump timing.	Check and adjust fuel injection pump timing.
	Uneven volume of fuel injected.	Check fuel injection pump and injectors.
	Broken or seized piston ring.	Replace rings and check cylinder.
	Piston ring, piston, or cylinder worn.	Bore or hone cylinder and replace piston.
	Piston ring end gaps not correct.	Stagger piston ring gaps.
	Piston rings installed incorrectly.	Install piston rings correctly.
	Intake/Exhaust valves worn.	Check valve guides and stems.
	Improper timing between injection pump, intake, and exhaust valves.	Adjust valve clearance. Check valve timing.
Low Engine Output—Exhaust Color Black	Clogged air filter.	Clean or replace air filter.
	Engine running too hot.	Check thermostat, fan belt tension.
		Check cooling system for level/leaks.
		Clean exhaust pipe.
	Water pump/alternator belt loose.	Adjust fan belt tension.
	Wrong type of fuel.	Drain and replace fuel.
	Poor fuel injection pattern.	Clean or replace fuel injector nozzles.
	Incorrect injection pump timing.	Check and adjust fuel injection pump timing.
	Uneven or excess volume of fuel injected.	Check fuel injection pump and injectors.
	Compression leakage from valve seat.	Grind valve seat; regrind valves.
	Seized intake/exhaust valve.	Replace valve and check valve guide.
	Improper timing between injection pump, intake, and exhaust valves.	Adjust valve clearance. Check valve timing.
	Engine at high altitude/temperature.	Use higher output engine.

Symptom	Problem	Solution
Engine Runs Rough	Loud knocking noise during combustion.	Advanced fuel injection pump timing—check and adjust fuel injection pump timing.
	Misfiring	Improper timing between injection pump, intake, and exhaust valves—adjust valve clearance. Check valve timing.
		Improper intake or exhaust valve clearance—adjust valve clearance.
		Compression leakage from valve seat. Grind valve seat; regrind valves.
		Seized intake/exhaust valve. Replace valve and check valve guide.
		Broken or seized piston ring. Replace rings and check cylinder.
		Crankshaft pin or bearing worn or seized. Regrind crank and replace bearings.
		Connecting rod bolt loose. Check for damage and torque bolts.
		Foreign matter in combustion chamber. Remove head and inspect for damage.
		Excessive timing gear backlash. Measure timing gear backlash.

	Uneven combustion sound.	Clogged air filter. Clean or replace air filter.
		Clogged exhaust pipe. Clean exhaust pipe.
		Water in fuel. Check and repair.
		Wrong type of fuel. Drain and replace fuel.
		Uneven volume of fuel injected. Check fuel injection pump and injectors.
		Poor fuel injection pattern. Clean or replace fuel injector nozzles.
	Engine surges during idle.	Water in fuel. Check and repair.
		Uneven volume of fuel injected. Check fuel injection pump and injectors.
		Poor fuel injection pattern. Clean or replace fuel injector nozzles.
		Governor not functioning properly. Repair or replace governor.
		Broken or seized piston ring. Replace rings and check cylinder.
		Crankshaft pin or bearing worn or seized. Regrind crank and replace bearings.
	Engine surges under load.	Water in fuel. Check and repair.
		Uneven volume of fuel injected. Check fuel injection pump and injectors.
		Poor fuel injection pattern. Clean or replace fuel injector nozzles.
		Governor not functioning properly. Repair or replace governor.
		Seized intake/exhaust valve. Replace valve and check valve guide.
		Crankshaft pin or bearing worn or seized. Regrind crank and replace bearings.
	Excessive engine vibration	Uneven volume of fuel injected. Check fuel injection pump and injectors.
		Poor fuel injection pattern. Clean or replace fuel injector nozzles.
		Seized intake/exhaust valve. Replace valve and check valve guide.
		Broken or seized piston ring. Replace rings and check cylinder.
		Governor not functioning properly. Repair or replace governor.
		Crankshaft pin or bearing worn or seized. Regrind crank and replace bearings.
		Connecting rod bolt loose. Check for damage and torque bolts.
		Improper injection pump timing. Check and adjust pump timing.
	Poor return to low speed.	Governor not functioning properly. Repair or replace governor.

Engine Oil Pressure Low

Symptom	Problem	Solution
Low Oil Pressure	Oil level low.	Fill crankcase to proper oil level.
	Oil filter clogged.	Replace oil filter.
	Incorrect oil type or weight being used.	Drain crankcase and refill with correct oil.
	Oil pump defective.	Remove and inspect oil pump. (See Oil Pump (Engines 3TNV8x-BJT, -BMJT, -BXJT) in Section 30, Group 30.)
	Oil pressure relief valve failed.	Inspect oil pressure relief valve. (See Oil Pump (Engines 3TNV8x-BJT, -BMJT, -BXJT) in Section 30, Group 30.)
	Oil pump screen clogged or pick-up tube cracked.	Remove oil pan and clean screen. Replace pick-up tube. (See Oil Pan and Crankcase Housing Extension in Section 30, Group 30.)
	Excessive main or connecting rod bearing clearance.	Determine bearing clearance. (See Connecting Rod Bearing Clearance Check in Section 30, Group 25.)

Coolant Temperature Abnormal

Symptom	Problem	Solution
Engine Coolant Temperature Above Normal	Coolant level low.	Fill cooling system to proper level.
	Radiator core and/or side screens dirty.	Clean radiator.
	Radiator cap defective.	Replace radiator cap as required. (See Radiator Pressure Cap Test in Section 30, Group 25.)
	Engine overloaded.	Reduce engine load.
	Crankcase oil level too low.	Fill crankcase to proper oil level.
	Fan belt loose or defective.	Replace fan belt/check tensioner.
	Premature belt wear or belt flies off pulley.	Check pulley alignment.

	Thermostat defective.	Test thermostat opening temperature; replace thermostat as required. (See Thermostat Opening Test in Section 30, Group 25.)
	Cylinder head gasket damaged.	Replace cylinder head gasket. (See Check for Head Gasket Failures in Section 20, Group 20.)
	Coolant pump defective.	Replace coolant pump.

Symptom	Problem	Solution
Engine Coolant Temperature Below Normal	Thermostat defective.	Test thermostat opening temperature; replace thermostat as required. (See Thermostat Opening Test in Section 30, Group 25.)

Coolant in Oil or Oil in Coolant

Symptom	Problem	Solution
Coolant in Oil or Oil in Coolant	Cylinder head gasket faulty.	Look for signs of head gasket failure. (See Check for Head Gasket Failures in Section 20, Group 20.)
	Oil cooler faulty.	Remove and inspect engine oil cooler.
	Cylinder bore(s) cracked.	Locate crack; repair/replace components as required.
	Cylinder head or block cracked	Locate crack; repair/replace components as required.

Turbocharger Failure Analysis

The following is a guide for diagnosing the cause of turbocharger failures after removal from the engine.

Turbocharger Failure Analysis

Problem	Possible Cause	Suggested Remedy
Compressor Housing Foreign Object Damage	Objects left in intake system.	Disassemble and inspect intake system for foreign objects. Inspect engine for internal damage.
	Leaking and/or defective intake system.	Inspect air intake system connections including air filter; repair as required. Inspect air intake related engine components.
Compressor Wheel Rub	Bearing failure.	Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required.
	Manufacturing defects.	Correct as required.
Oil and/or Dirt in Compressor Housing	Restricted air intake system.	Inspect and clean air cleaner.
	Prolonged periods of low rpm engine idling.	Check with operator to confirm conditions. (See Operator’s Manual.)
	Defective oil seal ring.	Repair as required.
	Restricted oil drain line.	Inspect and clear oil drain line as required.
Oil in Turbine Housing	Internal engine failure.	Inspect and repair engine as required.
	Oil leaking from compressor housing seal.	Verify that oil is in compressor housing and refer to “Oil and/or Dirt in Compressor Housing” as listed earlier in this chart.
Turbine Housing Center Wall Deteriorated	Excessive operating temperature.	Check for restricted air intake. Check engine for overfueling. Check injection pump timing.
Turbine Compressor Wheel Rub	Bearing failure.	Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required.
	Manufacturing defect.	Correct as required.
Foreign Object Damage	Internal engine failure.	Inspect and repair engine as required.
	Objects left in intake system.	Disassemble and inspect air intake system.
	Leaking air intake system.	Correct as required.
Oil and/or Excessive Carbon	Internal engine failure.	Verified by oil in turbine housing. Correct as required.
	Turbine seal failure.	Inspect for excessive heat from overfueling and/or restricted air intake.
	Prolonged periods of low rpm engine idling.	Ask operator to run engine under load or at a higher rpm (See Operator’s Manual).
	Restricted oil drain line.	Inspect and clear oil drain line as required.
Center Housing Leaks from Casting	Defective casting.	Replace turbocharger.
	Defective gasket.	Verify if leaks are occurring at gasket joints.
Center Housing Leaks from Joints	Loose attaching screws.	Tighten to specifications.
	Defective gasket.	Inspect and repair as required.
Excessive Carbon Build-Up in Center Housing or on Shaft	Hot engine shutdown.	Review proper operation with operator as shown in operator’s manual.
	Excessive operating temperature.	Restricted air intake; overfueling or mistimed engine.
	Restricted oil drain line.	Inspect and clean oil drain lines as required.
	Operating engine at high speeds and loads immediately after start-up.	Idle engine for a few minutes to allow oil to reach bearings before applying heavy loads.

Diagnostic Table

Diagnostic Table

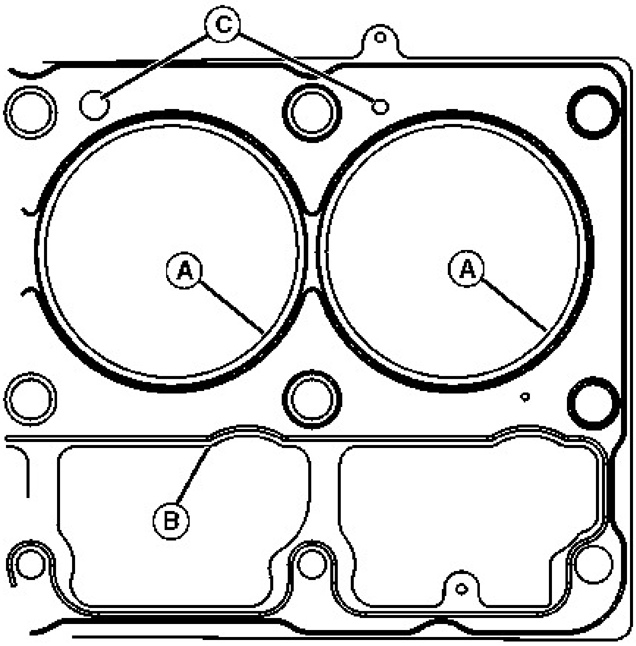
Test Conditions:
Machine parked on level surface. Park brake engaged. Key switch off unless indicated otherwise.

Diagnostic Table

Test/Check Point	Normal Condition	If Not Normal
Engine dipstick and exterior engine surface	Oil level between “L” and “H” marks.	Change oil and inspect for source of contamination.
	Oil not burnt, or contaminated with metal particles, fuel, or coolant.	Check gaskets, seals, plugs, cylinder head, block, and intake manifold and breather.
	No external leakage, filter clean.	Change oil filter.
Coolant tank and radiator	Coolant level between marks on tank when engine is warm. Coolant in radiator full to top.	Add proper coolant mix.
	Coolant not contaminated with oil, fuel, or discolored brown.	Drain and flush system. Check for source of contamination.
	Radiator screen free of debris.	Clean or replace.
	Hoses not cracked or leaking; clamps and radiator cap tight.	Pressure test radiator and cap. (See Cooling System Pressure Test and Radiator Pressure Cap Test in Section 30, Group 25.)
	Water pump/alternator belt tight; not glazed or cracked.	Replace and adjust belt tension. (See Fan/Alternator Drive Belt Adjustment in Section 30, Group 25.)
	Fan blades not damaged or warped.	Replace fan.
Fuel tank, pump, lines, filter, filter shutoff valve	Fuel level correct, not contaminated; correct grade of fuel; no water or debris in filter bowl/water separator.	Drain and clean fuel tank. Add fresh fuel. Replace filters.
	Filter shutoff valve in “ON” position.	Move to “ON” position.
	Fuel hoses not cracked or leaking.	Replace.
	Fuel hose clamps tight.	Replace or tighten.
	Fuel tank does not have vacuum.	Replace fuel tank vent hose.
Air filter and air intake	Air filter outlet hose not cracked; clamps tight.	Replace hose and/or tighten clamps.
	Elements not plugged. Air filter housing sealed; no dirt tracking inside filter element.	Replace element or housing.
	Air filter restriction indicator not leaking	Replace indicator.
Fuel shutoff solenoid (Key in “START” position	Fuel shutoff solenoid must pull in and stay in when key is returned to “ON”. Listen for clicking as key is cycled.	If solenoid will not pull in and hold in, see “Fuel Shutoff Solenoid Circuit Diagnosis” in Electrical section.
Fuel filter/water separator	Fuel level visible in filter bowl.	Drain water from bowl.
	Fuel bowl does not contain water.	Replace fuel filter. Recheck.
	Fuel present at injection pump inlet hose.	Test fuel pump.
Hand throttle control lever linkage. Throttle pedal linkage (gear only).	Full movement of governor control arm from idle to full speed.	Repair; replace or adjust linkage. (See Throttle Cable Adjustment in Section 30, Group 25.)
Intake and exhaust valves	Valve clearance within specification (engine cold).	Adjust valves. (See Valve Lift Check in Section 30, Group 25.)
	Valves not sticking.	Check valve guides and stems.
Fuel is reaching injectors	Cracked fuel injection lines at injectors. Crank engine. (Be sure that fuel shutoff solenoid has pulled in.) Fuel leaks out.	No fuel present: Check fuel shutoff valve is open, fuel level in tank, inspect filter/separator element. Test fuel pump.
Injectors are working properly	Injector spray pattern is normal and cracking pressure is within specifications.	Check spray pattern and cracking pressure. (See Fuel Injection Nozzle Test in Section 30, Group 25.)
Perform cylinder compression test at fuel injector ports	Cylinder compression within specification. Pressure difference between cylinders within specification.	Rebuild engine.
Flywheel and starting motor	Minimum cranking rpm within specification.	See “Starter Amp Draw Test” in Electrical section.
Fuel injection pump static timing test	Timing should be correct. (Remove pump as the LAST possible solution.)	Have injection pump static timing adjustment performed by a qualified service repair shop. (See Injection Pump Timing (EPA Engines) in Section 30, Group 25.)
Injection pump slow idle speed (engine running)	Engine runs at rpm specification.	(See Low Idle Adjustment in Section 30, Group 25.)
Governor	Engine runs smoothly through out rpm range with low smoke and good power.	Have governor torque capsule adjusted by a certified CARB/EPA service center.

Test/Check Point	Normal Condition	If Not Normal
Oil pressure sender port	Oil pressure to specification.	Test engine oil pressure. (See Engine Oil Pressure Test in Section 30, Group 25.)
Thermostat	Opening temperature within specification.	Perform thermostat opening test. (See Thermostat Opening Test in Section 30, Group 25.)
Muffler	Not restricted.	Replace muffler.

Check for Head Gasket Failures



LEGEND:

A	Combustion Sealing Area
B	Oil Sealing Areas
C	Coolant Sealing Areas

Diagnosing Head Gasket Joint Failures

Head gasket failures generally fall into three categories:

[1] - Combustion seal failures.

[2] - Coolant seal failures.

[3] - Oil seal failures.

Combustion seal failures occur when combustion gases escape between the cylinder head and head gasket combustion flange, or between the combustion flange and cylinder bore. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

Coolant or oil seal failures occur when oil or coolant escapes between the cylinder head and gasket body, or between the cylinder block and gasket body. The oil or coolant may leak to an adjacent coolant or oil passage, or externally. Since oil and coolant passages are primarily on right-hand (camshaft) side of engine, fluid leaks are most likely to occur in that area.

Follow these diagnostic procedures when a head gasket joint failure occurs or is suspected.

[1] - Before starting or disassembling engine, conduct a visual inspection of machine and note any of the following:

a. Oil or coolant in head gasket seam, or on adjacent surfaces.
b. Displacement of gasket from normal position.
c. Discoloration or soot from combustion gas leakage.
d. Leaking radiator, overflow tank, or hoses.
e. Leaking coolant from coolant pump weep hole.
f. Damaged or incorrect radiator, fan, or shroud.
g. Obstructed air flow or coolant flow.
h. Worn or slipping belts.
i. Damaged or incorrect pressure cap.
j. Presence of oil in coolant.
k. Low coolant levels or improper coolant.
l. Unusually high or low oil levels.
m. Oil degradation, dilution, or contamination.
n. Indications of fuel or timing adjustments.
o. Unburned fuel or coolant in exhaust system.

[2] - Obtain coolant and oil samples for further analysis.

[3] - Start and warm up engine if it can be safely operated. Examine all potential leakage areas again as outlined previously. Using appropriate test and measurement equipment, check for the following:

a. White smoke, excessive raw fuel, or moisture in exhaust system.
b. Rough, irregular exhaust sound, or misfiring.
c. Air bubbles, gas trapped in radiator and overflow tank.
d. Loss of coolant from overflow.
e. Excessive cooling system pressure.
f. Coolant overheating.
g. Low coolant flow.
h. Loss of cab heating (if equipped) (air lock).

[4] - Shut down engine. Recheck crankcase, radiator, and overflow tank for any significant differences in fluid levels, viscosity, or appearance.

[5] - Compare your observations from above steps with the diagnostic charts earlier in this group. If diagnostic evaluations provide conclusive evidence of combustion gas, coolant, or oil leakage from head gasket joint, the cylinder head must be removed for inspection and repair of gasket joint components.

Combustion Seal Leakage

Symptoms:

[1] - Exhaust from head gasket crevice

[2] - Air bubbles in radiator and overflow tank

[3] - Coolant discharge from overflow tube

[4] - Engine overheating

[5] - Power loss

[6] - Engine runs rough

[7] - White exhaust smoke

[8] - Loss of cab heat

[9] - Gasket section dislodged, missing (blown)

[10] - Coolant in cylinder

[11] - Coolant in crankcase oil

[12] - Low coolant level

Possible Causes:

[1] - Low head bolt clamping loads

[2] - Cracked and deformed gasket combustion flange

[3] - Out-of-flat, damaged or rough cylinder head surface

[4] - Missing or mislocated gasket fire ring

[5] - Excessive fuel delivery

[6] - Advanced injection pump timing

→NOTE:

Cracked cylinder head or cylinder bores may also allow combustion gas leakage into coolant.

Coolant Seal Leakage

Symptoms:

[1] - Coolant discharge from head gasket crevice

[2] - Coolant in crankcase oil

[3] - Low coolant level

[4] - High oil level

[5] - Coolant discharge from crankcase vent

Possible Causes:

[1] - Low head bolt clamping loads

[2] - Out-of-flat, damaged or rough block surface

[3] - Out-of-flat, damaged or rough cylinder head surface

[4] - Oil or coolant overheating

[5] - Cracks or creases in gasket body surfaces

[6] - Damage or voids in elastomer beading

Oil Seal Leakage

Symptoms:

[1] - Oil discharge from head gasket crevice

[2] - Oil in coolant

[3] - Low crankcase oil level

[4] - Reduced oil to rocker arms (noisy)

Possible Causes:

[1] - Low head bolt clamping loads

[2] - Out-of-flat, damaged or rough block surface

[3] - Out-of-flat, damaged or rough cylinder head surface

[4] - Oil or coolant overheating

[5] - Cracks or creases in gasket body surfaces

[6] -

→NOTE:

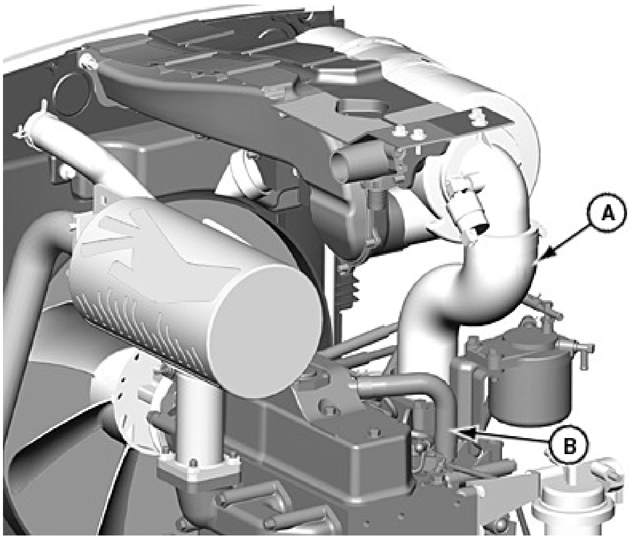
Defective oil cooler may also allow oil leakage into coolant.

Damage and voids in elastomer beading

Group 25 - Tests and Adjustments

Check Air Intake System

[1] -

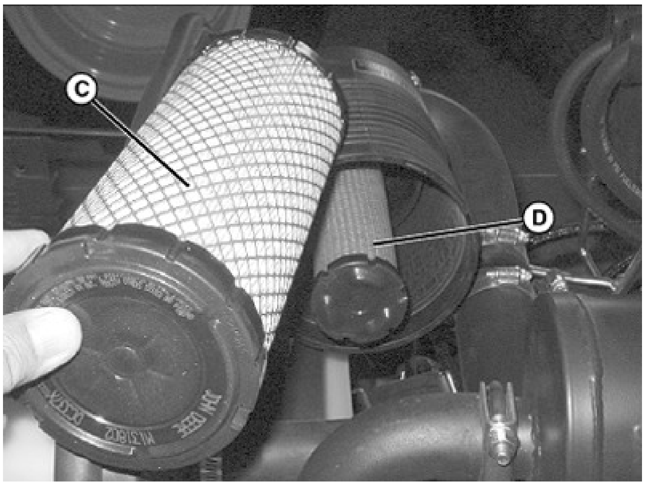


LEGEND:
A Air Cleaner-to-Engine Hose
B Crankcase Breather Hose

Other Air Intake Systems Similar

Check condition of air intake hoses (A and B). Replace hoses that are cracked, split, or otherwise in poor condition.

[2] -



LEGEND:
C Primary Filter Element
D Secondary Element

Check Air Cleaner Elements

Replace air cleaner primary filter element (C). Replace secondary element (D) if primary element has holes in it.

[3] - Check hose clamps for tightness. Replace clamps that cannot be tightened. This will help prevent dust from entering the air intake system, causing serious engine damage.

Air Restriction Indicator Test

Reason:

To check operation of air filter restriction indicator and check air intake system for leaks, restrictions, or obstructions.

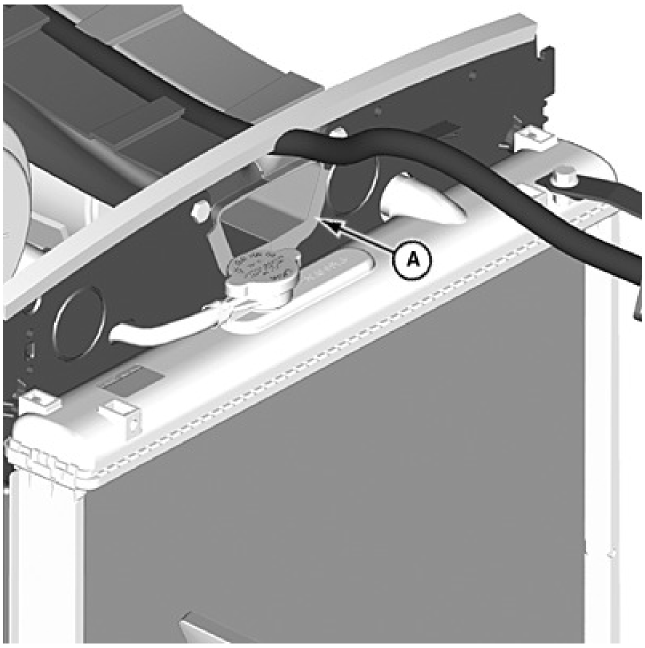
Procedure (Simulated Excess Restriction):

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Raise hood.

[3] - Start and run engine at SLOW idle.

[4] -



LEGEND:
A Air Cleaner Intake Tube

Air Cleaner Intake Tube

Cover the air cleaner intake tube (A) with a piece of cardboard.

[5] - Watch air filter restriction indicator. The indicator light should illuminate.

[6] - Remove cardboard and stop engine.

Results:

If restriction indicator DID NOT illuminate, check for:

- Loose or damaged hose clamps.
- Air leaks in air filter-to-intake manifold hose.
- Air leaks in intake manifold.
- Air leaks at indicator mounting threads.
- Cracked indicator housing or diaphragm.
- Clogged screen inside indicator mounting nipple.
- Damaged electrical circuit. See diagnosis in the Electrical section.

Check for Intake and Exhaust Restrictions

Low power, low boost pressure, and excessive black exhaust smoke can be caused by an intake air or exhaust restriction.

[1] - Inspect the exhaust pipe and muffler for damage or possible restrictions.

[2] - Inspect the intake piping. Look for collapsed pipes, dented pipes, cracked hose, and loose connections. Replace components as needed.

Fan/Alternator Drive Belt Adjustment

Reason:

To keep correct tension on the drive belt to the water pump and alternator. To prevent shortened belt and bearing life.

Equipment:

- JDG529 or JDST28 Belt Tension Gauge
  Belt Tension Gauge
  JDG529 or JDST28
  Adjust belt Tension
- Straightedge

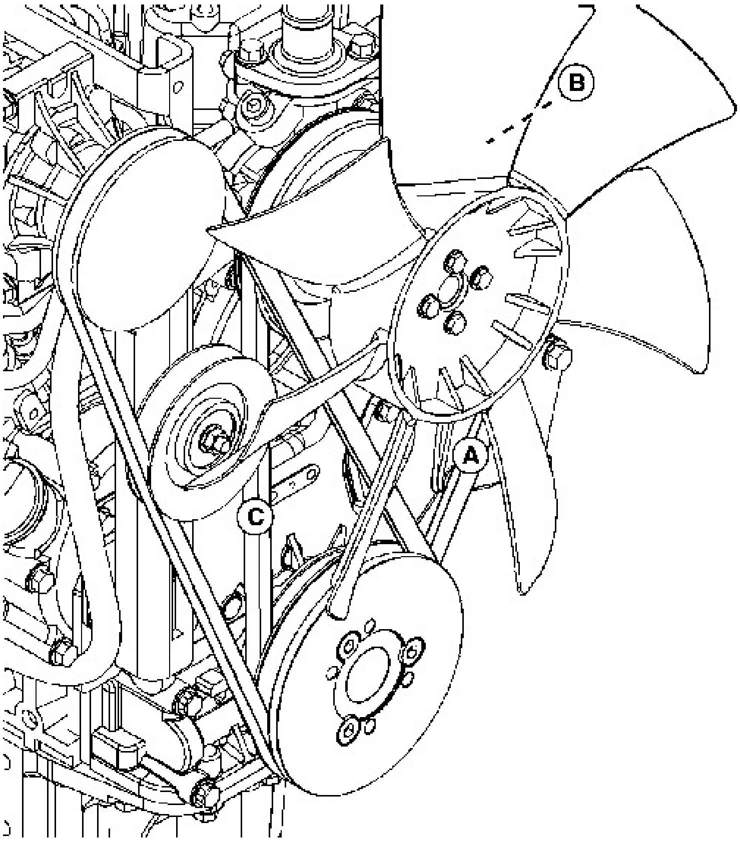
Procedure:

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

[3] - Raise hood.

[4] -



LEGEND:

A	Water Pump
B	Crankshaft Pulley
C	Alternator

Fan Belt Adjustment

Apply a force of **98 N (22 lb.-force)** to the alternator belt midway between water pump (A), crankshaft pulley (B), or alternator (C) using a belt tension gauge and a straightedge.

Belt Tension Gauge

JDG529 or JDST28

Adjust belt Tension

[5] - The deflection should be to specification.

Specifications:

Fan Belt Deflection Table

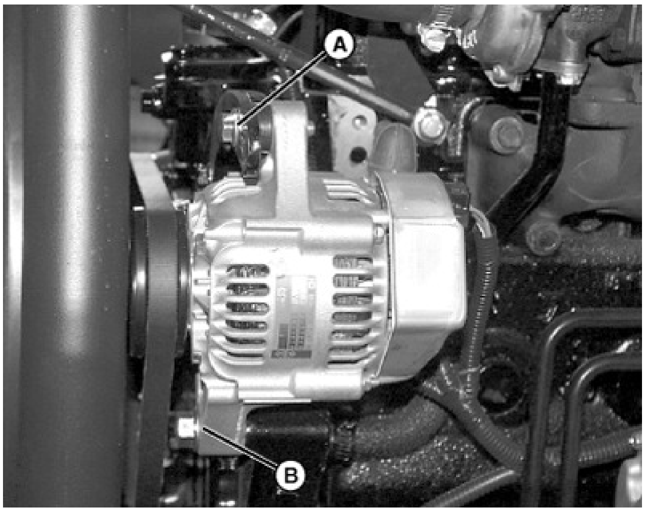
Deflection Point	Used Belt	New Belt
A	10—14 mm (0.40—0.55 in.)	8—12 mm (0.32—0.47 in.)
B	7—10 mm (0.28—0.40 in.)	5—8 mm (0.20—0.32 in.)
C	9—13 mm (0.35—0.51 in.)	7—11 mm (0.28—0.43 in.)

Results:

- If deflection is not within specifications, adjust belt.

Adjusting Alternator Belt Tension:

[1] -



LEGEND:

A Adjusting Cap Screw
B Alternator Pivot Cap Screw

Adjusting Belt Tension

Loosen adjusting cap screw (A).

[2] - Loosen alternator pivot cap screw (B).

[3] - Push alternator inward to loosen or outward to tighten belt.

[4] - Tighten cap screws.

[5] - Check belt tension.

A/C Compressor Belt Adjustment

Reason:

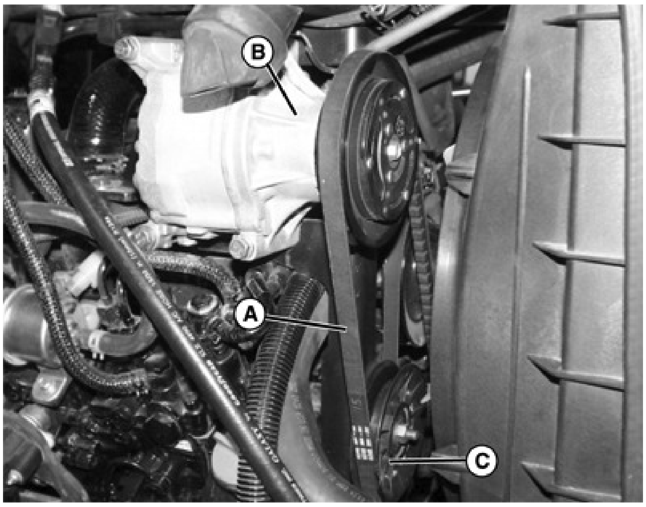
To keep correct tension on the drive belt to the AC compressor. To prevent shortened belt and bearing life.

Equipment:

- JDG529 or JDST28 Belt Tension Gauge
  Belt Tension Gauge
  JDG529 or JDST28
  Adjust belt Tension
- Straight Edge

Procedure:

[1] -



LEGEND:

A	Belt
B	Compressor
C	Tensioner Pulley

Air Conditioner Compressor Belt

Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

[3] - Raise hood.

[4] - Apply a force of **98 N (22 lb.-force)** to the belt (A) midway between the AC compressor and the tensioner pulley (C). Check belt tension using belt tension gauge and a straight edge.

Belt Tension Gauge

JDG529 or JDST28

Adjust belt Tension

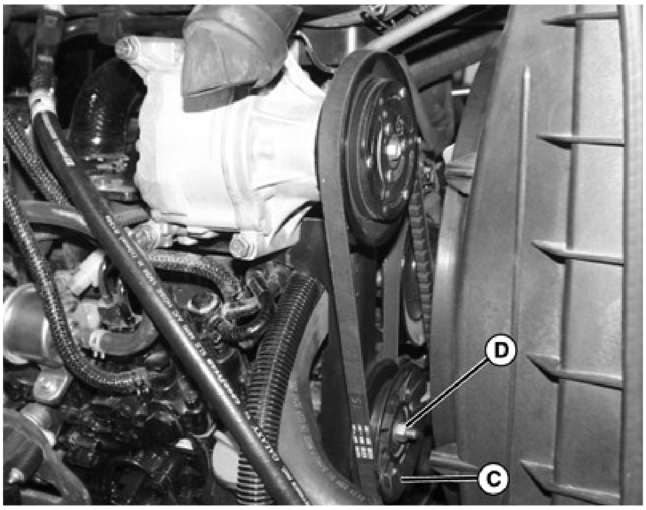
[5] - Belt tension should be to specification.

Item	Measurement	Specification
Compressor Belt	Tension	8—12 mm (0.32—0.47 in.)

Results:

- If belt tension is incorrect:

[1] -



LEGEND:

C	Tensioner Pulley
D	Nut

Air Conditioner Compressor

Loosen nut (D).

[2] - Slide tensioner pulley (C) up to loosen or down to tighten belt.

[3] - When correct tension is achieved tighten nut (D) and recheck tension.

Throttle Cable Adjustment

Reason:

To ensure that throttle cable is adjusted correctly and allows full high idle and slow idle position of governor throttle lever.

Equipment:

- Metric Wrenches
- Pliers

Procedure:

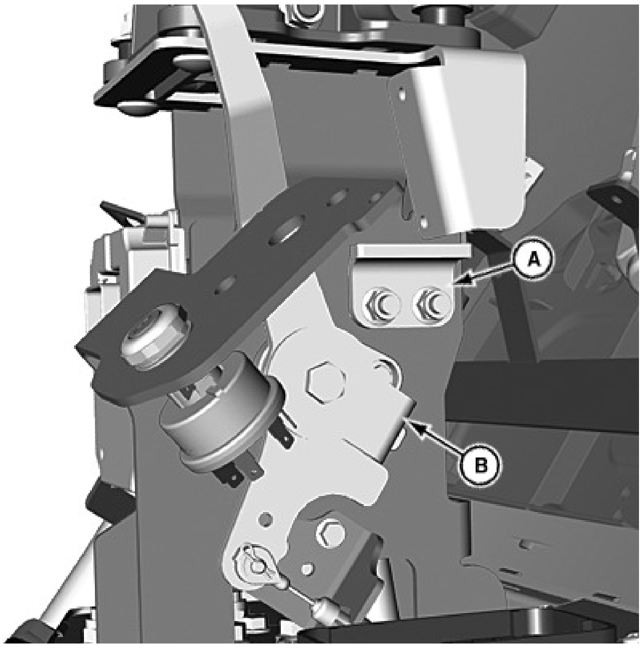
[1] - Park machine safely. See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

[3] - Raise hood.

[4] - Remove console cowl.

[5] -



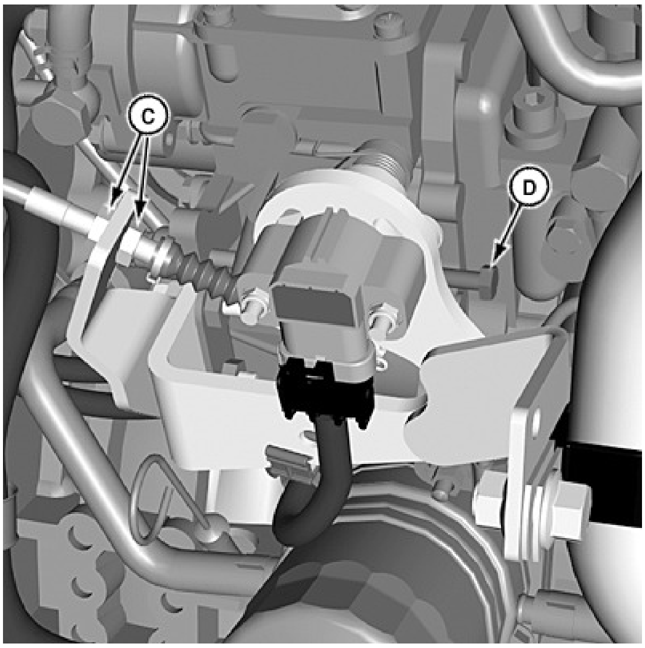
LEGEND:
A High Idle Throttle Stop Bracket
B Retaining Bracket

Throttle Shown Behind Control Console and Cowl

Loosen nuts and fast idle throttle stop bracket (A).

[6] - Ensure that throttle lever is at low idle and contacts retaining bracket (B).

[7] -

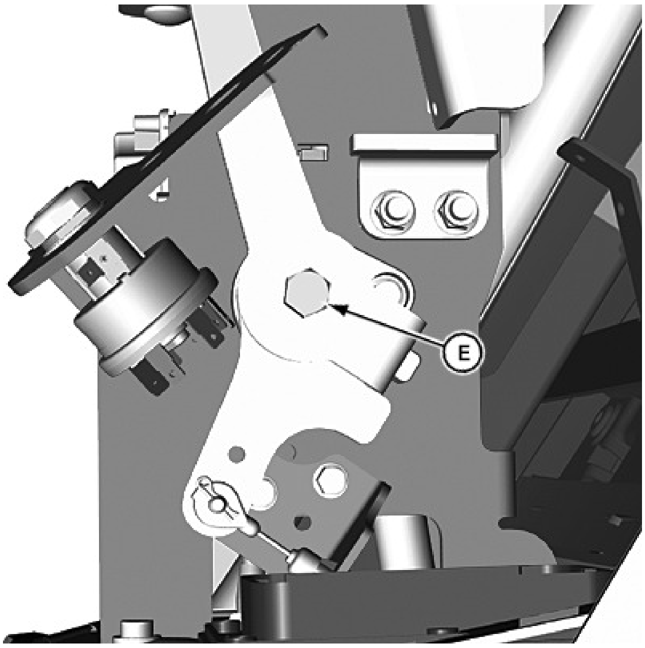


LEGEND:
C Throttle Cable Jam Nut (2 used)
D Low Idle Screw

Throttle Cable Jam Nuts

When hand throttle lever is at its low idle position and engine governor pull bracket is up against the low idle screw (D), adjust throttle cable jam nuts (C) to remove any slack from cable. Tighten jam nuts.

[8] -

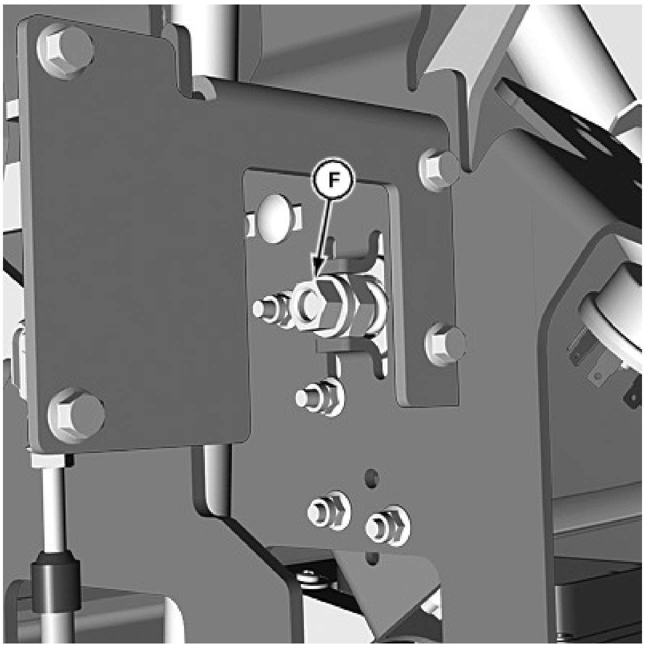


LEGEND:
E Hand Throttle Pivot Screw

Hand Throttle Pivot Screw

Tighten hand throttle pivot screw (E) so that approximately 89—98 N (20—22 lb.-force) is required to actuate hand throttle to full throttle.

[9] -



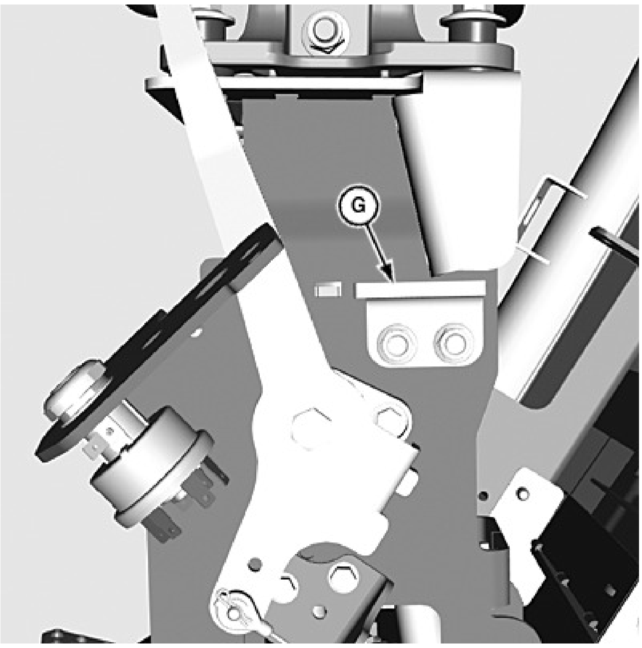
LEGEND:
F Special Torque Prevailing Nut

Looking Into Steering Column Support

When proper torque on throttle pivot bolt is established, tighten jam nut down on special torque prevailing nut (F).

[10] - Move throttle lever to full throttle position.

[11] -



LEGEND:
G Full Throttle Stop Bracket

Full Throttle Stop Bracket

Adjust full throttle stop bracket (G) to just contact the throttle lever. Tighten stop bracket screws.

Low Idle Adjustment

IMPORTANT:

Avoid Damage! The low idle adjustment is the only adjustment that can be made on this engine.

The high idle and torque capsule adjustments are pre-set by the engine manufacturer to comply with strict EPA/CARB emissions requirements, and are adjustable ONLY by authorized diesel service facilities.

Reason:

To achieve proper low idle rpm setting. Provides adequate rpm to keep the engine running smoothly without stalling.

Equipment:

- JT05719 Hand Held Digital Tachometer

→NOTE:

Make sure that the air cleaner is clean and not restricted. Replace the air cleaner element as necessary.

Procedure:

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Raise hood.

[3] - Place a small piece of reflective tape on the crankshaft pulley.

[4] - Start the engine and run for 5 minutes to attain operating temperature.

[5] - Move the throttle lever to low idle position.

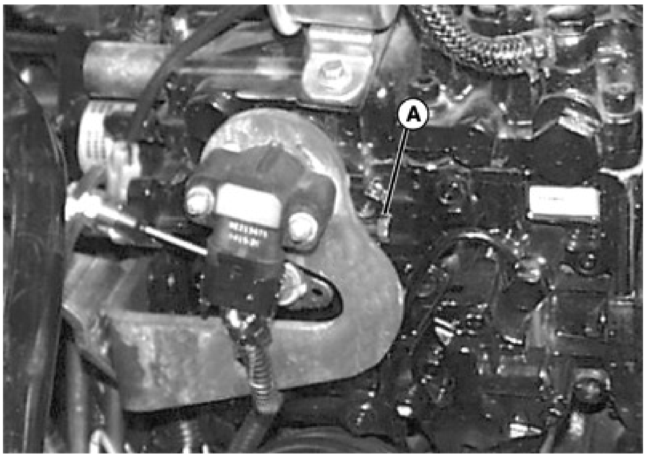
[6] - Use JT05719 hand held digital tachometer to check engine speed at the crankshaft pulley.

Hand Held Digital Tachometer

JT05719

Used to adjust engine slow idle.

[7] -



LEGEND:

A	Low Idle Stop Screw

Low Idle Stop Screw

Visually check that the injection pump throttle lever is against low idle stop screw (A). Slow idle speed is set to specification.

Item	Measurement	Specification
eHydro	Speed	1000 ± 50 rpm

Results:

- If the low idle rpm is not according to specifications loosen the idle screw jam nut. Turn the low idle stop screw to increase or decrease the engine speed until the low idle speed is correct. After adjustment, tighten the jam nut.

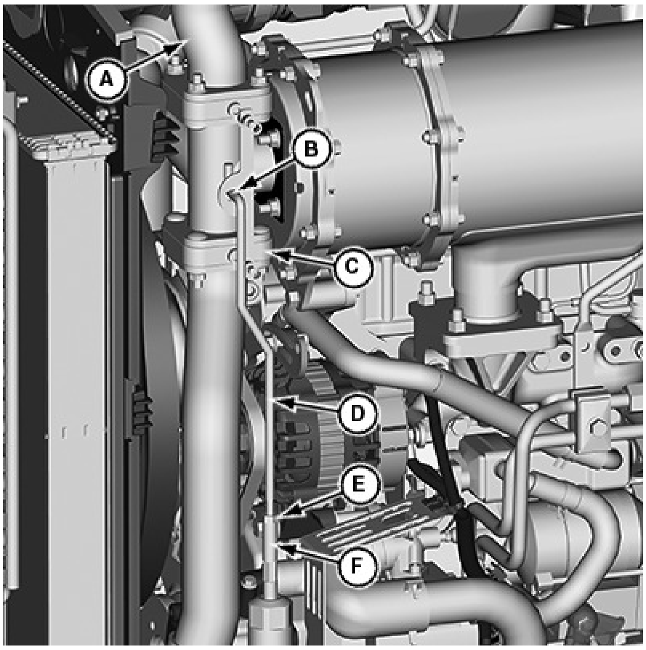
Exhaust Valve Actuator Rod Adjustment

When the actuator is de-energized, the bottom exhaust block should be in the fully-open position and top should be fully-closed. The split exhaust valve connect bracket should be resting on the upper actuator rod. When activated, the valves should perform their function in a maximum time of 2 seconds.

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05).

[2] - Remove hood assembly. (See Hood Removal and Installation (Cab and Open Station) in Section 120, Group 10).

[3] -



LEGEND:

A	Exhaust Stack
B	Split Exhaust Valve Connect Bracket
C	Exhaust Block Valve
D	Upper Actuator Rod
E	Lock Nut
F	Lower Actuator Rod

Actuator Rod Adjustment

Loosen the lock nut (E).

[4] - Turn the lower actuator rod (F) until the upper actuator rod (D) is no longer touching the split exhaust valve connect bracket (B) and the lower exhaust block valve (C) is fully-open.

[5] - Turn the lower actuator rod (F) until the upper actuator rod (D) just touches the split exhaust valve connect bracket (B) and then add another half turn.

[6] -

→NOTE:

There should be some exhaust leakage coming from the top exhaust stack (A).

Perform operations check. If there is leakage, then adjust lower actuator rod (F) until exhaust leakage is minimized.

Thermostat Opening Test

Reason:

To determine opening temperature of thermostat.

Equipment:

- Thermometer
- Glass Container
- Heating Unit

Procedure:

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

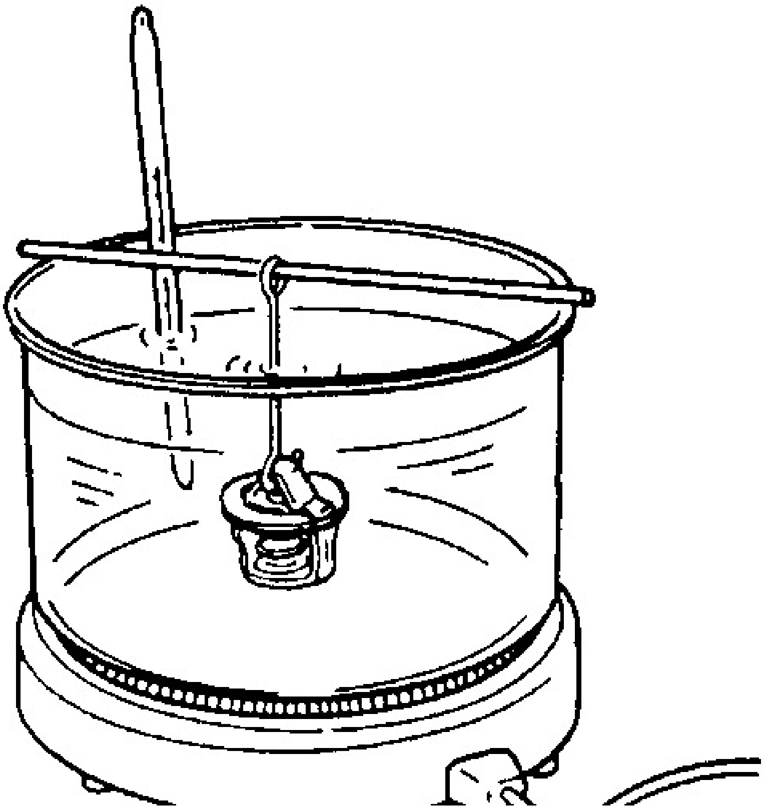
[3] - Raise hood.

[4] - Remove thermostat. (See Thermostat Removal and Installation in Section 30, Group 30.)

[5] -

CAUTION:

Avoid Injury! DO NOT allow thermostat or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if overheated.



Thermostat

Suspend the thermostat and a thermometer in a container of water.

[6] - Heat and stir the water. Observe opening action of thermostat and compare temperatures with specifications.

Item	Measurement	Specification
Begin Opening	Temperature	69.5—72.5 °C (157—163 °F)

Item	Measurement	Specification
Fully Open	Temperature	85 °C (185 °F)
Minimum Lift Height Above 85 °C (185 °F)	Height	8 mm (0.315 in.)

[7] - Remove the thermostat and observe the closing action as it cools.

Results:

- If thermostat does not open according to specifications, replace.
- If closing action is not smooth and slow, replace thermostat.

Cylinder Compression Test

Reason:

To determine the condition of the pistons, rings, cylinder walls, and valves.

Equipment:

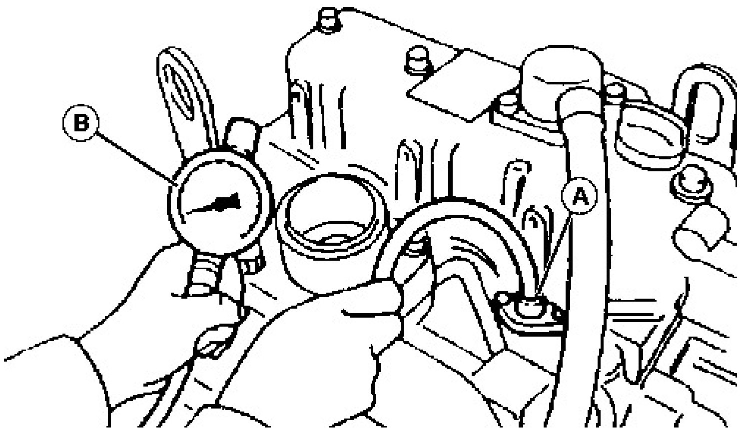
- JT01682 Compression Gauge Assembly
- JDG560 Adapter

Procedure:

[1] - Run engine for 5 minutes to bring to operating temperature. Shut off engine.

[2] - Remove the injection nozzles.

[3] -



LEGEND:
A JDG560 Adapter
B JT01682 Compression Gauge Assembly

Compression Gauge Assembly

Remove the heat protector from end of injector and install JDG560 adapter (A).

Adapter

JDG560

Used to test cylinder compression.

[4] - Install JT01682 Compression Gauge Assembly (B) and JDG560 Adapter.

Compression Gauge Assembly

JT01682

Used to test cylinder compression.

[5] - Disconnect the fuel control solenoid connector.

[6] -

IMPORTANT:

Avoid Damage! DO NOT overheat starting motor during test.

Crank the engine for five seconds with the starting motor. Minimum cranking speed is 250 rpm.

[7] - Record the pressure reading for each cylinder.

Item	Measurement	Specification
Cylinder Compression—3TNV84T	Pressure	2940 ± 100 kPa
		(29.4 ± 1 bar)
		(426 ± 14.5 psi)
Cylinder Compression—3TNV84T (Minimum)	Pressure	2450 ± 100 kPa
		(24.5 ± 1 bar)

Item	Measurement	Specification
		(355 ± 14.5 psi)
Cylinder Compression—3TNV88	Pressure	3430 ± 100 kPa
		(34.3 ± 1 bar)
		(497 ± 14.5 psi)
Cylinder Compression—3TNV88 (Minimum)	Pressure	2750 ± 100 kPa
		(27.5 ± 1 bar)
		(399 ± 14.5 psi)
Cylinder Compression—Difference Between Cylinders	Pressure	200—300 kPa
		(2—3 bar)
		(29—43 psi)
Minimum Cranking Speed	Speed	250 rpm

Results:

- If pressure reading is below specification, squirt clean engine oil into cylinders through injector ports and repeat test.
- If pressure increases significantly, check piston, rings, and cylinder walls for wear or damage.
- If pressure does not increase significantly after retest, check for leaking valves, valve seats, or cylinder head gasket.

Valve Clearance Adjustment

Reason:

To maintain proper clearance between valves and rocker arms for maximum compression and valve train life.

Equipment:

- Feeler Gauge
- 10 mm End Wrench
- Flat Blade Screwdriver
- 17 mm Wrench

Procedure:

[1] - Park machine safely. See Park Machine Safely in Section 10, Group 05.)

[2] - Raise hood.

[3] - The engine must be cool (room temperature) before the valve clearance is checked.

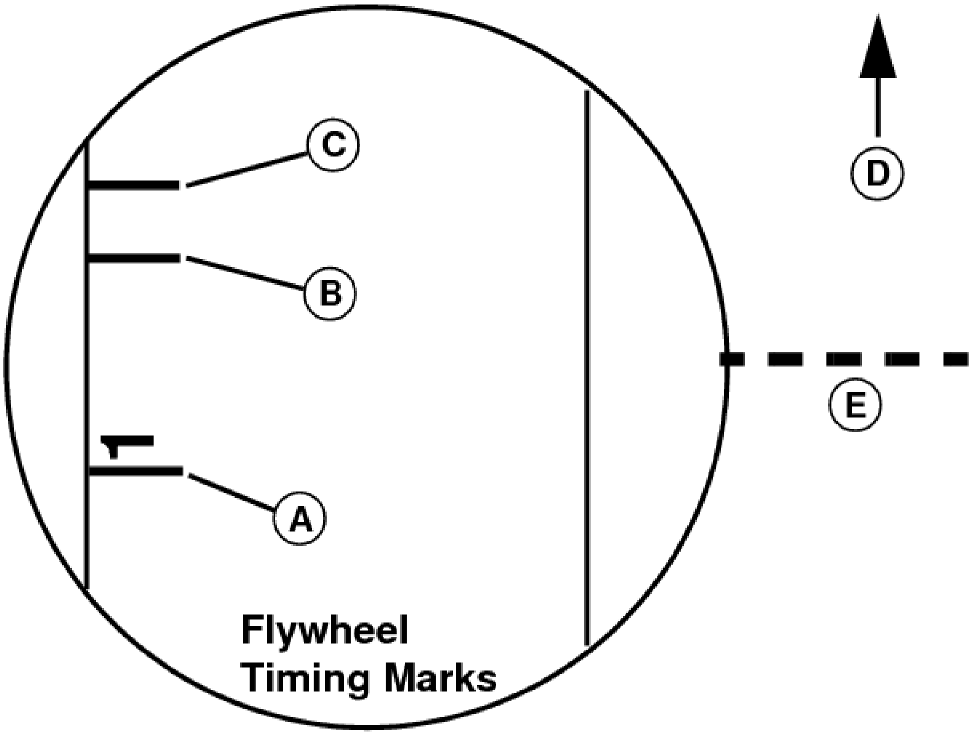
[4] - Be sure that ignition key is OFF before attempting to turn engine by hand.

[5] - Remove the rocker arm cover.

[6] -

→NOTE:

"Top dead center (TDC)" is when the number one piston is at its highest point of travel in the cylinder on the compression stroke. Number one cylinder is located at rear of engine (flywheel side).



Flywheel Timing Marks

LEGEND:

A	Number One Top Dead Center Mark
B	12° Before Top Dead Center

C	14° Before Top Dead Center
D	Direction of Engine Rotation
E	Center Line

Locate the inspection hole in right side of the transmission tunnel. The flywheel can be seen inside the inspection hole.

[7] -

→NOTE:

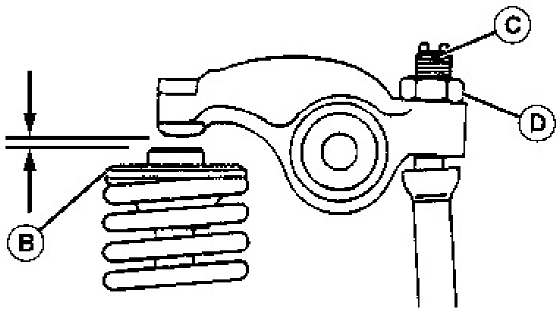
When top dead center is reached, the rocker arms for that cylinder will be motionless as the crankshaft if rotated. If rocker arms are still moving when TDC is approached, rotate crankshaft one full revolution and try again.

Turn the crankshaft pulley while watching the flywheel inside the inspection hole. Align the number one TDC mark (A) on the flywheel with the pointer on the tunnel.

[8] - Try to move rocker arms and/or push rods for No. 1 cylinder:

a. If the rocker arms and push rods are loose, the piston is at TDC of the compression stroke. Go to next step.
b. If the rocker arms and/or push rods are not loose, rotate the flywheel one revolution (360°). Recheck the rocker arms and push rods.

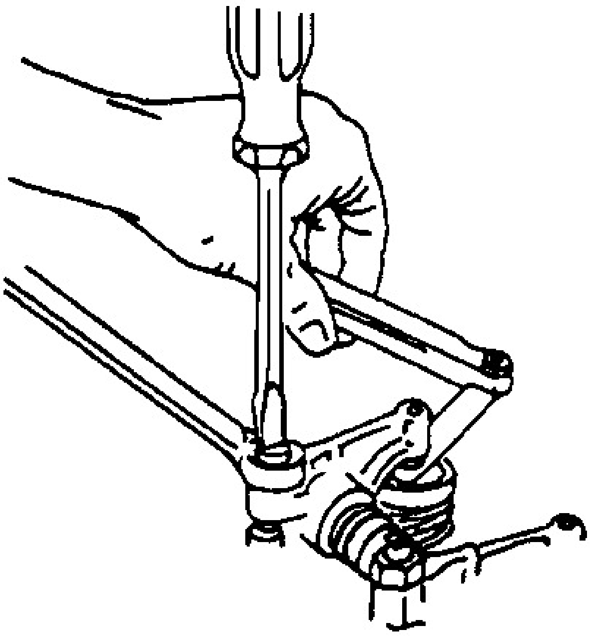
[9] -



LEGEND:

B	Valve Cap
C	Adjusting Screw
D	Lock Nut

Valve Cap and Rocker Arm



Feeler Gauge

Slide a feeler gauge between the valve cap (B) and rocker arm to measure the clearance.

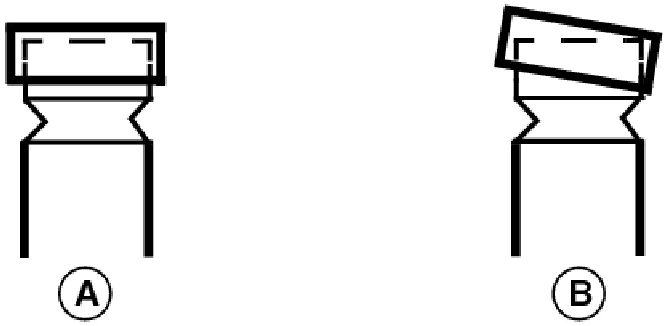
[10] - To adjust the valves, loosen the lock nut (D) and turn the adjusting screw (C) until the blade of the feeler gauge can be inserted between the rocker arm and valve cap. Hold the adjusting screw while tightening the lock nut.

Item	Measurement	Specification
Valve	Clearance	0.15—0.25 mm

Item	Measurement	Specification
		(0.006—0.010 in.)

[11] - Recheck the valve clearance after tightening the lock nut.

[12] -



Proper Valve Cap Seating

LEGEND:

A	Normal
B	Not Normal

Check that the valve cap on the valve stem remained seated on the valve and inside the valve spring retainer.

[13] - Turn the crankshaft pulley counter clockwise (as viewed from operator’s seat or flywheel end) approximately 2/3 of a revolution (240°) while watching the observation hole for the number three timing mark.

[14] - Check that the rocker arms and push rods for cylinder number three are loose.

[15] - Repeat steps 7—13 for number three cylinder.

[16] - Repeat steps 7—11 for number two cylinder.

[17] - Replace the rocker arm cover, air cleaner bracket and housing, and the muffler.

Valve Lift Check

Reason:

To test for excessive wear on camshaft lobes, cam followers, rocker arms, valve stems, valve caps, or bent push rods.

Equipment:

- Dial Indicator with magnetic base

Procedure:

[1] - Park machine safely. See Parking Safely in the Safety Section.

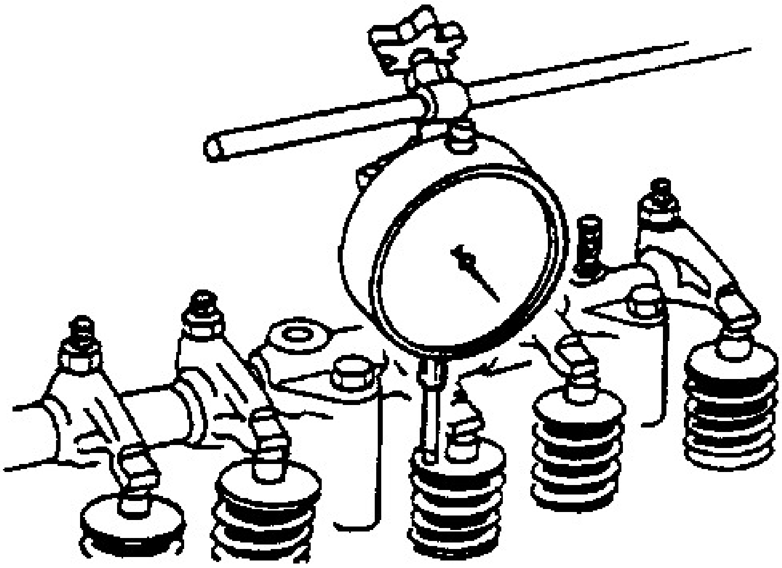
[2] - Allow engine to cool.

[3] - Raise hood.

[4] - Remove the rocker arm cover.

[5] - Check that valve clearance is within specification. Adjust if necessary.

[6] -



Dial Indicator

Fasten the dial indicator to the engine and position the indicator tip on the valve retainer. The valve must be fully closed and the rocker arm must move freely.

[7] - Zero the dial indicator.

[8] - Manually turn the crankshaft pulley clockwise (from the fan end).

[9] - Observe the dial indicator as the valve is moved to the full open position. Repeat for each valve.

Results:

- If valve lift is less than specification, remove and inspect camshaft, camshaft followers, push rods, valve caps and stems, and/or rocker arms for wear or damage.

Item	Measurement	Specification
Valve	Lift	7.5 mm
		(0.300 in.)

- The valve lift should be the same for all valves. If one or more valves have less travel than the others, remove and inspect the camshaft, followers and push rods. (See Camshaft in Section 30, Group 30.) If the camshaft, followers and push rods are within specification remove and inspect the cylinder head. (See Cylinder Head and Valves Removal and Installation in Section 30, Group 30.)

Radiator Bubble Test

Reason:

To determine if compression pressure is leaking from combustion cylinder into water jacket.

Equipment:

- JDG560 Adapter

Procedure:

[1] - With the coolant at the proper level and the radiator cap tight, run the engine for 5 minutes to bring it to operating temperature.

[2] - Remove the cap from the recovery tank.

[3] - Check for bubbles coming from the overflow hose at the bottom of the tank.

a. If bubbles are present, isolate the source of the compression leak.

[4] - Remove the injection nozzles.

[5] - Install JDG560 Adapter in the injection port of the cylinder to be tested.

Adapter

JDG560

Used to perform radiator bubble test.

[6] - Move the piston to the bottom of the stroke with intake and exhaust valves closed.

[7] - Connect the hose from a compressed air source to the adapter.

[8] - Apply shop air pressure into the cylinder.

[9] - Check for bubbles in the recovery tank or air escaping from the muffler, air cleaner, or oil fill opening.

[10] - Repeat for each cylinder.

Results:

- If bubbles are present:
- Check for cracks in cylinder head and block. Check for damaged head gasket.
- If air escapes from muffler:
- Check for worn exhaust valve.
- If air escapes from air cleaner:
- Check for worn intake valve.
- If air escapes from engine oil fill:
- Check for worn piston rings.

Radiator Pressure Cap Test

Reason:

Test the radiator cap for operating in the correct pressure range.

Equipment:

- D05104ST Cooling System Pressure Pump
  Cooling System Pressure Pump
  D05104ST
  Used to perform radiator pressure cap test.
- JDG692 Radiator Pressure Test Kit (Adapters)
  Radiator Pressure Test Kit
  JDG692
  Used to perform radiator pressure cap test.

Procedure:

[1] - Install the radiator cap on the pressure pump.

[2] - Apply pressure. Pressure valve in the cap should open at specification.

Item	Measurement	Specification
Radiator Pressure Cap—Opening	Pressure	88 kPa
		(0.88 bar)
		(12.8 psi)

Results:

- If the cap leaks, retighten and test again. Replace the cap if pressure is not within specification.

Cooling System Pressure Test

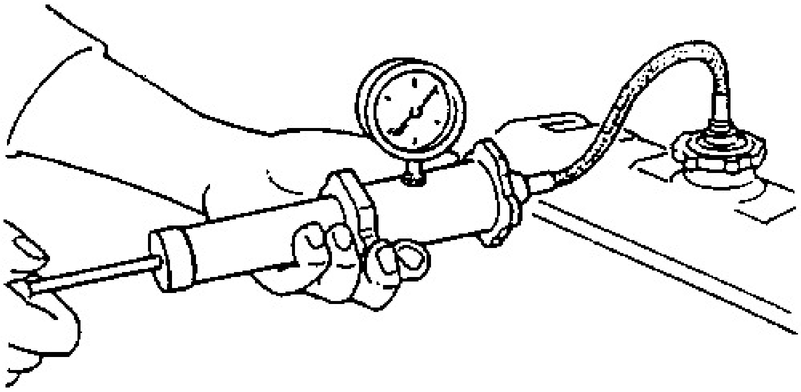
Reason:

Inspect the cooling system for leaks.

Equipment:

- D05104ST Cooling System Pressure Pump
  Cooling System Pressure Pump
  D05104ST
  Used to perform cooling system pressure test.
- JDG692 Radiator Pressure Test Kit (Adapters)
  Radiator Pressure Test Kit
  JDG692
  Used to perform cooling system pressure test.

Procedure:



.

[1] - Remove the cap and attach the pressure pump to radiator.

[2] - Apply pressure to specification.

Item	Measurement	Specification
Cooling System	Pressure	88—97 kPa (0.88—0.97 bar) (12.8—14.0 psi)

[3] - Check for leaks throughout the cooling system. Keep system pressurized for 5 minutes.

Results:

- Pressure should hold at specification. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.
- If the pressure test still indicates leakage after all external leaks have been stopped, a defective head gasket, cracked block, or cylinder head may be the cause. (See Radiator Bubble Test in Section 30, Group 25.)

Engine Oil Pressure Test

Reason:

To determine if engine bearings or lubrication system components are worn.

Equipment:

- JT03017 Hose Assembly
- JT05577 Pressure Gauge (100 psi)
- JT03349 Connector

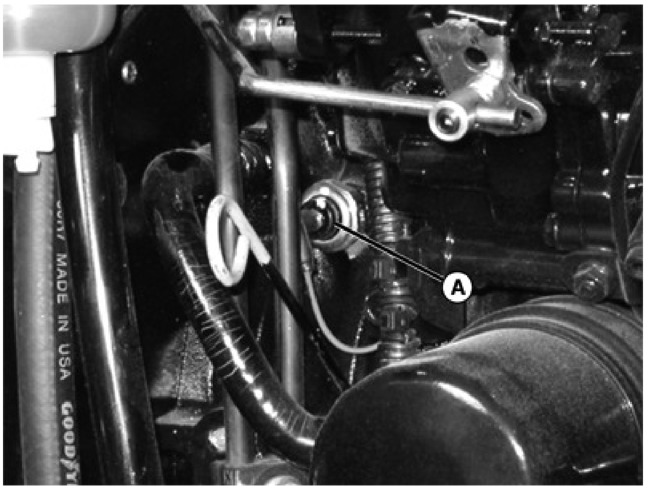
Procedure:

[1] - Park machine safely. See Parking Safely in the Safety Section.

[2] - Allow engine to cool.

[3] - Raise hood.

[4] -



LEGEND:

A	Oil Pressure Switch

Oil Pressure Switch

Remove wire to oil pressure switch (A).

[5] - Unscrew oil pressure switch from block.

[6] - Install JT03349 Connector into block.

Connector

JT03349

Used to perform oil pressure switch test.

[7] - Connect JT03017 Hose Assembly and JT05577 Pressure Gauge.

Hose Assembly

JT03017

Used to perform oil pressure switch test.

Pressure Gauge

JT05577

Used to perform oil pressure switch test.

[8] -

IMPORTANT:

Avoid Damage! Stop running engine if no oil pressure is present.

Start the engine. If pressure reading is below **70 kPa (0.7 bar) (10 psi)** at slow idle rpm, STOP THE ENGINE.

[9] - If the oil pressure is at least **70 kPa (0.7 bar) (10 psi)** run the engine approximately five minutes to heat the oil. Check the oil pressure at **2600 rpm** .

Results:

- If the oil pressure is not within specifications, inspect the oil pump and relief valve.

Item	Measurement	Specification
High Idle (Rated Speed)	Pressure	294—392 kPa (2.94—3.92 bar) (42.6—56.8 psi)
Slow Idle (Minimum)	Pressure	70 kPa (0.7 bar) (10 psi)

- If the oil pump is within specifications, the engine may have parts worn beyond specifications. (See Engine Troubleshooting in Section 20, Group 20.)

Check for Excessive Engine Crankcase Pressure (Turbocharged Engines)

Excessive blow-by coming out of the crankcase breather tube indicates that either the turbocharger seals are faulty or the piston rings and cylinder bores are not adequately sealing off the combustion chamber. This is a comparative check that requires some experience to determine when blow-by is excessive.

Run engine at high idle and check crankcase breather tube. Look for significant fumes and/or dripping oil coming out of the breather tube at fast idle, with no load.

If excessive blow-by is observed, perform the following to determine if the turbocharger is causing the blow-by:

[1] - Remove the turbocharger oil drain line where it connects to the engine block and run line into a bucket.

[2] - Run engine at high idle, slightly loaded, and determine if boost pressure is forcing oil through the drain line. Check crankcase breather tube to determine if blow-by has decreased.

[3] - If it appears that boost pressure is forcing oil through the drain line, and/or blow-by decreases with the drain line disconnected from block, replace the turbocharger.

Engine Oil Consumption

All engines consume some oil. The consumption rate depends on loading, design of key parts and engine condition. Since fuel consumption is an indicator of operating power levels, fuel used versus oil consumed is a critical factor in analyzing oil consumption. Oil consumption should be measured over a 100 hour period.

Long-term oil consumption (three oil drain intervals after the engine is broken in) with consumption rates poorer than 400:1 (100 gal. of fuel to1 qt. of oil) indicates a need to monitor/investigate. Suggested steps would be:

[1] - Check for signs of ingested dust or perform an Oilscan ™ test to check for silicon.

[2] - Check for proper crankcase oil fill level.

[3] - Perform compression test.

[4] - Remove head. Inspect for glazed or worn cylinder bores.

[5] - Inspect pistons for carbon deposits in the ring grooves.

[6] - Measure valve stem OD and valve guide ID to determine clearance.

When changing to a premium oil such as Torq-Gard Supreme ™ Plus-50 ™ , little oil consumption change is expected, although some engines will experience a noticeable change in consumption rates. This may be due to the following:

[7] -

→NOTE:

Ring gap alignment does not identify the leak source.

Intake valves do not have valve stem seals. Some oil deposits on the valve stem tulip are normal.

The previous oil may have left deposits on internal components. Use of Plus-50 oil will cause different chemical reactions in those deposits. The time required for the engine to regain the previous oil consumption rate will vary from one to three normal drain intervals.

[8] - Torq-Gard Supreme Plus-50 contains a high-performance anti-oxidant along with other additives resulting in the oil remaining in the specified viscosity grade throughout the recommended drain interval. API oil grades CD, CE, and CF-4 universal engine oils do not provide this oxidation resistance which results in more rapid thickening. Increased oil viscosity can reduce oil consumption.

Fuel System Leakage Test

Reason:

Tests the fuel system plumbing for external leakage. This test also determines if air is entering the fuel system at connections, allowing fuel to siphon back to tank.

Procedure:

[1] - Disconnect the fuel supply line and return line at the fuel tank.

[2] - Place the fuel return line into a suitable container to catch drained fuel.

[3] -

IMPORTANT:

Avoid Damage! DO NOT apply more than 103 kPa (1.03 bar) (15 psi) air pressure to the fuel system. Damage to the injection pump or personal injury may result.

Apply **34—69 kPa (0.34—0.69 bar) (5—10 psi)** air pressure to fuel supply hose until all fuel is drained from the system.

[4] - Plug the end of the fuel return hose.

[5] - Apply **34—69 kPa (0.34—0.69 bar) (5—10 psi)** air pressure to the fuel system at the fuel supply line. DO NOT exceed a maximum pressure of **103 kPa (1.03 bar) (15 psi)** .

[6] - Apply liquid soap and water solution to all joints and connections in the fuel system, and inspect for leaks.

Results:

- Find leaks and repair or replace parts as necessary.

Bleed Fuel System

Reason:

The machine incorporates a self bleeding fuel system which forces air out of the fuel filter, injection pump, and injection nozzles, and vents it back to the fuel tank. Fuel system bleeding is usually not necessary after a repair. If the system is completely drained and will not self-prime without overheating the starter, proceed as follows:

[1] - Park machine safely. See Parking Safely in the Safety Section.

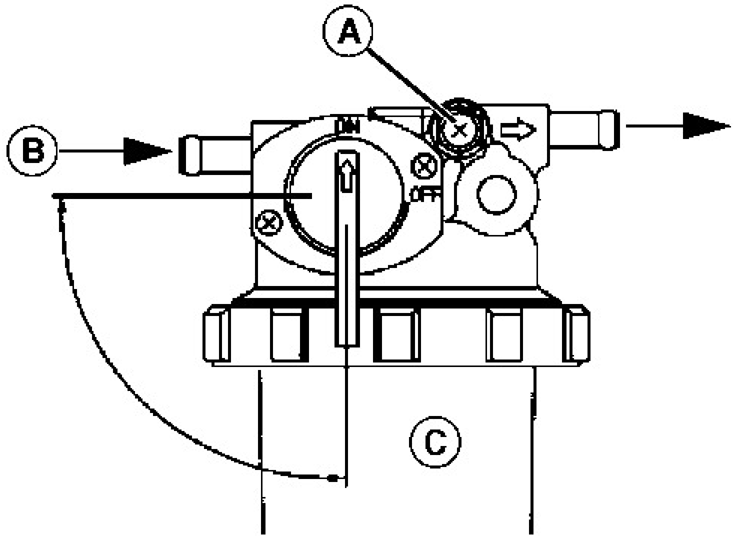
[2] - Raise hood.

[3] - Assure that all fuel line connections are securely tightened.

[4] - Be sure that fuel tank is not empty, and fuel valve on fuel filter is OPEN (“O” position).

[5] - Place the key switch ON for 10—15 seconds to allow the electric fuel pump and fuel system to bleed most of the air back to the tank through the return lines.

[6] -



LEGEND:

A	Air Bleeding Bolt
B	Close Position
C	Open Position

Fuel Water Separator

If the fuel filters were replaced and/or the fuel lines drained, loosen the air bleeding bolt (A) on the fuel water separator by turning it 2-3 turns.

[7] - When the fuel comes out clear and does not have bubbles, tighten the air bleeding bolt.

Fuel Supply Pump Pressure Test

Reason:

To determine supply pump operating pressure.

Equipment:

- JDG356 Fuel Pump Pressure Test Kit

Test Conditions:

- Fuel temperature 15°—25 °C (59—79 °F)

Flow Test:

[1] - Park machine safely. See Parking Safely in the Safety Section.

[2] - Allow engine to cool.

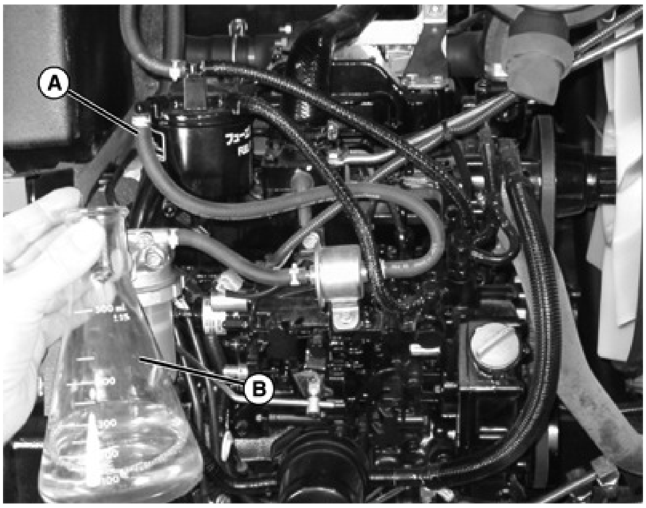
[3] - Raise hood.

[4] - Disconnect fuel shutoff solenoid wire.

[5] -

→NOTE:

Do not start engine for this test. The electric fuel pump operates with the key switch ON.



LEGEND:
A Fuel Supply Pump Outlet Hose
B Graduated Container

Open station model shown.

Disconnect fuel supply pump outlet hose (A) from fuel filter and place end of hose into a clean graduated container (B).

[6] - Collect fuel in graduated container (B) as key switch is turned ON for 15 seconds.

[7] - Compare fuel amount to specification.

Item	Measurement	Specification
Fuel Flow in 15 seconds	Volume	100 mL (minimum)
		(3.4 oz.)

Pressure Test:

[1] - Install the hose and gauge to outlet hose (A).

[2] - Place key switch in ON position.

[3] - Record fuel pressure reading on gauge.

Results:

- If the pressure does not meet specification, replace the fuel pump.

Item	Measurement	Specification
Fuel Pressure (maximum)	Pressure	37.3 kPa (0.37 bar) (5.4 psi)

Injection Pump Timing (EPA Engines)

CAUTION:

Avoid Injury! DO NOT adjust the fuel injection pump timing. For most engine problems, the fuel injection pump timing will not have to be adjusted. If the engine performed well at one time, then performance dropped, the fuel injection timing is NOT the problem.

Fuel injection timing, once set by the engine manufacturer, should NOT change during the life of the engine.

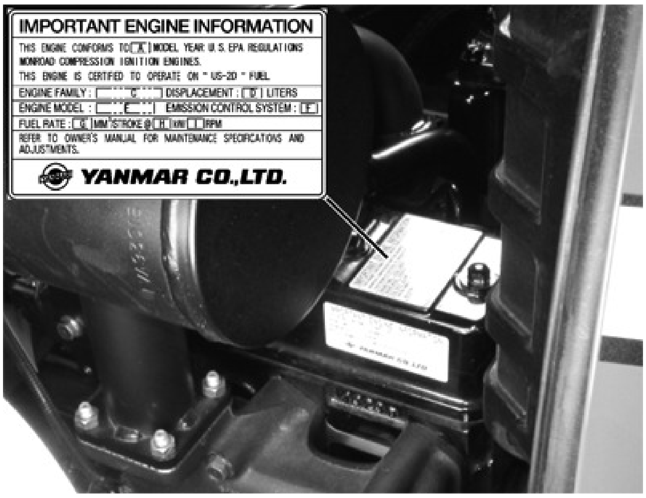
IMPORTANT:

Avoid Damage! Fuel injection pump timing should NOT change during the life of the engine unless the pump has been altered illegally, or there is excessive wear to the camshaft injection pump cam lobes and lifters.

First check the fuel quality, fuel supply, fuel injectors, air intake system, and engine compression in all cylinders before considering fuel injection timing problems.

If all other possibilities have been ruled out and it is determined that the fuel injection pump and governor assembly are in need of repair, they must be replaced ONLY as complete assemblies.

Only an authorized factory trained technician is allowed to remove and install these assemblies.



EPA Compliance Sticker

EPA engines have EPA compliance sticker on rocker arm cover as shown above.

Fuel Injection Nozzle Test

CAUTION:

Avoid Injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.

Reason:

To determine opening pressure, leakage, chatter, and spray pattern of the fuel injection nozzle.

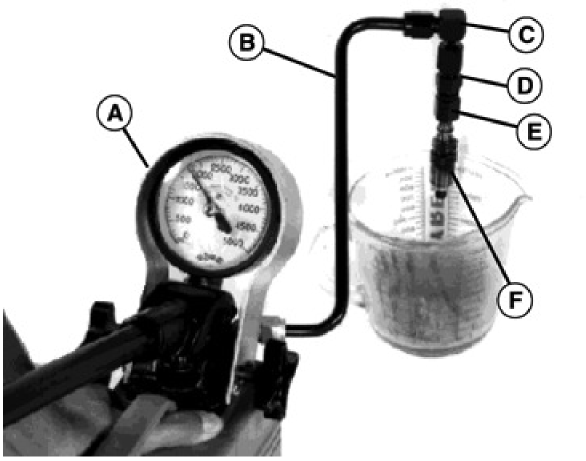
Equipment:

- D01110AA Adapter Set
- D01109AA Diesel Fuel Injection Nozzle Tester
- 23622 Straight Adapter
- Container

Connections:

IMPORTANT:

Avoid Damage! Use clean filtered diesel fuel when testing injection nozzles for best results.



LEGEND:

A	D01109AA Diesel Fuel Injection Nozzle Tester
B	36352 Hose
C	23617 Elbow Fitting
D	23621 Adapter
E	23622 Straight Adapter
F	Fuel Injection Nozzle

Fuel Injector Test

Connect the fuel injection nozzle (F) to D01109AA Diesel Fuel Injection Nozzle Tester (A) using parts 36352 (B), 23617 (C), 23621 (D) from D01110AA Adapter Set, and 23622 straight adapter (E).

Diesel Fuel Injection Nozzle Tester

D01109AA

Used to perform fuel injection nozzle test.

Procedure 1:

Test the fuel injection nozzle opening pressure following the Nozzle Tester manufacturer′s instructions.

Results:

- If the pressure reading does not meet specification, disassemble the injection nozzle and inspect for contamination or a stuck valve. If necessary, add or remove shims to change opening pressure.

Item	Measurement	Specification
Fuel Injection Nozzle Opening Pressure	Pressure	19 600 + 1000 kPa (1960 ± 10 bar) (2843 ± 145 psi)

Procedure 2:

Test fuel injection nozzle leakage following the nozzle tester manufacturer′s instructions.

[1] - Dry the nozzle completely using a lint-free cloth.

[2] - Pressurize the nozzle to **19 600 kPa (196 bar) (2843 psi)** .

[3] - Watch for leakage from nozzle spray orifice.

Results:

- Fuel should not leak from the nozzle when the nozzle is pressurized.
- If the injection nozzle leaks fuel, disassemble and inspect the nozzle assembly for contamination. Inspect the valve seating surface. Replace the nozzle assembly if necessary.

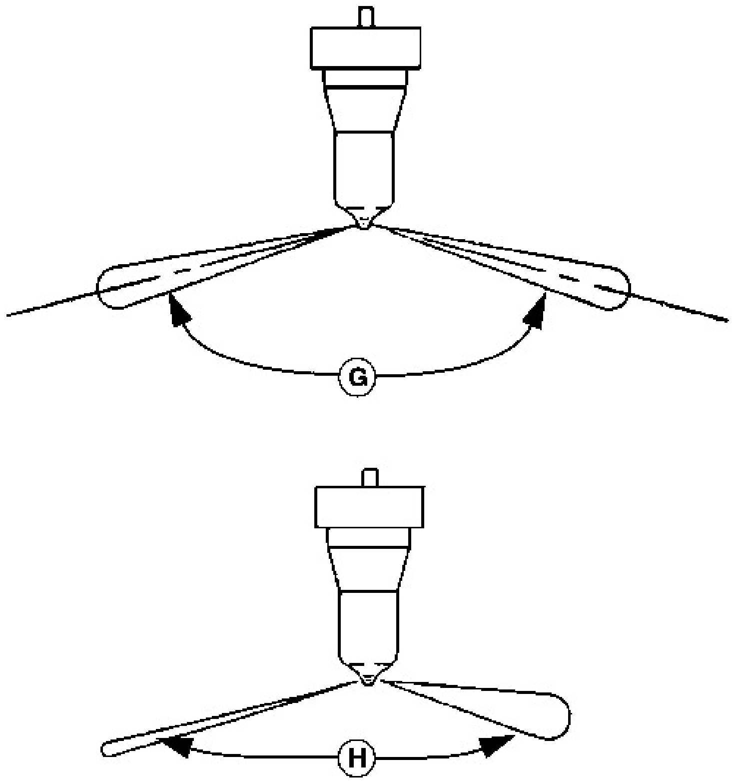
Procedure 3:

Test the fuel injection nozzle chatter and spray pattern following the nozzle tester manufacturer′s instructions.

[1] - Pressurize nozzle to **19 600 kPa (196 bar) (2843 psi)** .

[2] - With slow hand lever movement there should be a “chatter” sound.

[3] -



LEGEND:

G	Fine, Atomized Spray Pattern
H	Injection Angle

Spray Pattern

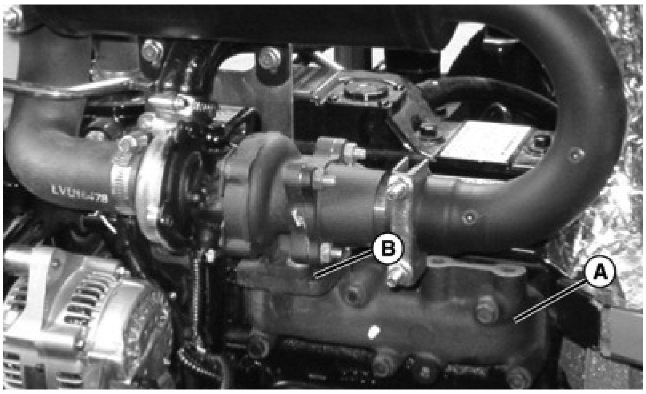
With fast hand lever movement the nozzle should exhibit an even, fine atomized spray pattern (G).

[4] - Place a sheet of white paper **30 cm (12 in.)** below the nozzle. The injection spray should form a perfect circle on the paper.

Results:

- If nozzle chatter or the spray pattern does not meet specifications, disassemble the injection nozzle and inspect the nozzle assembly for contamination. Inspect the valve seating surface. Replace the nozzle assembly if necessary.
- If there is a difference in the spray angle or injection angle (H), incomplete atomizing or sluggish starting/stopping of injection, disassemble the injection nozzle and inspect the nozzle assembly for contamination. Replace the nozzle assembly if necessary.

Check for Exhaust Air Leaks (Turbocharger)



LEGEND:

A	Exhaust Manifold
B	Turbocharger Gasket

Exhaust Leak Check

Exhaust leaks, upstream of the turbocharger, will cause the turbocharger turbine to rotate at a reduced speed resulting in low boost pressure, low power, and excessive black smoke.

Inspect the exhaust manifold gaskets between manifold and cylinder head, the exhaust manifold, and the turbocharger gasket for damage and signs of black soot deposits (indicating leakage). Replace components as needed.

Turbocharger Oil Seal Leak Check

Seals are used on both sides of the turbocharger rotor assembly. The seals are used to prevent exhaust gasses and air from entering the turbocharger housing. Oil leakage past the seals is uncommon but can occur.

A restricted or damaged turbocharger oil return line can cause the housing to pressurize, causing oil to leak by the seals. Additionally, intake or exhaust restrictions can cause a vacuum between the compressor and turbocharger housing, causing oil to leak by the seals.

Procedure:

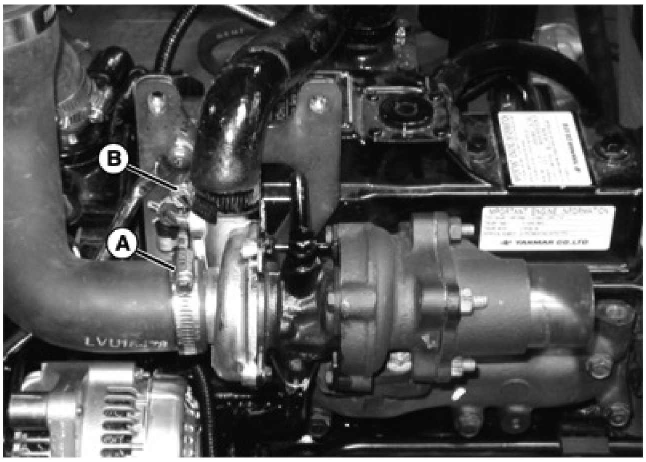
[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

[3] - Raise hood.

[4] - Remove the muffler.

[5] -



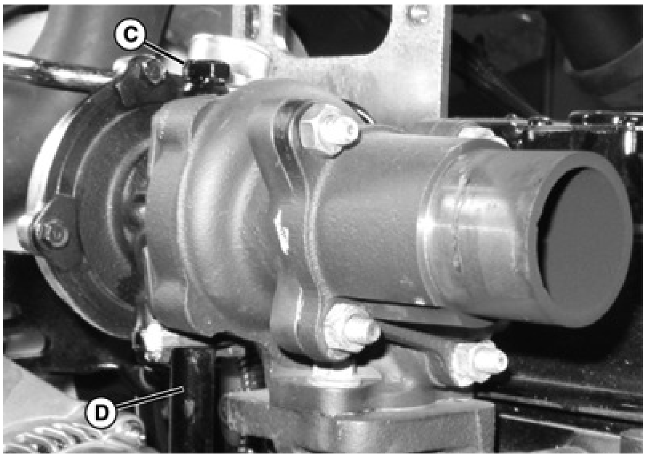
LEGEND:

A	Hose Clamp
B	Hose Clamp

Turbocharger

Loosen the hose clamps (A and B). Remove the inlet and outlet air hoses.

[6] -



LEGEND:

C	Inlet Line
D	Oil Return Line

Inlet Line

Inspect the turbine casing and inlet line (C) for evidence of oil leakage.

[7] - If oil leakage is present, perform the following:

a. Inspect turbocharger oil return line (D) for kinks or damage. Replace if necessary.
b. Check the air intake filter, hoses, and inlet hose for restrictions.
c. Check the exhaust system for restrictions to include position of exhaust outlet.

[8] - Perform necessary repairs and repeat test.

Turbocharger Waste Gate Test

Equipment:

- Pressure regulating valve—Allowing gradual adjustment in a range from 0—200 kPa (0—29 psi).

Procedure:

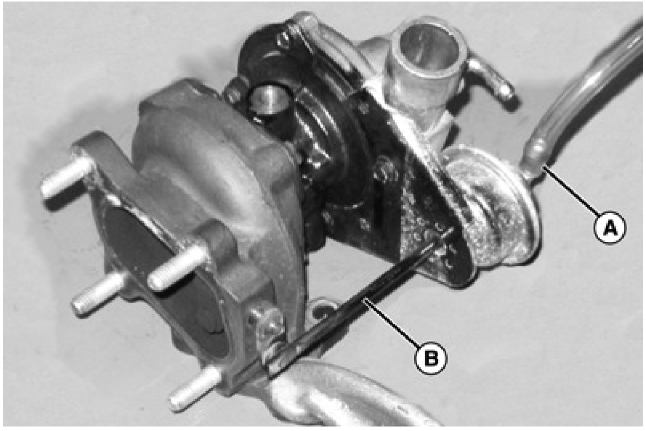
[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

[3] - Raise hood.

[4] - Check hose to waste gate actuator for kinks or cracks. Replace if damaged.

[5] -



LEGEND:

A	Waste Gate Actuator
B	Actuator Rod

Turbocharger

Disconnect hose from waste gate actuator (A).

[6] - Connect a regulated air source to actuator fitting.

[7] -

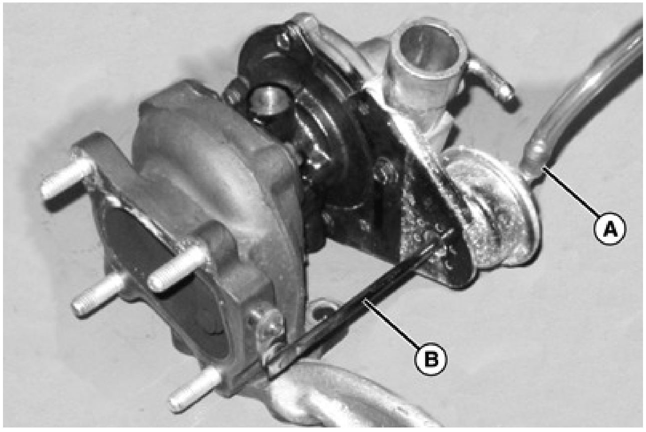
IMPORTANT:

Avoid Damage! Do not apply more than 400 kPa (58 psi) to the actuator.

Vary pressure to waste gate actuator from 0—193 kPa (0—1.93 bar) (0—20 psi). Check results below.

[8] - Apply 117 kPa (1.17 bar) (17 psi) to actuator, shut off and seal air supply. Wait one minute and measure pressure in actuator.

Results:

- 

LEGEND:

A	Waste Gate Actuator
B	Actuator Rod

Turbocharger

Actuator rod (B) should move in and out freely as pressure is varied.

- If rod does not move freely, disconnect turbocharger waste gate linkage. Check for movement and repair or replace components as necessary.
- After 117 kPa (1.17 bar) (17 psi) is applied, the pressure should not drop below 103 kPa (1.03 bar) (15 psi) after one minute. Replace actuator if pressure drop exceeds specification.

Turbocharger Inspection

The following inspection procedure is recommended for systematic failure analysis of a suspected failed turbocharger. This procedure will help to identify when a turbocharger has failed, and why it has failed so the primary cause of the failure can be corrected.

Proper diagnosis of a non-failed turbocharger is important for two reasons. First, identification of a turbocharger that has not failed will lead to further investigation and repair of the cause of the complaint.

Proper diagnosis also eliminates the expense incurred when a non-failed turbocharger is replaced.

The recommended inspection steps, which are explained in detail on following pages, are:

- Compressor Housing Inlet and Compressor Wheel.
- Compressor Housing Outlet.
- Turbine Housing Inlet.
- Turbine Housing Outlet and Turbine Wheel.
- External Center Housing and Joints.

→NOTE:

To enhance the turbocharger inspection, an inspection sheet (Form No. DF-2280 available from Distribution Service Center—English only) can be used that lists the inspection steps in order and shows potential failures for each step. Check off each step as you complete the inspection. Record any details or problems obtained during inspection. Retain this with the work order for future reference.

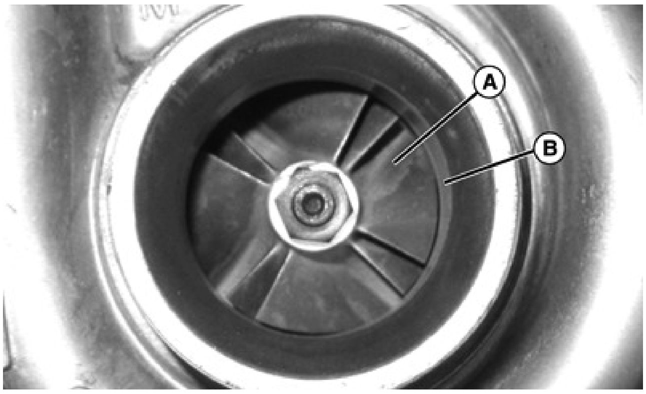
- Perform Axial End Play Test

Compressor Housing Inlet and Compressor Wheel:

[1] -

→NOTE:

Foreign object damage may be extensive or minor. The source of the foreign object must be found and corrected to eliminate further damage.



LEGEND:

A	Compressor Wheel
B	Housing

Compressor Wheel

Check compressor inlet and compressor wheel (A) for foreign object damage.

[2] - Mark findings on your checklist and continue the inspection.

[3] -

→NOTE:

You will need a good light source for this check.

Check compressor inlet for wheel rub on the housing (B). Look closely for score marks on the housing itself. Check the tips of the compressor wheel blades for damage.

Compressor Housing Outlet:

LEGEND:
A Compressor Housing Outlet

Compressor Housing Outlet

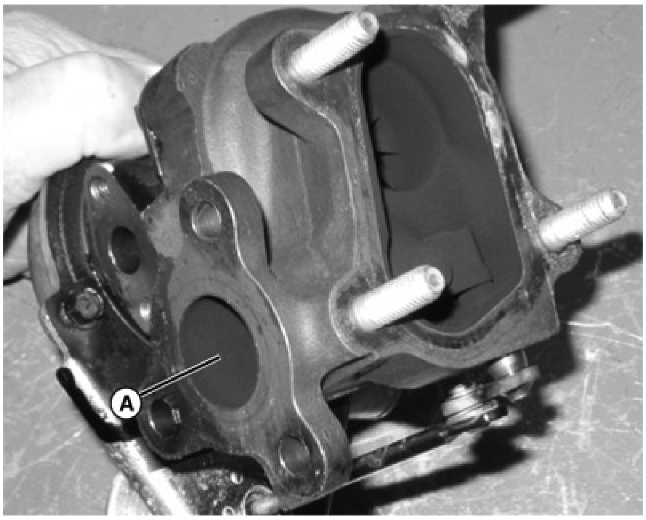
[1] - Check compressor housing outlet (A). The outlet should be clean and free of dirt or oil.

[2] - Mark it on your checklist if dirt or oil is found and continue the inspection.

Turbine Housing Inlet:

→NOTE:

If the inlet is wet with oil, or has excessive carbon deposits, an engine problem is likely.



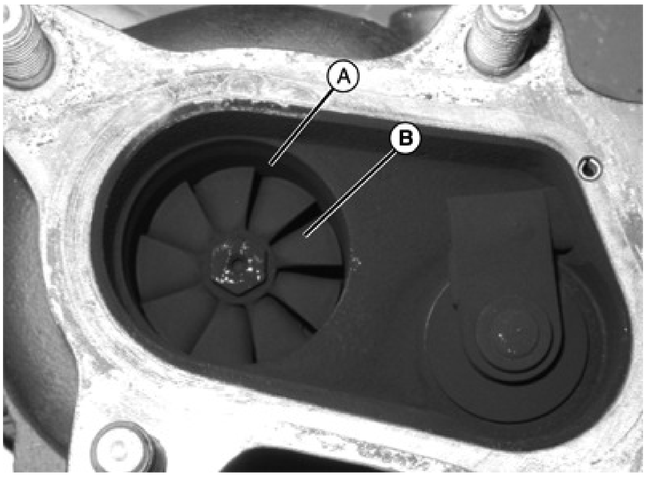
LEGEND:
A Turbine Housing Inlet

Turbine Housing Inlet

Check the turbine housing inlet (A) for oil in housing, excessive carbon deposits.

Turbine Housing Outlet and Turbine Wheel:

[1] -



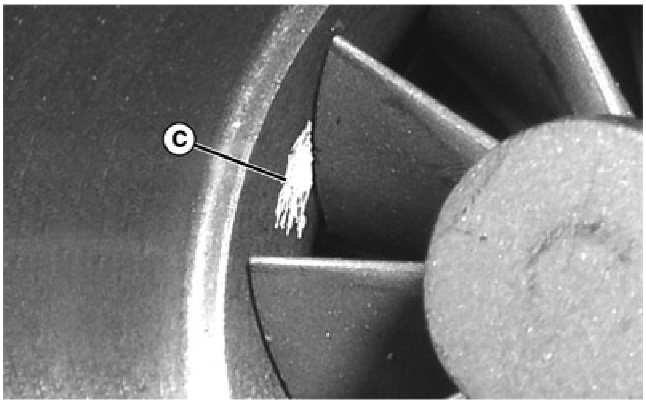
LEGEND:

A	Turbine Housing Outlet
B	Blades

Turbine Housing Outlet

Use a flashlight to look up inside the turbine housing outlet (A). Check blades (B) for foreign object damage.

[2] -



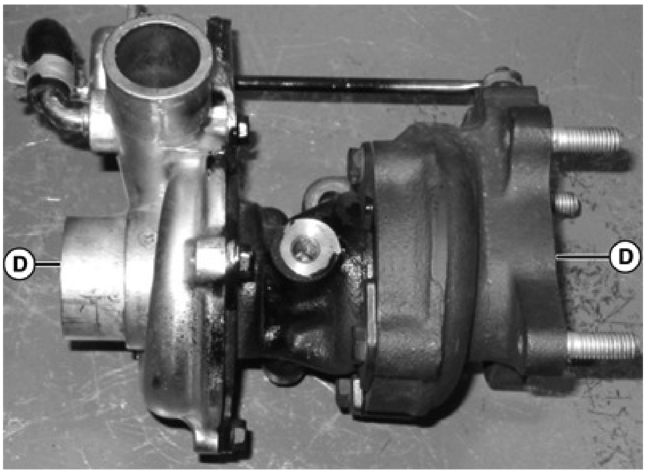
LEGEND:

C	Wheel Rub

Wheel Blades

Inspect the wheel blades and housing for evidence of wheel rub (C). Wheel rub can bend the tips of the blades with the housing showing wear or damage.

[3] -



LEGEND:

D	Shaft

Shaft

Rotate the shaft (D), using both hands, to check rotation and clearance. The shaft should turn freely, however there may be a slight amount of drag.

[4] -

IMPORTANT:

Avoid Damage! Use only moderate hand force (3-4 pounds) on each end of shaft.

→NOTE:

There will be some “play” because the bearings inside the center housing are free floating.

Next, pull up on the compressor end of the shaft and press down on the turbine end while rotating shaft. Neither the compressor wheel nor the turbine wheel should contact the housing at any point.

External Center Housing and Joints

IMPORTANT:

Avoid Damage! Before you conclude that the turbocharger has not failed, check the radial bearing clearance and axial bearing end play with a dial indicator. These procedures are not required if a failure has already been identified.

→NOTE:

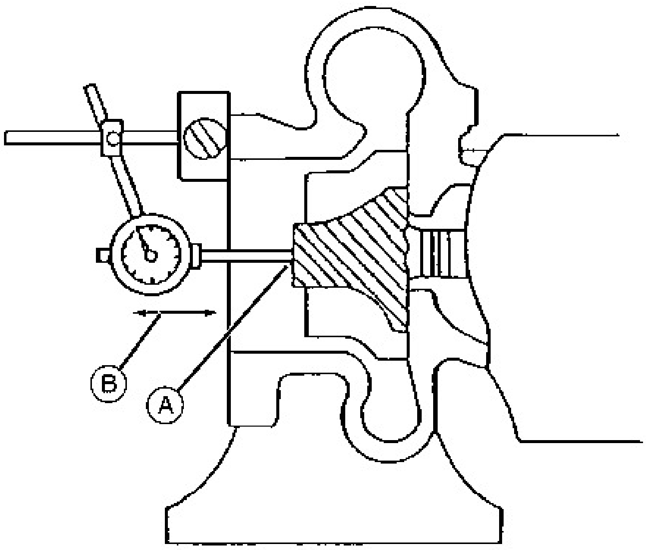
If oil is present, make sure that it is not coming from a leak at the oil supply or return line.

Visually check the outside of the center housing, all connections to the compressor, and turbine housing for oil.

Rotor Play Test:

This test will give an indication of the condition of the thrust bearing within the center housing and rotating assembly.

[1] -



LEGEND:

A	Indicator Tip
B	Direction of Axial Play

Rotor play in axial direction

Axial Direction:

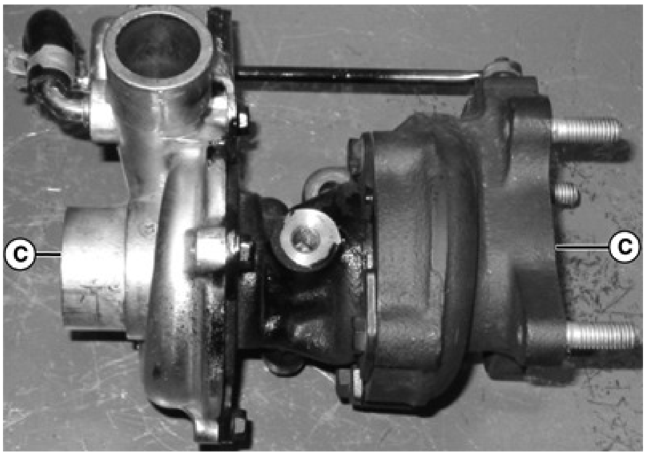
[2] - Mount magnetic base dial indicator so that indicator tip (A) rests on flat surface on turbine end of shaft. Preload indicator tip and zero the indicator dial.

[3] - Move shaft axially (B) back and forth by hand.

[4] - Observe and record total dial indicator movement. If bearing end play is not within specification, replace the turbocharger.

Item	Measurement	Specification
Rotor Play—Axial Direction	Play	0.022—0.053 mm (0.001—0.002 in.)
Rotor Play Wear Limit—Axial Direction	Play	0.07 mm (0.007 in.)

[5] -



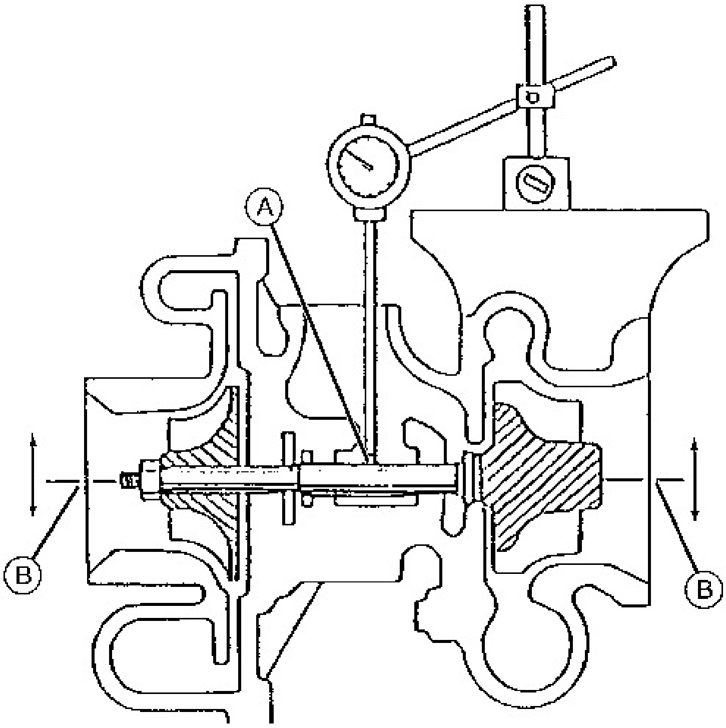
LEGEND:

C	Shaft

Shaft

Next, check shaft end play by moving the shaft (C) back and forth while rotating. There will be some end play but not to the extent that the wheels contact the housings.

[6] -



LEGEND:

A	Indicator Tip
B	Shaft

Rotor play in radial direction

Radial Direction:

[7] - Mount magnetic base dial indicator so that indicator tip (A) enters the center housing through the oil drain port and rests on the turbine shaft. Preload indicator tip. Zero dial on indicator.

[8] - Move both ends of the shaft (B) radially up and down by hand at the same time.

[9] -

> **→NOTE:**
>
> **These diagnostic procedures allow you determine the condition of the turbocharger. If the turbocharger has failed, analysis of your inspection notes should direct you to the specific areas of the engine to correct the problems causing the turbocharger failure. It is not unusual to find that a turbocharger has not failed. If your turbocharger passes the inspections, the problem lies elsewhere.**

Observe and record total dial indicator movement. If turbine shaft radial play is not within specification, install a replacement turbocharger.

Item	Measurement	Specification
Rotor Play—Radial Direction	Play	0.061—0.093 mm (0.002—0.004 in.)
Rotor Play Wear Limit—Radial Direction	Play	0.12 mm (0.005 in.)

Crankshaft End Play Check

Reason:

To determine the clearance between the crankshaft and the engine block.

Equipment:

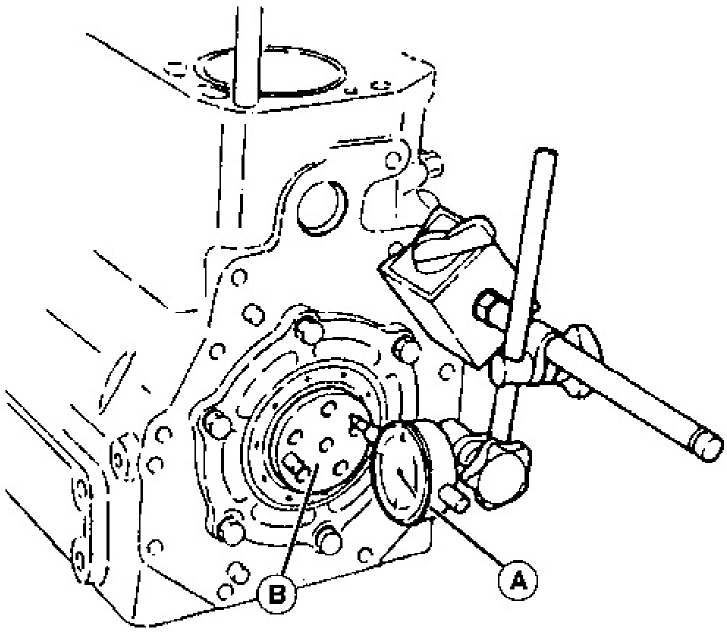
- Dial Indicator

Procedure:

[1] -

→NOTE:

Crankshaft end play can be measured at either end of crankshaft. Procedure is performed from the rear end. The flywheel is removed to show detail.



LEGEND:

A	Dial Indicator
B	End of Crankshaft

Dial Indicator

Fasten the dial indicator (B) to engine and position indicator tip on end of crankshaft (A).

[2] -

IMPORTANT:

Avoid Damage! Do not use excessive force when moving crankshaft to avoid damaging bearings.

Push the crankshaft toward rear as far as possible.

[3] - Zero the dial indicator.

[4] - Using a bar, gently pry the crankshaft as far forward as possible.

[5] - Check crankshaft end play to ensure that it is within specification.

Item	Measurement	Specification
Crankshaft	End Play	0.13—0.23 mm (0.005—0.009 in.)

Results:

- If the end play exceeds specification, replace the thrust bearings.

Item	Measurement	Specification
Crankshaft—Wear Limit	End Play	0.28 mm (0.011 in.)

Timing Gear Backlash Check

Reason:

To check for wear between meshing gears, resulting in excessive noise and poor engine performance.

Equipment:

- Dial Indicator

Procedure:

[1] - Measure the backlash between meshing gears.

[2] - The backlash for all gears EXCEPT the hydraulic pump gear is **0.07—0.15 mm (0.003—0.006 in.)** .

Item	Measurement	Specification
Timing Gear Backlash—All Except Hydraulic Pump Gear	Backlash	0.07—0.15 mm (0.003—0.005 in.)

[3] - The backlash for the hydraulic pump gear is **0.11—0.19 mm (0.004—0.008 in.)** .

Item	Measurement	Specification
Hydraulic Pump Gear	Backlash	0.11—0.19 mm (0.004—0.008 in.)

Results:

- If the backlash exceeds specifications, replace meshing gears as a set:
- Idler Gear, Camshaft Gear, Crankshaft Gear, Hydraulic Pump Gear AND/OR Idler Gear, Fuel Injection Pump Gear.

Camshaft End Play Check

Reason:

To determine proper side clearance between camshaft gear end journal and thrust plate.

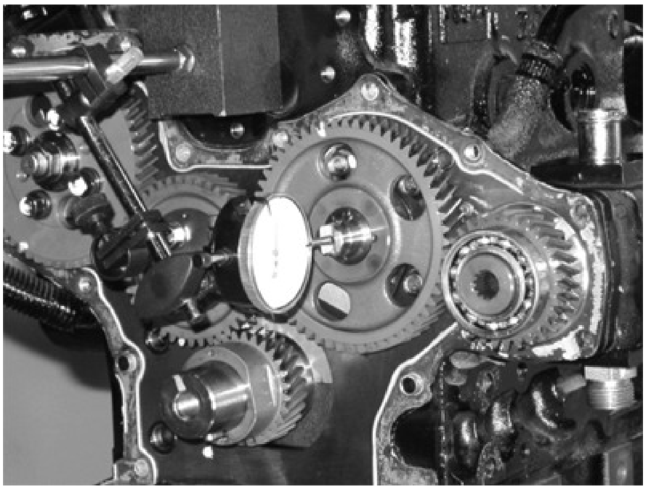
Equipment:

- Dial Indicator

Procedure:

[1] - Remove the timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[2] -



Dial Indicator

Fasten the dial indicator to the engine. Position indicator tip on end of camshaft.

[3] - Push the camshaft toward the rear as far as possible.

[4] - Zero the dial indicator.

[5] - Pull the camshaft forward as far as possible.

[6] - Standard end play is **0.05—0.20 mm (0.002—0.008 in.)** .

Item	Measurement	Specification
Camshaft	End Play	0.05—0.20 mm (0.002—0.008 in.)

Results:

- If the end play exceeds **0.30 mm (0.012 in.)** , remove the camshaft and replace the thrust plate.

Item	Measurement	Specification
Camshaft Wear Limit	End Play	0.30 mm (0.012 in.)

Connecting Rod Side Play Check

Reason:

To determine proper side clearance between the crankshaft and the connecting rod.

Equipment:

- Feeler Gauge

→NOTE:

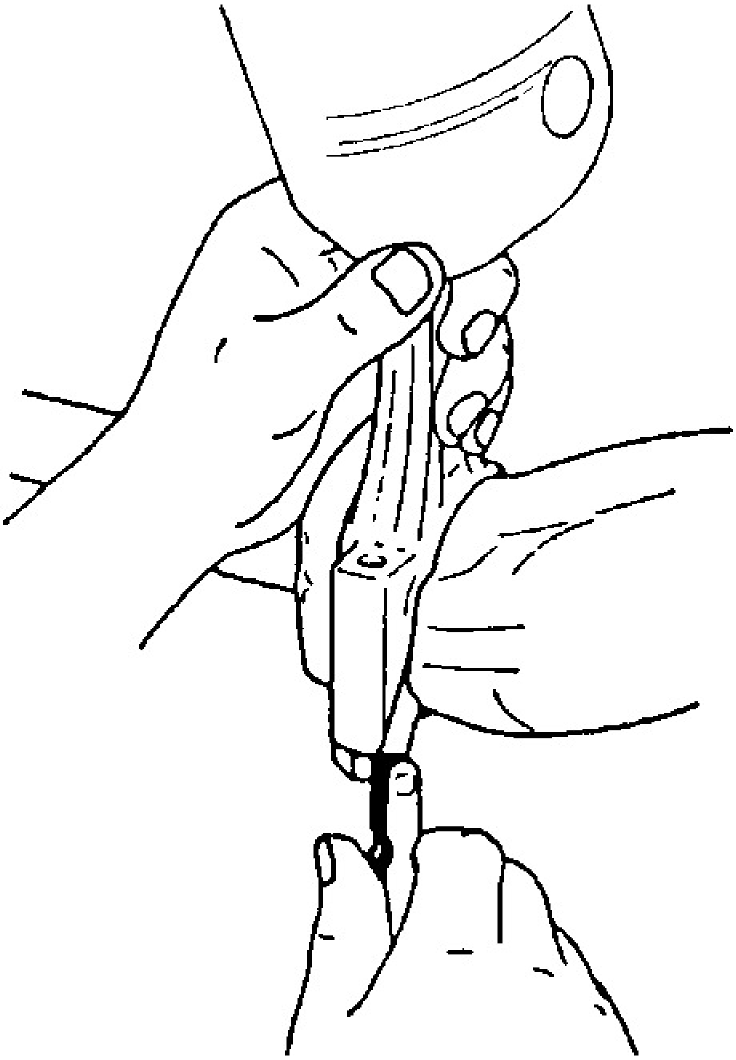
The engine must be removed from the machine to perform this test.

Procedure:

[1] - Remove the oil pan, crankcase extension, oil pick-up, and balancer assembly.

[2] - Insert a feeler gauge, according to specifications, between the connecting rod cap and the crankshaft.

[3] -



Connecting Rod

Connecting rod side play is **0.2—0.4 mm (0.008—0.016 in.)** .

Item	Measurement	Specification
Connecting Rod Side Play	Play	0.2—0.4 mm (0.008—0.016 in.)

Results:

- If the side play exceeds specification, replace the bearing inserts or the connecting rod.

Connecting Rod Bearing Clearance Check

Reason:

To measure oil clearance between connecting rod bearing and crankshaft journal.

Equipment:

- Plastigage ™

Procedure:

[1] -

→NOTE:

The engine must be removed from the machine to perform this procedure.

Remove the oil pan, and oil pickup.

[2] -

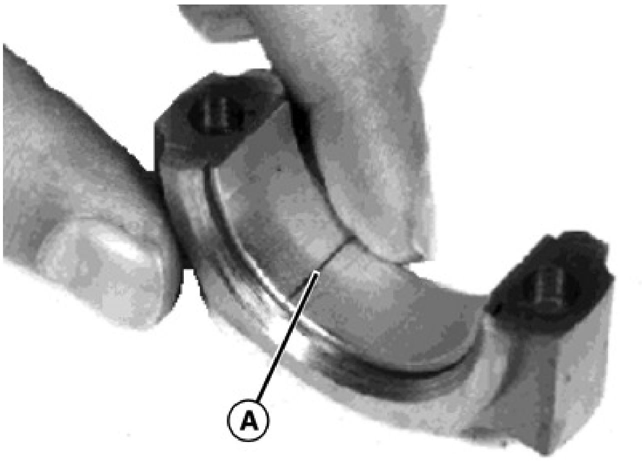
IMPORTANT:

Avoid Damage! The connecting rod caps must be installed on the same connecting rod and in the same direction to prevent crankshaft and connecting rod damage.

Remove the connecting rod cap.

[3] - Wipe oil from the bearing insert and the crankshaft journal.

[4] -



Bearing Insert

Put a piece of Plastigage ™ (A), or equivalent, along the full length of the bearing insert approximately **6 mm (0.25 in.)** off center.

[5] - Turn the crankshaft approximately 30° from bottom dead center.

[6] - Install the connecting rod end cap and original rod bolts. Tighten the rod bolts to specification.

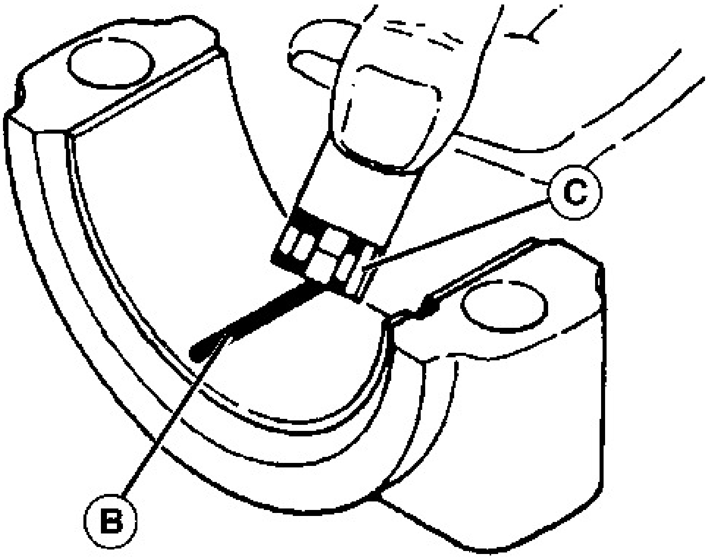
Item	Measurement	Specification
Rod Guide Bolt	Torque	44—49 N·m (33—36 lb.-ft.)

[1] - Remove the rod bolts and the connecting rod cap.

[2] -

→NOTE:

The flattened Plastigage (B) will be on either the bearing insert or crankshaft journal.



LEGEND:

B	Plastigage
C	Envelope

Bearing Insert

Use the graduation marks on the envelope (C) to compare the width of the flattened Plastigage (B) at its widest point. The number within the graduation marks indicates the bearing clearance in inches or millimeters depending on which side of the envelope is used.

[3] - Measure the connecting rod bearing oil clearance.

Item	Measurement	Specification
Connecting Rod Bearing	Oil Clearance	0.04—0.07 mm (0.002—0.003 in.)
Connecting Rod Bearing—Wear Limit	Oil Clearance	0.16 mm (0.006 in.)

Results:

- If the clearance exceeds the wear limit specification, replace the bearing inserts.
- Remove the Plastigage.

Crankshaft Main Bearing Clearance Check

Reason:

To measure oil clearance between main bearing and crankshaft journal.

Equipment:

- Plastigage ™

Procedure:

[1] -

→NOTE:

The engine must be removed from the machine to perform this test.

Remove the oil pan, and oil pickup.

[2] -

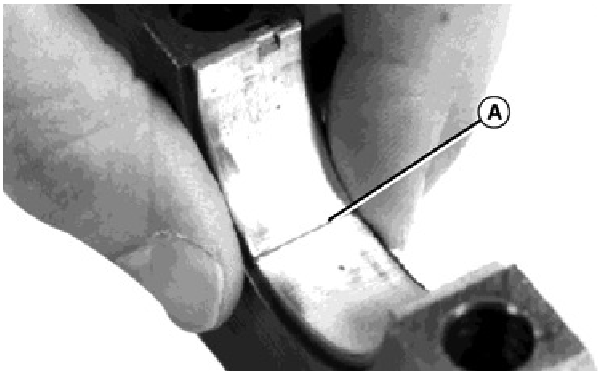
IMPORTANT:

Avoid Damage! Main bearing caps must be installed on the same main bearing and in the same direction to prevent crankshaft and main bearing damage.

Remove the main bearing cap.

[3] - Wipe oil from the bearing insert and the crankshaft journal.

[4] -



LEGEND:

A	Plastigage

Bearing Insert

Put a piece of Plastigage (A), or equivalent, along the full length of the bearing insert approximately **6 mm (0.25 in.)** off center.

[5] - Install the main bearing cap and bolts. Tighten the bolts to specification.

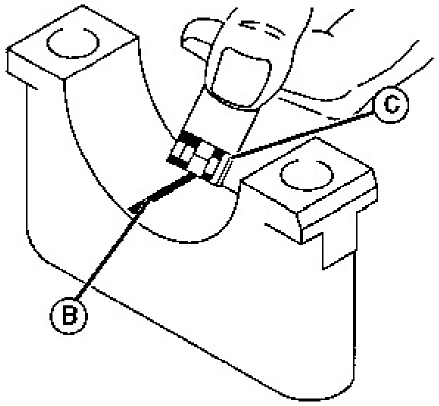
Item	Measurement	Specification
Main Bearing Bolt	Torque	91—98 N·m (68—72 lb.-ft.)

[1] - Remove the bolts and main bearing caps.

[2] -

→NOTE:

The flattened Plastigage (B) will be on either the bearing insert or crankshaft journal.



LEGEND:

B	Plastigage
C	Graduation Marks

Main Bearing Cap

Use the graduation marks (C) on the envelope to compare the width of the flattened Plastigage at its widest point. The number within the graduation marks indicates the bearing clearance in inches or millimeters, depending on which side of the envelope is used.

Item	Measurement	Specification
Main Bearing	Oil Clearance	0.04—0.07 mm
		(0.002—0.003 in.)
Main Bearing—Wear Limit	Oil Clearance	0.16 mm
		(0.006 in.)

Results:

- If the clearance exceeds the wear limit specification, replace the bearing inserts.
- Remove Plastigage.

Group 30 - Repair

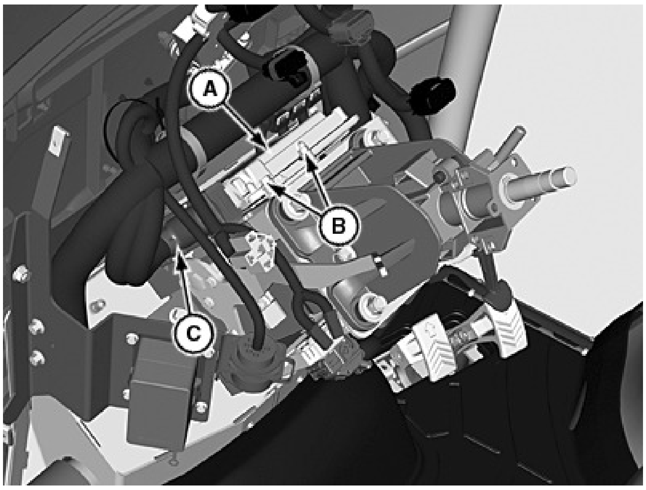
Engine Control Unit (ECU) Removal and Installation (Cab)

[1] - Disconnect negative (—) battery terminal.

[2] - Remove control panel. (See Control Panel Removal and Installation (Cab) in Section 120, Group 10.)

[3] - Remove cowl panel. (See Cowl Panel Removal and Installation (Cab) in Section 120, Group 10.)

[4] -



LEGEND:

A	Engine Control Unit
B	Cap Screw (4 used)
C	Harness Connector

Engine Control Unit

Disconnect harness connector (C).

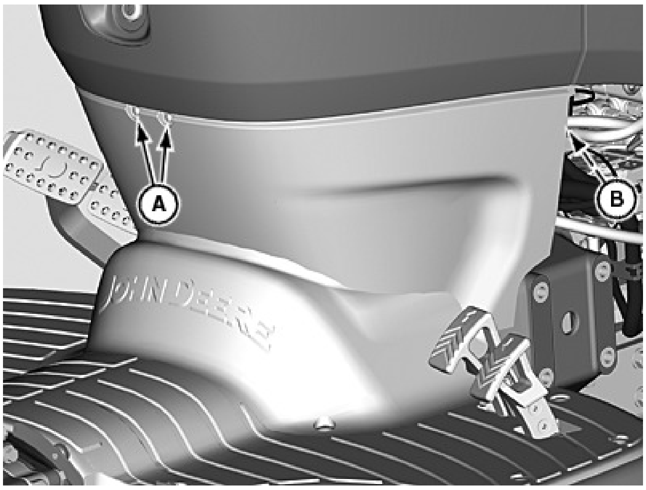
[5] - Remove four cap screws (B) and engine control unit (A).

[6] - Installation is done in the reverse order of removal.

Engine Control Unit (ECU) Removal and Installation (Open Station)

[1] - Disconnect negative (—) battery terminal.

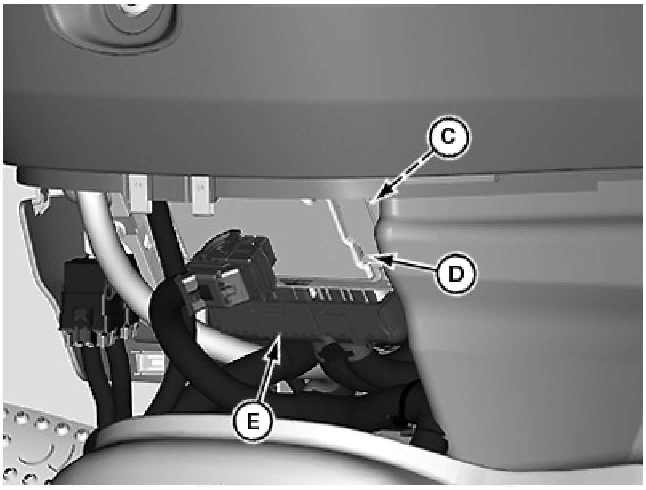
[2] -



LEGEND:

A	Screw (2 used)
B	Cap Screw (2 used)
C	Cap Screw (4 used)
D	Engine Control Unit
E	Harness Connector

Lower Skirt



Engine Control Unit

Remove two screws (A).

[3] - Remove two cap screws (B) and lower skirt.

[4] - Remove transmission control unit. (See Transmission Control Unit (TCU) Removal and Installation (Open Station) in Section 60, Group 40.)

[5] - Disconnect harness connector (E).

[6] - Remove four cap screws (C) and engine control unit (D).

[7] - Installation is done in the reverse order of removal.

Thermostat Removal and Installation

Removal

[1] - Park machine safely. See Parking Safely in the Safety Section.

[2] - Raise hood.

[3] - Allow engine to cool before servicing the cooling system.

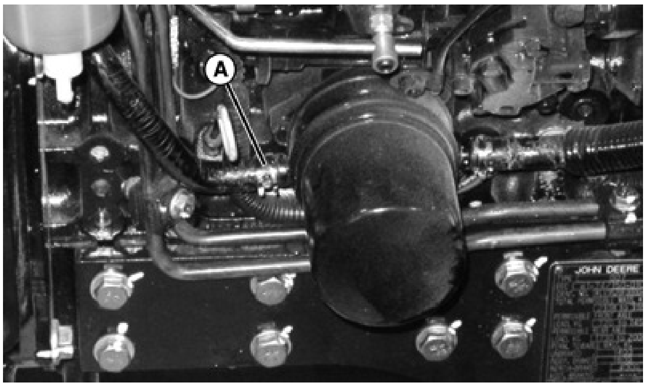
[4] - Open radiator cap.

[5] -

→NOTE:

Cooling system capacity is approximately 5.3 L (5.6 qt.).

Using a suitable container, drain coolant.

a. 

LEGEND:

A	Coolant Hose

Open station model shown.

Radiator drain plug is located on the engine side of the radiator in the lower left corner.

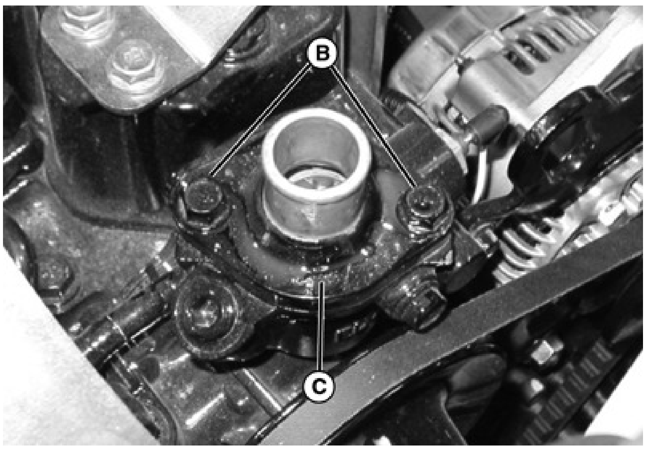
b. Engine block is drained at the oil cooler. Remove the coolant hose (A) at the oil filter. Route the hose into a container to drain the engine block.

[6] - Disconnect the wire harness from the air restriction sensor.

[7] - Remove air intake hose at turbocharger. Remove air cleaner assembly.

[8] - Loosen clamp. Remove upper radiator hose from thermostat housing.

[9] -



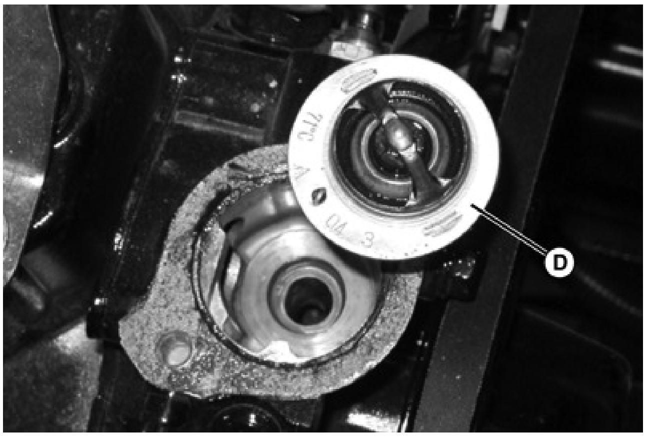
LEGEND:

B	Cap Screw (2 used)
C	Housing

Open station model shown.

Remove two cap screws (B) holding thermostat housing to water pump. Remove housing (C).

[10] -



LEGEND:

D	Thermostat

Open station model shown.

Remove thermostat (D).

[11] -

→NOTE:

Thermostat is offset and only fits in one direction. Make sure that it is installed as shown and fits down in recess.

Test or replace thermostat. Install thermostat with spring facing down.

[12] - Replace gasket. Tighten cap screws to specification..

Item	Measurement	Specification
Cap Screw-to-Thermostat	Torque	18 N·m
		(160 lb.-in.)

[13] - Close drain valve. Fill radiator with proper coolant to top of filler neck.

[14] - Fill coolant reservoir between the full cold and full hot marks.

[15] - Start engine. Allow it to reach proper operating temperature. Check radiator, hoses, and connections for leaks. Allow engine to cool, then check and adjust coolant level in recovery tank as needed.

Water Pump Removal and Installation

Removal:

[1] - Park machine safely. See Parking Safely in the Safety Section.

[2] - Raise hood.

[3] - Allow engine to cool before servicing cooling system.

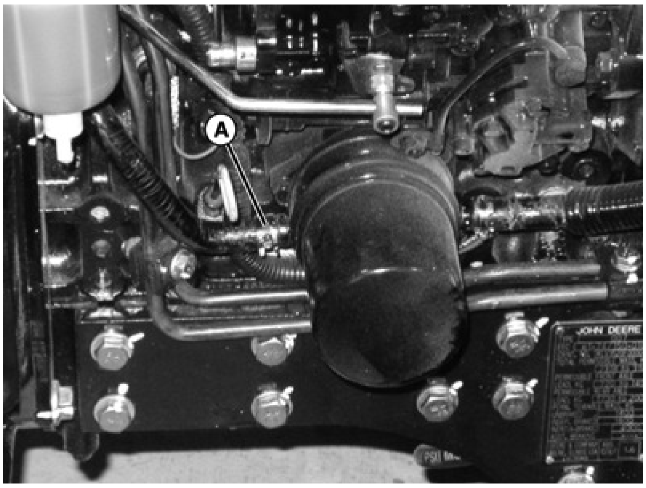
[4] - Open radiator cap.

[5] -

→NOTE:

Cooling system capacity is approximately 5.3 L (5.6 qt.).

Drain the coolant using a suitable container.

a. 

LEGEND:

A	Coolant Hose

Coolant Hose

Radiator drain plug is located on the engine side of the radiator in the lower left corner.

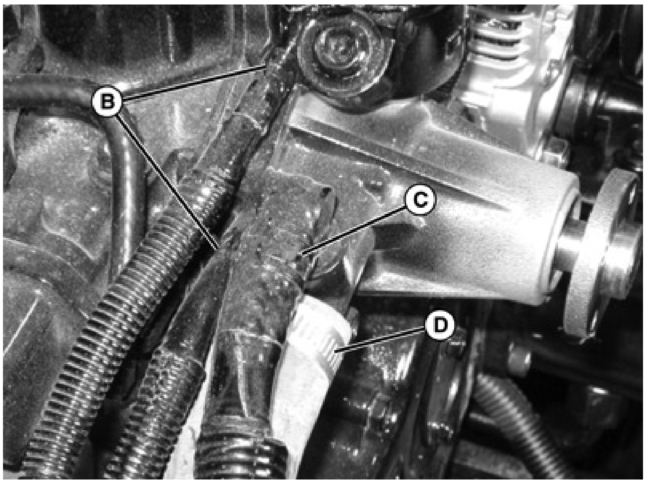
b. Engine block is drained at the oil cooler. Remove the coolant hose (A) at the oil cooler and route the hose into a container to drain the engine block.

[6] - Remove the radiator and shroud.

[7] - Loosen alternator mounting bolts. Remove water pump/alternator drive belt.

[8] - Remove four cap screws. Remove fan and sheave.

[9] -



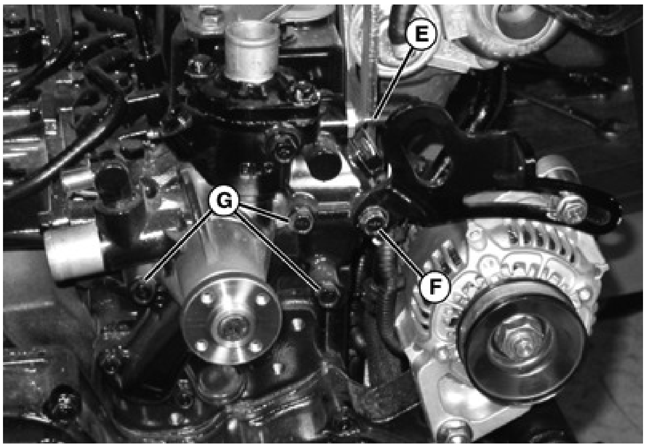
LEGEND:

B	Upper and Lower Cold Start Advance Coolant Hoses
C	Oil Cooler Hose
D	Lower Coolant Hose

Coolant Hoses

Remove the upper and lower cold start advance coolant hoses (B), oil cooler hose (C), and lower radiator hose (D).

[10] -



LEGEND:
E Coolant Temperature Switch Lead
F Cap Screw
G Cap Screws

Coolant Temperature Switch Lead

Disconnect coolant temperature switch lead (E). Remove switch from water pump if pump is to be replaced.

[11] - Remove alternator bracket cap screw (F). Pivot alternator clear of the water pump.

[12] - Remove the remaining water pump mounting cap screws (G), pump and gasket.

[13] - Inspect all parts for wear or damage.

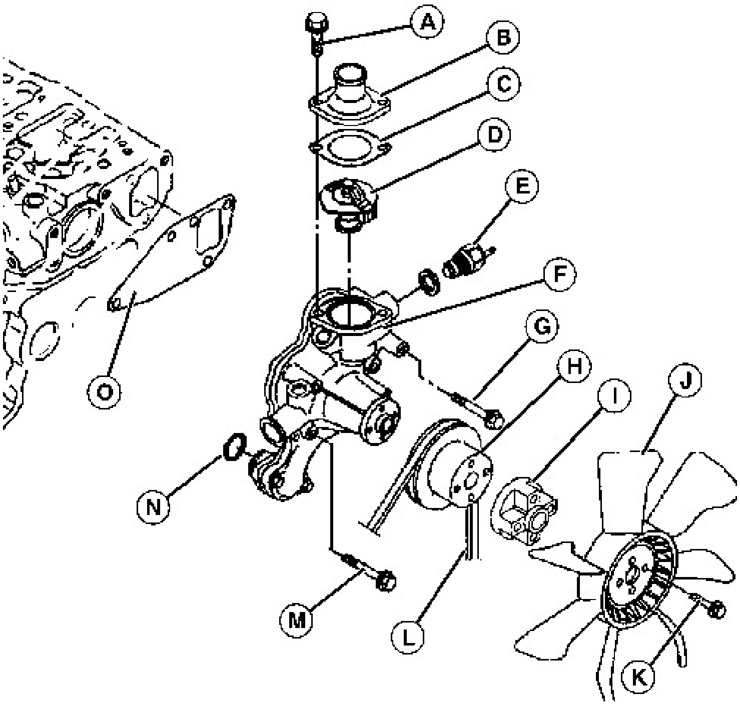
[14] - Clean cylinder block mating surfaces of all old gasket material.

Inspection:

[1] - Inspect the water pump for coolant leakage. If the origin of the leak cannot be determined, test the cooling system. (See Cooling System Pressure Test in Section 30, Group 25.)

a. If coolant is leaking at the pulley flange: The shaft seal is defective. Replace the water pump.
b. If coolant is leaking between the cylinder head and the pump housing: The gasket between the head and the pump is defective. Remove the water pump. Replace the gasket.

[2] -



LEGEND:
A Cap Screw, M8 x 20
B Thermostat Cover
C Gasket
D Thermostat
E Temperature Switch
F Water Pump
G Cap Screw, M8 x 60
H Pulley
I Spacer
J Fan
K Cap Screw, M6 x 55
L Fan Belt
M Cap Screw, M8 x 55
N O-ring
O Gasket

Water Pump Assembly Exploded View

Inspect the water pump for a worn bearing shaft.

- Remove the fan belt and check for movement of the fan. Replace the water pump if fan movement is excessive.
- If the bearing shaft is making noise when operating: Check the fan belt tension. If adjustment does not relieve the noise, the bearing shaft is defective. Replace the water pump.

Installation:

[1] - Installation is the reverse of removal.

[2] - Adjust water pump/alternator drive belt tension.

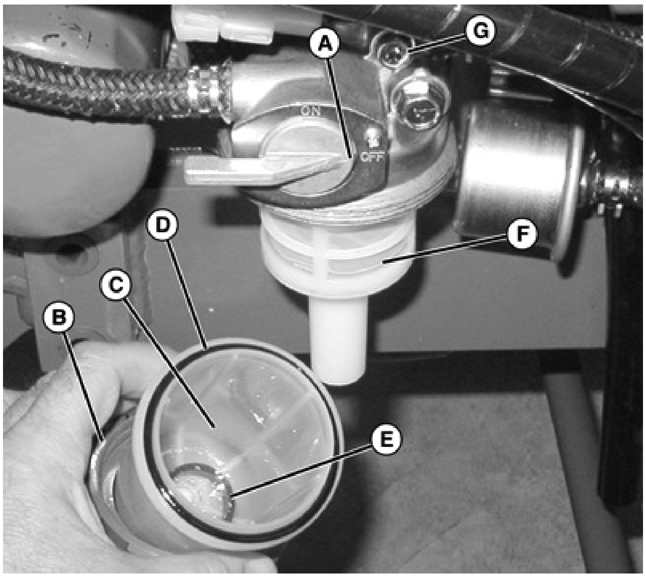
[3] - Close drain valve. Fill radiator to top of filler neck with proper coolant.

[4] - Fill coolant reservoir between the full cold and full hot marks.

[5] - Start engine. Allow it to reach proper operating temperature. Check radiator, hoses, and connections for leaks. Allow engine to cool, then check and adjust coolant level in recovery tank as needed.

Fuel Filter/Water Separator 3TNV

[1] -



LEGEND:

A	Fuel Shutoff Valve
B	Retaining Ring
C	Bowl
D	O-ring
E	Water Indicator Ring
F	Strainer
G	Air Bleed Screw

Fuel Filter

Turn fuel shutoff valve (A) OFF . Open drain valve on bottom of filter bowl. Turn air bleed screw (G) out a few turns to drain fuel from bowl.

[2] - Remove retaining ring (B) and bowl (C). Inspect O-ring (D) and water indicator ring (E). Replace if damaged.

[3] - Remove strainer (F). Clean screen with clean fuel and low pressure compressed air. Replace strainer if damaged.

[4] -

IMPORTANT:

Avoid Damage! Tighten only enough to keep the filter assembly from leaking. Overtightening the retaining nut may damage the filter cover or retaining ring.

Clean all parts. Assemble in the reverse order of disassembly.

[5] - Turn on fuel valve and open air bleed screw (G) if not already open. When fuel bowl is full and a steady stream of fuel without air bubbles is coming out of air bleed screw, close bleed screw.

Secondary Fuel Filter 3TNV

[1] -

Secondary Fuel Filter

The secondary filter is a spin on filter. Remove the filter.

[2] - Fill new filter. Lubricate gasket with clean fuel.

[3] - Install new filter per instructions printed on filter.

[4] - Turn key switch ON. Let electric fuel pump run for 30 seconds to purge air from filter and lines.

[5] - Start machine and check for leaks.

Fuel Injection Pump

Removing:

[1] -

CAUTION:

Avoid Injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.

IMPORTANT:

Avoid Damage! Never steam clean or pour cold water on an injection pump while the pump is running or warm. Doing so can damage the pump.

Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

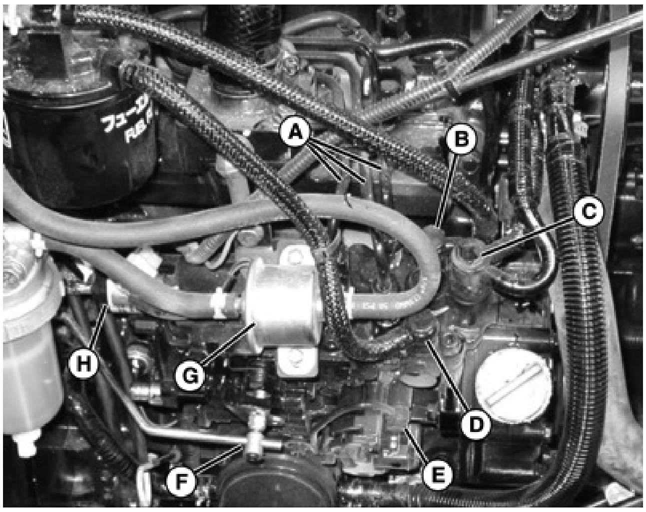
[2] - Raise hood.

[3] - Allow engine to cool before attempting to service cooling system.

[4] - Remove the radiator and shroud.

[5] - Clean the injection pump lines and area around the pump using parts cleaning solvent or steam cleaner.

[6] -



LEGEND:

A	Fuel Injection Lines
B	Hose
C	Cold Start Advance Hoses
D	Fuel Filter Hoses
E	External Lube Line
F	Throttle Linkage
G	Fuel Pump
H	Fuel Shutoff Solenoid

Open station model shown.

Loosen the fuel injection line nuts. When loosening the nuts on the injection pump, use another wrench to keep the delivery valves from loosening.

[7] - Loosen line clamps. Remove the fuel injection lines (A).

[8] - Remove the leak off hose (B).

[9] - Remove the cold start advance hoses (C).

[10] - Remove the fuel filter hoses (D).

[11] - Remove the external lube line (E).

[12] - Disconnect the throttle linkage (F).

[13] -

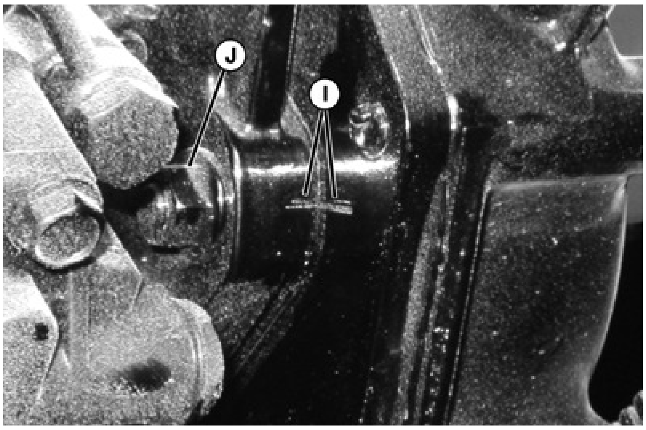
→NOTE:

It is not necessary to remove the pump line from the fuel pump.

Remove the cap screws securing the fuel pump (G) to the injection pump. Move the fuel pump clear of the injection pump.

[14] - Remove the fuel shutoff solenoid (H).

[15] -



LEGEND:

I	Timing Marks
J	Mounting Nut (2 used)

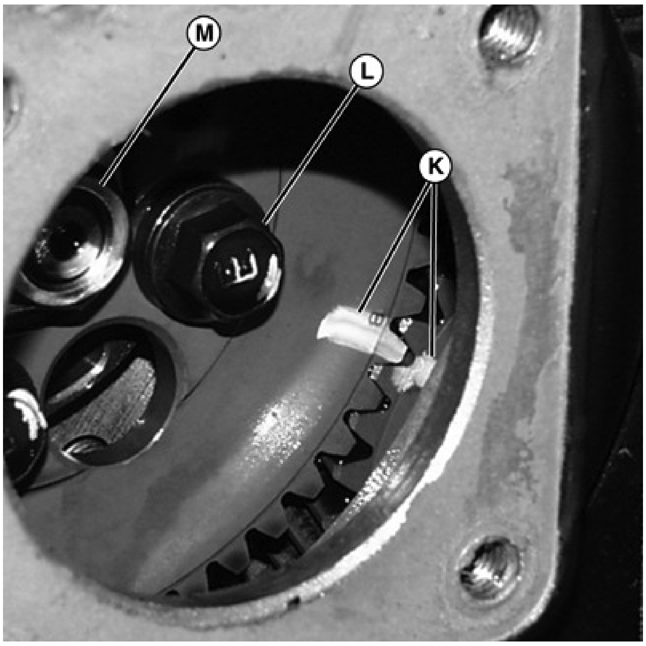
Injection Pump

Note the position of the timing marks (I) on the injection pump and the gear cover mounting plate.

[16] - Remove three mounting nuts (J).

[17] - Remove the access cover from the front of the timing gear cover.

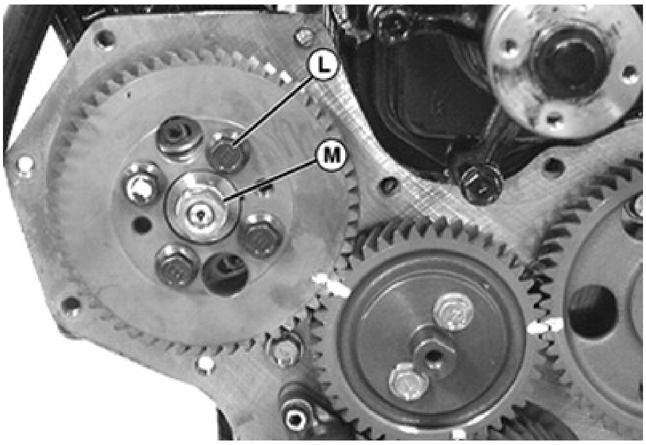
[18] -



LEGEND:

K	Idler Gear
L	Cap Screws
M	Nut

Injector Pump Gear



Timing gear cover removed for photo only. Timing gear cover does not need to be removed for injection pump removal.

Rotate engine until “B” marks on injection pump gear and idler gear (K) are aligned.

[19] -

> ***IMPORTANT:***
>
> ***Avoid Damage! DO NOT loosen four cap screws (L) attaching gear to hub! This gear/hub assembly times the injection pump camshaft in relation the crankshaft for precise timing of EPA engines. This procedure is done at the pump manufacturing plant and cannot be duplicated in the field!***

Remove nut (M).

[20] -

Gear Puller Attached To Injection Pump Gear

Use a puller to remove the gear from the injection pump shaft. Remove the puller. The gear remains in the timing gear cover.

[21] -

> ***IMPORTANT:***
>
> ***Avoid Damage! DO NOT attempt to service the injection pump or governor. If unit is in need of repair, it must be serviced by a qualified fuel injection repair shop. If replacement is necessary, replace entire unit.***

Remove the injection pump and O-ring.

Installing:

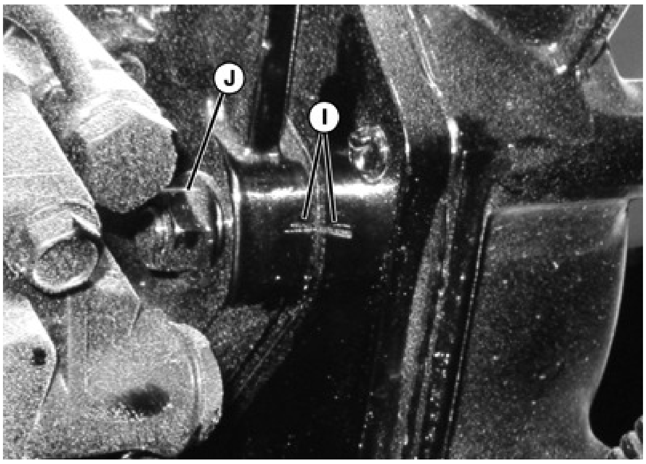
[1] - Install new O-ring to the injection pump.

[2] - Put injection pump onto back of gear cover mounting plate. Install three mounting nuts. Do not tighten. Align key on shaft with keyway in gear. Be sure to align marks on gears made during removal.

[3] - Install nut on timing gear. Tighten to specification.

Item	Measurement	Specification
Timing Gear Nut	Torque	58—68 N·m (43—50 lb.-ft.)

[1] -



LEGEND:

I	Marks
J	Nuts

Injection Pump

Align marks (I) on mounting plate and injection pump, to same place as when removed. Tighten mounting nuts (J) to specifications.

Item	Measurement	Specification
Injector Line Nuts	Torque	30—35 N·m (22—25 lb.-ft.)

[2] - Place a thin bead of John Deere form in place gasket on the cover. Install the cover.

[3] - Install and connect fuel shutoff solenoid.

[4] - Connect hoses to/from fuel filter.

[5] - Install fuel injection lines and tighten line clamps to specification.

Item	Measurement	Specification
Injector Line Nuts	Torque	30—35 N·m (22—25 lb.-ft.)

[1] - Mount the fuel pump on the injection pump.

[2] - Connect and adjust the throttle linkage. (See Throttle Cable Adjustment in Section 30, Group 25.)

[3] -

> ***IMPORTANT:***
>
> ***Avoid Damage! If the oil has been drained out of the fuel injection pump housing, add oil as necessary. The fuel injection pump can be damaged if operated without the proper amount of oil.***

Remove the fill plug and add clean engine oil to the housing. Add until the oil begins to drip out of external lube line inlet.

[4] - Install the external lube line. When installing the line, put one copper washer between the mounting bolt head and lube line and the other between the lube line and housing.

[5] - If a new injection pump is being installed, check and adjust injection pump static timing. (See Injection Pump Timing (EPA Engines) in Section 30, Group 25.)

Fuel Injection Nozzles

Removing:

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Raise hood.

[3] - Allow engine to cool.

[4] -

IMPORTANT:

Avoid Damage! Never steam clean or pour cold water on injection pump while the pump is running or warm. Doing so can damage the pump.

Clean the injection pump lines and area around the pump using parts cleaning solvent or steam cleaner.

[5] -

CAUTION:

Avoid Injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.

Loosen fuel injection line connectors-to-nozzles slightly to relieve pressure in the fuel system.

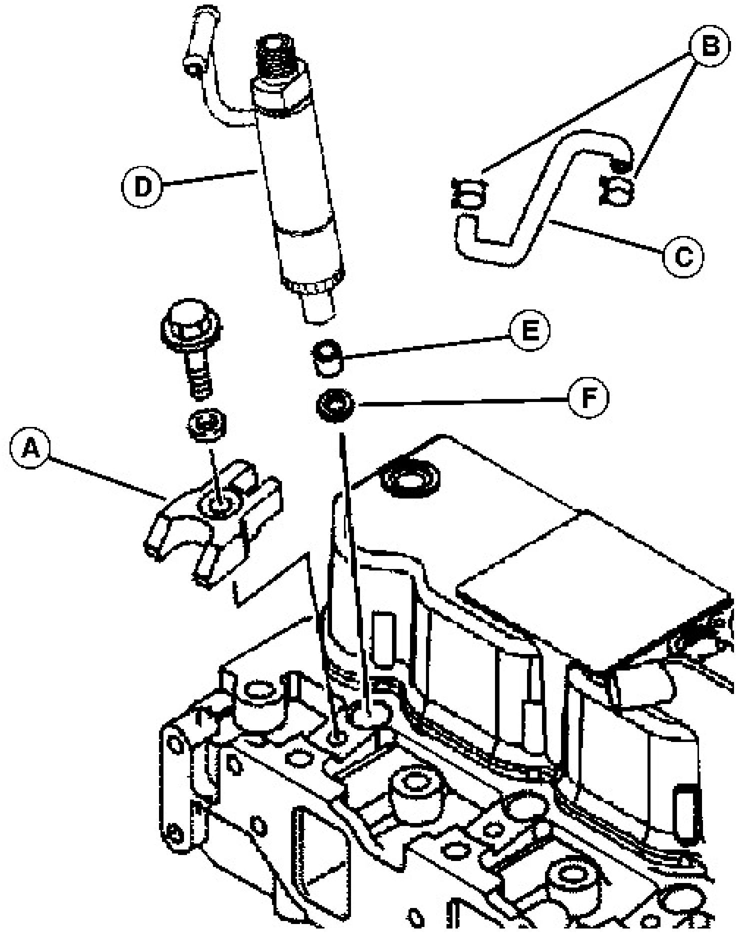
[6] -

→NOTE:

Nozzles are matched to the cylinders. If removing more than one nozzle, tag nozzles, according to the cylinder from which it was removed.

Loosen line clamp(s) and remove fuel injection lines.

[7] -



LEGEND:

A	Retaining Plates
B	Clamps
C	Leak-off Hoses
D	Injection Nozzle
E	Ring
F	Heat Protector

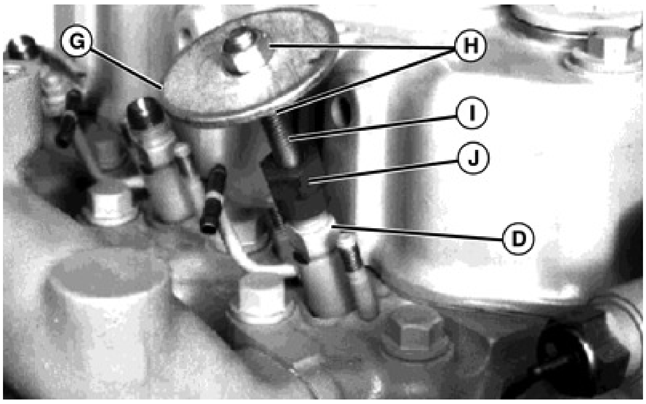
Injection Nozzle

Remove clamps (B) and leak-off hoses (C).

[8] - Remove nuts and retaining plates (A).

[9] - Remove injection nozzle (D), ring (E) and TEFLON ™ heat protector (F). If ring and protector stay in cylinder head, thread a cap screw into protector and pull from cylinder head.

[10] -



LEGEND:

D	Nozzle
G	Large Flat Washer
H	Nut (2 used)
I	Cap Screw
J	Old Injection Line

Injection Nozzle

If nozzles are stuck in cylinder head:

a. Grind the head of a cap screw (I) so it fits inside a nut from an old injection line (J).
b. Use two nuts (H) to attach a large flat washer (G) to the cap screw.
c. Install assembly onto nozzle (D) and use a puller and slide hammer to pull nozzle from cylinder head.

[11] - Test injection nozzles. (See Fuel Injection Nozzle Test in Section 30, Group 25.)

Installing:

Installation is the reverse of removal.

- Install a new ring and heat protector when installing injection nozzles.

Disassembly/Assembly:

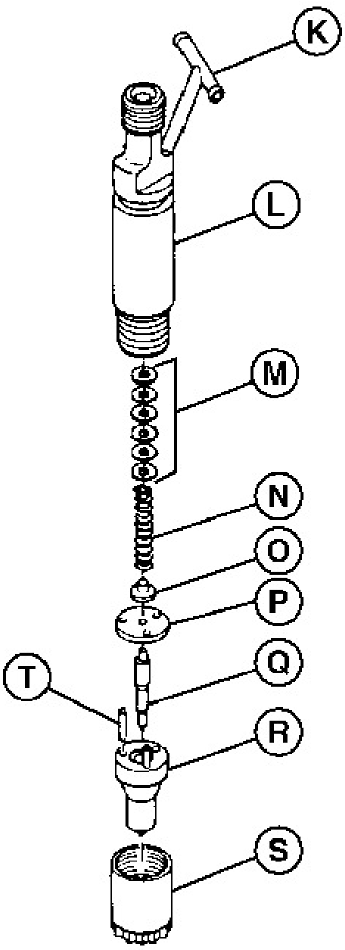
[1] -

→NOTE:

If servicing more than one nozzle, keep parts for each nozzle separate from one another.

Remove retaining nut (S) and disassemble internal parts of injection nozzle. Keep parts organized for ease of assembly.

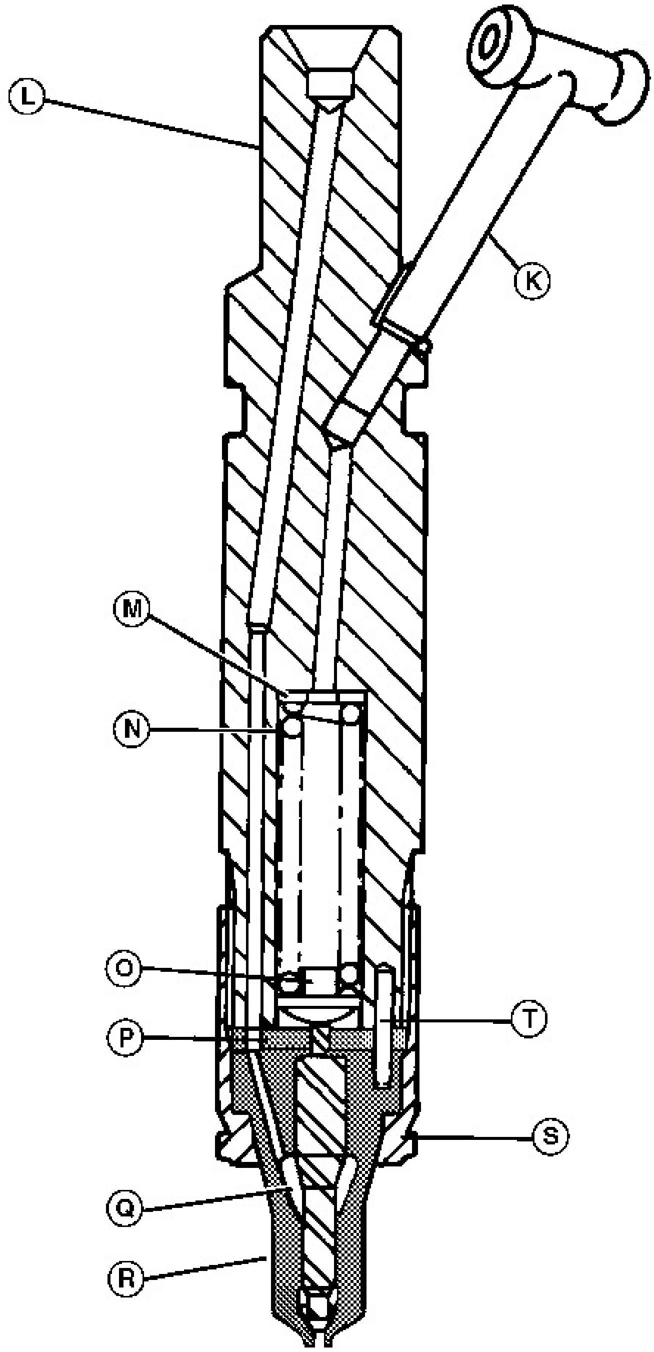
[2] -



LEGEND:

K	Return Pipe
L	Injector Body
M	Shim(s)
N	Spring
O	Spring Seat
P	Separator Plate
Q	Nozzle Valve
R	Nozzle Body
S	Retaining Nut
T	Index Pin

Injector Assembly



Injector Assembly

Clean and inspect nozzle assembly. See “Cleaning/Inspection” below.

[3] - Carefully clamp injector body (L) in a soft-jaw vice.

[4] -

→NOTE:

Insert the same number of shims (M) that were removed from injector. Number of shims will affect the opening pressure of the fuel nozzle and will be tested after assembly.

Reassemble fuel nozzle in the order shown above.

[5] - Tighten retaining nut to specification.

Item	Measurement	Specification
Injector Retaining Nut	Torque	6.8—8.8 N·m (60—78 lb.-in.)

[6] - After assembly is complete, test injection nozzle. (See Fuel Injection Nozzle Test in Section 30, Group 25.)

Cleaning/Inspection:

[1] -

→NOTE:

To clean nozzles properly, JDF13 Nozzle Cleaning Kit is recommended. The Cleaning Kit is available through the John Deere SERVICEGARD™ Catalog.

Nozzle Cleaning Kit

JDF13

Used to clean fuel injector nozzles.

Remove anti-corrosive grease from new or reconditioned nozzles by washing them thoroughly in diesel fuel.

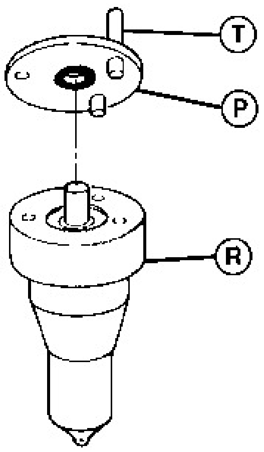
[2] -

IMPORTANT:

Avoid Damage! Never use a steel brush to clean nozzles as this will distort the spray hole.

Remove carbon from used nozzles, and clean by washing in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush (supplied in Nozzle Cleaning Kit).

[3] -



LEGEND:

P	Separator Plate
R	Nozzle Body
T	Index Pin

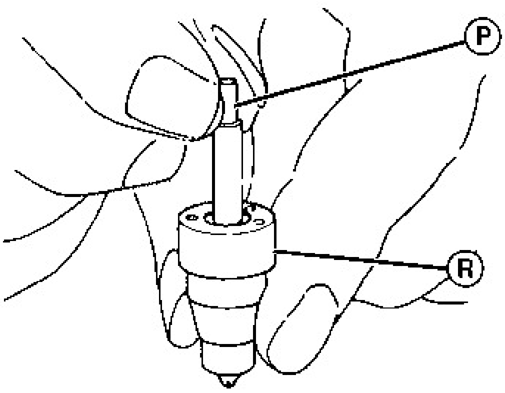
Nozzle

After removing carbon or lacquer from the exterior of nozzle, inspect sealing surfaces between separator plate (P) and nozzle body (R) for nicks or scratches.

[4] - Contact area of separator plate (both parts) must not be scored or pitted. Use an inspection magnifier (No. 16487 or equivalent) to aid in making the inspection.

[5] - Check nozzle contact surface on separator plate for wear. If contact surface is more than **0.10 mm (0.004 in.)** , replace nozzle assembly.

[6] -



LEGEND:

P	Nozzle Valve
R	Nozzle Body

Nozzle Body

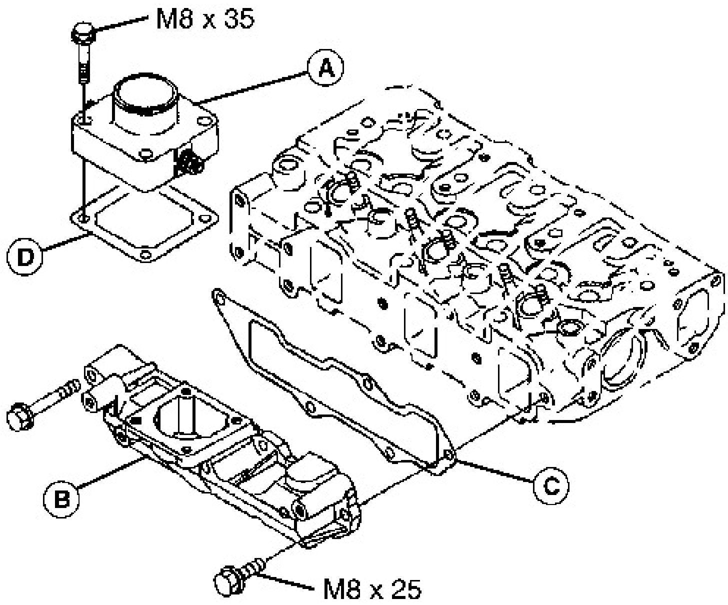
Inspect the piston (large) part of nozzle valve (P) to see that it is not scratched or scored and that lower (tip) end of valve is not broken. If any of these conditions are present, replace the nozzle assembly.

[7] - Further inspect the nozzle assembly by performing a slide test. Use the following procedure:

a. Dip the nozzle valve (P) in clean diesel fuel. Insert valve in nozzle body (R).
b. Hold nozzle vertical, and pull valve out about 1/3 of its engaged length.
c. Release valve. Valve should slide down to its seat by its own weight.

[8] - Replace nozzle assembly if the valve does not slide freely to its seat.

Intake Manifold



LEGEND:

A	Heater
B	Intake Manifold
C	Manifold Gasket
D	Heater Gasket

Intake Manifold

[1] - Remove the fuel filter bracket (not shown).

[2] - Remove the intake air heater (A).

[3] - Remove the fuel injection lines (not shown).

[4] - Remove the intake manifold (B).

[5] - Clean the mating surfaces, and replace the intake manifold gasket (C).

[6] - Install the intake manifold.

[7] - Replace the intake air heater gasket (D). Install the intake air heater.

[8] - Install the fuel injection lines.

[9] - Tighten fasteners to specification.

Turbocharger Removal and Installation

Turbochargers used on the engines covered in this manual are available through service parts as a complete remanufactured assembly only. Individual components for repair are not available.

Removal:

CAUTION:

Avoid Injury! Touching hot surfaces can burn skin. Allow the engine to cool before servicing or working near the engine and components.

IMPORTANT:

Avoid Damage! When cleaning turbocharger, do not spray directly into compressor cover or turbine housing. If turbocharger inspection is required, do not clean exterior prior to removal. Doing so may wash away evidence of a potential failure.

Thoroughly clean exterior of turbocharger and surrounding area to prevent entry of dirt into the intake system during removal.

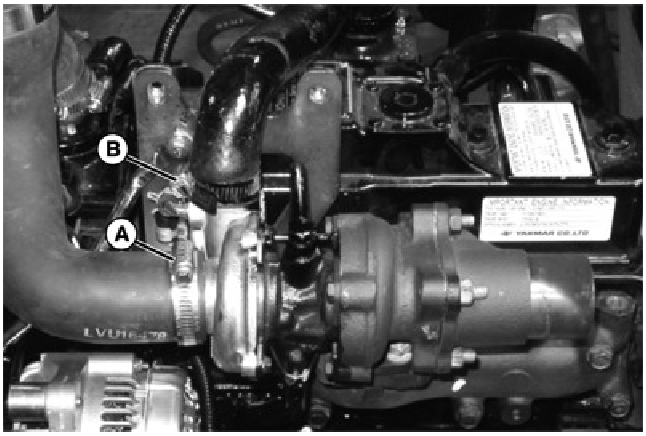
[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Allow engine to cool.

[3] - Raise hood.

[4] - Remove the muffler.

[5] -



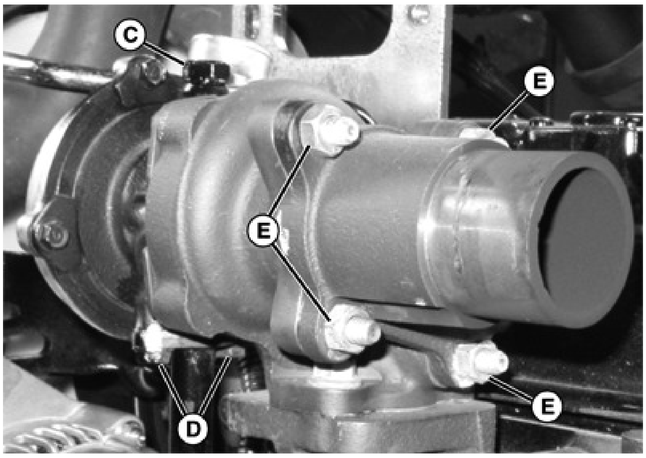
LEGEND:

A	Hose Clamp
B	Hose Clamp

Turbocharger

Loosen the hose clamps (A and B) and remove the inlet and outlet air hoses.

[6] -



LEGEND:

C	Banjo Bolt
D	Cap Screw (2 used)
E	Nut (4 used)

Center Housing

Disconnect banjo bolt (C), seal washers, and oil inlet line from center housing.

[7] - Remove two cap screws (D). Disconnect the oil return tube from the center housing.

[8] - Remove four nuts (E). Remove the exhaust adaptor from the turbine housing.

[9] - Remove three turbocharger mounting nuts securing turbocharger to exhaust manifold. Remove turbocharger.

[10] - Cap or plug all openings on engine (exhaust and intake manifold related). Place turbocharger on a clean flat table for inspection.

[11] - Perform turbocharger inspection. (See Turbocharger Inspection in Section 30, Group 25.)

Installation:

[1] -

IMPORTANT:

Avoid Damage! If turbocharger failed because of foreign material entering the air intake system, be sure to examine the system. Clean as required to prevent a repeat failure.

DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur.

Fill oil return (drain) port with clean engine oil. Spin rotating assembly by hand to lubricate bearings.

[2] - If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.

[3] - Put a new gasket on turbocharger-to-exhaust manifold mounting surface.

[4] - Position turbocharger against gasket on exhaust manifold.

[5] - Apply PT569 NEVER-SEEZ ™ Compound to turbocharger mounting studs. Install nuts. Tighten to specifications.

Number	Name	Use
• PT569 (us)	NEVER-SEEZ	Turbocharger Mounting Studs

Item	Measurement	Specification
Turbocharger-to-Exhaust Manifold Nuts	Torque	32 N·m (22 lb.-ft.)

[6] -

→NOTE:

Remove caps or plugs from turbocharger.

Install turbocharger oil return (drain) tube using a new O-ring. Tighten cap screws to specifications.

Item	Measurement	Specification
Turbocharger Oil Return Line Cap Screws	Torque	11 N·m (97 lb.-in.)

[7] - Position the seal washers (one on each side) on the oil inlet line. Install the banjo bolt. Tighten to specification.

Item	Measurement	Specification
Turbocharger Oil Inlet Line Banjo Bolt	Torque	10 N·m (88.5 lb.-in.)

[8] - Connect air intake hoses to turbocharger. Tighten connections securely.

[9] - Install the exhaust adaptor to the turbine housing and tighten the nuts to specification.

Item	Measurement	Specification
Exhaust Adaptor-to-Turbocharger Nuts	Torque	32 N·m (22 lb.-ft.)

[10] - Install the muffler assembly. Tighten connections securely.

[11] - Disconnect the fuel shutoff solenoid electrical connector. If removed, connect all other electrical connections.

[12] -

IMPORTANT:

Avoid Damage! BEFORE STARTING an engine with a new or repaired turbocharger, crank the engine over (but do not start) for several seconds to allow engine oil to reach turbocharger bearings. The electrical system will not allow engine to crank longer than 15 seconds at a time to avoid damaging starting motor.

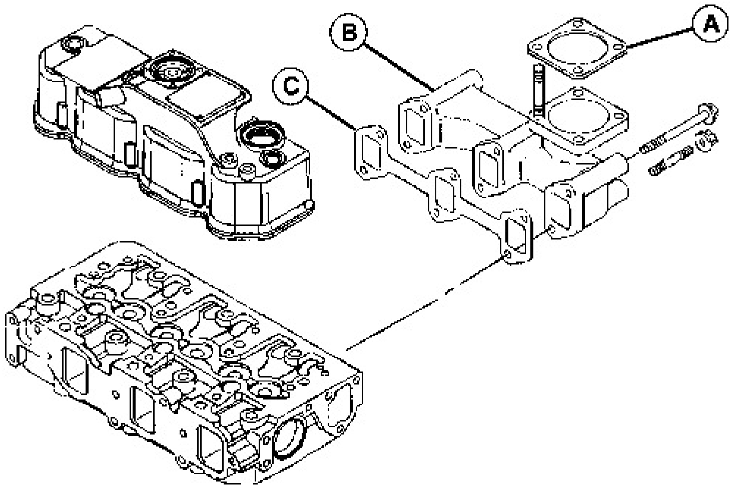
Turn the key switch to START. Hold for 3—5 seconds to allow engine oil to reach turbocharger bearings.

[13] - Connect the fuel shutoff solenoid electrical connector.

[14] - Start and run engine at low idle while checking oil inlet and air piping connections for leaks.

[15] - Install the exhaust system heat shield.

Exhaust Manifold



LEGEND:

A	Gasket
B	Exhaust Manifold
C	Gasket

Exhaust Manifold

[1] - Remove muffler, turbocharger (if equipped), and gasket (A).

[2] - Remove exhaust manifold (B) and gasket (C).

[3] - Clean the mating surfaces. Replace exhaust manifold gasket.

[4] - Install exhaust manifold. Tighten all fasteners.

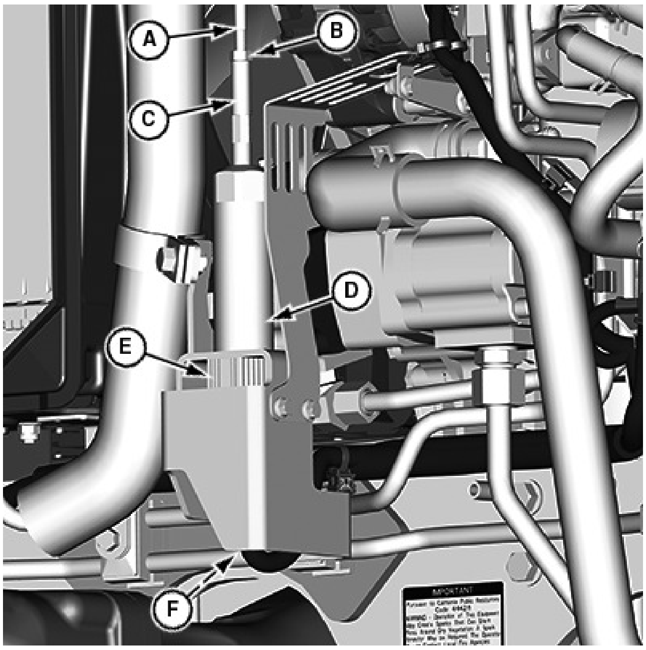
Exhaust Valve Actuator

[1] - Park machine safely. See Park Machine Safely .

[2] - Remove hood assembly. See Hood Removal and Installation (Cab and Open Station) .

[3] - Disconnect negative (–) battery cable.

[4] -



LEGEND:

A	Upper Actuator Rod
B	Lock Nut
C	Lower Actuator Rod
D	Cover
E	Actuator
F	Harness Connector

Exhaust Valve Actuator

Disconnect harness connector (F) from bottom of exhaust valve actuator.

[5] - Loosen lock nut (B) and unscrew lower actuator rod (C) from upper actuator rod (A).

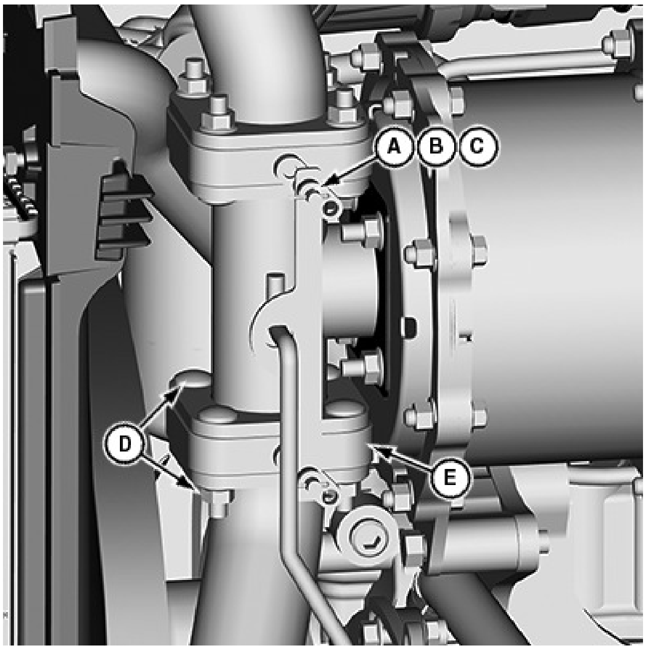
[6] - Unscrew cover (D) and remove actuator (E) from mounting bracket.

[7] - Install parts in reverse order. Adjust exhaust valve actuator rod when reassembly is complete. See Exhaust Valve Actuator Rod Adjustment .

Exhaust Valve Block

[1] - Allow exhaust system to cool.

[2] -



LEGEND:

A	Cotter Pin (2 used)
B	Washer (2 Used)
C	Bushing (4 used)
D	Flange Nut and Carriage Bolt (4 used)
E	Exhaust Valve Block

Exhaust Valve Block

Remove cotter pins (A), washers (B), and bushings (C). Rotate and slide split exhaust valve connect bracket out of the way.

[3] - Remove flange nuts and carriage bolts (D) from exhaust block that is being removed.

[4] - Remove exhaust valve block (E).

[5] -

→NOTE:

Since the exhaust valve blocks operate in a high temperature area, make sure to operate both blocks manually. Check for any binding or bearing noise.

Install parts in reverse order.

Starting Motor Removal and Installation

Removing:

[1] - Park machine safely. (See Park Machine Safely .)

[2] - Allow engine and coolant to cool.

[3] - Raise hood and open radiator cap.

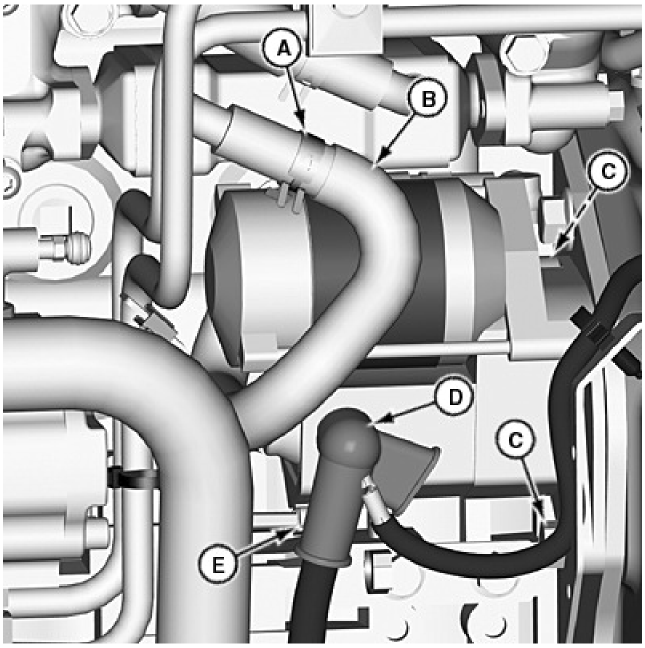
[4] -

IMPORTANT:

Avoid Damage! Always disconnect the negative cable from the battery before working on any electrical components.

Disconnect negative cable from battery.

[5] -



LEGEND:

A	Clamp
B	Coolant Hose
C	Cap Screw (2 used)
D	Boot
E	Solenoid Wire

Starting Motor

Remove clamp (A) and EGR manifold coolant hose (B). Coolant will escape when the hose is disconnected from manifold. Drain the remaining coolant using a suitable container.

[6] - Slide boot back (D) and remove nut securing positive battery cable and the cable that leads to the bus bar fuse holder.

[7] - Disconnect the starting motor solenoid wire (E).

[8] - Remove two cap screws (C) and starting motor.

Installing:

Installation the reverse of removal.

IMPORTANT: DO NOT overtighten the starting motor cap screws.

Tighten the starting motor cap screws to specification.

Item	Measurement	Specification
Starting Motor Cap Screw	Torque	88 N·m (65 lb.-ft.)

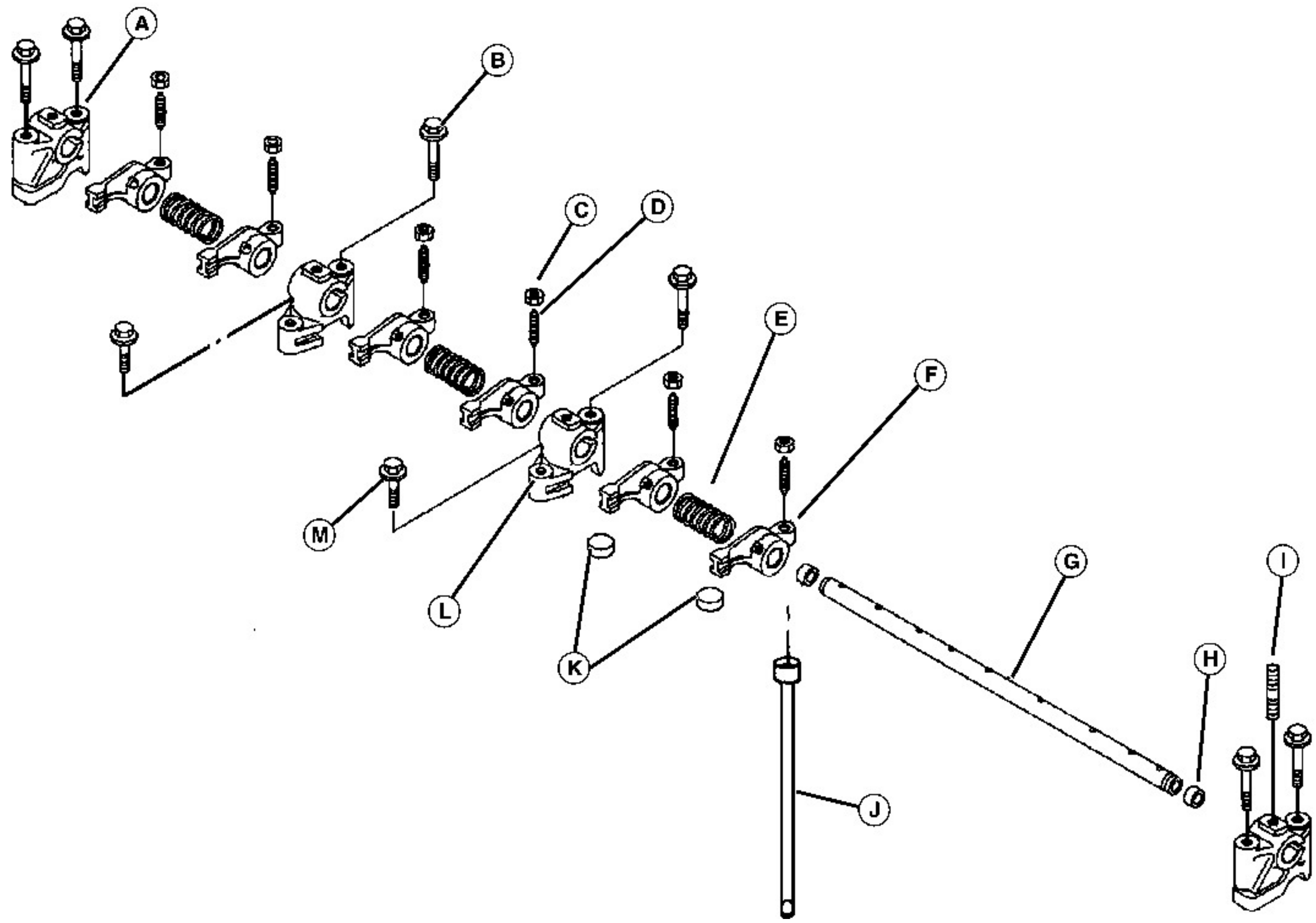
IMPORTANT: DO NOT overtighten the starting motor cable nut.

Tighten the starting motor cable nut to specification.

Item	Measurement	Specification
Starting Motor Cable Nut	Torque	10 ± 2 N·m (7.4 ± 1.5 lb.-ft.)

Rocker Arm Assembly

Removal/Installation and Disassembly/Assembly:



Rocker Arm Exploded View

LEGEND:

A	Shaft End Support (2 used)
B	Cap Screw, M8 x 50 (6 used)
C	Jam Nut (6 used)
D	Adjuster Screw (6 used)
E	Spring (3 used)
F	Rocker Arm
G	Rocker Arm Shaft
H	Plug (2 used)
I	Stud
J	Push Rod (6 used)
K	Valve Caps (6 used)
L	Center Support (2 used)
M	Cap Screw, M8 x 25

[1] - Remove the rocker cover.

[2] - Remove the rocker arm end support and rocker arm center support mounting cap screws.

[3] - Lift the rocker arm assembly from the cylinder head and set the assembly on a bench.

[4] -

→NOTE:

If the rocker arm shaft assembly is to be disassembled, replace components in same location on the rocker arm shaft they were removed from.

Note the positions of the rocker arm assembly components. Slide the components off the rocker arm shaft.

[5] - Lift the push rods from the cylinder head. Note the order of removal for reassembly.

[6] - Inspect the rocker arm components and push rods.

[7] - Reinstall the push rods to their original location in the cylinder head, with the ball shaped end down in head.

[8] - Lubricate parts with new oil during assembly.

[9] - Assemble the rocker arm assembly components in the reverse order of removal.

[10] - Place the rocker arm assembly on the cylinder head.

a. Align the rocker arms with the valves and push rods.
b. Align the rocker arm end and center supports with corresponding holes in the cylinder head.

[11] - Install the rocker arm support cap screws. Tighten the cap screws to specification.

Item	Measurement	Specification
Rocker Arm Support Cap Screw	Torque	26 N·m (19 lb.-ft.)

[12] - Adjust the valve clearance.

Inspection:

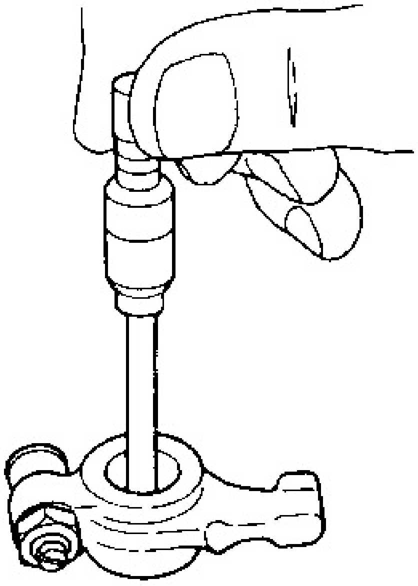
[1] -

Rocker Arm Shaft

Measure the outer diameter of the rocker arm shaft.

a. Rocker arm shaft outer diameter is **15.966—15.984 mm (0.6285—0.6295 in.)** .
b. Replace the rocker arm shaft if the outer diameter is less than **15.94 mm (0.6275 in.)** .

[2] -



Rocker Arms and Supports

Measure the inner diameters of the rocker arms and supports.

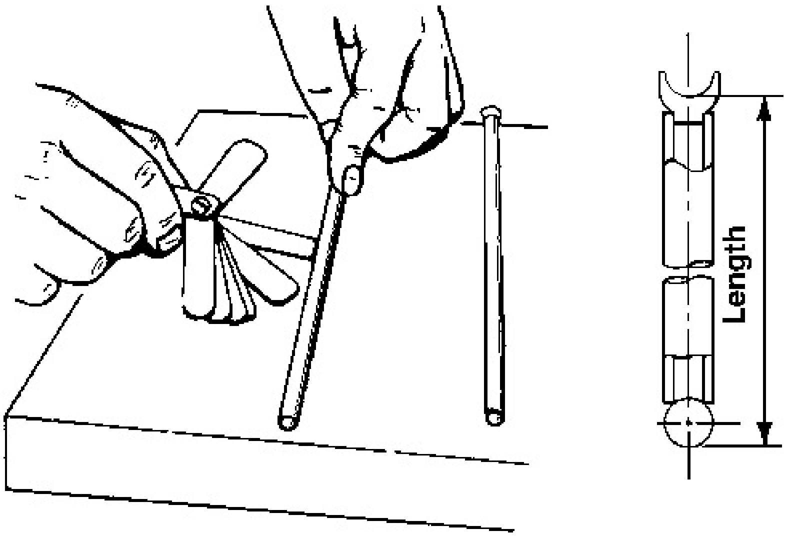
a. Standard inner diameter is **16.00—16.02 mm (0.630—0.631 in.)** .
b. Replace the rocker arms or supports if the inner diameter is more than **16.07 mm (0.633 in.)** .

[3] - Measure the rocker arm shaft to rocker arm bushing oil clearance. Oil clearance is the difference between the outer diameter of the rocker arm shaft and the inner diameter of the rocker arms.

a. Standard oil clearance is **0.02—0.05 mm (0.001—0.002 in.)** .
b. If the clearance exceeds **0.13 mm (0.005 in.)** replace the rocker arm shaft and rocker arms.

Measure Bending of Push Rod:

[1] -



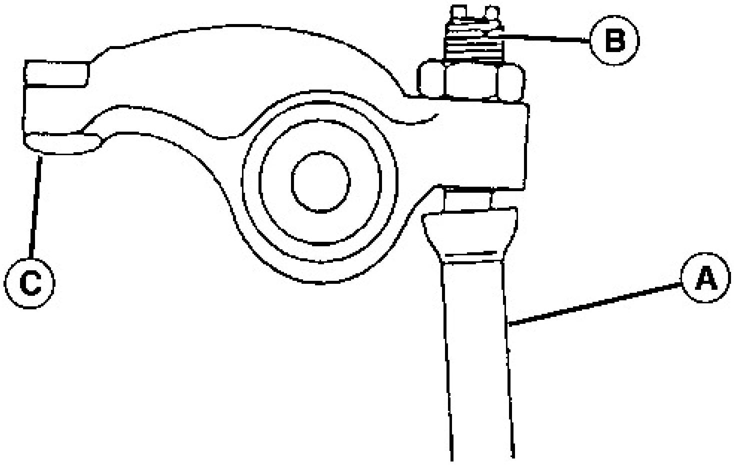
Push Rod

Place the push rod on a flat surface.

[2] - Use a feeler gauge to measure gaps between the push rod and flat surface. Replace a push rod with over **(0.03 mm (0.001 in.)** bend.

Inspect Rocker Arm Contact Surfaces:

[1] -



LEGEND:

A	Push Rod
B	Adjusting Screw
C	Surface

Rocker Arm Contact Surface

Check the surface of the adjusting screw that contacts the push rod (A) for wear. Replace the adjusting screw (B) if it is worn or damaged.

[2] - Check the surface (C) of the rocker arm that comes in contact with the valve cap for wear. Replace rocker arm if necessary.

[3] - Check the socket portion of the push rod where the valve clearance adjusting screw contacts the push rod. Replace the push rod if it is worn or damaged.

Cylinder Head and Valves Removal and Installation

Removal:

[1] - Remove the rocker arm cover.

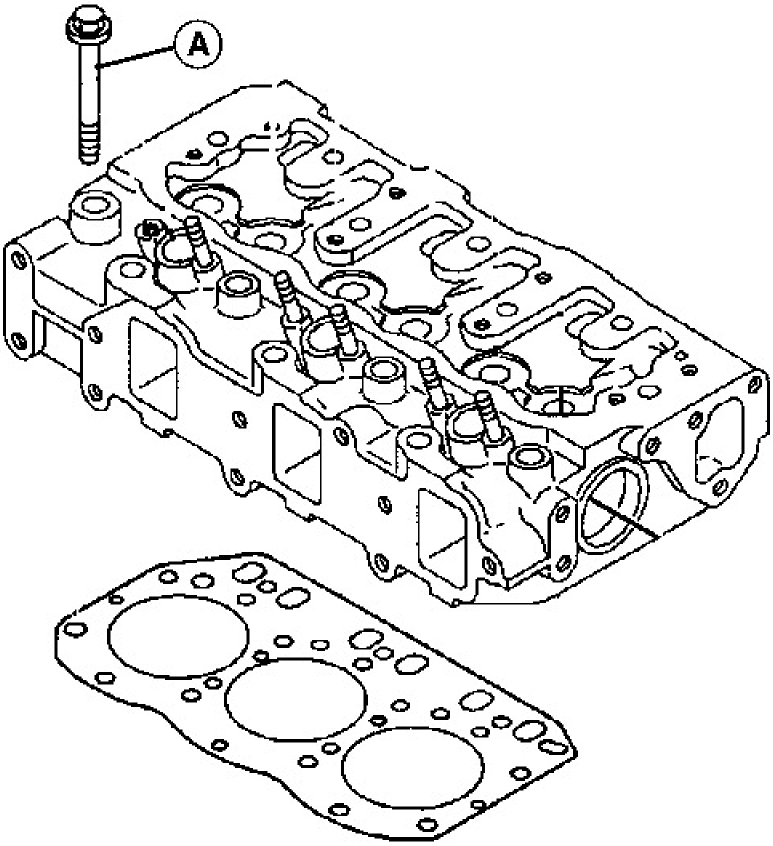
[2] - Remove rocker arm assembly, push rods, and valve caps. (See Rocker Arm Assembly in Section 30, Group 30.)

[3] - Remove the exhaust and intake manifolds. (See Exhaust Manifold and Intake Manifold in Section 30, Group 30.)

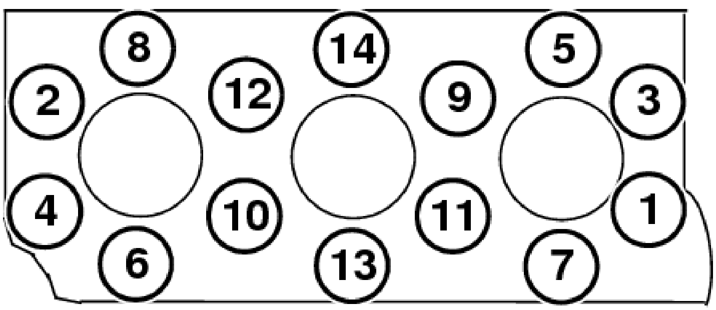
[4] - Remove the water pump.

[5] - Remove fuel injection nozzles. (See Fuel Injection Nozzles in Section 30, Group 30.)

[6] -



Cylinder Head



Cylinder Head Bolt Pattern

LEGEND:

A	Cylinder Head Bolt (14 used)

Remove the 14 cylinder head bolts (A) in the order shown.

[7] - Remove the cylinder head from the engine block.

[8] - Disassemble and inspect the cylinder head and valves. (See Cylinder Head and Valves Disassembly and Assembly in Section 30, Group 30.)

Installation:

[1] - Assemble the cylinder head and valves. (See Cylinder Head and Valves Disassembly and Assembly in Section 30, Group 30.)

[2] -

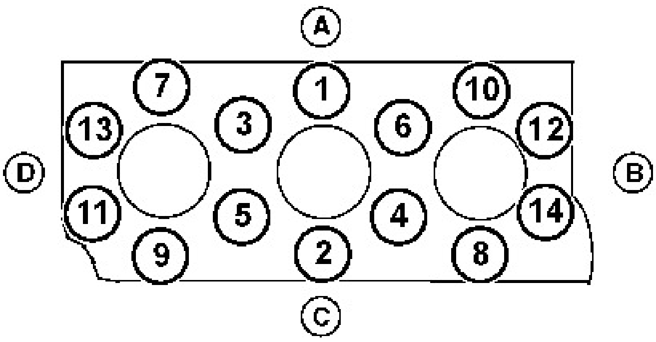
IMPORTANT:

Avoid Damage! The oil passage in the gasket must be located over the oil passage in cylinder block.

Place a new cylinder head gasket on the engine block. Dowels in the engine block assist in aligning the gasket.

[3] - Place the cylinder head on the engine block. Dowels in the engine block again assist in alignment.

[4] -



Cylinder Head Bolt—Tightening Order

Dip the head bolts in new engine oil. Install and tighten in the sequence shown, in three stages of gradually-increasing torque. Tighten the head bolts to specification.

Item	Measurement	Specification
Cylinder Head Bolt	Initial Torque	42—47 N·m (31—35 lb.-ft.)
Cylinder Head Bolt	Intermediate Torque	65—70 N·m (48—52 lb.-ft.)
Cylinder Head Bolt	Final Torque	85—91 N·m (63—67 lb.-ft.)

[5] -

IMPORTANT:

Avoid Damage! Cylinder head bolts must be checked for proper torque after 50 hours of engine operation.

Install fuel injection nozzles. (See Fuel Injection Nozzles in Section 30, Group 30.)

[6] - Install the water pump.

[7] - Install the exhaust and intake manifolds. (See Exhaust Manifold and Intake Manifold in Section 30, Group 30.)

[8] - Install rocker arm assembly, push rods, and valve caps.

Cylinder Head and Valves Disassembly and Assembly

Removing:

[1] - Remove the valve caps from the valves. The valve caps should be installed on the valves they were removed from.

[2] - Compress the valve spring using a valve spring compressor and remove the collet halves, retainer, valve spring, and valve stem seal for each valve.

[3] - The intake and exhaust valve guides are press fit. Replace the guides only if necessary. (See Valve Guides in Section 30, Group 30.)

[4] -

→NOTE:

The valve seats are not replaceable. If inspection of the cylinder head reveals valve seats that are damaged or worn beyond repair, the cylinder head must be replaced. See Valve Seats in Section 30, Group 30 for inspecting valve seats.

Inspect remaining parts for wear or damage.

Installing:

IMPORTANT:

Avoid Damage! Replace stem seals if removed. Used seals will leak.

[1] - Install new valve stem seals over the valve guides.

[2] - Apply clean engine oil on intake and exhaust valve stems during assembly.

[3] - Install the valve springs with smaller pitch end or paint mark toward cylinder head.

[4] - Compress the valve springs and retainer until the collet halves can be installed in the grooves of the valve stem.

[5] - Carefully release the tension on the spring compressor.

[6] - Tap on the end of the valve with a plastic hammer to ensure that the collet halves have seated on the valve stem.

[7] - Repeat for the remaining valves.

[8] -

→NOTE:

After each valve has been assembled, seat the retainer with a tap on top of valve stem with a plastic hammer.

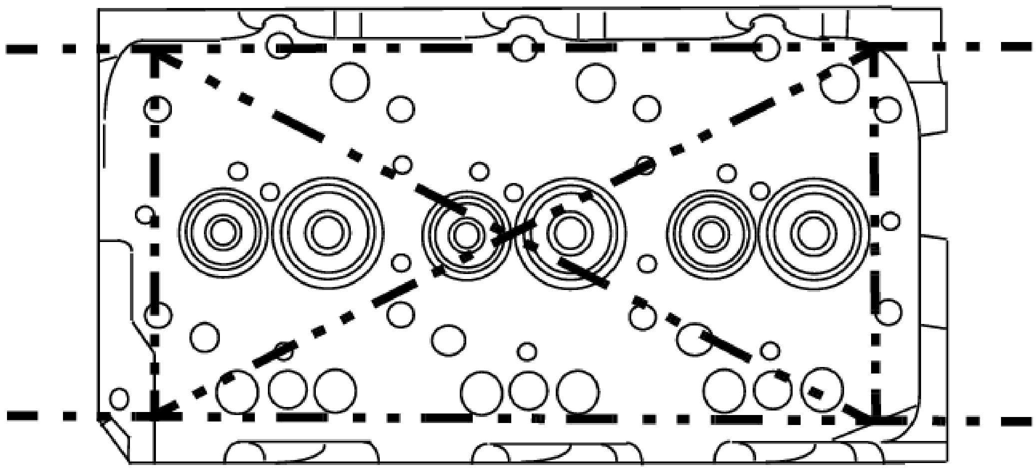
Measure valve recession if new valves were installed. (See Valve Recession in Section 30, Group 30.)

Inspection/Replacement:

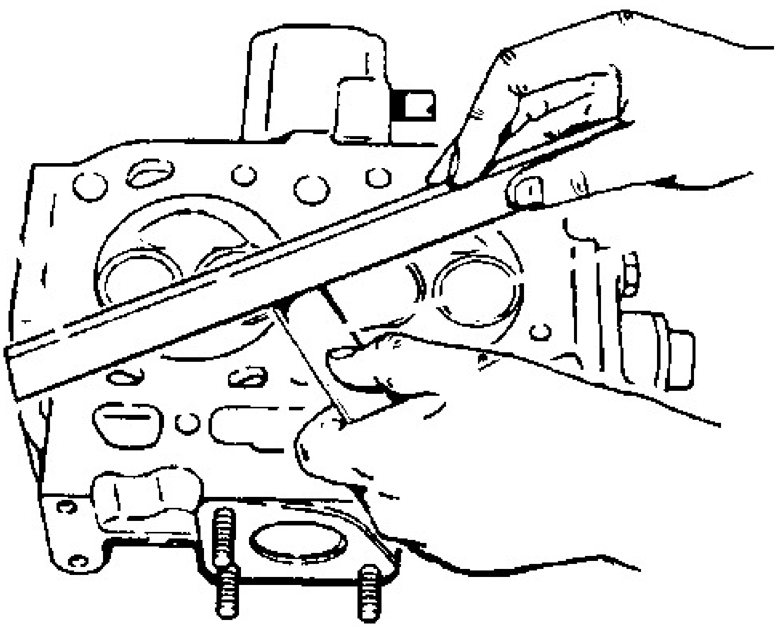
Before inspection, thoroughly clean all components of carbon or dirt.

Cylinder Head:

[1] -



Cylinder Head



Cylinder Head

To measure the cylinder head flatness, place a straightedge along each of the four sides and each diagonal. Measure clearance between straight edge and combustion surface with a feeler gauge.

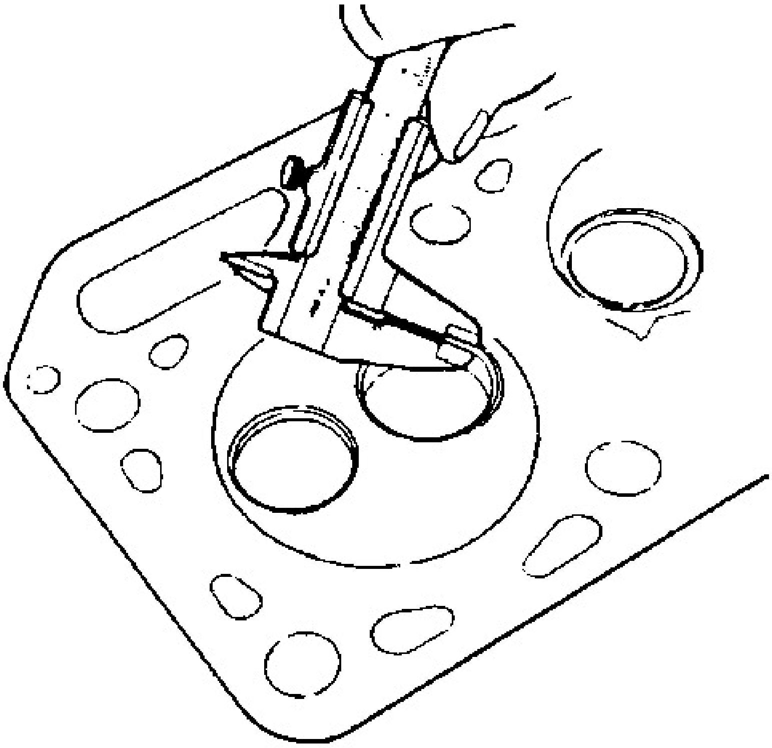
a. Standard distortion is **0.05 mm (0.002 in.)** or less.
b. If the distortion exceeds **0.05 mm (0.002 in.)** , but is less than **0.15 mm (0.006 in.)** resurface the cylinder head.
c. If the distortion is **0.15 mm (0.006 in.)** or more, replace the cylinder head.

[2] - If the cylinder head was resurfaced:

a. Measure piston-to-cylinder head clearance. (See Measure Piston-To-Cylinder Head Clearance in Section 20, group 30.)
b. Measure valve recession. (See Valve Recession in Section 30, Group 30.)
c. Measure valve seat width. (See Valve Seats in Section 30, Group 30.)

Valve Seats

[1] -



Measure Valve Seats

Measure the valve seat widths.

Item	Measurement	Specification
Valve Seat	Width	1.07—1.24 mm (0.042—0.049 in.)
Valve Seat—Wear Limit	Width	1.74 mm (0.069 in.)

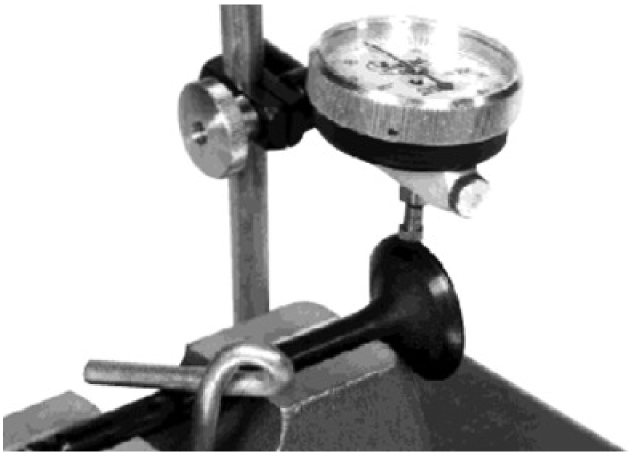
[2] - Measure exhaust valve seats.

Item	Measurement	Specification
Exhaust Valve Seat	Width	1.24—1.45 mm (0.049—0.057 in.)
Exhaust Valve Seat—Wear Limit	Width	1.94 mm (0.076 in.)

[3] - If necessary, grind the valve seats to specifications. (See Grind Valve Seats in Section 30, Group 30.)

Intake and Exhaust Valves:

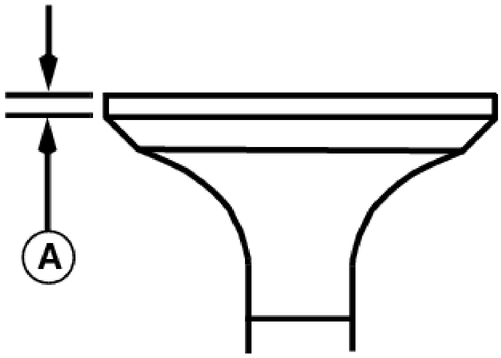
[1] -



Inspect Valves

Check the valves for out-of-round, bent, or warped condition using a valve inspection center. Replace valve if necessary.

[2] -



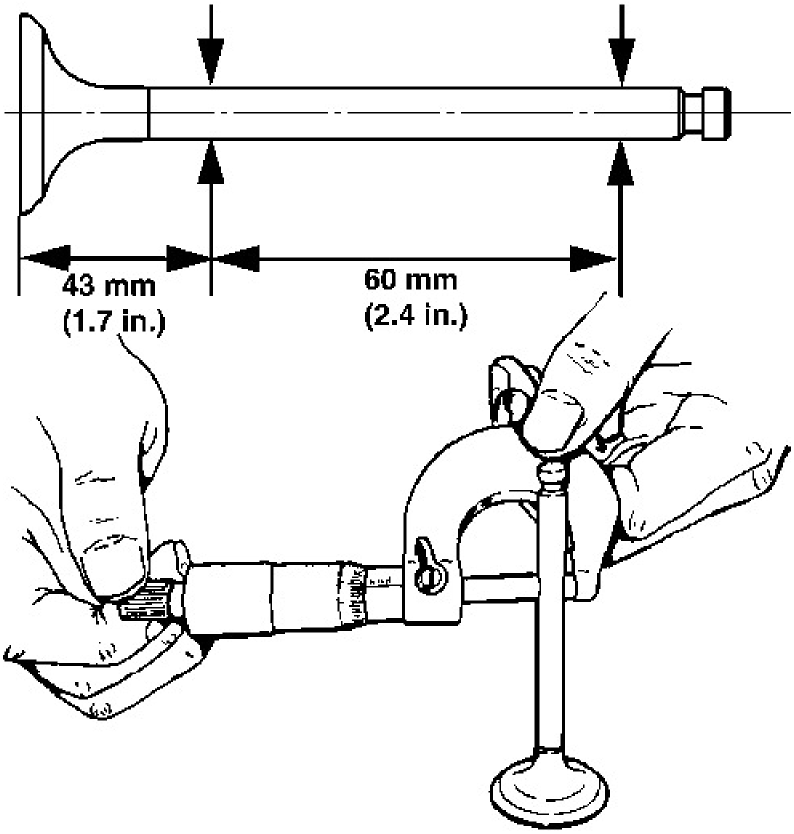
Inspect Valves

LEGEND:

A Valve Head Thickness

If the valve faces are worn, burned or pitted, grind the valves to the proper face angle. If the valve head thickness (A) is less than **0.50 mm (0.020 in.)** after grinding, replace the valve.

[3] -



Inspect Valve Stem

Measure the valve stem diameter at two locations, as shown.

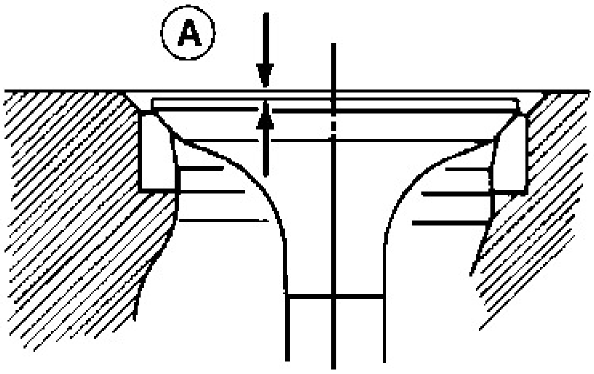
Item	Measurement	Specification
Intake Valve Stem	OD	7.96—7.98 mm (0.313—0.314 in.)

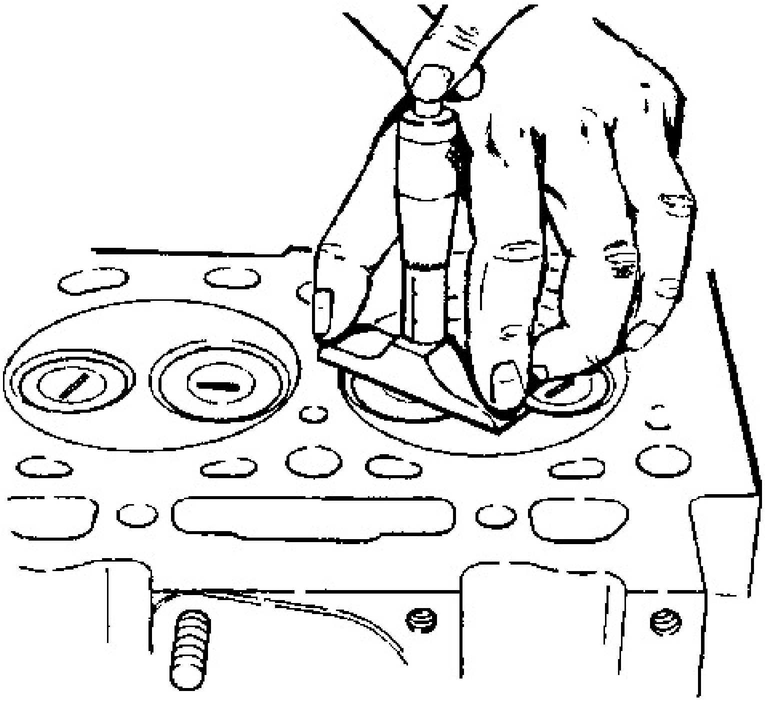
Item	Measurement	Specification
Exhaust Valve Stem	OD	7.96—7.97 mm (0.313—0.314 in.)

- If the valve stem diameter is less than the wear limit, replace the valve.

Item	Measurement	Specification
Intake Valve Stem—Wear Limit	OD	7.90 mm (0.311 in.)
Exhaust Valve Stem—Wear Limit	OD	7.90 mm (0.311 in.)

Valve Recession





Valve Recess

Measure valve recession (A) using a depth gauge.

Item	Measurement	Specification
Valve Recession	Recess	0.3—0.5 mm (0.012—0.020 in.)
Valve Recession—Wear Limit	Recess	0.8 mm (0.031 in.)

Valve Guides

[1] - Clean the valve guides using a valve guide brush.

[2] - Measure the valve guide inside diameter.

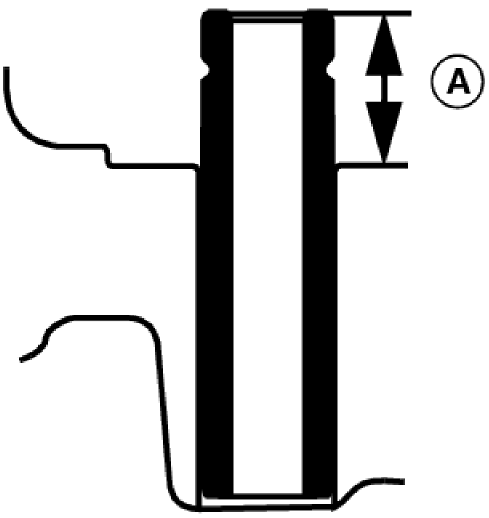
Item	Measurement	Specification
Valve Guide	ID	8.01—8.03 mm (0.315—0.316 in.)
Valve Guide—Wear Limit	ID	8.10 mm (0.319 in.)

[3] - Subtract the valve stem outer diameter from the valve guide inner diameter to obtain the oil clearance.

Item	Measurement	Specification
Intake Valve Stem-To-Guide Oil	Clearance	0.035—0.07 mm (0.001—0.003 in.)
Intake Valve Stem-To-Guide Oil Clearance—Wear Limit	Clearance	0.18 mm (0.007 in.)
Exhaust Valve Stem-To-Guide Oil	Clearance	0.045—0.07 mm (0.002—0.003 in.)
Exhaust Valve Stem-To-Guide Oil Clearance—Wear Limit	Clearance	0.18 mm (0.007 in.)

- If the ID of the valve guide is less than the wear limit, determine the guide-to-stem oil clearance (guide diameter minus stem diameter).
- If the oil clearance exceeds **0.15 mm (0.006 in.)** but is less than **0.18 mm (0.007 in.)** , knurl the valve guides using D-20019WI Valve Guide Knurler

[4] -



Valve Guide

LEGEND:

A	Valve Guide Projection

If clearance exceeds **0.18 mm (0.007 in.)** , replace valve guides using JDE118 Valve Guide Driver.

Valve Guide Driver

JDE118

Used to install valve guides.

- New valve guides must be cooled in a container of liquid nitrogen or equivalent before driving into cylinder head.
- The intake and exhaust valve guides are different. The exhaust valve guide has one groove and the intake valve guide has none.
- Install the valve guides with the tapered ends down. Push the valve guides into the cylinder head until the valve guide projection (A) is within specification.

Item	Measurement	Specification
Valve Guide Projection	Protrusion	15 mm (0.591 in.)

- Ream the inside diameter of valve guides using D-20021WI Valve Guide Reamer.

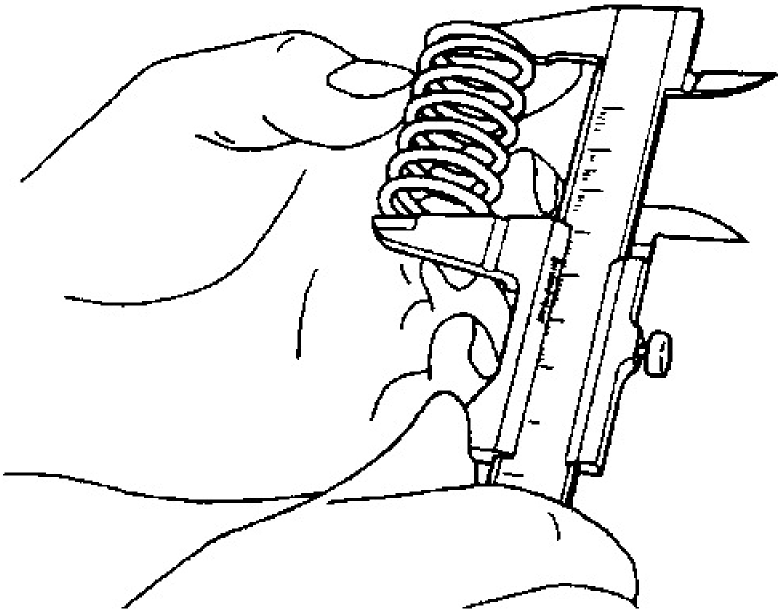
  Valve Guide Reamer

  D-20021WI

  Used to ream the inner diameter of valve guides.

Valve Springs

[1] -

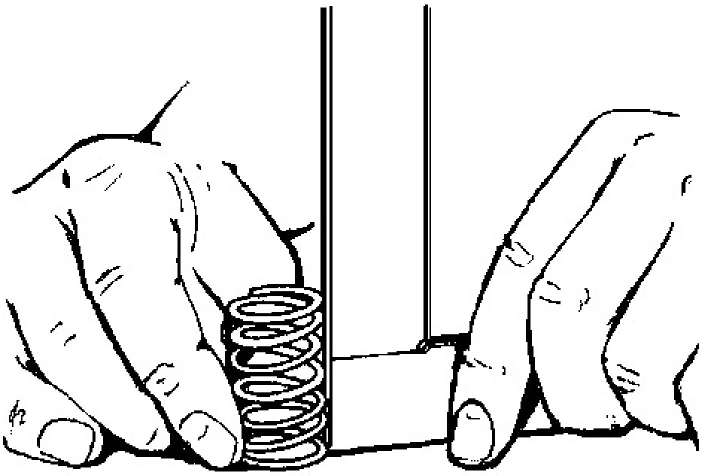


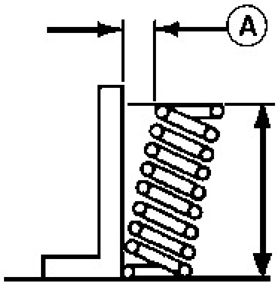
Valve Spring Free Length

Measure the valve spring free length.

Item	Measurement	Specification
Valve Spring Free Length	Length	42 mm (1.654 in.)

[2] -





LEGEND:

A Spring Inclination

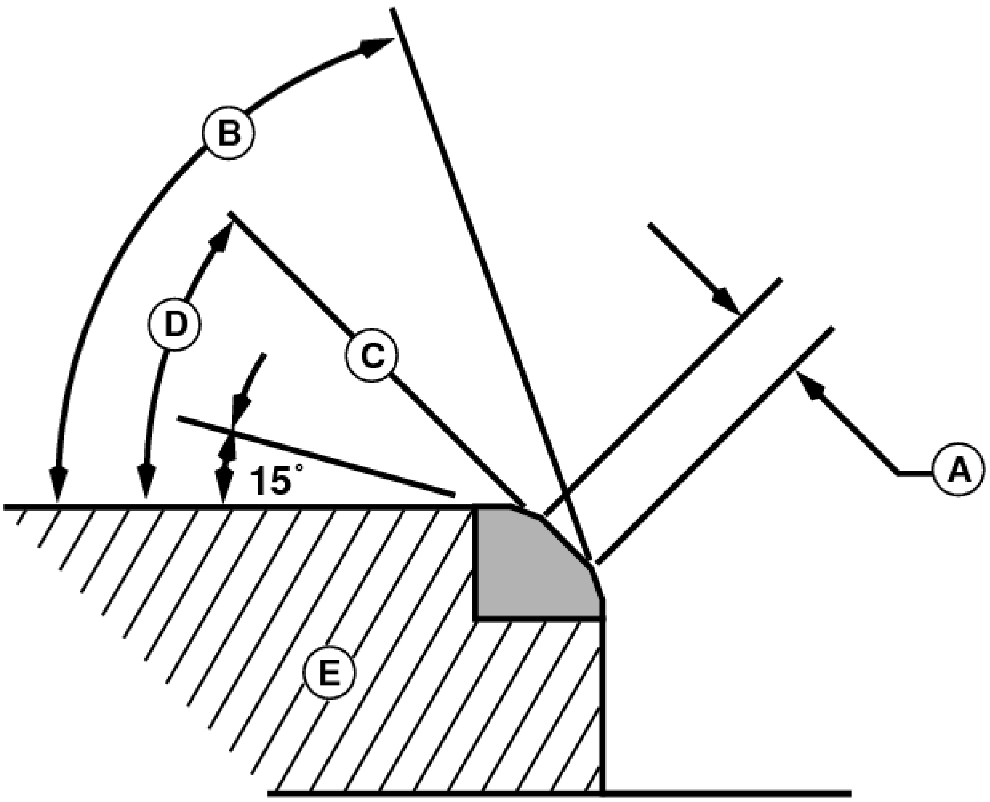
Valve Spring Inclination

Measure the spring inclination (A). Replace the spring if the measurement exceeds **1.40 mm (0.055 in.)** .

Grind Valve Seats

[1] -

→NOTE:



Valve Seat Dimensions

LEGEND:

A	Seat Width
B	Lower Seat Surface
C	Upper Seat Surface
D	Valve Seats

LIGHTLY grind the valve seats for only a few seconds to avoid excessive valve seat width.

Grind the intake valve seat using a 30° seat grinder and the exhaust valve seat using a 45° seat grinder. Follow the tool manufacturers instructions.

[2] - Measure the valve seat width after grinding.

[3] - If the seat width (A) is too wide after grinding, grind the lower seat surface (B) using a 70° seat grinder until the seat width is close to specifications.

[4] - Grind the upper seat surface (C) using a 15° seat grinder until the seat width is narrowed to specifications.

[5] - If the valve seats (D) are ground, measure valve recession. (See Cylinder Head and Valves Disassembly and Assembly in Section 30, Group 30.) Check the contact pattern between the seat and valve with bluing dye.

[6] - Lap the valves. (See Lap Valves in Section 30, Group 30.)

[7] - If the valve recession exceeds the maximum specifications or the seats cannot be reconditioned, replace the valves or the cylinder head.

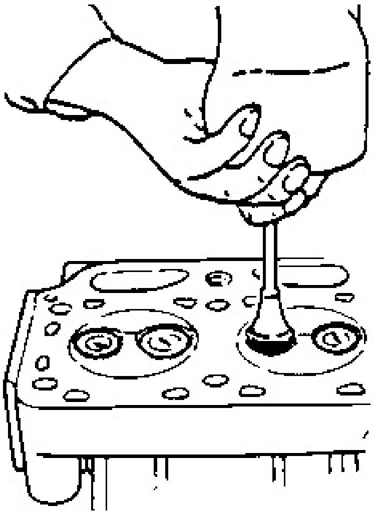
Lap Valves

If the seat does not make proper contact, lap the valve into the seat:

[1] -

→**NOTE:**

Use a rubber type lapping tool for valves without a lapping tool groove slit.



Lap Valve

Apply a small amount of fine lapping compound to the face of the valve.

[2] - Turn the valve to lap the valve to the seat.

[3] - Lift the valve from the seat every 8 to 10 strokes. Lap until a uniform ring appears around the surface of the valve face.

[4] - Wash all parts in solvent to remove lapping compound. Dry all parts.

[5] - Check the position of the lap mark on the valve face. Lap marks must be on or near the center of the valve face.

Measure Piston-To-Cylinder Head Clearance

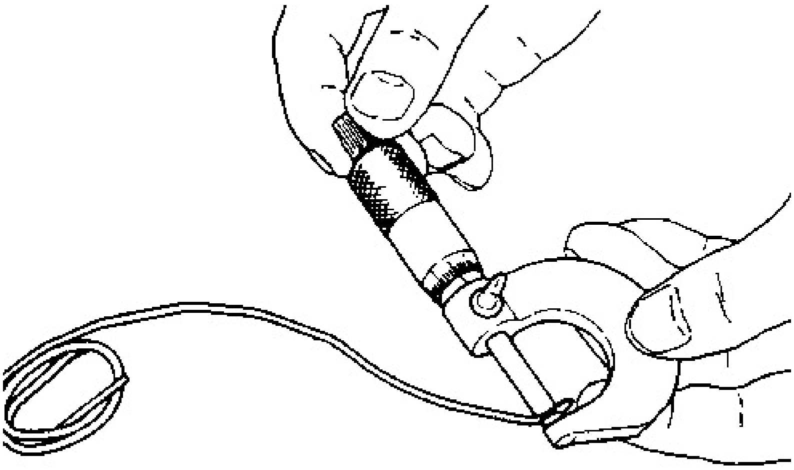
[1] - Place three **10 mm (0.4 in.)** long pieces of **1.5 mm (0.06 in.)** diameter soft wire in three positions on the flat part of the piston head.

[2] - Install the cylinder head and old gasket. Install cylinder head bolts and tighten in proper sequence. (See Cylinder Head and Valves Removal and Installation in Section 30, Group 30.)

[3] - Slowly turn the crankshaft one complete revolution.

[4] - Remove the cylinder head and gasket.

[5] -



Measure Compressed Wire

Measure the thickness of the flattened section of each piece of wire. Calculate the average thickness of the wires to obtain the piston-to-cylinder head clearance specification. If the clearance is less than specification, replace cylinder head. (See Cylinder Head and Valves Removal and Installation in Section 30, Group 30.)

Item	Measurement	Specification
Piston-to-Cylinder Head	Clearance	0.64—0.82 mm (0.025—0.032 in.)

Piston and Connecting Rod

Removal:

[1] -

→NOTE:

The engine must be removed from the machine to perform this procedure.

Remove the oil pan and oil pickup tube.

[2] - Remove the cylinder head. (See Cylinder Head and Valves Removal and Installation in Section 30, Group 30.)

[3] - Check the cylinder bore for ridges. These ridges can cause damage to piston if ridge is not removed.

[4] - If necessary, remove any ridge from the top of the cylinder bore using a ridge reamer.

[5] - Measure the connecting rod side play. (See Connecting Rod Side Play Check in Section 30, Group 25.)

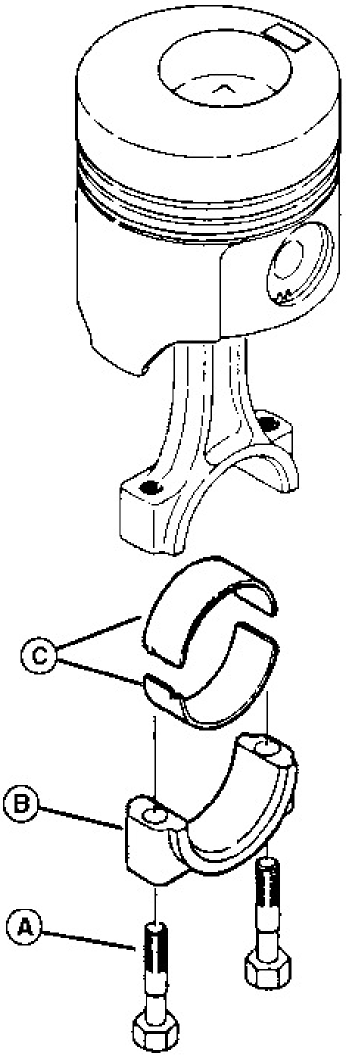
[6] - Measure the crankshaft end play. (See Crankshaft End Play Check in Section 30, Group 25.)

[7] - Measure the connecting rod bearing clearance. (See Connecting Rod Bearing Clearance Check in Section 30, Group 25.)

[8] -

IMPORTANT:

Avoid Damage! Keep the connecting rods and rod caps together. Rods and caps are a matched set. Note the alignment marks on each part.



LEGEND:

A	Rod Bolts
B	Connecting Rod Cap
C	Bearing Inserts

Connecting Rod

Remove the rod bolts (A), connecting rod cap (B), and bearing inserts (C).

[9] -

IMPORTANT:

Avoid Damage! The pistons and cylinders are matched. Pistons must be installed in the cylinders from which they were removed.

Note the connecting rod alignment mark in relation to the cylinders. Starting at the flywheel end with cylinder number one, then two, etc.

[10] - Push the piston and connecting rod out of the cylinder bore using a wooden dowel.

[11] - Disassemble and inspect all parts for wear or damage.

[12] - Inspect the cylinder bore. (See Cylinder Bore in Section 30, Group 30.)

Installation:

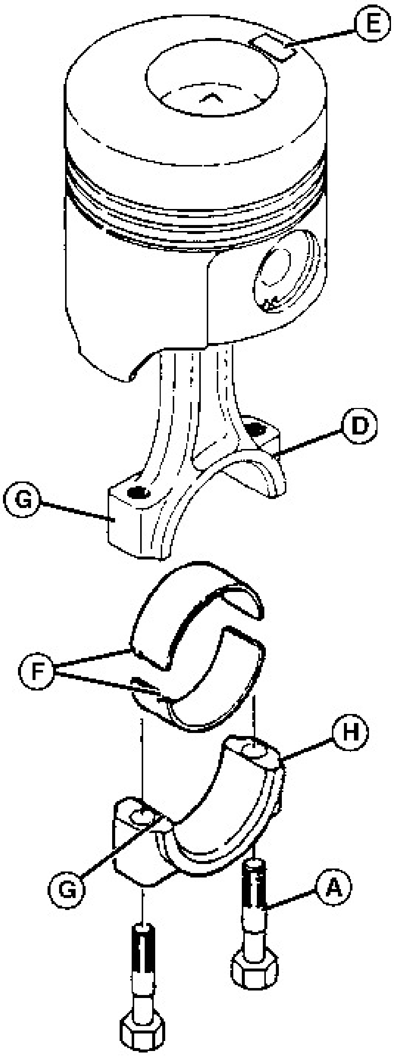
- Apply clean engine oil to all parts during installation.
- Always replace the connecting rod bolts. DO NOT reuse the bolts.

IMPORTANT:

Avoid Damage! Pistons must be installed in the cylinders from which they were removed and in the same direction. Be careful not to damage the crankshaft rod journals while installing pistons.

[1] - Assemble the piston and connecting rod.

[2] -



LEGEND:

D	Connecting Rod
E	Piston Size Mark
F	Tangs
G	Grooves
H	Alignment Marks

Piston and Connecting Rod

Install the piston and connecting rod into the cylinder from which it was removed. The alignment mark on the connecting rod (D) and/or the piston size mark (E) on top of piston should point toward the fuel injection pump.

[3] -

> ***IMPORTANT:***
>
> ***Avoid Damage! Do not touch bearing insert surfaces. Oil and acid from your finger will corrode the bearing surface.***

Install the bearing inserts to the connecting rod and rod cap, aligning tangs (F) with grooves (G).

[4] -

> ***IMPORTANT:***
>
> ***Avoid Damage! Connecting rod caps must be installed on the same connecting rods they were removed from.***

Match the connecting rods to caps using alignment marks (H). Install the rod caps.

[5] - Dip the entire connecting rod bolt in clean engine oil. Install new bolts and tighten to specification.

Item	Measurement	Specification
Connecting Rod Bolt	Torque	44—49 N·m (33—36 lb.-ft.)

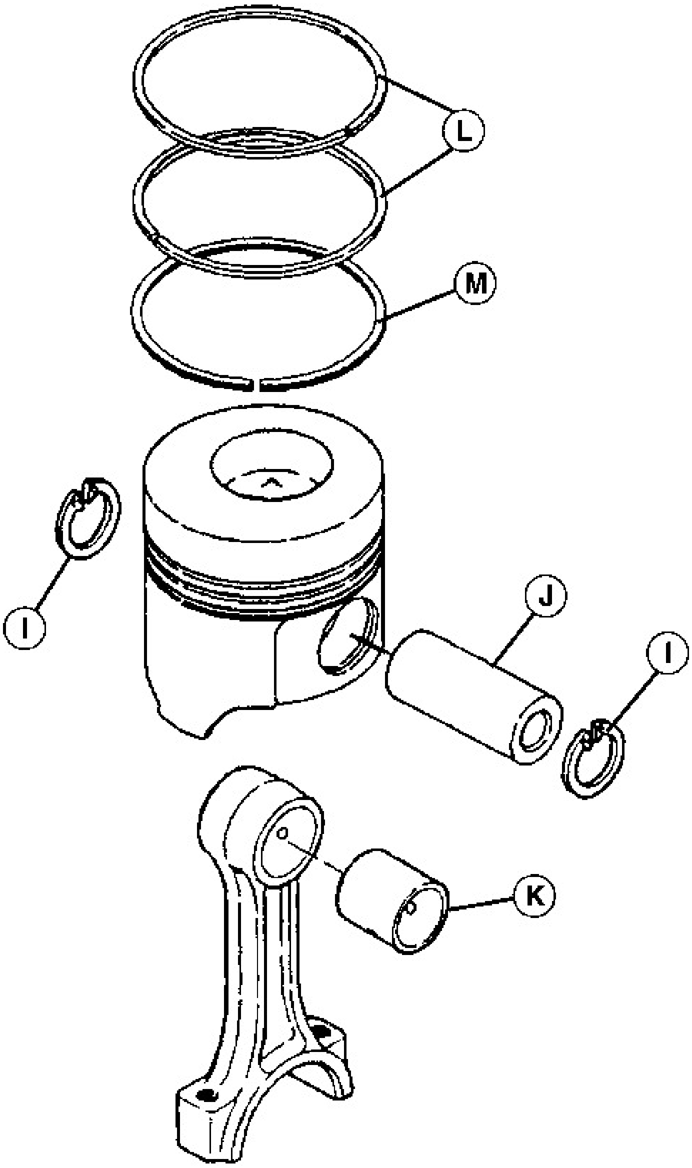
[6] - If a new piston and connecting rod were installed, stamp a number corresponding to the cylinder number on the connecting rod and rod cap.

[7] - Install the cylinder head. (See Cylinder Head and Valves Removal and Installation in Section 30, Group 30.)

[8] - Install the oil pan and oil pickup tube.

Disassembly:

> ***IMPORTANT:***
>
> ***Avoid Damage! Pistons must be installed on the same connecting rod they were removed from.***



LEGEND:

I	Snap Rings
J	Piston Pin
K	Piston Pin Bushing
L	Compression Rings
M	Expander

- ***Piston***

  Put a mark on each piston and connecting rod to aid in assembly.
- Remove snap rings (I) from piston pin (J) and remove pin.
- The piston pin bushing (K) is press fit in the connecting rod. Remove the bushing only if replacement is necessary.
- Inspect all parts for wear or damage. Replace as necessary.
- Remove the first and second compression rings (L) and oil ring with expander (M).

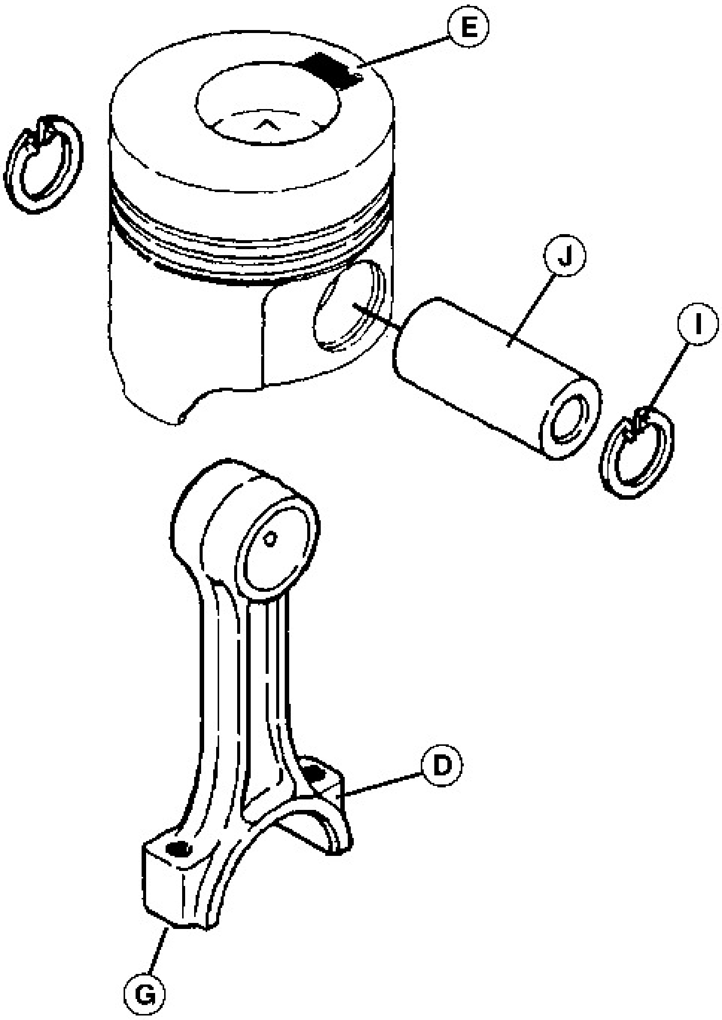
Assembly:

- Apply new engine oil to all parts during assembly.

[1] -

IMPORTANT:

Avoid Damage! The pistons must be installed on the same connecting rod they were removed from.



LEGEND:

D	Connecting Rod Stamped Mark
E	Piston Mark
G	Bearing Insert Groove
I	Snap Rings
J	Piston Pin

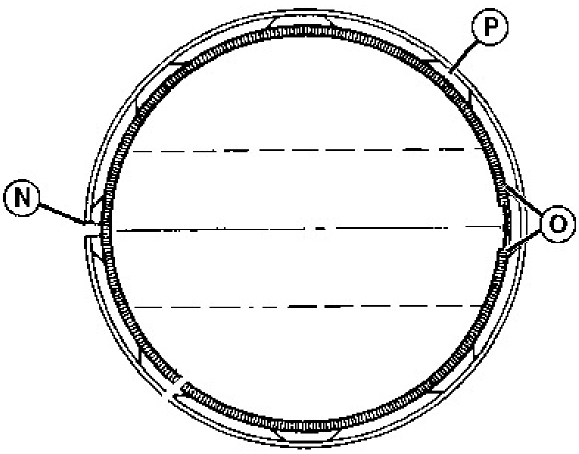
Piston

Assemble the piston to the connecting rod with piston mark (E) on the same side as the connecting rod stamped mark (D). If a new connecting rod is used, assemble the piston to the connecting rod with piston mark opposite the connecting rod bearing insert groove (G). Be sure that the oil hole in the piston pin bushing is aligned with the hole in the connecting rod.

[2] - Install the piston pin (J) and snap rings (I).

[3] - Install an oil ring expander in the bottom ring groove of the piston, with the ends above either end of the piston pin.

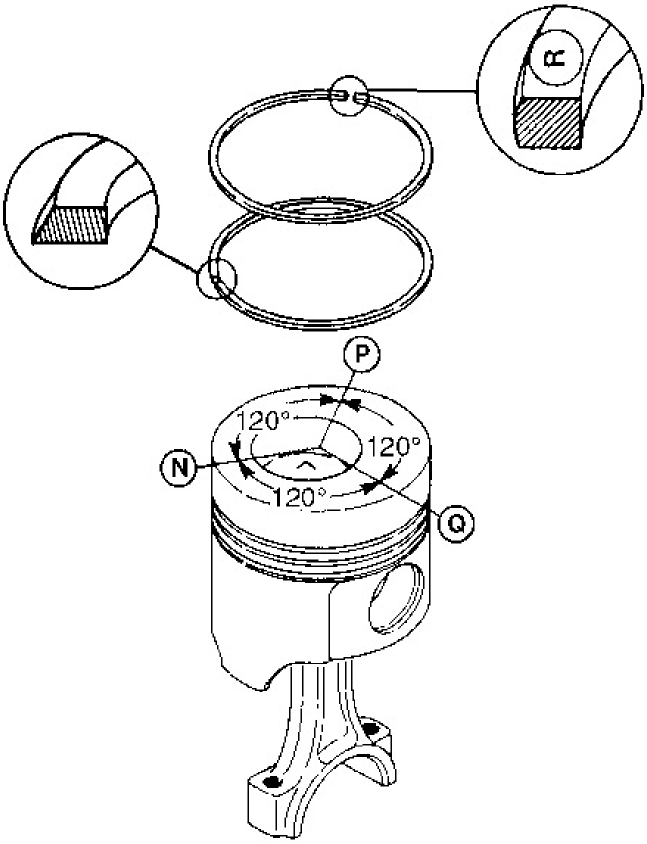
[4] -



LEGEND:

N	Oil Ring Gap
O	Expander Ends
P	Gap
Q	Gap

Oil Ring



Ring Positions

Install the oil ring over the expander with the ring gap (N) opposite (180°) of the expander ends (O).

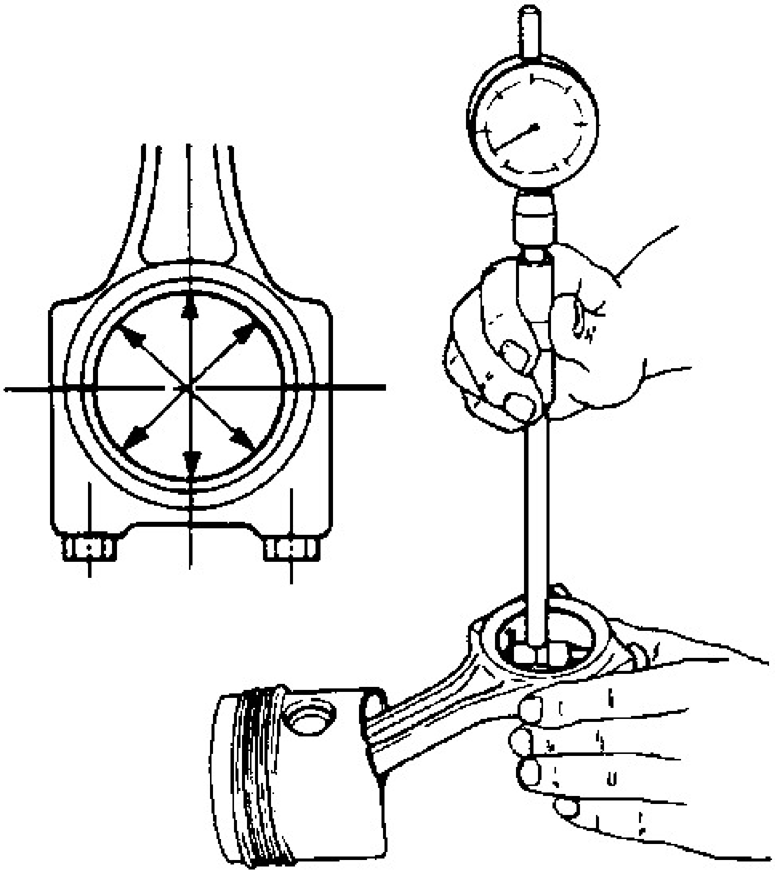
[5] - Install the second compression ring, with the small diameter of taper toward top of piston, in the middle groove. Turn the ring until the gap (P) is 120° away from the oil ring gap (N).

[6] - Install the first compression ring (chrome plated), with the manufacturer′s mark “R,” “T,” or “RN” (near the ring gap) toward the top of the piston, in the top groove. Turn the ring until the gap (Q) is 120° away from the second ring gap.

Piston Inspection

Connecting Rod Bearing:

[1] -



Inspect Piston

Install the connecting rod cap and bearing inserts on the connecting rod. Install the old connecting rod bolts and tighten to specification.

Item	Measurement	Specification
Connecting Rod Bolt	Torque	44—49 N·m
		(33—36 lb.-ft.)

[2] - Measure the connecting rod bearing diameter. Replace the bearing inserts if the bearing diameter is not within specification.

Item	Measurement	Specification
Connecting Rod Bearing	ID	47.952—47.962 mm
		(1.8878—1.8882 in.)

[3] - Measure the oil clearance between the bearing inserts and the crankshaft, and verify that the clearance is within specification. If the bearing oil clearance exceeds the wear limit, grind the crankshaft connecting rod journals and install undersized bearing inserts, or replace the bearing inserts and the crankshaft.

Item	Measurement	Specification
Connecting Rod Bearing Oil	Clearance	0.038—0.074 mm
		(0.001—0.003 in.)
Connecting Rod Bearing Oil Clearance—Wear Limit	Clearance	0.15 mm
		(0.006 in.)

Piston Ring Groove:

[1] -

Piston Ring Groove

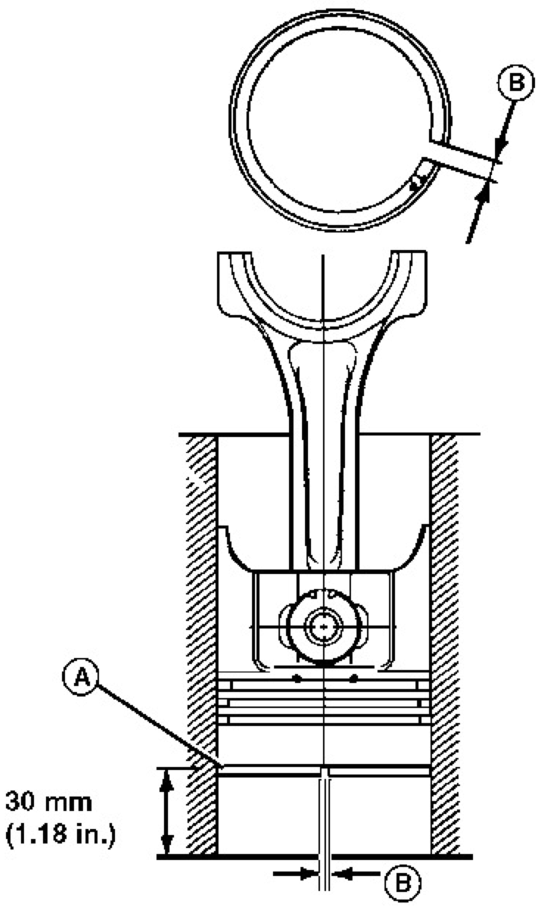
With the rings installed on the piston, measure the piston ring groove side clearance. Measure at several places around each piston.

[2] - Replace the rings or the piston if the clearances exceed specification.

Item	Measurement	Specification
First Compression Ring Groove	Side Clearance	0.08—0.11 mm (0.003—0.004 in.)
Second Compression Ring Groove,—3TNV88	Side Clearance	0.04—0.07 mm (0.001—0.003 in.)
Second Compression Ring Groove,—3TNV84	Side Clearance	0.05—0.08 mm (0.002—0.003 in.)
Oil Control Ring Groove	Side Clearance	0.03—0.06 mm (0.001—0.002 in.)

Piston Ring End Gap:

[1] -



LEGEND:

A	Ring
B	Gap

Piston Ring End Gap

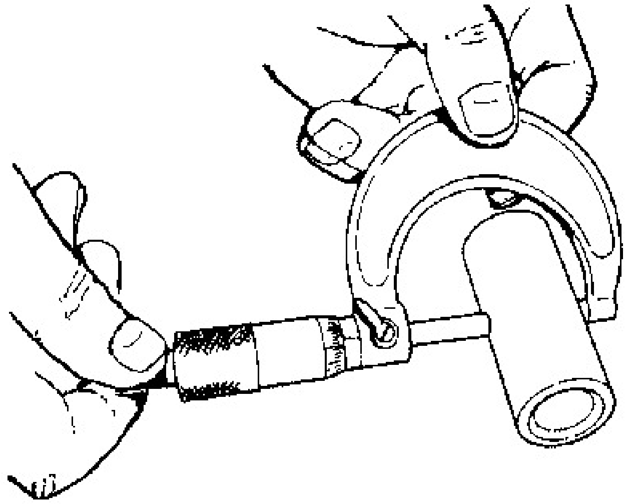
Use a piston to push the ring (A) approximately **30 mm (1.18 in.)** from the bottom of the cylinder bore.

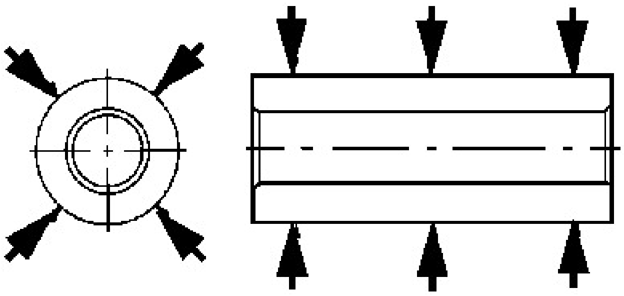
[2] - Measure the piston ring end gap (B).

Item	Measurement	Specification
Piston Ring End Gap	Gap	0.20—0.40 mm (0.008—0.016 in.)
Piston Ring End Gap—Wear Limit	Gap	1.50 mm (0.059 in.)

Piston Pin Diameter:

[1] -





Piston Pin Diameter

Measure the piston pin diameter. Measure the diameter at six places.

[2] - Replace any pin not within specification.

Item	Measurement	Specification
Piston Pin	OD	25.99—26.00 mm (1.023—1.024 in.)
Piston Pin—Wear Limit	OD	25.90 mm (1.020 in.)

Piston Pin Bore:

[1] -

.

Measure the pin bore diameter in the piston.

Item	Measurement	Specification
Piston Pin Bore	Diameter—Inner	26.00—26.01 mm (1.023—1.024 in.)
Piston Pin Bore—Wear Limit	ID	26.04 mm (1.025 in.)

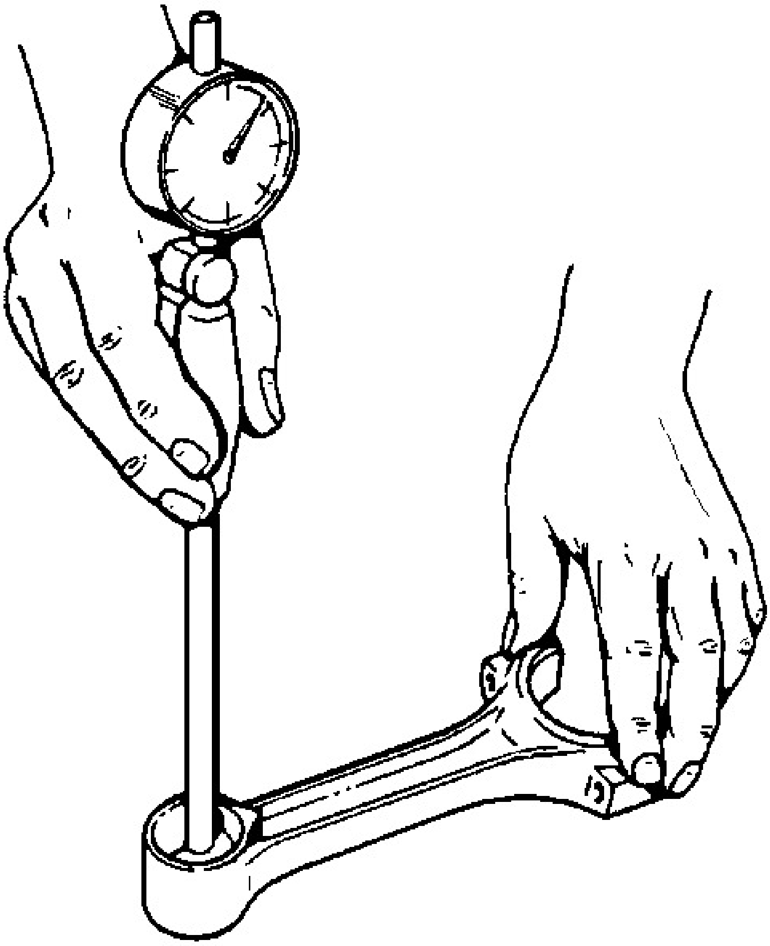
[2] - Piston pin-to-piston oil clearance is the bore inner diameter minus the pin outer diameter.

Item	Measurement	Specification
Piston Pin-to-Piston	Oil Clearance	0.00—0.02 mm (0.00—0.001 in.)
Piston Pin-to-Piston Oil Clearance—Wear Limit	Clearance	0.12 mm (0.005 in.)

- If the piston pin bore exceeds the wear limit, replace the piston.
- If the piston pin is less than the wear limit, replace the piston pin.
- If the bore clearance exceeds the wear limit replace the piston, piston pin or both.

Piston Pin Bushing:

[1] -



Piston Pin Bushing

Measure the piston pin bushing diameter in the connecting rod. If the bushing diameter exceeds the wear limit, replace bushing.

Item	Measurement	Specification
Piston Pin Bushing	ID	26.03—26.04 mm
		(1.025—1.025 in.)
Piston Pin Bushing—Wear Limit	ID	26.10 mm
		(1.028 in.)

[2] -

→NOTE:

The piston pin bushing is a press fit. Replace the bushing using a driver set. When installing the bushing, make sure to align the oil hole in the bushing with the hole in the connecting rod.

Piston pin-to-rod bore oil clearance is the bore inner diameter minus the pin outer diameter. If the bushing clearance (bushing inner diameter minus pin outer diameter) exceeds specification replace the bushing or the piston pin.

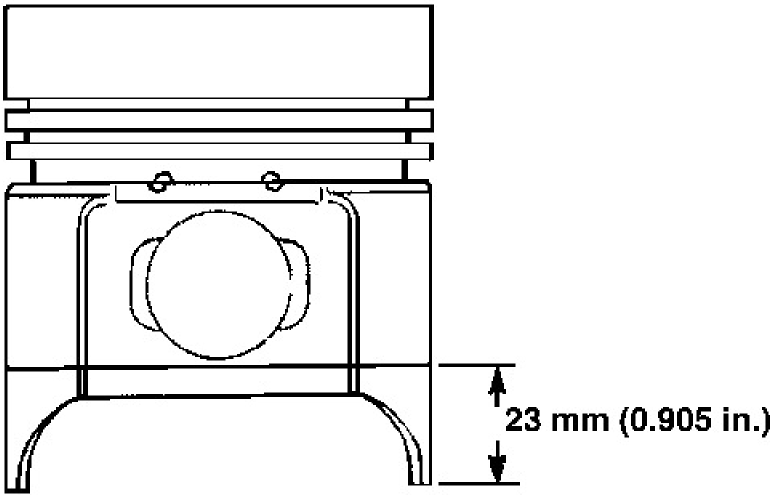
Item	Measurement	Specification
Piston Pin-to-Rod Bore	Oil Clearance	0.03—0.05 mm
		(0.001—0.002 in.)
Piston Pin-to-Rod Bore Oil Clearance—Wear Limit	Clearance	0.20 mm
		(0.008 in.)

Piston Diameter:

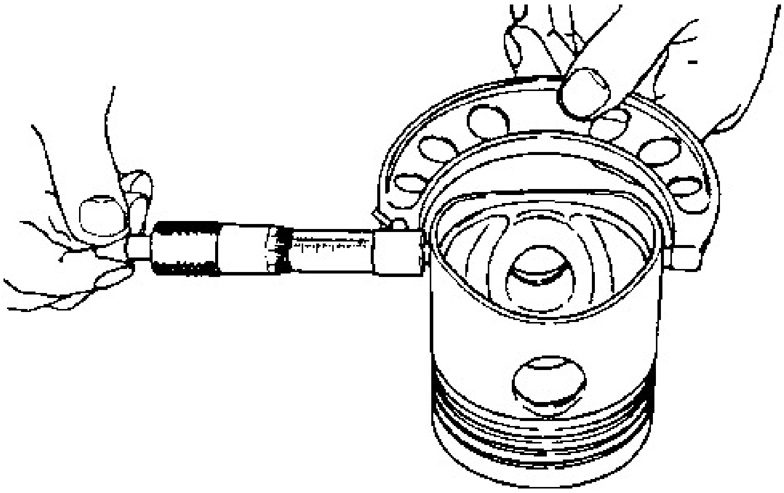
[1] -

→NOTE:

If the engine has had a previous overhaul, oversize pistons and rings may have been installed. Pistons and rings are available in 0.25 mm (0.010 in.) oversize.



Piston Diameter



Piston Diameter

Measure the piston diameter perpendicular to the piston pin bore **23 mm (0.905 in.)** from the bottom of the piston skirt.

[2] - If the piston diameter is less than the wear limit, install a new piston.

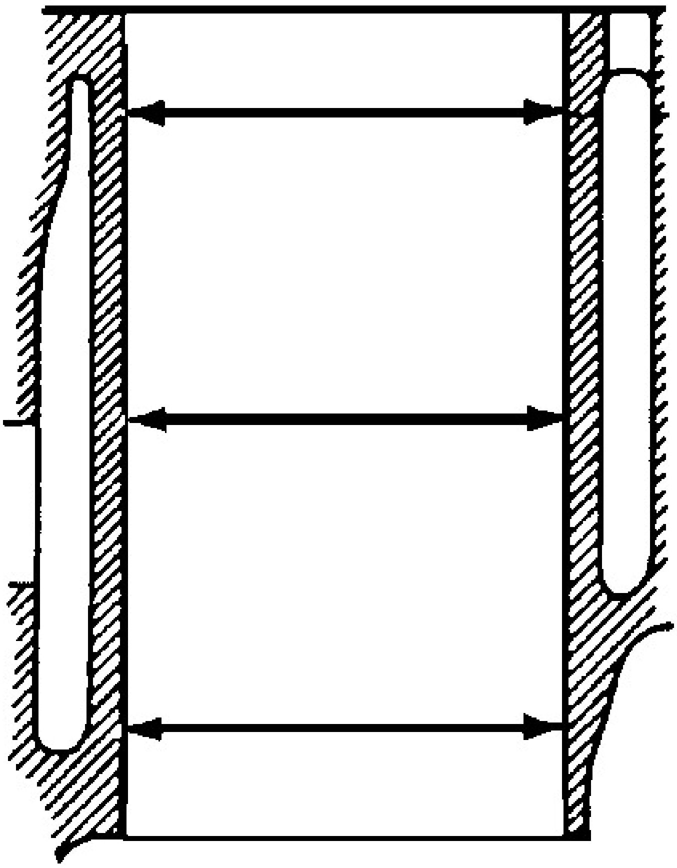
Item	Measurement	Specification
Standard Piston—3TNV84	OD	83.95—83.98 mm (3.305—3.306 in.)
Standard Piston Wear Limit—3TNV84	OD	83.90 mm (3.303 in.)
Standard Piston—3TNV88	OD	87.95—87.98 mm (3.462—3.464 in.)
Standard Piston Wear Limit—3TNV88	OD	87.90 mm (3.461 in.)
Standard Piston, Oversize—3TNV84	OD	84.20—84.23 mm (3.315—3.316 in.)
Standard Piston, Oversize Wear Limit—3TNV84	OD	84.10 mm (3.311 in.)
Standard Piston, Oversize—3TNV88	OD	88.20—88.23 mm (3.472—3.474 in.)
Standard Piston, Oversize Wear Limit—3TNV88	OD	88.10 mm (3.469 in.)

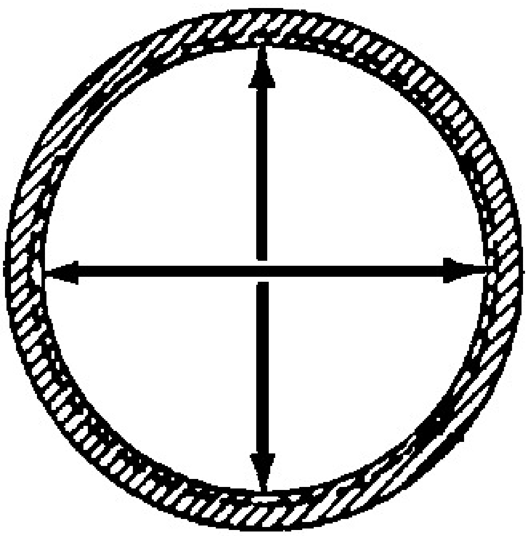
Cylinder Bore

[1] -

→NOTE:

If the engine has had a previous overhaul, the cylinders may have been bored oversize. Pistons and rings are available in 0.25 mm (0.010 in.) oversize.





Cylinder Bore

Measure the cylinder bore diameter at the top, middle, and bottom. At these three positions, measure in both directions; along the crankshaft center line and the direction of the crankshaft rotation.

Item	Measurement	Specification
Cylinder Bore—3TNV84	ID	84.00—84.03 mm

Item	Measurement	Specification
		(3.307—3.308 in.)
Cylinder Bore Wear Limit—3TNV84	ID	84.20 mm
		(3.315 in.)
Cylinder Bore—3TNV88	ID	88.00—88.03 mm
		(3.465—3.466 in.)
Cylinder Bore Wear Limit—3TNV88	ID	88.20 mm
		(3.472 in.)
Oversize Bore—3TNV84	ID	84.25—84.28 mm
		(3.317—3.318 in.)
Oversize Bore—3TNV88	ID	88.25—88.28 mm
		(3.474—3.476 in.)
Piston-to-Cylinder Clearance		0.040—0.070 mm
		(0.0016—0.0027 in.)
Cylinder Roundness	Out-of-Round	0.01—0.03 mm
		(0—0.001 in.)
Cylinder Roundness—Wear Limit	Out-of-Round	0.03 mm
		(0.001 in.)
Cylinder Angle	Taper	0.00—0.01 mm
		(0—0.0004 in.)
Cylinder Taper—Wear Limit	Angle	0.03 mm
		(0.001 in.)

[2] - Perform the following based on measurement results:

- If the cylinder bore standard ID exceeds the wear limit, have the cylinder rebored.
- If the cylinder is rebored, oversize pistons and rings must be installed.
- If the cylinder bore exceeds the oversize bore ID, replace the cylinder block.
- If the piston-to-cylinder bore clearance (cylinder bore ID minus piston OD) exceeds specification, replace the cylinder block, piston or both; or rebore cylinder and install oversize piston and rings.
- Slight uneven wear, flaws, or minor damage may be corrected by deglazing. See “Deglazing” below.

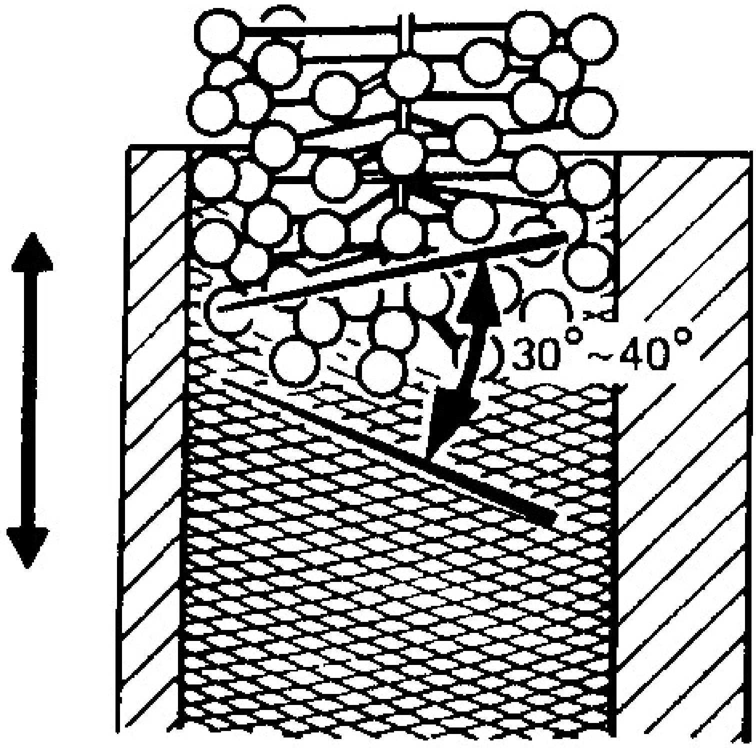
Deglazing:

[1] -

> ***IMPORTANT:***
>
> ***Avoid Damage! If the cylinder bores are to be deglazed with crankshaft installed in engine, put clean shop towels over crankshaft to protect journal and bearing surfaces from any abrasives.***

Deglaze the cylinder bores using a flex-hone with 180 grit stones.

[2] -



Deglazing

Use the flex-hone as instructed by the manufacturer to obtain a **30—40° crosshatch pattern** as shown.

Item	Measurement	Specification
Cylinder—Deglazing	Surface Finish	30—40° crosshatch pattern

[3] -

IMPORTANT:

Avoid Damage! Do not use gasoline, kerosene, or commercial solvents to clean cylinder bores. Solvents will not remove all abrasives from cylinder walls.

Remove excess abrasive residue from the cylinder walls using a clean dry rag. Clean the cylinder walls using clean white rags and warm soapy water. Continue to clean the cylinder until white rags show no discoloration.

Reboring:

[1] -

→NOTE:

The cylinder block can be rebored to use oversize pistons and rings. Pistons and rings are available in 0.25 mm (0.010 in.) oversize.

Align the center of bore to the drill press center.

[2] -

IMPORTANT:

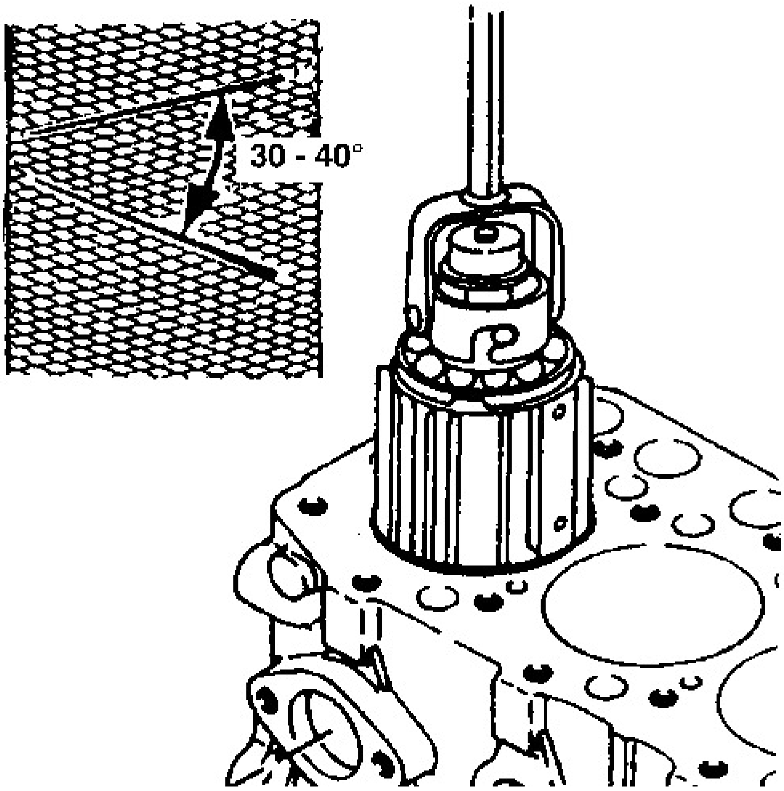
Avoid Damage! Check stone for wear or damage. Use a rigid hone with 300 grit stones.

Adjust the hone so the lower end is even with the lower end of cylinder bore.

[3] - Adjust the rigid hone stones until they contact the narrowest point of the cylinder.

[4] - Coat the cylinder with honing oil. The hone should turn by hand. Adjust the hone if it is too tight.

[5] -



Reboring

Run the drill press at about 250 rpm. Move the hone up and down in order to obtain a **30—40° crosshatch pattern** .

Item	Measurement	Specification
Cylinder—Deboring	Surface Finish	30—40° crosshatch pattern

[6] -

→NOTE:

Measure the bore when the cylinder is cool.

Stop the press and check the cylinder diameter.

[7] -

→NOTE:

Finish should not be smooth. It should have a 30—40° crosshatch pattern.

Remove the rigid hone when the cylinder is within **0.03 mm (0.001 in.)** of desired size.

[8] - Use a flex hone with 180 grit stones for honing to final size.

[9] - Check the bore for size, taper and out-of-round. See inspection procedures.

[10] -

IMPORTANT:

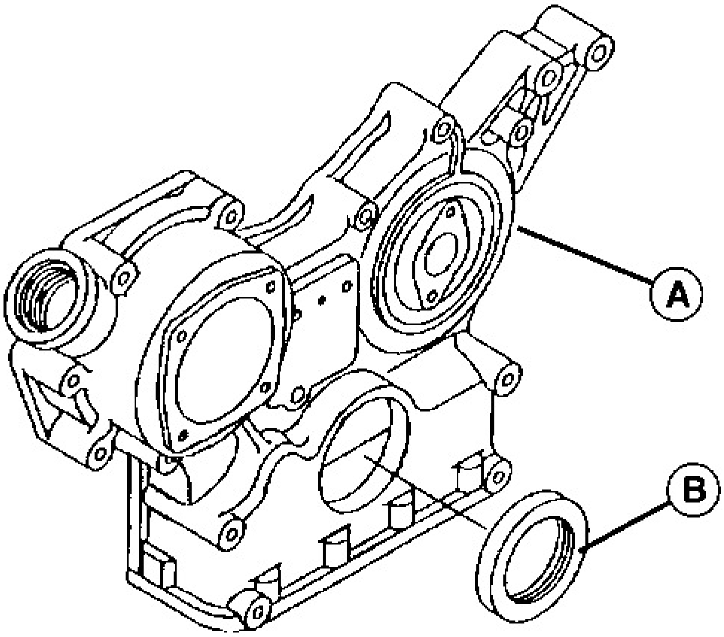
Avoid Damage! Do not use solvents to clean the cylinder bores. Solvents will not remove all the metal particles and abrasives produced during honing.

Clean the cylinder thoroughly using warm soapy water until clean white rags show no discoloration.

[11] - Dry the cylinder and apply engine oil.

Crankshaft Front Oil Seal

[1] -



LEGEND:

A	Timing Gear Cover
B	Oil Seal

Timing Gear Cover

Remove the timing gear cover (A). (See Timing Gear Cover in Section 30, Group 30.)

[2] - Replace the oil seal (B). Install new seal with the lip toward inside of gear housing cover, flush with the surface of the cover.

Crankshaft Rear Oil Seal

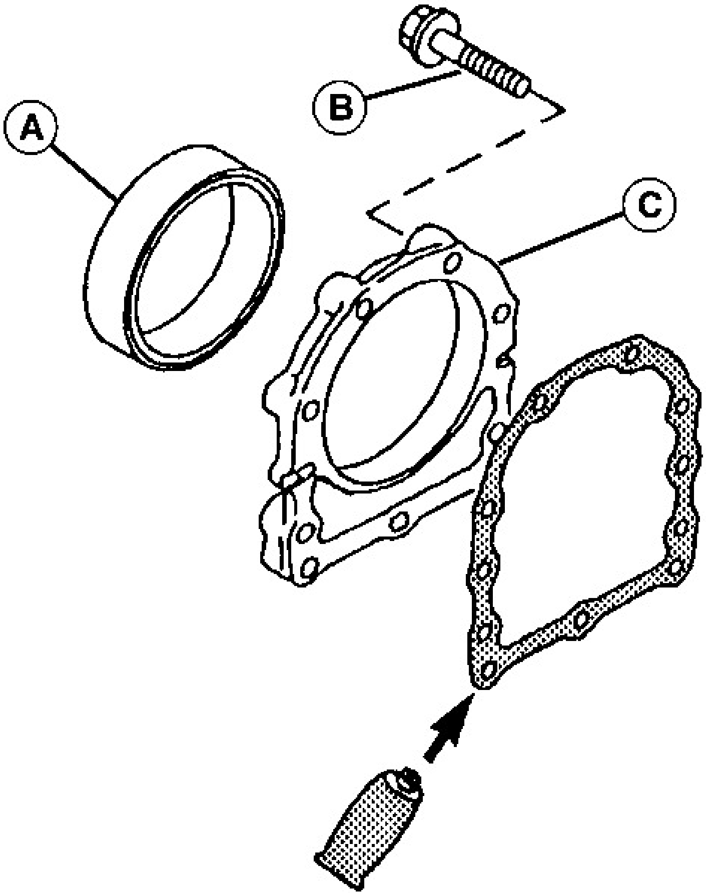
Replacement:

[1] - Split the machine between the flywheel housing and the tunnel. See “Machine Splitting—Front” in the appropriate power train section.

[2] - Remove the drive coupling.

[3] - Remove flywheel. (See Flywheel and Coupling in Section 30, Group 30.)

[4] -



LEGEND:

A	Rear Oil Seal
B	Cap Screws
C	Rear Oil Seal Case

Rear Oil Seal

Remove the rear oil seal (A), case-to-crankcase extension cap screws and the oil seal case-to- crankcase cap screws (B).

[5] - Remove the rear oil seal case (C).

[6] - Replace the oil seal using an appropriate seal driver, with the lip toward the cylinder block, flush with the surface of the oil seal case.

[7] -

→NOTE:

If the crankshaft is grooved at the oil seal contact point, the seal can be installed 3 mm (0.12 in.) farther into the oil seal case.

Install the oil seal case to the crankcase and crankcase extension.

Crankshaft and Main Bearings

Removing:

[1] - Check the crankshaft end play. (See Crankshaft End Play Check in Section 30, Group 25.)

[2] - Remove the cylinder head. (See Cylinder Head and Valves Removal and Installation in Section 30, Group 30.)

[3] - Remove the rear oil seal. (See Crankshaft Rear Oil Seal in Section 30, Group 30.)

[4] - Remove the timing gear cover mounting plate. (See Timing Gear Cover in Section 30, Group 30.)

[5] - Check the crankshaft rod bearing clearance. (See Connecting Rod Bearing Clearance Check in Section 30, Group 25.)

[6] -

IMPORTANT:

Avoid Damage! Connecting rod caps must be installed on the same connecting rods from which they were removed. Note the alignment marks on the caps and rods.

Check the crankshaft main bearing clearance. (See Crankshaft Main Bearing Clearance Check in Section 30, Group 25.)

[7] -

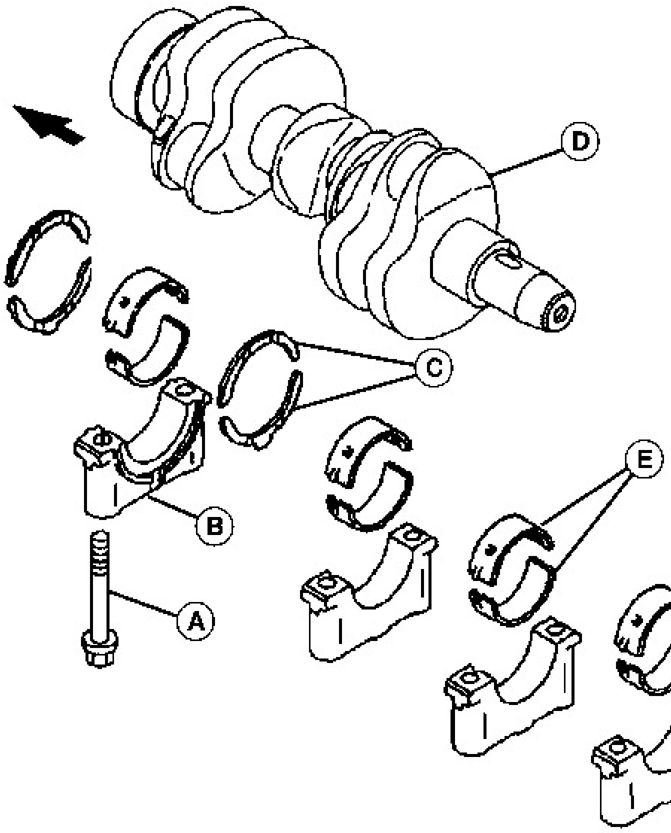
IMPORTANT:

Avoid Damage! Main bearing caps must be installed on the same main bearings from which they were removed.

Remove the connecting rod bolts and rod caps. Discard the connecting rod bolts.

[8] - Push the pistons and connecting rods away from crankshaft.

[9] -



LEGEND:

A	Main Bearing Bolts
B	Caps
C	Cap Thrust Bearings
D	Crankshaft
E	Main Bearing Inserts

Crankshaft

Remove the main bearing bolts (A), caps (B) and cap thrust bearings (C).

[10] - Remove the crankshaft (D).

[11] - Remove the block thrust bearings and main bearing inserts (E).

[12] - Inspect all parts for wear or damage.

Installing:

[1] -

> **→NOTE:**
>
> **Apply clean engine oil to all parts during installation.**

> ***IMPORTANT:***
>
> ***Avoid Damage! Do not touch bearing insert surfaces. Oil and acid from your finger will corrode the bearing surface.***

Install the grooved bearing inserts in the crankshaft bearing bores, aligning the tangs with the slots in the bores.

[2] - Install the block thrust bearings with the oil grooves facing away from the engine block.

[3] - Install the crankshaft.

[4] - Install the bearing inserts in the main bearing caps, aligning the tangs with the slots in the caps.

[5] -

> **→NOTE:**
>
> **The main bearing caps have “raised arrows” that are stamped with numbers. Both correspond to their location on the engine block. Install all bearing caps with the “arrow” toward the flywheel end of the engine. Install the bearing caps beginning with the thrust bearing cap (no number), number 1, then 2, etc. The main bearing cap at the gear train end does not have a number.**

Install the thrust bearings, with the oil grooves facing away from the cap, in the number “1” main bearing cap.

[6] - Install the main bearing caps in their original locations with arrows pointing toward the flywheel side of the engine.

[7] -

> ***IMPORTANT:***
>
> ***Avoid Damage! DO NOT use power tools or air wrenches to tighten main bearing bolts.***

Dip each main bearing bolt entirely in clean engine oil. Install the bolts and tighten. DO NOT tighten to specifications.

[8] - Using a soft-faced hammer, tap the front end of the crankshaft then the rear end of the crankshaft to align the thrust bearings.

[9] - Tighten the main bearing bolts to specification. When tightening, start at the center main bearing cap and work your way out, alternating to the ends. Turn the crankshaft by hand. If it does not turn easily, disassemble the parts and find the cause.

Item	Measurement	Specification
Main Bearing Bolt	Torque	93—98 N·m (69—72 lb.-ft.)

[1] -

> ***IMPORTANT:***
>
> ***Avoid Damage! The connecting rod caps must be installed on the same connecting rods they were removed from. Never reuse connecting rod bolts, replace with new.***

Match the connecting rod caps to the rods using alignment marks. Install the caps to the rods.

[2] - Dip entire connecting rod bolt in new engine oil. Install new bolts to the rods, and tighten to specification.

Item	Measurement	Specification
Connecting Rod Bolt	Torque	44—49 N·m (33—36 lb.-ft.)

[1] - Install the timing gear cover mounting plate. (See Timing Gear Cover Mounting Plate in Section 30, Group 30.)

[2] - Install the rear oil seal. (See Crankshaft Rear Oil Seal in Section 30, Group 30.)

[3] - Install the flywheel. (See Flywheel and Coupling in Section 30, Group 30.)

[4] - Install the timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[5] - Install the front oil seal. (See Crankshaft Front Oil Seal in Section 30, Group 30.)

[6] - Install the oil pan.

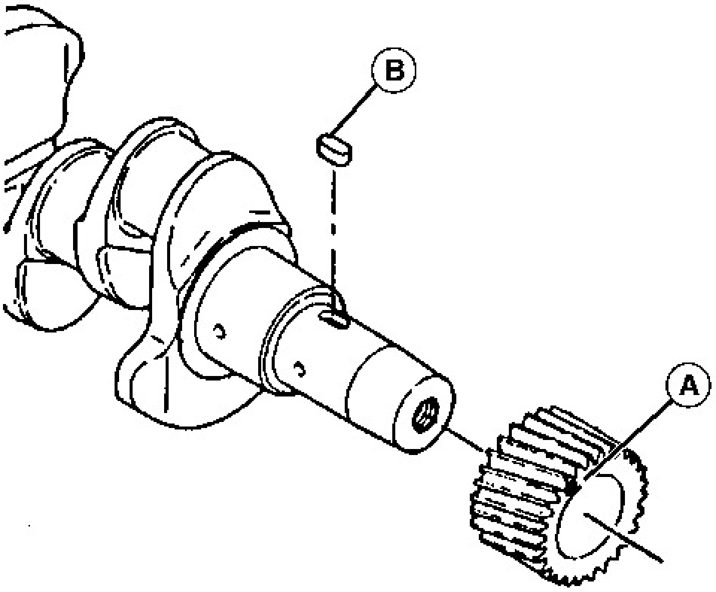
Inspection/Replacement:

- Inspect the crankshaft gear for chipped or broken teeth. Replace if necessary.

To Replace Gear:

[1] - Remove the gear from crankshaft using a knife-edge puller and a press.

[2] -



LEGEND:

A	Timing Mark
B	Key

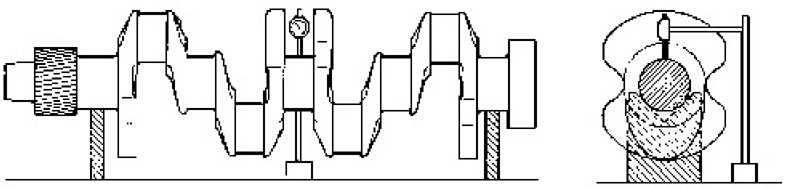
Crankshaft

Heat new gear to approximately 150 °C (302 °F). Install gear with timing mark (A) toward press table. Align slot in gear with key (B) in shaft. Press crankshaft into gear until gear is tight against crankshaft shoulder.

[3] -

CAUTION:

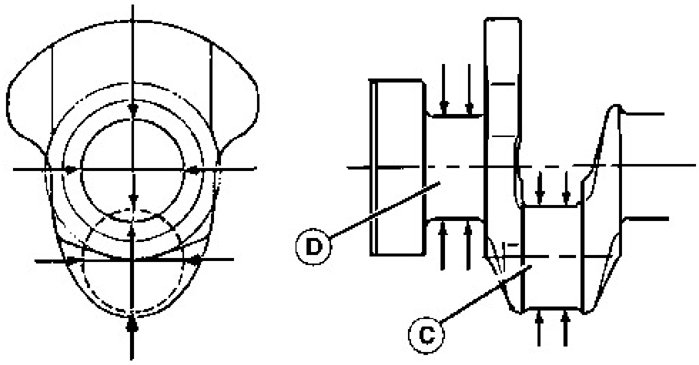
Avoid Injury! DO NOT heat oil over 182 °C (360 °F). Oil fumes or oil can ignite above 193 °C (380 °F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.



Crankshaft

Inspect the crankshaft for bend using V-blocks and a dial indicator. Turn the crankshaft slowly and read variations on the indicator. If the variation is greater than **0.02 mm (0.001 in.)** , replace the crankshaft.

[4] - Measure the crankshaft connecting rod journal and main bearing journal diameters at several places around each journal.



LEGEND:

C Connecting Rod Journal Diameter

D Main Bearing Journal Diameter

- ***Journals***

  If the journal diameter (C) is less than the specification, but greater than the wear limit, have the journals ground undersize by a qualified machine shop.

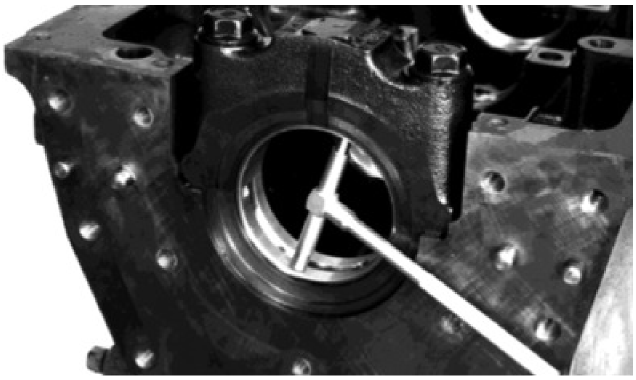
Item	Measurement	Specification
Connecting Rod Journal	OD	47.95—47.96 mm
		(1.888—1.888 in.)
Connecting Rod Journal—Wear Limit	OD	47.91 mm
		(1.886 in.)
Main Bearing Journal	OD	53.95—53.96 mm
		(2.124—2.124 in.)
Main Bearing Journal—Wear Limit	OD	53.91 mm
		(2.122 in.)

- If journals are ground, undersize bearing inserts must be installed. Bearing inserts are available in **0.25 mm (0.010 in.)** undersize.
- If the journal diameter is less than the wear limit, replace the crankshaft.

[5] - Install the bearing inserts and main bearing caps on the main bearings. Tighten the main bearing bolts to specification.

Item	Measurement	Specification
Main Bearing Bolt	Torque	93—98 N·m
		(69—72 lb.-ft.)

[6] -



Main Bearing Inner Diameter

Measure the main bearing inner diameter. Subtract the main bearing journal outer diameter of the crankshaft from the main bearing inner diameter to obtain the main bearing oil clearance.

Item	Measurement	Specification
Main Bearing	Oil Clearance	0.04—0.07 mm
		(0.002—0.003 in.)
Main Bearing Oil Clearance—Wear Limit	Clearance	0.15 mm

Item	Measurement	Specification
		(0.006 in.)

[7] - Perform the following based on measurement results:

- If the crankshaft is within specification, but the main bearing oil clearance exceeds the wear limit, replace the bearing inserts.
- If the crankshaft is not within specification, have crankshaft journals ground undersize by a qualified machine shop and install undersized bearing inserts.
- If the crankshaft is worn past the wear limit, replace the crankshaft.

[8] - Clean and inspect the oil passages in the main bearing journals, connecting rod journals, and main bearing bores in cylinder block.

[9] - Inspect the crankshaft for cracks or damage. Replace if necessary.

Flywheel and Coupling

Removal/Installation:

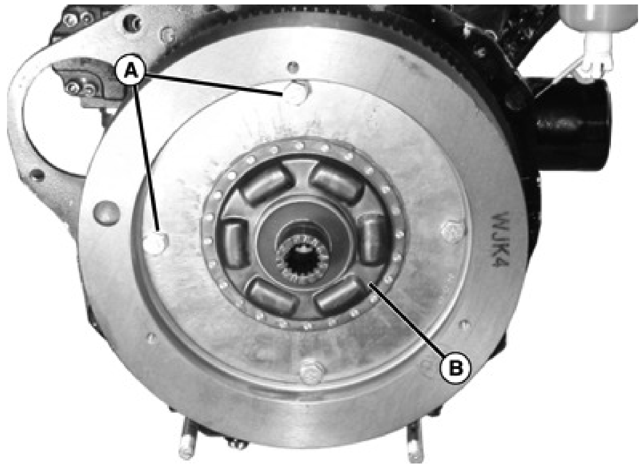
[1] -

IMPORTANT:

Avoid Damage! Always install new flywheel mounting bolts.

Split the machine between the flywheel housing and the tunnel. See “Machine Splitting—Front” in the appropriate power train section.

[2] -



LEGEND:

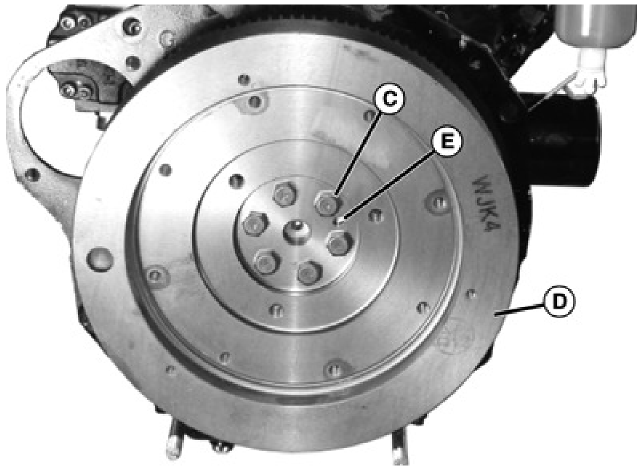
A	Cap Screw (4 used)
B	Coupling

Flywheel

Mark coupling (B) as to which side faces flywheel for proper reassembly.

[3] - Remove four coupling cap screws (A) and remove coupling (B) from the flywheel.

[4] -



LEGEND:

C	Cap Screws
D	Flywheel
E	Dowel Pin

Flywheel

Remove the flywheel mounting cap screws (C) and remove the flywheel (D) from crankshaft.

[5] - Dowel pin (E) in the crankshaft correctly locates the flywheel on the crankshaft.

[6] - Install the flywheel. Apply lubrication oil to the flywheel bolts. Tighten to specification.

Item	Measurement	Specification
Coupling Cap Screws	Torque	83—88 N·m
		(62—65 lb.-ft.)
Flywheel Cap Screws	Torque	83—88 N·m
		(62—65 lb.-ft.)

[7] - Installation of the flexplate or coupling, is the reverse of removal.

Camshaft

Removing:

[1] - Remove the rocker arm assembly and push rods. (See Rocker Arm Assembly in Section 30, Group 30.)

[2] - Remove the timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[3] - Check the camshaft end play. (See Camshaft End Play Check in Section 30, Group 25.)

[4] - Check the backlash of the timing gears. (See Timing Gear Backlash Check in Section 30, Group 25.)

[5] -

→NOTE:

If a magnetic follower holder kit is not available, turn engine until oil pan is upward, to hold cam followers away from camshaft.

Hold the cam followers away from the camshaft using a magnetic follower holder kit such as D15001NU.

Magnetic Follower Holder Kit

D15001NU.

Used to remove and install camshaft.

[6] - Rotate the crankshaft and align the timing marks.

[7] -

IMPORTANT:

Avoid Damage! DO NOT allow the camshaft lobes to hit any bearing surfaces while removing the camshaft. Machined surfaces can be damaged.

Remove two thrust plate mounting cap screws, the thrust plate, and the camshaft.

[8] - Inspect all parts for wear or damage.

Installing:

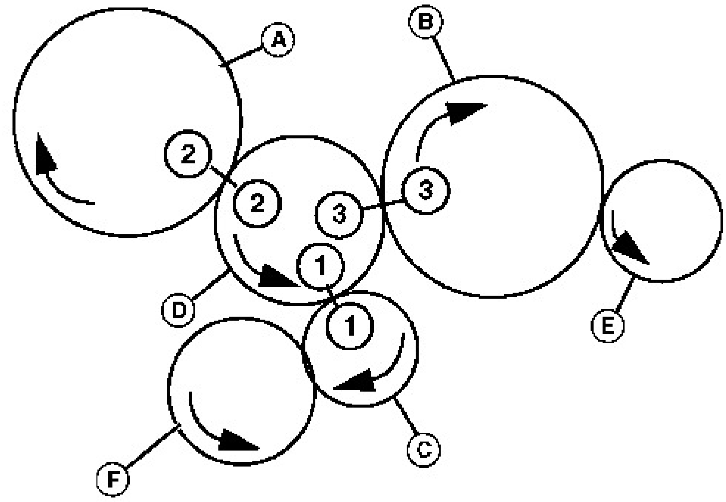
[1] -

IMPORTANT:

Avoid Damage! DO NOT allow camshaft lobes to hit bearing surfaces while installing camshaft. Machined surfaces and bearings can be damaged.

→NOTE:

Apply clean engine oil on all parts during installation.



LEGEND:

A	Fuel Injection Drive Gear
B	Camshaft Gear
C	Crankshaft Gear
D	Idler Gear
E	Hydraulic Pump Gear

Viewed From Gear Case

Rotate the crankshaft to align the timing marks (1, 2 and 3).

[2] -

→NOTE:

The fuel injection drive gear (A), the camshaft gear (B) and the crankshaft gear (C) all must be correctly timed to the idler gear (D). It is not necessary to time the hydraulic pump gear (E) or oil pump gear (F—3TNV8x-BJT, -BMJT, -BXJT engines). Due to the odd number of teeth on the idler gear, timing marks will only align periodically.

Install the camshaft.

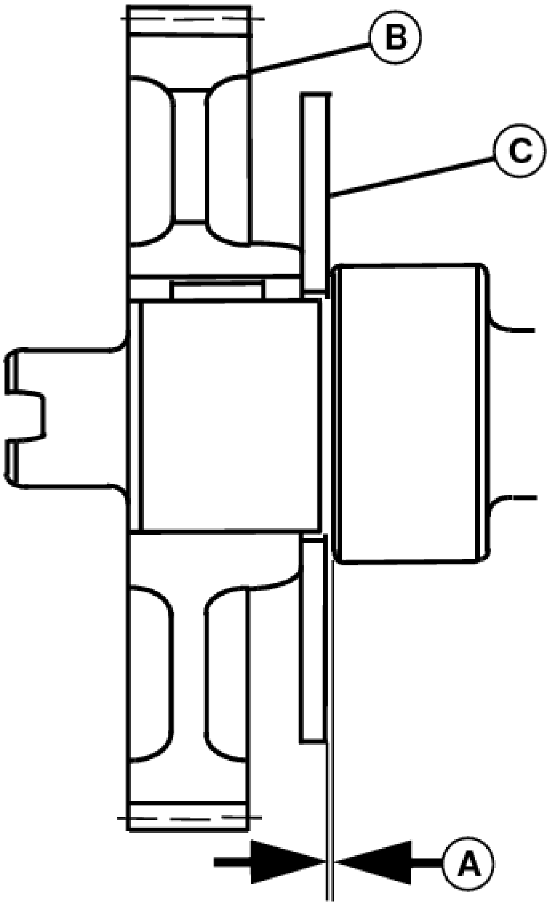
[3] - Install the thrust plate and cap screws.

[4] - Install the timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[5] - Install the push rods and rocker arm assembly.

Inspection/Replacement:

[1] -



Camshaft Side Gap

LEGEND:

A	Side Gap
B	Camshaft Gear
C	Thrust Plate

Check the camshaft side gap using a feeler gauge. If the side gap (A) exceeds **0.05—0.25 mm** , remove the camshaft gear (B) and replace thrust plate (C).

Item	Measurement	Specification
Camshaft	Side Gap	0.05—0.25 mm
		(0.002—0.010 in.)

[2] - Remove the gear (if necessary) from camshaft using a knife-edge puller and a press. Inspect the gear for chipped or broken teeth. Replace the gear if necessary.

Gear Removal/Installation:

[1] -

CAUTION:

Avoid Injury! DO NOT heat oil over 182 °C (360 °F). Oil fumes or oil can ignite above 193 °C (380 °F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

Heat the gear in oil to approximately **150 °C (300 °F)** .

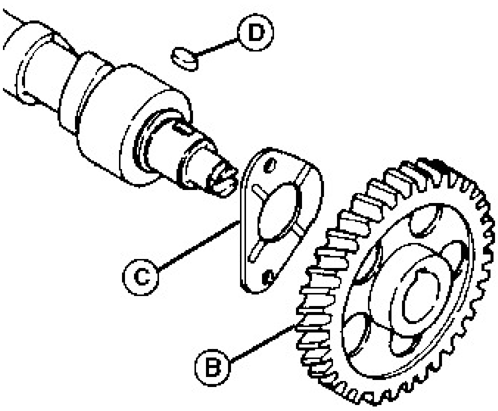
[2] -

IMPORTANT:

Avoid Damage! Be sure that thrust plate is not between camshaft gear and camshaft shoulder while installing gear.

→NOTE:

Thrust plate must spin freely on camshaft.



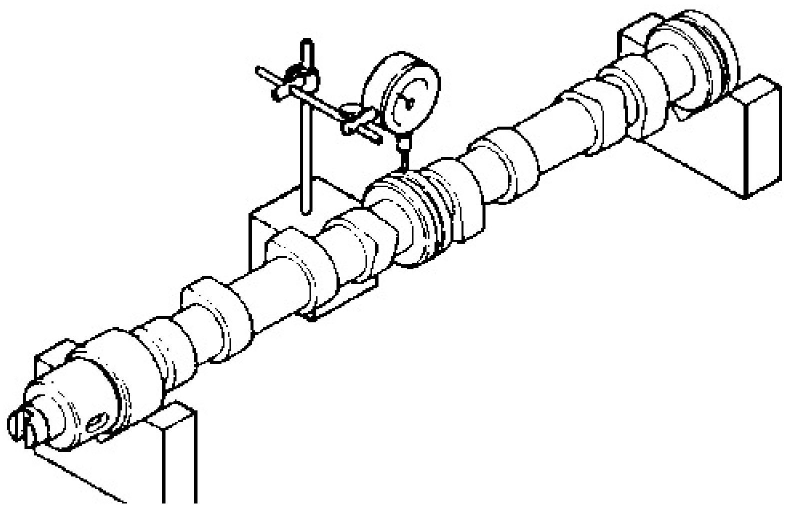
LEGEND:

B	Gear
C	Thrust Plate
D	Key

Gear

Install the thrust plate (C) if removed. Install the gear (B) with timing mark “C” side toward press table. Align the slot in the gear with key (D) in shaft. Press the camshaft into gear until gear is tight against camshaft shoulder.

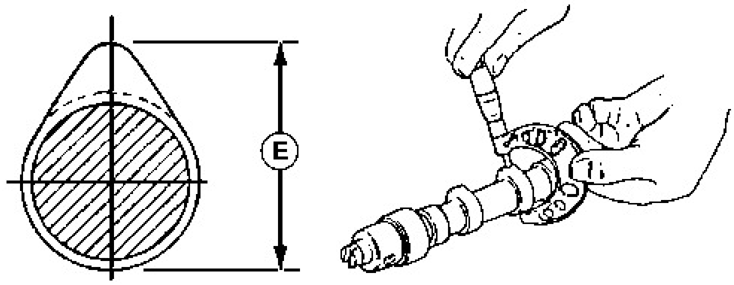
[3] -



Camshaft

Inspect the camshaft for bend using V-blocks and a dial indicator. Turn the camshaft slowly and read variations on the indicator.

[4] -



LEGEND:
E Camshaft Lobe Height

Camshaft Lobe Height

Measure the camshaft lobe height (E).

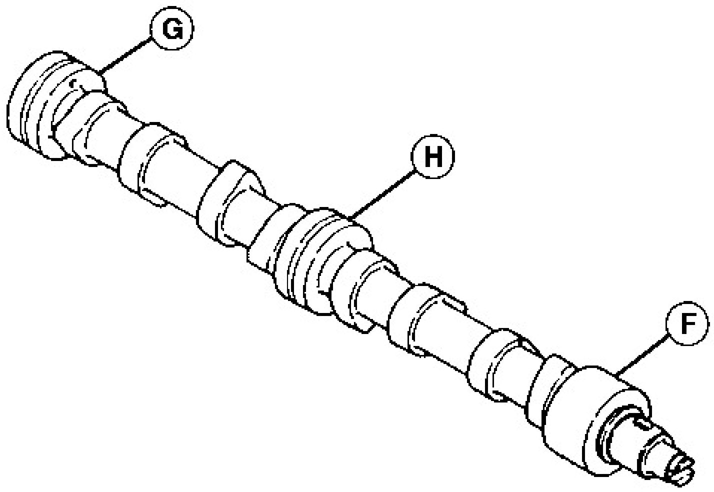
[5] - Camshaft lobe height is **38.6—38.8 mm (1.52—1.528 in.)** .

Item	Measurement	Specification
Camshaft Lobe	Height	38.6—38.8 mm (1.52—1.528 in.)

[6] - If the lobe height is less than **38.35 mm (1.51 in.)** , replace the camshaft.

Item	Measurement	Specification
Camshaft Lobe—Wear Limit	Height	38.35 mm (1.51 in.)

[7] -



LEGEND:
F Gear Housing
G Flywheel End Camshaft Journal
H Intermediate Camshaft Journal

Camshaft Journals

Measure the camshaft journal diameters.

[8] - Measure the camshaft journal diameters.

- Gear housing (F) and flywheel end camshaft journal (G) outer diameter is **44.93—44.95 mm (1.769—1.770 in.)** .

Item	Measurement	Specification
Flywheel End Camshaft Journal	OD	44.93—44.95 mm (1.769—1.770 in.)

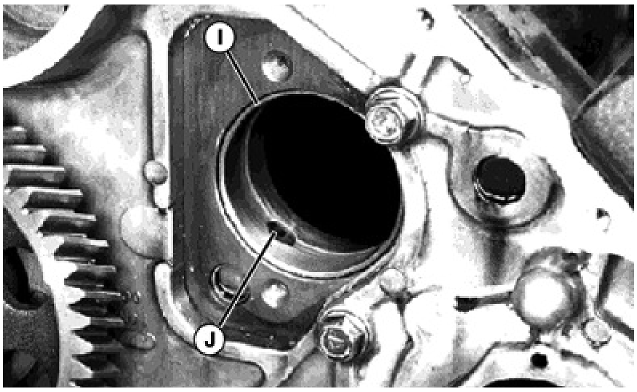
- Intermediate camshaft journal (H) outer diameter is **44.91—44.94 mm (1.768—1.769 in.)** .

Item	Measurement	Specification
Intermediate Camshaft Journal	OD	44.91—44.94 mm (1.768—1.769 in.)

- If the journal diameters are less than **44.85 mm (1.766 in.)** , replace the camshaft.

Item	Measurement	Specification
Camshaft Journal—Flywheel End and Intermediate	OD	44.85 mm (1.766 in.)

[9] -



LEGEND:

I	Camshaft Bushing
J	Oil Holes

Camshaft Bushing

Measure the camshaft bushing (I) diameter at the gear housing end.

- Standard camshaft bushing inner diameter is **44.99—45.06 mm (1.771—1.774 in.)** .

Item	Measurement	Specification
Camshaft Bushing	ID	44.99—45.06 mm (1.771—1.774 in.)

- Replace the bushing if the diameter exceeds **45.10 mm (1.776 in.)** .

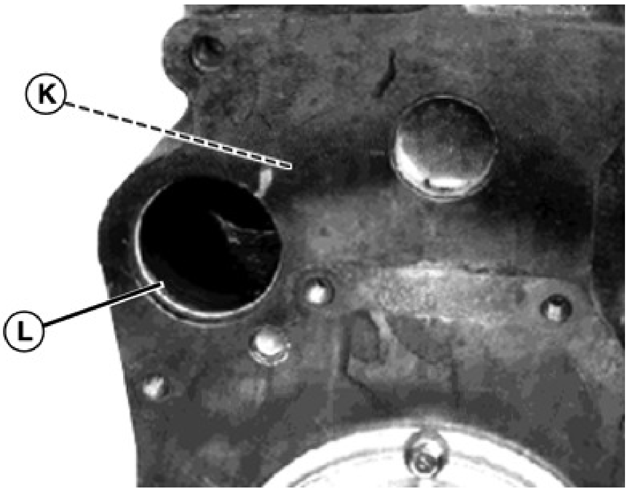
Item	Measurement	Specification
Camshaft Bushing—Wear Limit	ID	45.10 mm (1.776 in.)

- If the bushing clearance (bushing inner diameter minus camshaft journal outer diameter) exceeds **0.20 mm (0.008 in.)** , replace the bushing, camshaft or both.

Item	Measurement	Specification
Camshaft Bushing	Oil Clearance	0.20 mm (0.008 in.)

- Replace the camshaft bushing using a chisel. Be careful not to push the bushing inside the engine.
- Align the oil holes (J) in new bushing and cylinder block. Install bushing using a driver set.

[10] -



LEGEND:

K	Intermediate Camshaft Bore
L	Flywheel End Camshaft Bore

Camshaft Bore

Measure the intermediate (K) and flywheel end (L) camshaft bore diameters.

- Standard camshaft bore inner diameter is **45.00—45.025 mm (1.772—1.773 in.)** .

Item	Measurement	Specification
Camshaft Bore—Intermediate and Flywheel	ID	45.00—45.025 mm (1.772—1.773 in.)

- If the bore diameter exceeds **45.10 mm (1.776 in.)** , replace cylinder block.

Item	Measurement	Specification
Camshaft Bore—Intermediate and Flywheel	ID	45.10 mm (1.776 in.)

- If the bore clearance (bore inner diameter minus camshaft journal outer diameter) exceeds **0.20 mm (0.008 in.)** , replace camshaft, cylinder block or both.

Item	Measurement	Specification
Camshaft Bore, Intermediate, and Flywheel	Oil Clearance	0.20 mm (0.008 in.)

- Apply John Deere Form-In-Place Gasket, or an equivalent, on the outer edge of the plug. Install the plug until it bottoms in the bore.

Camshaft Followers

Removing/Installing:

[1] - Remove the camshaft. (See Camshaft in Section 30, Group 30.)

[2] - Remove the oil pan and strainer.

[3] -

IMPORTANT:

Avoid Damage! Cam followers must be installed in the same bores from which they were removed.

Put a mark on each cam follower and the cylinder block bore to aid in installation.

[4] - Remove the cam followers.

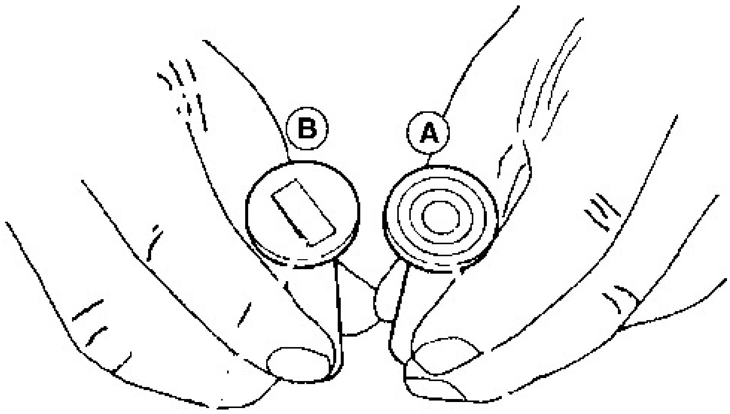
[5] - Inspect all parts for wear or damage.

[6] - Apply clean engine oil to all parts during installation.

[7] - Install parts in reverse order.

Inspection:

[1] -



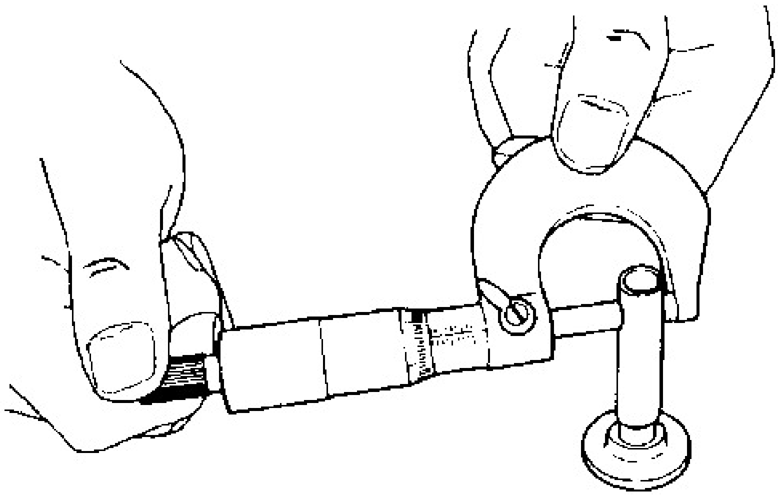
LEGEND:

A	Normal Contact
B	Abnormal Wear

Cam Follower

Inspect the cam follower contact surface for normal contact (A) or abnormal wear (B). Replace if necessary.

[2] -



Cam Follower Stem

Measure the cam follower stem diameter.

a. Standard cam follower stem outer diameter is **11.98—11.99 mm (0.471—0.472 in.)** .

Item	Measurement	Specification
Cam Follower Stem	OD	11.98—11.99 mm (0.471—0.472 in.)

b. If the stem diameter is less than **11.93 mm (0.470 in.)** , replace cam follower.

Item	Measurement	Specification
Cam Follower Stem—Wear Limit	OD	11.93 mm (0.470 in.)

[3] - Measure the cam follower bore diameter in the cylinder block.

a. Standard cam follower bore inner diameter is **12.00—12.02 mm (0.472—0.473 in.)** .

Item	Measurement	Specification
Cam Follower Bore	ID	12.00—12.02 mm (0.472—0.473 in.)

b. If the cam follower bore diameter exceeds **12.05 mm (0.474 in.)** , replace the cylinder block.

Item	Measurement	Specification
Cam Follower Bore—Wear Limit	ID	12.05 mm (0.474 in.)

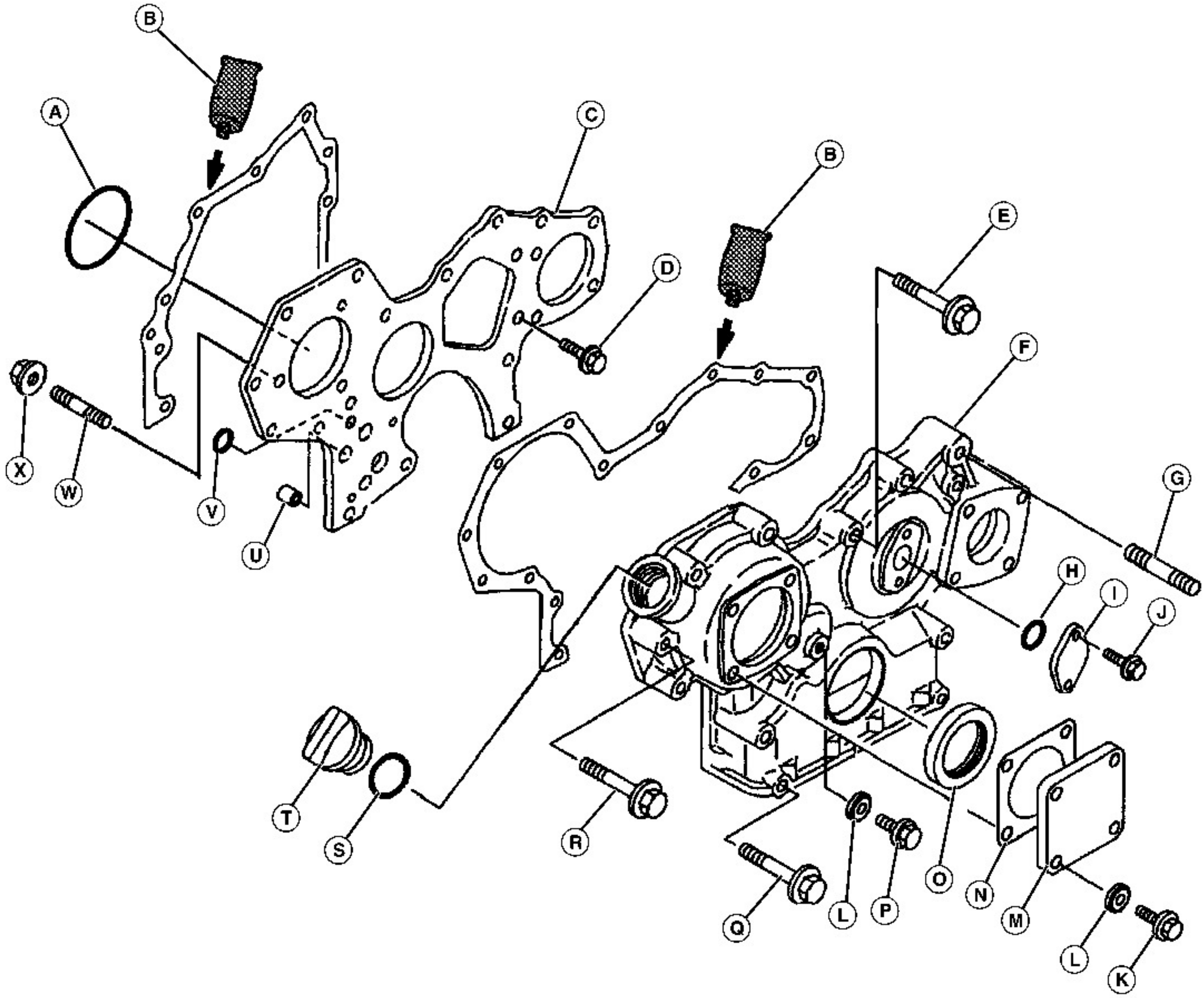
c. Standard cam follower bore clearance is **0.01—0.04 mm (0.0004—0.002 in.)** .

Item	Measurement	Specification
Cam Follower Bore	Clearance	0.01—0.04 mm (0.0004—0.002 in.)

d. If the bore clearance (bore inner diameter minus follower stem outer diameter) exceeds **0.12 mm (0.005 in.)** , replace the cam follower, cylinder block or both.

Item	Measurement	Specification
Cam Follower Bore—Wear Limit	Clearance	0.12 mm (0.005 in.)

Timing Gear Cover



Timing Gear Cover—Exploded View

LEGEND:

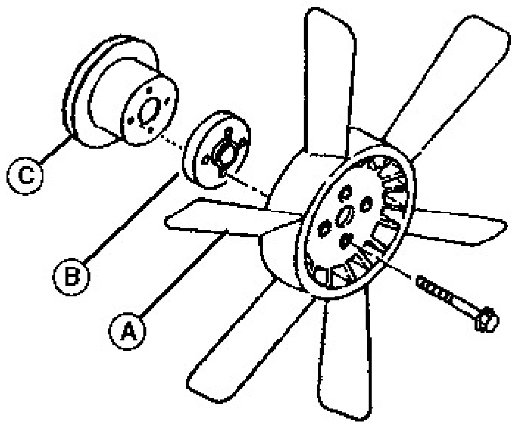
A	O-ring
B	Form-In-Place Gasket
C	Mounting Plate
D	Bolt, M8 x 16
E	Cap Screw, M8 x 55
F	Timing Gear Cover
G	Stud, M10
H	O-ring
I	Cover
J	Cap Screw
K	Cap Screw, M8 x 12
L	Seal Washer, M8
M	Cover
N	Gasket
O	Oil Seal
P	Cap Screw, M8 x 16
Q	Cap Screw, M8 x 85
R	Cap Screw, M8 x 45
S	O-ring
T	Oil Fill Cap
U	Dowel
V	O-ring

W	Stud, M8 x 22
X	Nut

Removal/Installation:

[1] - Remove the alternator and belt.

[2] -



LEGEND:

A	Fan
B	Spacer
C	Pulley

Fan

Remove the fan (A), spacer (B) and pulley (C).

[3] - Remove the crankshaft pulley cap screw and washer.

[4] - Remove the crankshaft pulley using a two-jaw puller.

[5] -

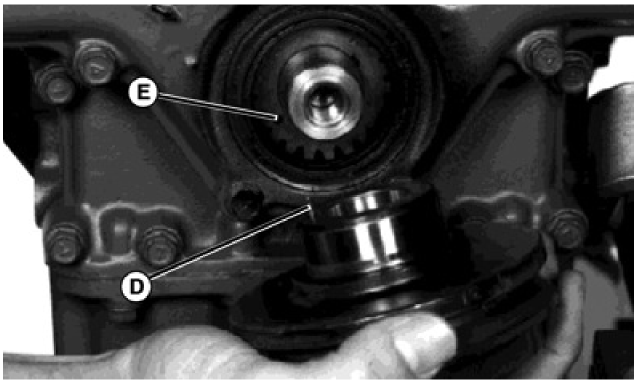
→NOTE:

It is not necessary to remove end cover and O-ring or fuel injection pump gear cover to remove timing gear cover.

Remove the mounting cap screws and timing gear cover.

[6] - Inspect the crankshaft oil seal for wear or damage. Replace if necessary. Replace the oil seal using a driver set. Install the seal with lip toward inside of gear housing cover. Install the seal flush with surface of cover.

[7] -



LEGEND:

D	Pin
E	Hole

Crankshaft Pulley

Installation is done in the reverse order of removal.

a. Replace the seal washer.
b. Align the pin (D) in crankshaft pulley with the hole (E) in the crankshaft gear. Install the crankshaft pulley.
c. Adjust the fan/alternator drive belt tension.

Idler Gear

Removing/Installing:

[1] - Remove the timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[2] - Check the backlash of timing gears. (See Timing Gear Backlash Check in Section 30, Group 25.)

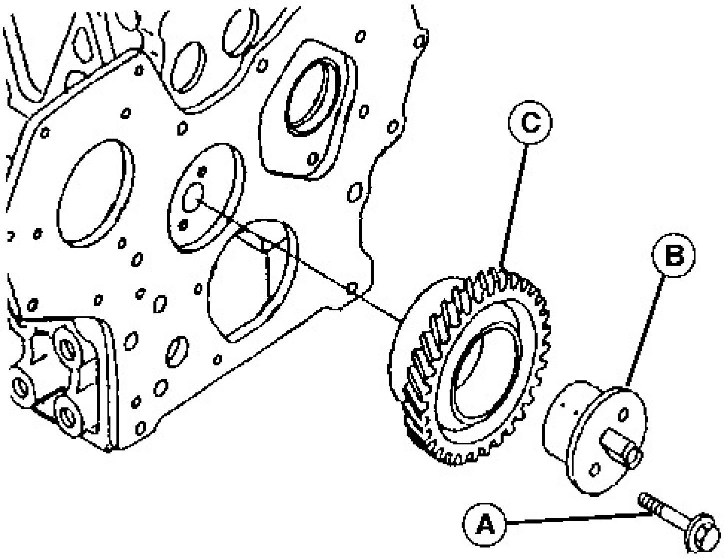
[3] -

→NOTE:

Due to the odd number of teeth on the idler gear, timing marks will only align periodically. When all timing marks on gears align, the piston closest to the water pump is at TDC on compression stroke. Number one cylinder is closest to the flywheel.

Rotate the crankshaft and align the timing marks.

[4] -



LEGEND:

A	Cap Screw (2 used)
B	Shaft
C	43T Gear

Idler Gear

Remove two cap screws (A), shaft (B) and 43T gear (C).

[5] - Inspect all parts for wear or damage.

[6] - Installation is done in the reverse order of removal.

[7] - Inspect the gear for chipped or broken teeth. Replace if necessary.

a. Measure the idler gear shaft diameter.
b. Standard idler gear shaft outer diameter is **45.95—45.98 mm (1.809—1.810 in.)** .

Item	Measurement	Specification
Idler Gear Shaft	OD	45.95—45.98 mm (1.809—1.810 in.)

c. If the shaft diameter is less than **45.93 mm (1.808 in.)** , replace idler gear shaft.

Item	Measurement	Specification
Idler Gear Shaft—Wear Limit	OD	45.93 mm (1.808 in.)

[8] - Measure the idler gear bushing diameter.

a. Standard idler gear bushing inner diameter is **46.00—46.03 mm (1.811—1.812 in.)** .

Item	Measurement	Specification
Idler Gear Bushing	ID	46.00—46.03 mm (1.811—1.812 in.)

b. Replace the bushing if diameter exceeds **46.03 mm (1.812 in.)** .

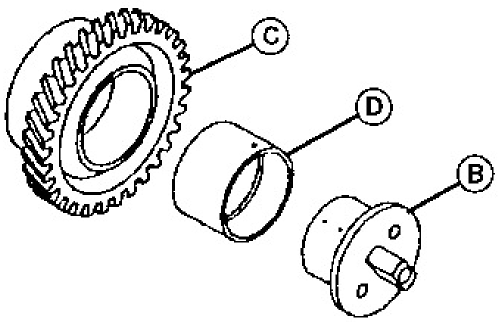
Item	Measurement	Specification
Idler Gear Bushing—Wear Limit	ID	46.03 mm (1.812 in.)

c. If the bore clearance (bushing inner diameter minus shaft outer diameter) exceeds **0.15 mm (0.006 in.)** , replace the bushing, shaft, or both.

Item	Measurement	Specification
Idler Gear Bushing	Clearance	0.15 mm (0.006 in.)

To Replace The Bushing:

[1] -



LEGEND:

C	Idler Gear
D	Bushing

Idler Gear Bushing

Replace the bushing using a driver set.

[2] - Align the oil holes in bushing (D) and idler gear (C).

[3] - Install the bushing flush with surface of idler gear.

Timing Gear Cover Mounting Plate

Removing/Installing:

[1] - Remove the camshaft. (See Camshaft in Section 30, Group 30.)

[2] - Remove the idler gear. (See Idler Gear in Section 30, Group 30.)

[3] - Remove the fuel injection pump.

[4] - Remove the oil pump. (See Oil Pump (Engines 3TNV8x-JT, -MJT) or Oil Pump (Engines 3TNV8x-BJT, -BMJT, -BXJT) in Section 30, Group 30.)

[5] - Remove the mounting cap screws and plate.

[6] - Replace the O-rings.

[7] - Installation is the reverse of removal.

Oil Pan and Crankcase Housing Extension

Removal/Installation

[1] - Remove engine from machine.

[2] - Remove flywheel from engine. (See Flywheel and Coupling .)

[3] - Remove the oil pan.

[4] - Remove the oil pick up strainer.

[5] - Remove flywheel housing-to-crankcase housing extension cap screws.

[6] - Remove rear oil seal case-to-crankcase housing extension cap screws.

[7] - Remove crankcase housing extension from engine block.

[8] - Clean and inspect all parts. Replace as necessary.

[9] - Remove sealant residue from oil pan, housing extension and engine block mating surfaces.

Installation

Installation is done in the reverse order of removal.

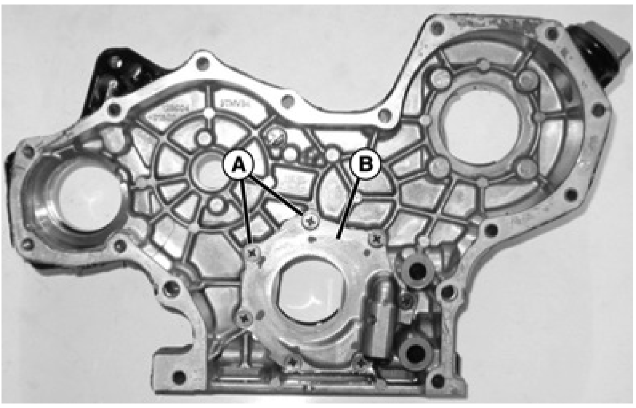
- Apply RTV adhesive to extension housing-to-engine block mating surface.
- Apply RTV adhesive to oil pan mounting flange.
- Fill the engine with correct engine oil.

Oil Pump (Engines 3TNV8x-JT, -MJT)

Removal/Installation

[1] - Remove timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[2] -



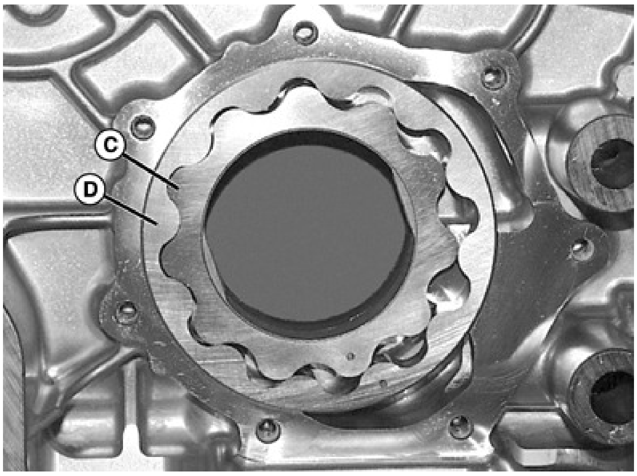
LEGEND:

A	Screw (7 used)
B	Oil Pump Cover

Oil Pump Cover

Remove the seven screws (A) from oil pump cover (B) and remove cover.

[3] -



LEGEND:

C	Inner Rotor
D	Outer Rotor

Inner and Outer Rotor

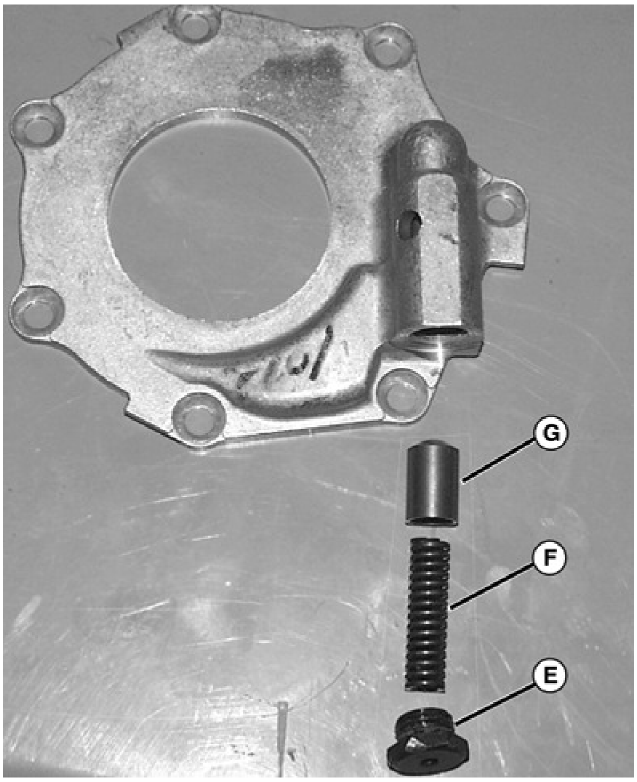
Remove inner rotor (C) and outer rotor (D) and check for wear or damage. Check inside of cover for wear or deep scratches. Replace any worn or damaged parts.

[4] -

Oil Pump Cover

Inspect inside of oil pump cover for grooves or deep scratches. Replace cover if worn or damaged.

[5] -



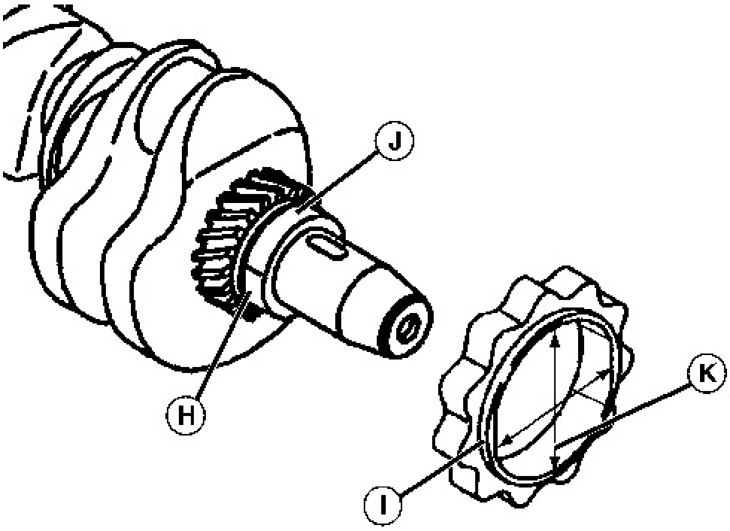
LEGEND:

E	Relief Valve Cap
F	Spring
G	Valve

Relief Valve Cap

Remove relief valve cap (E), spring (F), and valve (G). Inspect all parts for wear or damage. Replace any worn or damaged parts

[6] -



LEGEND:

H	Crankshaft Gear
I	Inner Rotor
J	Crankshaft Gear Boss
K	Inner Rotor

Crankshaft Gear

Measure across the flats on the crankshaft gear (H). Measurement should be **49.45—49.75 mm (1.946—1.958 in.)** .

Item	Measurement	Specification
Crankshaft Gear	Distance	49.45—49.75 mm (1.946—1.958 in.)

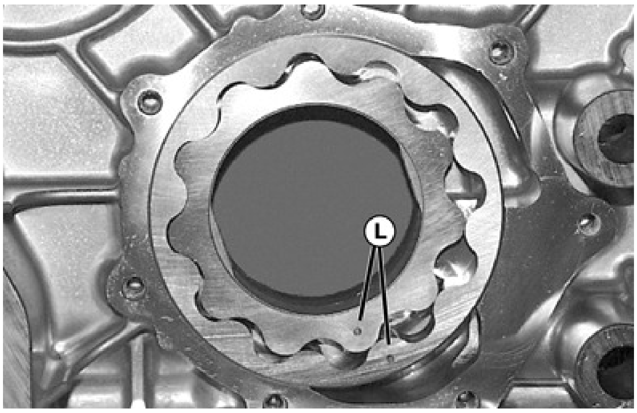
[7] - Measure across inside of flats on the inner rotor (I). Measurement should be **49.95—50.05 mm (1.966—1.970 in.)** .

Item	Measurement	Specification
Inner Rotor	Distance	49.95—50.05 mm (1.966—1.970 in.)

[8] - Measure outer diameter of crankshaft gear boss (J). Measurement should be **53.05—53.15 mm (2.088—2.092 in.)** . Measure inner diameter of inner rotor (K). Measurement should be **53.45—53.55 mm (2.104—2.108 in.)** .

Item	Measurement	Specification
Crankshaft Gear Boss	OD	53.05—53.15 mm (2.088—2.092 in.)
Inner Rotor	ID	53.45—53.55 mm (2.104—2.108 in.)

[9] -



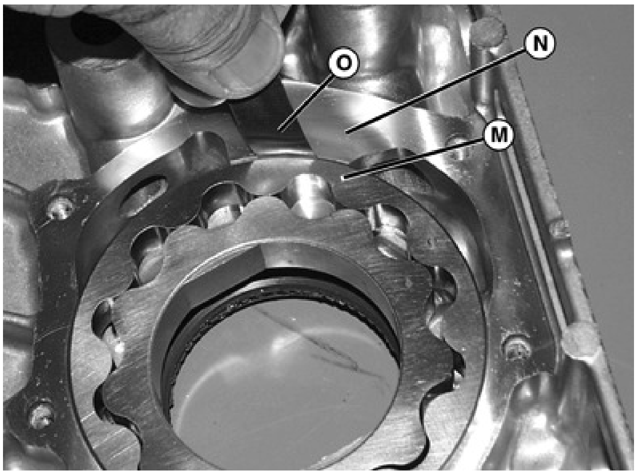
LEGEND:

L	Marks

Inner and Outer Rotors

When installing inner and outer rotors, make sure marks (L) are near each other and facing outward.

[10] -



LEGEND:

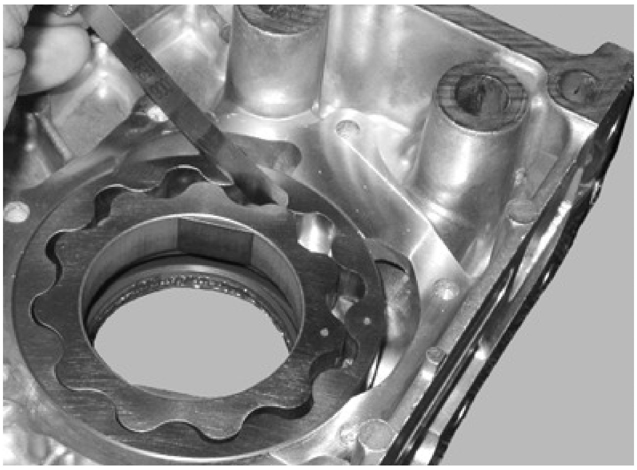
M	Outer Rotor
N	Timing Cover
O	Feeler Gauge

Inner and Outer Rotor

Measure clearance between outer rotor (M) and timing cover (N) with a feeler gauge (O). Standard clearance is **0.12—0.21 mm (0.0047—0.008 in.)** . Wear limit is **0.30 mm (0.012 in.)** . If clearance exceeds wear limit, replace timing cover and both rotors.

Item	Measurement	Specification
Timing Cover-to-Outer Rotor	Clearance	0.12—0.21 mm (0.0047—0.008 in.)
Timing Cover-to-Outer Rotor—Wear limit	Clearance	0.30 mm (0.012 in.)

[11] -

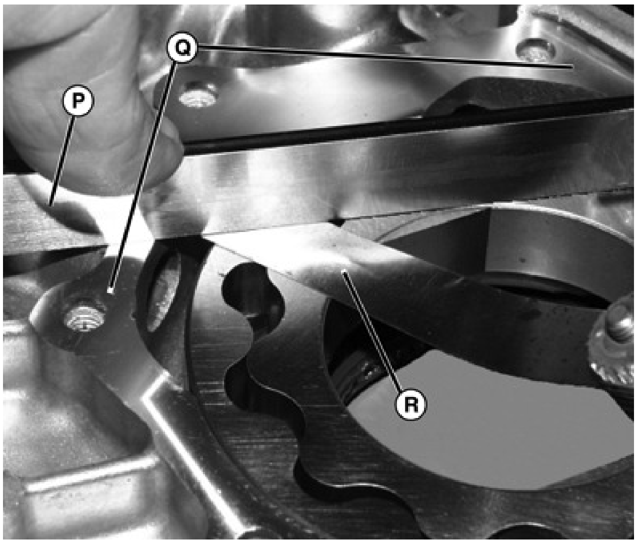


Inner and Outer Rotors

Measure between high spots of inner and outer rotors with a feeler gage. If clearance exceeds **0.16 mm (0.006 in.)** replace rotors.

Item	Measurement	Specification
Inner Rotor-to-Outer Rotor	Clearance	0.16 mm (0.006 in.)

[12] -



LEGEND:
P Straight Edge
Q Timing Gear Cover Bosses
R Feeler Gauge

Timing Gear Cover Bosses

Place a straight edge (P) across timing gear cover bosses (Q) and measure gap between edge of timing gear cover and the rotors with a feeler gauge (R). Standard gap is **0.02—0.07 mm (0.0008—0.0027 in.)** . Wear limit is . If clearance exceeds wear limit replace timing gear cover and rotors.

Item	Measurement	Specification
Edge of Timing Gear Cover-to-Rotors	Gap	0.02—0.07 mm (0.0008—0.0027 in.)
Edge of Timing Gear Cover-to-Rotors—Wear Limit	Gap	0.12 mm (0.0047 in.)

[13] - Assemble in the reverse order of disassembly.

[14] - Apply medium strength thread locking compound to oil pump cover screws when installing.

Oil Pump (Engines 3TNV8x-BJT, -BMJT, -BXJT)

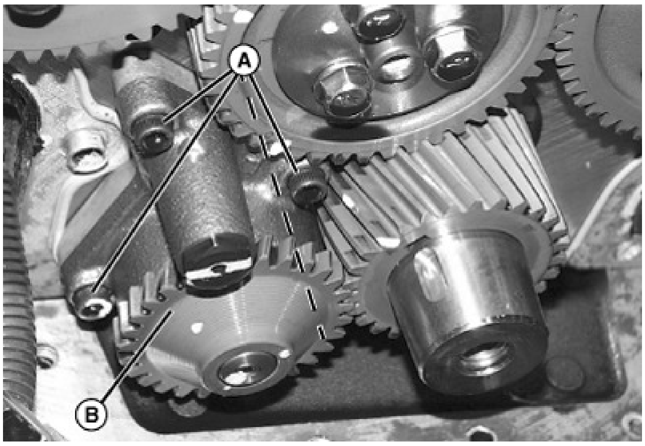
Removing/Installing:

[1] - Remove timing gear cover. (See Timing Gear Cover in Section 30, Group 30.)

[2] - Check the oil pump gear backlash. Replace the oil pump assembly if backlash is more than **0.12 mm (0.005 in.)** .

Item	Measurement	Specification
Oil Pump Gear	Backlash	0.12 mm (0.005 in.)

[3] -



LEGEND:
A Mounting Screw (4 used)
B Oil Pump

Oil Pump

Remove the four mounting screws (A) and the oil pump (B).

[4] -

LEGEND:
C Gasket

Oil Pump Gasket

Remove gasket (C) from engine block.

Installation:

[1] - Make sure that all old gasket material has been removed from engine block and oil pump.

[2] - Install new gasket on oil pump.

[3] - Install oil pump on engine block with four socket head bolts.

[4] - Tighten bolts to specification.

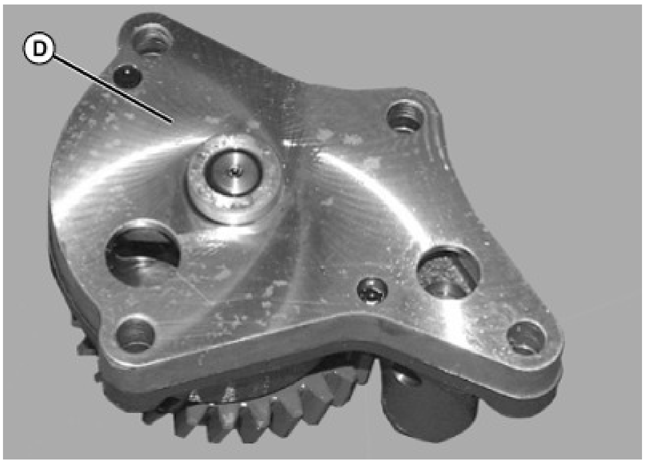
Item	Measurement	Specification
Socket Head Bolt-to-Oil Pump	Torque	25 N·m (18 lb.-ft.)

Oil Pump Disassembly/Assembly:

→NOTE:

There are no serviceable parts inside the oil pump. If anything is worn beyond specification replace entire oil pump.

[1] -



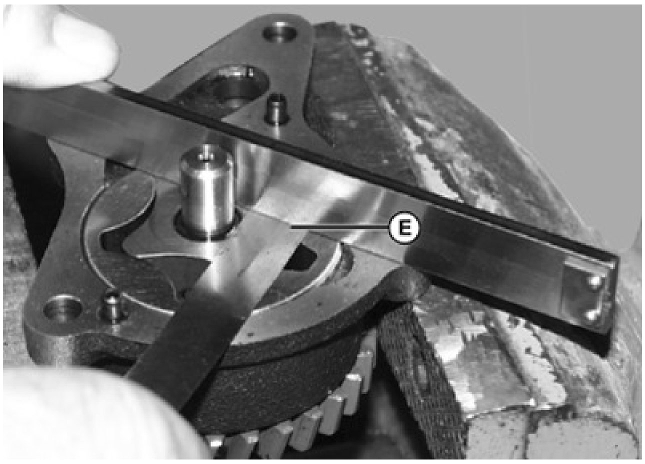
LEGEND:

D	Plate

Oil Pump

Carefully remove plate (D) from back of oil pump.

[2] -



LEGEND:

E	Rotor Recess

Oil Pump Body

Lay a straightedge across the pump body and check the rotor recess (E) with a feeler gauge.

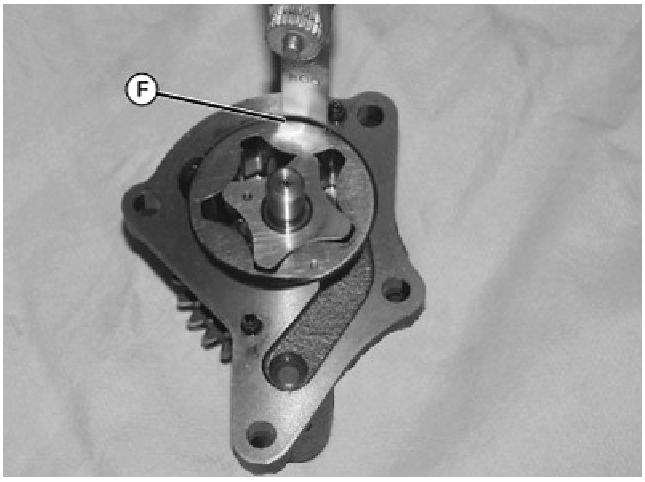
- Standard rotor recess is **0.03—0.09 mm (0.001—0.004 in.)** .

Item	Measurement	Specification
Oil Pump Rotor	Recess	0.03—0.09 mm (0.001—0.004 in.)

- Replace the pump if the recess exceeds **0.15 mm (0.006 in.)** .

Item	Measurement	Specification
Oil Pump Rotor—Wear Limit	Recess	0.15 mm (0.006 in.)

[3] -



LEGEND:

F	Clearance

Oil Pump Body

Measure outer rotor-to-pump body clearance (F) with a feeler gauge.

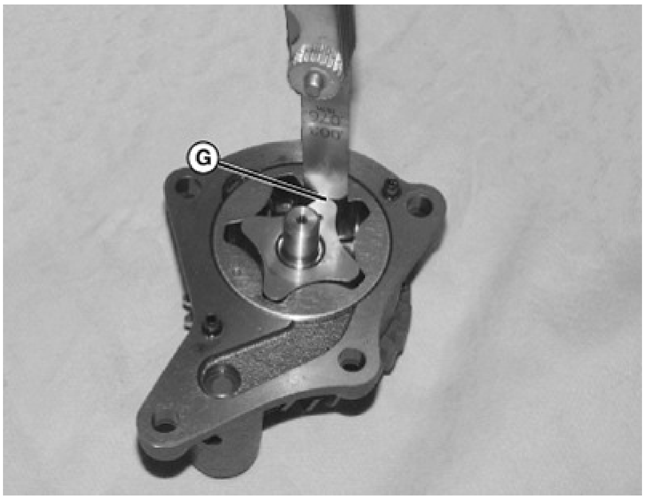
- Standard clearance is **0.10—0.16 mm (0.004—0.006 in.)** .

Item	Measurement	Specification
Outer Rotor-to-Oil Pump Body	Clearance	0.10—0.16 mm (0.004—0.006 in.)

- Replace the pump if the clearance is more than **0.25 mm (0.010 in.)** .

Item	Measurement	Specification
Outer Rotor-to-Oil Pump Body—Wear Limit	Clearance	0.25 mm (0.010 in.)

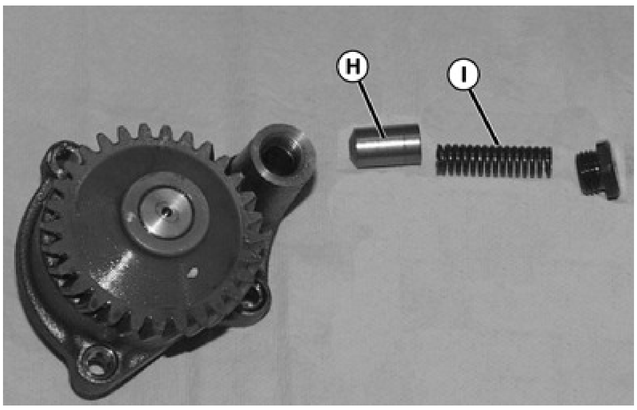
[4] -



LEGEND:

G	Clearance
H	Relief Valve Piston
I	Spring

Oil Pump Rotors



Relief Valve Piston

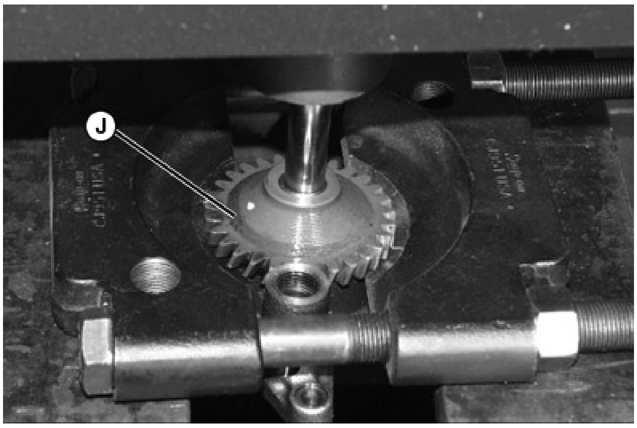
Check inner-to-outer rotor clearance (G) with feeler gauge.

- Check inner-to-outer rotor clearance (G) with feeler gauge. Replace the pump if clearance is more than **0.15 mm (0.006 in.)** .

Item	Measurement	Specification
Oil Pump—Inner-to-Outer Rotor	Clearance	0.15 mm (0.006 in.)

- Check the oil pressure relief valve. If the relief valve piston (H) is sticking in the pump body, clean parts to allow free movement of the piston in pump body.

[5] -



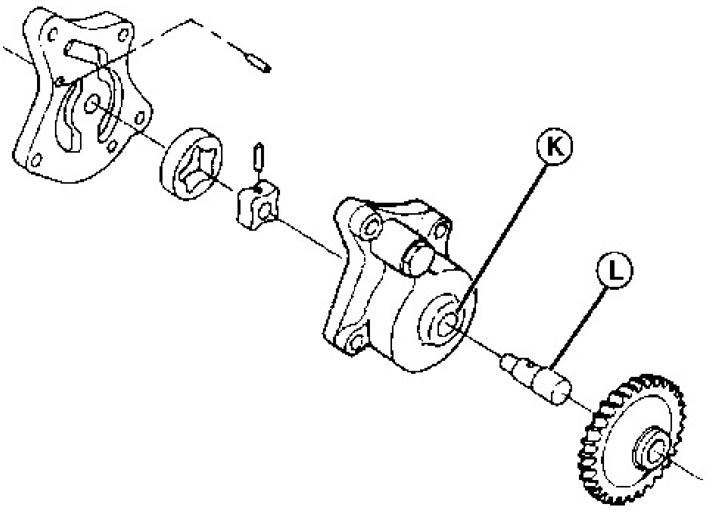
LEGEND:

J	Drive Gear

Drive Gear

Press drive gear (J) from pump shaft as shown.

[6] -



LEGEND:

K	Shaft Hole
L	Rotor Shaft

Rotor Shaft

Measure the outer diameter of rotor shaft (L) and the inner diameter of shaft hole (K) in cover.

- Standard clearance is **0.01—0.04 mm (0.001—0.002 in.)** .

Item	Measurement	Specification
Outer Diameter of Rotor Shaft-to-Inner Diameter of Shaft Hole	Clearance	0.01—0.04 mm (0.001—0.002 in.)

- Replace the pump if the clearance is greater than **0.2 mm (0.008 in.)** .

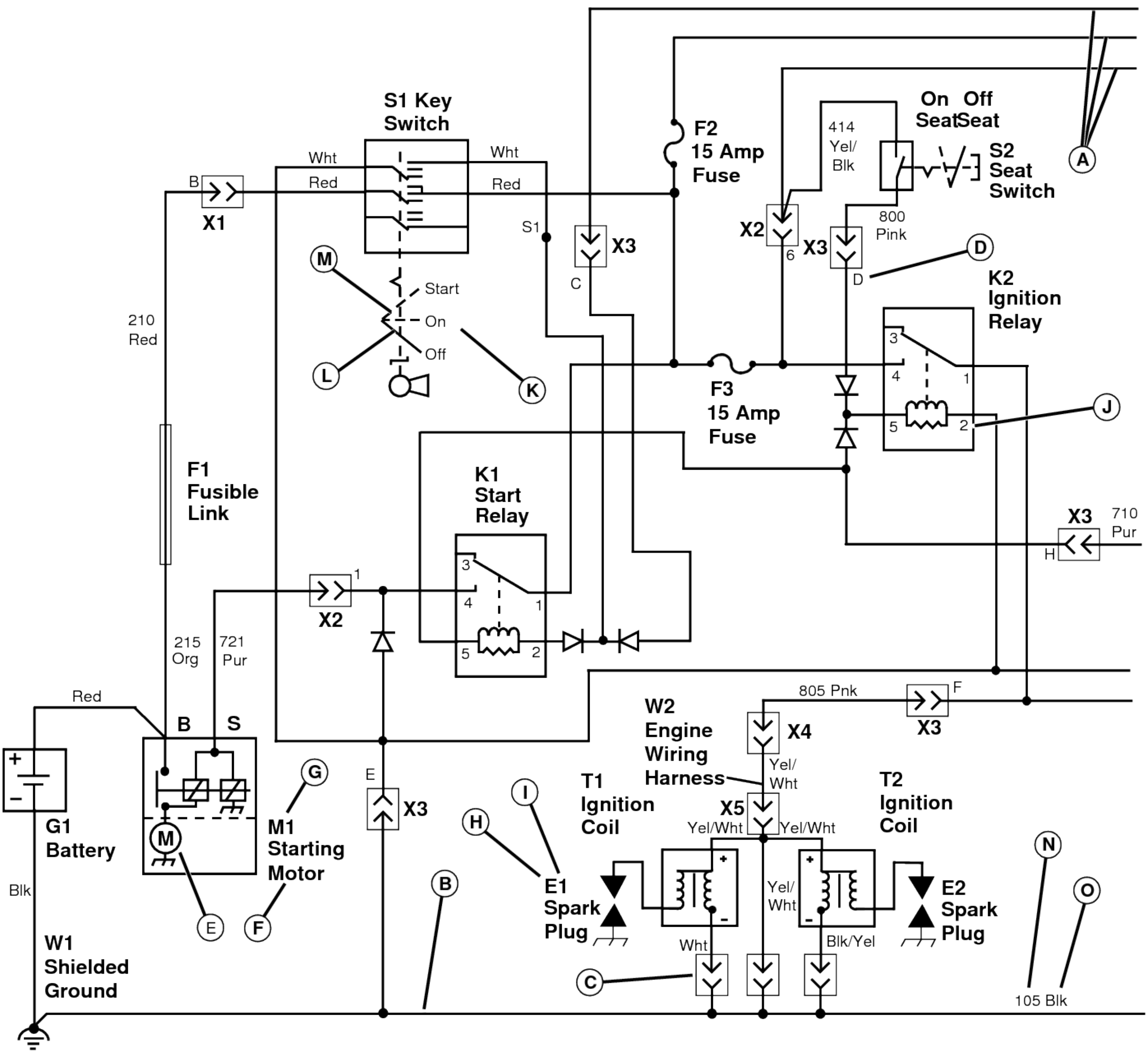
Item	Measurement	Specification
Outer Diameter of Rotor Shaft-to-Inner Diameter of Shaft Hole—Wear Limit	Clearance	0.2 mm (0.008 in.)

Section 40 - ELECTRICAL - NORTH AMERICA

Table of contents

Group 05 - General Information

Reading Electrical Schematics



Reading Electrical Schematics

LEGEND:

A	Power Wire
B	Ground Wire
C	Connector
D	Terminal Pin Location
E	Symbol
F	Name
G	Identification Code
H	Identifying Letter
I	Number
J	Terminal Designation
K	Switch Position
L	Solid Line
M	Dash Line
N	Circuit Number
O	Wire Color

The schematic is made up of individual circuits laid out in a sequence of related functions. It is formatted with all power wires (A) across the top and all ground wires (B) across the bottom. Current flow is generally from top to bottom through each circuit and component. All components are shown in the off position. The diagram does not list connector (C) information unless needed to avoid confusion. If the connector is shown, the number next to it is the terminal pin location (D) in the connector.

Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

The identifying letter is always the same for a specific component, but the identifying numbers are numbered consecutively from upper left to lower right. The terminal designation (J) is placed directly inside or outside the symbol next to the connecting wire path. Switch positions (K) are also placed directly inside or outside the symbol. The solid line (L) shows the position the switch is currently in and dash lines (M) represent other switch positions.

The circuit number (N) and wire color (O) of the wires are shown directly next to the wire path.

The same component name and identification code are used consistently on all diagrams in this section. Components can be easily cross-referenced.

Theory of Operation Information

The theory of operation stories divide the electrical system into individual circuits by function. Each circuit is isolated from the main wiring schematic and only shows the components that are used in it. The story contains information on function, operating conditions, and theory of operation. The circuit schematics are drawn with the components in the operating position, with the power, or battery positive, into them across the top and the ground, or battery negative, across the bottom.

Diagnostic Information

The diagnostic procedure is used to test the complete circuit regardless of the problem or complaint. Select a symptom or system from the quick check or troubleshooting chart and follow the test procedures under that heading.

The diagnostic procedure lists:

- Test conditions
- Test sequence
- Test location
- Normal reading
- Check or test to perform if reading is not normal

When performing the test or check, be sure to set your machine up to the TEST POINT/PROCEDURES listed in the first column and follow the sequence carefully. The middle RESULTS column gives the reading or condition that should be obtained in **BOLD** print. If the results of the test or check are not normal, perform the test, check, or adjustment listed below the **BOLD** print. The system diagram that accompanies each test procedure is drawn to resemble machine components. The leader line points to the exact point the test is to be made.

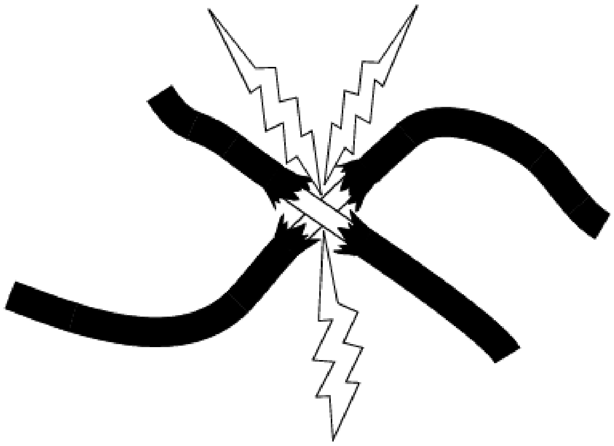
Wire Color Abbreviation Chart

Wire Color Abbreviation Chart

Wire Color Abbreviation Chart	
Blk	Black
Blu	Blue
Brn	Brown
Grn	Green
Gry	Gray
Org	Orange
Pnk	Pink
Pur	Purple
Red	Red
Tan	Tan
Wht	White
Yel	Yellow
Blk/Wht	Black/White
Blu/Wht	Blue/White
Brn/Wht	Brown/White
Brn/Yel	Brown/Yellow
Dk Blu	Dark Blue
Dk Brn/Lt Grn	Dark Brown/Light Green
Dk Brn/Red	Dark Brown/Red
Dk Brn/Yel	Dark Brown/Yellow
Dk Grn	Dark Green
Lt Blue	Light Blue
Lt Grn	Light Green
Org/Wht	Orange/White
Pnk/Blk	Pink/Black
Pur/Wht	Purple/White
Red/Blk	Red/Black
Red/Wht	Red/White
Wht/Blk	White/Black
Wht/Red	White/Red
Yel/Blk	Yellow/Black
Yel/Red	Yellow/Red
Yel/Wht	Yellow/White

Common Circuit Tests

Shorted Circuit



Shorted Circuit

A shorted circuit may result in the wrong component operating (that is, improper wire-to-wire contact). To test for a shorted or improperly wired circuit:

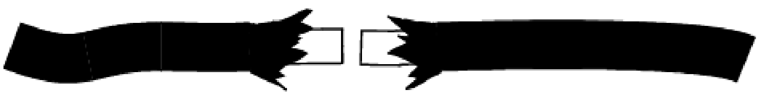
[1] - Turn component switch ON.

[2] - Start at the controlling switch of the component that should not be operating.

[3] - Follow the circuit and disconnect wires at connectors until component stops operating.

[4] - Shorted or improper connections will be the last two wires disconnected.

High Resistance or Open Circuit



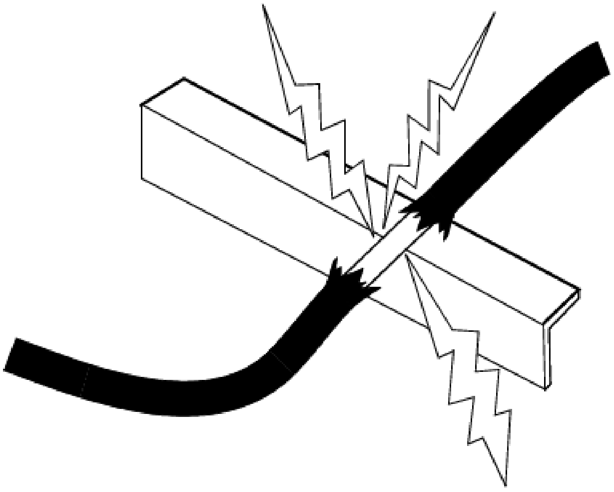
High Resistance or Open Circuit

High resistance or open circuits usually result in slow, dim, or no component operation (that is, poor, corroded, or disconnected connections). Voltage at the component will be low when the component is in operation. To test for high resistance and open circuits:

[1] - Check all terminals and grounds of the circuit for corrosion.

[2] - If terminals are not corroded or loose, the problem is in the component or wiring.

Grounded Circuit



Grounded Circuit

Grounded circuits usually result in no component operation or a blown fuse.

Conductors for 12-Volt Circuits

Stranded Conductors For 12 Volt Circuits

Stranded Conductors For 12-Volt Circuits						
SAE Wire Size (Gauge)	20	18	16	14	12	10
Metric Wire Size (mm)	0.5	0.8	1.0	2.0	3.0	5.0
Typical Stranding	7 X 28	16 X 30	19 X 29	19 X 27	19 X 25	19 X 23
Minimum Conductor Area In Circular Mils	1072	1537	2336	3702	5833	9343

Group 10 - Specifications

System Specifications

Item	Measurement	Specification
Battery:		
Type	Voltage	12 Volt DC
Size	BCI Group Size	34
Amperage	CCA Rating (Amps @ -18°C (0°F)	500 amps
Amperage	Reserve Capacity	120
Load Test (minimum)	Amperage	325 amps for 15 seconds

Item	Measurement	Specification
Starting Motor:		
Type		Solenoid Shift
Size (3120)		1.2 kW (1.61 hp)
Size (all other models)		1.4 kW (1.88 hp)
Amp Draw (on machine)	Amperage	300 amps (max.)
No-Load Amp Draw (free running)	Amperage	325 amps (max.) @ 4440 rpm
Starting Solenoid Pull-in Amp Draw	Amperage	55.5 (max.)
Starting Solenoid Hold-in Amp Draw	Amperage	10.5 amps (max.)

Item	Measurement	Specification
Alternator:		
Regulated Output	Voltage	14.2—14.8 VDC @ 25°C (77°F)
Unregulated Output	Voltage	50 VAC
Current Output	Amperage	40 amps

Item	Measurement	Specification
Fuel Shutoff Solenoid:		
Range	Voltage	6—16 VDC, 12 VDC Nominal
Starting Current (maximum)	Amperage	35 amps
Operating Current	Amperage	0.3 amps

Item	Measurement	Specification
Sensors:		
Engine Coolant Temperature (variable)	Resistance	22—520 ohms
Fuel Gauge (variable)	Resistance	8—89 ohms
Engine Oil Switch Closes (light ON to OFF)	Pressure	40—75 kPa (5.8—10.8 psi)

Item	Measurement	Specification
Lighting:		
Headlights (halogen)	Power	37.5 watts
Tail/Turn Light	Type	1157
Hazard Lights	Type	1156
Work Lights (halogen)	Type	886

Item	Measurement	Specification
Torque Specifications:		
Alternator Positive Cable Nut	Torque	13.5 N·m (120 lb.-in.)
Position Sensor Lock Nut	Torque	5 N·m (44.25 lb.-in.)
Starting Solenoid Positive Cable Nut	Torque	13.5 N·m (120 lb.-in.)
Load Center Mounting Nut	Torque	7.5 N·m

Item	Measurement	Specification
		(66.3 lb.-in.)
HST Drive Controller Connector Cap Screw	Torque	2.0 N·m
		(17.7 lb.-in.)
MFWD Engagement Sensing Switch	Torque	27 N·m
		(19.9 lb.-ft.)
Mid PTO Switch	Torque	27 N·m
		(19.9 lb.-ft.)

Essential or Recommended Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Electronic Control Analyzer

JDG1575

Test and adjust position sensors.

Weatherpack Extraction Tool

JDG364

To remove contacts from weatherpack connectors.

Electrical Circuit Analyzer

JT07324A

To diagnose key switch and associated electrical circuits.

Current Clamp-On Probe

JT02153

To diagnose current amperage with in electrical wires.

Analog/Digital Multimeter

JT05791

To diagnose electrical system circuits and components.

Probe Light

JDG186

To test for current continuity and grounds.

Hydrometer

NA

Used to check specific gravity of electrolyte in battery cells.

Battery Tester (or Voltmeter)

JT05685

Used to measure battery voltage.

Current Gun

JT05712

Used to measure alternator output current.

Hand-Held Digital Tachometer

JT05719

Used to measure speed of starting motor.

1.83 m (6 ft.) Transmission Control Unit (TCU) Cable

DS10130

TCU cable is used to communicate with the TCU on the following models with HST transmissions. Models include: 3x20 Series with HST.

23 cm (9 in.) Instrument Cluster Controller (ICC) Cable

DS10131

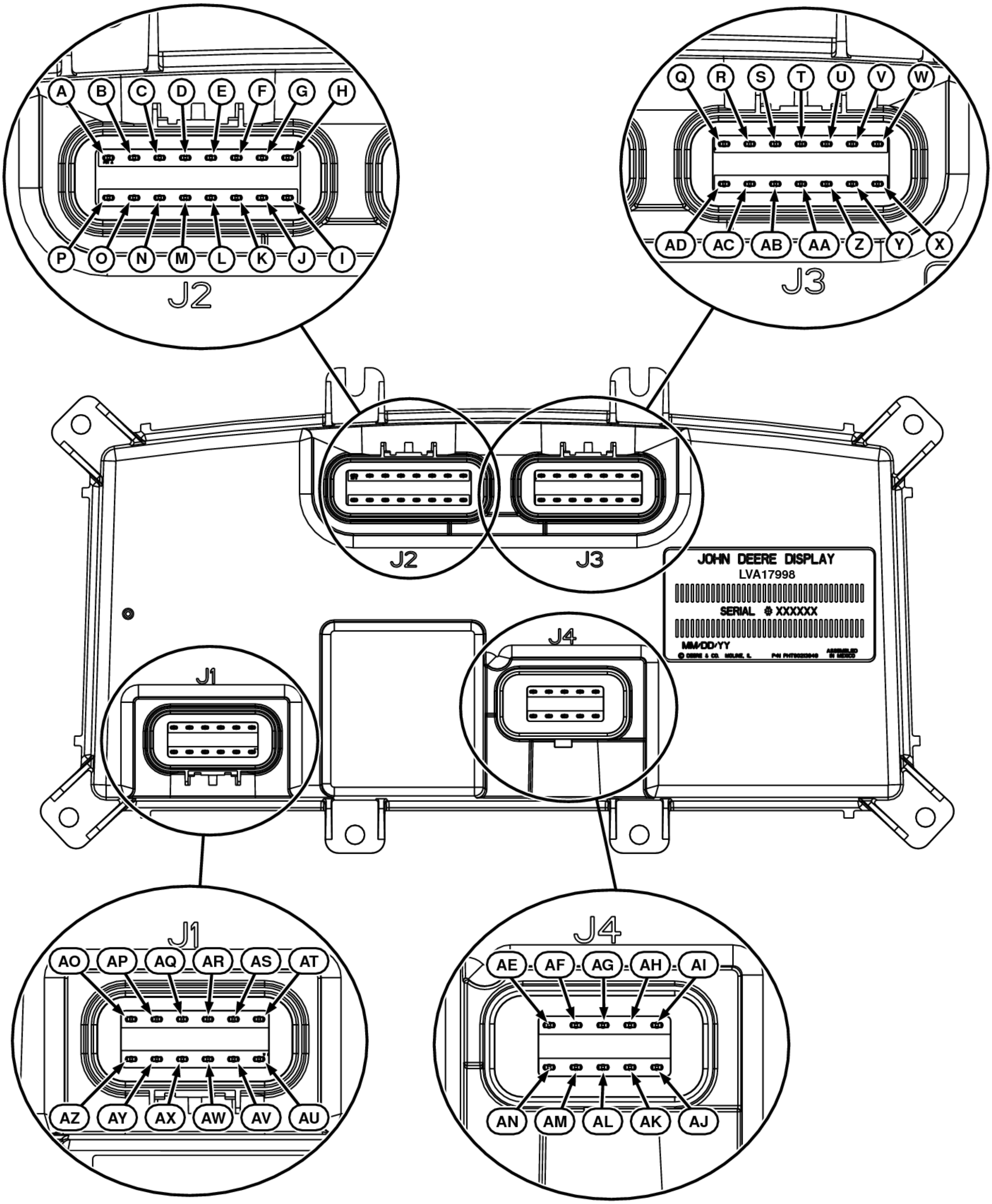
The ICC cable is an adaptor used to the connect the TCU cable to the ICC. This cable shall be connected to the 1.83 m (6 ft.) TCU cable for connecting to the ICC.Models include: 3x20 Series with HST or PRT.

Other Materials

Number	Name	Use
• TY9374/TY9375 (us)	Pipe sealant with TEFLON ™	Seal threads on temperature sensor and oil pressure switches.
• NA (us)	Bearing Puller Set	Used to remove pulley from alternator.
• NA (us)	400-grit Silicon Carbide Sandpaper	Used to polish slip rings.

Group 15 - Component Location

A1 Display Panel Signal Component Location



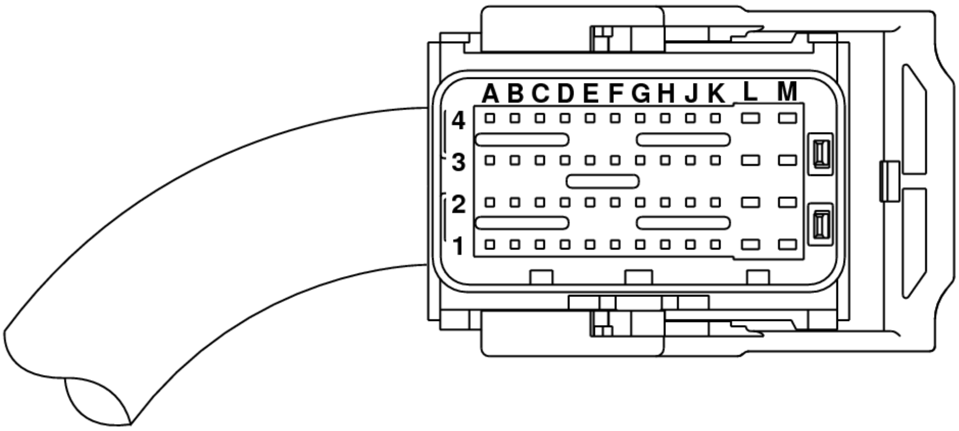
Display Panel Signal Location

LEGEND:

A	J2-A CAN_LO, 9925A Grn
B	J2-B CAN_HI, 9924A Yel

C	J2-C Warning / Hazard Switch, 1103 Org
D	J2-D Light Switch (Backlight), 1138D Gry
E	J2-E Audible Alarm, 2008 Gry Not Used on PowrReverser Transmission
F	J2-F Not Used
G	J2-G Left Turn Signal Trailer Output, 1145E Grn
H	J2-H Right Turn Signal Trailer Output, 1135E Grn
I	J2-S Right Turn Signal, 1135A Grn
J	J2-R Left Turn Signal, 1145A Grn
K	J2-P Mid Mount Proxy Sensor Input, 4006 Grn
L	J2-N Front PTO Input, 0562AT Red
M	J2-M Not Used
N	J2-L Engine Oil Pressure Input, 5347C Pur
O	J2-K Not Used
P	J2-J Not Used
Q	J3-A Hold In Coil Output, 5342 Red
R	J3-B Mid PTO Sense In, 4687C Pur
S	J3-C Park Brake Input,4586A Blu
T	J3-D Engine Crank, 0572C Red
U	J3-E PTO On (Momentary Switch) In, 4573B Org Not Used on PowrReverser Transmission
V	J3-F Continuous Flow Input, 7793 Org
W	J3-G Exhaust Valve Actuator, 5305 Grn
X	J3-H TCU Transmission Enable, 4034 Yel Not Used on PowrReverser Transmission
Y	J3-J Not Used
Z	J3-K Seat Switch Input, 0539B Wht
AA	J3-L Preheat Output, 5304 Yel
AB	J3-M Not Used
AC	J3-N Starter Relay, 0518 Gry
AD	J3-P Neutral Sensing Switch, 4529 Wht Not Used on eHydro Transmission
AE	J4-E Not Used
AF	J4-D Not Used
AG	J4-C MFWD Switch Input, 4555A Grn
AH	J4-B Not Used
AI	J4-A Not Used
AJ	J4-K Not Used
AK	J4-J Prt Reverse, 5351A Brn
AL	J4-H Not Used
AM	J4-G Fuel Level Input, 2353A Org
AN	J4-F Rear PTO Input, 4777A Pur
AO	J1-M Ground, 0050F Blk
AP	J1-L Right Turn Signal In, 1125A Grn
AQ	J1-K Left Turn Signal In, 1115A Grn
AR	J1-J Display Mode Switch In, 4004 Yel
AS	J1-H PTO Switch In, 4574A Yel
AT	J1-G PTO Solenoid Out, 4747A Pur
AU	J1-A Unswitched Instrument Power, 122B Red
AV	J1-B Unswitched Instrument Power, 122C Red
AW	J1-C Unswitched Instrument Power, 122D Red
AX	J1-D Unswitched Instrument Power , 122E Red
AY	J1-E Air Intake Filter, 5404 Yel
AZ	J1-F Switched Instrument Power, 0562D Red

TCU J1 Transmission Control Unit (TCU) Component Location



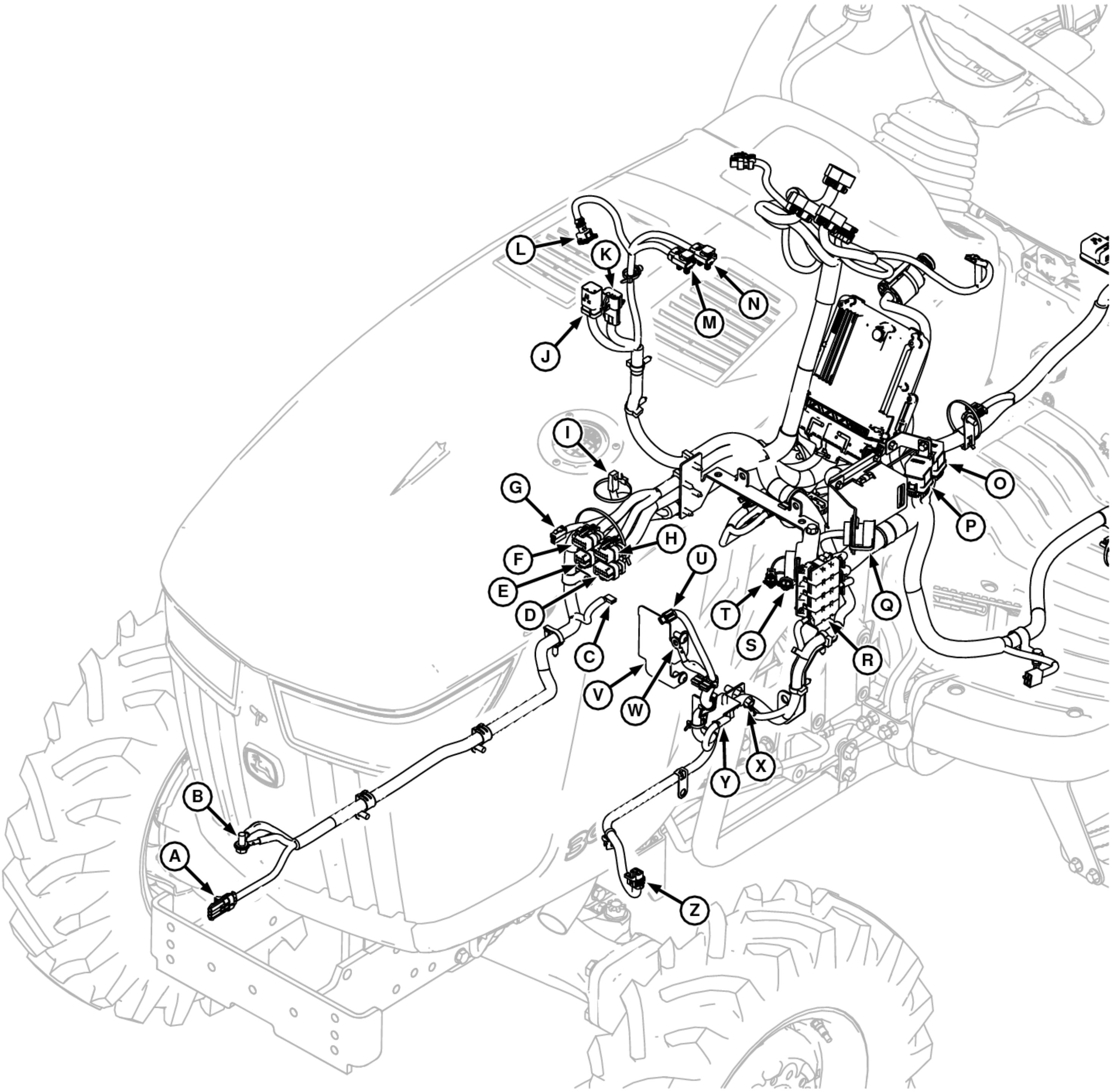
Transmission Control Unit

Transmission Control Unit

A2 Transmission Control Unit (TCU)			
Terminal	**OOS Wire Number**	**Cab Wire Number**	**Component**
A1	9924 Yel	9924B Yel	Can1—High
B1	9925D Grn	9925B Grn	Can1—Low
C1			Not Used
D1			Not Used
E1			Not Used
F1			Not Used
G1	0592C Red	0592A Red	Come Home Mode
H1	0562X Red	0562U Red	Transmission Interlock (IGN)
J1	4034 Yel	4034 Yel	Transmission Interlock (ICC)
K1	0539C Wht	0539C Wht	Operator Presence Switch
L1	0142 Red	0142 Red	Battery
M1	4472 Red	4472 Red	12V ELX
A2			Not Used
B2	4692A Red	4692A Red	FWD/REV Proportional Solenoid Valves (Supply)
C2			Not Used
D2			Not Used
E2			Not Used
F2			Not Used
G2	4268A Gry	4268 Gry	Load Match Switch
H2			Not Used
J2	4269A Wht	4269 Wht	Motion Match Switch
K2	4673A Org	4673A Org	Reference Supply (Pedals, Throttle, Sensors)
L2	0050H Blk	0050H Blk	Ground
M2	0550A Blk	0550A Blk	Reference Supply—Return
A3			Not Used
B3	4247A Pur	4247 Pur	Brake Pedal Switch
C3	4499 Wht		Throttle position Sensor
D3	4265A Grn	4265 Grn	Cruise Control Switch (Set/Decel)
E3	4166A Blu	4166A Blu	Reverse Pedal Position (A)
F3	4014A Yel	4014A Yel	Forward Pedal Position (A)
G3			Not Used

A2 Transmission Control Unit (TCU)			
H3	4625A Grn	4625A Grn	Forward Pedal Position (B)
J3			Not Used
K3			Not Used
L3			Not Used
M3			Not Used
A4			Not Used
B4			Not Used
C4	4261A Brn	4261 Brn	Auto Mode (eTHROTTLE)
D4	4266A Blu	4266 Blu	Cruise Control Switch (Res/Acel)
E4	4238A Gry	4238A Gry	Cruise Control Switch—ON
F4			Not Used
G4	4677A Pur	4677A Pur	Reverse Pedal Position (B)
H4	4267A Pur	4267 Pur	Cruise Control Max Speed—ON
J4	4203A Org	4203 Org	Backup Alarm (Output)
K4	4697A Pur	4697A Pur	Reverse Proportional Solenoid Valve (Return)
L4	4696A Blu	4696A Blu	Forward Proportional Solenoid Valve (Return)
M4	4005A Grn	4005A Grn	Primary Wheel Speed Sensor

W1 Chassis Wiring Harness Component Location (Front) (Open Station)



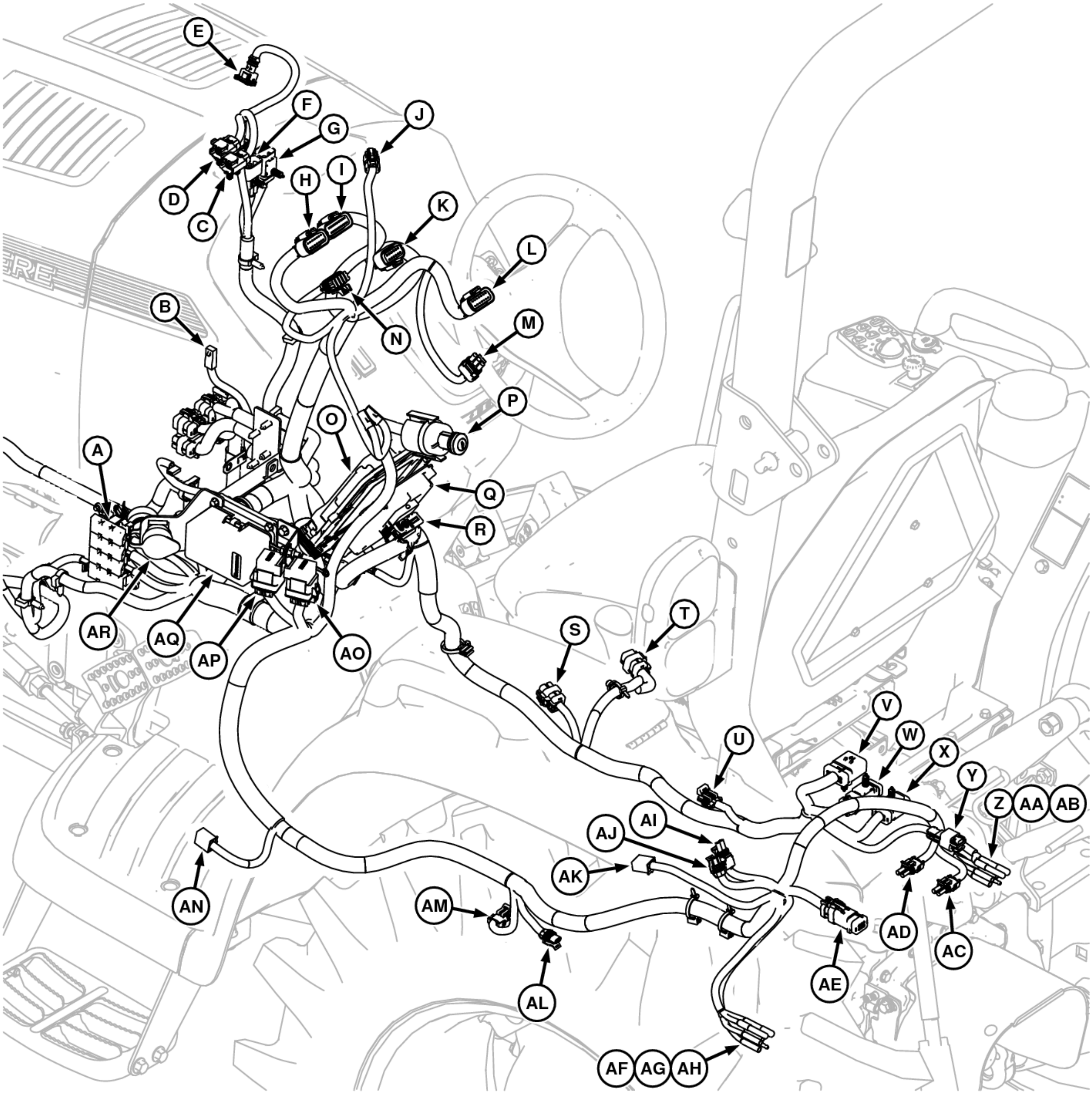
Sheet 1 of 2

LEGEND:

A	Mid Mount Prox Sensor
B	Ground Terminal
C	Oil Pressure Switch
D	12 Pin Engine Interface (Gray)
E	8 Pin Engine Interface (Red)
F	12 Pin Engine Interface (Yellow)
G	Fuel Pump
H	12 Pin Engine Interface (Red)
I	Glow Plug
J	DPF Interconnect
K	Junction Block Power
L	Air Restriction Switch
M	DPF Inlet Temp Sensor
N	DPF Mid Temp Sensor

O	Starter Relay
P	Glow Plug Relay
Q	Service Adviser Diagnostic Interface
R	Fuse Block
S	Audible Alarm
T	Alarm Assembly
U	Alternator
V	Alternator Shield
W	Alternator B+
X	Fuse Block to Starter
Y	Starter
Z	Exhaust Valve Actuator

W1 Chassis Wiring Harness Component Location (Rear) (Open Station)



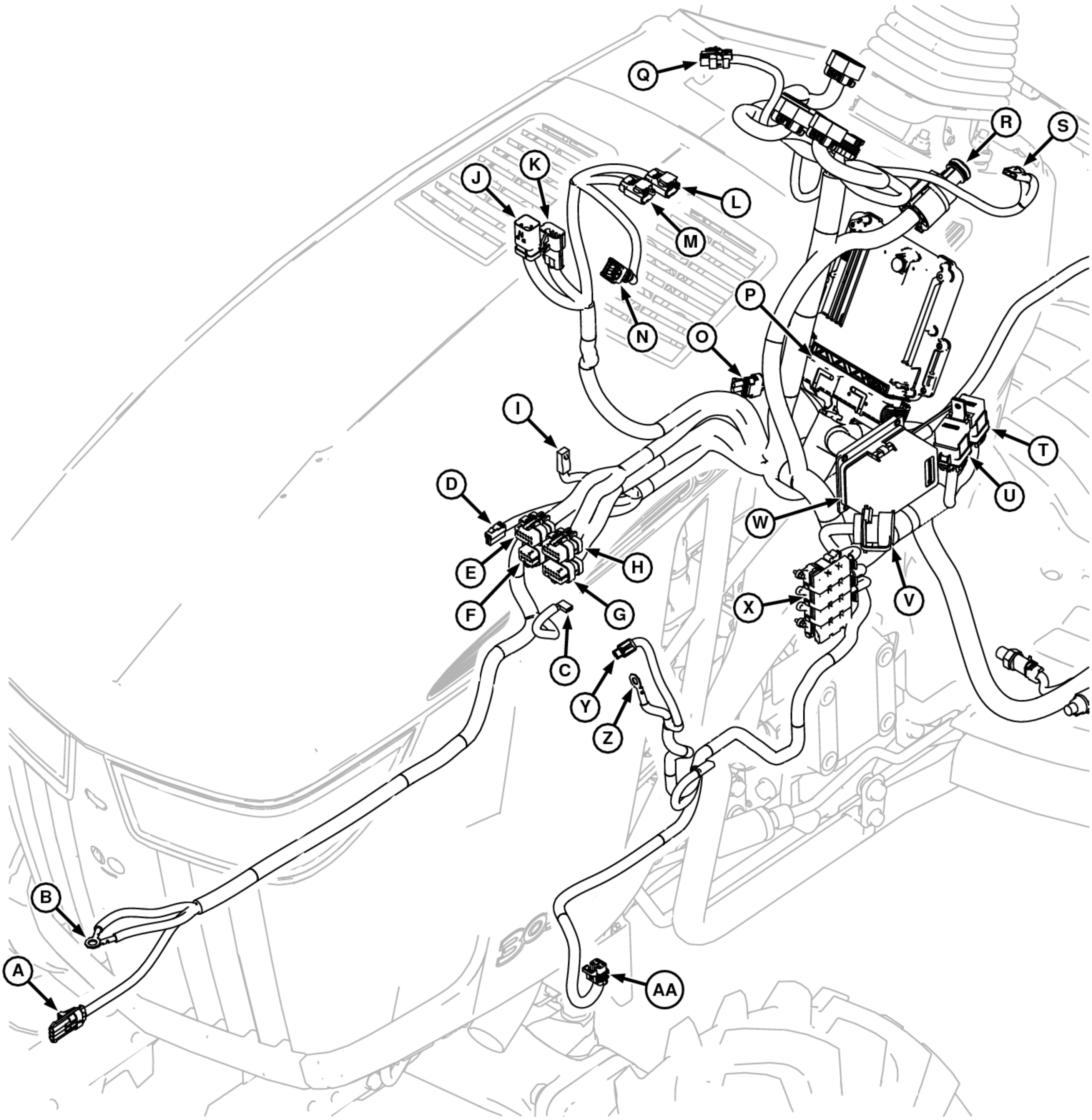
Sheet 2 of 2

LEGEND:

A	Fuse Block
B	Glow Plug
C	DPF Mid Temp Sensor
D	DPF Inlet Temp Sensor
E	Air Restriction Switch
F	Junction Block Power
G	DPF Interconnect
H	Display J3
I	Display J2
J	Fuel Guage Sensor
K	Display J1
L	Dash Panel Module
M	Hand Throttle Sensor
N	Display J4

O	Engine Control Unit (ECU)
P	Key Switch
Q	Transmission Control Unit (TCU)
R	TCU Connector
S	Forward Pedal Pot
T	Reverse Pedal Pot
U	MFWD Speed Sensor
V	Right Fender Interconnect 1
W	Creep to Repo Harness Connector
X	Right Fender Interconnect 2
Y	Backup Alarm
Z	Right Turn Tail Ground/Hazard Light
AA	Right Tail Lamp/Turn Lamp
AB	Right Work Light/Ground
AC	Rear PTO Sensing Switch
AD	Mid PTO Sensing Switch
AE	7 Pin Trailer Connector
AF	LeftTurn Tail Ground/Hazard Light
AG	Left Tail Lamp/Turn Lamp
AH	Left Work Light/Ground
AI	Air Ride Seat
AJ	Seat Switch
AK	Park Brake Switch
AL	PTO Solenoid
AM	MFWD Sensing
AN	Brake Switch
AO	Starter Relay
AP	Glow Plug Relay
AQ	Load Center
AR	Service Advisor Diagnostic Interface

W2 Chassis Wiring Harness Component Location (Front) (Open Station)—PowrReverser Transmission



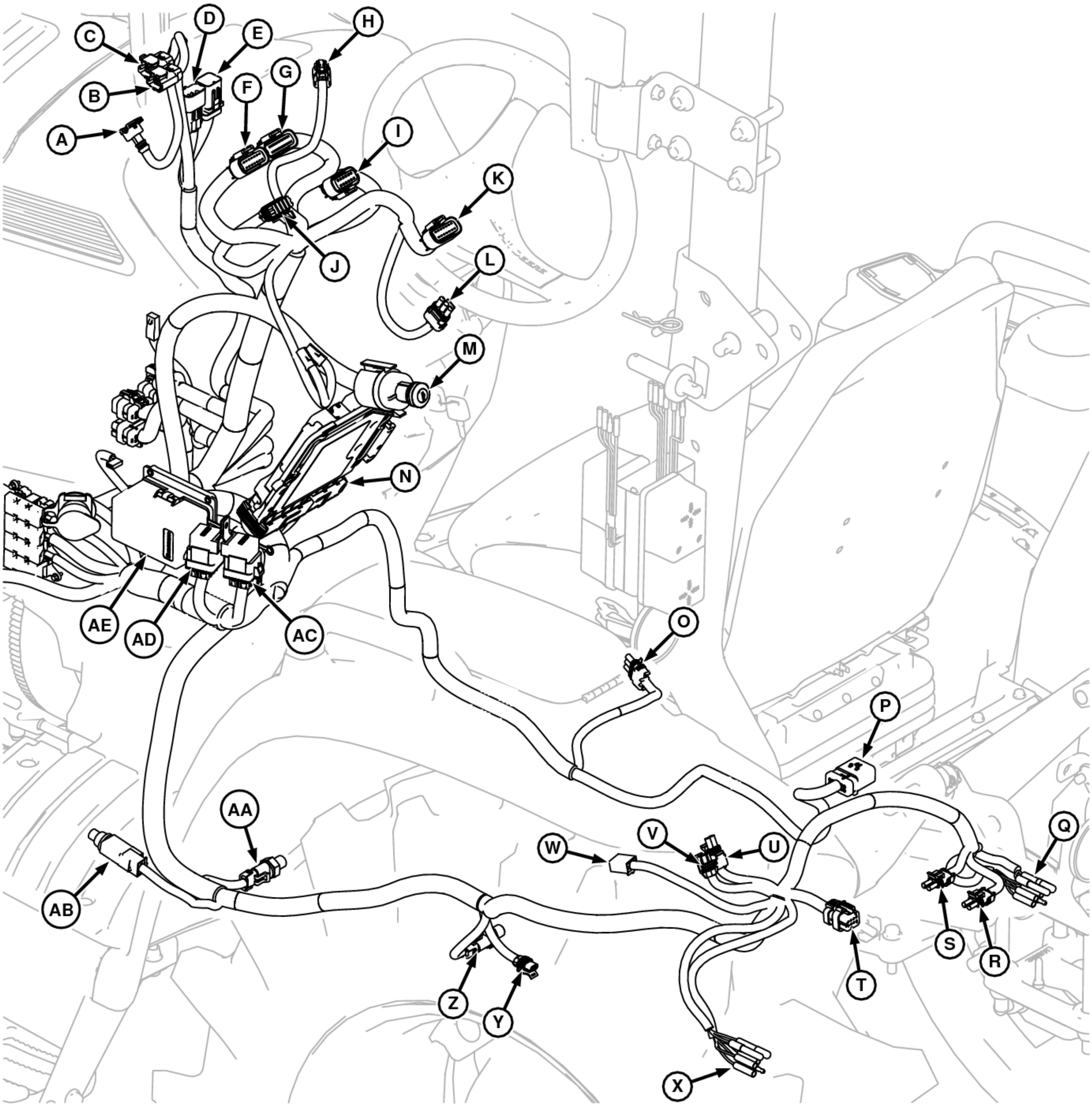
Sheet 1 of 2

LEGEND:

A	Mid Mount Prox Sensor
B	Ground Terminal
C	Oil Pressure Switch
D	Fuel Pump
E	12 Pin Engine Interface (Yellow)
F	8 Pin Engine Interface (Red)
G	12 Pin Engine Interface (Gray)
H	12 Pin Engine Interface (Red)
I	Glow Plug
J	DPF Interconnect
K	Junction Block Power
L	DPF Mid Temp Sensor

M	DPF Inlet Temp Sensor
N	Air Restriction Switch
O	Foot Throttle Sensor
P	Engine Control Unit (ECU) Connector
Q	Fuel Gauge Sensor
R	Key Switch
S	Horn
T	Starter Relay
U	Glow Plug Relay
V	Service Advisor Diagnostic Interface
W	Load Center
X	Fuse Block
Y	Alternator
Z	Alternator B+
AA	Exhaust Valve Actuator

W2 Chassis Wiring Harness Component Location (Rear) (Open Station)—PowrReverser Transmission



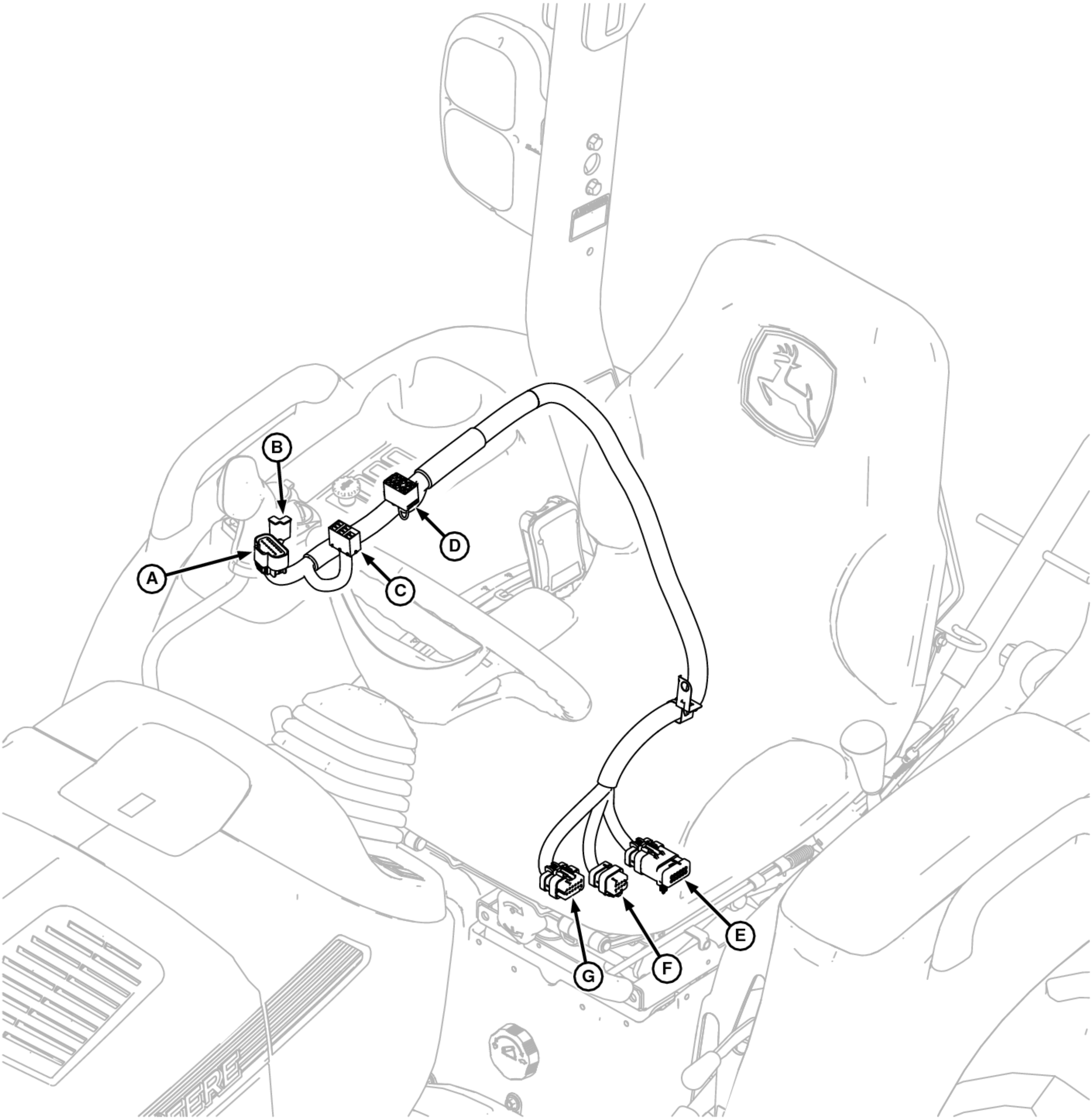
Sheet 2 of 2

LEGEND:

A	Air Restriction Switch
B	DPF Mid Temp Sensor
C	DPF Inlet Temp Sensor
D	Junction Block Power
E	DPF Interconnect
F	Display J3
G	Display J2
H	Fuel Guage Sensor
I	Display J1
J	Display J4
K	Dash Panel Module
L	Hand Throttle Sensor

M	Key Switch
N	Engine Control Unit (ECU) Connector
O	Foot Throttle Sensor
P	Right Fender Interconnect
Q	Right Turn Tail Ground/Hazard Light, Right Tail Lamp/Turn Lamp, and Right Work Light/Ground
R	Rear PTO Sensing Switch
S	Mid PTO Sensing Switch
T	7 Pin Trailer Connector
U	Air Ride Seat
V	Seat Switch
W	Park Brake Switch
X	Left Turn Tail Ground/Hazard Light, Left Tail Lamp/Turn Lamp, and Left Work Light/Ground
Y	PTO Solenoid
Z	MFWD Sensing
AA	Brake Switch
AB	Neutral Sensing Switch
AC	Starter Relay
AD	Glow Plug Relay
AE	Load Center

W3 Fender Wiring Harness Component Location (Open Station)

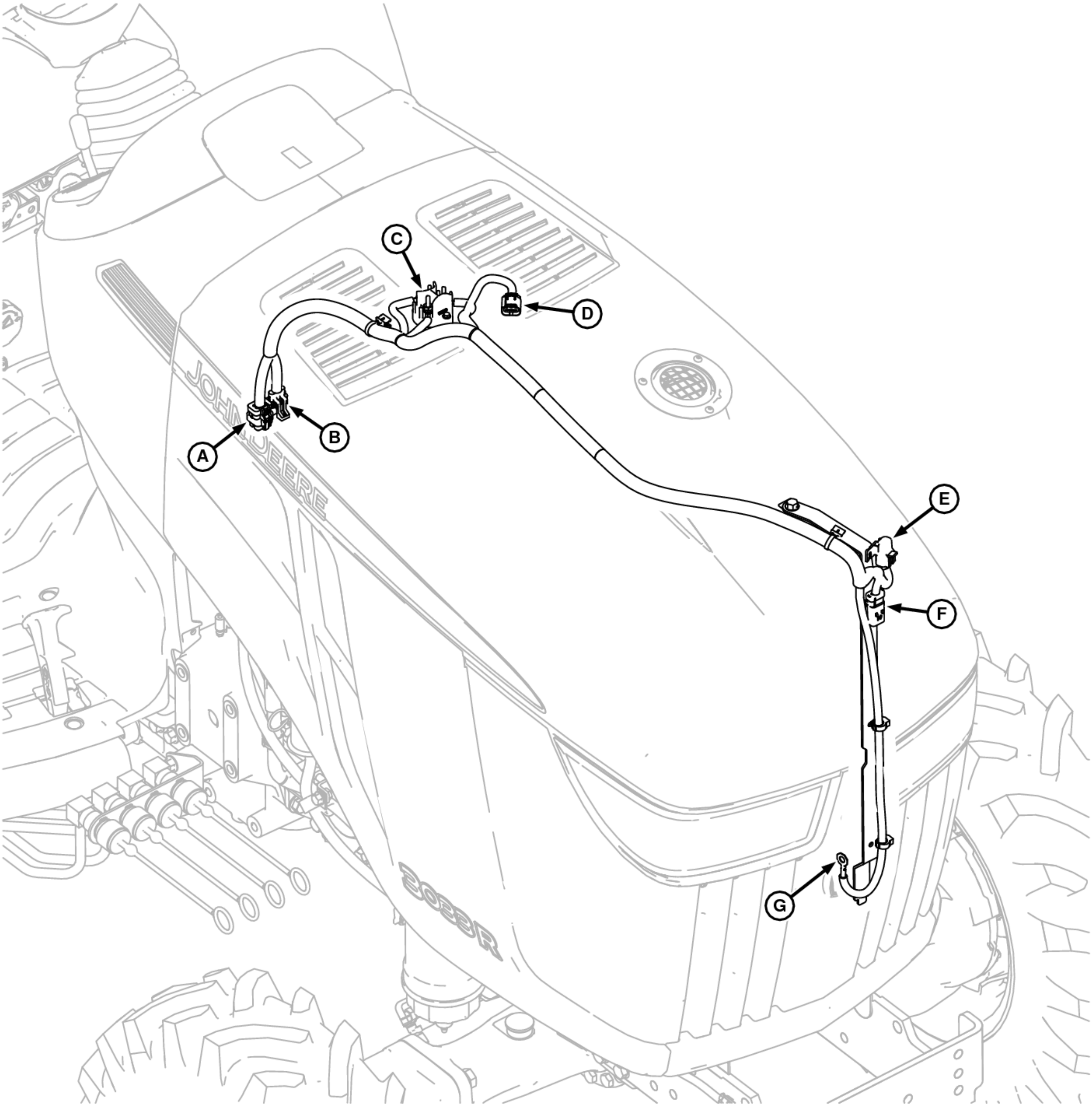


Fender Wiring Harness

LEGEND:

A	Cruise Upgrade Module
B	Power Port
C	PTO Switch
D	Diverter Switch
E	Third EH Hydraulic Kit Harness
F	Right Fender Connect 2
G	Right Fender Connect 1

W4 Hood Wiring Harness Component Location

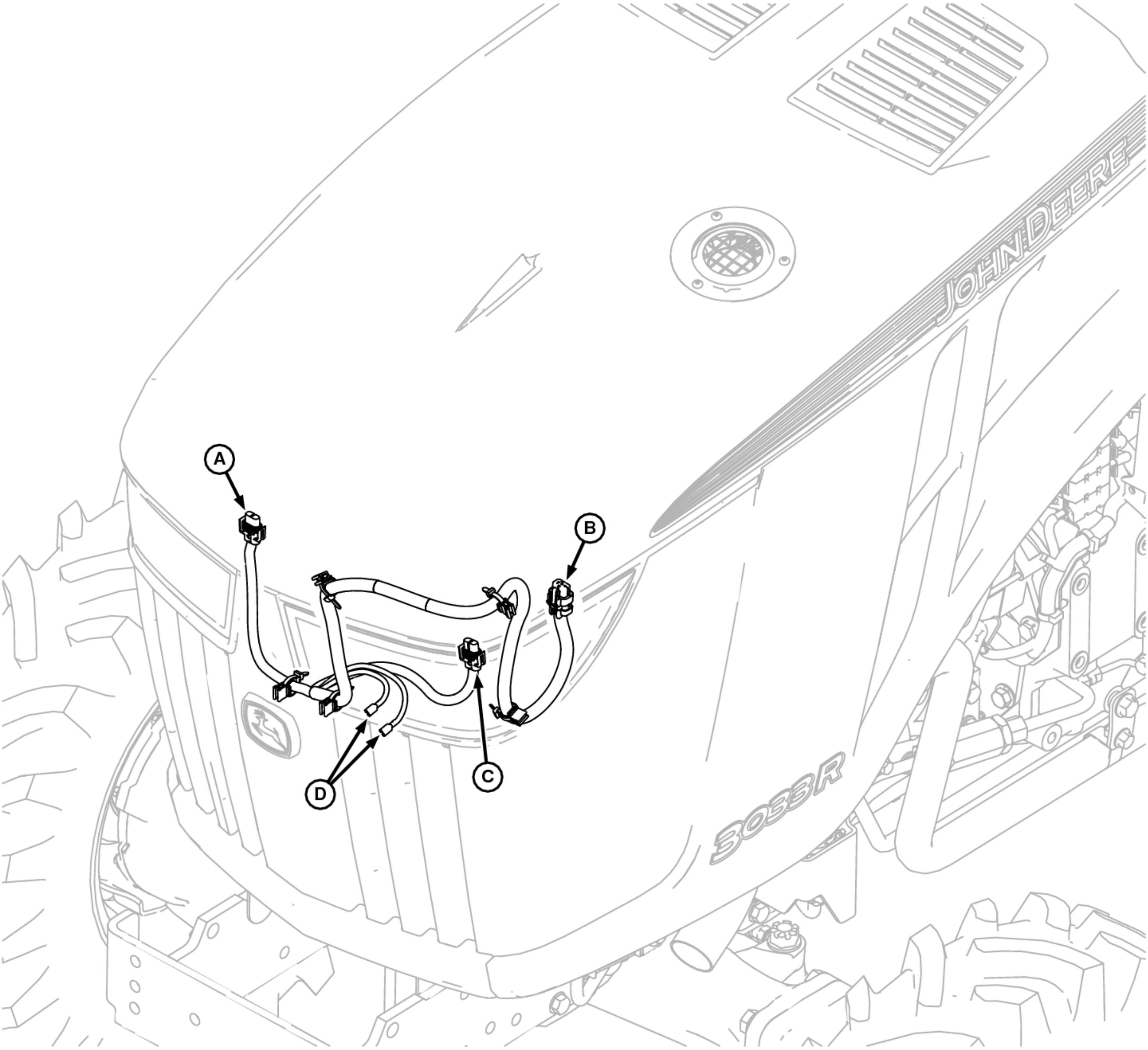


Hood Wiring Harness

LEGEND:

A	DPF Engine Harness Connector (8 Pin Yellow)
B	Junction Block Power
C	Junction Block Negative/B+/ACC
D	DPF Switch
E	Fuse Holder
F	Grille Harness Connect
G	Battery Post (Positive)

W5 Grille Wiring Harness Component Location

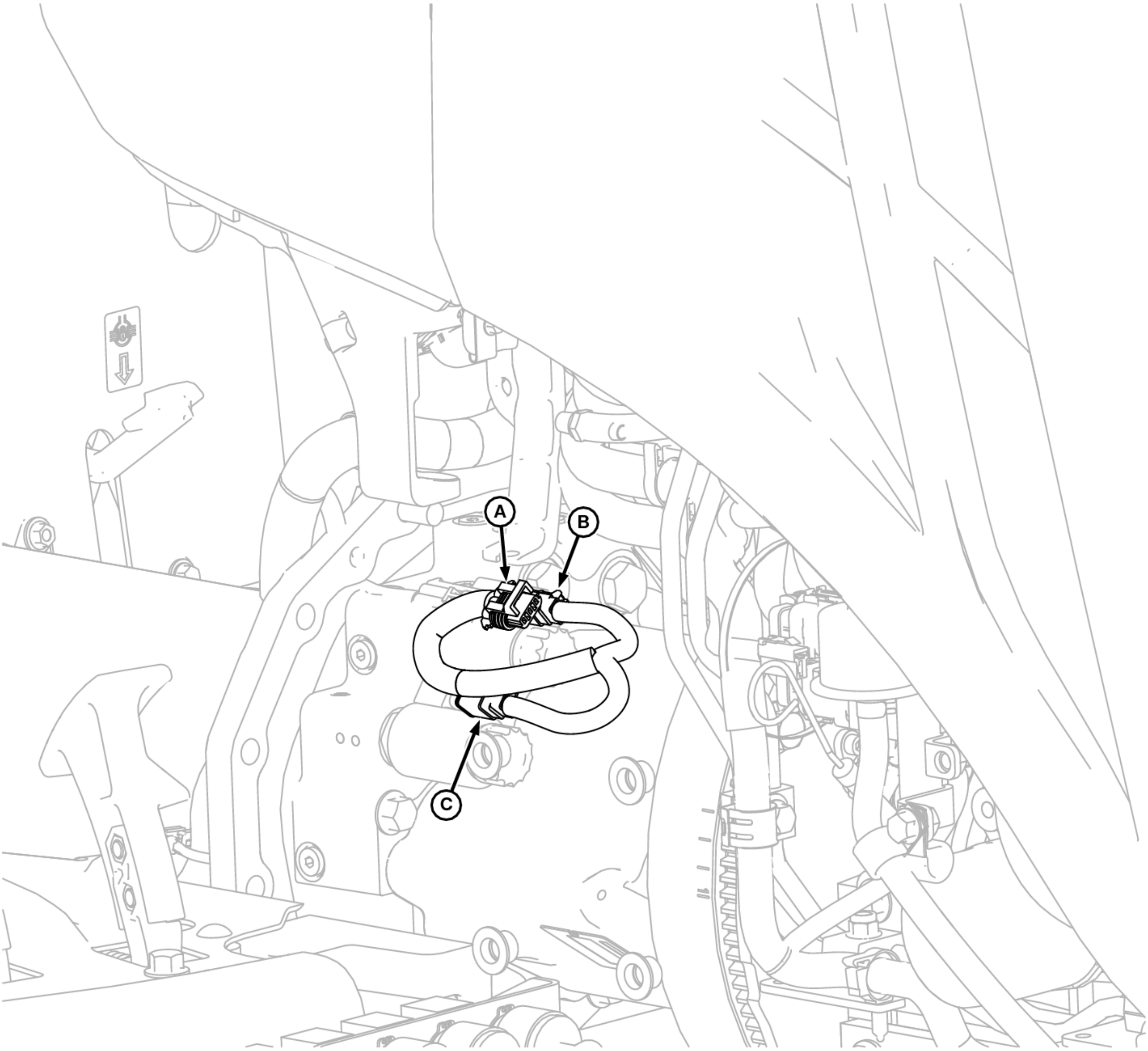


Grille Wiring Harness

LEGEND:

A	Right Headlight
B	Hood Harness Connect
C	Left Headlight
D	Horn Connector

W6 HST Valve Wiring Harness Component Location

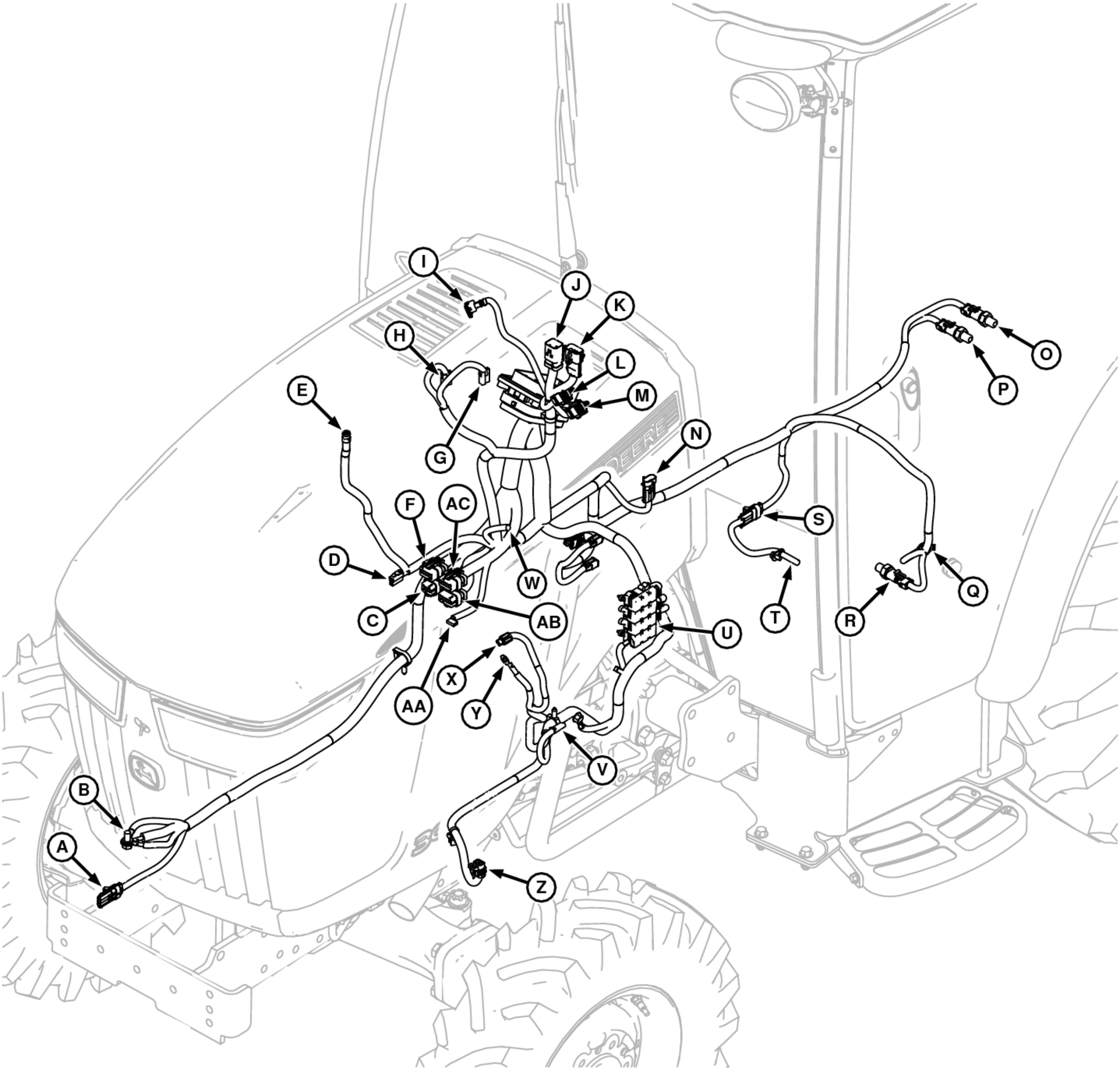


HST Valve Wiring Harness

LEGEND:

A	Reverse/Forward Solenoid Interconnect
B	Forward Proportional Solenoid
C	Reverse Proportional Solenoid

W7 Chassis Wiring Harness Component Location (Cab)



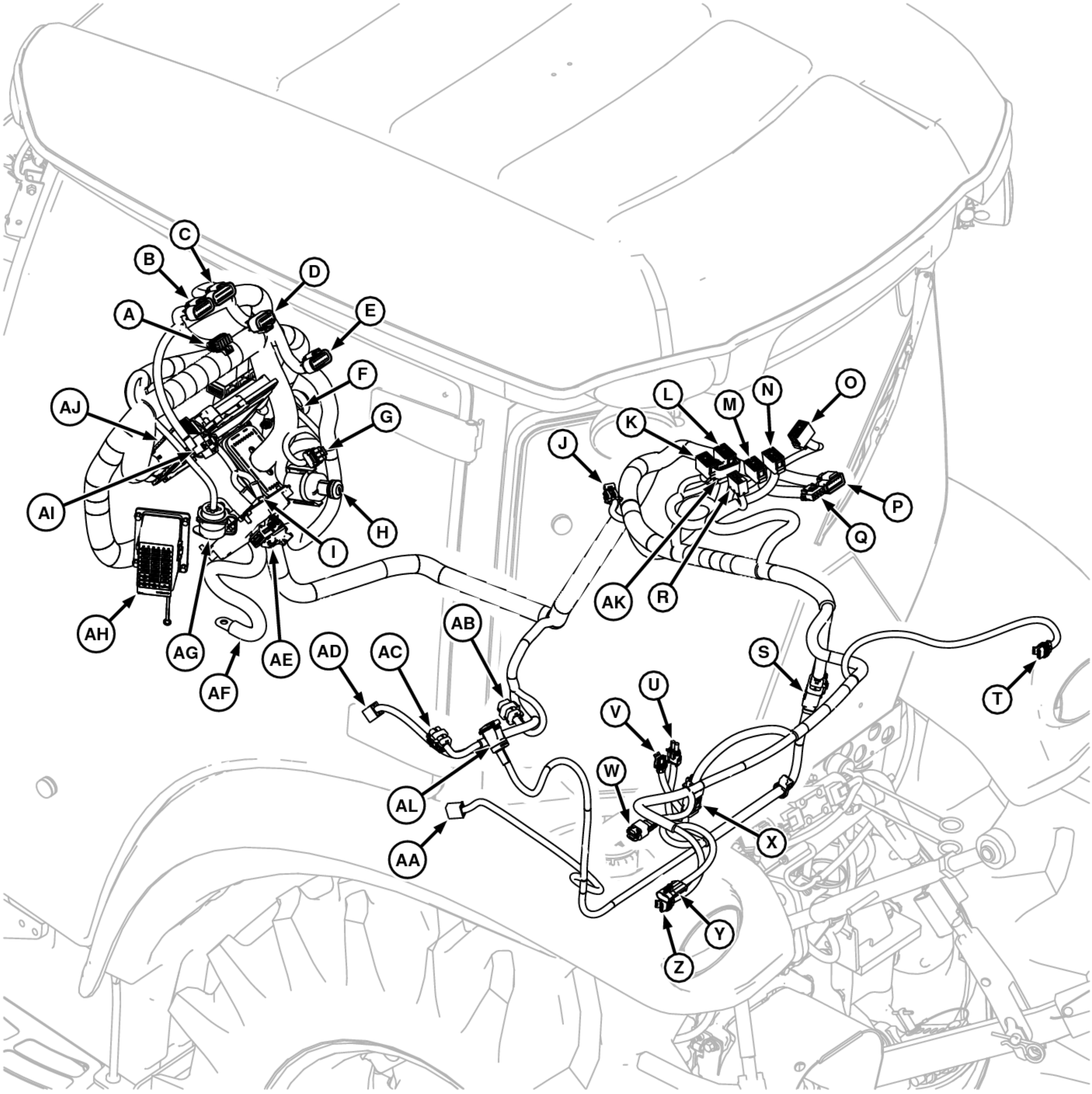
Cab Chassis Wiring Harness

LEGEND:

A	Mid Mount Proximity Sensing Switch
B	Ground Terminal
C	Yanmar Harness - C Connect (8 Pin Red)
D	Fuel Pump
E	Air Conditioning Clutch
F	Yanmar Harness - B Connect (12 Pin Yellow)
G	Rear Washer Pump
H	Front Washer Pump
I	Air Filter Restriction Switch
J	DPF Interconnect
K	Juntion Block Power
L	DPF Inlet Temp Sensor
M	DPF Mid Temp Sensor
N	HST Solenoids Interconnect

O	Rear PTO Sensing Switch
P	Mid PTO Sensing Switch
Q	Rear PTO Solenoid
R	MFWD Sensing Switch
S	MFWD Speed Sensing Switch
T	Hall Effect Sensor
U	Fuse Block
V	Start Motor Solenoid
W	Glow Plug
X	Alternator
Y	Alternator Power
Z	Exhaust Valve Actuator
AA	Engine Oil Pressure Switch
AB	Yanmar Harness - C Connect (12 Pin Gray)
AC	Yanmar Harness - C Connect (12 Pin Red)

W8 Lower Wiring Harness Component Location (Cab)



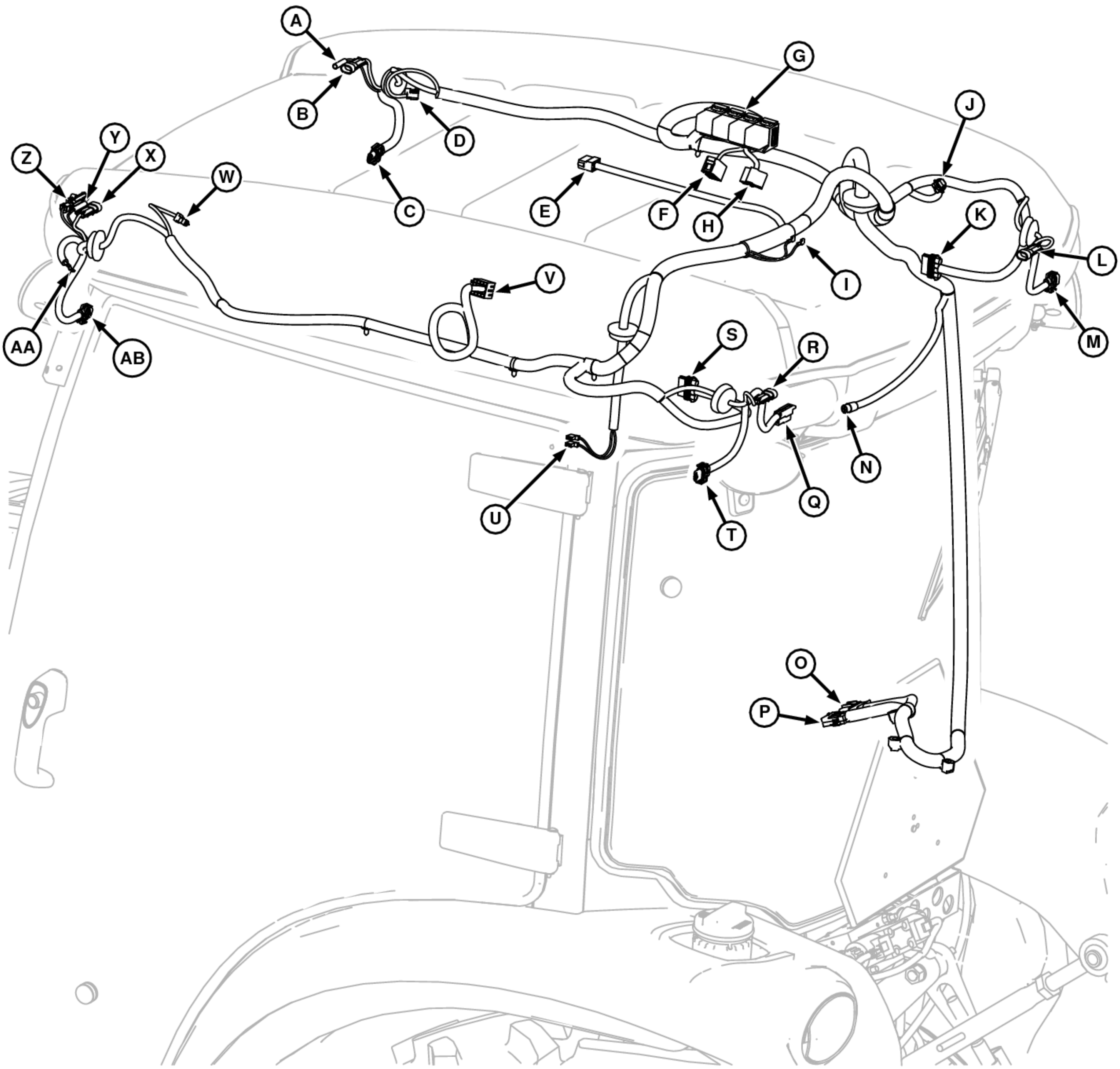
Lower Cab Wiring Harness

LEGEND:

A	Display J4
B	Display J3
C	Display J2
D	Display J1
E	Dash Panel Module
F	Audible Alarm
G	Hand Throttle Sensor
H	Key Switch
I	Horn
J	EH Handle Harness
K	Diverter Switch
L	Beacon Lamp Switch
M	Rear Wiper Switch
N	Rear Work Light Switch

O	Dual Rear Continuous Switch
P	Roof Harness Connect
Q	Roof Harness Connect
R	PTO Switch
S	Rear Harness Connect
T	Right Tail Light
U	Air Ride Seat
V	Seat Switch
W	Backup Alarm
X	7 Pin Trailer Connector
Y	Fuel Sender
Z	Left Tail Light
AA	Brake Switch
AB	Forward Pedal Pot
AC	Reverse Pedal Pot
AD	Park Brake Switch
AE	TCU Connection
AF	Cab to Chassis Ground Harness
AG	Service Advisor Diagnostic Interface
AH	Load Center
AI	Front Wiper Switch
AJ	Engine Control Unit (ECU) (2 used)
AK	Cruise Upgrade Module
AL	Power Port

W9 Upper Wiring Harness Component Location (Cab)



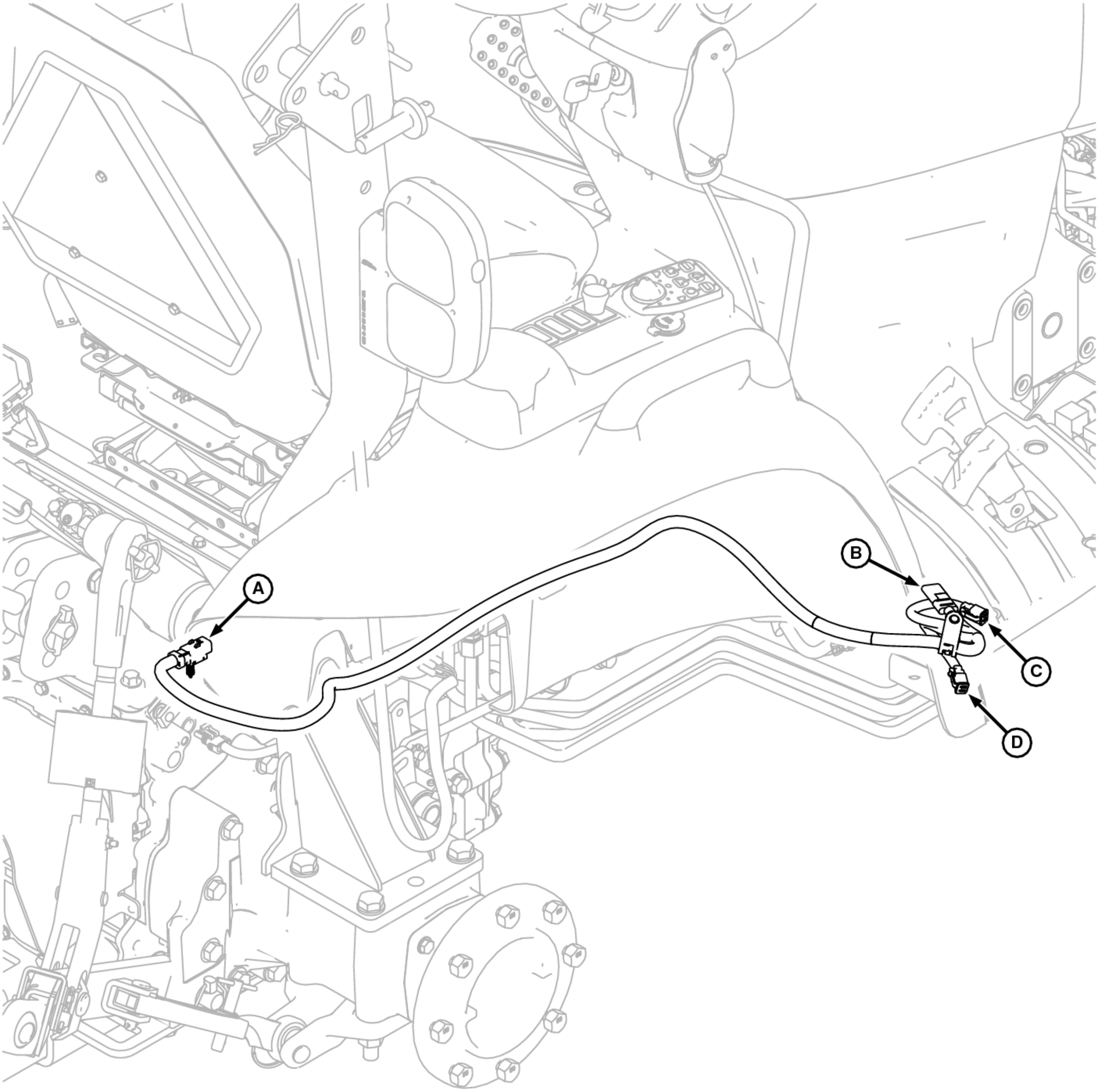
Upper Cab Wiring Harness

LEGEND:

A	Right Front Marker Light
B	Right Front Amber Light
C	Right Front Work Light
D	Right Speaker
E	Dome Light
F	HVAC Enable Switch
G	Power & Blower Relays
H	Blower Switch
I	HVAC Temp Switch
J	Hi-Lo Pressure Switch
K	Right Blower Motor
L	Right Rear Amber Light
M	Right Rear Work Light
N	Rear Wiper Motor

O	Cab Harness Connect
P	Cab Harness Connect
Q	License Plate
R	Left Rear Amber Light
S	Left Blower Motor
T	Left Rear Work Light
U	Door Switch
V	Radio
W	Left Speaker
X	Left Front Amber Light
Y	Left Front Marker Light
Z	Beacon with Cap
AA	Beacon Ground
AB	Left Front Work Light

W10 Diverter Valve Jumper Harness Component Location

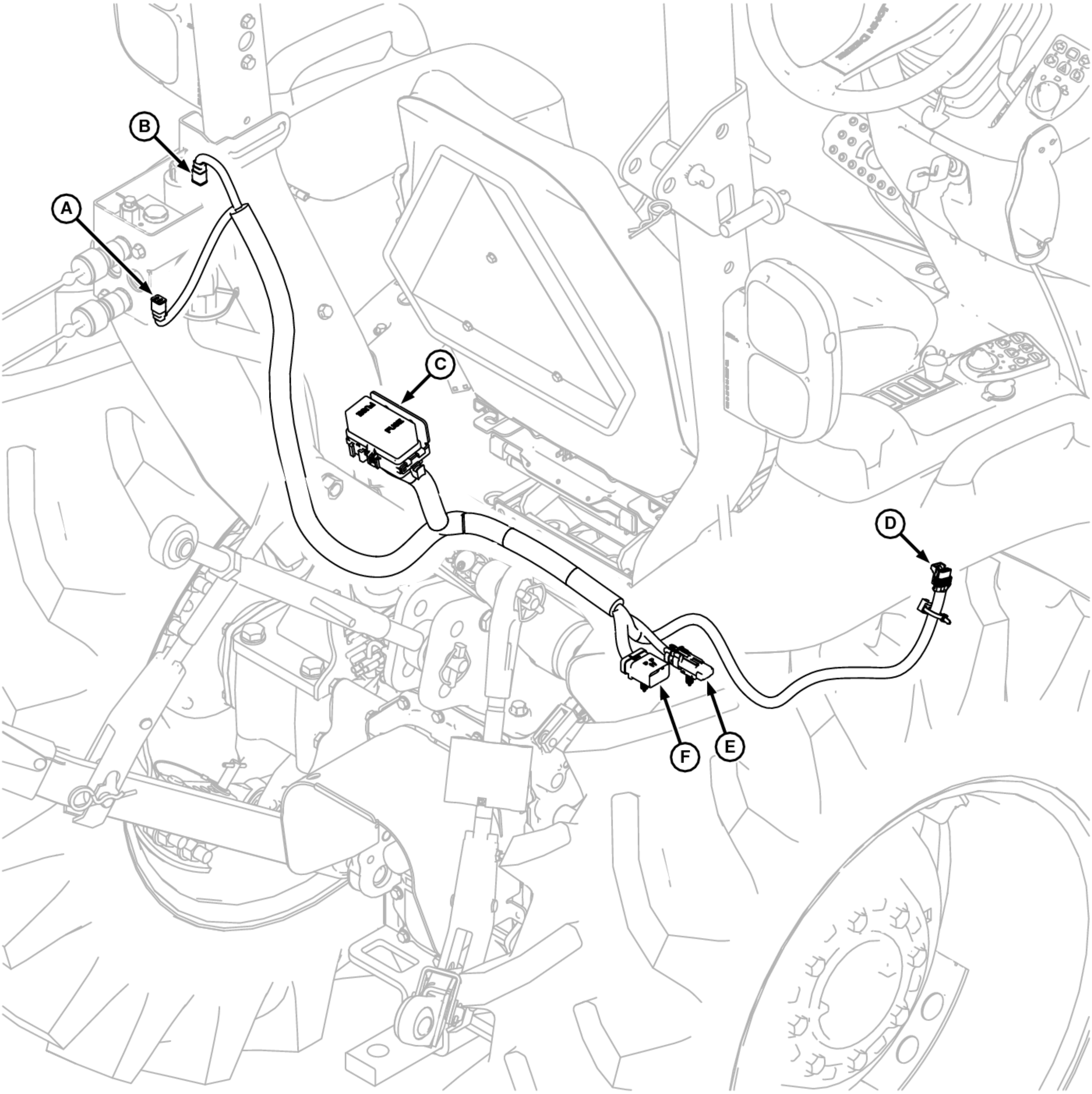


W10 Diverter Valve Jumper Harness

LEGEND:

A	3rd EH Harness Interconnect
B	Diode (5A)
C	Upper Hydraulic Solenoid Valve
D	Lower Hydraulic Solenoid Valve

W11 3rd EH Wiring Harness Component Location (Open Station) (—OCT 2014)

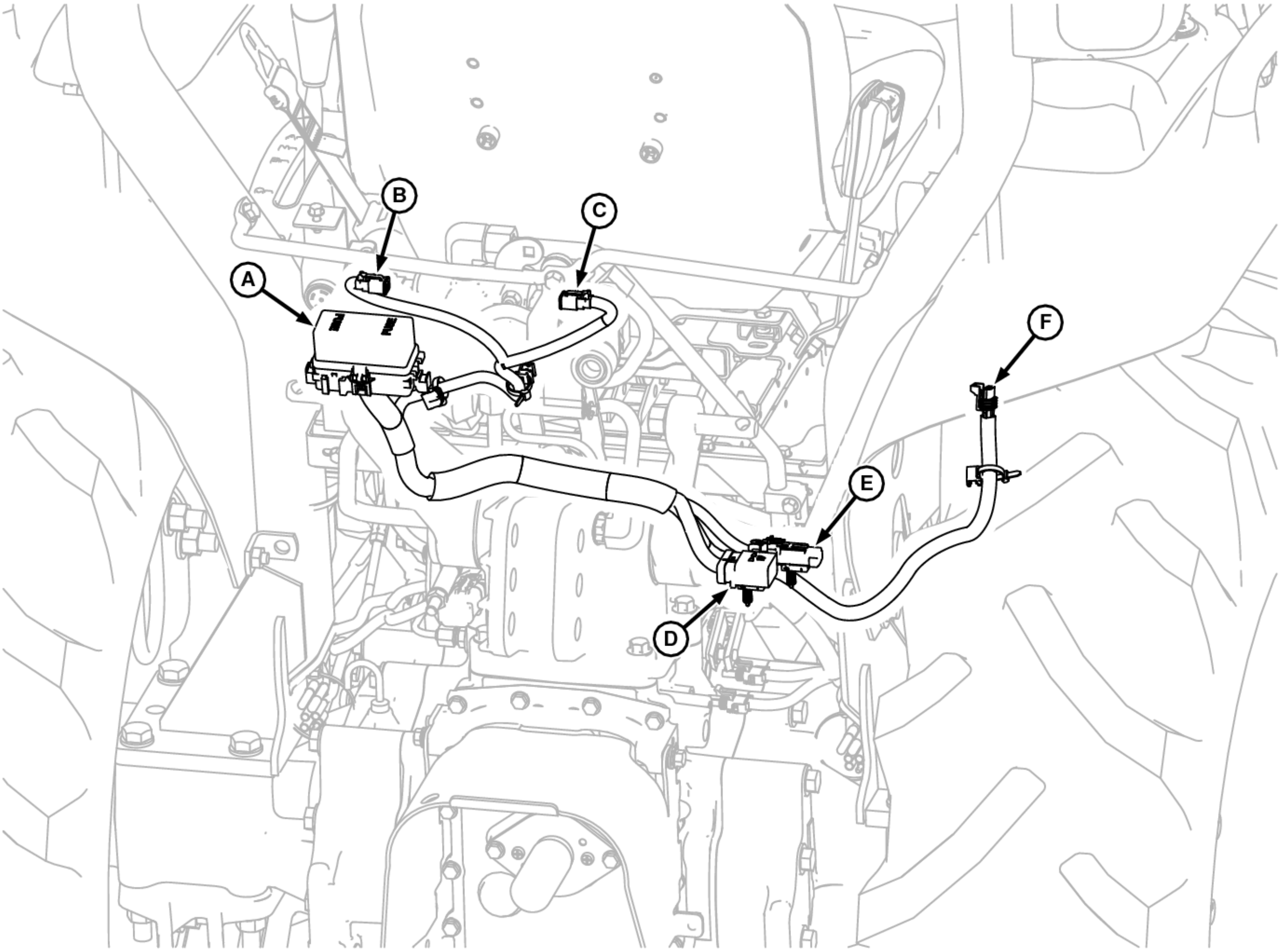


W11 3rd EH Wiring Harness (Open Station)

LEGEND:

A	3rd Function Solenoid B
B	3rd Function Solenoid A
C	Load Center
D	3rd EH Handle
E	Diverter Jumper Kit
F	3rd EH Hydraulic Kit

W11 3rd EH Wiring Harness Component Location (Open Station) (OCT 2014—)

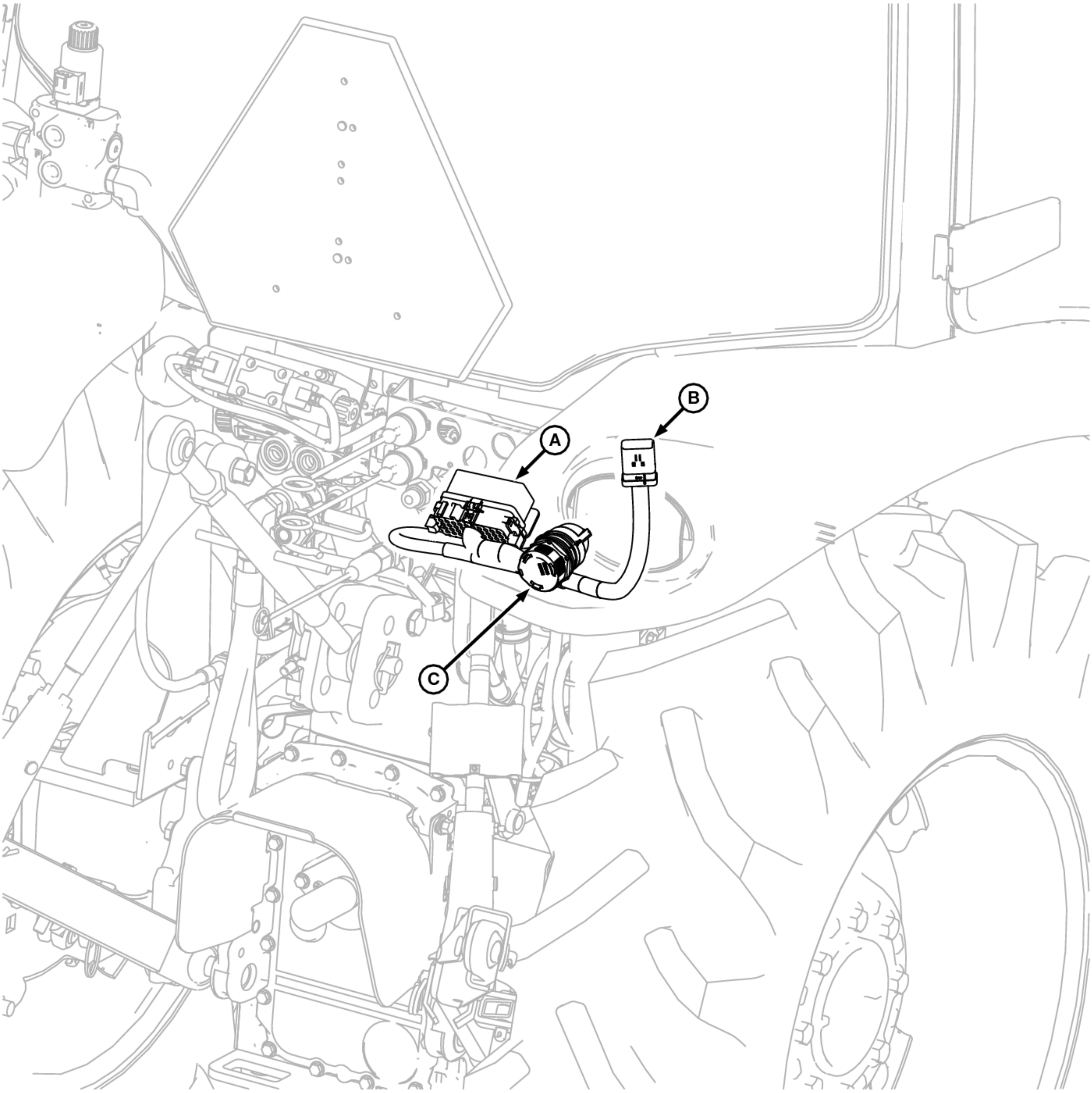


W11 3rd EH Wiring Harness (Open Station)

LEGEND:

A	Load Center
B	3rd Function Solenoid B
C	3rd Function Solenoid A
D	Rear Harness Connect
E	Diverter Jumper
F	3rd EH Handle/Mutli-Function Lever

W12 Load Center Harness Component Location (Cab)



W12 Load Center Harness (Cab)

LEGEND:

A	Load Center
B	Rear Harness Interconnect
C	3rd EH, Diverter, Creep to REPO

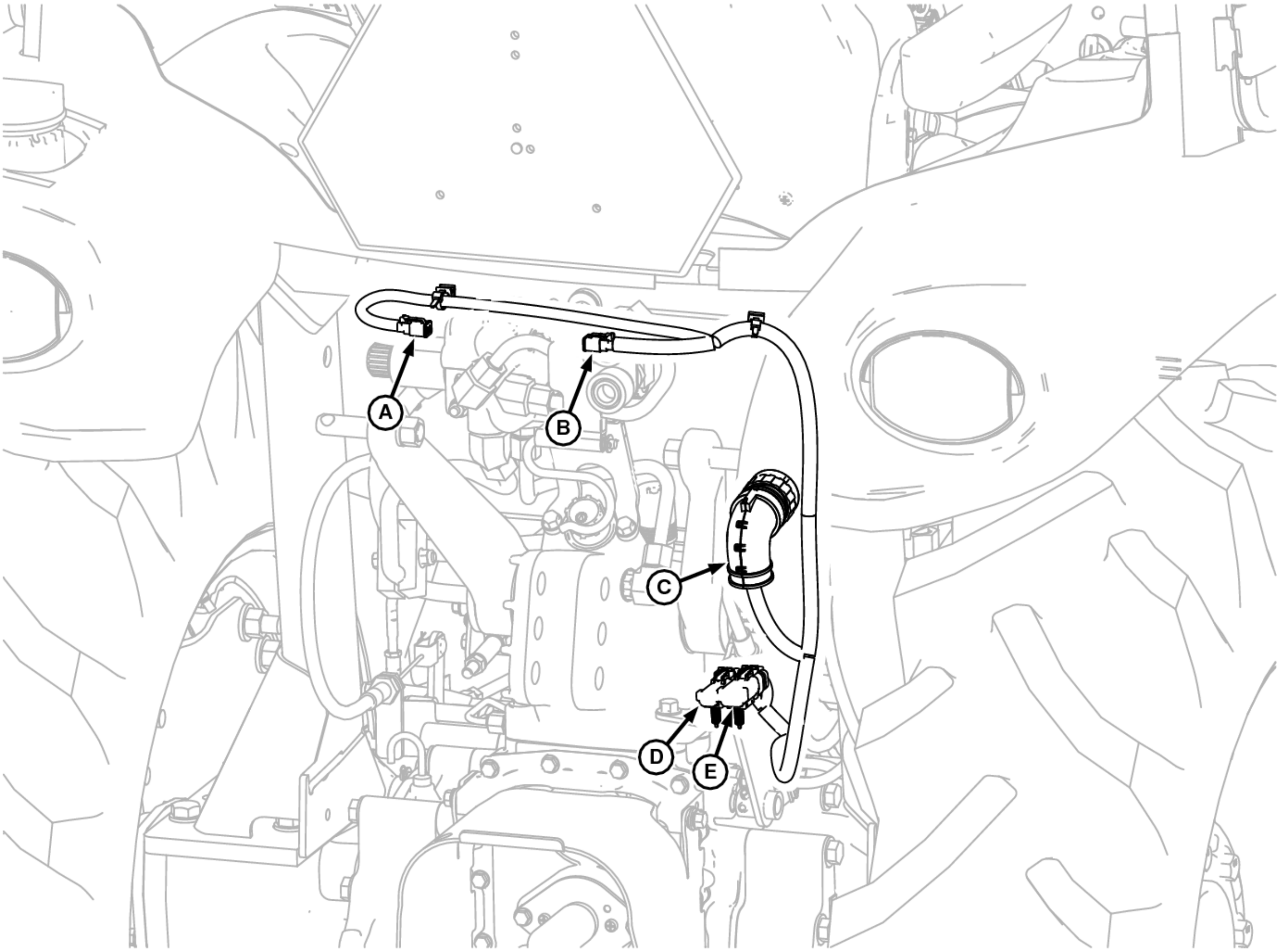
W13 3rd EH, Diverter, Creep to REPO Harness Component Location (Cab)(—OCT 2014)

W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

A	3rd Function Solenoid A
B	3rd Function Solenoid B
C	Load Center Jumper Harness
D	Diverter Jumper Harness
E	Creep to REPO Harness

W13 3rd EH, Diverter, Creep to REPO Harness Component Location (Cab)(OCT 2014—)

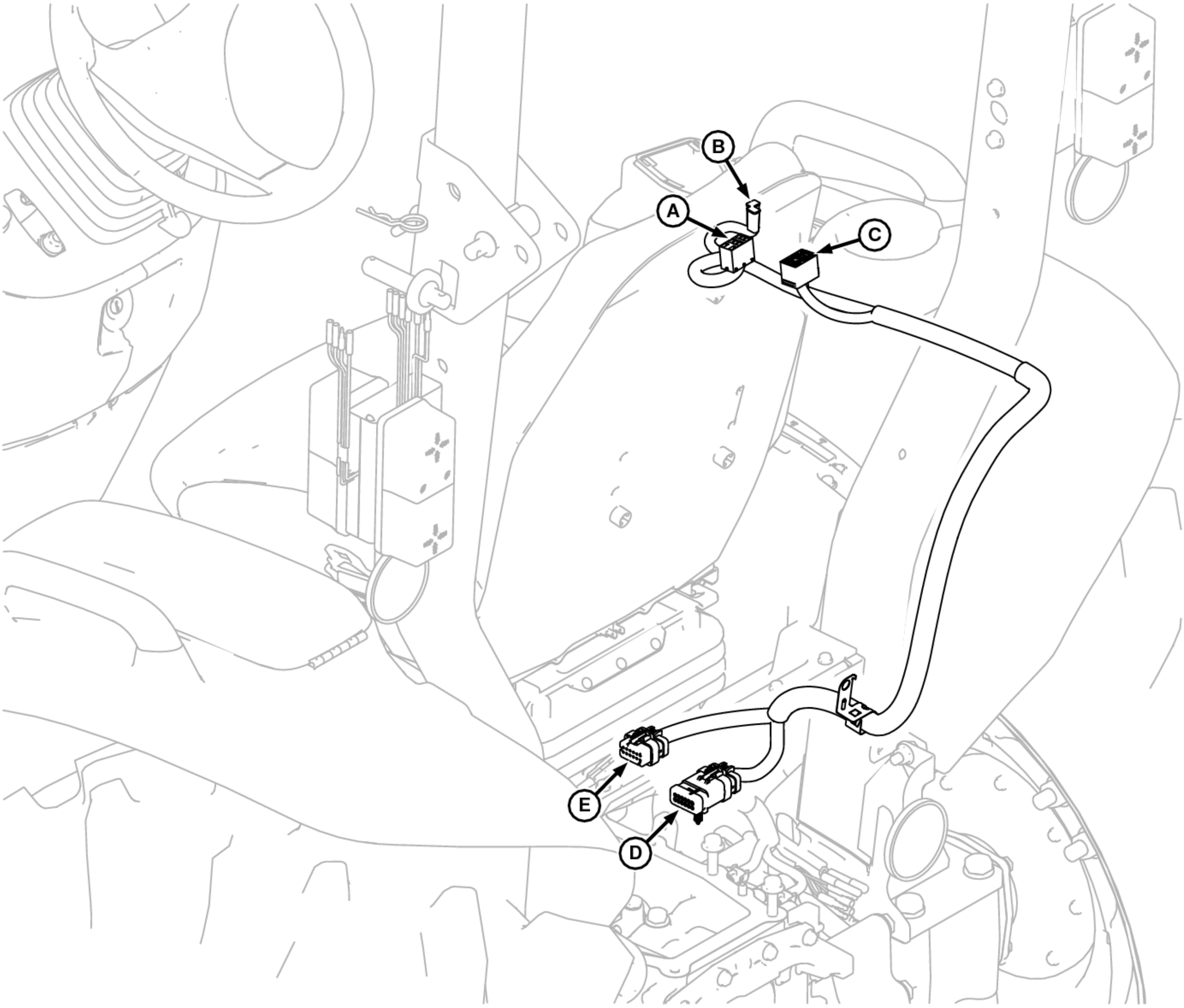


W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

B	3rd Function Solenoid B
A	3rd Function Solenoid A
C	Load Center Jumper Harness
D	Diverter Jumper Harness
E	Creep to REPO Harness

W16 Fender Wiring Harness Component Location (Open Station)—PowrReverser Transmission

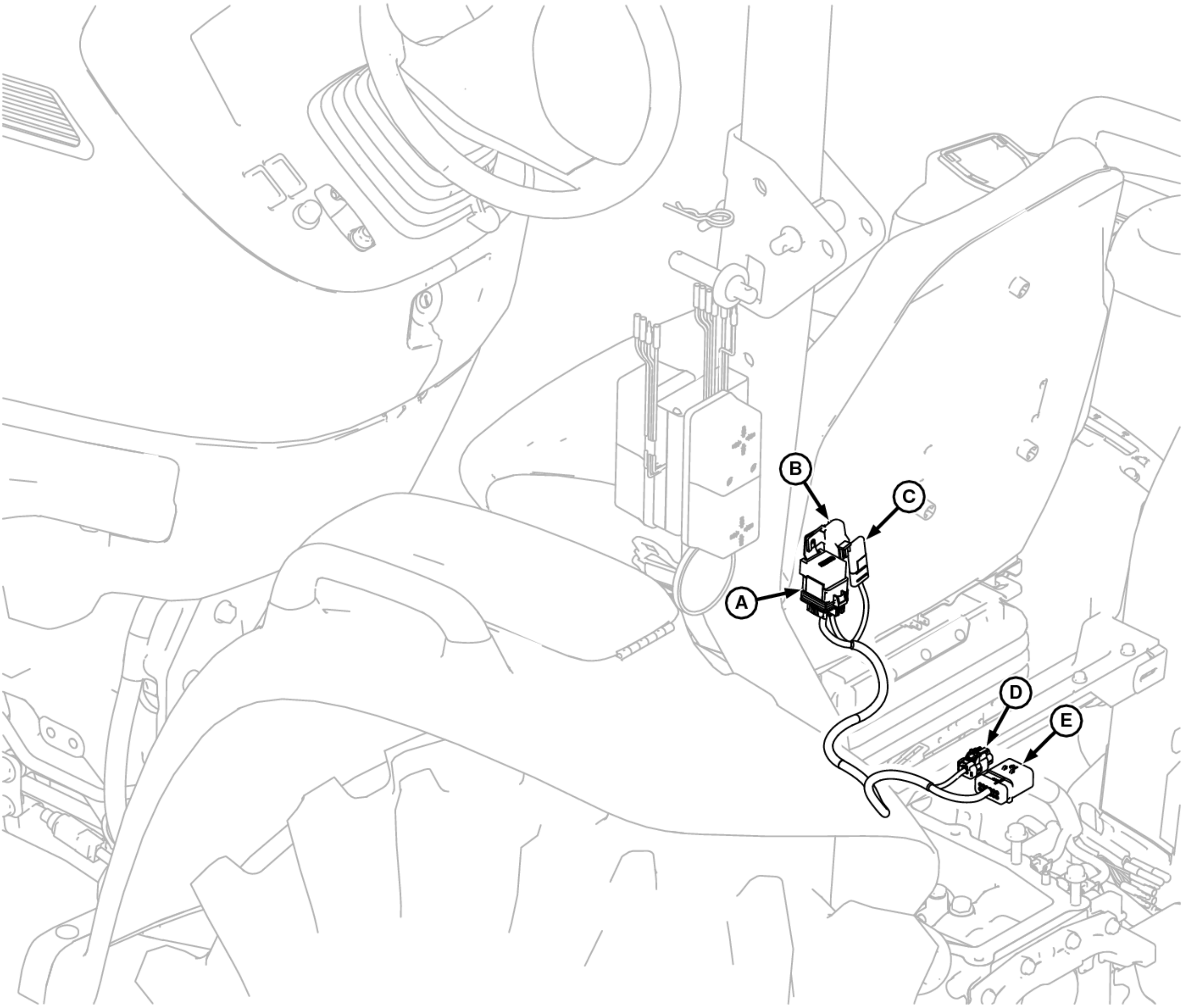


Right Fender PRT

LEGEND:

A	PTO Switch
B	Power Port
C	Diverter Switch
D	Third EH Hydraulic Kit Harness
E	Right Fender Connect

W17 Diverter Wiring Harness Component Location (Open Station)

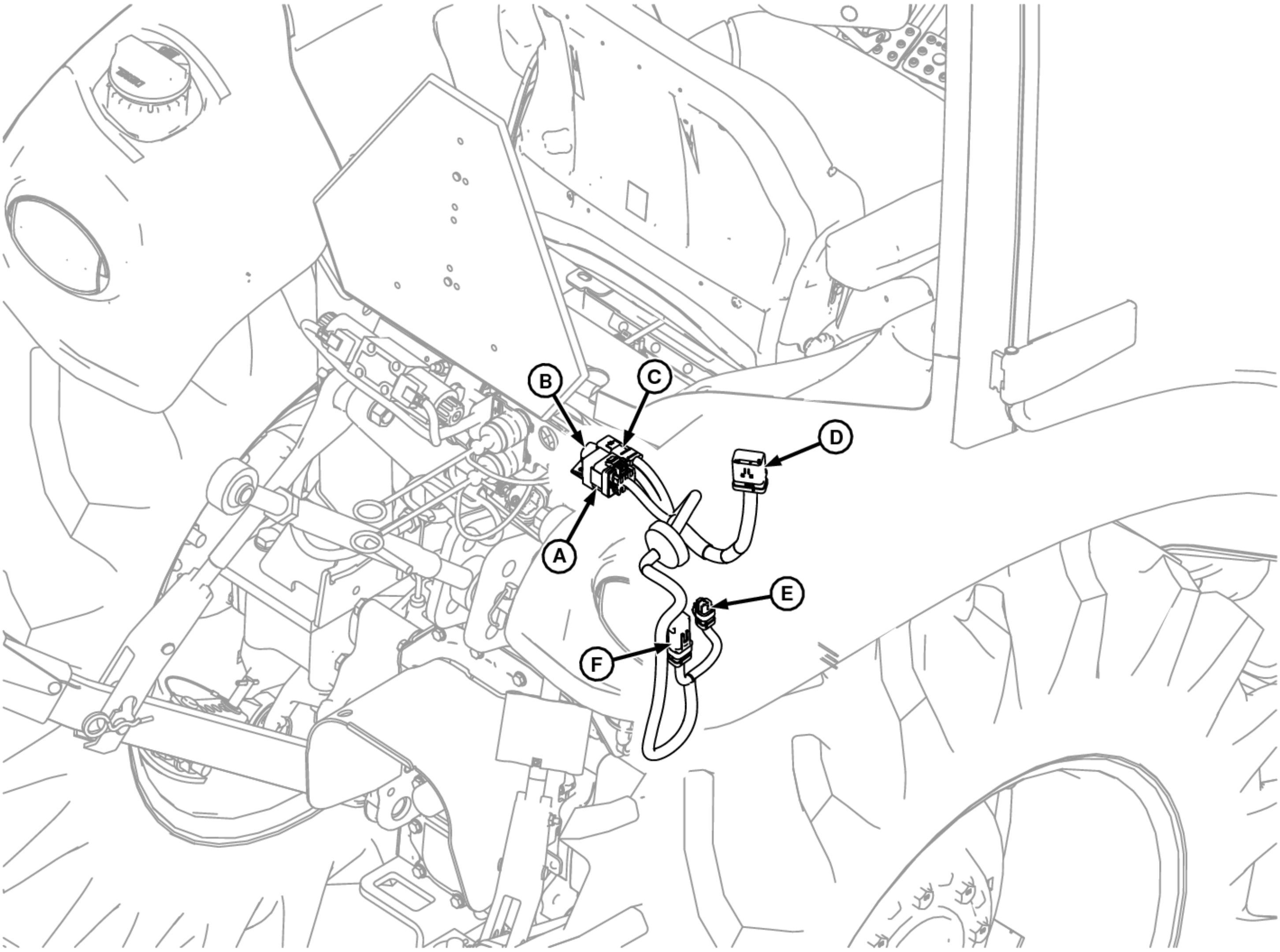


Diverter Harness PTR

LEGEND:

A	Diverter Relay
B	Diverter Fuse
C	Diverter Diode
D	Diverter Harness-to-Right Fender Harness
E	Diverter Jumper Harness Connector

W18 Diverter Wiring Harness Component Location (Cab)

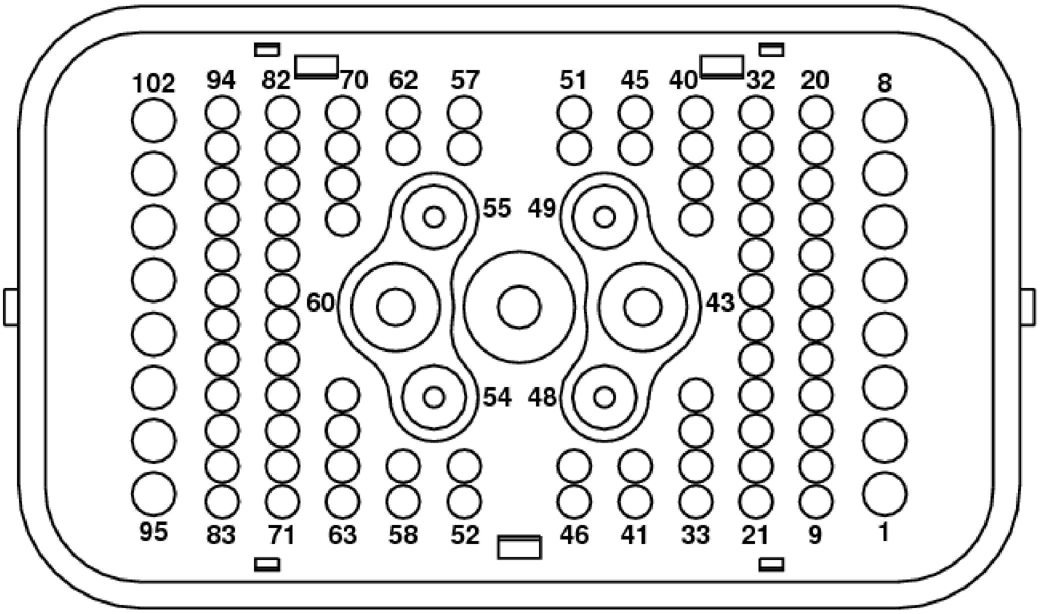


Diverter Wiring Harness Component Location (Cab)

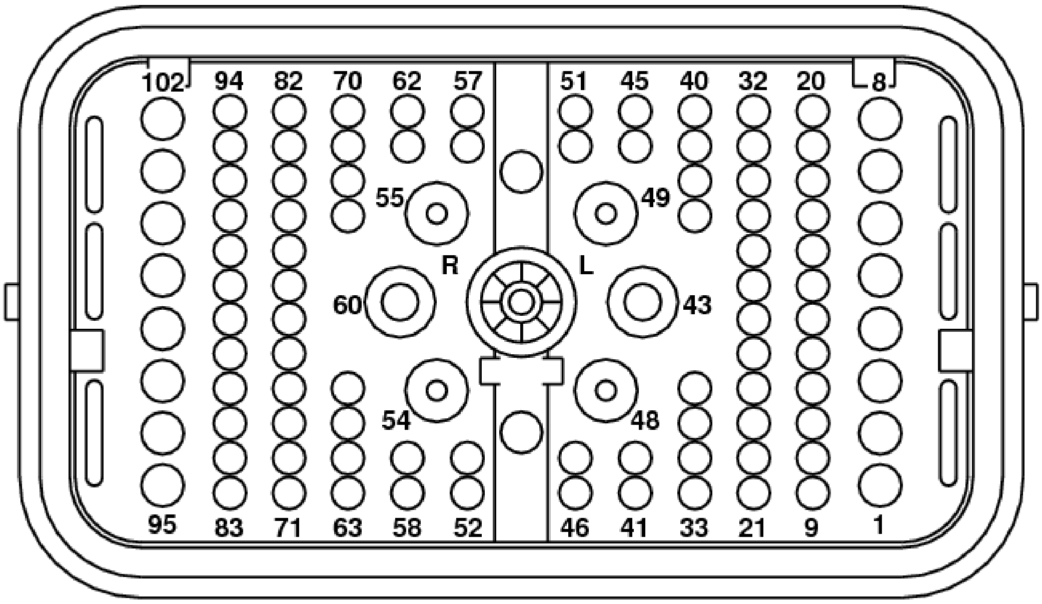
LEGEND:

A	Diverter Relay
B	Diverter Fuse
C	Diverter Diode
D	Rear Harness Connector
E	Rockshaft/Diverter Solenoid
F	Diverter Wiring Harness to REPO Harness Interconnect

Chassis Harness Interconnect Component Location



Chassis Harness Interconnect



Lower Harness Interconnect

X50 Harness Interconnect

X50 Harness Interconnect			
		Chassis Harness Interconnect	Lower Harness Interconnect
Wire Pin	Wire Color	Wire Number	Wire Number
1		NOT USED	NOT USED
2		NOT USED	NOT USED
3		NOT USED	NOT USED
4		NOT USED	NOT USED
5		NOT USED	NOT USED

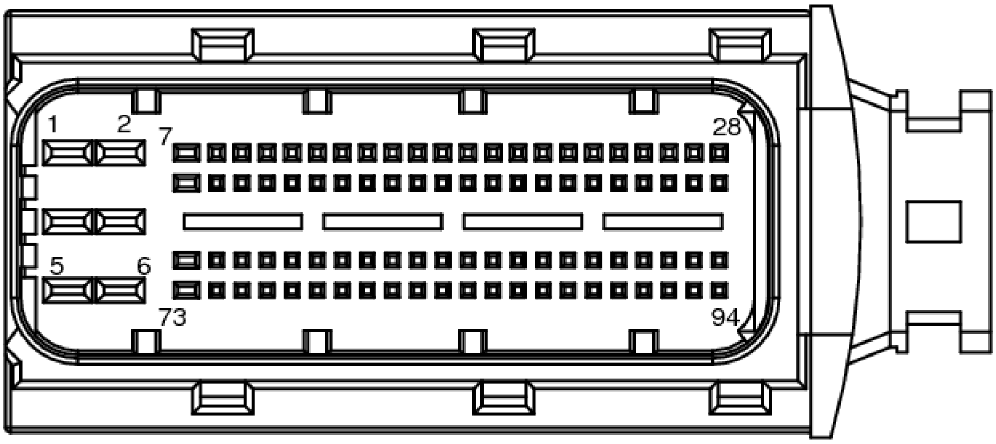
X50 Harness Interconnect			
6		NOT USED	NOT USED
7		NOT USED	NOT USED
8		NOT USED	NOT USED
9		5484B	5484A
10		5485B	5485A
11		5430B	5430A
12	Yel	5454B	5454A
13	Org	5403B	5403A
14	Wht	5429B	5429A
15	Blu	5476B	5476A
16	Grn	5435B	5435A
17	Brn	5401B	5401A
18	Yel	5464B	5464A
19	Pur	5407B	5407A
20	Red	5402B	5402A
21	Yel	5424B	5424A
22	Wht	5439B	5439A
23	Blk	5410B	5410A
24	Pur	5427B	5427A
25	Blk	5420B	5420A
26	Grn	5355B	5355A
27	Blk	5460B	5460A
28	Brn	5411B	5411A
29	Org	5403C	5403D
30	Org	5043B	5043A
31	Pur	9907B	9907A
32	Blu	9906B	9906A
33	Blk	0050L	0050P
34	Red	5432B	5432A
35	Grn	5425B	5425A
36	Blk	5450B	5450A
37	Yel	5414B	5414A
38	Blu	5416B	5416A
39	Red	5462B	5462A
40	Grn	5415B	5415A
41	Blk	5480B	5480A
42	Red	5472B	5472A
43		NOT USED	NOT USED
44	Blu	5456B	5456A
45	Blk	5490B	5490A
46	Wht	5409B	5409A
47	Blu	5426B	5426A
48	Blk	0010E	0010D
49	Org	0383B	0383A
50	Blk	5500B	5500A
51		NOT USED	NOT USED
52		NOT USED	NOT USED
53		NOT USED	NOT USED

X50 Harness Interconnect			
54	Red	0002P	0002T
55	Red	0002A	0002B
56		NOT USED	NOT USED
57		NOT USED	NOT USED
58		NOT USED	NOT USED
59		NOT USED	NOT USED
60		NOT USED	NOT USED
61		NOT USED	NOT USED
62		NOT USED	NOT USED
63		NOT USED	NOT USED
64		NOT USED	NOT USED
65		NOT USED	NOT USED
66		NOT USED	NOT USED
67		NOT USED	NOT USED
68		NOT USED	NOT USED
69	Wht	2239A	2239
70	Pur	2227A	2227
71	Red	0212B	0212A
72	Yel	5304	5304A
73	Grn	5305	5305A
74	Blk	5440B	5440A
75	Red	5422B	5422A
76	Red	5442B	5442A
77	Yel	5444B	5444A
78	Blu	5436B	5436A
79	Grn	5405B	5405A
80	Red	0552D	0552B
81	Org	2903A	2903B
82	Red	0562AX	0562G
83	Blu	4696B	4696A
84	Red	4692D	4692A
85	Pur	4697B	4697A
86	Brn	5351B	5351A
87	Pur	5347B	5347C
88	Blu	2216A	2216B
89	Pur	4777A	4777B
90	Pur	4687C	4687D
91	Grn	4555B	4555A
92	Pur	4747B	4747A
93	Grn	4006B	4006A
94	Grn	4005B	4005A
95	Red	0152A	0152B
96		NOT USED	NOT USED
97		NOT USED	NOT USED
98	Red	0502A	0502B
99	Blk	0050A	0050G
100	Wht	5309B	5309A
101	Red	0602A	0602B

X50 Harness Interconnect			
102	Wht	1119C	1119D

Engine Control Unit (ECU) Component Location

ECU-J1



ECU-J1

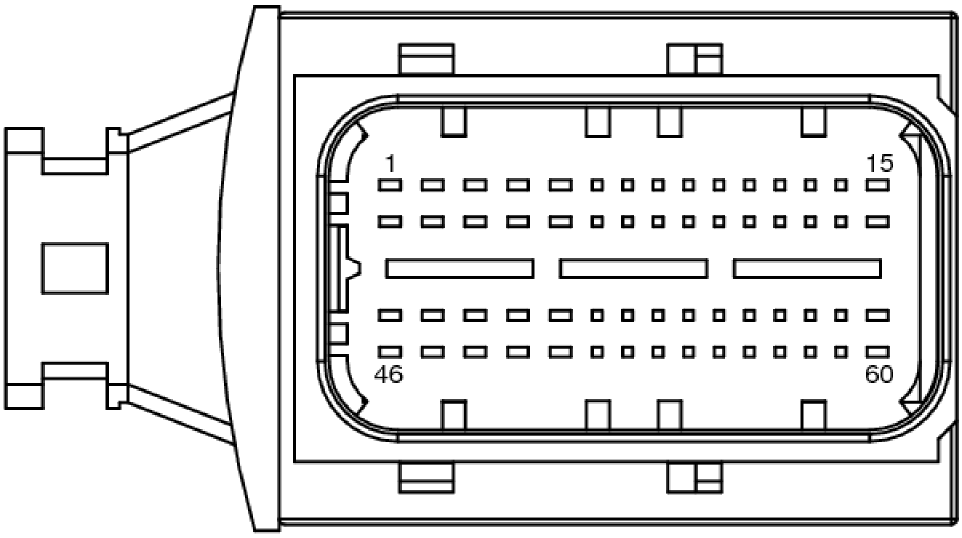
ECU-J1

ECU-J1			
PIN	eHydro Transmission OOS Wire Number / Color	eHydro Transmission Cab Wire Number / Color	PowrReverser Transmission Wire Number / Color
1	0602B Red	0602C Red	0602B Red
2	0050C Blk	0050F Blk	0050C Blk
3	0602C Red	0602D Red	0602C Red
4	0050D Blk	0050M Blk	0050D Blk
5	0602D Red	0602E Red	0602D Red
6	0050E Blk	0050N Blk	0050E Blk
7	Not Used	Not Used	Not Used
8	Not Used	Not Used	Not Used
9	Not Used	Not Used	Not Used
10	Not Used	Not Used	Not Used
11	Not Used	Not Used	Not Used
12	0472B Red	0472B Red	0472B Red
13	Not Used	Not Used	Not Used
14	Not Used	Not Used	Not Used
15	5347D Pur	5347D Pur	5347D Pur
16	Not Used	Not Used	Not Used
17	Not Used	Not Used	Not Used
18	5406 Blu	5406 Blu	5406 Blu
19	Not Used	Not Used	Not Used
20	5425 Grn	5425A Grn	5425 Grn
21	5420 Blk	5420A Blk	5420 Blk
22	Not Used	Not Used	Not Used
23	5432 Red	5432A Red	5432 Red
24	5422A Red	5422A Red	5422A Red

ECU-J1			
25	Not Used	Not Used	Not Used
26	Not Used	Not Used	Not Used
27	5437 Pur	5437 Pur	5437 Pur
28	5457 Pur	5457 Pur	5457 Pur
29	Not Used	Not Used	Not Used
30	Not Used	Not Used	Not Used
31	Not Used	Not Used	Not Used
32	5342 Red	5342 Red	5342 Red
33	5411A Brn	5411A Brn	5411A Brn
34	Not Used	Not Used	Not Used
35	0572D Red	0572D Red	0572D Red
36	Not Used	Not Used	Not Used
37	Not Used	Not Used	Not Used
38	Not Used	Not Used	Not Used
39	5439 Wht	5439A Wht	5439 Wht
40	Not Used	Not Used	Not Used
41	Not Used	Not Used	Not Used
42	Not Used	Not Used	Not Used
43	5493 Org	5493 Org	5493 Org
44	Not Used	Not Used	5423 Org
45	5402 Red	5402A Red	5402 Red
46	Not Used	Not Used	Not Used
47	Not Used	Not Used	Not Used
48	Not Used	Not Used	Not Used
49	Not Used	Not Used	Not Used
50	Not Used	Not Used	Not Used
51	Not Used	Not Used	Not Used
52	5450 Blk	5450A Blk	5450 Blk
53	9925E Grn	9925G Grn	9925E Grn
54	9907 Pur	9907A Pur	9907 Pur
55	Not Used	Not Used	5400 Blk
56	5409A Wht	5409A Wht	5409A Wht
57	Not Used	Not Used	Not Used
58	Not Used	Not Used	5417 Pur
59	Not Used	Not Used	Not Used
60	Not Used	Not Used	Not Used
61	5447 Pur	5447 Pur	5447 Pur
62	5470 Blk	5470 Blk	5470 Blk
63	5436A Blu	5436A Blu	5436A Blu
64	Not Used	Not Used	Not Used
65	Not Used	Not Used	Not Used
66	Not Used	Not Used	Not Used
67	Not Used	Not Used	Not Used
68	5446 Blu	5446 Blu	5446 Blu
69	Not Used	Not Used	Not Used
70	0385A Grn	0385A Grn	0385A Grn
71	5412 Red	5412 Red	5412 Red
72	Not Used	Not Used	Not Used

ECU-J1			
73	Not Used	Not Used	Not Used
74	5410 Blk	5410A Blk	5410 Blk
75	9924E Yel	9924G Yel	9924E Yel
76	9906 Blu	9906A Blu	9906 Blu
77	5440B Blk	5440A Blk	5440G Blk
78	Not Used	Not Used	Not Used
79	5427 Pur	5427A Pur	5427 Pur
80	5444A Yel	5444A Yel	5444A Yel
81	5442A Red	5442A Red	5442A Red
82	Not Used	Not Used	Not Used
83	Not Used	Not Used	Not Used
84	Not Used	Not Used	Not Used
85	5424 Yel	5424A Yel	5424 Yel
86	Not Used	Not Used	Not Used
87	Not Used	Not Used	Not Used
88	0562AE Red	0562AE Red	0562AE Red
89	Not Used	Not Used	Not Used
90	Not Used	Not Used	Not Used
91	Not Used	Not Used	Not Used
92	Not Used	Not Used	Not Used
93	Not Used	Not Used	Not Used
94	Not Used	Not Used	Not Used

ECU-J2



ECU-J2

ECU-J2

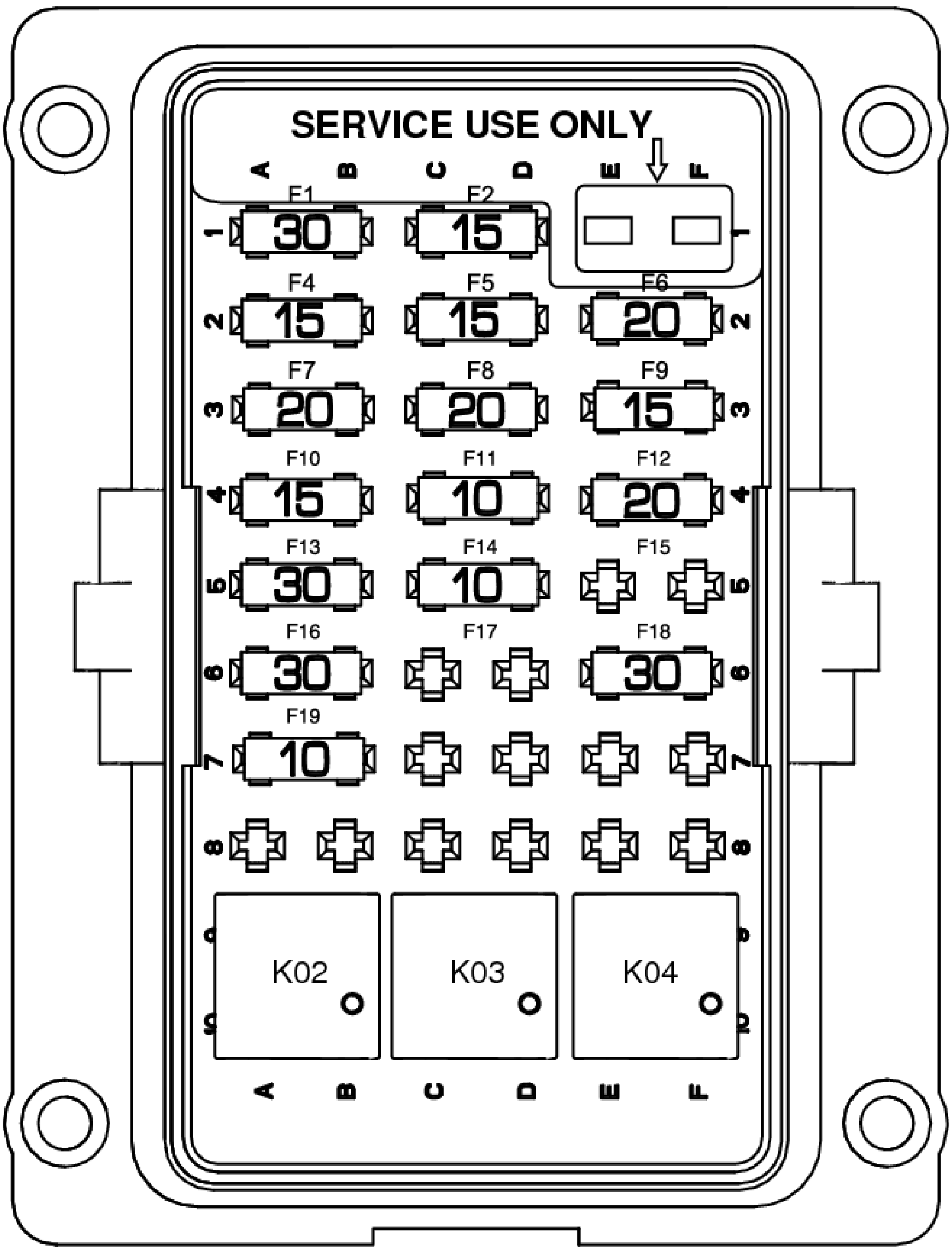
ECU-J2			
PIN	**eHydro Transmission OOS Wire Number / Color**	**eHydro Transmission Cab Wire Number / Color**	**PowrReverser Transmission Wire Number / Color**
1	Not Used	Not Used	Not Used
2	Not Used	Not Used	Not Used

ECU-J2			
3	Not Used	Not Used	Not Used
4	5464 Yel	5464A Yel	5464 Yel
5	5407 Pur	5407A Pur	5407 Pur
6	Not Used	Not Used	Not Used
7	5462 Red	5462A Red	5462 Red
8	5472 Red	5472A Red	5472 Red
9	Not Used	Not Used	Not Used
10	Not Used	Not Used	Not Used
11	5426 Blu	5426A Blu	5426 Blu
12	5405A Grn	5405A Grn	5405A Grn
13	Not Used	Not Used	Not Used
14	Not Used	Not Used	Not Used
15	Not Used	Not Used	Not Used
16	5401 Brn	5401A Brn	5401 Brn
17	5476 Blu	5476A Blu	5476 Blu
18	5403 Org	5403A Org	5403B Org
19	5414 Yel	5414A Yel	5414 Yel
20	5416 Blu	5416A Blu	5416 Blu
21	Not Used	Not Used	Not Used
22	Not Used	Not Used	Not Used
23	Not Used	Not Used	Not Used
24	Not Used	Not Used	Not Used
25	5480 Blk	5480A Blk	5480 Blk
26	5415 Grn	5415A Grn	5415 Grn
27	Not Used	Not Used	Not Used
28	5355 Grn	5355A Grn	5355 Grn
29	5460 Blk	5460A Blk	5460 Blk
30	Not Used	Not Used	Not Used
31	Not Used	Not Used	Not Used
32	Not Used	Not Used	Not Used
33	5435 Grn	5435A Grn	5435 Grn
34	Not Used	Not Used	Not Used
35	Not Used	Not Used	Not Used
36	Not Used	Not Used	Not Used
37	5456 Blu	5456A Blu	5456 Blu
38	5430	5430A	5430
39	5484	5484A	5484
40	Not Used	Not Used	Not Used
41	Not Used	Not Used	Not Used
42	Not Used	Not Used	Not Used
43	Not Used	Not Used	Not Used
44	Not Used	Not Used	Not Used
45	Not Used	Not Used	Not Used
46	Not Used	Not Used	Not Used
47	5429 Wht	5429A Wht	5429 Wht
48	5454 Yel	5454A Yel	5454 Yel
49	Not Used	Not Used	Not Used
50	Not Used	Not Used	Not Used

ECU-J2			
51	5500 Blk	5500A Blk	5500 Blk
52	5490 Blk	5490A Blk	5490 Blk
53	Not Used	Not Used	Not Used
54	5485	5485A	5485
55	Not Used	Not Used	Not Used
56	Not Used	Not Used	Not Used
575	Not Used	Not Used	Not Used
58	Not Used	Not Used	Not Used
59	5403B Org	5403D Org	5403A Org
60	Not Used	Not Used	Not Used

Load Center Harness Connector Identification

eHydro Transmission Open Station



eHydro Transmission Open Station

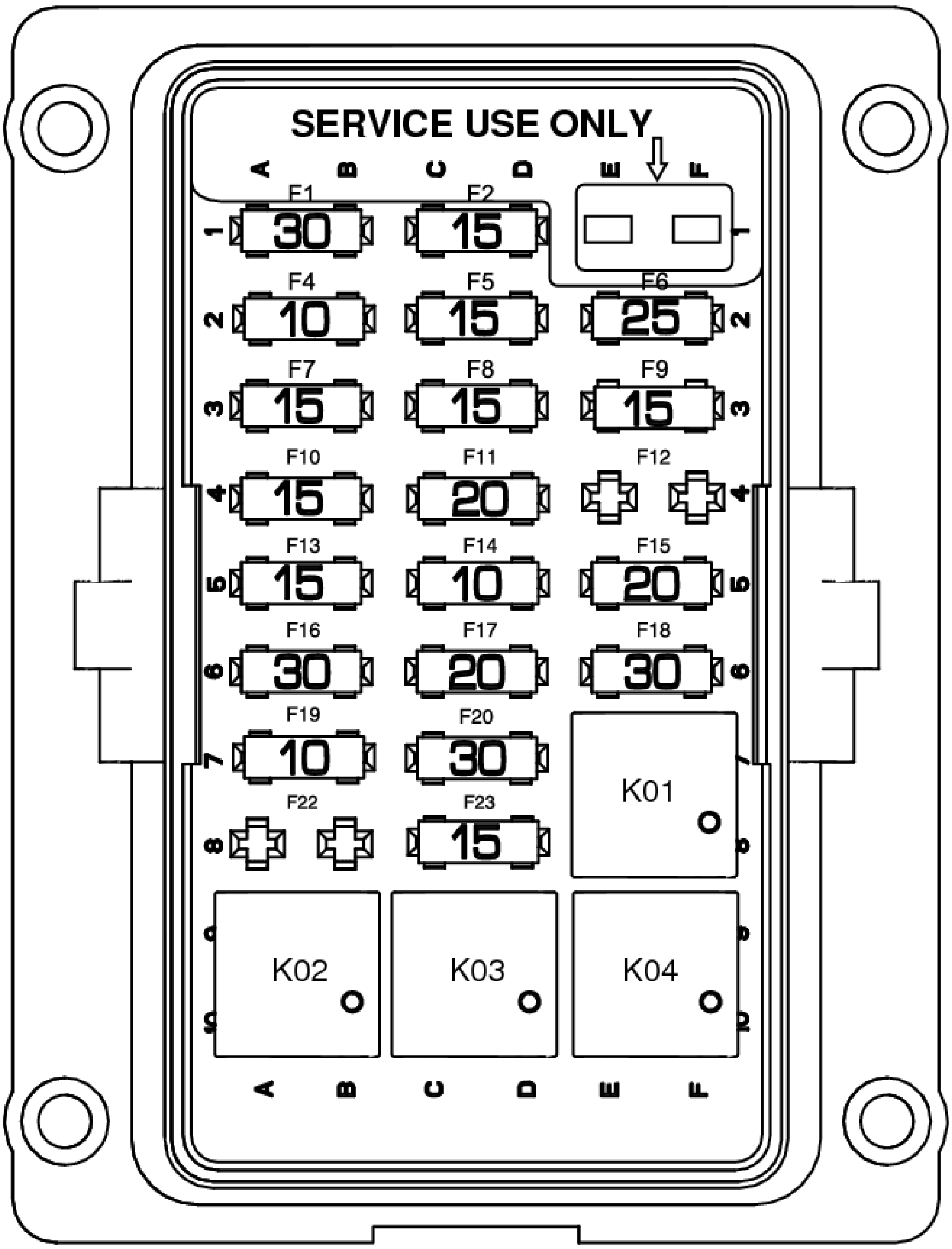
Load Center Open Station

Component	Terminal	Wire Number/Color
F1 Fuse 30 Amp		
Key Switch	1A 1B	0002B Red 0012 Red
F2 Fuse 15 Amp		
Right Fender Interconnect, Power Port	1C 1D	0002C Red 0262A Red
F3 Service Use only		
	1E 1F	0562E Red 0592 Red

Component	Terminal	Wire Number/Color
F4 Fuse 15 Amp		
Brake Lights	2A 2B	0002L Red 0052A Red
F5 Fuse 15 Amp		
Ignition Power	2C 2D	0072 Red 0562A Red
F6 Fuse 20 Amp		
Work Light (Option)	2E 2F	1137 Pur 1147A Pur
F7 Fuse 20 Amp		
Tail light	3A 3B	1138C Gry 1118A Gry
F8 Fuse 20 Amp		
Headlights	3C 3D	1138B Gry 1119C Wht
F9 Fuse 15 Amp		
Accessory	3E 3F	0212A Red 0552A Red
F10 Fuse 15 Amp		
Air Ride Seat (Option)	4A 4B	0212B Red 2263A Org
F11 Fuse 10 Amp		
EGR	4C 4D	0002G Red 0692 Red
F12 Fuse 20 Amp		
7-Pin Trailer (Option)	4E 4F	0002F Red 0252 Red
F13 Fuse 30 Amp		
Junction Block	5A 5B	0002K Red 0502A Red
F14 Fuse 10 Amp		
ELX	5C 5D	0472A Red 4472 Red
F15 Fuse		
Spare	5E 5F	
F16 Fuse 30 Amp		
Light Switch	6A 6B	0002E Red 0132A Red
F17 Fuse		
Spare	6C 6D	
F18 Fuse 30 Amp		
Display Panel	6E 6F	0002D Red 0122A Red
F19 Fuse 10 Amp		
TCM	7A 7B	0002H Red 0142 Red
K02		
EGR Valve Relay	9A 9B 10A 10B	0010D Blk 5043 Org 0692 Red 5446 Blu
K03		
Brake Light Relay	9C 9D 10C 10D	0010AX Blk 1133A Org 0052B Red 1116 Blu

Component	Terminal	Wire Number/Color
K04		
7-Pin Connector Relay (optional kit)	9E 9F 10E 10F	0010CB Blk 0582A Red 0252 Red 0562AL Red

eHydro Transmission Cab



eHydro Transmission Cab

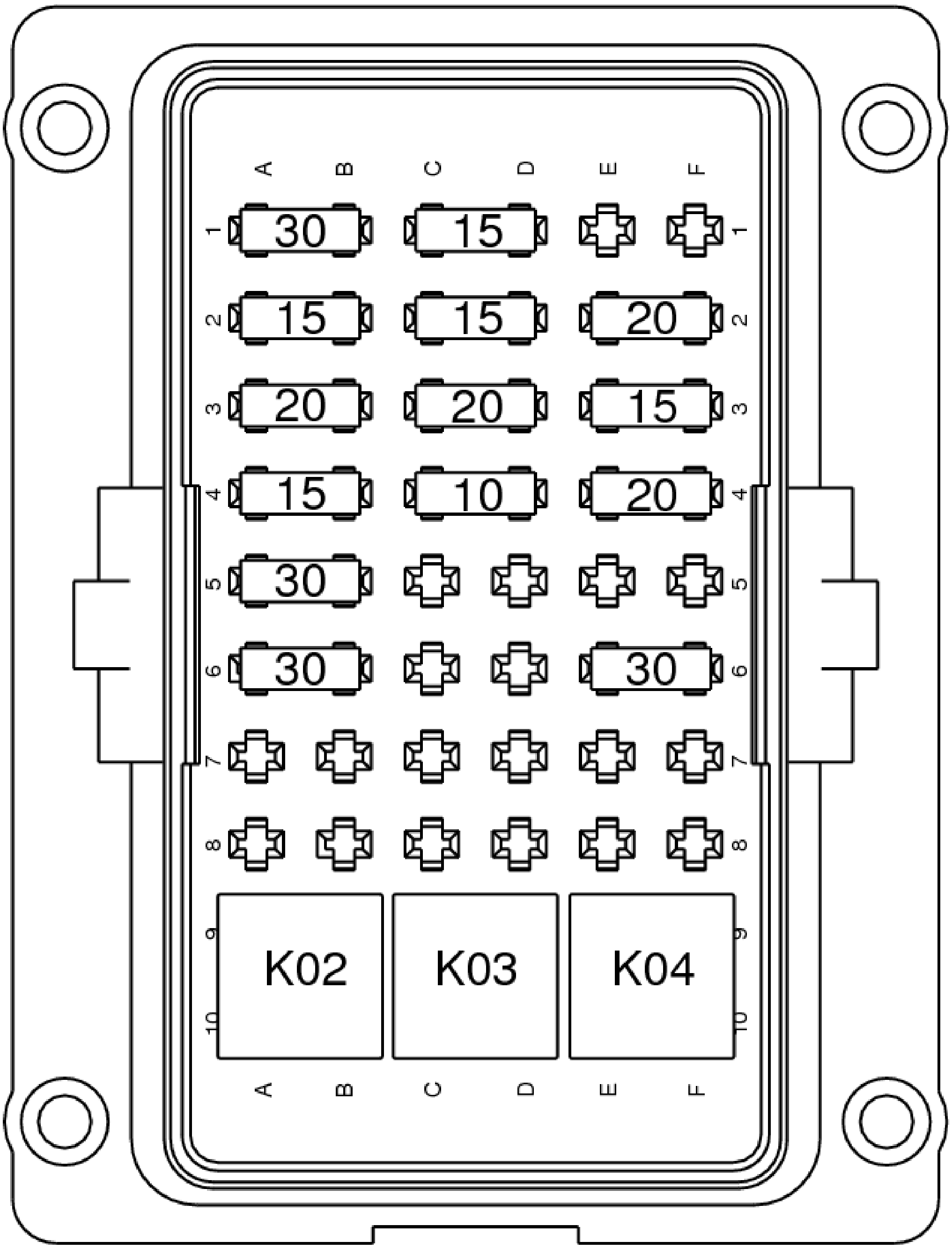
eHydro Load Center Cab

Component	Terminal	Wire Number/Color
F1 Fuse 30 Amp		
Key Switch	1A 1B	0002C Red 0012A Red
F2 Fuse 15 Amp		

Component	Terminal	Wire Number/Color
Right Fender Interconnect, Power Port	1C 1D	0002D Red 0262 Red
F3 Service Use Only		
	1E 1F	0562T Red 0592A Red
F4 Fuse 10 Amp		
EGR	2A 2B	0002J red 0692 Red
F5 Fuse 15 Amp		
Ignition	2C 2D	0072 Red 0562A Red
F6 Fuse 25 Amp		
Work Lights	2E 2F	0002H Red 0162B Red
F7 Fuse 15 Amp		
RH Tail Light	3A 3B	1138E Gry 1118A Gry
F8 Fuse 15 Amp		
Headlights	3C 3D	1138B Gry 1119D Wht
F9 Fuse 15 Amp		
Accessory	3E 3F	0312A Red 0552A Red
F10 Fuse 15 Amp		
Air Ride Seat (Option)	4A 4B	0312B Red 2263 Org
F11 Fuse 20 Amp		
Wiper	4C 4D	0312E Red 2272A Red
F12 Fuse 20 Amp		
7-Pin Trailer	4E 4F	0002F Red 0252 Red
F13 Fuse 15 Amp		
LH Tail Light	5A 5B	1138F Gry 1128A Gry
F14 Fuse 10 Amp		
ELX	5C 5D	0472 Red 4472 Red
F15 Fuse 20 Amp		
Roof Harness 2	5E 5F	0002K Red 0092A Red
F16 Fuse 30 Amp		
Light Switch	6A 6B	0002M Red 0132A Red
F17 Fuse 20 Amp		
Roof Harness 1	6C 6D	0002G red 0082A Red
F18 Fuse 30 Amp		
Display Panel	6E 6F	0002E Red 0122A Red
F19 Fuse 10 Amp		
TCM	7A 7B	0002R Red 0142 Red
F20 Fuse 30 Amp		
Junction Box	7C 7D	0002N Red 0502B Red

Component	Terminal	Wire Number/Color
F23 Fuse 15 Amp		
Brake Light	8C 8D	0002U Red 0052A Red
K01		
Work Light Relay	7E 7F 8E 8F	0010V Blk 1157A Pur 0162C Red 1137 Pur
K02		
EGR Valve Relay	9A 9B 10A 10B	0010F Blk 5043 Org 0692 Red 5446 Blu
K03		
Brake Light Relay	9C 9D 10C 10D	0010AS Blk 1133A Org 0052B Red 1116 Blu
K04		
7-Pin Connector Relay (optional kit)	9E 9F 10E 10F	0010U Blk 0582A Red 0252 Red 312C Red

PowrReverser Transmission



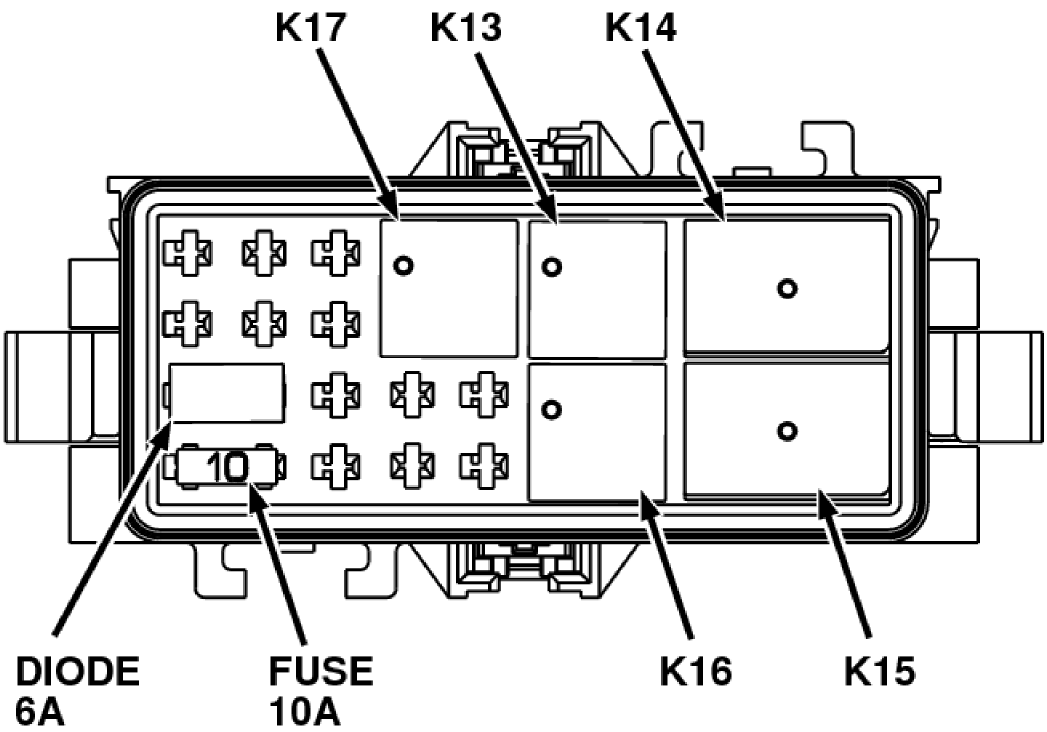
PowrReverser Transmission

Load Center PowrReverser

Component	Terminal	Wire Number/Color
F1 Fuse 30 Amp		
Key Switch	1A 1B	0002B Red 0012 Red
F2 Fuse 15 Amp		
Right Fender Interconnect, Power Port	1C 1D	0002C Red 0262A Red
F3 Service Use only		
	1E 1F	
F4 Fuse 15 Amp		
Brake Lights	2A 2B	0002L Red 0052A Red
F5 Fuse 15 Amp		

Component	Terminal	Wire Number/Color
Ignition Power	2C 2D	0072 Red 0562A Red
F6 Fuse 20 Amp		
Work Light (Option)	2E 2F	1137 Pur 1147A Pur
F7 Fuse 20 Amp		
Tail light	3A 3B	1138C Gry 1118A Gry
F8 Fuse 20 Amp		
Headlights	3C 3D	1138B Gry 1119C Wht
F9 Fuse 15 Amp		
Accessory	3E 3F	0212A Red 0552A Red
F10 Fuse 15 Amp		
Air Ride Seat (Option)	4A 4B	0212B Red 2263A Org
F11 Fuse 10 Amp		
EGR	4C 4D	0002G Red 0692 Red
F12 Fuse 30 Amp		
7-Pin Trailer (optional kit)	4E 4F	0002F Red 0252 Red
F13 Fuse 30 Amp		
Junction Block	5A 5B	0002K Red 0502A Red
F14 Fuse		
Spare	5C 5D	
F15 Fuse		
Spare	5E 5F	
F16 Fuse 30 Amp		
Light Switch	6A 6B	0002H Red 0132A Red
F17 Fuse		
Spare	6C 6D	
F18 Fuse 30 Amp		
Display Panel	6E 6F	0002D Red 0122A Red
F19 Fuse		
Spare	7A 7B	
K02		
EGR Valve Relay	9A 9B 10A 10B	0010D Blk 5043 Org 0692 Red 5446 Blu
K03		
Brake Light Relay	9C 9D 10C 10D	0010AX Blk 1133A Org 0052B Red 1116 Blu
K04		
7-Pin Connector Relay (optional kit)	9E 9F 10E 10F	0010CB Blk 0582A Red 0252 Red 0562AL Red

3rd EH Load Center (Open Station) (—OCT 2014)

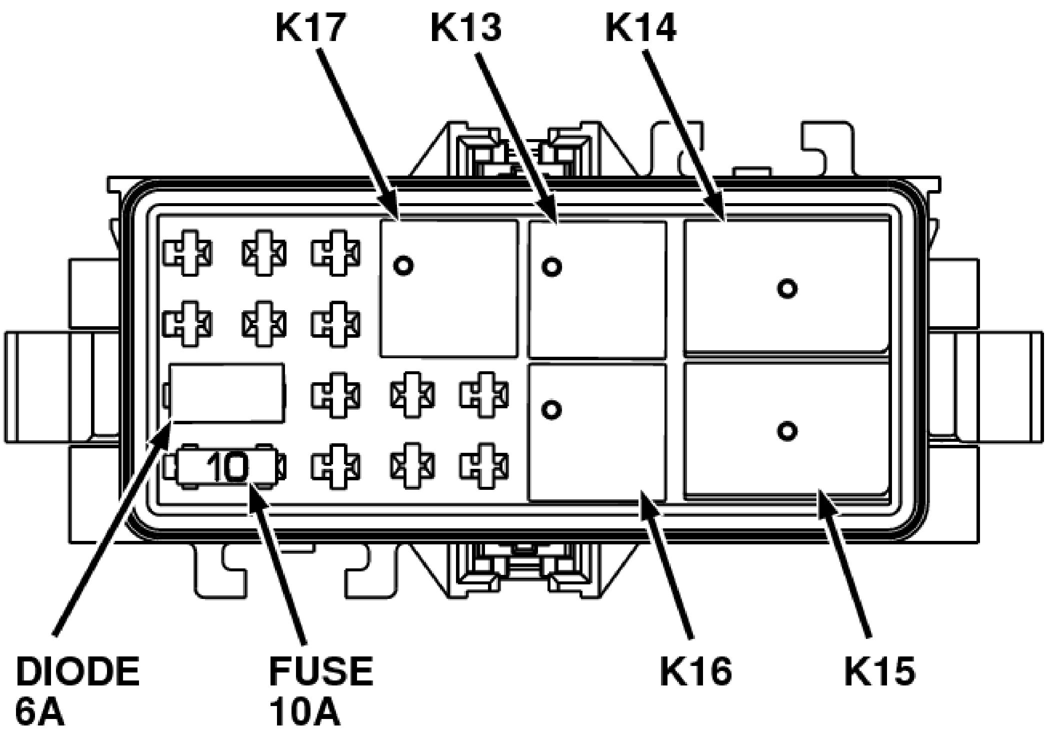


3rd EH Load Center

3rd EH Load Center

Component	Terminal	Wire Number/Color
F24 Fuse 10 Amp		
Diverter Switch	1A 2A	0552A Red 0202A Red
V04 Diode 6 Amp		
Diverter Kit	1B 2B	7789A Red 7793C Red
K13		
Control Relay A	6C 6D 7C 7D	7783A Org 7791B Brn 0010BR Blk 0202H Red
K14		
3rd Function Lockout Relay A	8C 8D 9D 10C	7783B Org 0010BU Blk 7785 Grn 7764A Yel
K15		
3rd Function Lockout Relay B	8A 8B 9B 10A	7764C Yel 0010BY Blk 7786 Blu 7783C Org
K16		
Control Relay B	6A 6B 7A 7B	7764B Yel 0010CC Blk 7799B Wht 0202J Red
K17		
Diverter Relay (optional kit)	4C 4D 5C 5D	7789C Wht 7784B Yel 0010BT Blk 0202F Red

3rd EH Load Center (Open Station) (OCT 2014—)

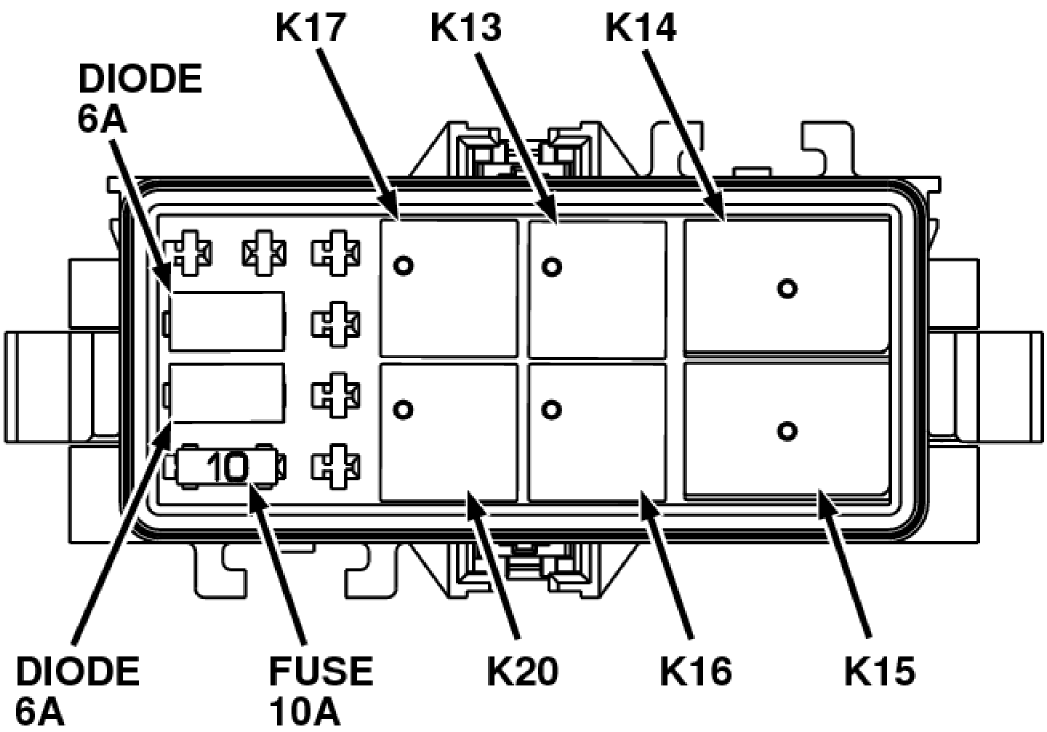


3rd EH Load Center

3rd EH Load Center

Component	Terminal	Wire Number/Color
F24 Fuse 10 Amp		
Diverter Switch	1A 2A	0552A Red 0202A Red
V04 Diode 6 Amp		
Diverter Kit	1B 2B	7789A Red 7793C Red
K13		
Control Relay A	6C 6D 7C 7D	7783A Org 7791B Brn 0010BR Blk 0202H Red
K14		
3rd Function Lockout Relay A	8C 8D 9D 10C	7783B Org 0010BU Blk 7795 Grn 7764A Yel
K15		
3rd Function Lockout Relay B	8A 8B 9B 10A	7764C Yel 0010BY Blk 7796 Blu 7783C Org
K16		
Control Relay B	6A 6B 7A 7B	7764B Yel 0010CC Blk 7799B Wht 0202J Red
K17		
Diverter Relay (optional kit)	4C 4D 5C 5D	7789C Wht 7784B Yel 0010BT Blk 0202F Red

Load Center Jumper (Cab)



Load Center Jumper (Cab)

3rd EH Load Center

Component	Terminal	Wire Number/Color
F24 Fuse 10 Amp		
Diverter Switch	1A 2A	0552AP Red 0202A Red
V04 Diode 6 Amp		
Diverter Kit	1B 2B	7789B Red 7793B Red
V05 Diode 6 Amp		
Dual Rear Continuous	1C 2C	7769C Wht 7793C Org
K13		
Control Relay A	6C 6D 7C 7D	7783A Org 7791B Brn 0010BR Blk 0202H Red
K14		
3rd Function Lockout Relay A	8C 8D 9D 10C	7783B Org 0010BU Blk 7785 Grn 7764A Yel
K15		
3rd Function Lockout Relay B	8A 8B 9B 10A	7764C Yel 0010BY Blk 7786 Blu 7783C Org
K16		
Control Relay B	6A 6B 7A 7B	7764B Yel 0010CC Blk 7799B Wht 0202J Red
K17		

Diverter Relay (optional kit)	4C 4D 5C 5D	7789C Wht 7784B Yel 0010BT Blk 0202F Red
K20		
Dual Rear Continuous Relay	4A 4B 5A 5B	7769B Wht 7778G Gry 0010BV Blk 0202K Red

Group 20 - Schematics and Harnesses

Schematic and Wiring Harness Legend

Components:

A01—Display Panel

A02—Radio

A09—Engine Control Unit (ECU)

A09-J1—ECU Connector

A09-J2—ECU Connector

B01—Fuel Gauge Sensor

B02—Coolant Temperature Sensor

B03—Air Filter Restriction Switch

B04—Engine Oil Pressure Switch

B33—MFWD Speed Sensing Switch

B34—Mid-Mount Proxy Sensor

E01—Left Headlight

E02—Right Headlight

E03—Left Position Light

E03_X01—Ground

E03_X02—Tail

E03_X03—Turn

E03_X04—Turn/Haz

E04—Right Position Light

E04_X01—Ground

E04_X02—Tail

E04_X03—Turn

E04_X04—Turn/Haz

E05—Left Work Light

E06—Right Work Light

E07—Right Front Amber Light

E08—Right Front Work Light

E09—Right Rear Amber Light

E10—Right Rear Work Light

E11—Left Front Amber Light

E12—Left Front Work Light

E13—Left Rear Amber Light

E14—Left Rear Work Light

E15—Dome Light

E16—License Plate Light

E17—Beacon Light

E18—Right Front Marker Light

E19—Left Front Marker Light

E20—Right Tail Light

E21—Left Tail Light

E22—Right Position Light

E22_X01—Turn

E22_X02—Brake

E22_X03—Marker

E22_X04—Ground

E22_X05—Hazard

E22_X06—Hazard

E22_X07—Ground

E23—Left Position Light

E23_X01—Turn

E23_X02—Brake

E23_X03—Marker

E23_X04—Ground

E23_X05—Hazard

E23_X06—Hazard

E23_X07—Ground

E24—Right Turn Light

E25—Right Brake Marker Light

E26—Left Brake Marker Light

E27—Left Turn Light

F1—Key Switch Fuse (30A)

F2—Power Port Fuse (15A)

F3—Service Use Only

F4—Brake Light Fuse (15A)

F5—Ignition Power Fuse (15A)

F6—Work Light Fuse (20A)

F7—Tail Light Fuse (20A)

F8—Headlight Fuse (20A)

F9—Accessory Fuse (15A)

F10—Air Ride Seat Fuse (if equipped) (15A)

F11—EGR Fuse (10A)

F12—Trailer Fuse (20A)

F13—Junction Block Fuse (30A)

F14—ELX Fuse (10A)

F15—Spare

F16—Light Switch Fuse (30A)

F17—Spare

F18—Instrument Panel Fuse (30A)

F19—TCU/TCM Fuse (10A)

F20—Glow Plug Fuse (40A)

F21—Load Center Fuse (50A)

F22—Alternator Fuse (80A)

F23—Inline Fuse (500A)

F24—Diverter Valve Fuse (10A)

F40—ECU Fuse (25A)

G01—Battery

G02—Alternator

G03—Alternator (Cab)

H01—Horn

H02—Warning Alarm

H03—Backup Alarm

H04—Left Speaker

H05—Right Speaker

H06—Power Port

ICC-J1—Display Interconnect

ICC-J2—Display Interconnect

ICC-J3—Display Interconnect

ICC-J4—Display Interconnect

K01—Work Light Relay (Cab)

K02—EGR Relay

K03—Brake Light Relay

K04—7-Pin Trailer Power Relay

K05—Accessory Power Relay

K06—Work Light Relay

K07—Start Relay

K08—Glow Plug Relay

K09—Right Power Relay

K10—Left Power Relay

K11—Right Blower Relay

K12—Left Blower Relay

K13—Control Relay A

K14—3rd Function Lockout Relay A

K15—3rd Function Lockout Relay B

K16—Control Relay B

K17—Diverter Relay

K18—Fuel Shutoff Relay

K19—Manifold Heater Relay

K20—Dual Rear Continuous Relay

LC01—Load Center

LC02—Load Center 3rd EH (Open Station)

LC03—Load Center Harness (Cab)

LC04—Fuse Holder

M01—Starting Motor

M02—Fuel Pump

M03—Front Wiper Motor

M04—Rear Washer Pump

M05—Front Washer Pump

M06—Exhaust Valve Actuator

M07—Left Blower Motor

M08—Right Blower Motor

M09—Rear Wiper Motor

P01—Forward Pedal Sensor

P02—Reverse Pedal Sensor

P03—Hand Throttle

P04—Foot Throttle Sensor

R01—Glow Plugs

R02—Manifold Heater

S01—Key Switch

S02—Dash Panel Module

S03—PTO Switch

S06—Differential Pressure Switch

S08—Inlet Temperature Sensor

S09—Mid-Temperature Sensor

S10—Dual Continuous Switch

S14—Rear Work Light Switch

S15—Horn Switch

S16—Beacon Light Switch

S20—Front Wiper Switch

S21—Rear Wiper Switch

S22—HVAC Temperature Sensor

S23—High-Low Pressure Switch

S24—Door Light Switch

S25—Dome Light Switch

S27—Diverter Switch

S28—Blower Switch

S29—HVAC Switch

S38—Seat Switch

S39—Air Ride Seat

S40—MFWD Engagement Sensing Switch

S41—Brake Switch

S42—Park Brake Switch

S46—Cruise Module

S48—Rear PTO Sensing Switch

S49—Mid PTO Sensing Switch

S50—Neutral Sensing Switch

S54—3rd Function Control Switch

T01—Ground Terminal

T02—Ground Terminal

T03—Ground Terminal

T13—Phase Terminal

T20—Ground

TCU-J1—Transmission Control Unit Interconnect

V03—Diode (5A)

V04—Diode (6A)

V05—Diode (6A)

W1—Chassis Wiring Harness (Open Station)

W2—Chassis Wiring Harness (PowrReverser)

W3—Fender Wiring Harness (Open Station)

W4—Hood Harness

W5—Grille Wiring Harness

W6—HST Valve Wiring Harness

W7—Chassis Wiring Harness (Cab)

W8—Lower Wiring Harness (Cab)

W9—Upper Wiring Harness (Cab)

W10—Diverter Valve Wiring Harness (Open Station)

W11—3rd EH Wiring Harness (Open Station)

W12—Load Center Harness (Cab)

W13—3rd EH, Diverter, Creep to REPO Harness (Cab)

W14—Seat Switch Jumper Harness (Cab)

W15—Seat Switch Jumper Harness (Open Station)

W16—Fender Wiring Harness—PowrReverser Transmission

W17—Diverter Wiring Harness (Open Station)

W01—Ground (Machine)

W02—Beacon Light Ground

X102—Service Advisor

X103—1/2 Watt Resistor

X01-W1—12-Pin Engine Interface (Yellow)

X01-W2—12-Pin Engine Interface (PowrReverser) (Yellow)

X01-W7—12-Pin Engine Interface (Yellow)

X02—Junction Block

X03-W4—Hood to Grille Harness Interconnect

X03-W5—Grille to Hood Harness Interconnect

X04-W1—8-Pin Engine Interface (Red)

X04-W2—8-Pin Engine Interface (PowrReverser) (Red)

X04-W7—8-Pin Engine Interface (Red)

X05-W1—12-Pin Engine Interface (Red)

X05-W2—12-Pin Engine Interface (PowrReverser) (Red)

X05-W7—12-Pin Engine Interface (Red)

X06-W1—12-Pin Engine Interface (Gray)

X06-W2—12-Pin Engine Interface (PowrReverser) (Gray)

X06-W7—12-Pin Engine Interface (Gray)

X07-W1—Chassis to Hood Harness Interconnect

X07-W2—Chassis to Hood Harness Interconnect (PowrReverser)

X07-W4—Hood to Chassis Harness Interconnect

X07-W7—Chassis to Hood Harness Interconnect

X08-W1—Chassis to Hood Harness Interconnect

X08-W2—Chassis to Hood Harness Interconnect (PowrReverser)

X08-W4—Hood to Chassis Harness Interconnect

X08-W7—Chassis to Hood Junction Block Interconnect

X09-W1—Chassis to Right Fender Harness Interconnect 1

X09-W2—Chassis to Right Fender Harness (PowrReverser) Interconnect 1

X09-W3—Right Fender to Chassis Harness Interconnect 1

X09-W16—Right Fender to Chassis Harness Interconnect 1 (PowrReverser)

X10-W1—Chassis to Right Fender Harness Interconnect 2

X10-W3—Right Fender to Chassis Harness Interconnect 2

X11-W3—Right Fender to 3rd EH Harness Interconnect

X11-W16—Right Fender to 3rd EH Harness Interconnect (PowrReverser)

X11-W11—3rd EH to Right Fender Harness Interconnect

X12-W10—Diverter Valve to 3rd EH Harness Interconnect (or 3rd EH, Diverter, Creep to REPO Harness (Cab)

X12-W11—3rd EH to Diverter Valve Harness Interconnect

X13-W1—Chassis to Front PTO Switch Interconnect

X13-W2—Chassis to Front PTO Switch Interconnect (PowrReverser)

X13-W7—Lower Cab Wiring Harness to Front PTO Switch Interconnect

X14-WI—Chassis to Front PTO Harness Interconnect

X14-W2—Chassis to Front PTO Harness Interconnect (PowrReverser)

X14-W7—Chassis to Front PTO Harness Interconnect

X15-W1—Chassis to Creep to Reposition Switch Harness Interconnect

X17-W17—Rear Harness Connector

X17-W18—Rear Harness Connector

X26-W1—Chassis to HST Harness Interconnect

X26-W6—HST to Chassis Harness Interconnect

X26-W7—Chassis to HST Harness Interconnect

X27-W9—Upper Cab Wiring Harness to Dome Light

X28-W9—Upper Cab Wiring Harness to Right Front Amber Light

X29-W9—Upper Cab Wiring Harness to Right Front Work Light

X30-W9—Upper Cab Wiring Harness to Right Rear Amber Light

X31-W9—Upper Cab Wiring Harness to Right Rear Work Light

X32-W9—Upper Cab Wiring Harness to Left Front Amber Light

X33-W9—Upper Cab Wiring Harness to Left Front Work Light

X34-W9—Upper Cab Wiring Harness to Left Rear Amber Light

X35-W9—Upper Cab Wiring Harness to Left Rear Work Light

X38-W1—Chassis to Seat Switch Harness Interconnect

X38-W8—Lower Cab to Seat Switch Harness Interconnect

X38-W14—Seat Switch to Lower Cab Harness Interconnect

X38-W15—Seat Switch to Chassis Harness Interconnect

X50-W7—Chassis to Lower Cab Wiring Harness Interconnect

X50-W8—Lower Cab to Chassis Wiring Harness Interconnect

X51-W1—Chassis to 7-Pin Wiring Harness Interconnect

X51-W2—Chassis to 7-Pin Wiring Harness Interconnect (PowrReverser)

X51-W8—Lower Cab to 7-Pin Wiring Harness Interconnect

X51-W19—7-Pin to Lower Cab Wiring Harness Interconnect

X52-W8—Lower Cab to Upper Cab Wiring Harness Interconnect

X52-W9—Upper Cab to Lower Cab Wiring Harness Interconnect

X53-W8—Lower Cab to Upper Cab Wiring Harness Interconnect

X53-W9—Upper Cab to Lower Cab Wiring Harness Interconnect

X54-W8—Rear Harness to Load Center Interconnect

X54-W12—Load Center to Rear Harness Interconnect

X55-W12—Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect

X55-W13—3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect

X56-W13—3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect

X56-W18—Diverter Wiring Harness to REPO Harness Interconnect

X57-W13—3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect

X65—CAN Terminator

X78-W8—Lower Cab to 3rd EH SCV Handle Harness

X78-W11—3rd EH Wiring Harness to 3rd EH SCV Handle Harness

XG02—Regulator Terminal

XG03—Output Terminal

Y01—Starter Motor Solenoid

Y02—Rockshaft/Diverter Solenoid

Y03—Rear PTO Solenoid

Y04—3rd Function Solenoid A

Y05—Forward Proportional Solenoid

Y06—Reverse Proportional Solenoid

Y07—3rd Function Solenoid B

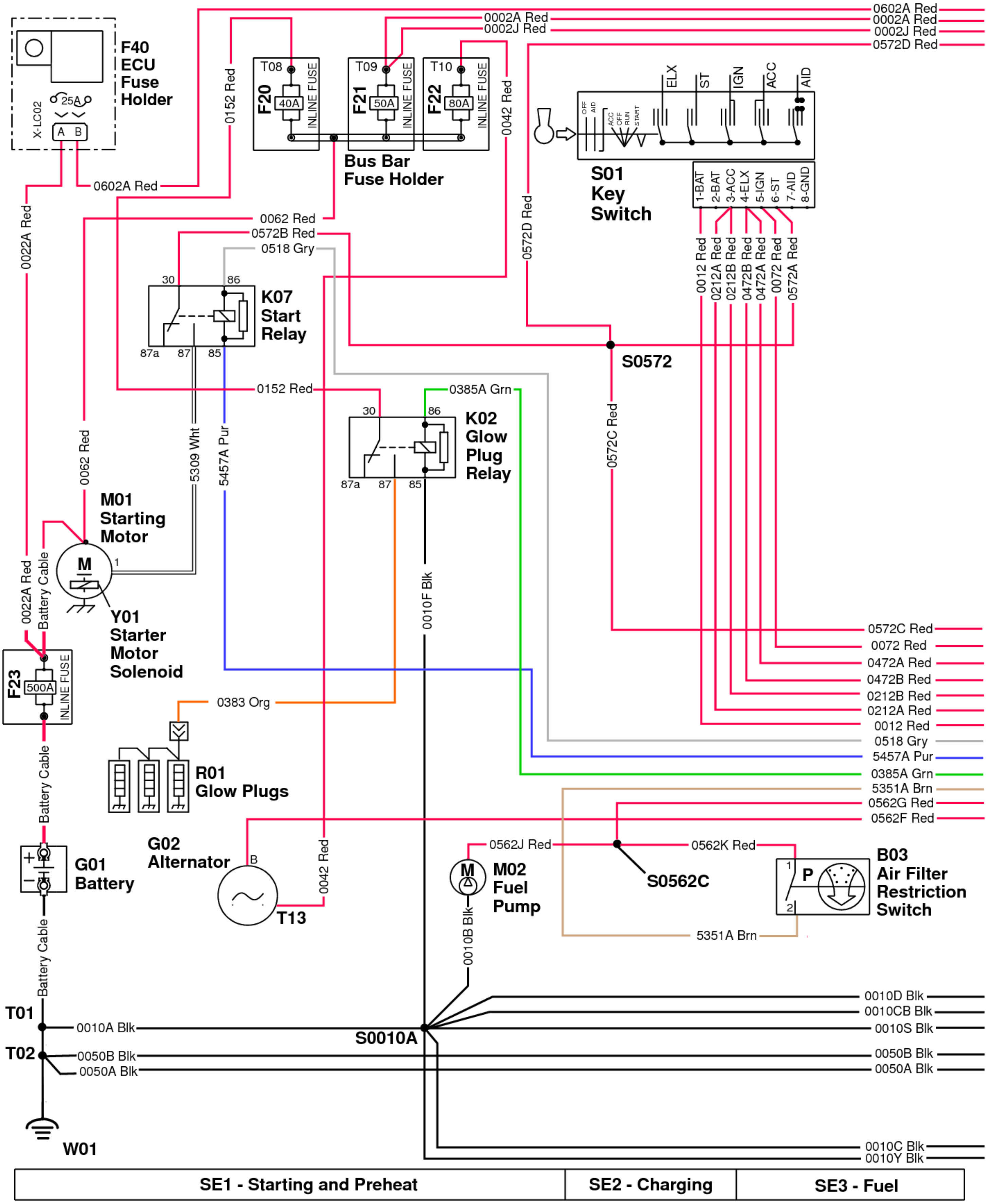
Y08—Upper Hydraulic Solenoid Valve

Y09—Lower Hydraulic Solenoid Valve

Y10—Fuel Solenoid

Y23—Air Conditioning Compressor Clutch

Main Wiring Schematic (Open Station)

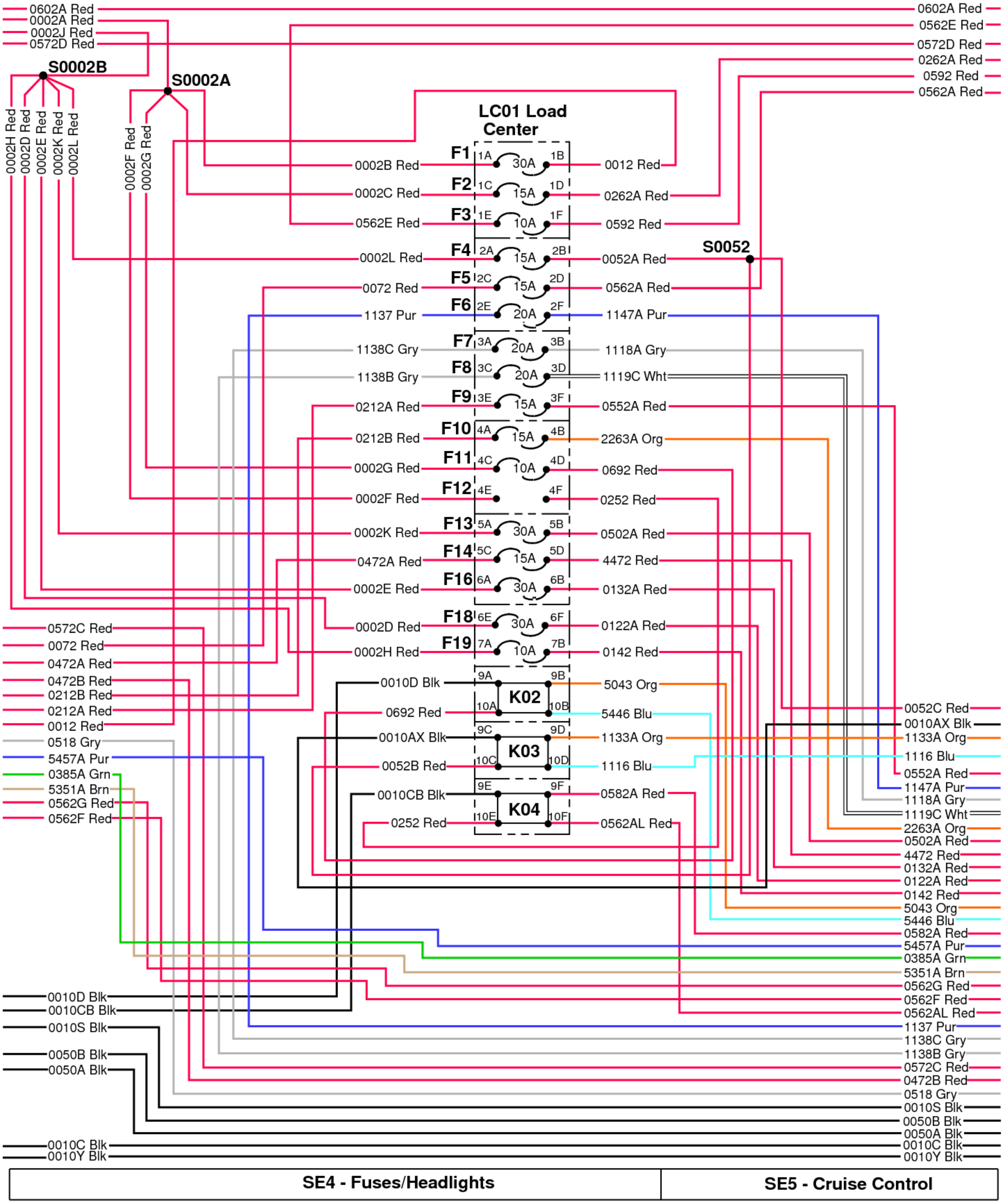


Main Wiring Schematic Open Station (1 of 11)

LEGEND:

B03	Air Filter Restriction Switch
F20	Inline Fuse (40A)
F21	Inline Fuse (50A)
F22	Inline Fuse (80A)

F23	Inline Fuse (500A)
F40	ECU Fuse (25A)
G01	Battery
G02	Alternator
K07	Start Relay
K08	Glow Plug Relay
M01	Starting Motor
M02	Fuel Pump
R01	Glow Plugs
S01	Key Switch
Y01	Starter Motor Solenoid
W01	Ground

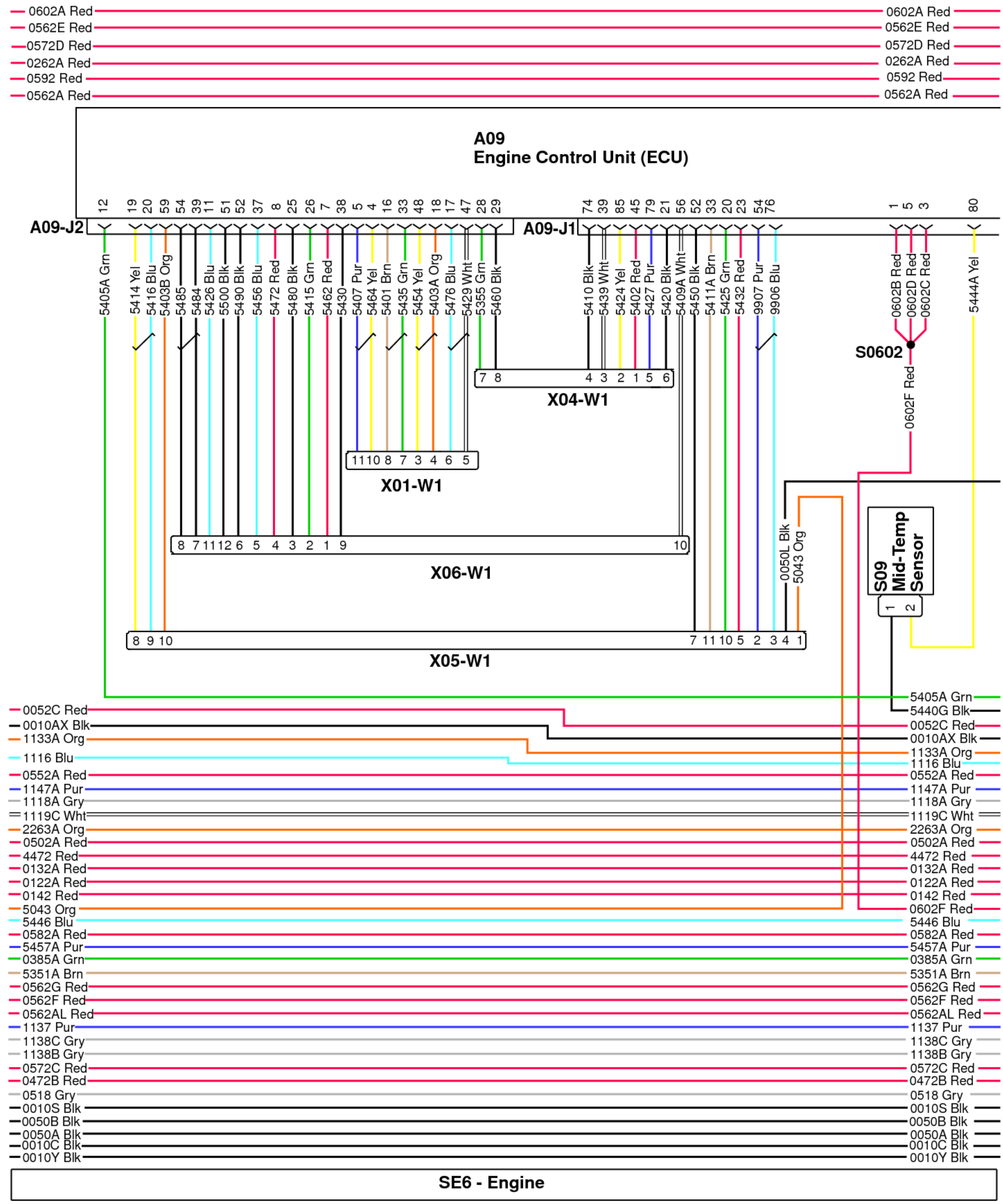


Main Wiring Schematic Open Station (2 of 11)

LEGEND:

F1	Fuse 30A
F2	Fuse 15A
F3	Service Use Only
F4	Fuse 15A
F5	Fuse 15A
F6	Fuse 20A

F7	Fuse 20A
F8	Fuse 20A
F9	Fuse 15A
F10	Fuse 15A
F11	Fuse 10A
F12	Fuse 20A
F13	Fuse 30A
F14	Fuse 10A
F15	Spare
F16	Fuse 30A
F17	Spare
F18	Fuse 30A
F19	Fuse 10A
K02	EGR Relay
K03	Brake light Relay
X01	Load Center

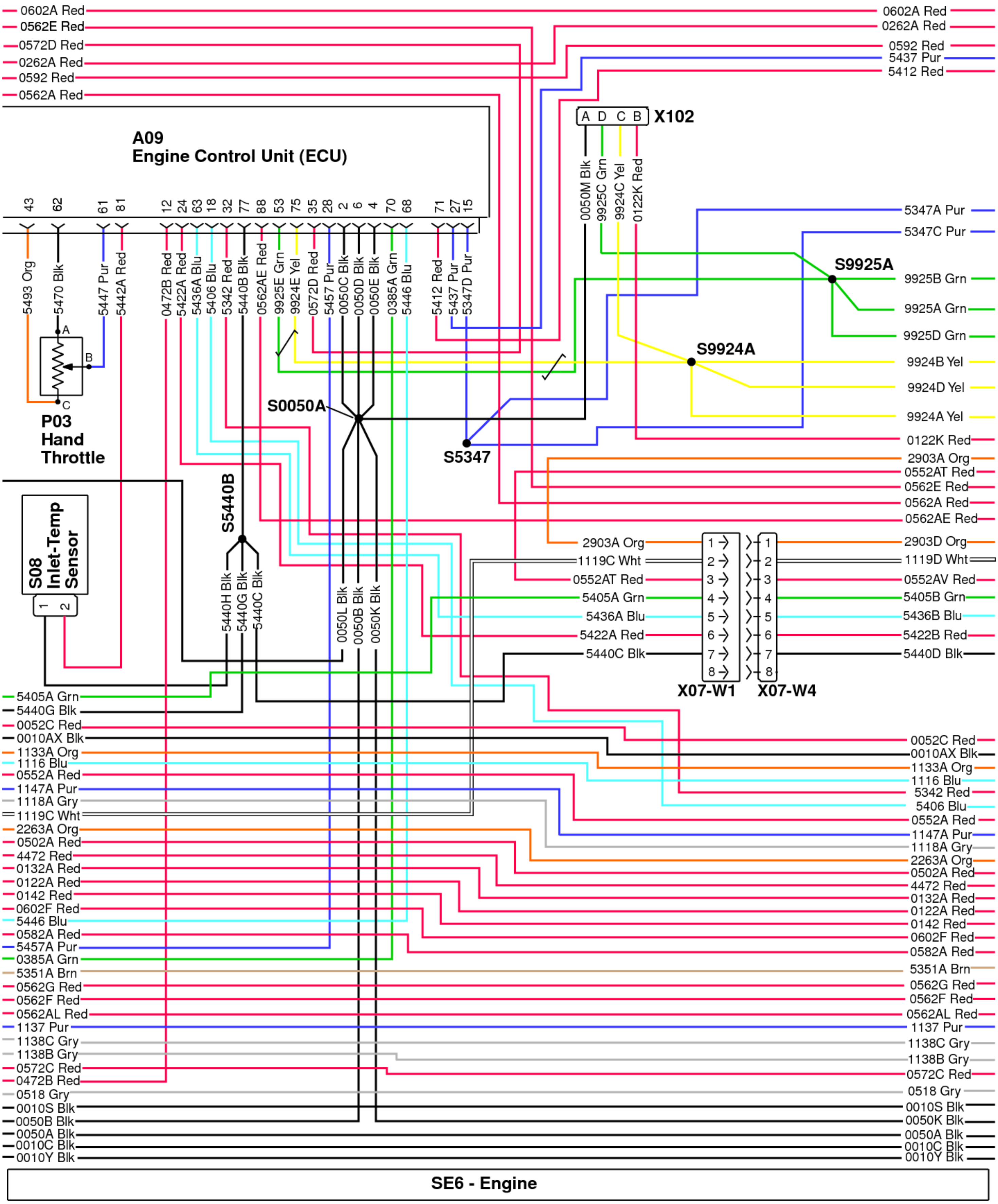


Main Wiring Schematic Open Station (3 of 11)

LEGEND:

A09	Engine Control Unit (ECU)
A09-J1	ECU Connector
A09-J2	ECU Connector
X01-W1	12 Pin Engine Interface (Yellow)
X04-W1	8 Pin Engine Interface (Red)
X05-W1	12 Pin Engine Interface (Red)

X06-W1	12 Pin Engine Interface (Gray)
S09	Mid-Temperature Sensor

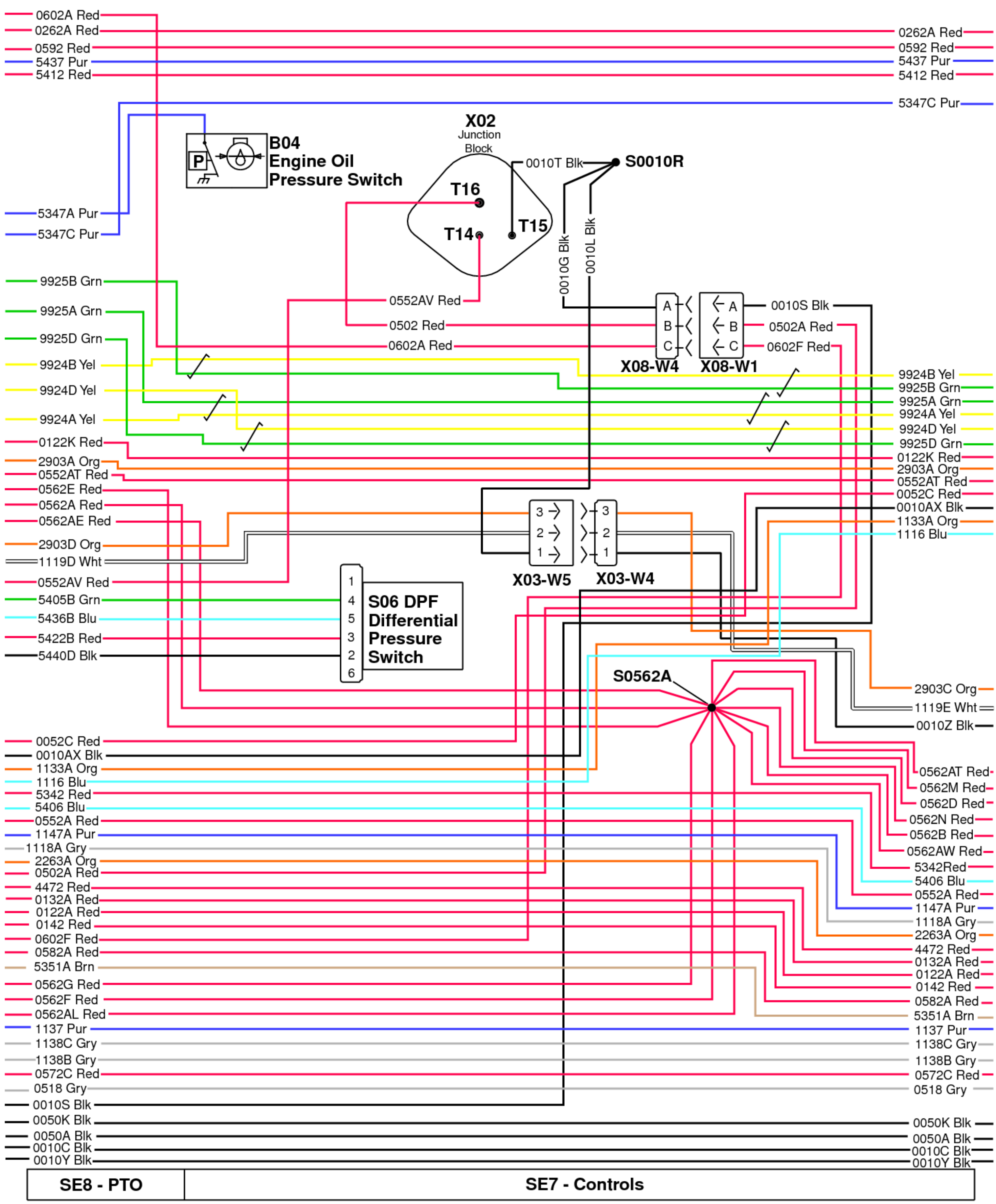


Main Wiring Schematic Open Station (4 of 11)

LEGEND:

A09	Engine Control Unit (ECU)
P03	Hand Throttle
S08	Inlet Temperature Sensor
X07-W1	Chassis to Hood Harness Interconnect

X07-W4 Hood to Chassis Harness Interconnect
X102 Service Advisor

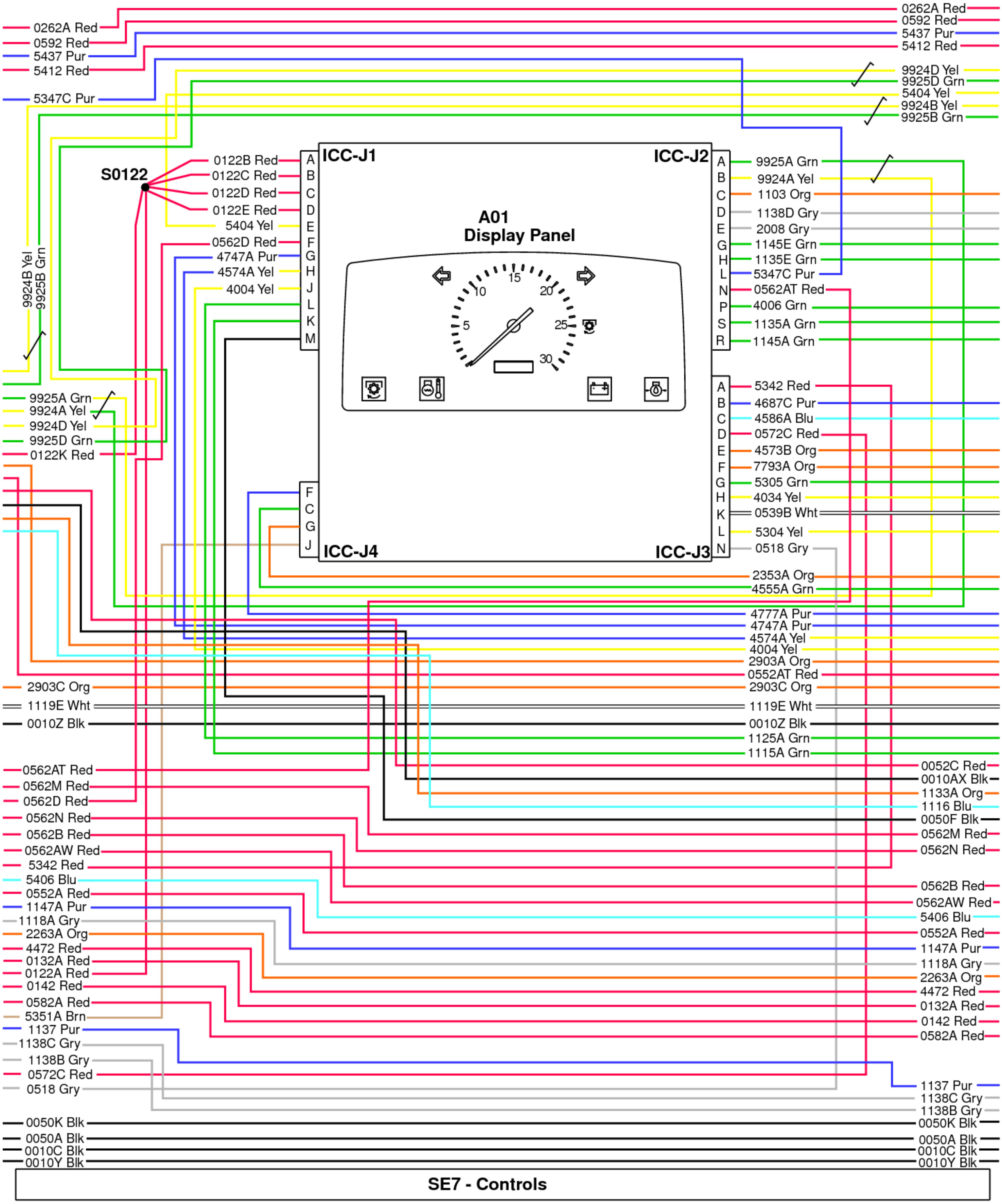


Main Wiring Schematic Open Station (5 of 11)

LEGEND:

B04	Engine Oil Pressure Switch
S06	Differential Pressure Switch
X02	Junction Block
X03-W4	Hood to Grille Harness Interconnect

X03-W5	Grille to Hood Harness Interconnect
X08-W1	Chassis to Hood Harness Interconnect
X08-W4	Hood to Chassis Harness Interconnect

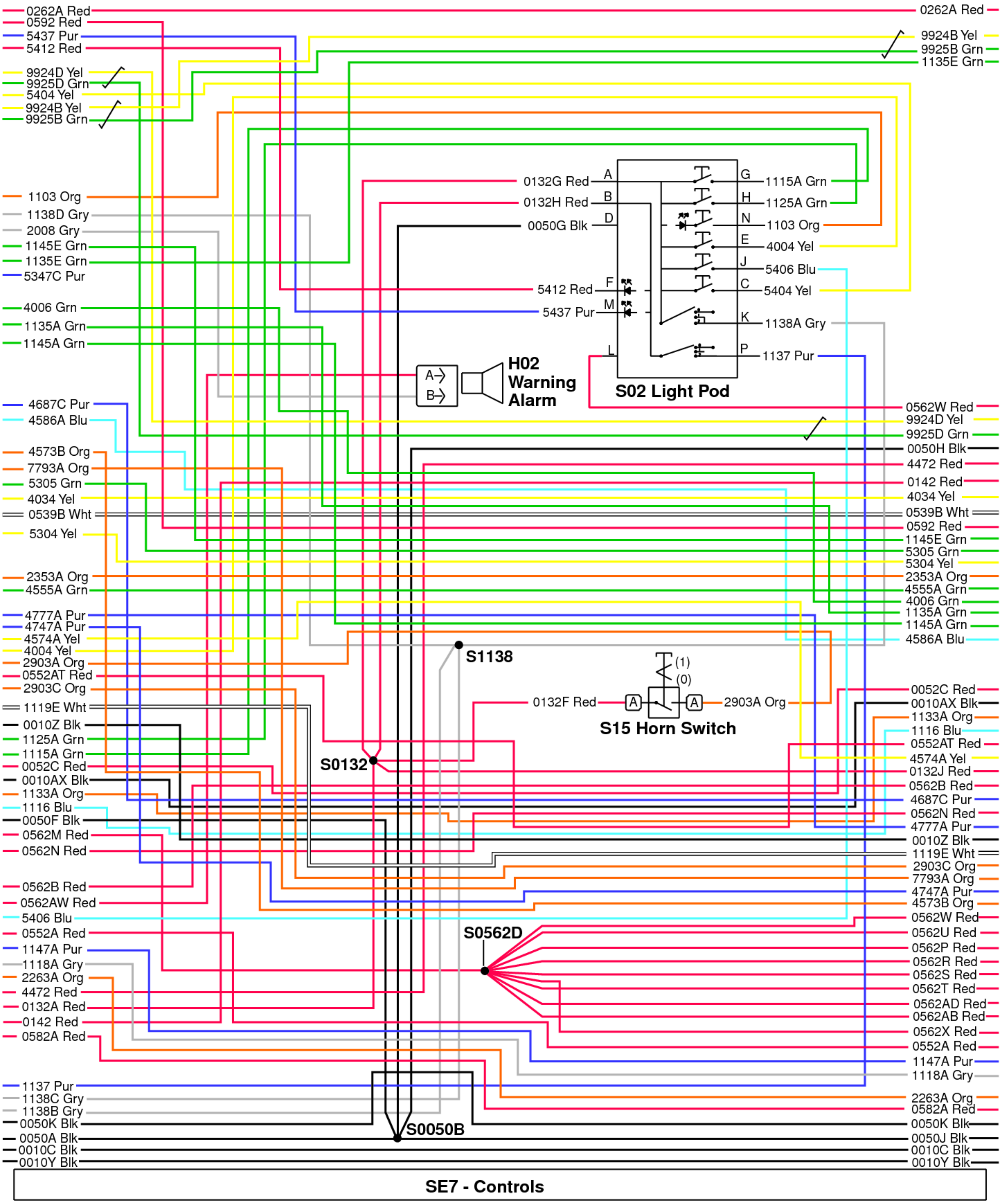


Main Wiring Schematic Open Station (6 of 11)

LEGEND:

A01	Display Panel
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect

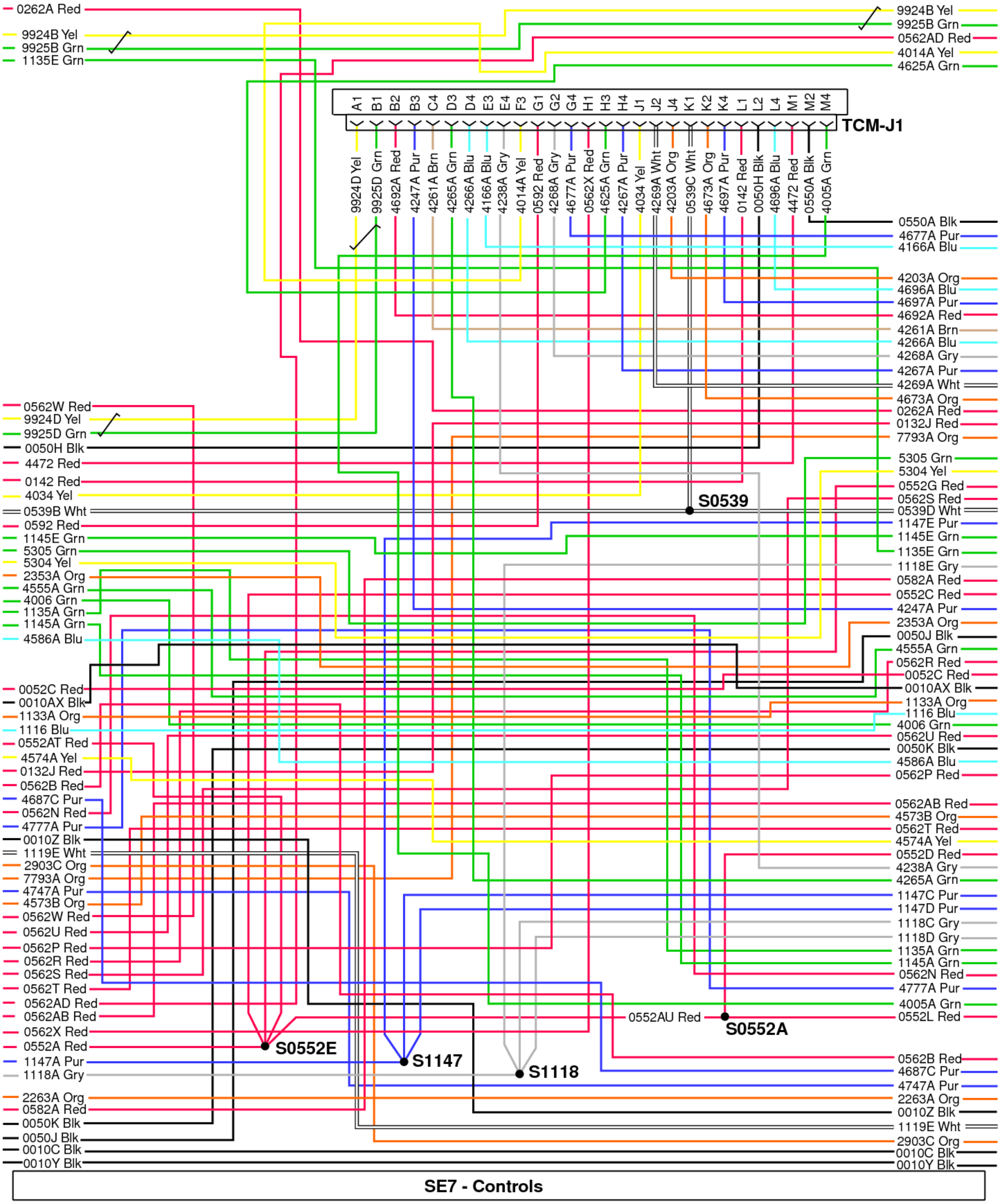
ICC-J3 Display Interconnect
ICC-J4 Display Interconnect



Main Wiring Schematic Open Station (7 of 11)

LEGEND:

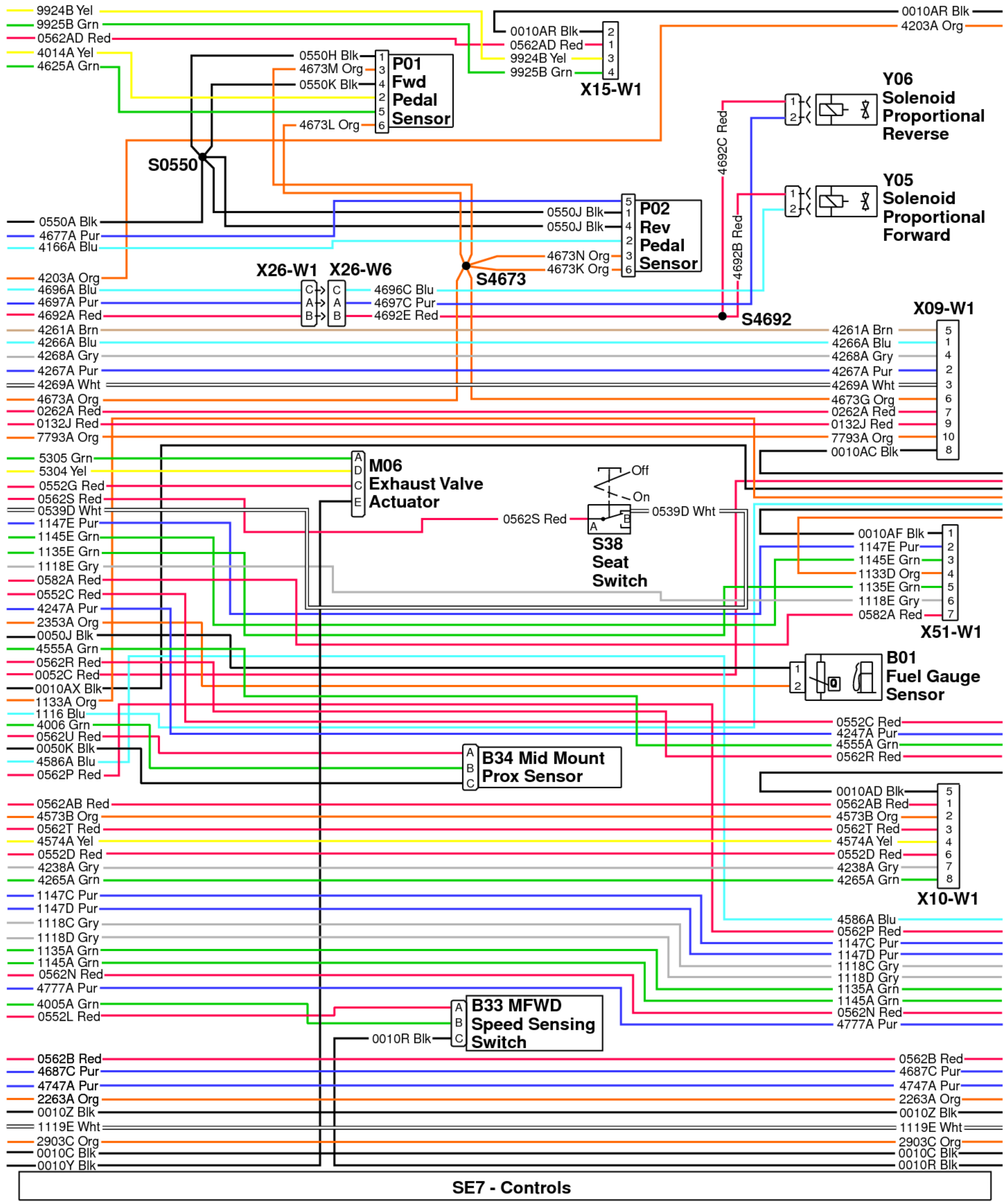
H02 Warning Alarm
S02 Dash Panel Module
S15 Horn Switch



Main Wiring Schematic Open Station (8 of 11)

LEGEND:

TCU-J1	Transmission Control Unit Interconnect

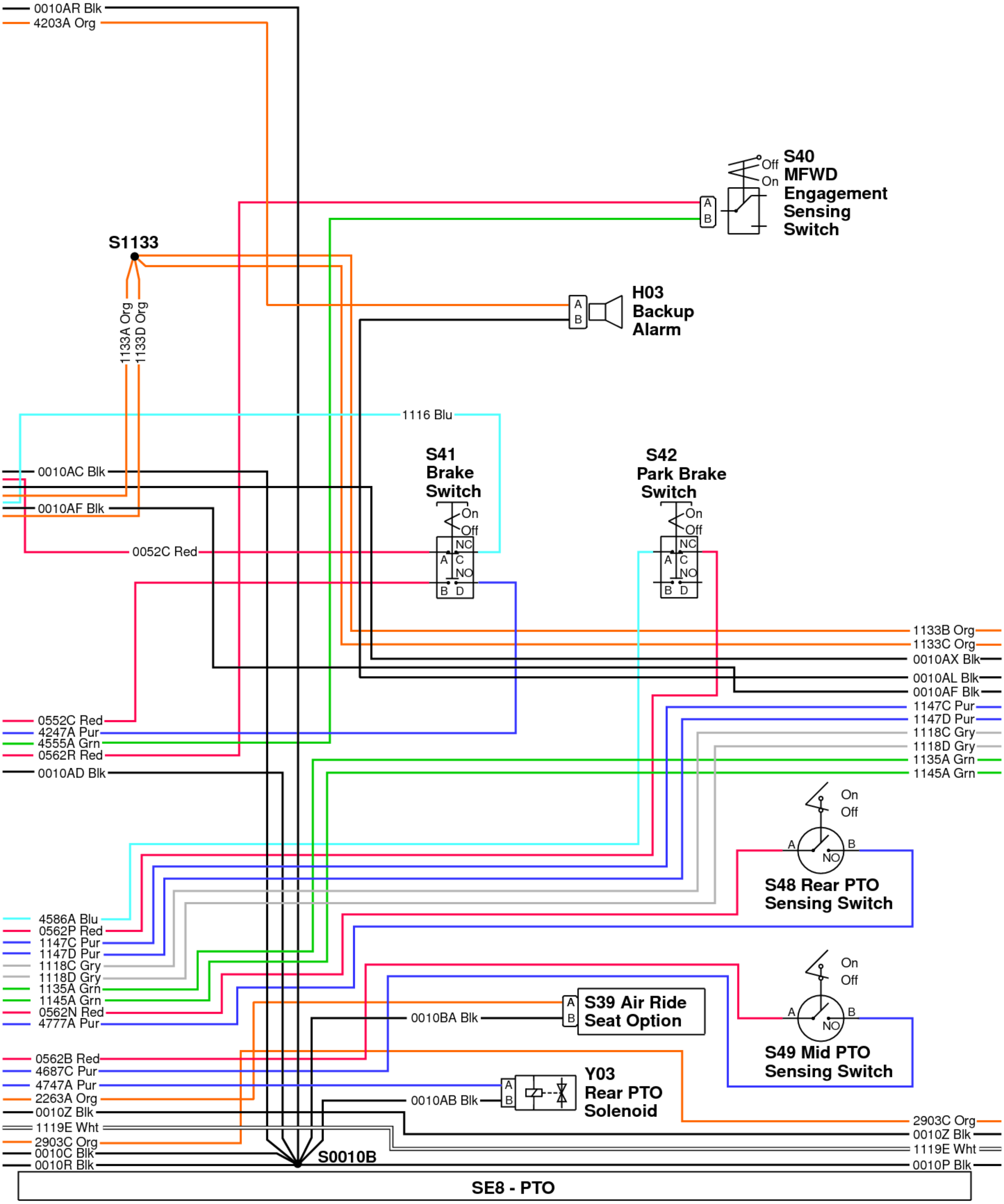


Main Wiring Schematic Open Station (9 of 11)

LEGEND:

B01	Fuel Gauge Sensor
B33	MFWD Speed Sensing Switch
B34	Mid-Mount Proxy Sensor
M06	Exhaust Valve Actuator
P01	Forward Pedal Sensor
P02	Reverse Pedal Sensor

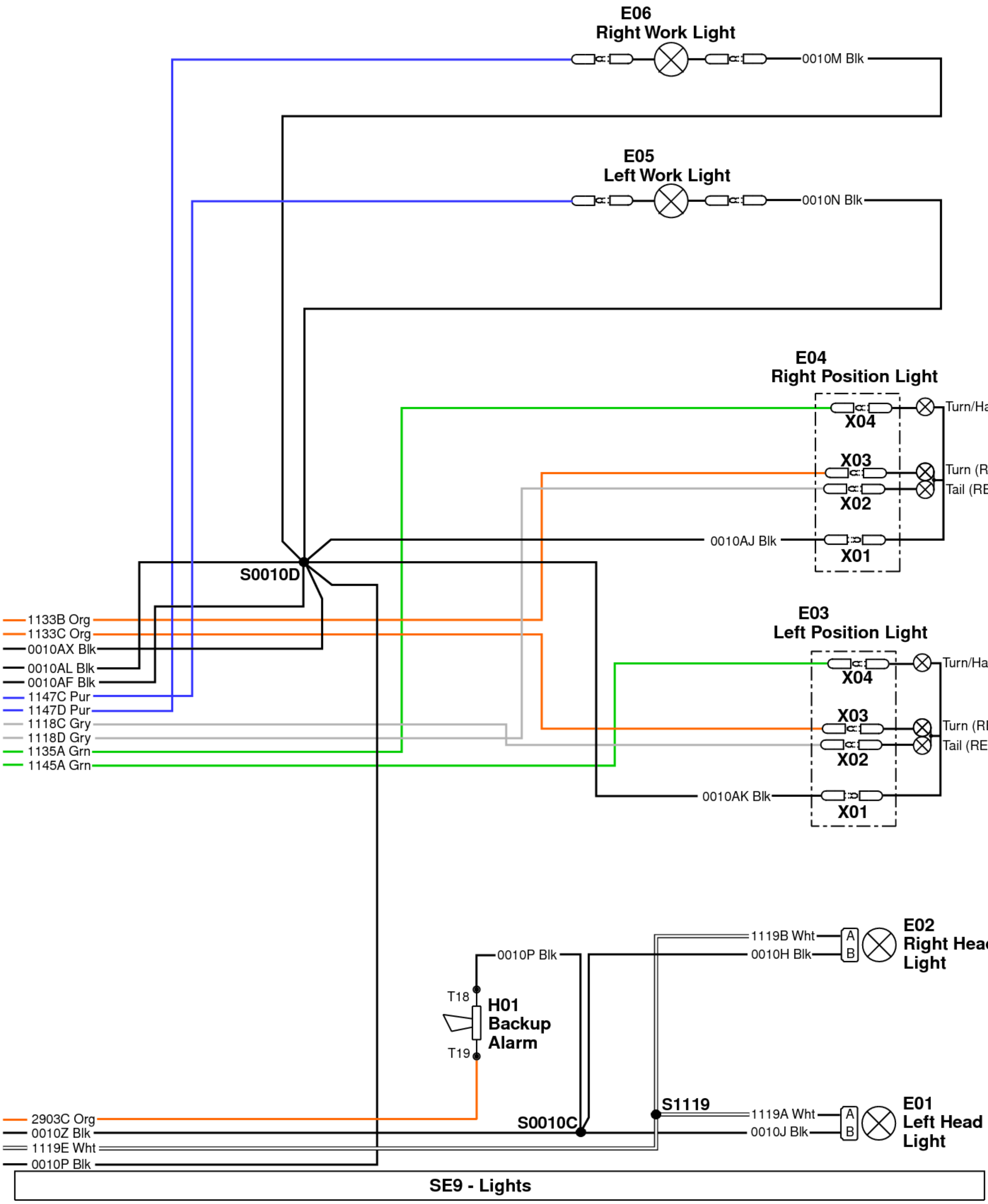
S38	Seat Switch
X09-W1	Chassis to Right Fender Harness Interconnect 1
X10-W1	Chassis to Right Fender Harness Interconnect 2
X15-W1	Chassis to Creep to Repo Interconnect
X26-W1	Chassis to HST Harness Interconnect
X26-W6	HST to Chassis Harness Interconnect
X51-W1	Chassis to 7 Pin Trailer Interconnect
Y05	Forward Proportional Solenoid
Y06	Reverse Proportional Solenoid



Main Wiring Schematic Open Station (10 of 11)

LEGEND:

H03	Backup Alarm
S39	Air Ride Seat (Option)
S40	MFWD Engagement Sensing Switch
S41	Brake Switch
S42	Park Brake Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
Y03	Rear PTO Solenoid



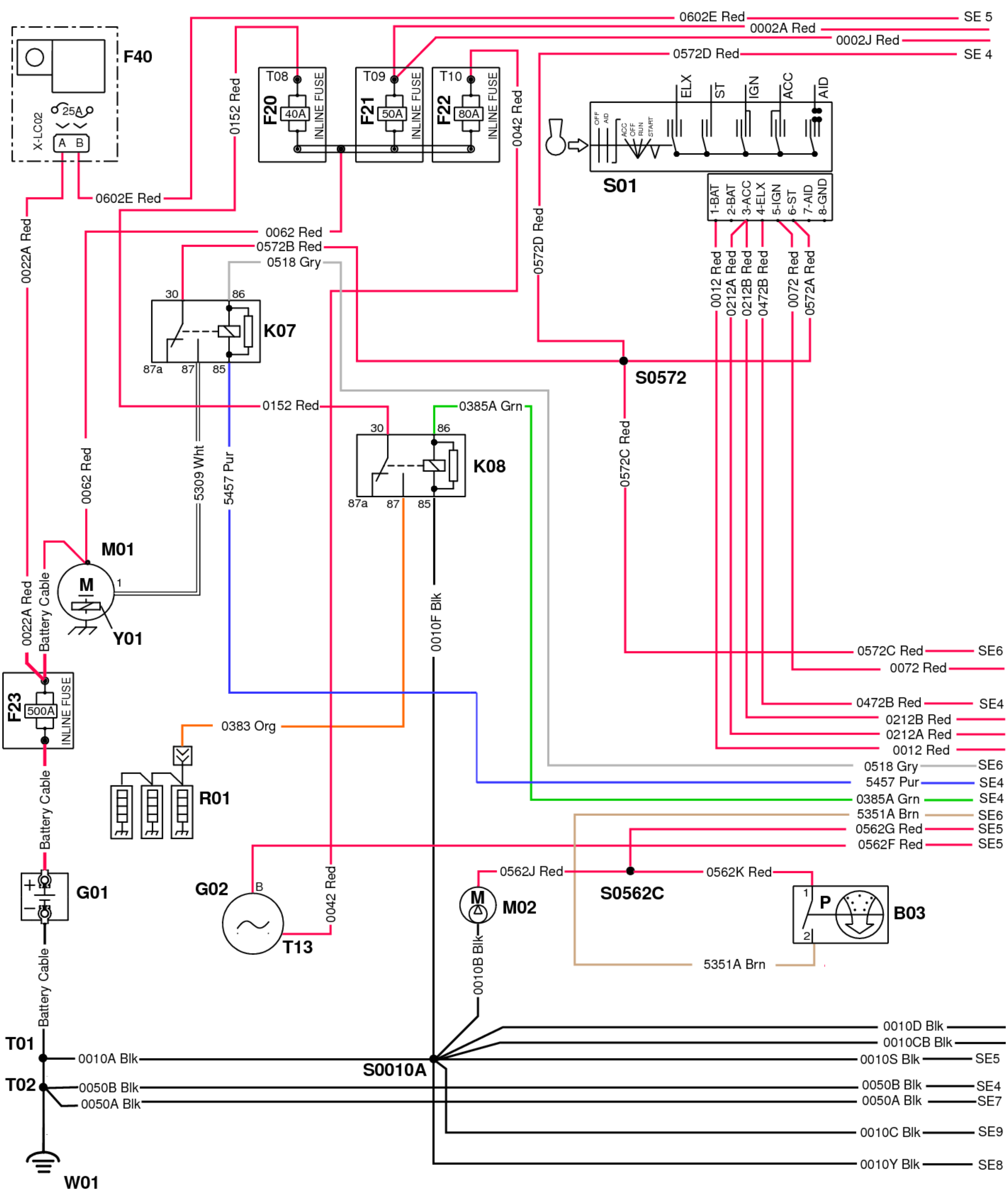
Main Wiring Schematic Station (11 of 11)

LEGEND:

E01	Left Headlight
E02	Right Headlight
E03	Left Position Light
E03_X01	Ground
E03_X02	Tail
E03_X03	Turn

E03_X04	Turn/Haz
E04	Right Position Light
E04_X01	Ground
E04_X02	Tail
E04_X03	Turn
E04_X04	Turn/Haz
E05	Left Work Light
E06	Right Work Light
H01	Horn

Main Wiring Schematic (Open Station)—PowrReverser Transmission

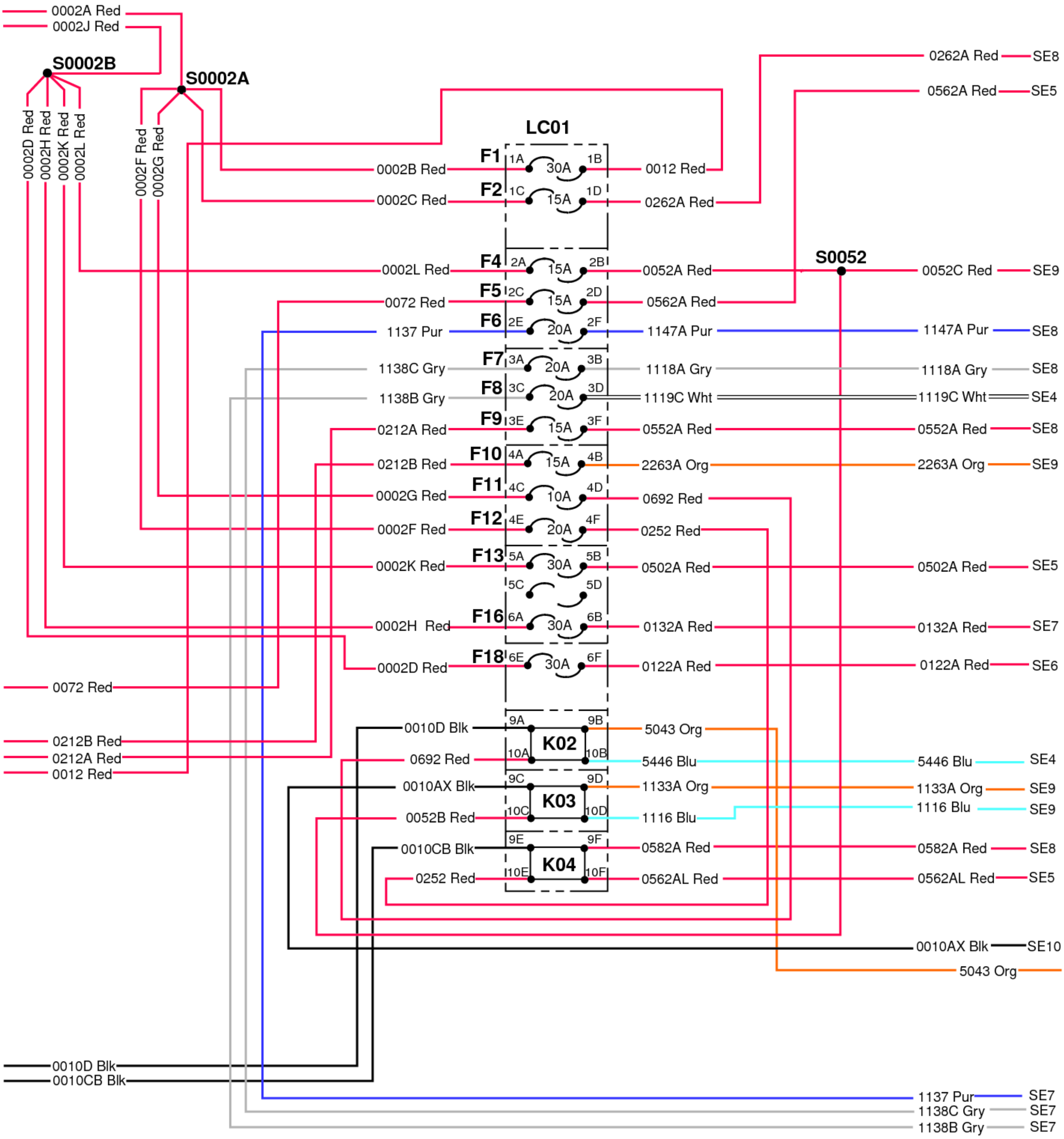


SE1—Starting and Charging

LEGEND:

B03	Air Filter Restriction Switch
F20	Inline Fuse (40A)
F21	Inline Fuse (50A)
F22	Inline Fuse (80A)

F23	Inline Fuse (500A)
F40	ECU Fuse (25A)
G01	Battery
G02	Alternator
K07	Start Relay
K08	Glow Plug Relay
M01	Starting Motor
M02	Fuel Pump
R01	Glow Plugs
S01	Key Switch
T01	Ground
T02	Ground
T13	Phase Terminal
Y01	Starter Motor Solenoid
W01	Ground

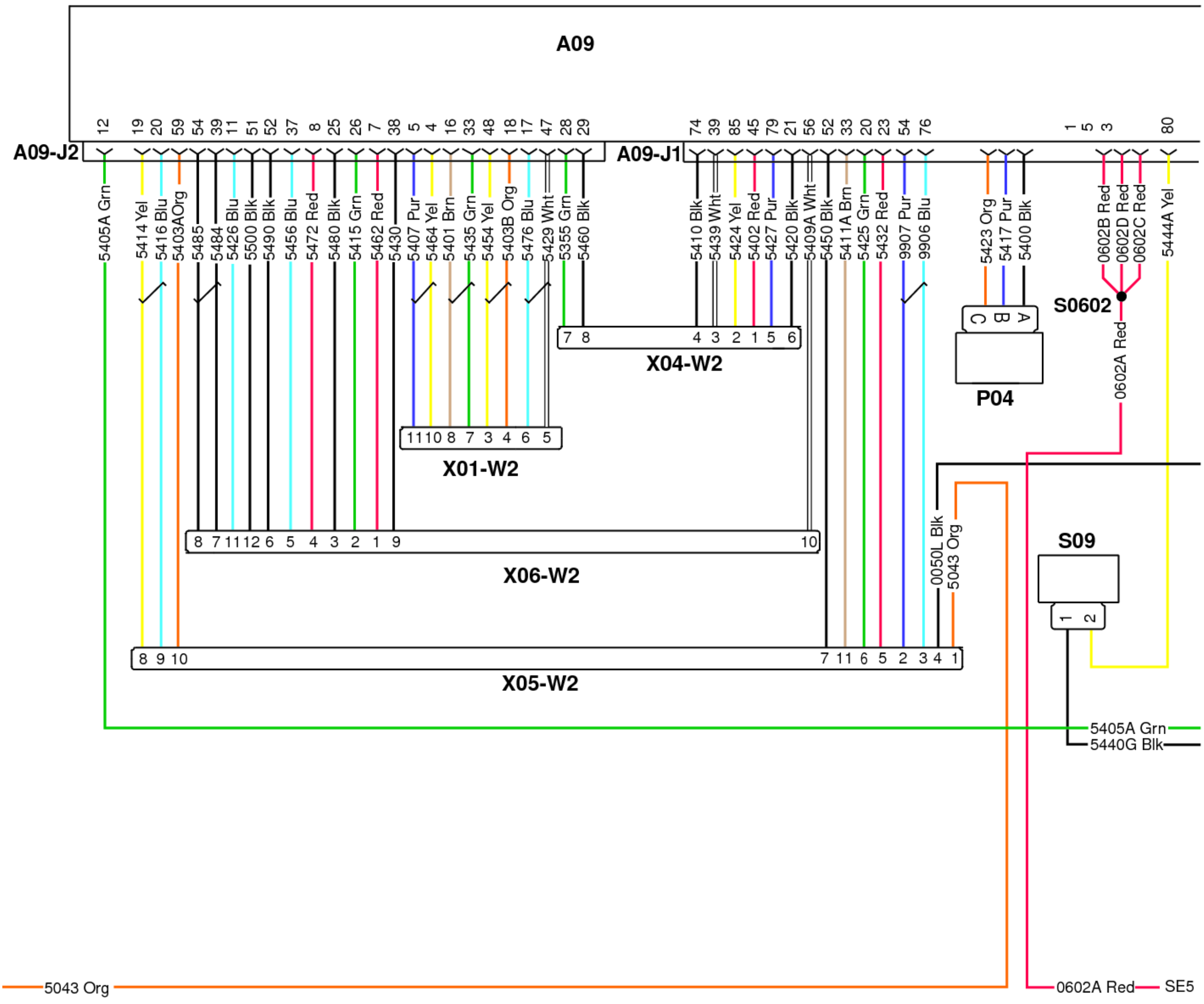


SE2—Fuses and Relays

LEGEND:

F1	Fuse 30A
F2	Fuse 15A
F4	Fuse 15A
F5	Fuse 15A
F6	Fuse 20A
F7	Fuse 20A

F8	Fuse 20A
F9	Fuse 15A
F10	Fuse 15A
F11	Fuse 10A
F12	Fuse 20A
F13	Fuse 30A
F16	Fuse 30A
F17	Spare
F18	Fuse 30A
K02	EGR Relay
K03	Brake light Relay
K04	7 Pin Trailer Power Relay
LC01	Load Center

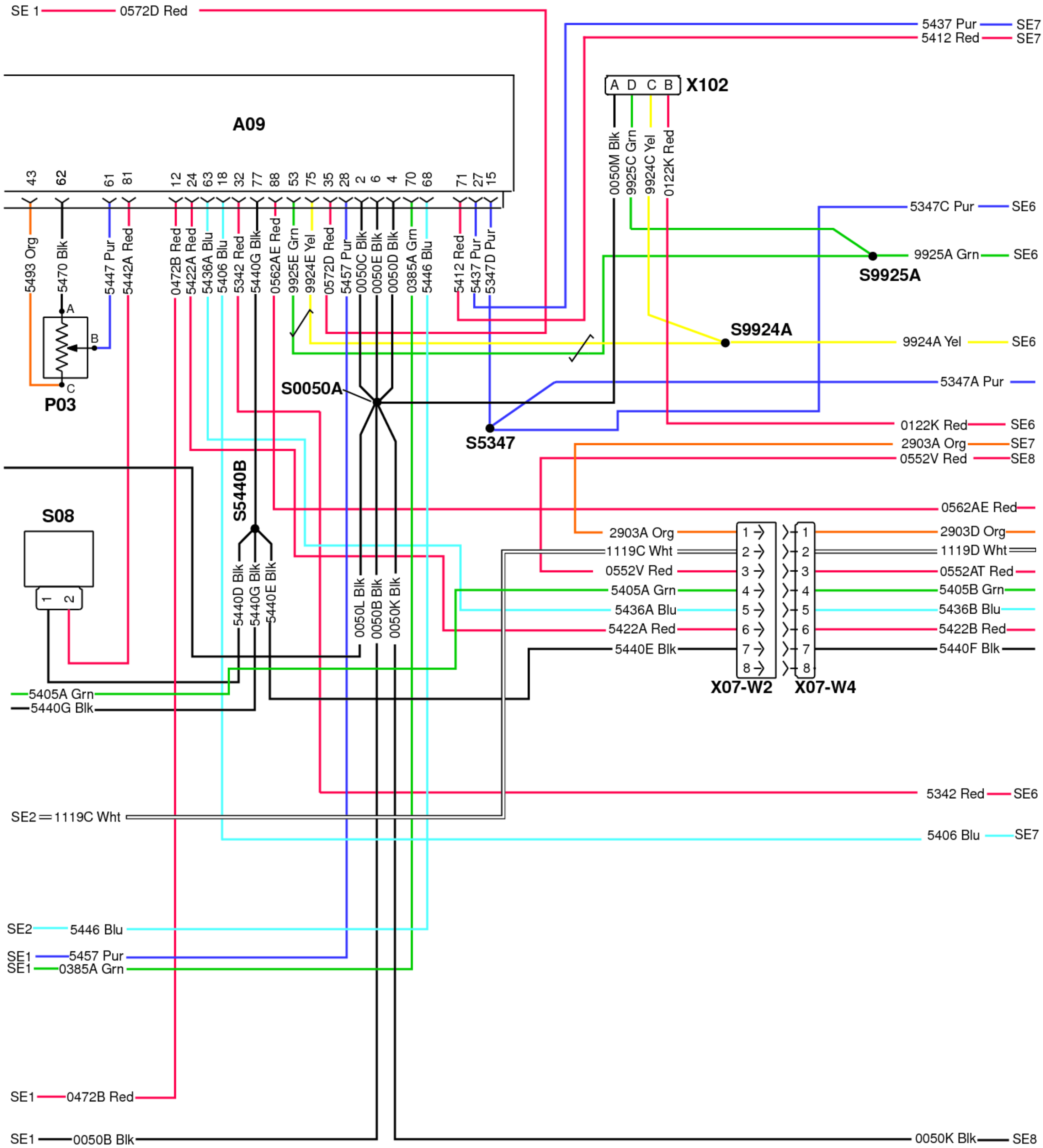


SE3—Engine

LEGEND:

A09	Engine Control Unit (ECU)
A09-J1	ECU Connector
A09-J2	ECU Connector
P04	Foot Throttle Sensor
X01-W2	12 Pin Engine Interface (Yellow)
X04-W2	8 Pin Engine Interface (Red)

X05-W2	12 Pin Engine Interface (Red)
X06-W2	12 Pin Engine Interface (Gray)
S09	Mid-Temperature Sensor

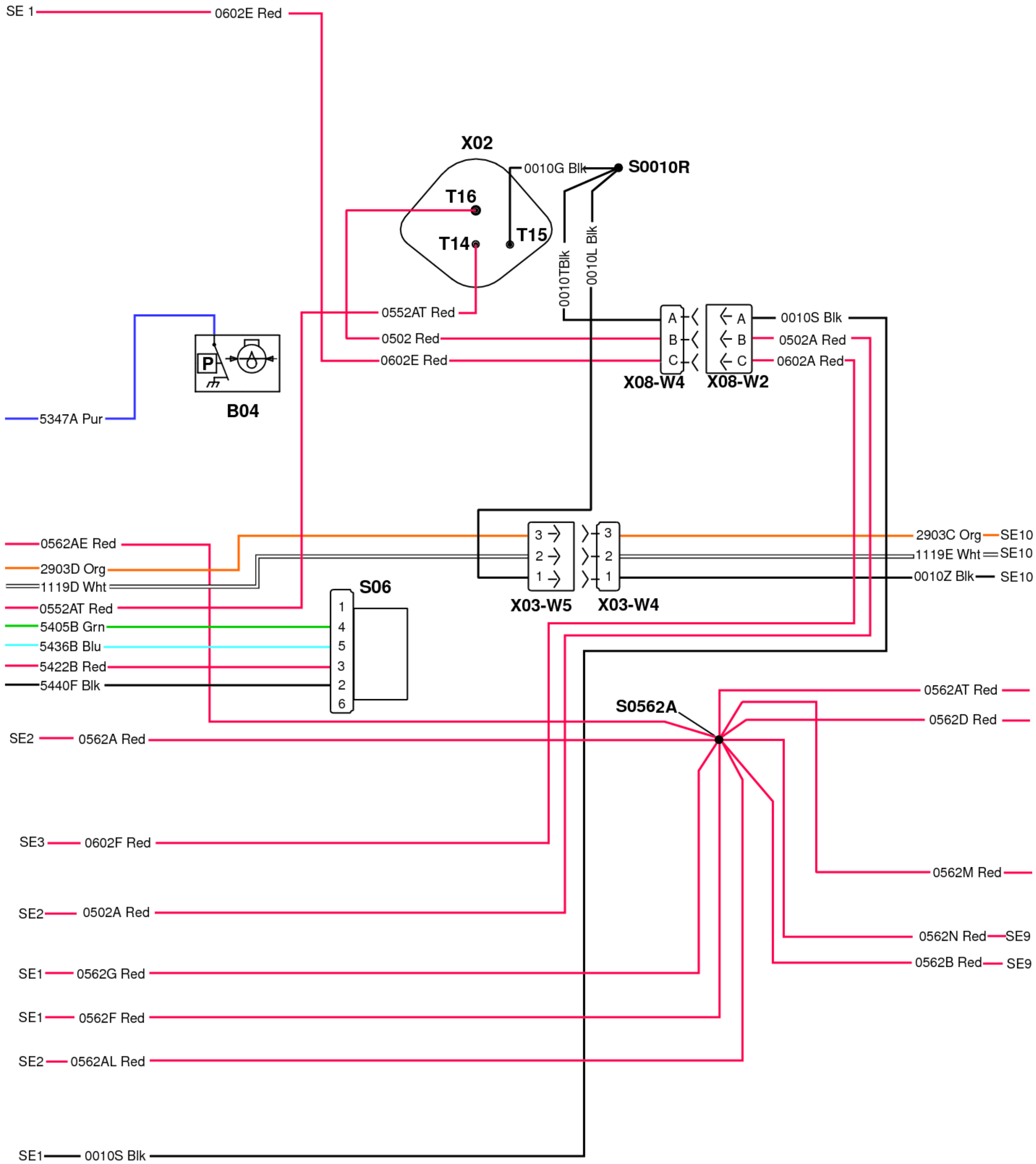


SE4—Engine

LEGEND:

A09	Engine Control Unit (ECU)
P03	Hand Throttle
S08	Inlet Temperature Sensor

X07-W2	Chassis to Hood Harness Interconnect
X07-W4	Hood to Chassis Harness Interconnect
X102	Service Advisor

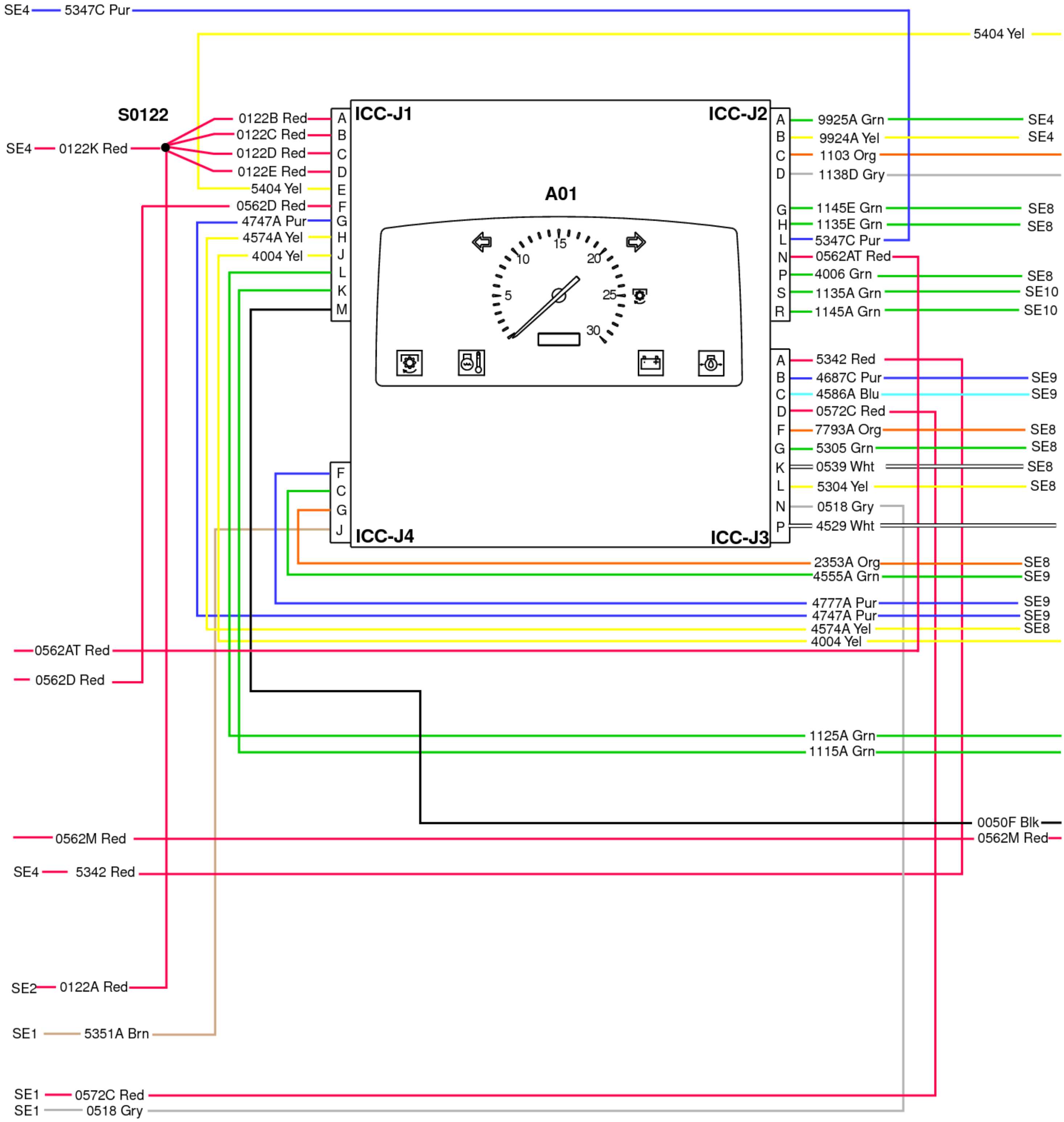


SE5—Junction Block

LEGEND:

B04	Engine Oil Pressure Switch
S06	Differential Pressure Switch
X02	Junction Block

X03-W4	Hood to Grille Harness Interconnect
X03-W5	Grille to Hood Harness Interconnect
X08-W2	Chassis to Hood Harness Interconnect
X08-W4	Hood to Chassis Harness Interconnect

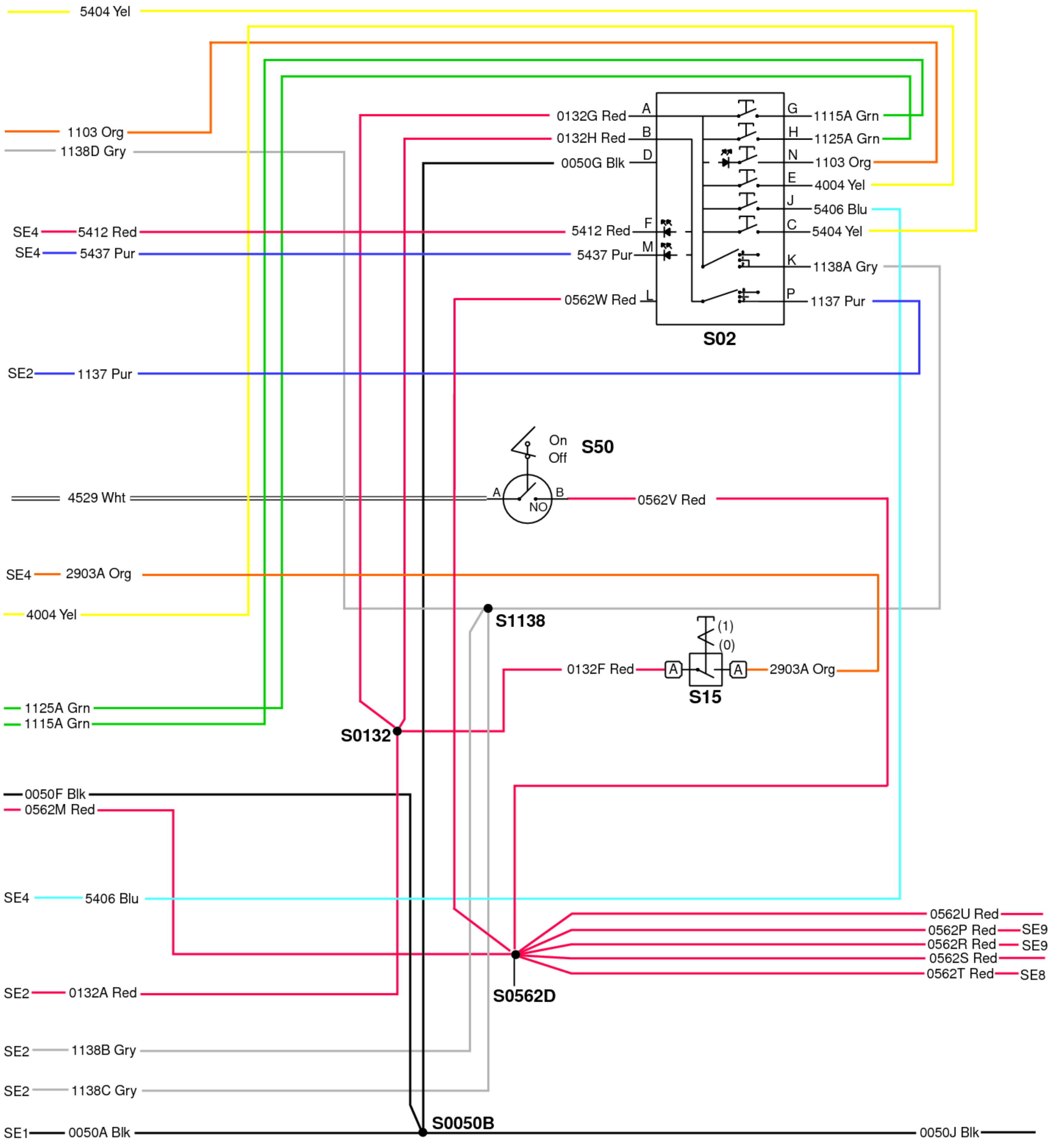


SE6—Display Panel

LEGEND:

A01	Display Panel
ICC-J1	Display Interconnect

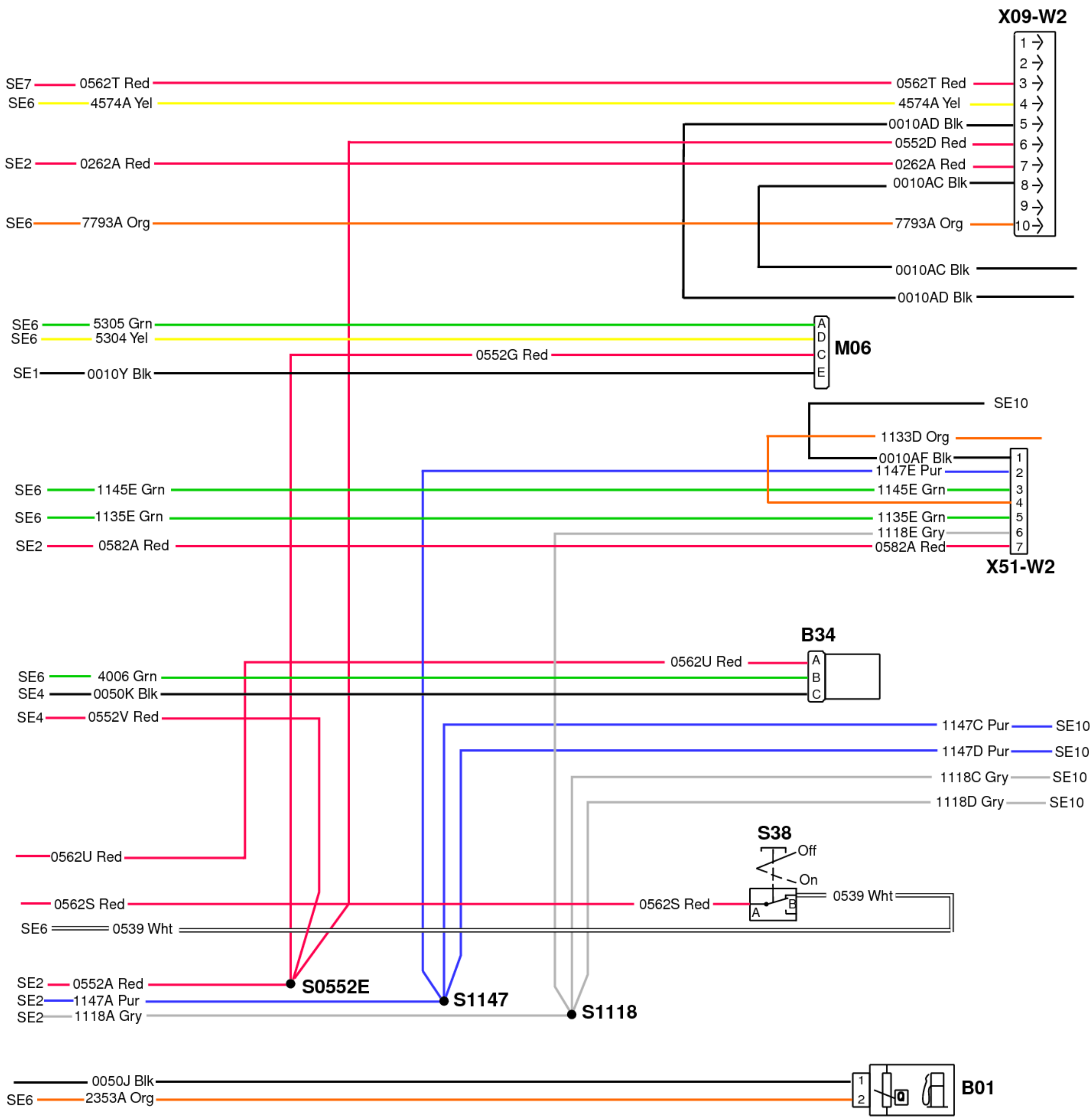
ICC-J2 Display Interconnect
ICC-J3 Display Interconnect
ICC-J4 Display Interconnect



SE7—Dash Panel Module

LEGEND:

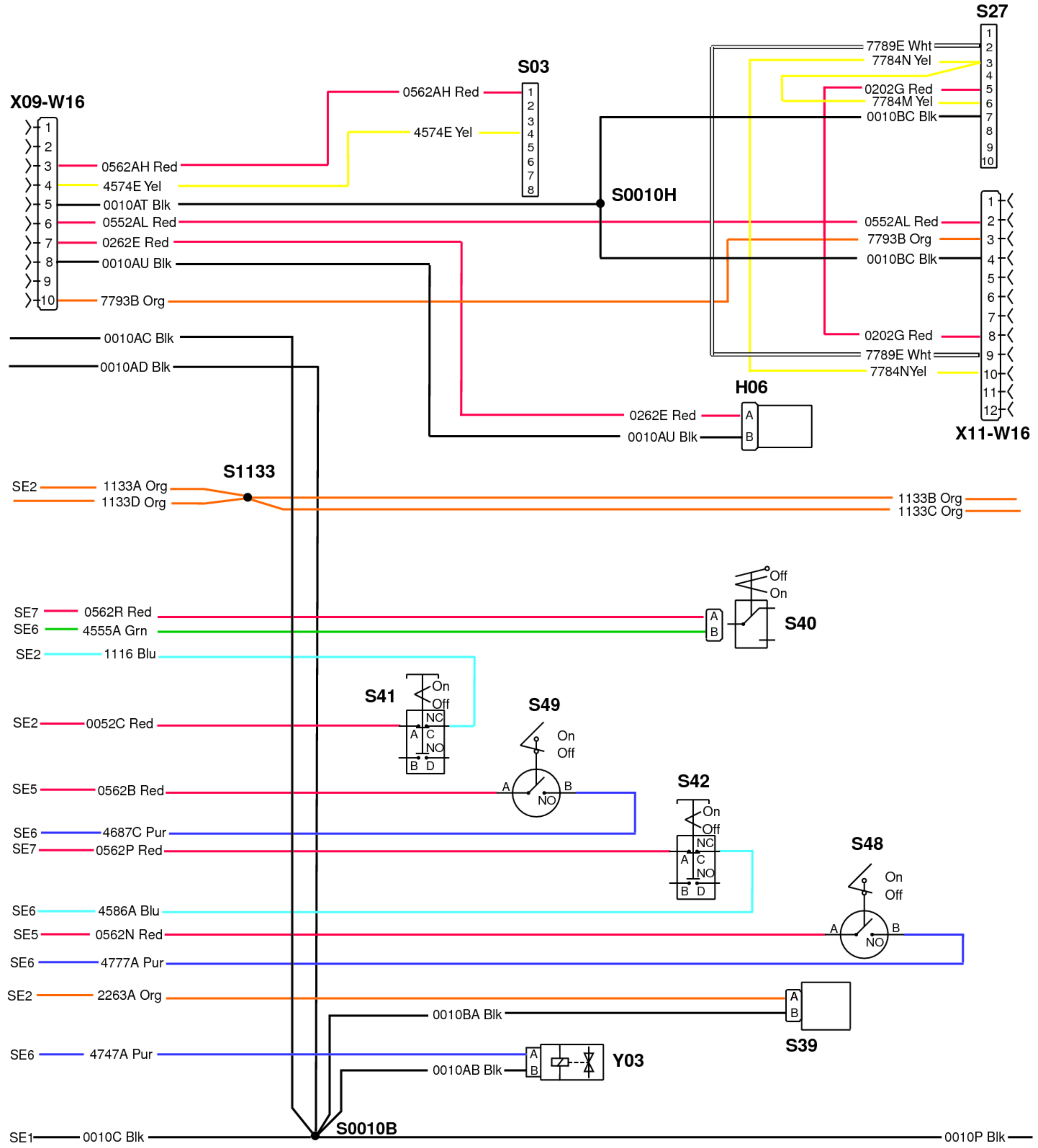
S02 Dash Panel Module
S15 Horn Switch
S50 Neutral Start Switch



SE8—Controls

LEGEND:

B01	Fuel Gauge Sensor
B34	Mid Mount Proxy Sensor
M06	Exhaust Valve Actuator
S38	Seat Switch
X09-W2	Chassis to Right Fender Harness Interconnect 1
X51-W2	Chassis to 7 Pin Trailer Interconnect

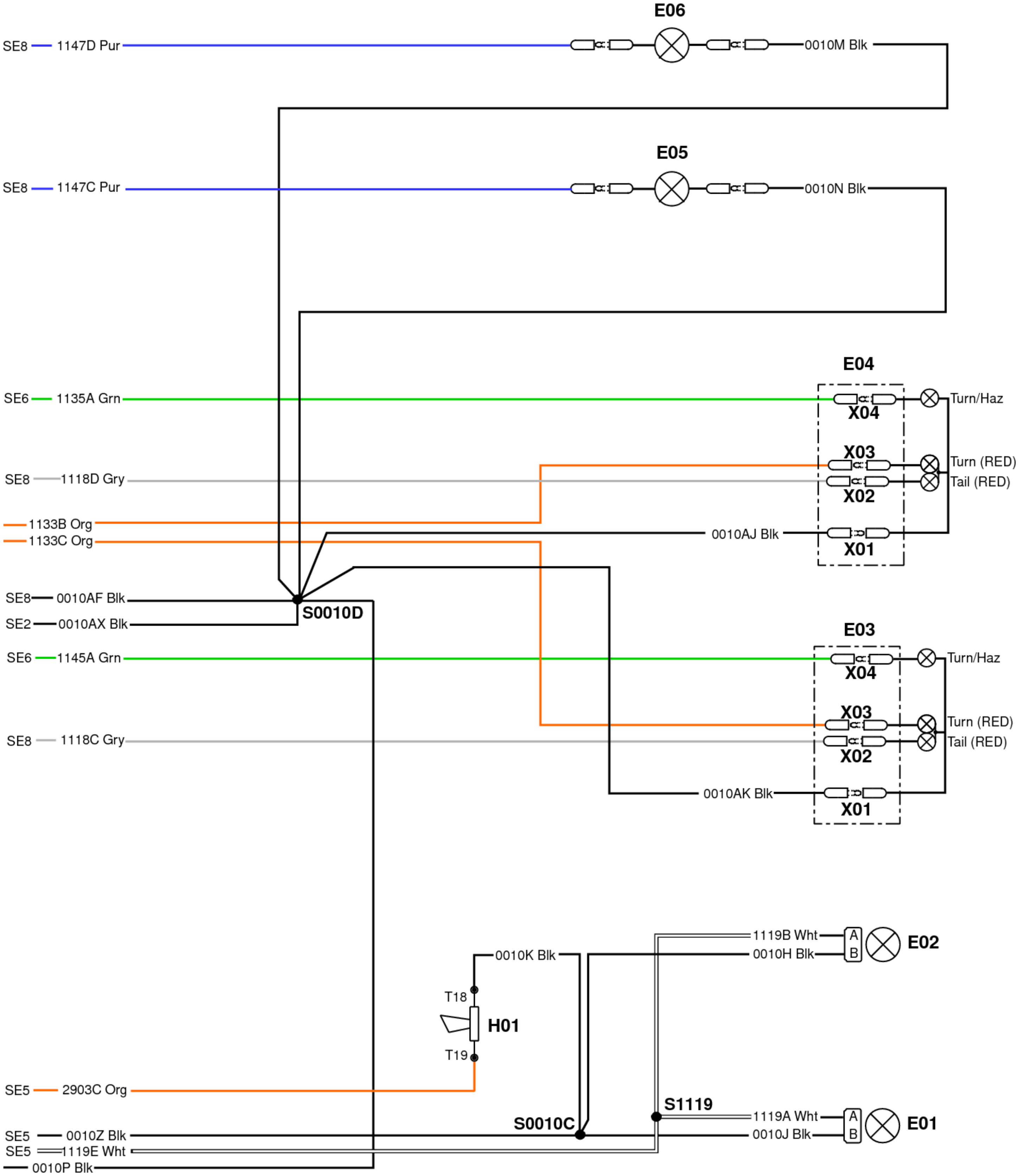


SE9—Controls

LEGEND:

H06	Power Port
S03	PTO Switch
S27	Diverter Switch
S39	Air Ride Seat (Option)
S40	MFWD Engagement Sensing Switch
S41	Brake Switch

S42	Park Brake Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
X09-W16	Right Fender to Chassis Harness Interconnect 1
X11-W16	Right Fender to 3rd EH Harness Interconnect
Y03	Rear PTO Solenoid

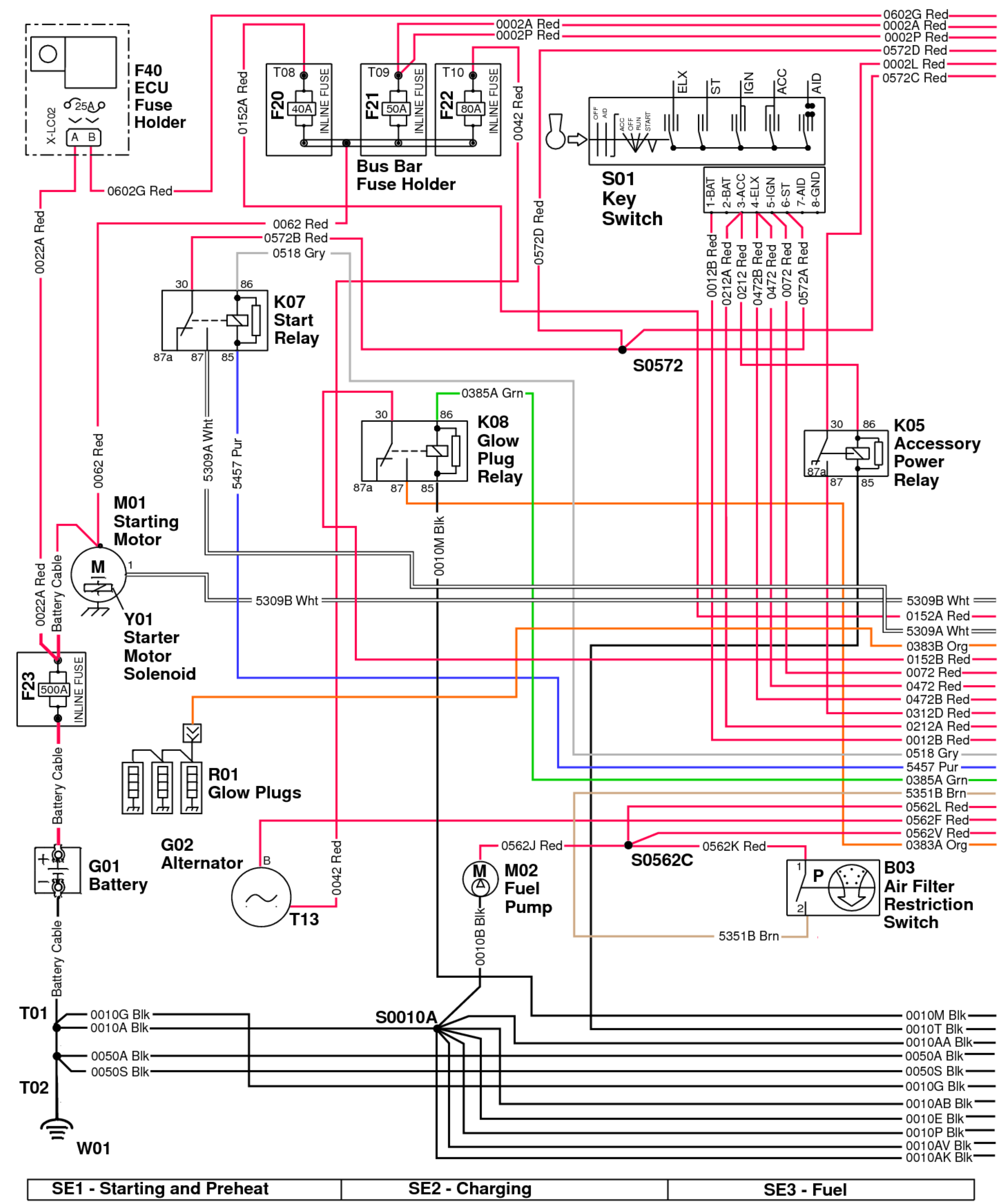


SE10—Lights

LEGEND:

E01	Left Headlight
E02	Right Headlight
E03	Left Position Light
E03_X01	Ground
E03_X02	Tail
E03_X03	Turn
E03_X04	Turn/Haz
E04	Right Position Light
E04_X01	Ground
E04_X02	Tail
E04_X03	Turn
E04_X04	Turn/Haz
E05	Left Work Light
E06	Right Work Light
H01	Horn

Main Wiring Schematic (Cab)

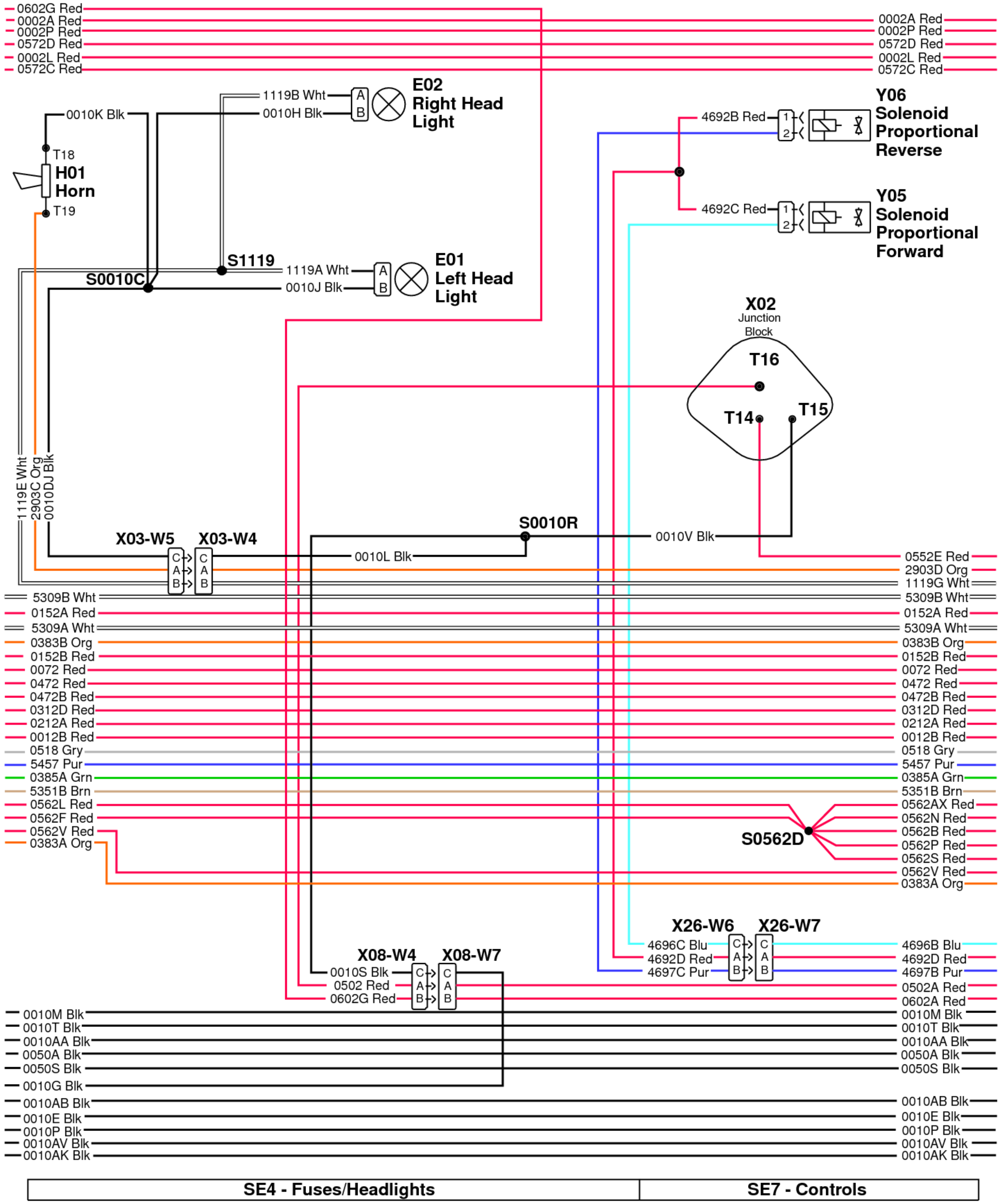


Main Wiring Schematic Cab (1 of 16)

LEGEND:

B03	Air Filter Restriction Switch
F20	Inline Fuse (40A)
F21	Inline Fuse (50A)
F22	Inline Fuse (80A)

F23	Inline Fuse (500A)
F40	ECU Fuse (25A)
G01	Battery
G02	Alternator
K05	Accessory Power Relay
K07	Start Relay
K08	Glow Plug Relay
M01	Starting Motor
M02	Fuel Pump
R01	Glow Plugs
S01	Key Switch
W01	Ground
Y01	Starter Motor Solenoid

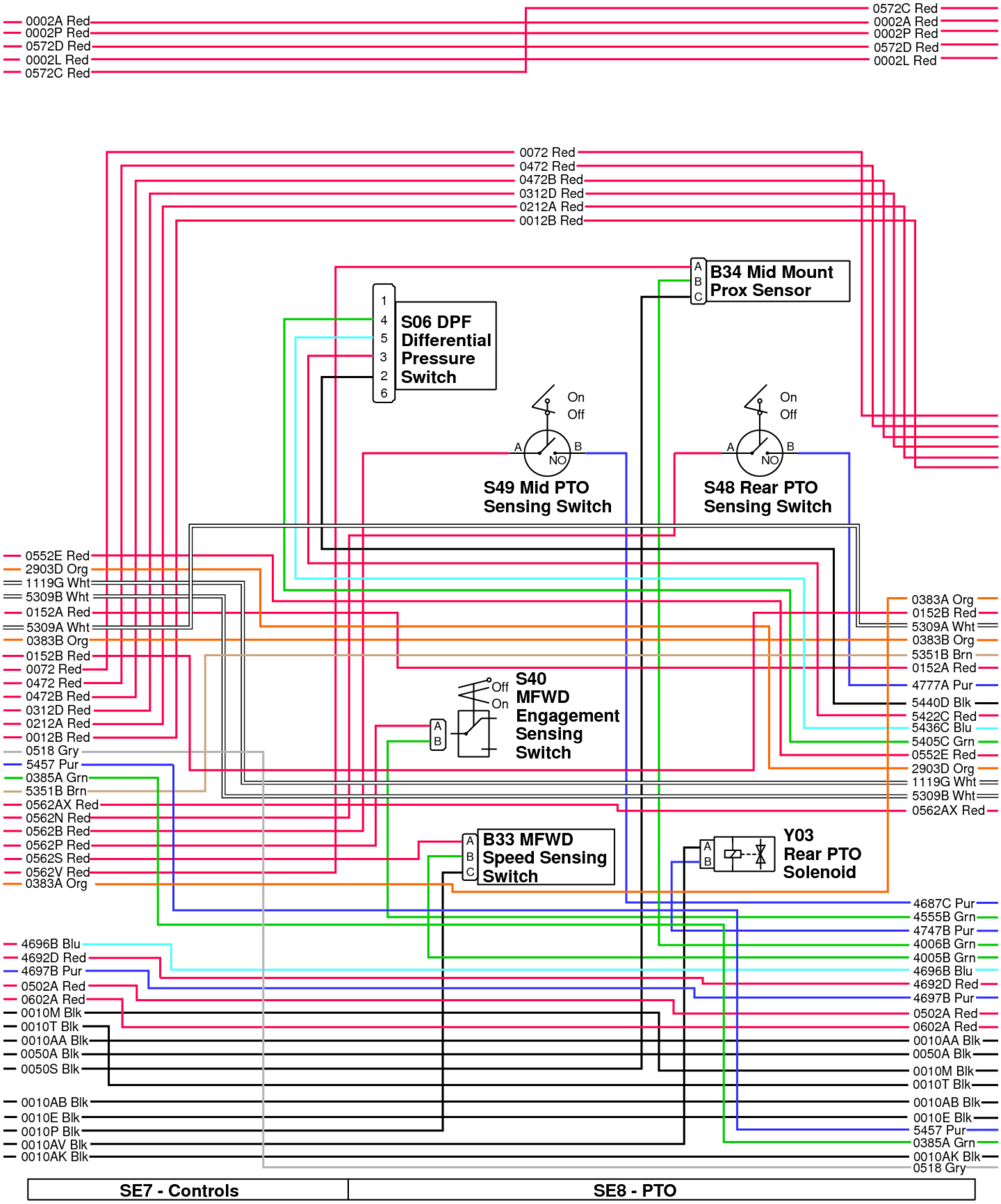


Main Wiring Schematic Cab (2 of 16)

LEGEND:

E01	Left Headlight
E02	Right Headlight
H01	Horn
X02	Junction Block
Y05	Forward Proportional Solenoid
Y06	Reverse Proportional Solenoid

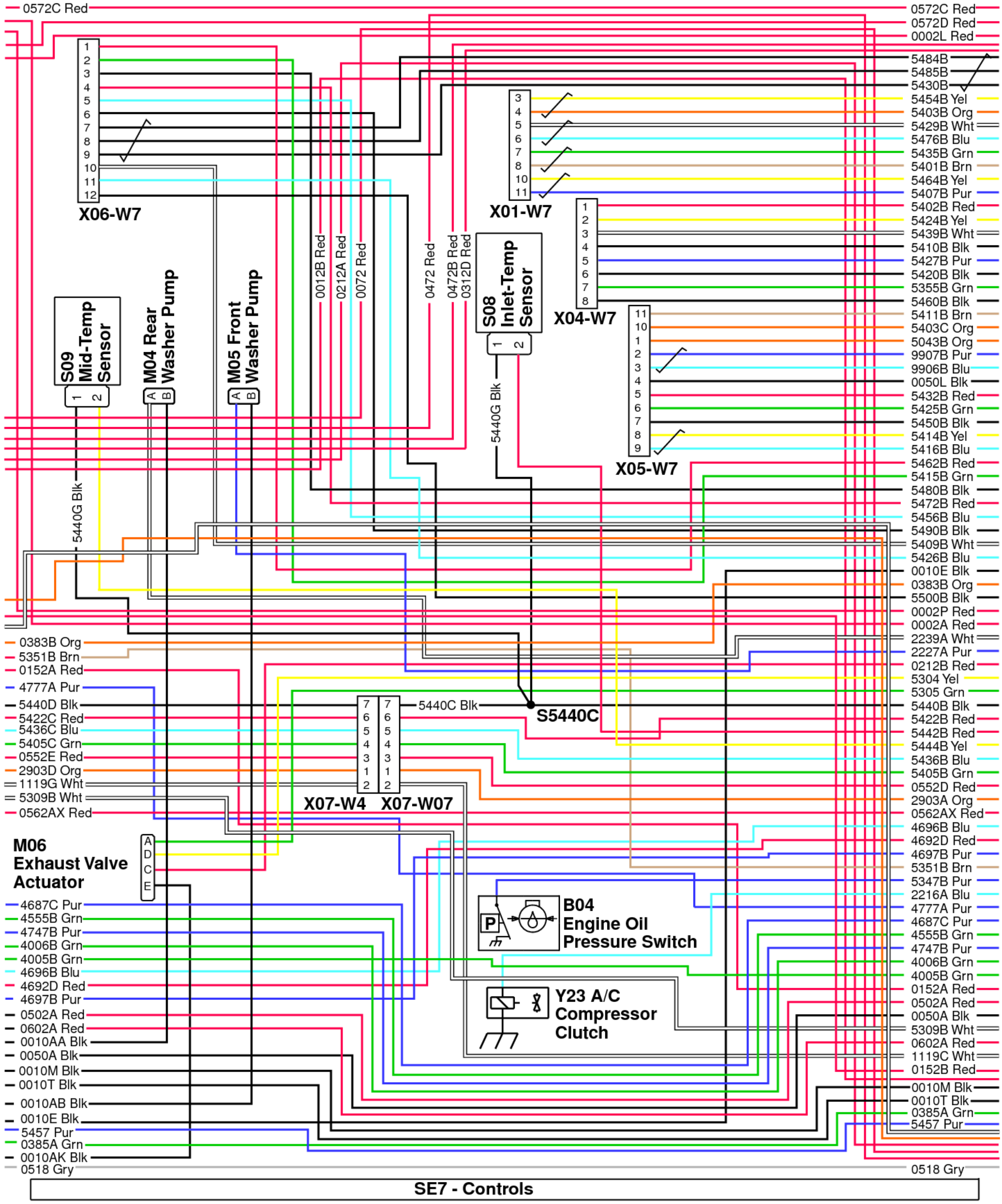
X03-W4 Hood to Grille Harness Interconnect
X03-W5 Grille to Hood Harness Interconnect
X08-W4 Hood to Chassis Harness Interconnect
X08-W7 Chassis to Hood Junction Block Interconnect
X26-W6 HST to Chassis Harness Interconnect
X26-W7 Chassis to HST Harness Interconnect



Main Wiring Schematic Cab (3 of 16)

LEGEND:

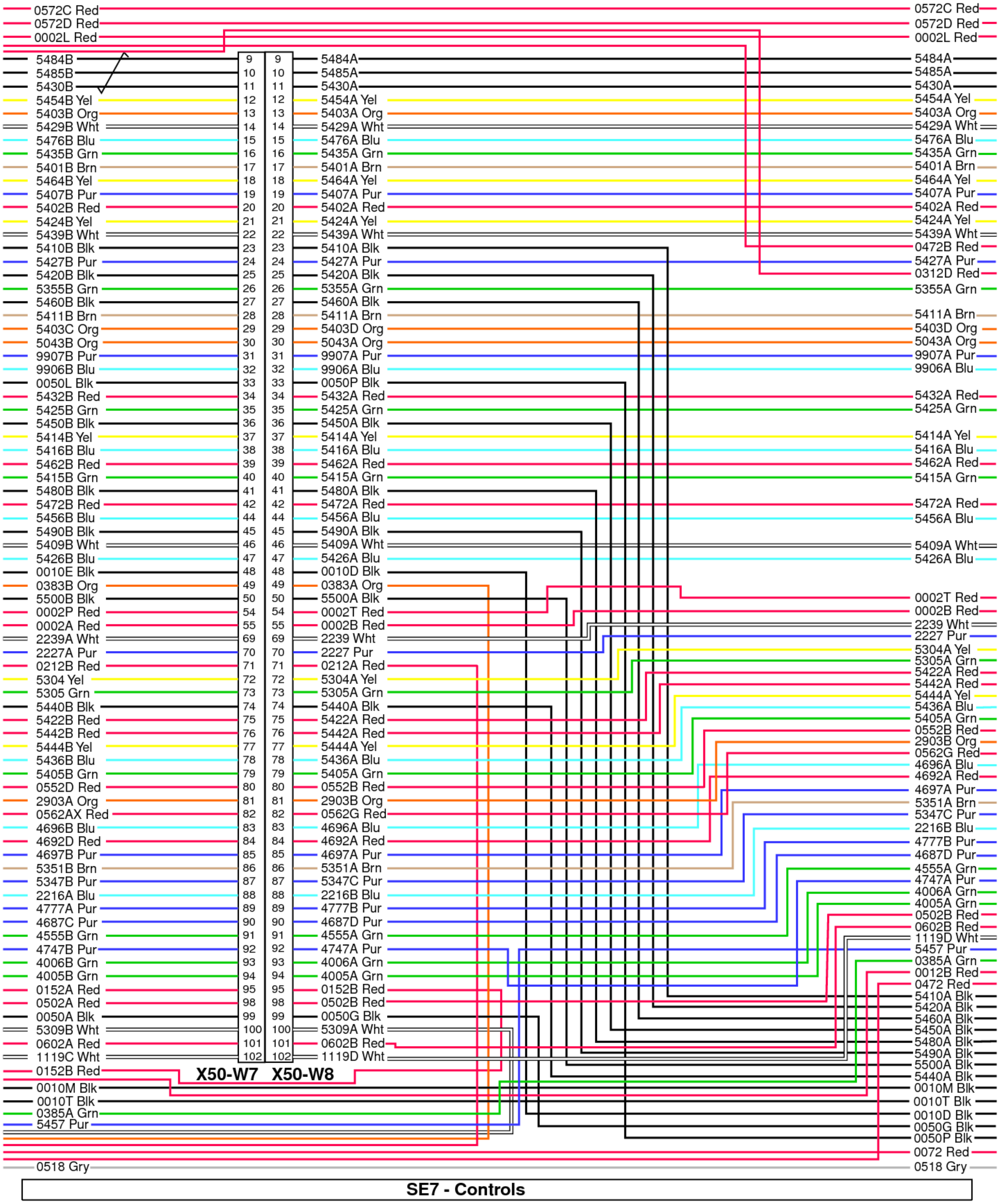
B33	MFWD Speed Sensing Switch
B34	Mid Mount Proxy Sensor
S06	Differential Pressure Switch
S40	MFWD Engagement Sensing Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
Y03	Rear PTO Solenoid



Main Wiring Schematic Cab (4 of 16)

LEGEND:

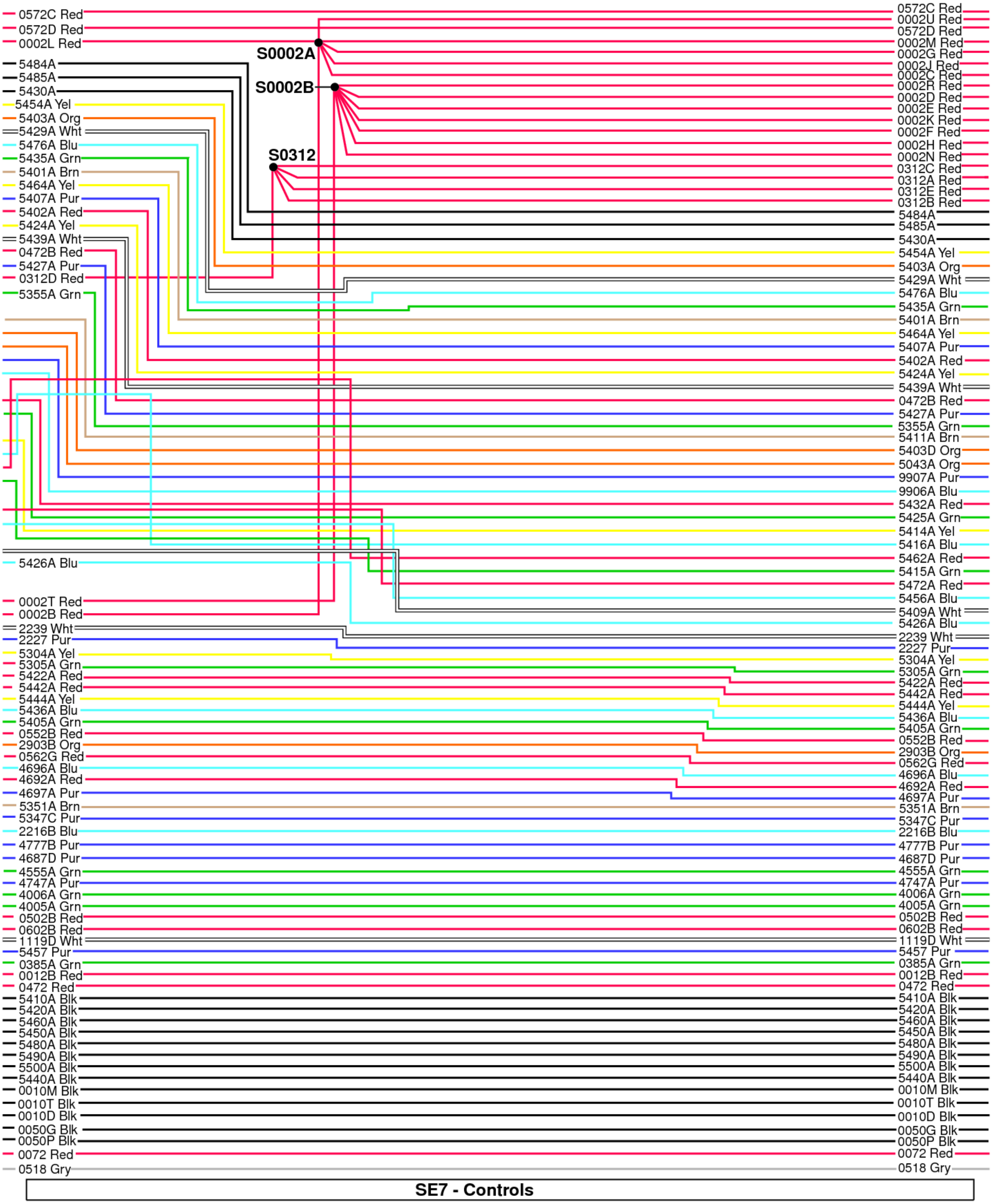
B04	Engine Oil Pressure Switch
M04	Rear Washer Pump
M05	Front Washer Pump
M06	Exhaust Valve Actuator
S08	Inlet Temperature Sensor
S09	Mid Temperature Sensor
Y23	A/C Compressor
X01-W7	12 Pin Engine Interface (Yellow)
X04-W7	8 Pin Engine Interface (Red)
X05-W7	12 Pin Engine Interface (Red)
X06-W7	12 Pin Engine Interface (Gray)
X07-W4	Hood to Chassis Harness Interconnect
X07-W7	Chassis to Hood Harness Interconnect



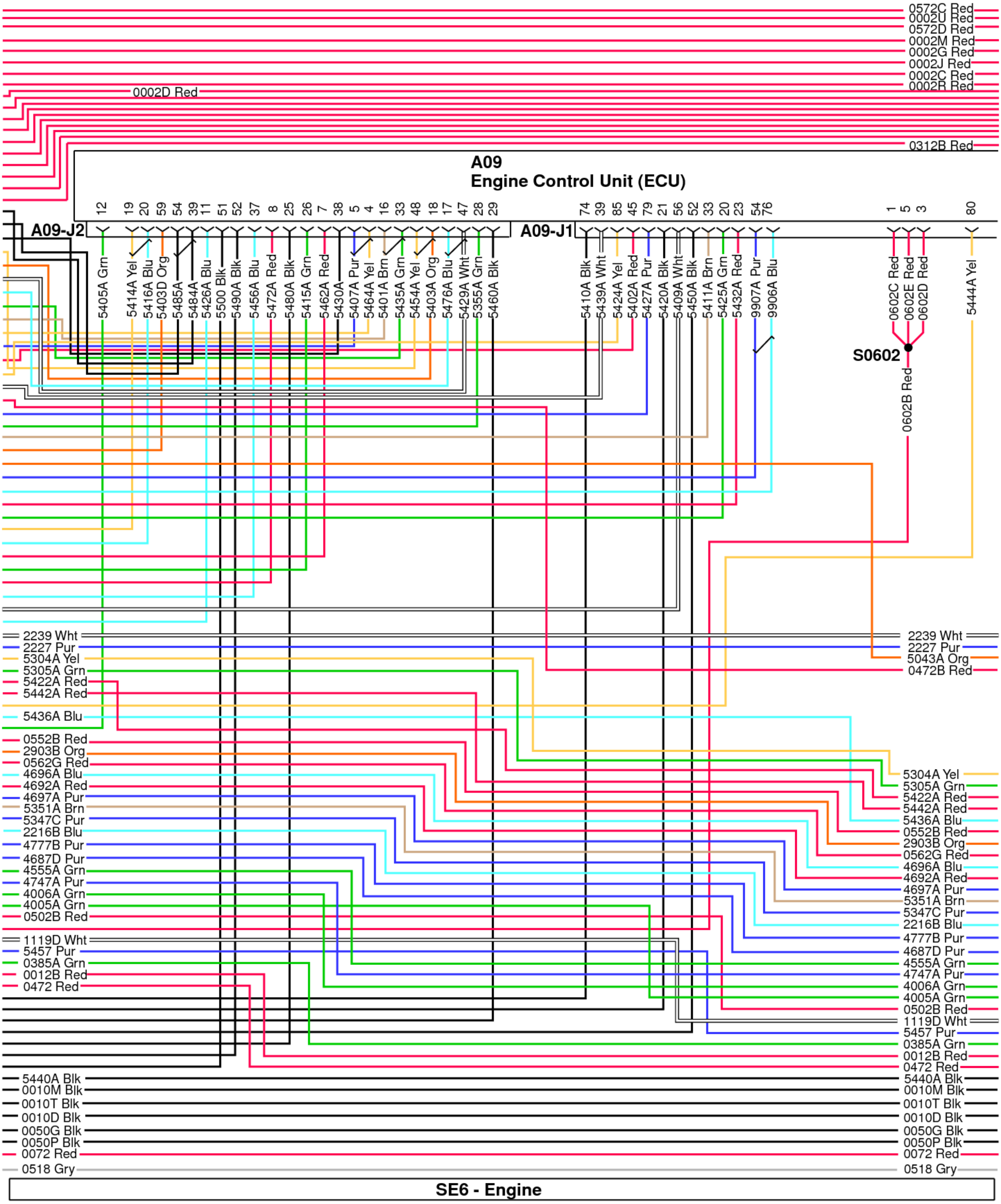
Main Wiring Schematic Cab (5 of 16)

LEGEND:

X50-W7	Chassis to Lower Wiring Harness Interconnect
X50-W8	Lower Cab to Chassis Wiring Harness Interconnect



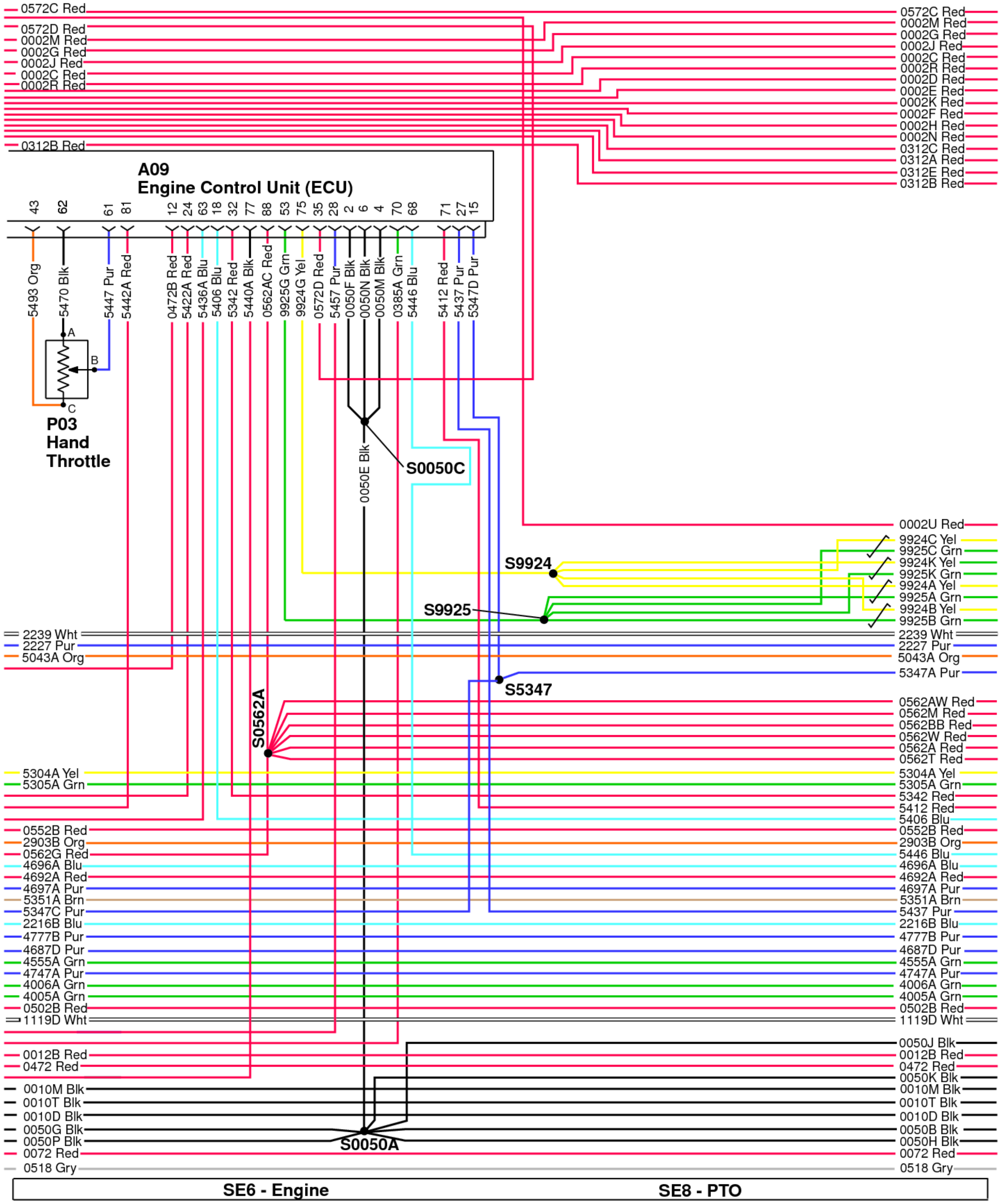
Main Wiring Schematic Cab (6 of 16)



Main Wiring Harness (7 of 16)

LEGEND:

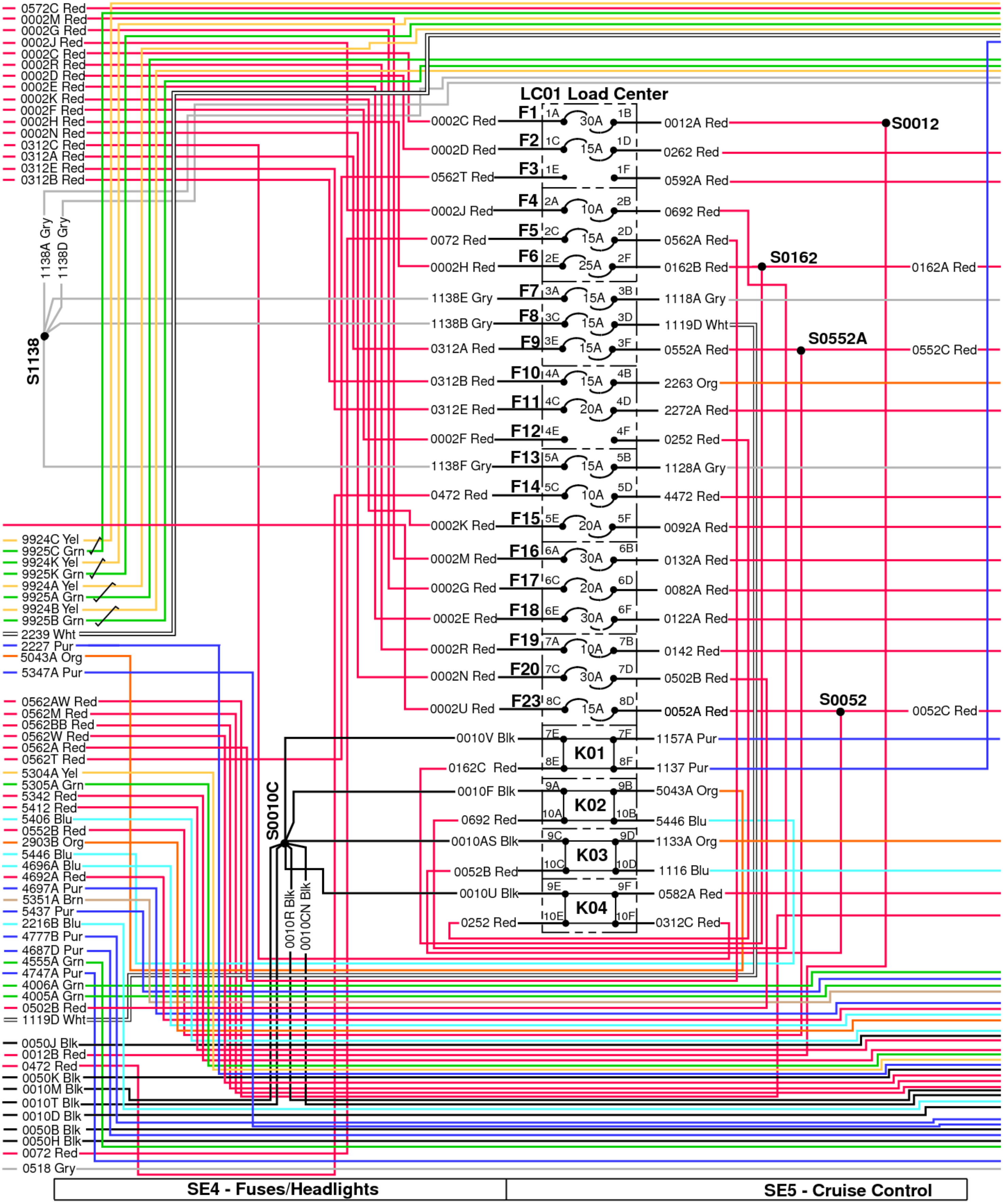
A09	Engine Control Unit (ECU)
A09-J1	ECU Connector
A09-J2	ECU Connector



Main Wiring Schematic Cab (8 of 16)

LEGEND:

A09	Engine Control Unit (ECU)
P03	Hand Throttle

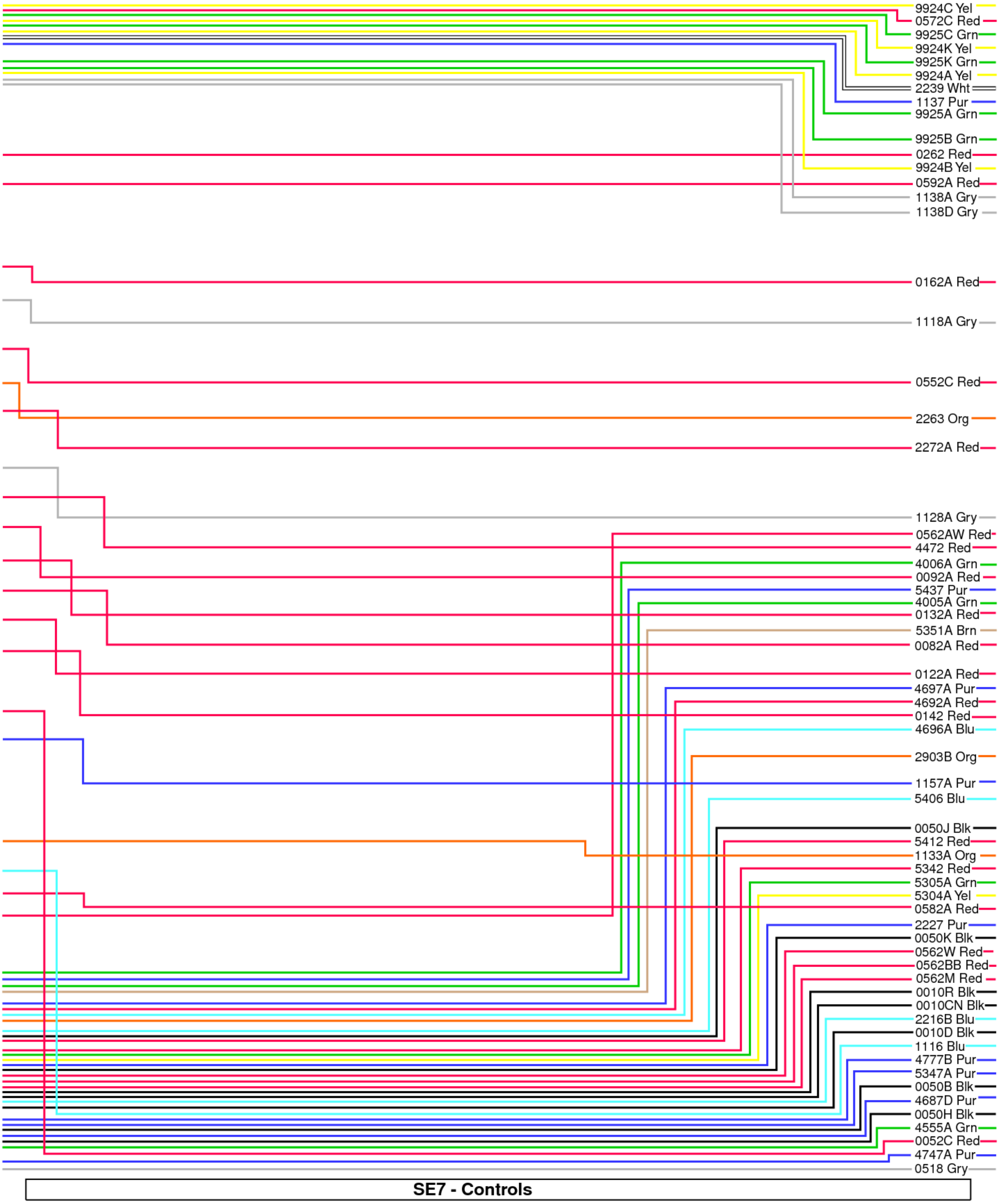


Main Wiring Schematic (9 of 16)

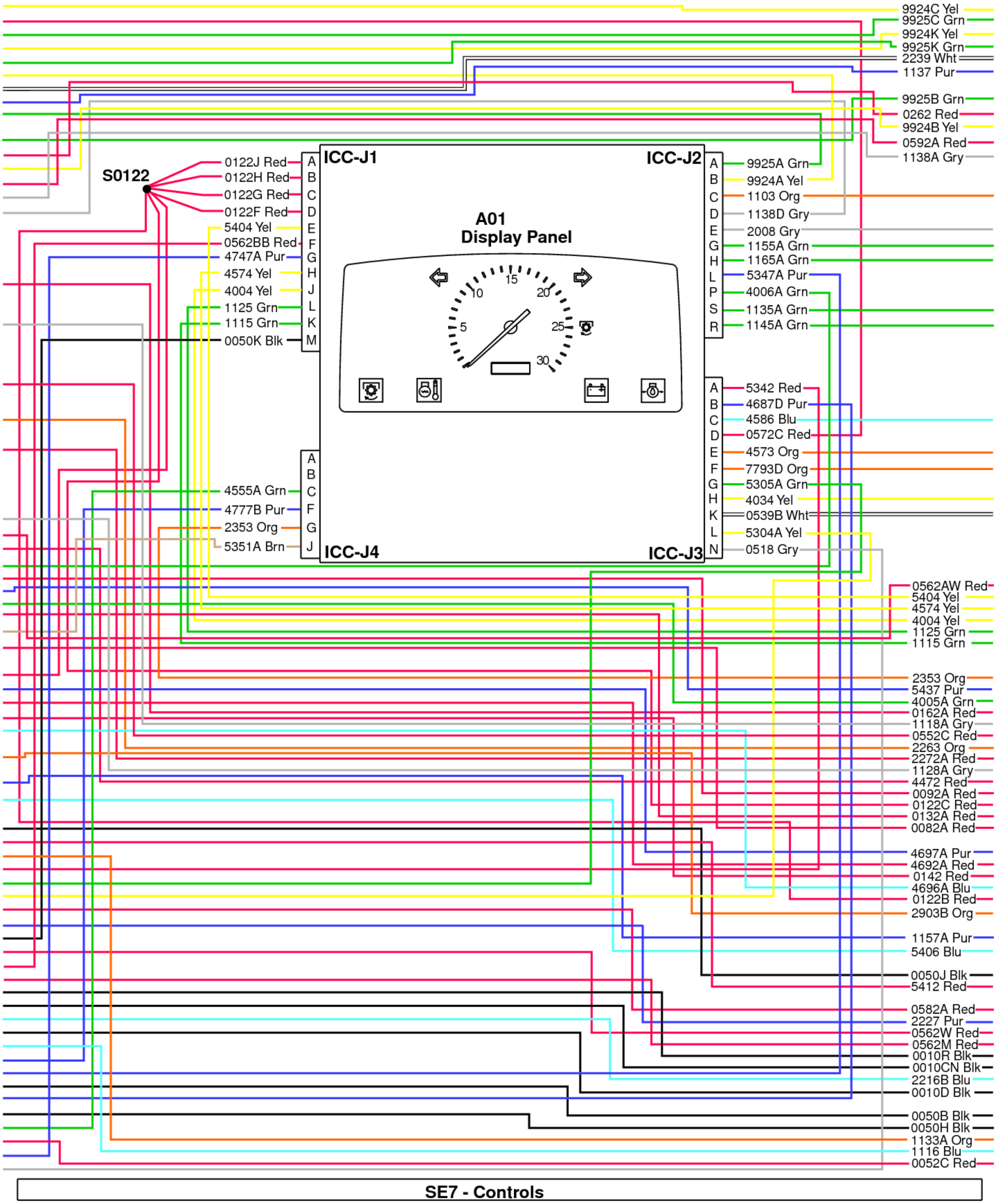
LEGEND:

F1	Fuse 30A
F2	Fuse 15A
F3	Service Use only
F4	Fuse 10A
F5	Fuse 15A
F6	Fuse 25A

F7	Fuse 15A
F8	Fuse 15A
F9	Fuse 15A
F10	Fuse 15A
F11	Fuse 20A
F12	Fuse 20A (Optional)
F13	Fuse 15A
F14	Fuse 10A
F15	Fuse 20A
F16	Fuse 30A
F17	Fuse 20A
F18	Fuse 30A
F19	Fuse 10A
F20	Fuse 30A
F22	Fuse 15A
K01	Work Light Relay
K02	EGR Relay
K03	Brake Light Relay
X01	Load Center



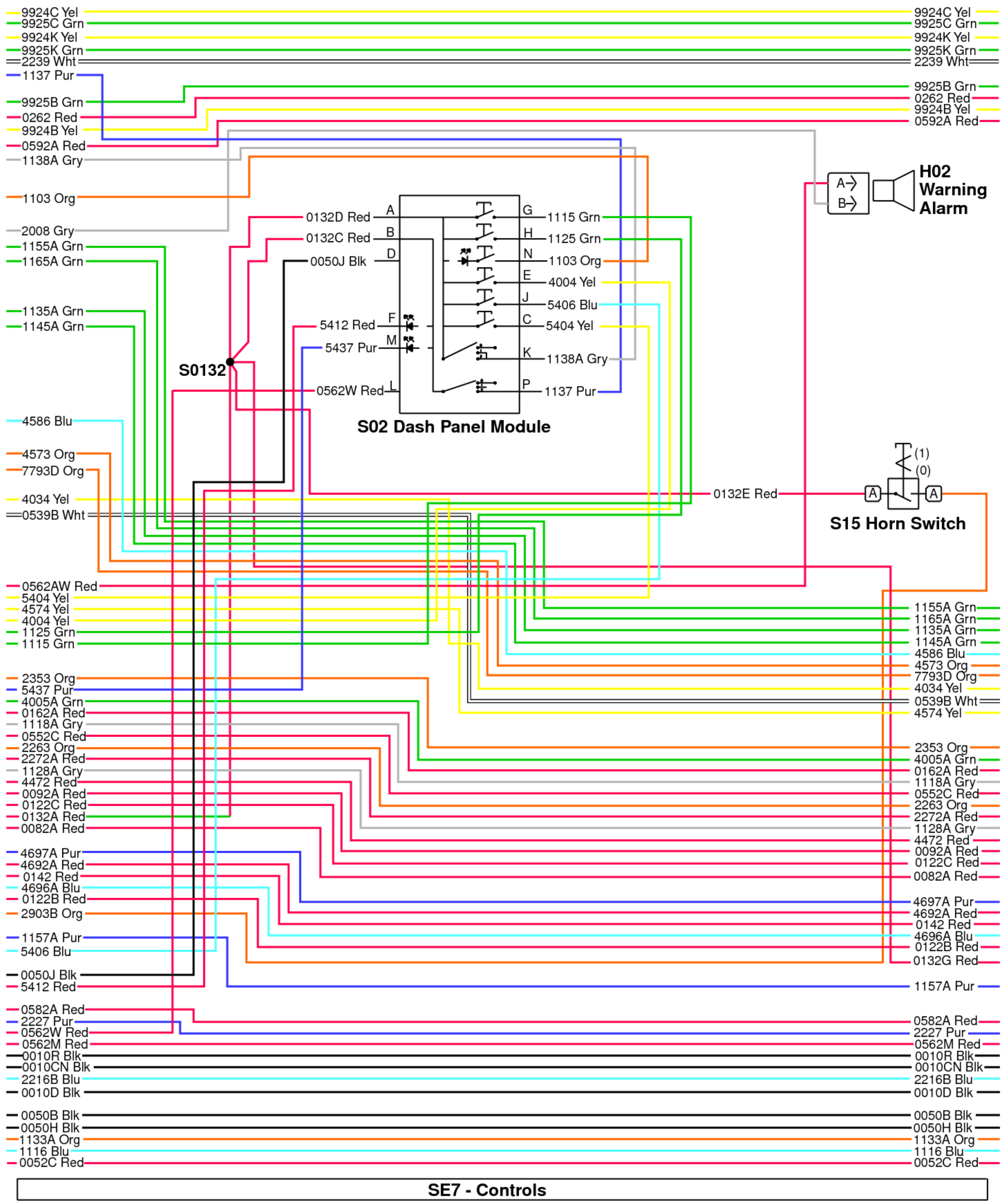
Main Wiring Schematic Cab (10 of 16)



Main Wiring Schematic Cab (11 of 16)

LEGEND:

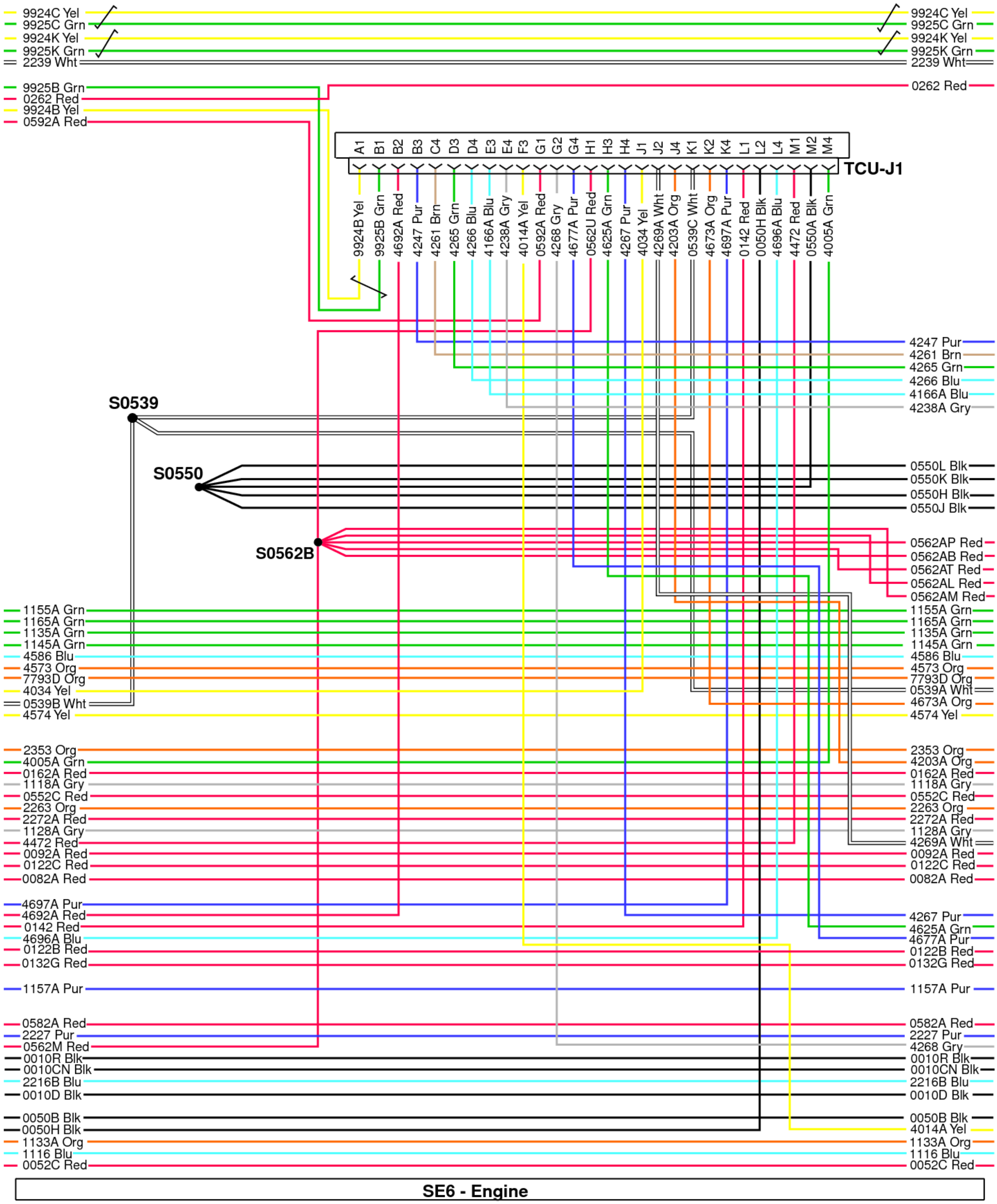
A01	Display Panel
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect



Main Wiring Schematic Cab (12 of 16)

LEGEND:

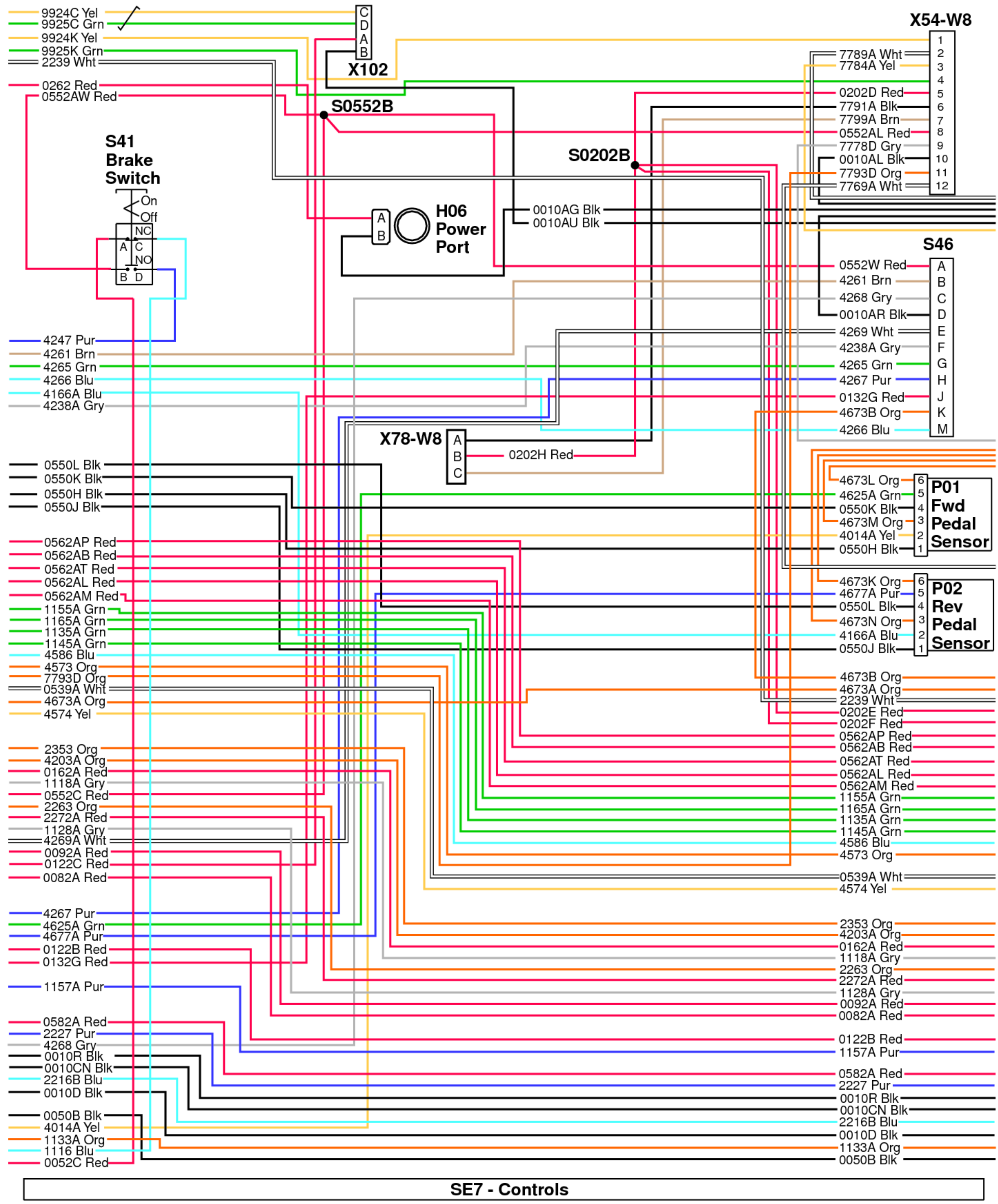
H02	Warning Alarm
S02	Dash Panel Module
S15	Horn Switch



Main Wiring Schematic Cab (13 of 16)

LEGEND:

TCU-J1	Transmission Control Unit Interconnect

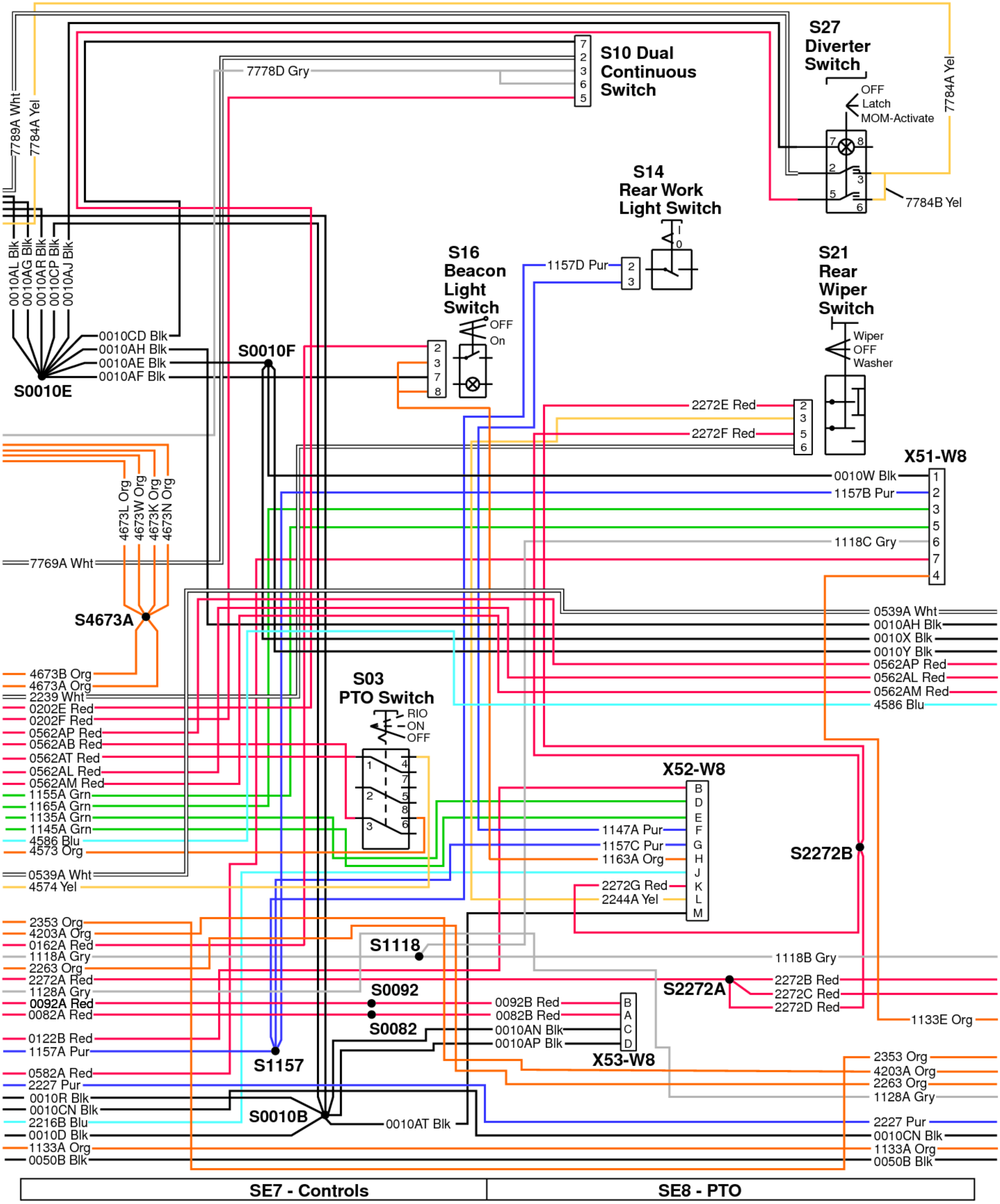


Main Wiring Schematic (14 of 16)

LEGEND:

H06	Power Port
S41	Brake Switch
S46	Cruise Module
P01	Forward pedal Sensor
P02	Reverse Pedal Sensor
X54 - W8	Rear Harness to Load Center Interconnect

X78 - W8	Lower Cab to EH Handle Harness
X102	Service Advisor

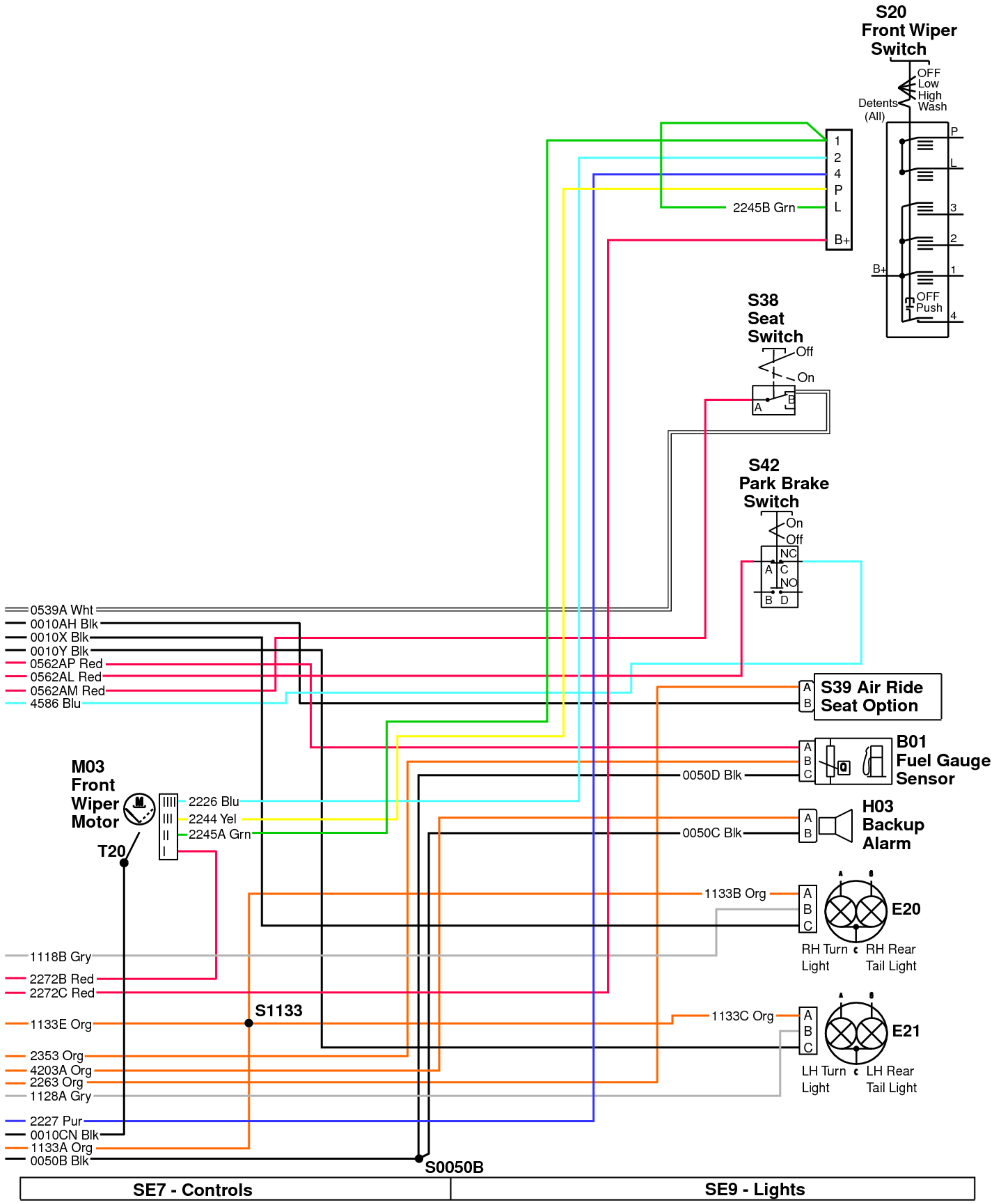


Main Wiring Harness (15 of 16)

LEGEND:

S03	PTO Switch
S10	Dual Continuous Switch
S14	Rear Work Light Switch
S16	Beacon Light Switch

S21	Rear Wiper Switch
S27	Diverter Switch
X51 - W8	Lower Cab to 7 Pin Wiring Harness Interconnect
X52 - W8	Lower Cab to Upper Cab Wiring Harness Interconnect
X53 - W8	Lower Cab to Upper Cab Wiring Harness Interconnect



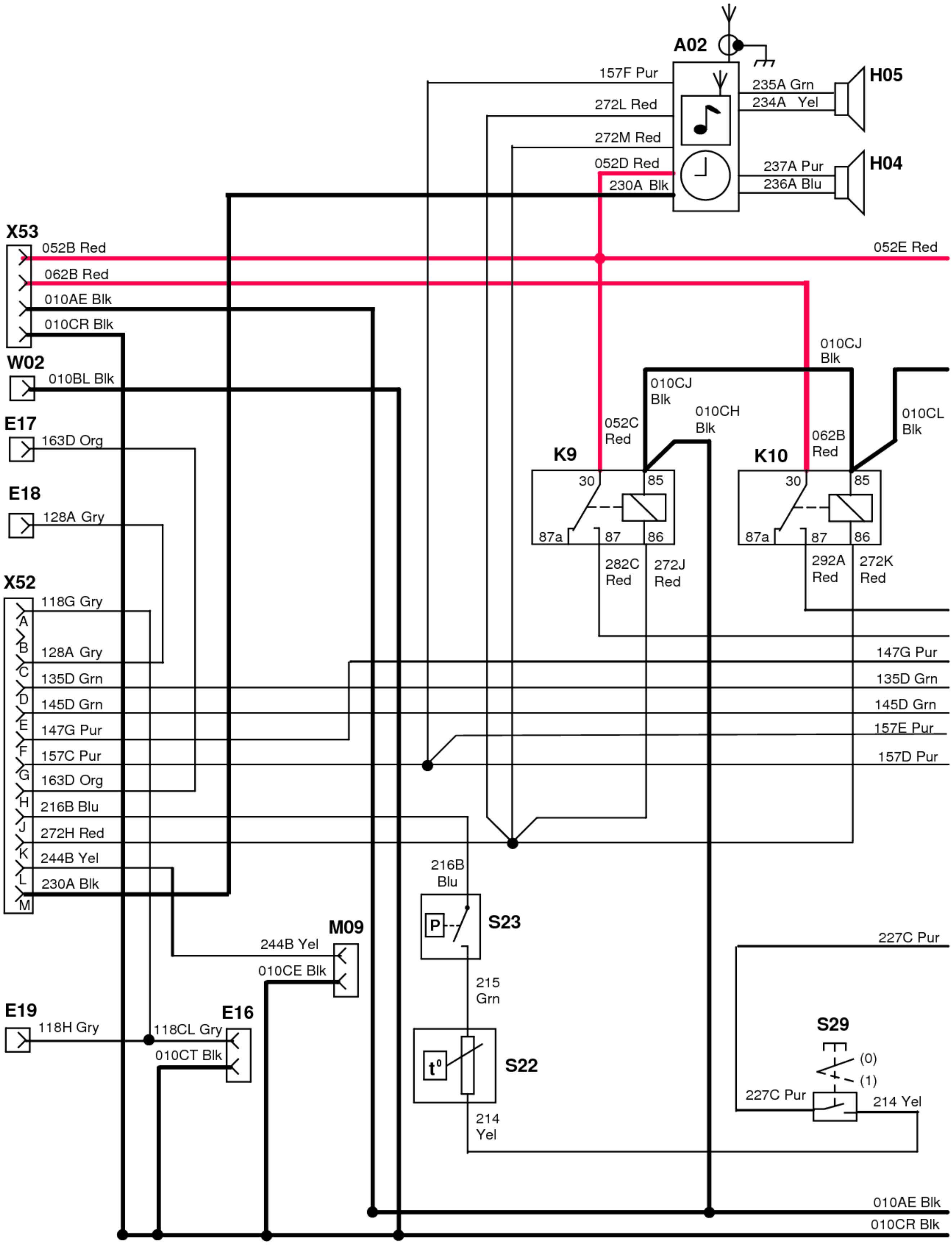
Main Wiring Schematic Cab (16 of 16)

LEGEND:

M03	Front Wiper Motor

B01	Fuel Gauge Sensor
E20	Right Tail Light
E21	Left Tail Light
H03	Backup Alarm
S20	Front Wiper Switch
S38	Seat Switch
S39	Air Ride Seat
S42	Park Brake Switch

Upper Wiring Schematic (Cab)

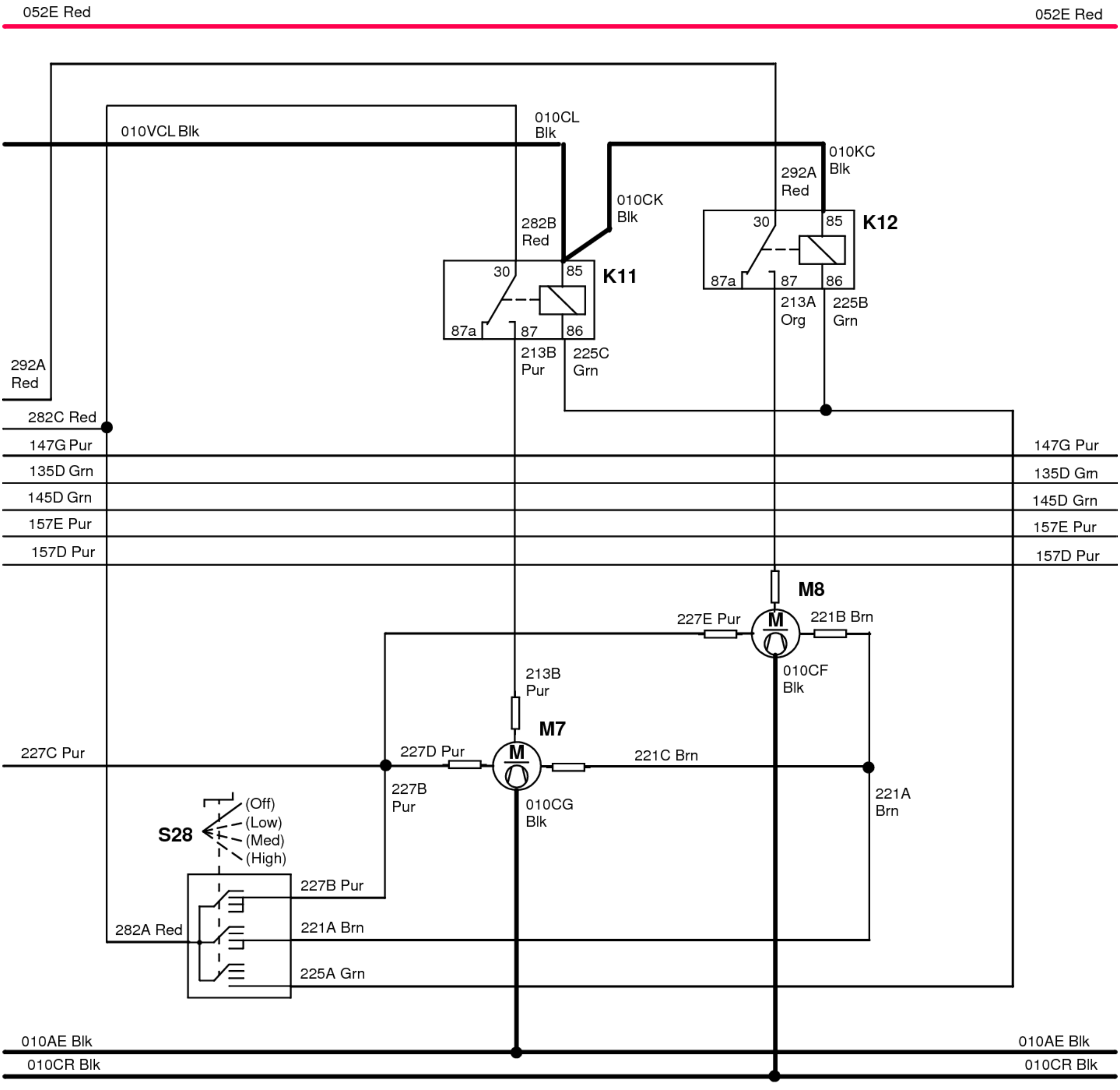


W9—Upper Cab Electrical Schematic (1 of 3)

LEGEND:

A02	Radio
E16	License Plate Light
E17	Beacon Light
E18	Right Front Marker Light

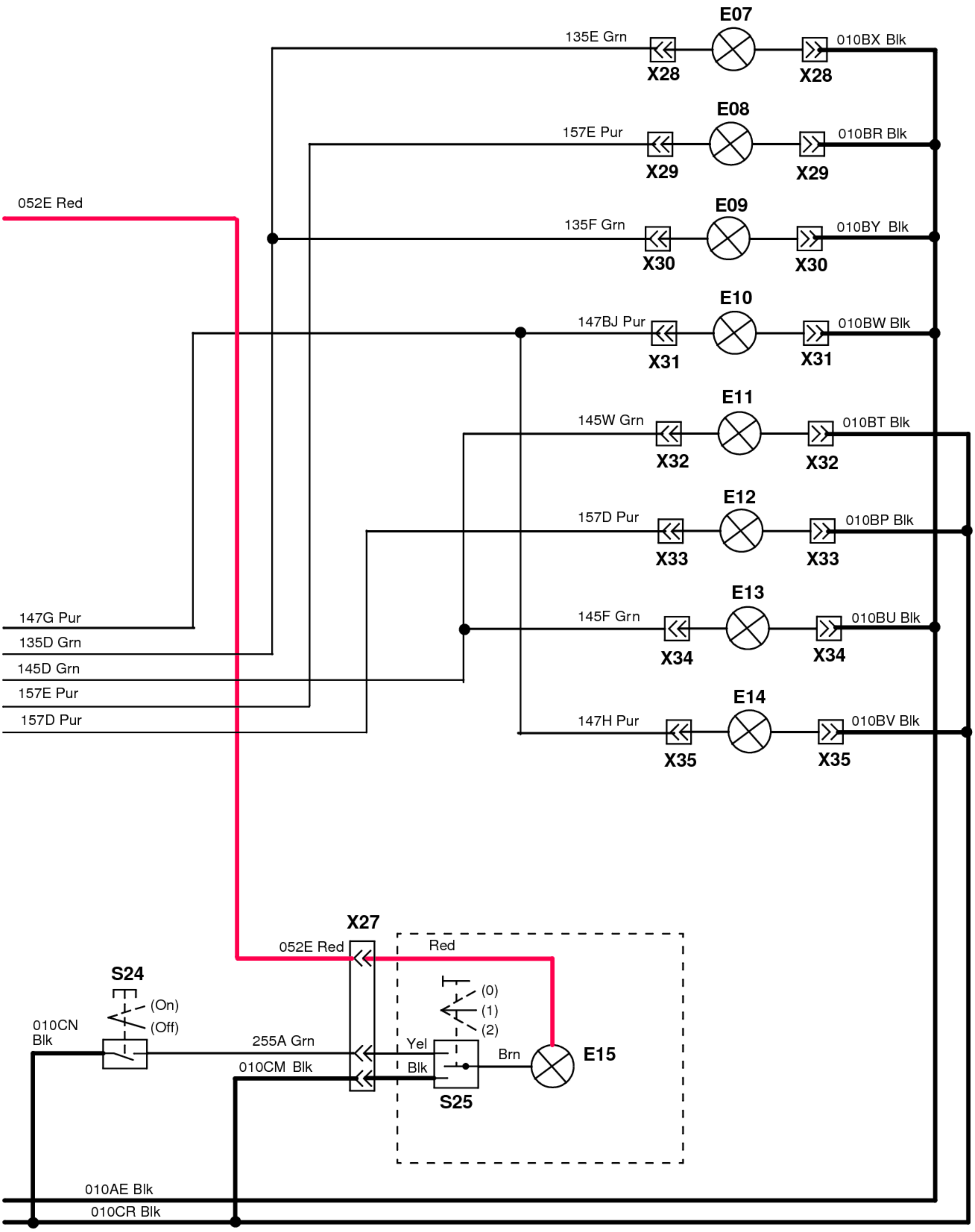
E19	Left Front Marker Light
H04	Left Speaker
H05	Right Speaker
K9	Relay
K10	Relay
M09	Rear Wiper Motor
S22	Temperature Sensor
S23	Hi/Lo Pressure Switch
S29	HVAC Switch
W02	Beacon Light Ground
X52	Lower Cab to Upper Cab Wiring Harness Interconnect
X53	Upper Cab to Lower Cab Wiring Harness Interconnect



W9—Upper Cab Electrical Schematic (2 of 3)

LEGEND:

K11	Right Blower Relay
K12	Left Blower Relay
M07	Left Blower Motor
M08	Right Blower Motor
S28	Blower Switch



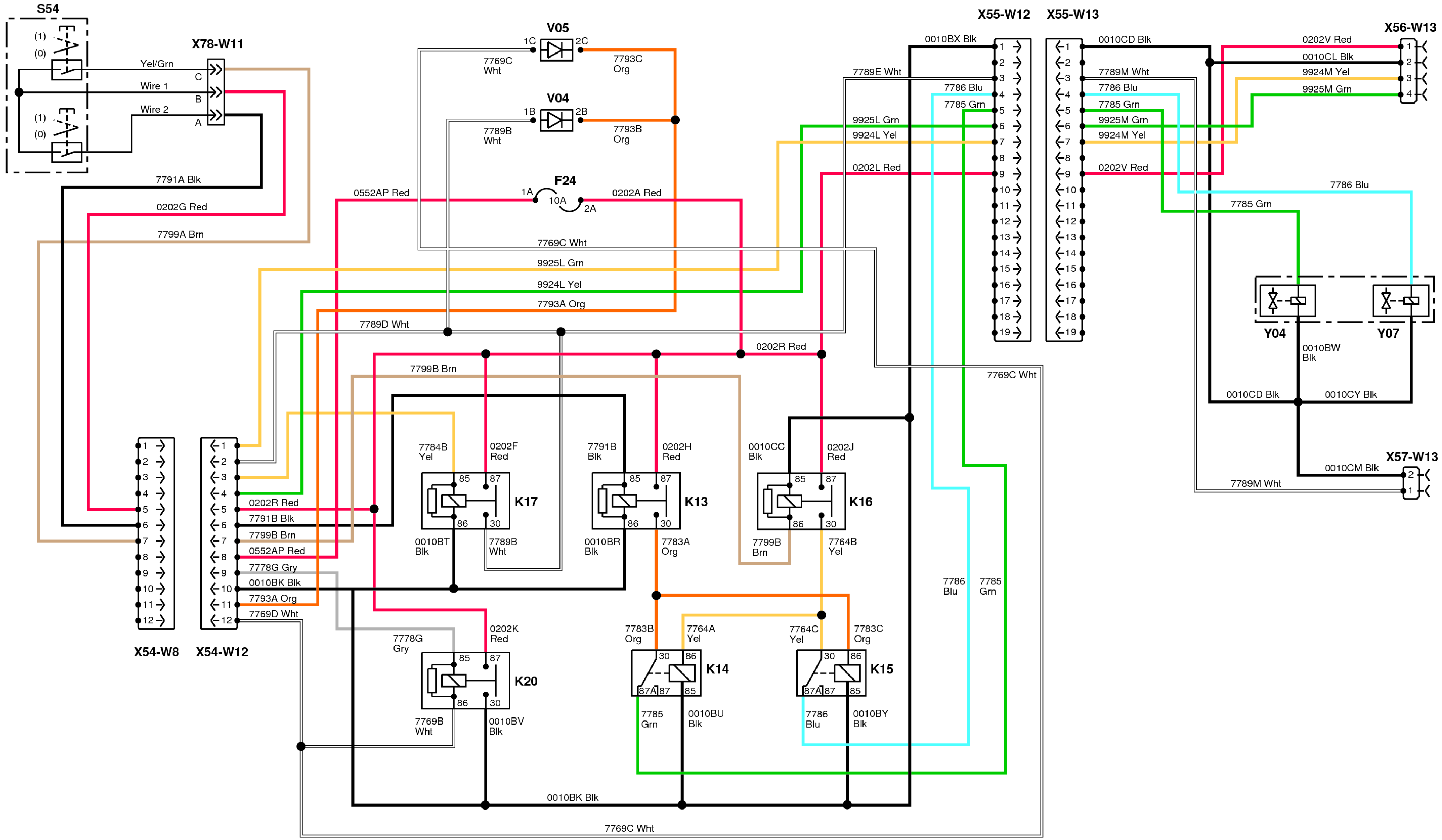
W9—Upper Cab Electrical Schematic (3 of 3)

LEGEND:

E07	Right Front Amber Light
E08	Right Front Work Light
E09	Right Rear Amber Light
E10	Right Rear Work Light
E11	Left Front Amber Light
E12	Left Front Work Light

E13	Left Rear Amber Light
E14	Left Rear Work Light
E15	Dome Light
S24	Door Light Switch
S25	Dome Light Switch
X27	Upper Cab Wiring Harness to Dome Light
X28	Upper Cab Wiring Harness to Right Front Amber Light
X29	Upper Cab Wiring Harness to Right Front Work Light
X30	Upper Cab Wiring Harness to Right Rear Amber Light
X31	Upper Cab Wiring Harness to Right Rear Work Light
X32	Upper Cab Wiring Harness to Left Front Amber Light
X33	Upper Cab Wiring Harness to Left Front Work Light
X34	Upper Cab Wiring Harness to Left Rear Amber Light
X35	Upper Cab Wiring Harness to Left Rear Work Light

3rd SCV Function Wiring Schematic (Cab) (—OCT 2014)

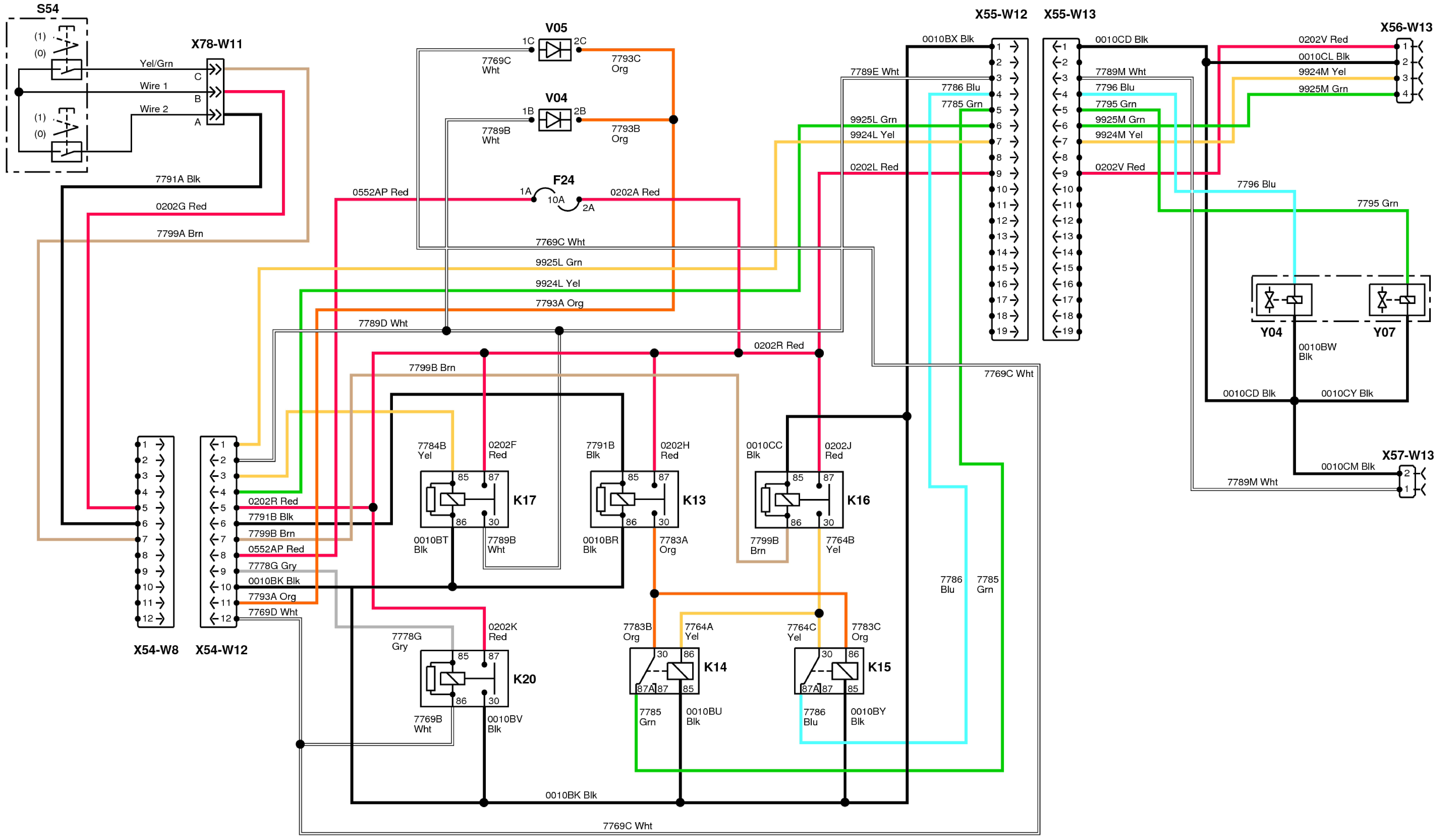


3rd Function Wiring Schematic

LEGEND:

F24	Diverter Valve Fuse (10A)
K13	Control Relay A
K14	3rd Function Lockout Relay A
K15	3rd Function Lockout Relay B
K16	Control Relay B
K17	Diverter Relay
K20	Dual Rear Continuous Relay
S54	3rd Function Control Switch
V04	Diode (6A)
V05	Diode (6A)
X54-W8	Rear Harness to Load Center Interconnect
X54-W12	Load Center to Rear Harness Interconnect
X55-W12	Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect
X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

3rd SCV Function Wiring Schematic (Cab) (OCT 2014—)

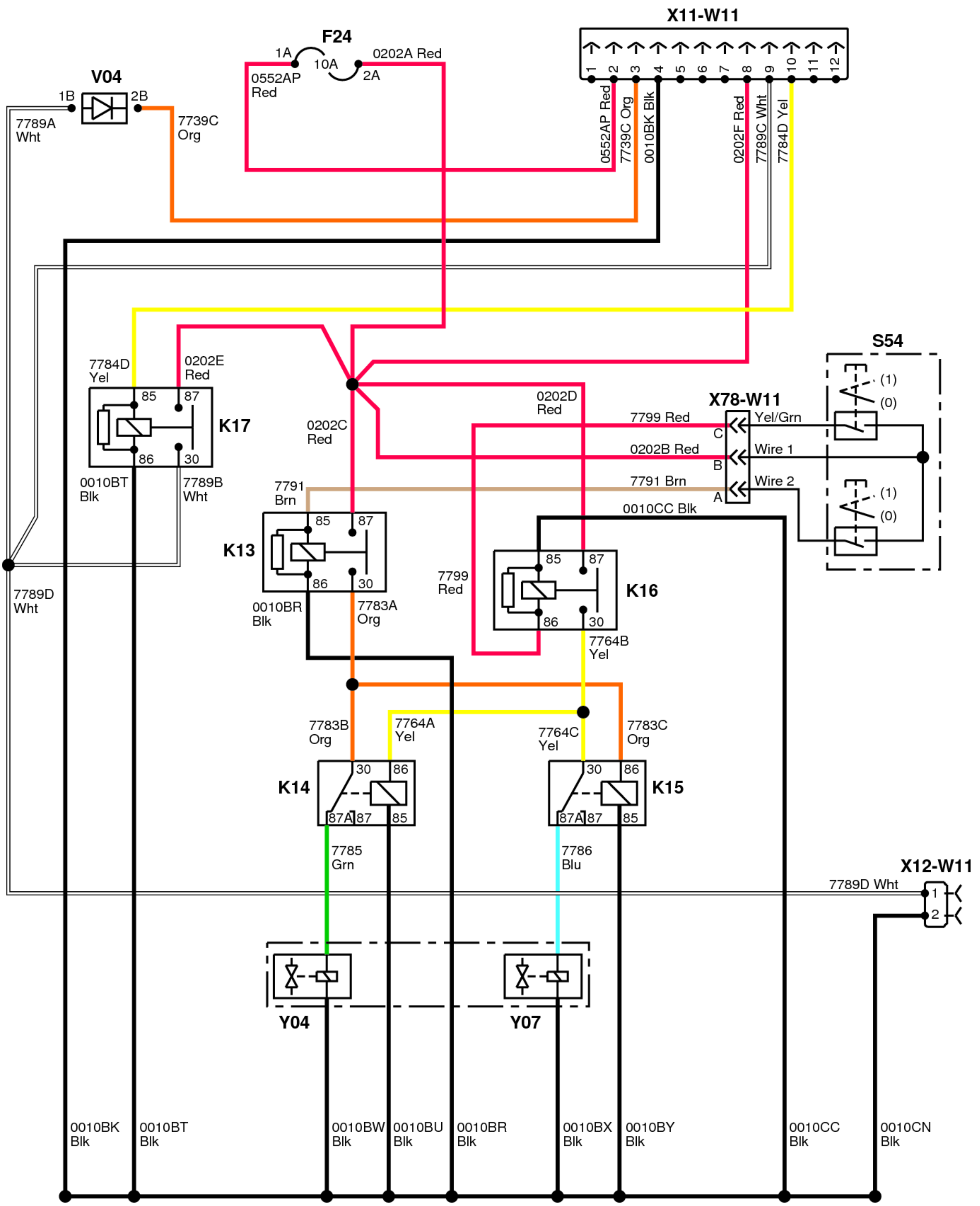


3rd SCV Function Wiring Schematic

LEGEND:

F24	Diverter Valve Fuse (10A)
K13	Control Relay A
K14	3rd Function Lockout Relay A
K15	3rd Function Lockout Relay B
K16	Control Relay B
K17	Diverter Relay
K20	Dual Rear Continuous Relay
S54	3rd Function Control Switch
V04	Diode (6A)
V05	Diode (6A)
X54-W8	Rear Harness to Load Center Interconnect
X54-W12	Load Center to Rear Harness Interconnect
X55-W12	Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect
X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

3rd SCV Function Wiring Schematic (Open Station) (—OCT 2014)



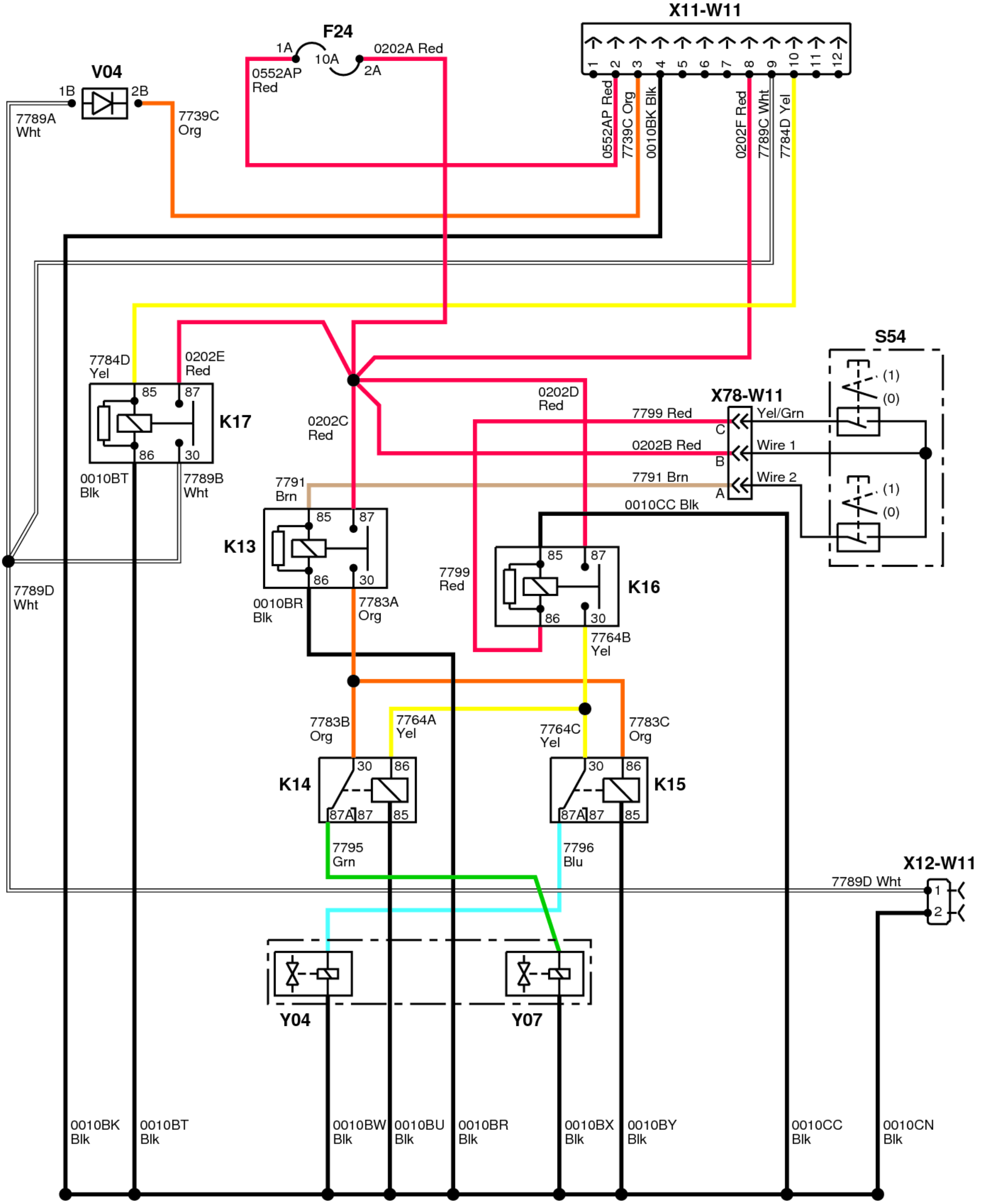
3rd SCV Function Wiring Schematic

LEGEND:

F24	10 Amp Fuse
K13	Third Function "A" Control Relay
K14	Third Function "A" Lockout Relay
K15	Third Function "B" Lockout Relay

K16	Third Function “B” Control Relay
K17	Diverter Relay
S54	Third Function Control Switch
X78-W11	EH Handle to Lower Cab Harness
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Harness
V04	Diode
Y04	Third Function Solenoid A
Y07	Third Function Solenoid B

3rd SCV Function Wiring Schematic (Open Station) (OCT 2014—)



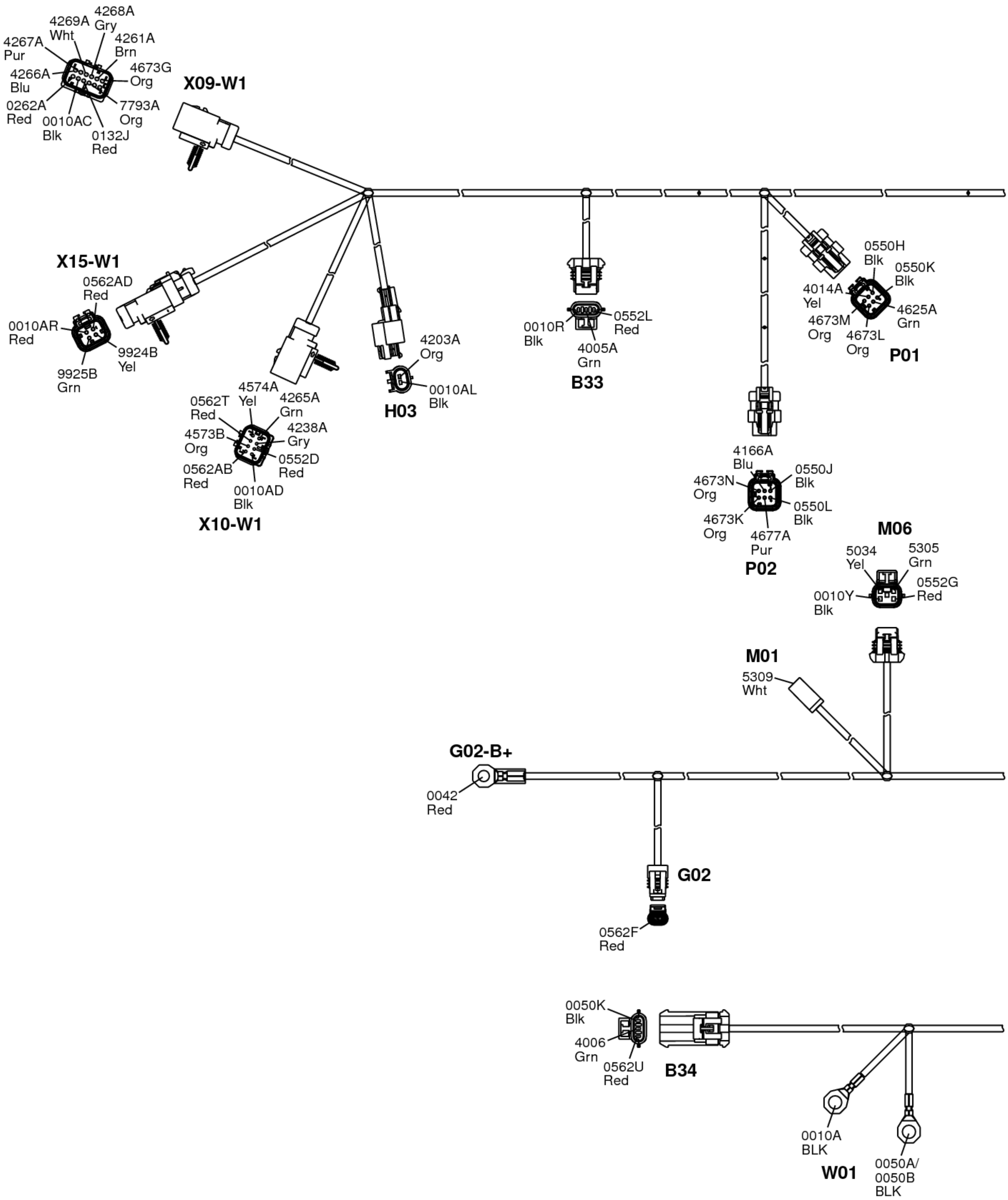
3rd SCV Function Wiring Schematic

LEGEND:

F24	10 Amp Fuse
K13	Third Function “A” Control Relay
K14	Third Function “A” Lockout Relay
K15	Third Function “B” Lockout Relay

K16	Third Function “B” Control Relay
K17	Diverter Relay
S54	Third Function Control Switch
X78-W11	EH Handle to Lower Cab Harness
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Harness
V04	Diode
Y04	Third Function Solenoid A
Y07	Third Function Solenoid B

W1 Chassis Wiring Harness (Open Station)

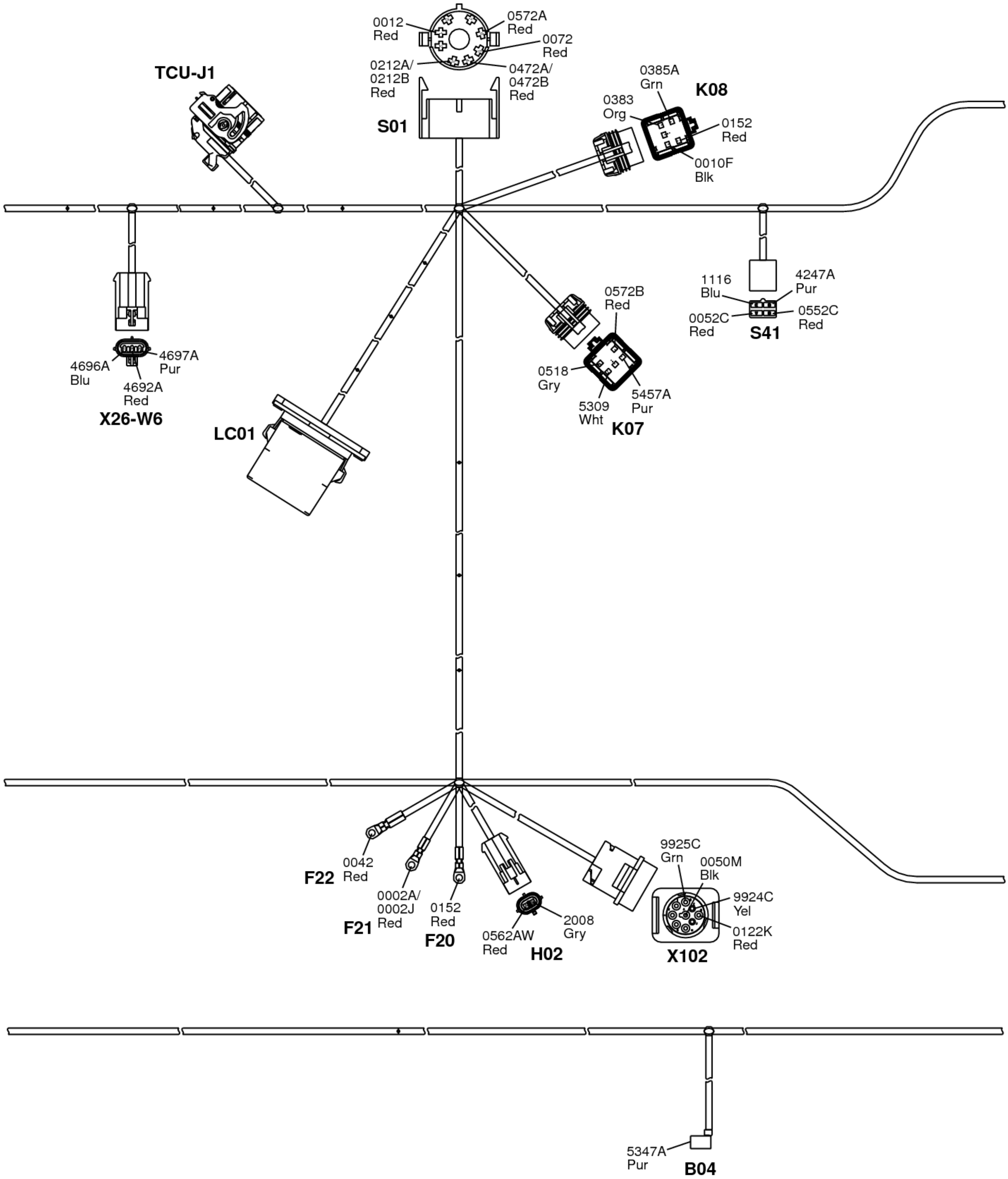


W1 Chassis Wiring Harness (1 of 4)

LEGEND:

B33	MFWD Speed Sensing Switch
B34	Mid-Mount Proxy Sensor
G02-B+	Alternator Power
G02	Alternator

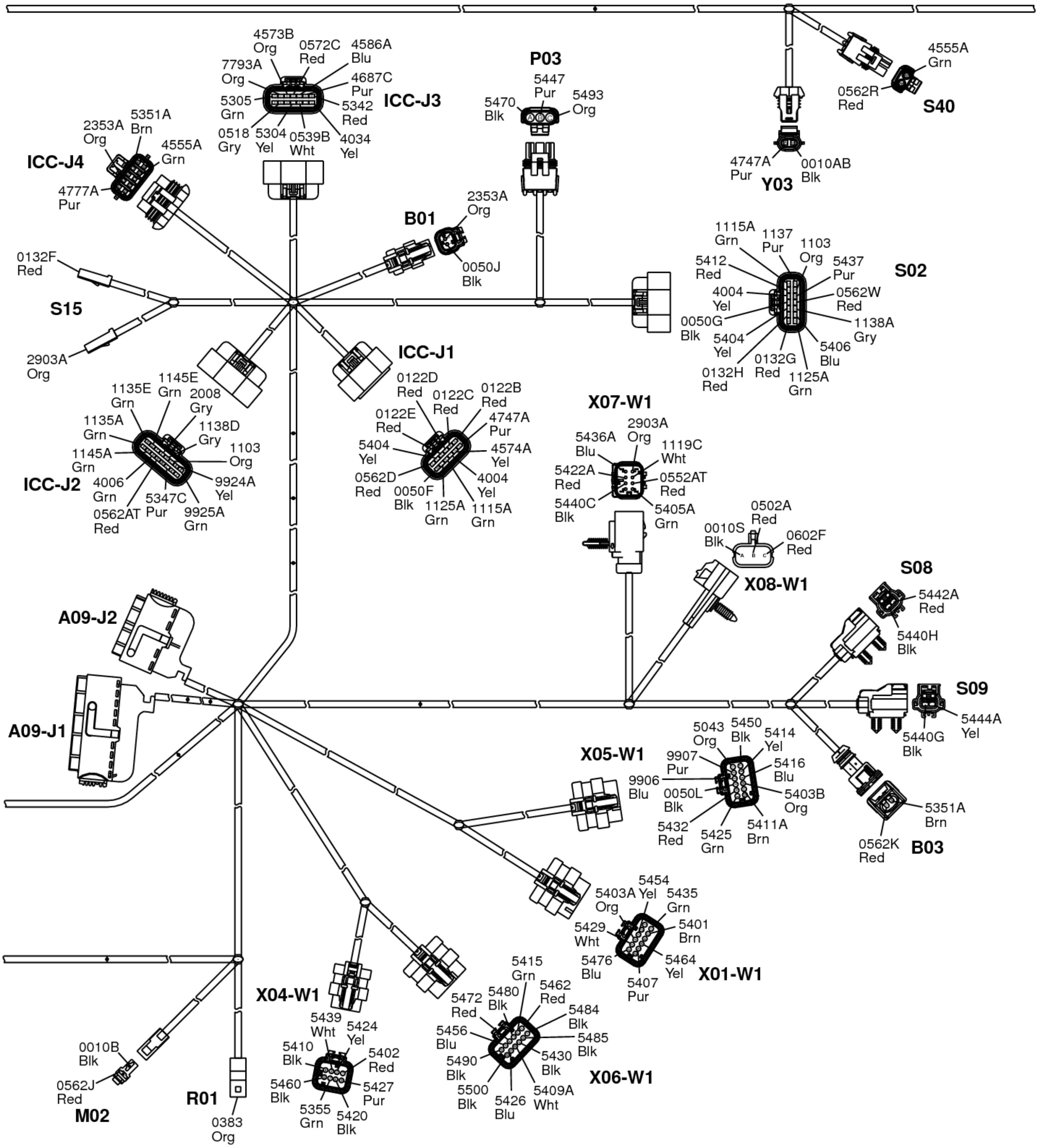
H03	Backup Alarm
M01	Starting Motor
M06	Exhaust Valve Actuator
P01	Forward Pedal Sensor
P02	Reverse Pedal Sensor
X09-W1	Chassis to Right Fender Interconnect 1
X10-W1	Chassis to Right Fender Interconnect 2
X15-W1	Chassis to Creep to Repo Switch Interconnect
W01	Ground



W1 Chassis Wiring Harness (2 of 4)

LEGEND:

B04	Oil Pressure Switch
F20	Glow Plug Relay Fuse
F21	Load Center Fuse
F22	Alternator Fuse
H02	Warning Alarm
K07	Starter Relay
K08	Glow Plug Relay
LC01	(See Load Center Harness Connector Identification .)
S01	Key Switch
S41	Brake Switch
TCU-J1	(See TCU J1 Transmission Control Unit (TCU) Component Location .)
X26-W6	HST - Chassis Harness Interconnect
X102	Service Advisor

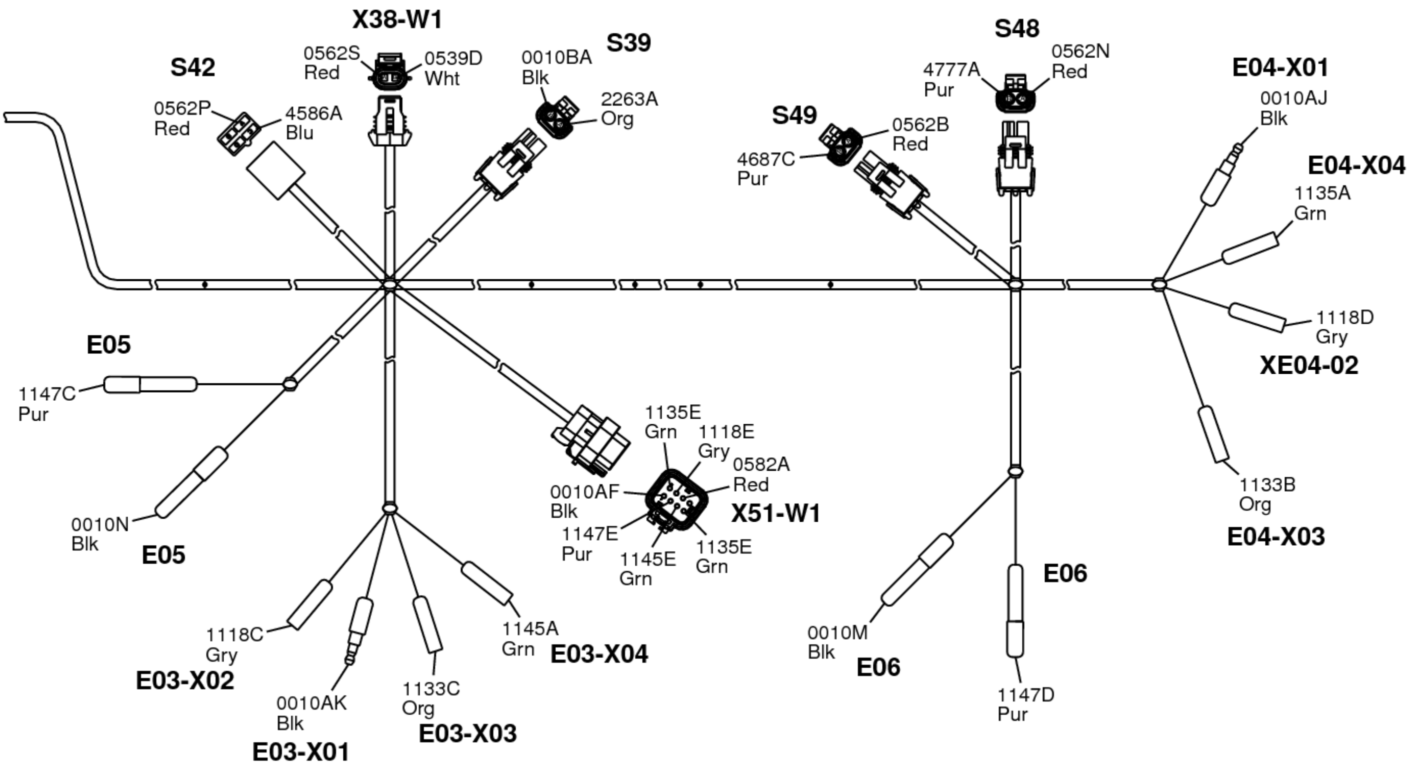


W1 Chassis Wiring Harness (3 of 4)

LEGEND:

A09-J1	(See Engine Control Unit (ECU) Component Location .)
A09-J2	(See Engine Control Unit (ECU) Component Location .)
B01	Fuel Gauge Sensor
B03	Air Filter Restriction Switch
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect

ICC-J3	Display Interconnect
ICC-J4	Display Interconnect
M02	Fuel Pump
P03	Hand Throttle
R01	Glow Plug
S02	Dash Panel Module
S08	Inlet Temp Sensor
S09	Mid-Temp Sensor
S15	Horn
S40	MFWD Engagement Sensing Switch
X01-W1	12 Pin (Yel) Engine Interface
X04-W1	8 Pin (Red) Engine Interface
X05-W1	12 Pin (Red) Engine Interface
X06-W1	12 Pin (Gry) Engine Interface
X08-W1	Junction Block Power
X07-W1	Chassis - Hood Harness Interconnect
Y03	Rear PTO Solenoid



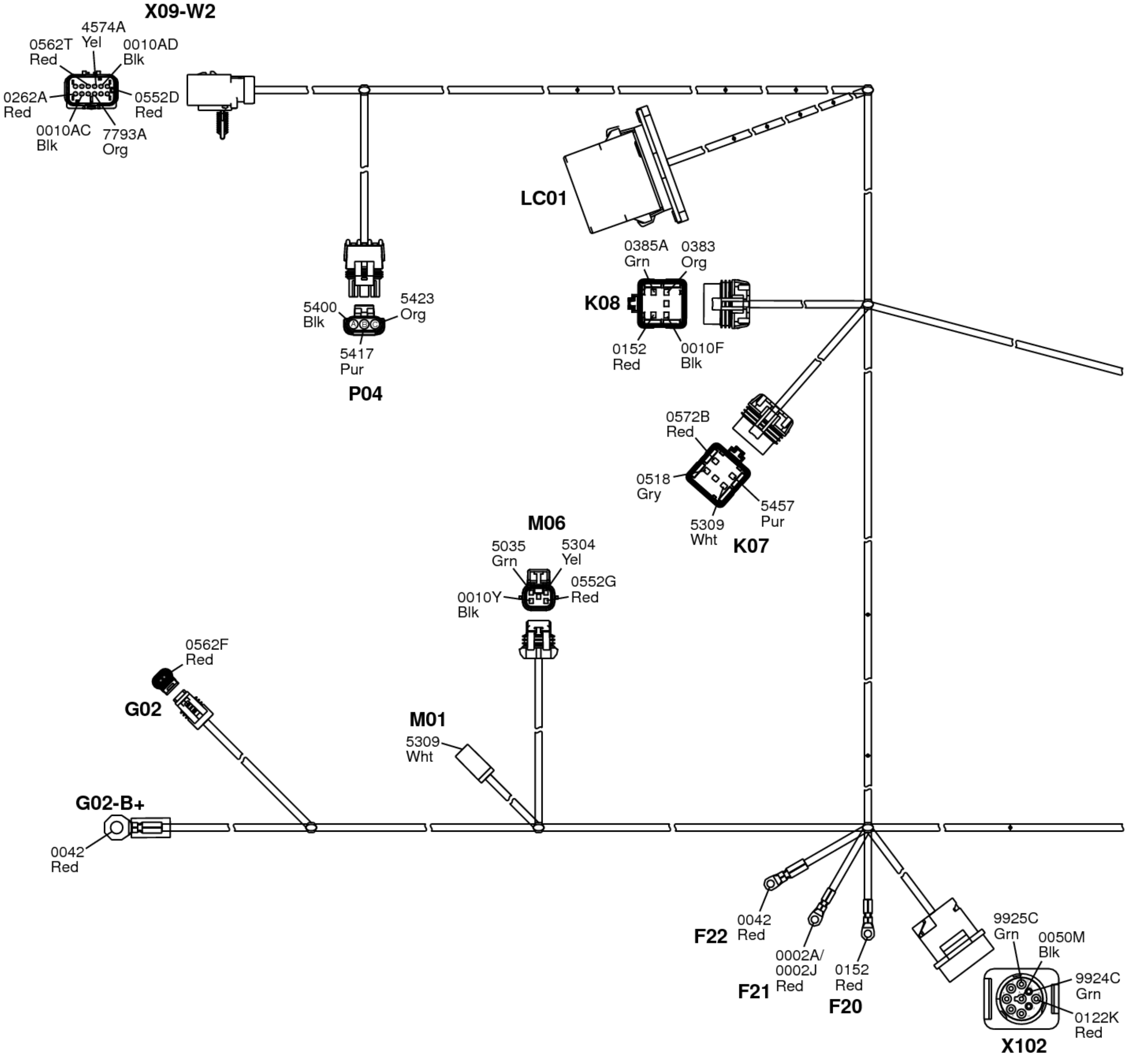
W1 Chassis Wiring Harness (4 of 4)

LEGEND:

E03-X01	Ground
E03-X02	Tail Light
E03-X03	Turn Light
E03-X04	Turn/Hazard Light
E04-X01	Ground
E04-X02	Tail Light

E04-X03	Turn Light
E04-X04	Turn/Hazard Light
E05	Left Work Light
E06	Right Work Light
S39	Air Ride Seat
S42	Park Brake Switch
S48	Rear PTO sensing Switch
S49	Mid PTO Sensing Switch
X38-WI	Chassis to Seat Switch Harness Interconnect
X51-W1	Chassis to 7-Pin Wiring Harness Interconnect

W2 Chassis Wiring Harness (Open Station)—PowrReverser Transmission

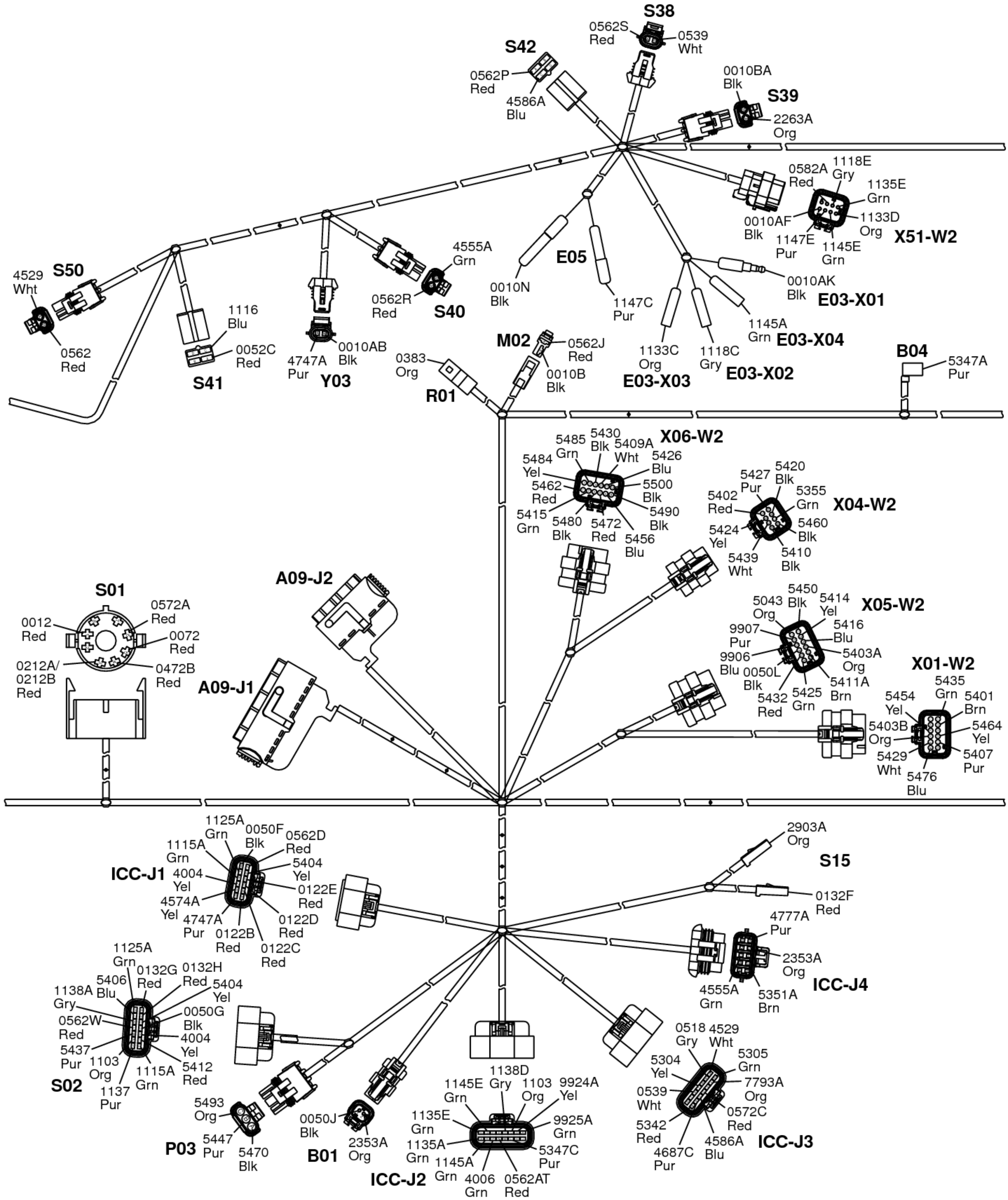


W2 PowrReverser Chassis Wiring Harness (1 of 3)

LEGEND:

F20	Glow Plug Relay Fuse
F21	Load Center Fuse
F22	Alternator Fuse
G02-B+	Alternator Power

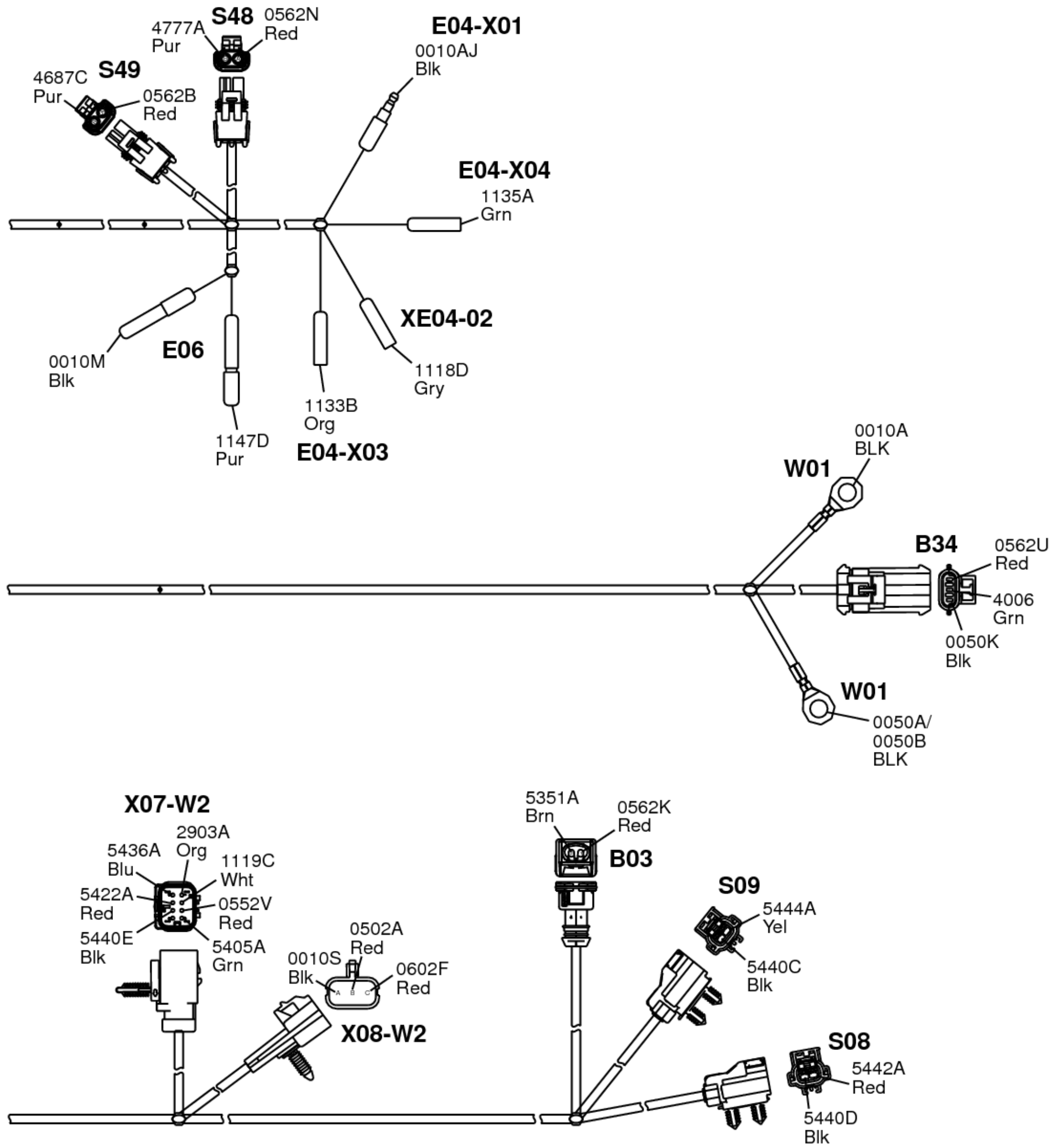
G02	Alternator
K07	Starter Relay
K08	Glow Plug Relay
LC01	(See Load Center in Section 40, Group 15.)
M01	Starting Motor
M06	Exhaust Valve Actuator
P01	Foot Pedal Sensor
X09-W2	Chassis to Right Fender Interconnect
X102	Service Advisor



W2 PowrReverser Chassis Wiring Harness (2 of 3)

LEGEND:

A09-J1	(See Engine Control Unit (ECU) in Section 40, Group 15.)
A09-J2	(See Engine Control Unit (ECU) in Section 40, Group 15.)
B01	Fuel Gauge Sensor
B04	Oil Pressure Switch
E03-X01	Left Side Turn/Tail Light Ground
E03-X02	Left Side Tail Light
E03-X03	Left Side Turn Light
E03-X04	Left Side Turn/Hazard Light
E05	Left Work Light
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect
M02	Fuel Pump
P03	Hand Throttle
R01	Glow Plug
S01	Key Switch
S02	Dash Panel Module
S15	Horn
S38	Seat Switch
S39	Air Ride Seat
S40	MFWD Engagment Sensing Switch
S41	Brake Switch
S42	Park Brake Switch
S50	Neutral Start Switch
X01-W2	12 Pin (Yel) Engine Interface
X04-W2	8 Pin (Red) Engine Interface
X05-W2	12 Pin (Red) Engine Interface
X06-W2	12 Pin (Gry) Engine Interface
X51-W2	Chassis to 7 Pin Wiring Harness Interconnect
Y03	Rear PTO Solenoid



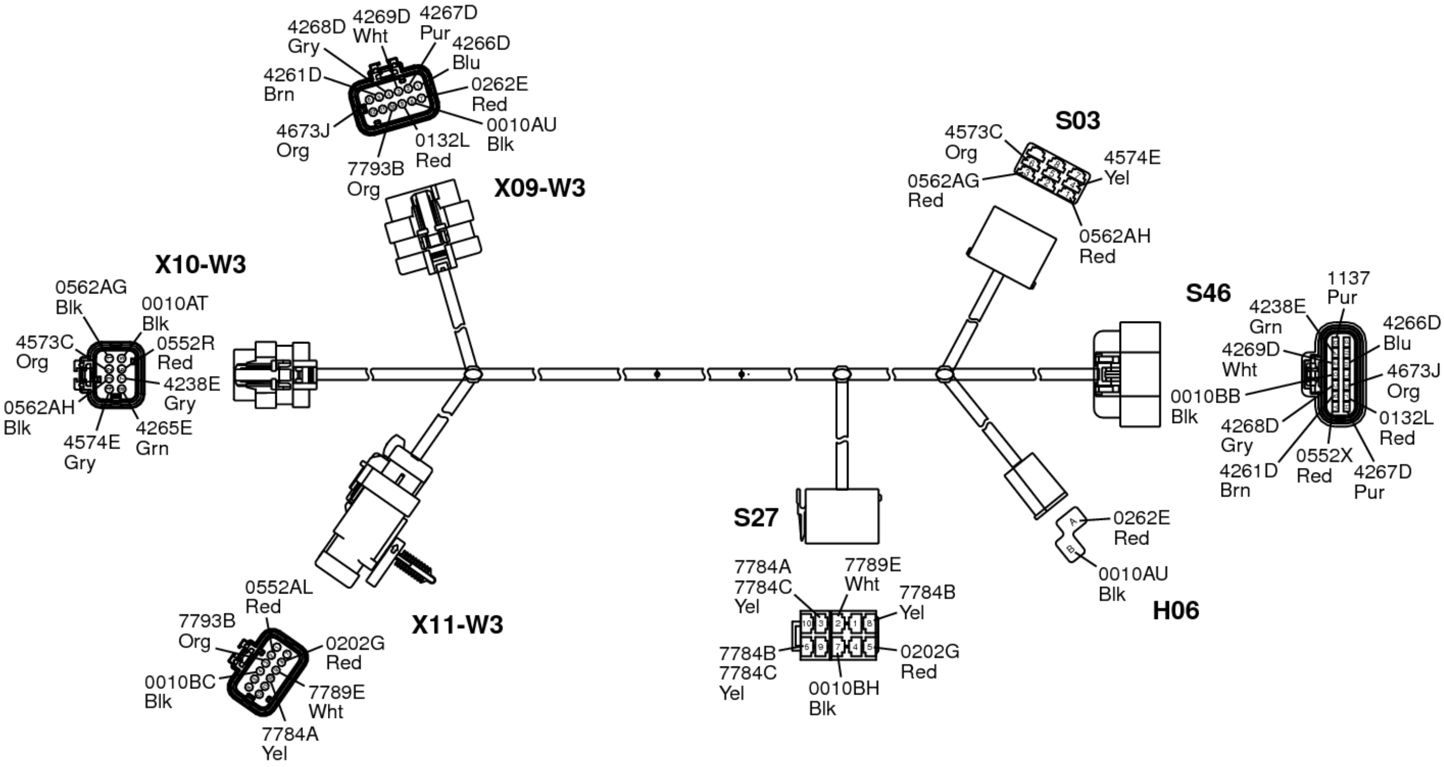
W2 PowrReverser Chassis Wiring Harness (3 of 3)

LEGEND:

B34	Mid Mount Proxy Sensor
B03	Air Filter Restriction Switch
E04-X01	Right Side Turn/Tail Light Ground
E04-X02	Right Side Tail Light
E04-X03	Right Side Turn Light
E04-X04	Right Side Turn/Hazard Light

E06	Right Work Light
S08	Inlet Temp Sensor
S09	Mid Temp Sensor
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
X07-W2	Chassis - Hood Harness Interconnect
X08-W2	Junction Block Power
W01	Ground

W3 Fender Wiring Harness (Open Station)

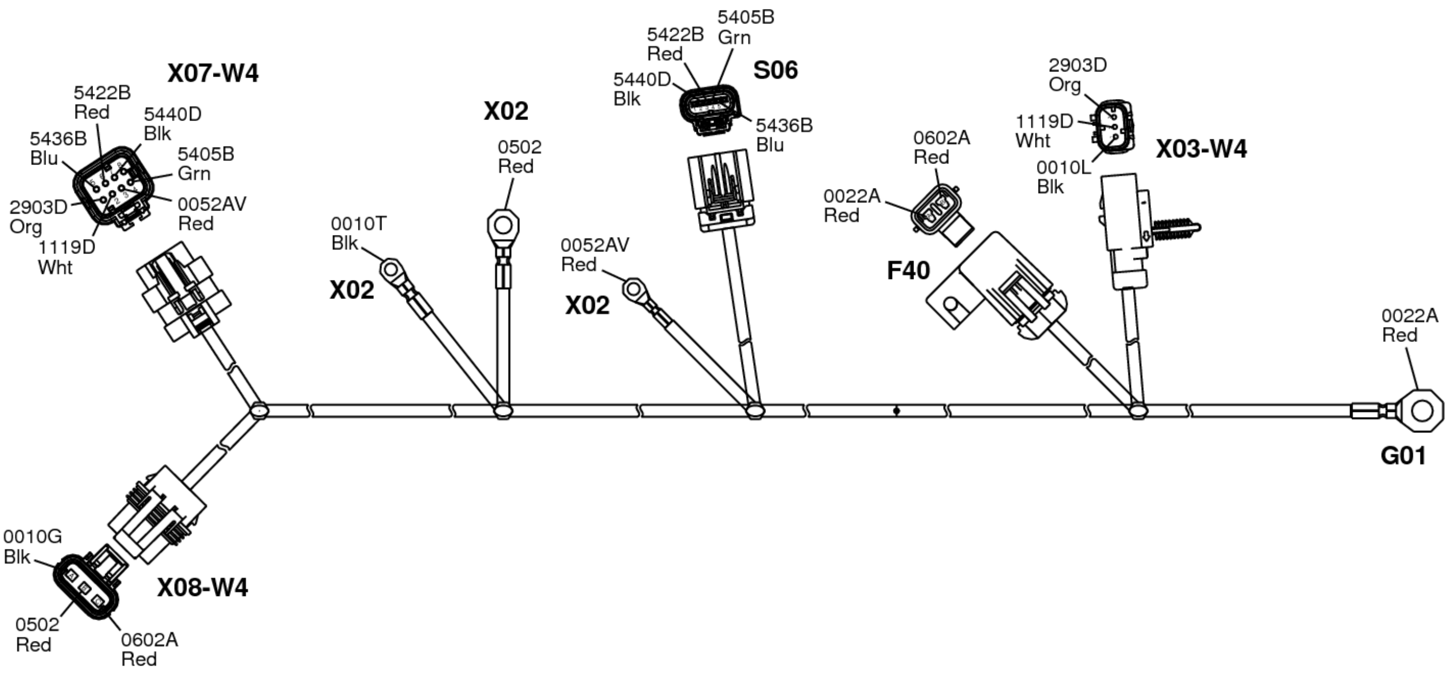


W3 Fender Wiring Harness—Open Station

LEGEND:

H06	Power Port
S03	PTO Switch
S46	Cruise Module
S27	Diverter Switch
X09-W3	Right Fender to Chassis Interconnect 1
X10-W3	Right Fender to Chassis Interconnect 2
X11-W3	Right Fender to 3rd EH Harness Interconnect

W4 Hood Harness

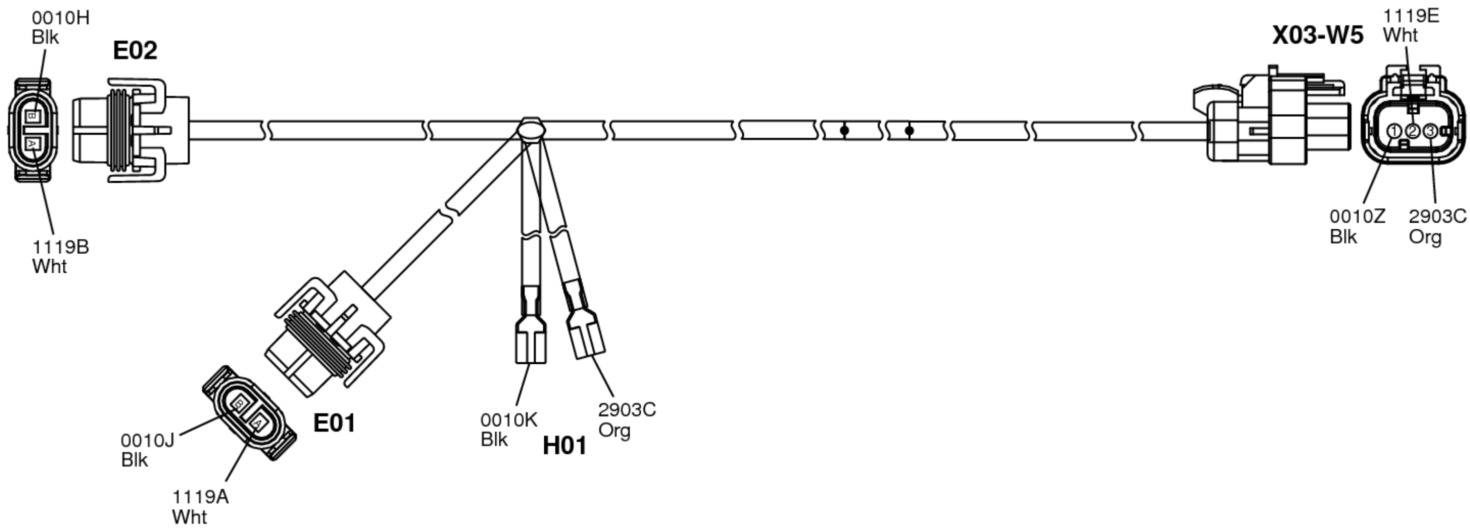


W4 Hood Harness

LEGEND:

F40	ECU Fuse (25A)
G01	Battery
S06	Differential Pressure Switch (DPF)
X02	Junction Block
X03-W5	Grill to Harness Interconnect
X07-W4	Hood to Chassis Harness Interconnect
X08-W4	Hood to Chassis Harness Interconnect

W5 Grille Wiring Harness

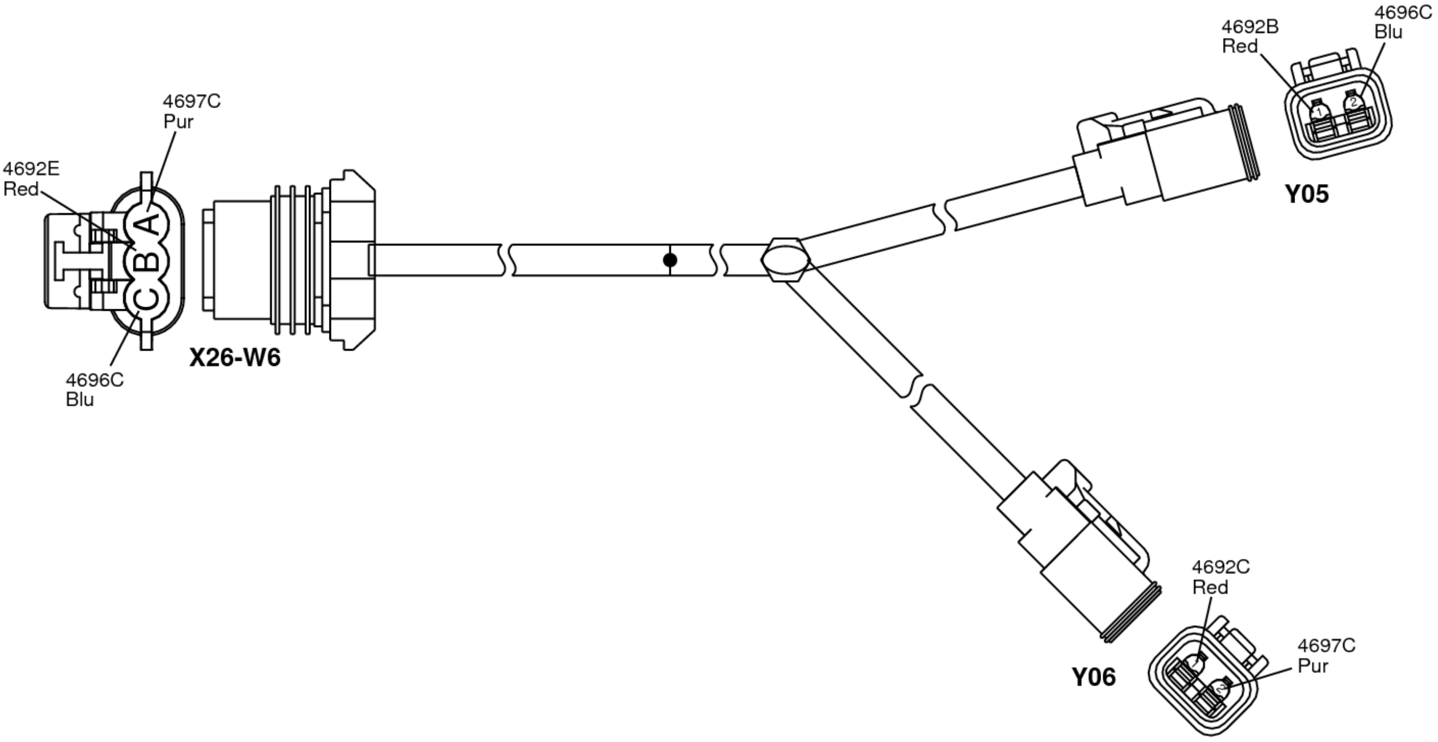


W5 Grill Wiring Harness

LEGEND:

E01	Right Head Light
E02	Left Head Light
H01	Horn
X03-W4	Hood to Grille Harness Interconnect

W6 HST Valve Wiring Harness

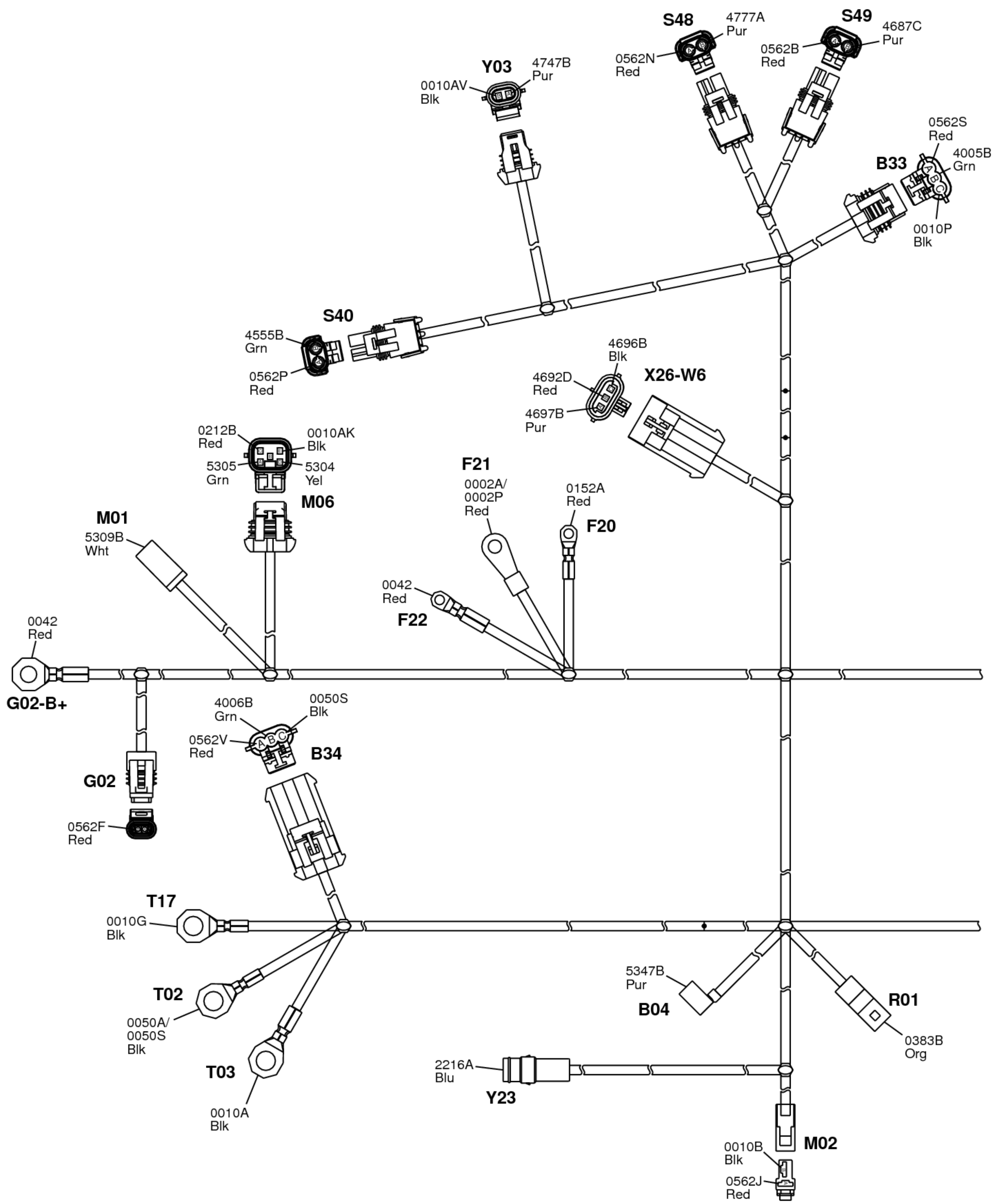


W6 HST Valve Wiring Harness

LEGEND:

X26-W6	HST to Chassis Harness Interconnect
Y05	Forward Proportional Solenoid
Y06	Reverse Proportional Solenoid

W7 Chassis Wiring Harness (Cab)

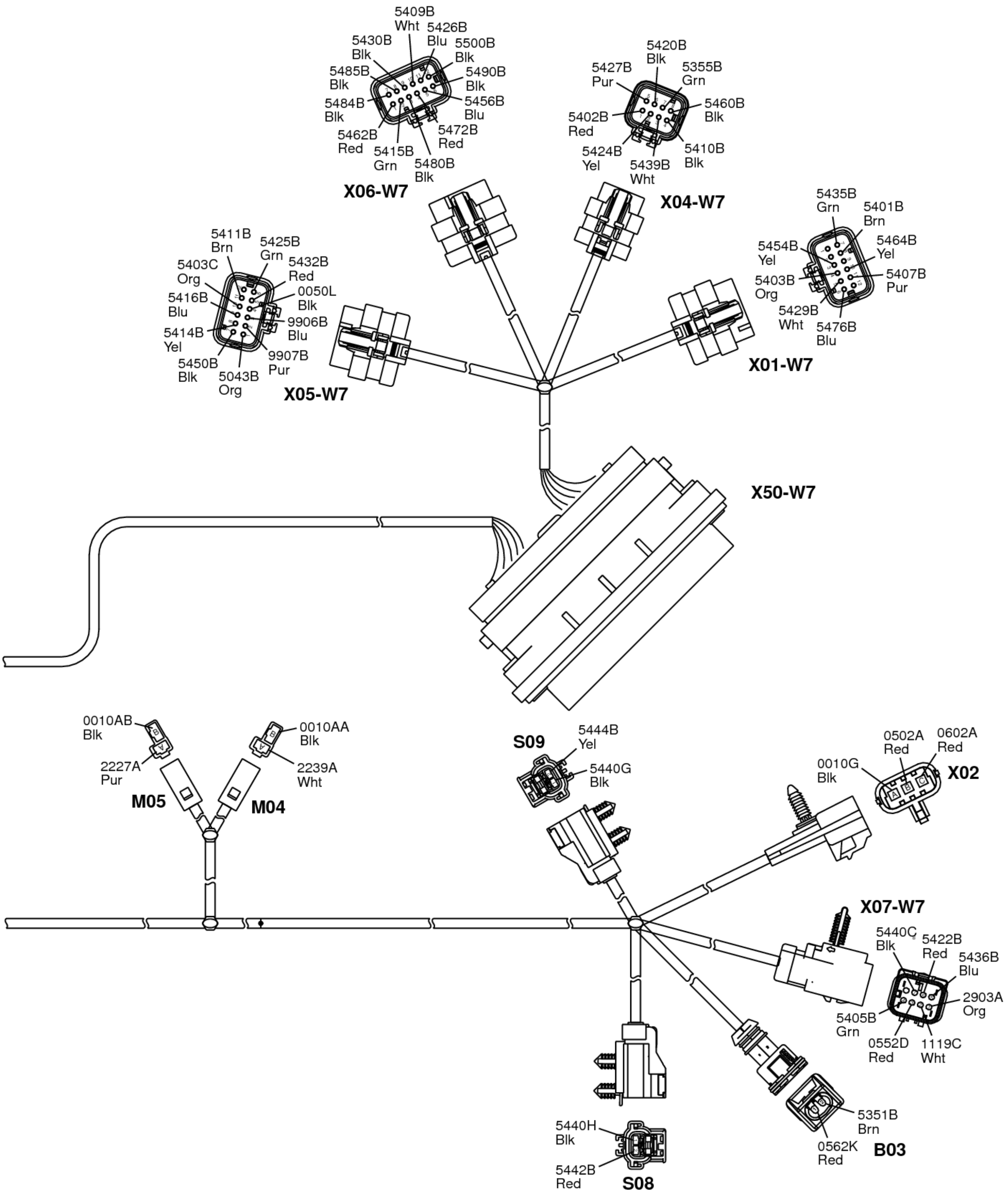


W7 Chassis Wiring Harness (1 of 2)

LEGEND:

B04	Engine Oil Pressure Switch
B33	MFWD Speed Sensing switch
B34	Mid Mount Proxy Sensor
F20	Glow Plug Relay Fuse

F21	Load Center Fuse
F22	Alternator Fuse
G02	Alternator
G02-B+	Alternator Power
M01	Starting Motor
M02	Fuel Pump
M06	Exhaust Valve Actuator
R01	Glow Plug Connection
S40	MFWD Engagement Sensing Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
T02	Ground
T03	Ground
T17	Ground
X26-W6	HST to Chassis Harness Interconnect
Y03	Rear PTO Solenoid
Y23	A/C Compressor Clutch



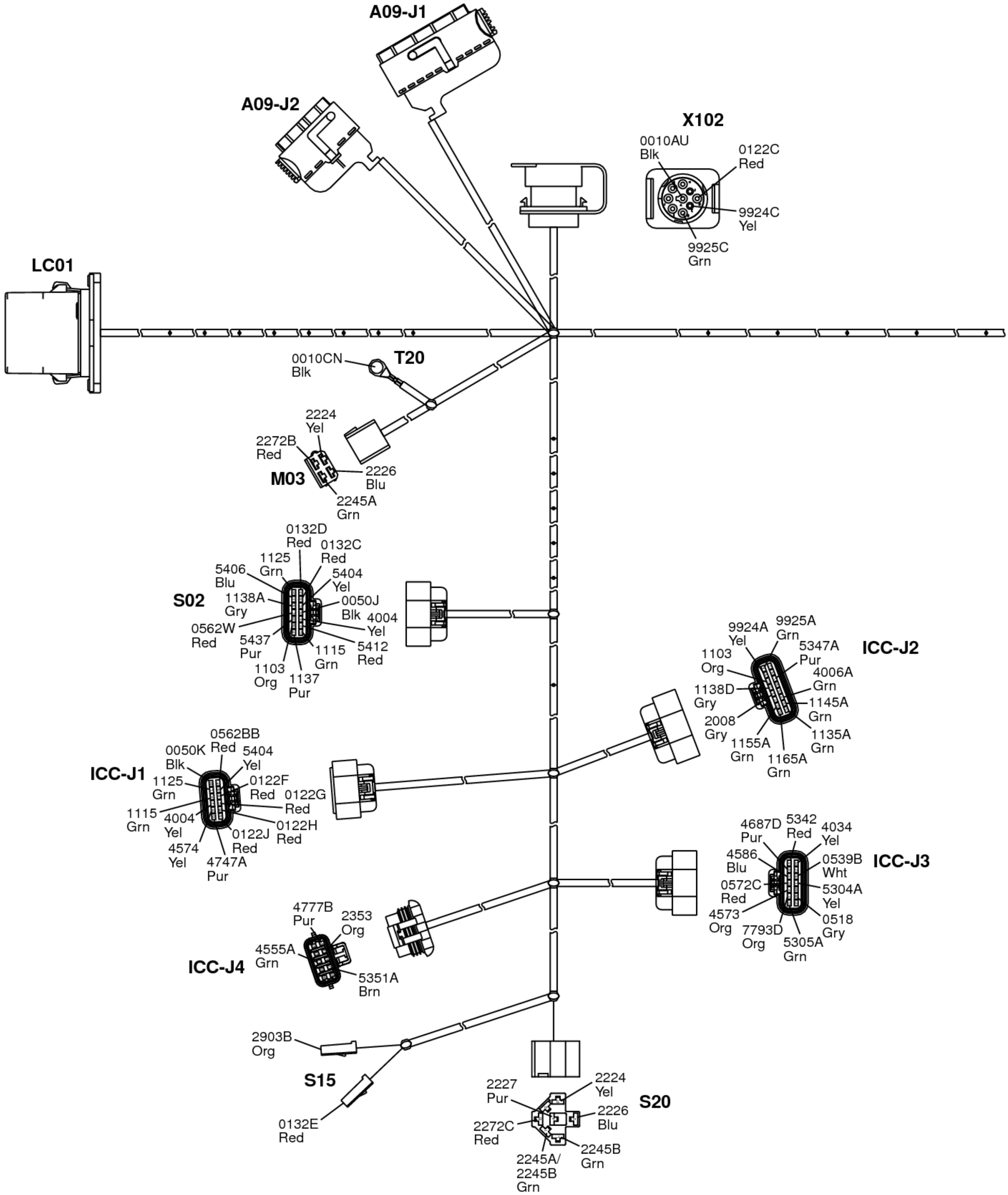
W7 Chassis Wiring Harness (2 of 2)

LEGEND:

B03	Air Filter Restriction Switch
M04	Rear Washer Pump
M05	Front Washer Pump
S08	Inlet Temperature Sensor
S09	Mid Temperature Sensor
X02	Junction Block

X01-W7	12 Pin Engine Interface Yel
X04-W7	8 Pin Engine Interface Red
X05-W7	12 Pin Engine Interface Red
X06-W7	12 Pin Engine Interface Gry
X07-W7	Chassis to Hood Harness Interconnect
X50-W7	Chassis to Lower Wiring Harness Interconnect

W8 Lower Wiring Harness (Cab)

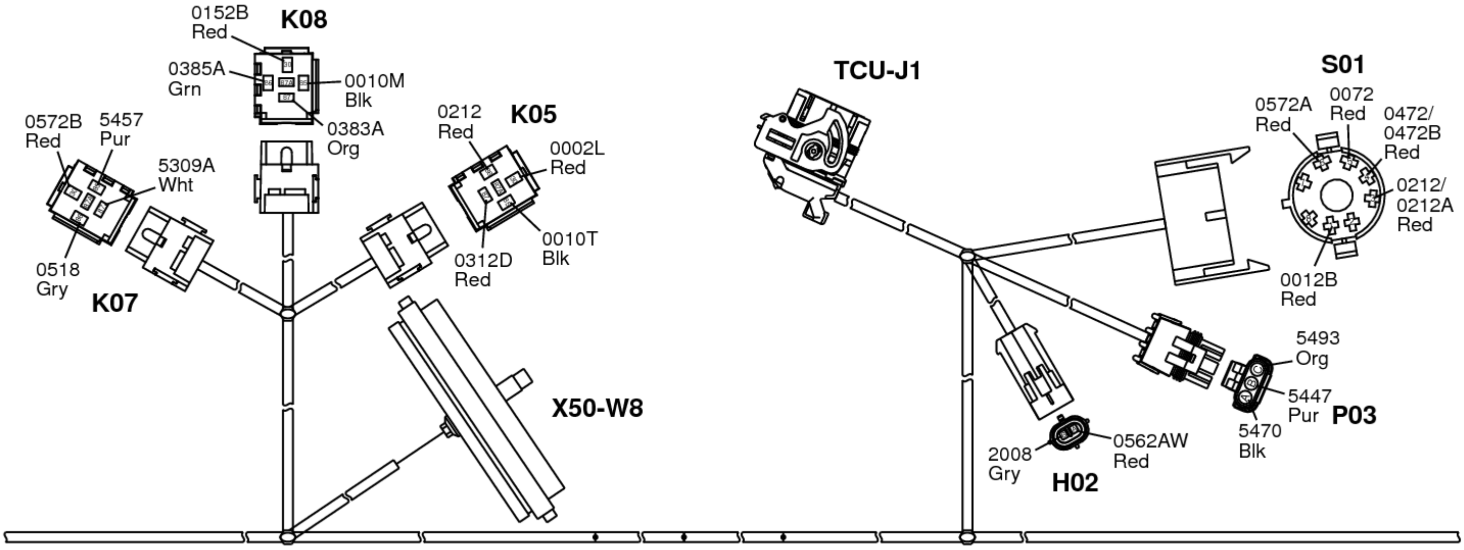


W8 Lower Wiring Harness (1 of 4)

LEGEND:

A09-J1	ECU Connector
A09-J2	ECU Connector
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect

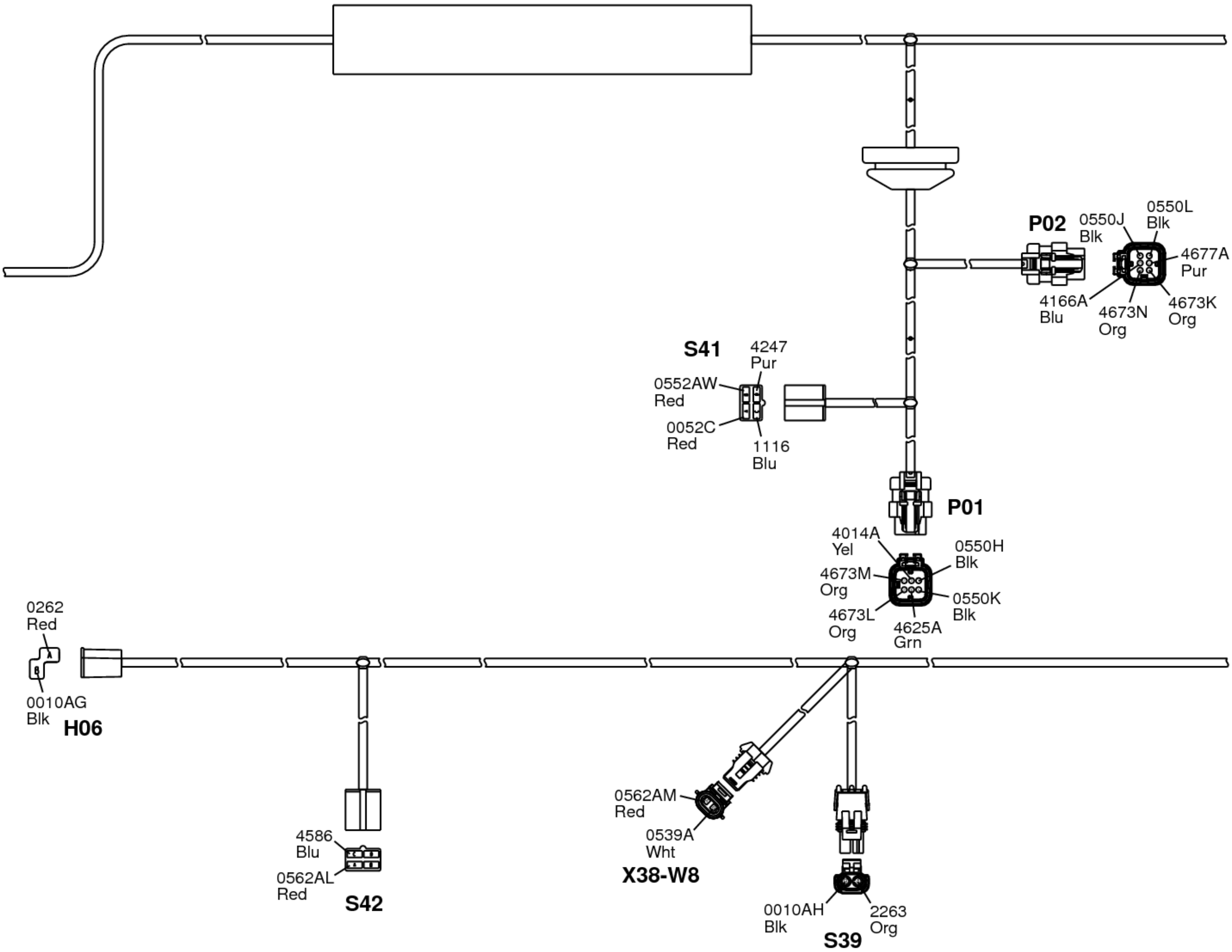
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect
LC01	Load Center
M03	Front Wiper Moter
S02	Dash Panel Module
S15	Horn
S20	Front Wiper Switch
T20	Front Wiper Ground
X102	Service Advisor



W8 Lower Cab Wiring Harness (2 of 4)

LEGEND:

H02	Warning Alarm
K05	Accessory Power relay
K07	Start Motor Relay
K08	Glow Plug Relay
P03	Hand Throttle
S01	Key Switch
TCU-J1	Transmisson Control Unit Interconnect
X50-W8	Lower Cab to Chassis Wiring Harness

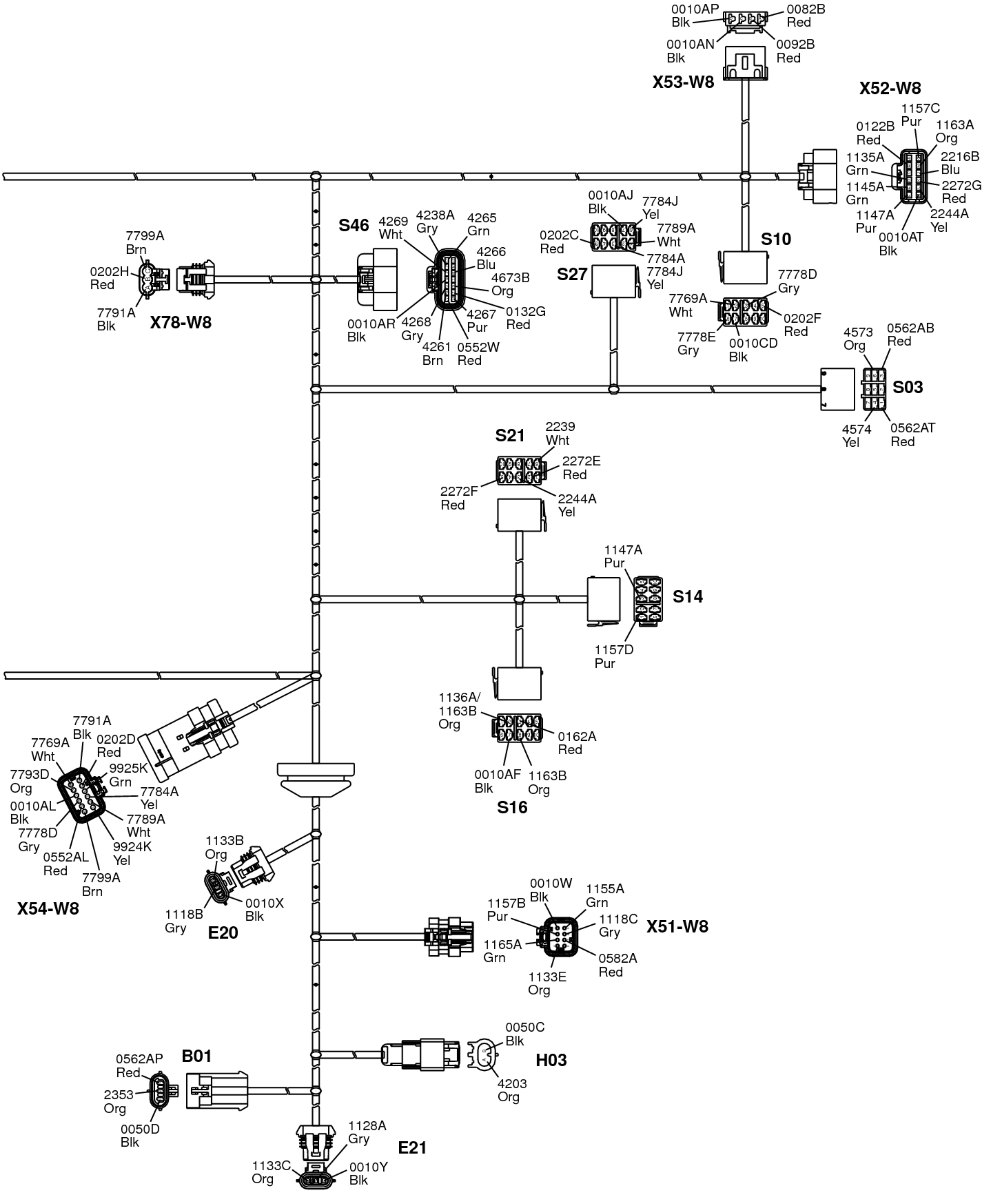


W8 Lower Cab Wiring Harness (3 of 4)

LEGEND:

H06	Power Port
P01	Forward Pedal Position
P02	Reverse Pedal Position
S39	Air Ride Seat
S41	Park Brake Switch
S42	Brake Switch

X38 - W8 Lower Cab to Seat Switch Harness Interconnect



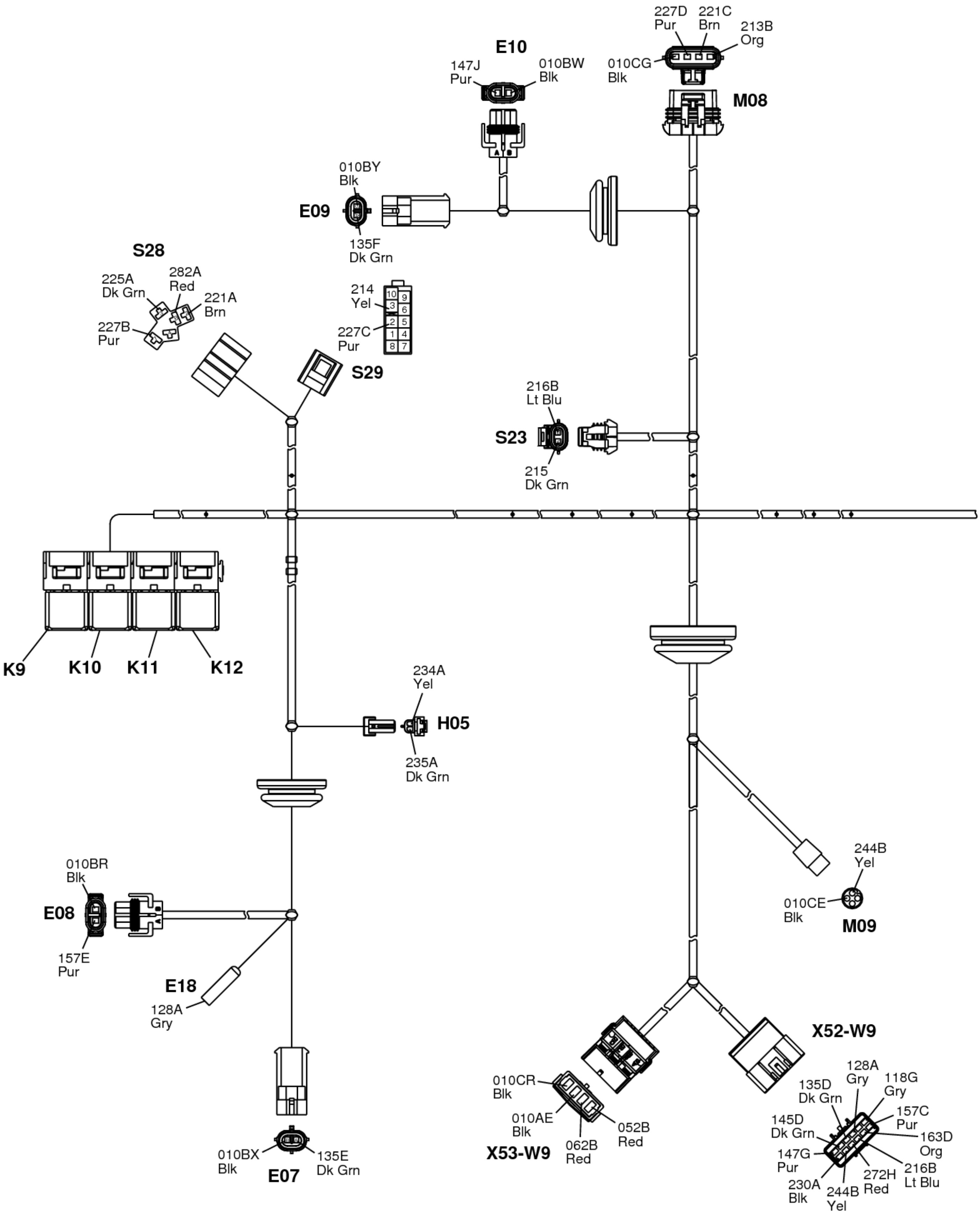
W8 Lower Cab Wiring Harness (4 of 4)

LEGEND:

B01	Fuel Guage Sensor
E20	Right Tail Light
E21	Left Tail Light
H03	Back Up Alarm
S03	PTO Switch

S10	Duel Rear Continuuous Switch
S14	Rear Work Light
S16	Beacon Light Switch
S21	Rear Wiper Switch
S27	Diverter Switch
S46	Cruise Control Module
X51 - W8	Lower Cab to 7 Pin Wiring Harness Interconnect
X52 - W8	Lower Cab to Upper Cab Interconnect
X52 - W8	Lower Cab to Upper Cab Interconnect
X54 - W8	Rear Harness Interconnect
X78 - W8	Lower Cab to EH Handle Interconnect

W9 Upper Wiring Harness (Cab)

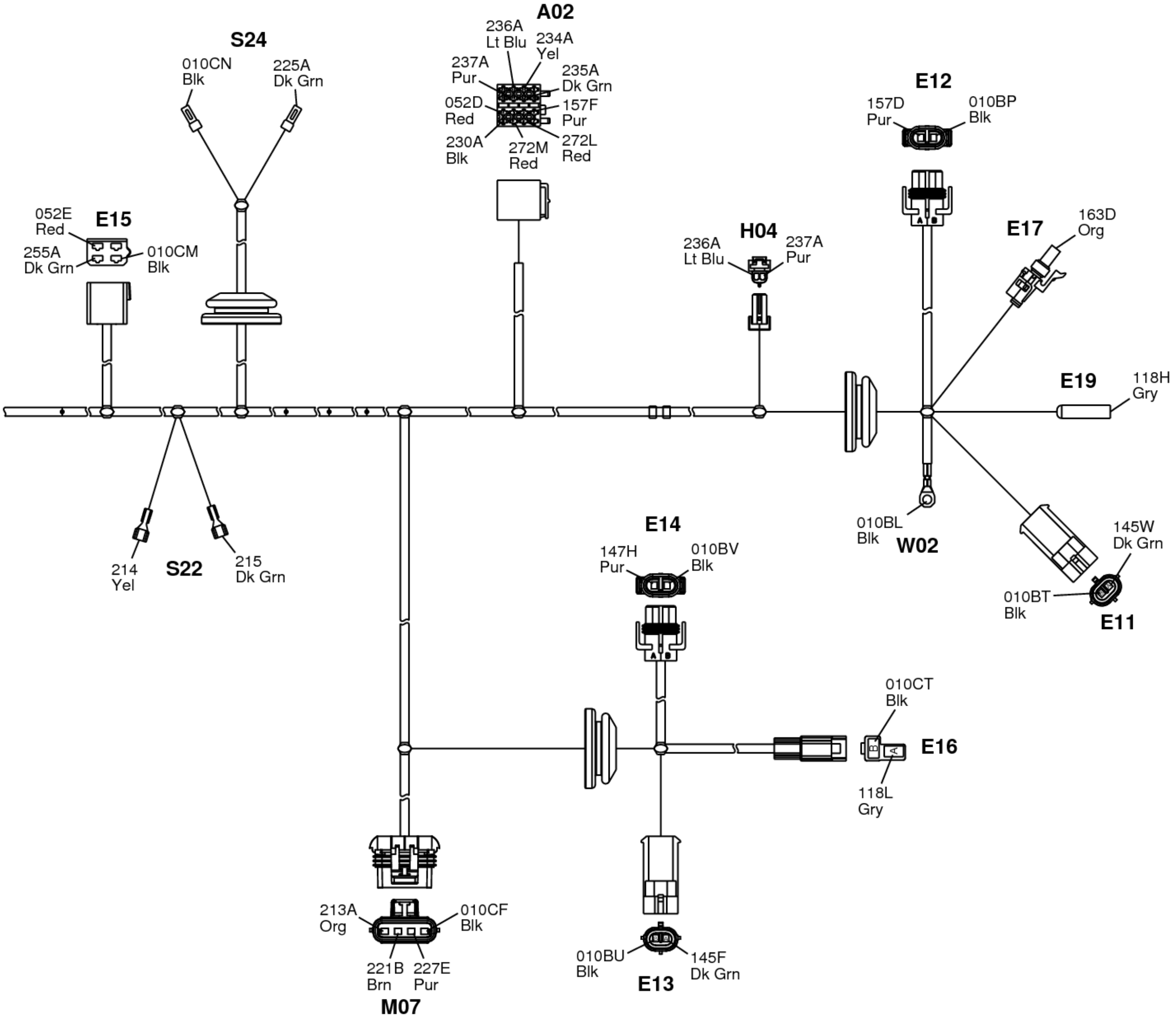


W9 Upper Cab Wiring Harness (1 of 2)

LEGEND:

E07	Right Front Amber Light
E08	Right Front Work Light
E09	Right Rear Amber Light
E10	Right Rear Work Light

E18	Right Front Marker Light
H05	Right Speaker
K9	Right Power Relay
K10	Left Power Relay
K11	Right Blower Motor Relay
K12	Left Blower Motor Relay
M08	Right Blower Motor
M09	Rear Wiper Motor
S23	High-Low Pressure Switch
S28	Blower Switch
S29	HVAC Switch
X52-W9	Upper Cab to Lower Wiring Harness Interconnect
X53-W9	Upper Cab to Lower Wiring Harness Interconnect



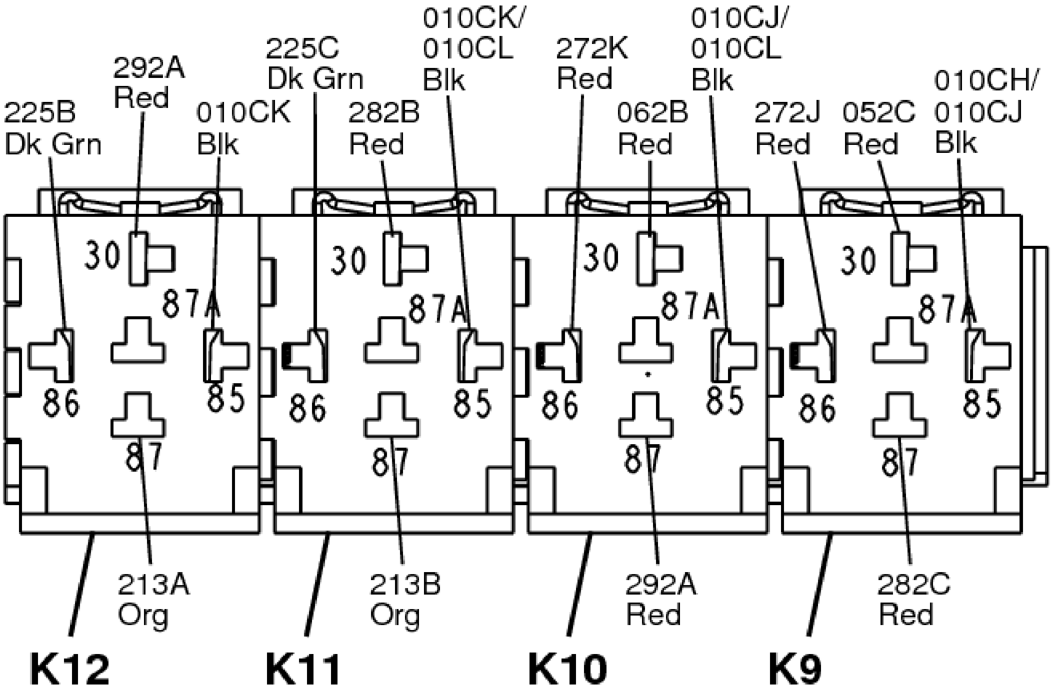
W9 Upper Cab Wiring Harness (2 of 2)

LEGEND:

A02	Radio
E11	Left Front Amber Light
E12	Left Front Work Light
E13	Left Rear Amber Light
E14	Left Rear Work Light
E15	Dome Light

E16	License Plate Light
E17	Beacon Light (Option)
E19	Left Front Marker Light
H04	Left Speaker
M07	Left Blower Motor
S22	HVAC Temperature Sensor
S24	Door Light Switch
W02	Beacon Light Ground

W9 Upper Wiring Harness Relay Block (Cab)

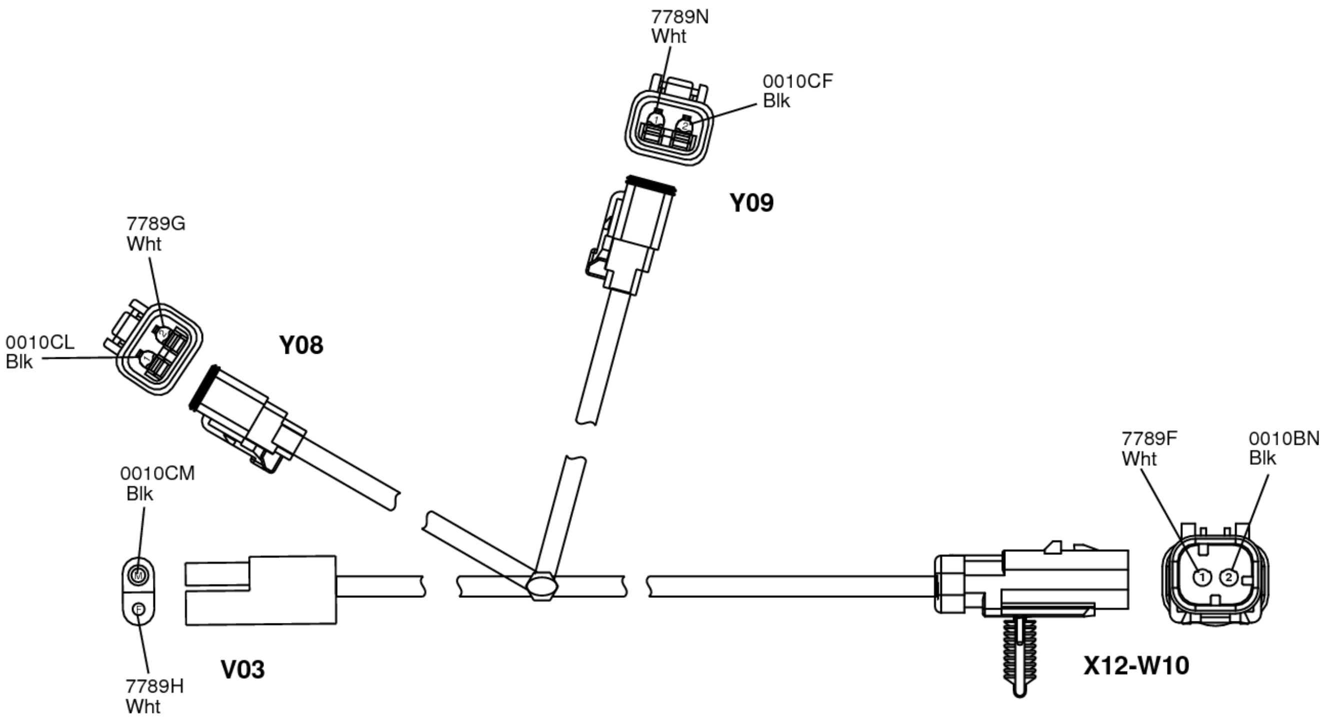


W9 Upper Cab Wiring Harness Relay Block

LEGEND:

K9	Right Power Relay
K10	Left Power Relay
K11	Right Blower Relay
K12	Left Blower Relay

W10 Diverter Valve Jumper Harness

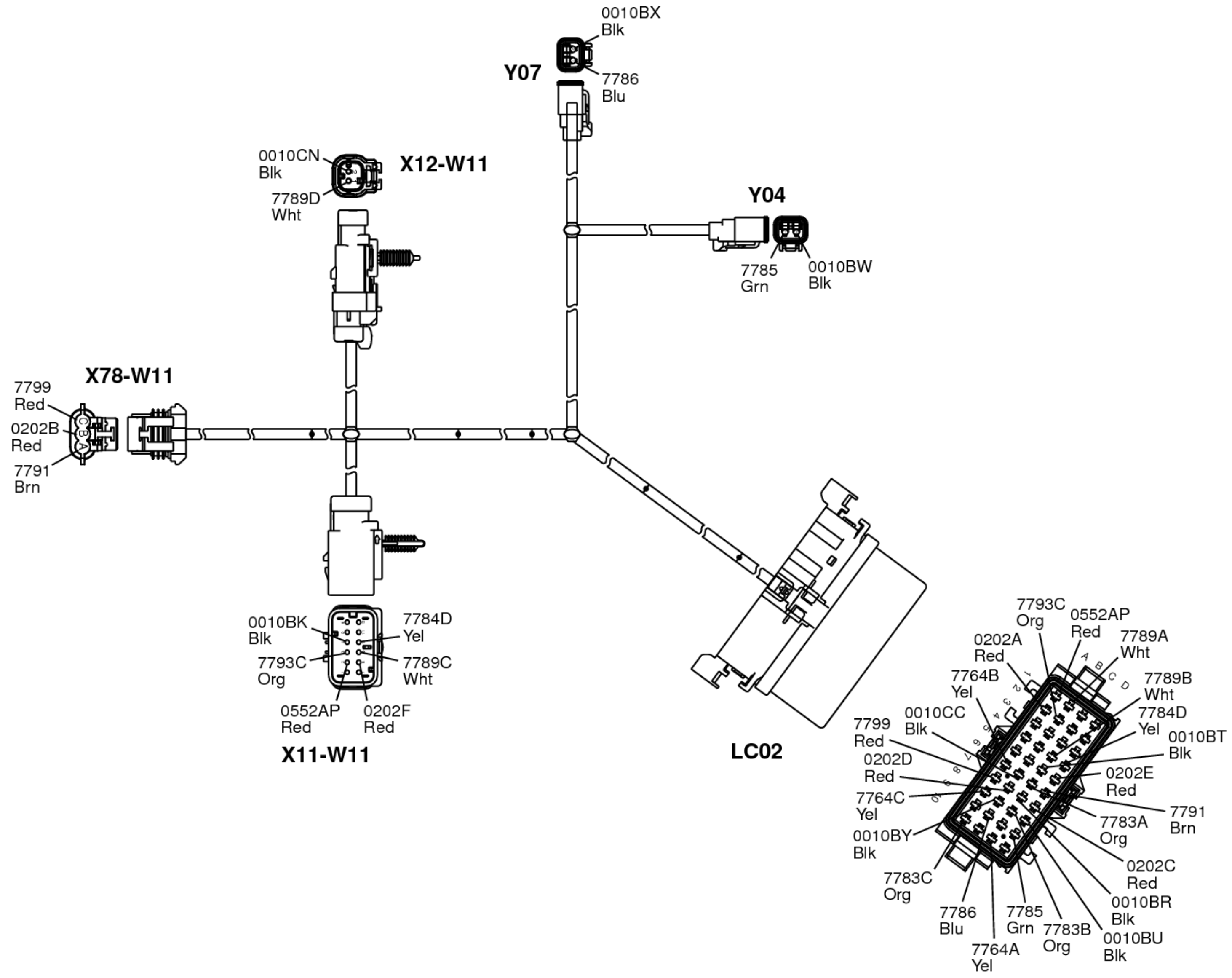


Diverter Valve Wiring Harness

LEGEND:

V03	Diode (5A)
X12-W10	Diverter Valve to 3rd EH Harness Interconnect (or 3rd EH, Diverter, Creep to REPO Harness (Cab)
Y08	Upper Hydraulic Solenoid Valve
Y09	Lower Hydraulic Solenoid Valve

W11 3rd EH Wiring Harness (Open Station) (—OCT 2014)

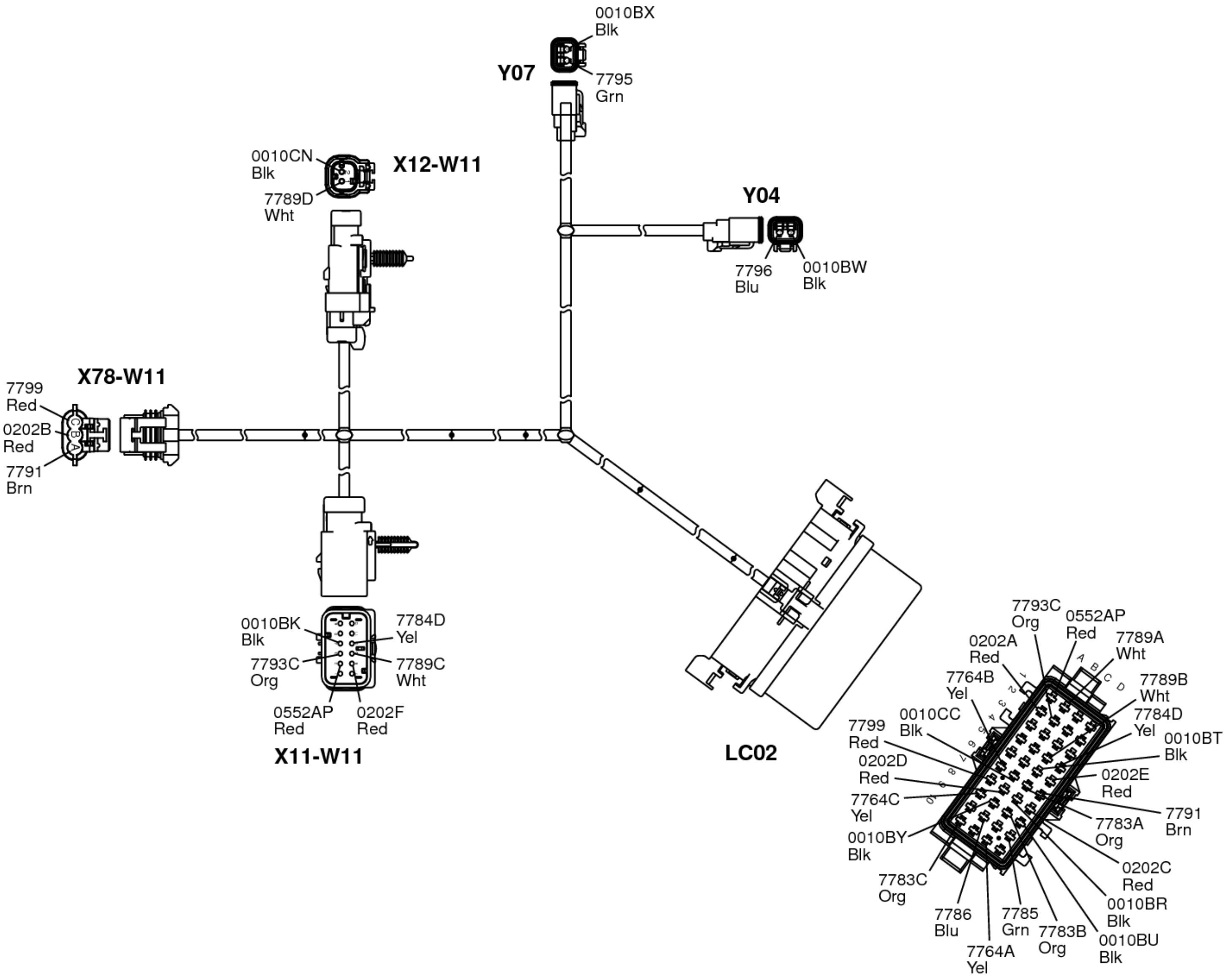


3rd EH Function Wiring Harness

LEGEND:

LC02	Load Center 3rd EH
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Jumper Harness
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W11 3rd EH Wiring Harness (Open Station) (OCT 2014—)

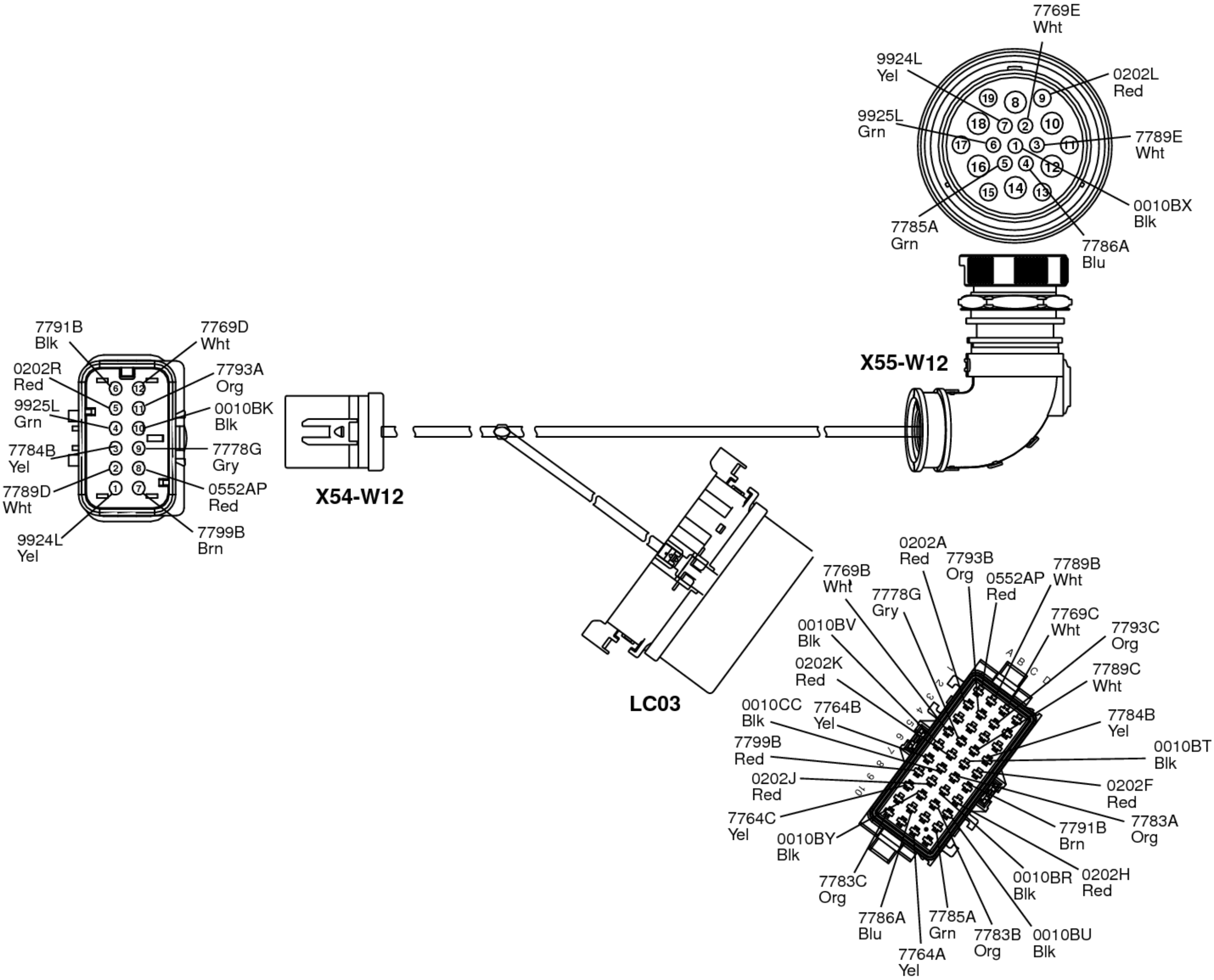


3rd EH Function Wiring Harness

LEGEND:

LC02	Load Center 3rd EH
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Jumper Harness
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W12 Load Center Harness (Cab)

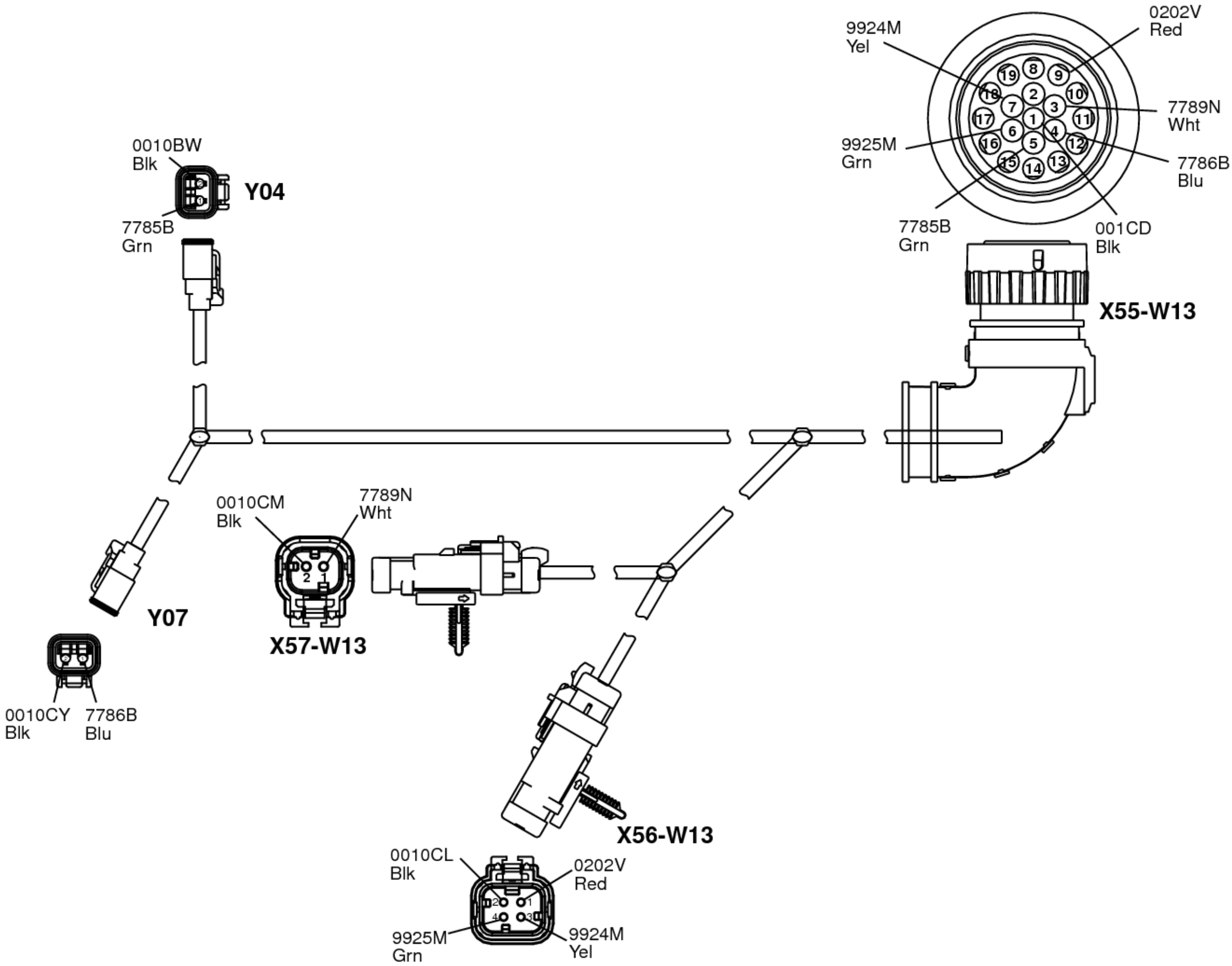


W12 Load Center Harness (Cab)

LEGEND:

LC03	Load Center Harness
X54-W12	Load Center to Rear Harness Interconnect
X55-W12	Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect

W13 3rd EH, Diverter, Creep to REPO Harness (Cab) (—OCT 2014)

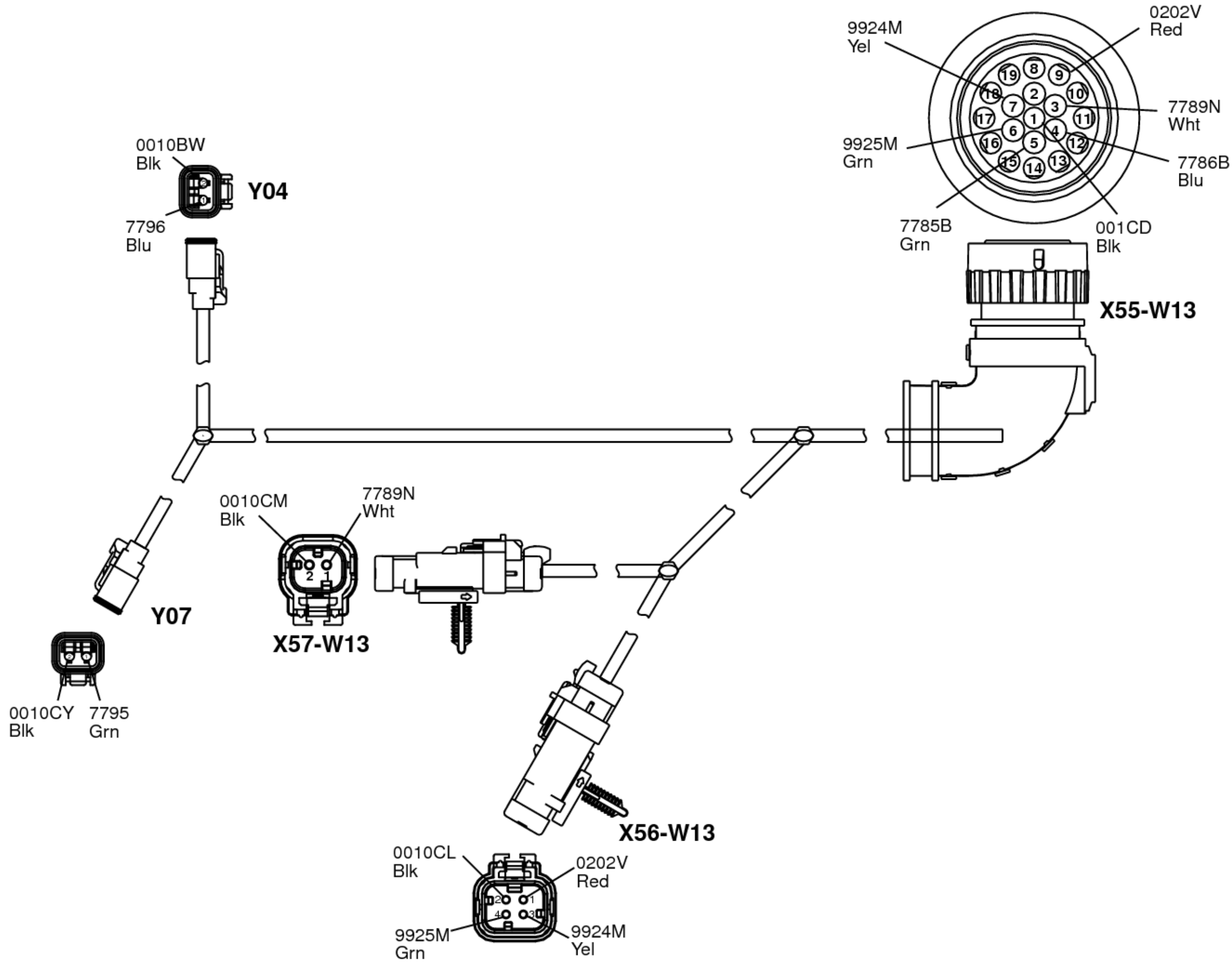


W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W13 3rd EH, Diverter, Creep to REPO Harness (Cab) (OCT 2014—)

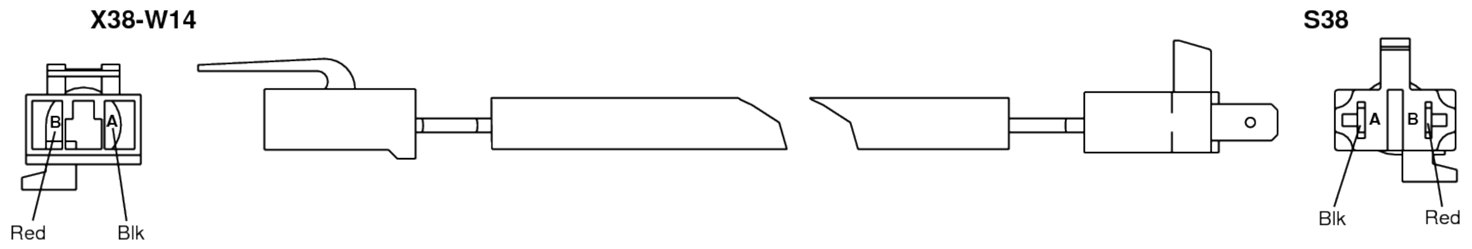


W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W14 Seat Switch Jumper Harness (Cab)

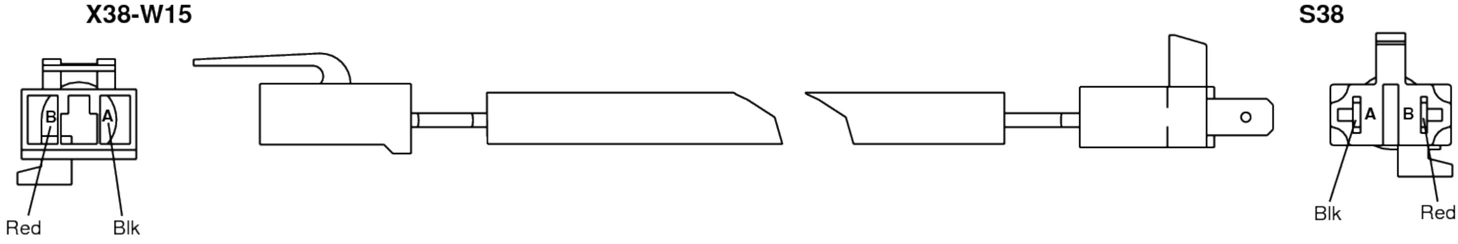


W14 Seat Switch Jumper Harness (Cab)

LEGEND:

S38	Seat Switch
X38-W14	Seat Switch to Lower Cab Harness Interconnect

W15 Seat Switch Jumper Harness (Open Station)

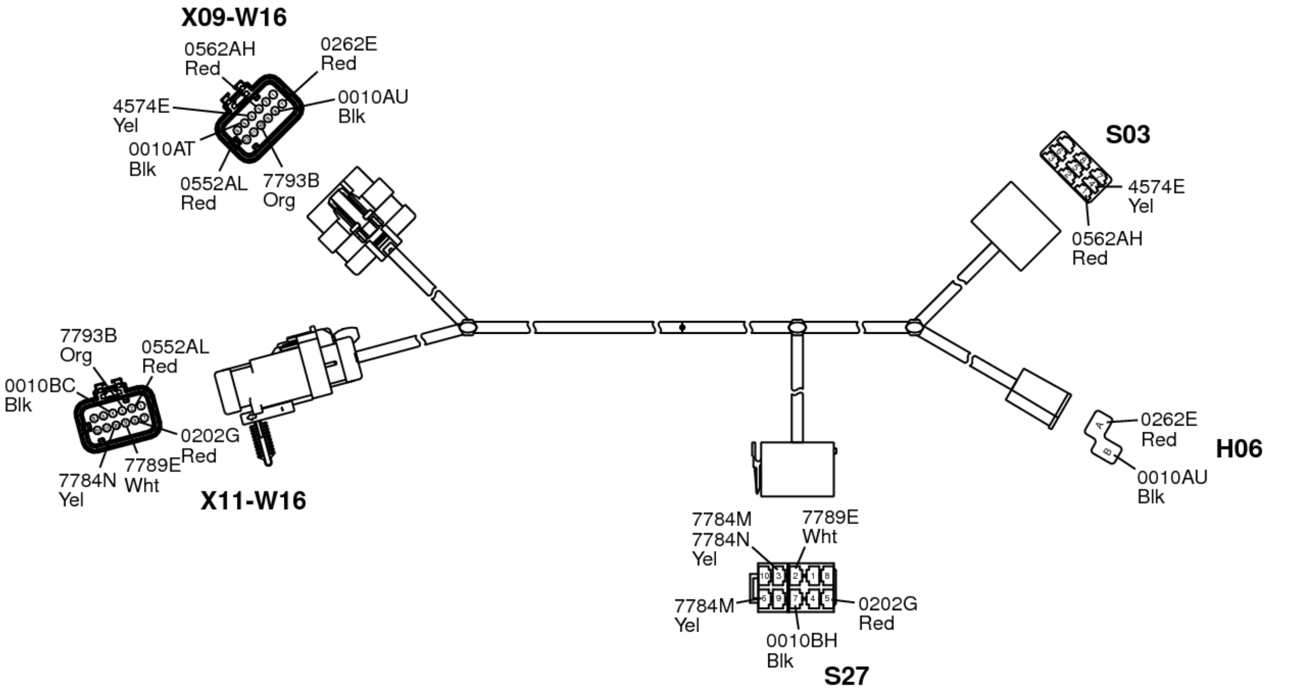


W15 Seat Switch Jumper Harness (Open Station)

LEGEND:

S38	Seat Switch
X38-W15	Seat Switch to Chassis Harness Interconnect

W16 Fender Wiring Harness (Open Station)—PowrReverser Transmission

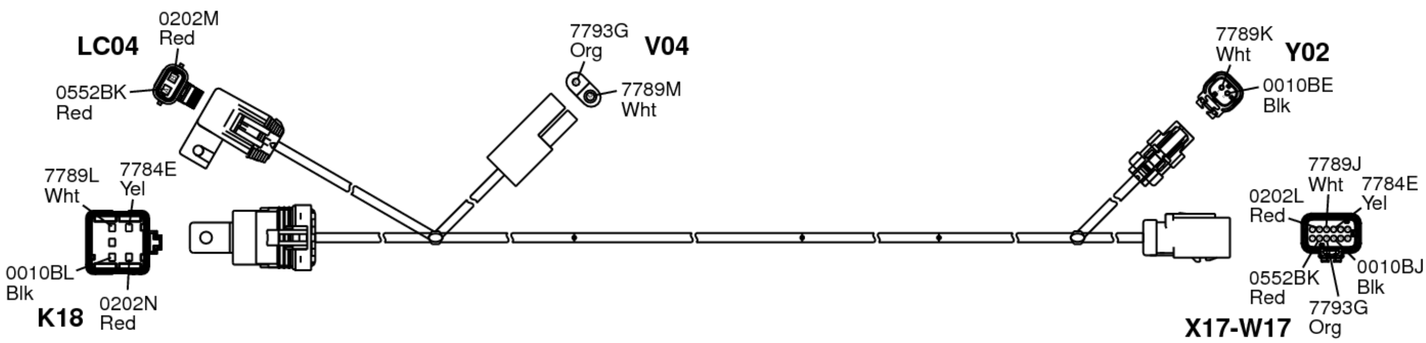


W16 Fender Wiring Harness

LEGEND:

H06	Power Port
S03	PTO Switch
S27	Diverter Switch
X09-W16	Right Fender to Chassis Harness Interconnect 2
X11-W16	Right Fender to 3rd EH Harness Interconnect

W17 Diverter Wiring Harness (Open Station)

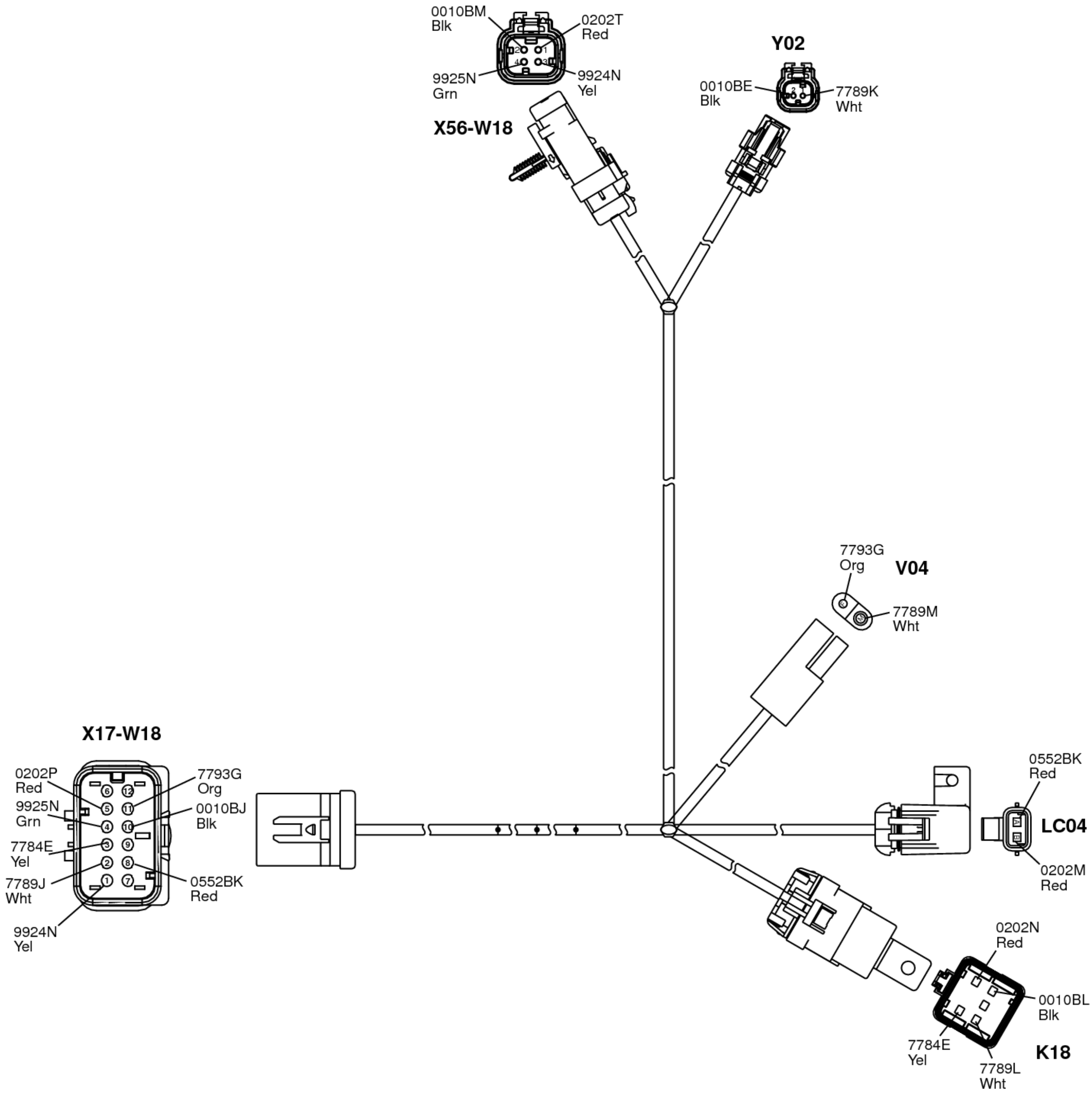


W17 Diverter Wiring Harness

LEGEND:

K18	Fuel Shutoff Relay
LC04	Fuse Holder
V04	Diode 6 Amp
X17-W17	Rear Harness Connector
Y02	Diverter Solenoid

W18 Diverter Wiring Harness (Cab)



W18 Diverter Wiring Harness (Cab)

LEGEND:

K18	Fuel Shutoff Relay
LC04	Fuse Holder
V04	Diode 6 Amp
X17-W18	Rear Harness Connector

X56-W18	Diverter Wiring Harness to REPO Harness Interconnect
Y02	Diverter Solenoid

Group 30 - Operation and Diagnostics

Power Circuit Operation

Function

To provide unswitched and switched power to the primary electrical components whenever the battery is properly connected.

The power circuits are divided among the unswitched power circuits, switched power circuits (key switch in Run position), and secondary power circuits. The secondary power circuits become energized when switched power circuits energize relays and/or control modules, providing current paths to the secondary circuits. The secondary power circuits will not be energized if the relay or control module controlling the current path(s) fail.

Unswitched Power

Voltage must be present at each of the following components with the key switch in the off position:

- A09 Engine control unit (ECU) terminal 1
- A09 Engine control unit (ECU) terminal 3
- A09 Engine control unit (ECU) terminal 5
- ECU Fuse holder terminal A
- F20 Fuse 40A
- F21 Fuse 50A
- F22 Fuse 80A
- G02 Alternator T13
- ICC-J1 terminal A
- ICC-J1 terminal B
- ICC-J1 terminal C
- ICC-J1 terminal D
- ICC-J1 terminal F
- K8 Glow plug relay terminal 30
- K2 EGR valve relay terminal 10A
- S01 Key switch terminal 1
- S02 Dash panel module terminal A
- S02 Dash panel module terminal B
- S15 Horn switch terminal A
- TCU-J1 terminal L1
- X102 Service advisor terminal B
- F2 Power port terminal 1C

The positive battery cable connects the battery to the starting motor. The starting motor bolt is used as the 12-volt DC tie point for the rest of the electrical system.

The battery cables and the starting motor tie point connections must be good for the machine electrical system to work properly. The ground cable and positive cable connections are equally important. Proper starting motor operation depends on these cables and connections to carry high current.

Except for the B terminal of the alternator, the electrical circuit is protected by the F20, F21, and F22 fused bus bar beyond the starting motor tie point. The engine control unit (ECU) is another unswitched power circuit that is protected by a fuse.

Switched Power

In addition to the voltage present at the locations of the unswitched power circuits, voltage must be present at the following components during the following conditions: key switch in the Run position, direction pedals not pressed, PTO(s) off, park brake locked, MFWD disengaged, and operator off seat:

- A01 Display unit ICC-J2 terminal N
- A09 ECU terminal 35
- A09 ECU terminal 88
- B33 MFWD speed sensing switch terminal A
- S39 Air ride seat option terminal A
- S41 Brake switch terminal B

These circuits are controlled by the key switch and are protected by the F20, F21, and F22 fused bus bar.

Cranking Circuit Operation

Function

To energize the starter motor solenoid and engage the starter motor to start the engine.

Operating Conditions

- Key switch in START position
- Transmission in any position
- Rear PTO switch in OFF position

Theory of Operation

CAUTION:

Avoid Injury! ALWAYS engage park brake when starting the engine.

The starting circuit is controlled through the A01 display panel based upon “IF” “THEN” logic. If the operating conditions are met, then the display panel will supply an output signal to the K07 start relay.

Unswitched power is supplied to the A01 display panel at terminals A—D (122B —122E Red wires) on the ICC-J1 connector. When the key switch is in the RUN or START position, switched power is supplied to the A01 display panel at terminal F (0562 series Red wires) on the ICC-J1 connector, powering up the display panel. For more information, see Power Circuit Operation in Section 40, Group 30.

The display panel will supply an output to 0518 Gry wire to energize the K07 start relay when it detects the following inputs:

- Battery voltage at terminal D (0572C Red wire) on the ICC-J3 connector from S1 key switch (START position).
- No voltage at terminal H (4574 series Yel wire) on the ICC-J1 connector from S03 rear PTO switch (OFF position).
- Input data at terminal R (9924A Yel wire) on the ICC-J2 connector from the A09 ECU controller indicating engine speed is less than 400 rpm.

When placed in the START position, the key switch provides power to the 572A Red wire, which splices to the 572C and 572D Red wires. The 572A Red wire supplies the input signal to the display, while the 572B Red wire supplies power to terminal 30 on the K07 start relay.

When all cranking conditions have been met, the display panel will provide output power on 0518 Gry wire to the start relay at terminal 86, energizing the relay for up to 60 seconds per starting attempt.

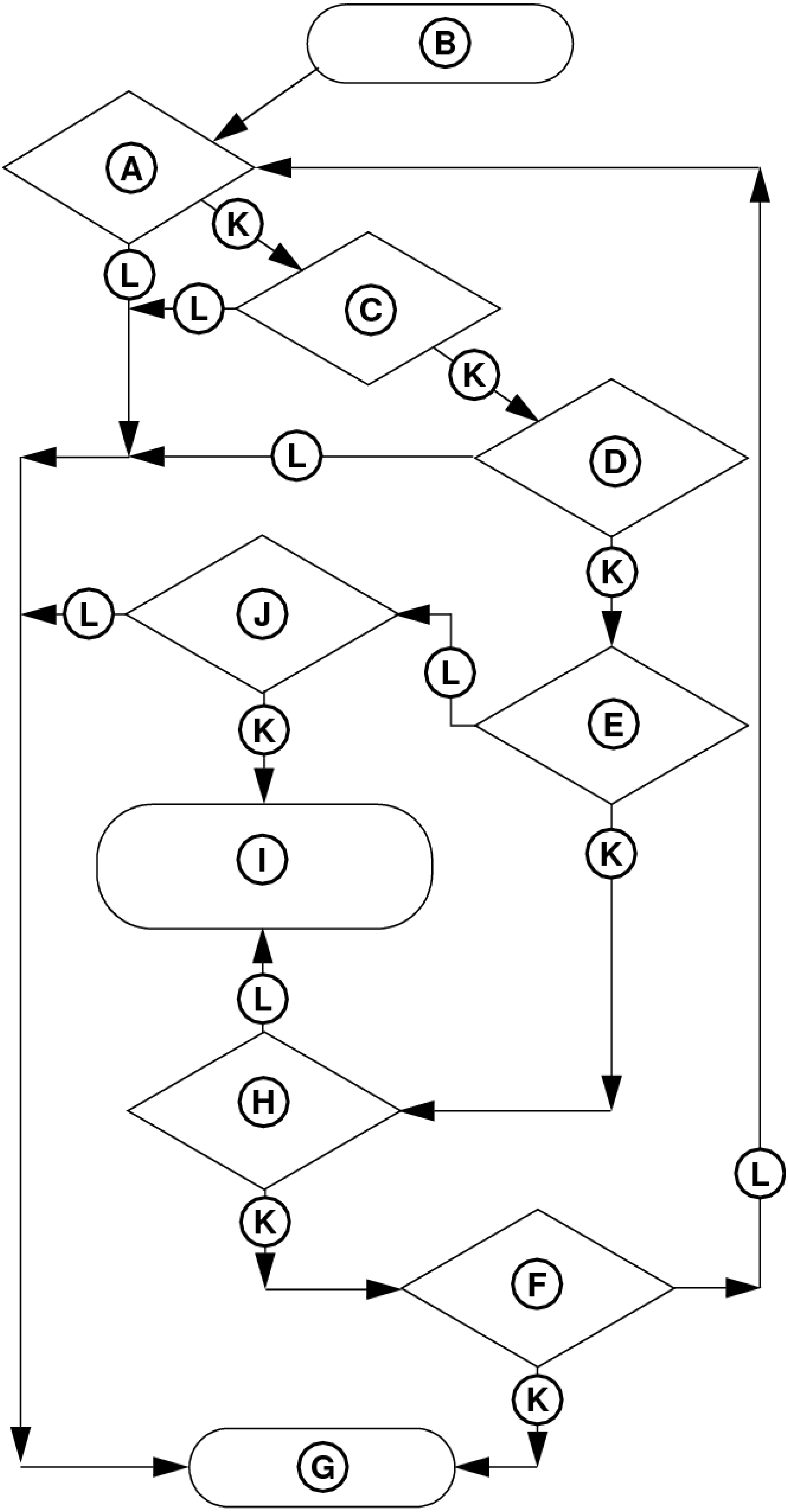
When energized, the start relay contacts are closed, allowing current to flow from the 0572D Red wire through the 5309 series Wht wires to the Y01 starting motor solenoid, energizing the starting motor solenoid. With the starting motor solenoid energized, the solenoid contacts close and high current from the battery flows through the battery cable and starter motor solenoid contacts to the starting motor. The starting motor activates and cranks the engine.

During the cranking process, the display panel monitors engine speed data provided by the A09 ECU controller. From the data, the A09 ECU controller determines the speed the engine is turning, then transmits the engine speed information across the 9924A Yel and 9924B Grn wires to the A01 display panel.

If the engine speed is greater than 400 rpm when the key switch is placed in the START position to crank the engine, the logic in the display panel will determine the engine is already running and will not provide an output signal to the start relay. If, during the cranking function, the engine speed increases to 800 rpm or greater for 3 consecutive seconds, the logic in the display panel will determine the engine is running and will remove the output signal to the start relay, even if the key switch is still in the START position.

For the engine to start, the pull-in and hold-in coils of the fuel shutoff solenoid must be energized. For operation of the fuel circuit, see Fuel Supply/Engine Shutoff Circuit Operation in Section 40, Group 30.

The following flow chart is a diagram of the display panel cranking circuit logic.


B
A
K
L
L
C
K
L
D
L
J
K
L
E
K
I
L
H
K
F
L
K
G

Flow Chart

LEGEND:

A	Park Brake Locked?
B	Attempt to Start Engine
C	Rear PTO Off?
D	Key Switch in Start Position?
E	Start Relay Already Engaged?
F	Three Consecutive Seconds?
G	No Output Signal to Start Relay
H	Engine Speed > 800 rpm?
I	Output Signal to Start Relay (maximum 60 seconds)
J	Engine Speed < 400 rpm?
K	Yes
L	No

Fuel Supply/Engine Shutoff Circuit Operation

Function

To start or stop the supply of fuel to the engine.

To cut power to the fuel shutoff solenoid and stop the machine engine when desired or in an unsafe operating condition.

Operating Conditions (Cranking)

- PTO(s) off.
- Transmission in any position.
- Key switch in the START position.

Operating Conditions (Engine on, Operator on Seat)

- Key switch in the RUN position.
- Operator on seat.
- PTO(s) off or on.
- Transmission in any position.

Operating Conditions (Engine on, Operator off Seat)

- Key switch in the RUN position.
- Park brake locked.
- Transmission in any position.
- PTO(s) off, and then.
- Operator may leave seat.

Operating Conditions (Engine on, Operator off Seat, Rear PTO Engaged)

- Key switch in the RUN position.
- Park brake locked.
- Transmission in any position.
- Mid PTO off (option).
- Operator may leave seat, and then.
- Rear PTO can be on.

Engine must stop when

- Operator places the key switch in the OFF position,

or;

- PTO(s) on, and
- Operator gets out of seat (if off seat PTO logic is not engaged),

or

- Transmission is in any position, and
- Operator gets out of seat.

Theory of Operation—Fuel Supply Logic

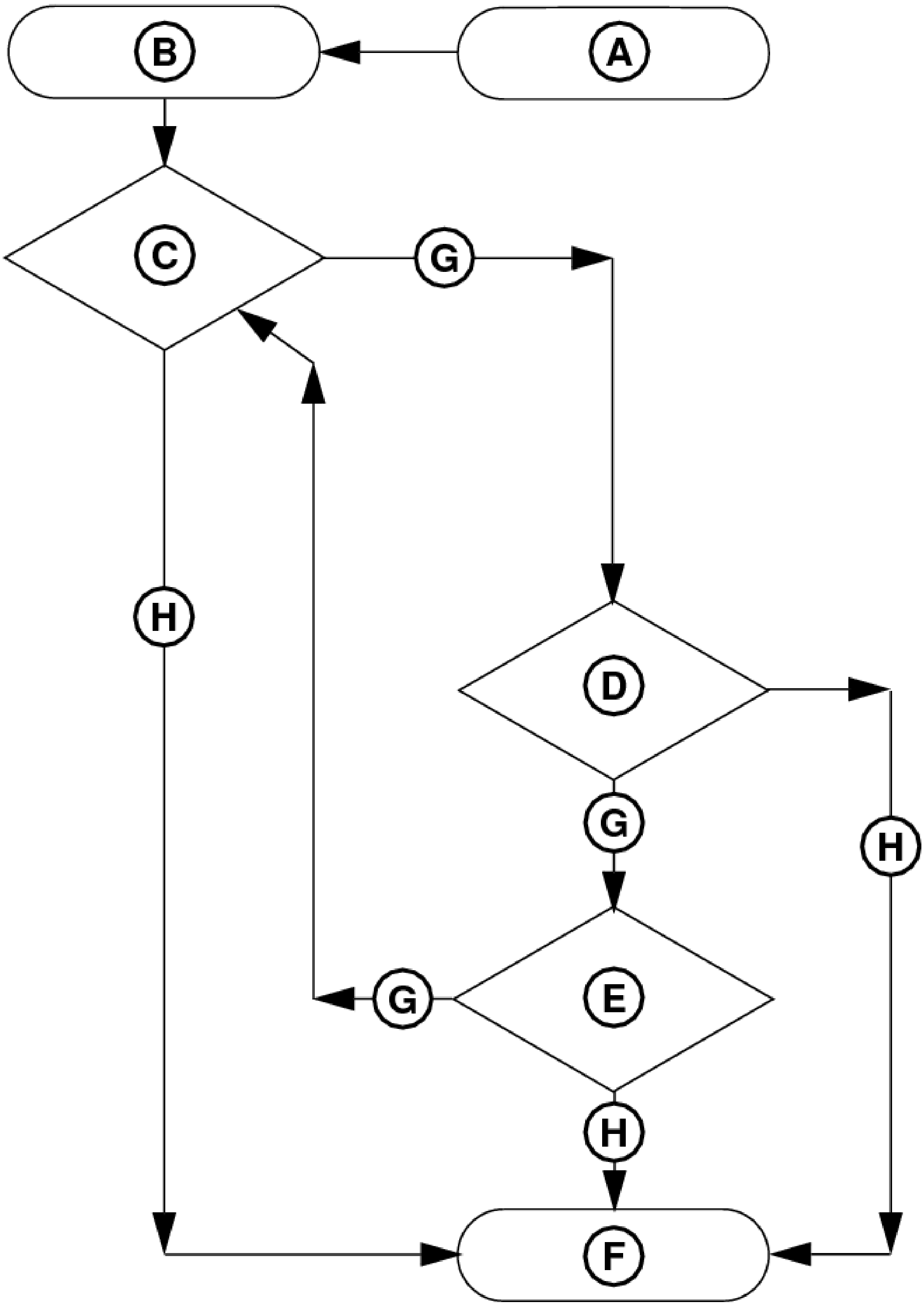
The fuel system is designed to inject fuel into the piston cylinders, where heat from compression ignites the fuel and air mixture.

When the key switch is placed in either the run or start positions, current from the switched power circuit is provided to the A01 display panel through either the S38 seat switch (on seat) or the S03 rear PTO switch (off).

Fuel is supplied to the engine by the M02 fuel pump over the 0562J Red wire when the S01 key switch is placed in either the START or RUN position. Ground for this circuit is through the 0010B and 0010A Blk wires on the W01 ground circuit.

→NOTE:

See relevant engine component technical manual (CTM) for detailed fuel system operation.



Flow Chart

LEGEND:

A	Fuel Solenoid Off
B	Place Key Switch in RUN Position
C	Operator on Seat?
D	PTOs Off?
E	Off Seat PTO Logic On?
F	Fuel Solenoid On
G	No
H	Yes

Theory of Operation—Engine Shutoff

When the operator places the key switch in the OFF position or if an unsafe condition is created, the engine will stop by having the fuel supply to the engine shut off.

The fuel supply is shut off when voltage to the suction control valve and M02 fuel pump are removed.

→NOTE:

See relevant engine component technical manual (CTM) for detailed fuel system operation.

Engine on, Operator ON Seat Logic

The seat switch is the main and most direct circuit to provide input to the A01 display panel.

This on seat logic circuit provides voltage to the ECU for normal operator on seat operation of the machine.

Power is provided through the key switch, 072 Red wire, F5 fuse, 562 series of Red wires, S38 seat switch (S39 with optional air ride seat) (operator on seat), 0539B Wht wires to the A01 display panel ICC-J3 connector.

Engine On, Operator OFF Seat Logic

The S03 rear PTO switch is the second path to provide input to the A01 display panel and then to A09 engine control unit for fuel shutoff.

The rear PTO switch provides power to the fuel circuit. Power is provided from the key switch to the 072 Red wire, F5 fuse, 562 series of Red wires.

The 562 series Red wire at terminal 1 provides power to the S03 rear PTO switch (PTO off).

If the PTO is off, the transmission is in neutral, and without the operator on the seat, the display panel will then provide an input at 4574 Yel wire at ICC-J1 terminal H to the ECU through 9924A Yel and 9925A Grn wires,

Engine On, Operator OFF Seat, Rear PTO Engaged Logic (Off Seat PTO Logic)

To operate a machine with the rear PTO engaged and allow the operator to leave the seat requires that the off seat PTO logic be activated. The off seat PTO logic is activated and deactivated automatically as the operator uses different functions of the machine.

To activate the off seat PTO logic, the A01 display panel requires proper input signals from the following circuits during the following conditions:

Engine On, Operator OFF Seat, Rear PTO Engaged Logic (Off Seat PTO Logic)

Input Circuit	Operating Condition
Seat switch	Operator on seat
Rear PTO switch	Off position
Park brake switch	Park brake locked
S49 Mid PTO sense switch	S49 Mid PTO sense switch off (if equipped)
Alternator	Engine running

Once the off seat PTO logic has been activated, the operator may leave the seat and then engage the rear PTO. With the mid PTO engaged, the operator must remain on the seat in order for the engine to remain running.

Except for the seat switch, if any of the other inputs change once the operator has left the seat and engaged the rear PTO, the engine will shut off.

If the operator returns to the seat, the engine will continue to run with the rear PTO engaged, however the off seat PTO logic will be deactivated, and the engine will shut off if the operator leaves the seat, unless the off seat PTO logic is activated again.

The A01 display panel requires four constant and two changing inputs to operate the rear PTO with operator off the seat. Five inputs supply battery voltage and one input supplies a frequency signal to the display panel to activate the off seat PTO logic. The changing inputs are from the seat switch indicating that the operator has left the seat, and the rear PTO switch indicating that the operator has engaged the rear PTO.

The switched power circuit provides power to the display panel through the following circuits:

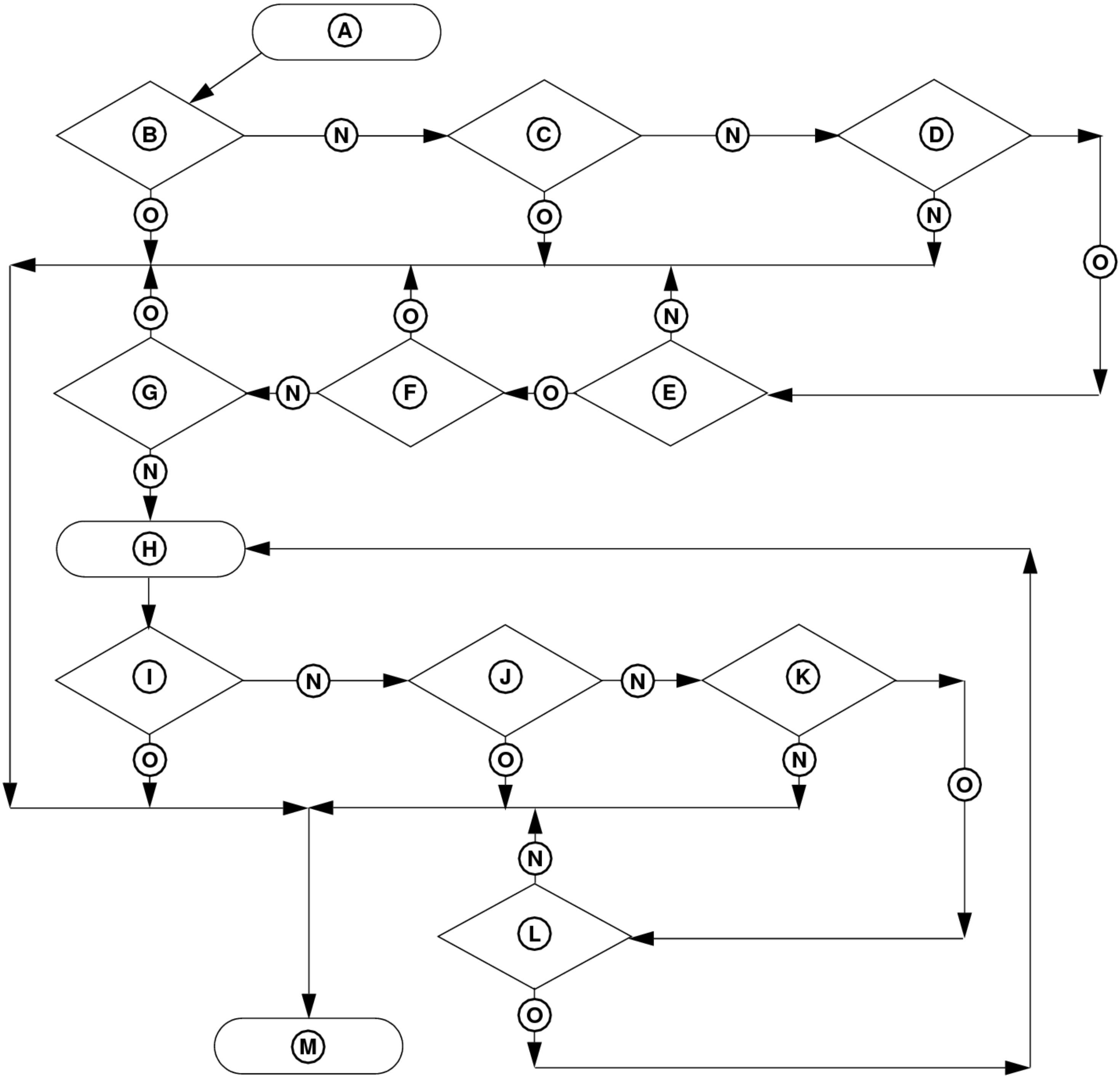
- The 562 series Red wire provides power to the S42 park brake switch (park brake locked), 4586 Blu wire, A01 display panel (ICC-J3 connector).
- The 562B Red wire provides power to the S49 Mid PTO sense switch, if equipped, 4687C Pur wire, and on to the A01 display panel ICC-J3 connector.
- The frequency input is a result of the engine running and is supplied by the TCM (transmission control module).
- The 562 series Red wire provides power to the S38 seat switch (operator on seat), 0539 series Wht wires, A01 display

panel ICC-J3 connector.
- The 562 series Red wire provides power through the S03 rear PTO switch (PTO on), 4574 Yel wire, and on to the A01 display panel ICC-J1 connector.

Once the inputs have been established, the operator may leave the seat, removing power from the seat switch input of the A01 display panel and engage the rear PTO inputting power from 4574 series Yel wire at the A01 display panel.

The rear PTO will remain engaged until the operator disengages the rear PTO, or unlocks the park brake, or engages the mid PTO, or places the key switch in either the OFF or START position.

It the operator returns to the seat, the rear PTO will remain engaged, however, the off seat PTO logic will be deactivated.



Flow Chart

LEGEND:

A	Off Seat PTO Logic Off
B	Mid PTO Off?
C	Park Brake Locked?
D	Operator on Seat?
E	Engine Crank Signal On?
F	Rear PTO Off?
G	Engine Cranked at Least Once?

H	Off Seat PTO Logic On?
I	Mid PTO Off?
J	Park Brake Locked?
K	Operator on Seat?
L	Engine Crank Signal On?
M	Off Seat PTO Logic Off
N	Yes
O	No

Charging Circuit Operation

Function

To maintain battery voltage between 12.4 and 13.2 volts.

Operating Conditions

- Key switch in RUN position.
- Engine running.

Theory of Operation

The charging system consists of the G02 alternator with an integrated voltage regulator/rectifier. Charging output is controlled by the regulator/rectifier. The status of the charge rate is indicated by the display panel discharge light.

With the key switch in the RUN position, battery sensing circuit current flows through the key switch to the alternator voltage regulator/rectifier over the 562F Red wire. (See Power Circuit Operation in Section 40, Group 30 for a description of the complete circuit to the battery positive terminal.) The battery sensing circuit allows the voltage regulator/rectifier to monitor battery voltage.

A rotating winding (field) in the alternator induces AC current in the alternator stator coils. The AC current flows to the voltage regulator/rectifier. The voltage regulator/rectifier converts AC current to DC current needed to charge the battery.

If battery voltage is low (sensed via the 562F Red wire), the regulator/rectifier allows DC current to flow to the battery to charge it through the battery charging circuit 0042 Red wire, Fuse F22, and 0062 Red wire. When the battery is fully charged, the voltage regulator/rectifier stops current flow to the battery.

If the alternator output current falls below system usage or is insufficient to maintain a preset voltage, the alternator/battery charging light illuminates on A01 display panel through 122 Red wires (terminals A—D on the ICC-JI connector) and the display panel circuit board.

The alternator is grounded through the mounting hardware to the engine.

If the voltage regulator is grounded to the alternator cover, the alternator produces unregulated amperage (maximum output).

Tachometer Circuit Operation

Function

To indicate engine rpm to the operator.

Operating Conditions

- Key switch in RUN position.
- Engine running.

Theory of Operation

The tachometer is integrated into the display panel and does not have any external wiring. The tachometer operates only when the engine is running. The tachometer uses engine sensors for a reference signal and then inputs this signal from the A09 engine control unit to the A01 display panel over the 9924A Yel and 9925A Grn series wires.

Hour Meter Circuit Operation

Function:

To indicate engine hours of use to the operator.

Operating Conditions:

- Key switch in run position.
- Engine running.

Theory of Operation:

The hour meter is integrated into the display panel and does not have any external wiring. The hour meter operates only when the engine is running. The hour meter uses the engine tachometer circuit to indicate that the engine is running. If the tachometer is not functioning, the hour meter will not work.

Speedometer Circuit Operation

Function:

To indicate ground speed of the machine.

Operating Conditions:

- Key switch in run position.
- Engine running with machine in motion.

Theory of Operation:

The speedometer is integrated into the display panel and does not have any external wiring. The speedometer operates only when the engine is running and the machine is in motion. The speedometer uses the B33 MFWD speed sensor for a reference signal to indicate machine ground speed and inputs this signal to the A01 display panel over the 9924 Yel and 9925 Grn series wires.

Fuel Gauge Circuit Operation

Function:

Inform the operator of the approximate fuel level in the fuel tank.

Operating Condition:

The key switch must be in run or start position.

Theory of Operation:

The fuel level in the fuel tank is measured by the B01 fuel gauge sensor. The sensor is a variable resistor. The resistance is set by movement of a float in the fuel tank. The variable resistance creates a variable voltage difference across the fuel gauge. The voltage difference ranges from approximately 3.65—3.85 VDC (fuel tank full) to approximately 1.0 VDC (fuel tank empty). The fuel gauge is part of the display panel.

Rear and Mid PTO Circuit Operation

Rear PTO Function

To engage the rear PTO and illuminate the rear PTO light on the display panel to alert the operator that the rear PTO is activated.

Operating Conditions

- Key switch in RUN or START position.
- Operator on seat, or off-seat PTO logic activated.
- PTO selector lever at REARWARD position.
- Rear PTO switch in ON position.

Rear PTO Theory of Operation:

The rear PTO circuit is controlled by the A1 display panel based upon “IF” “THEN” logic. If the operating conditions are met, then the display panel will supply an output signal to the Y03 rear PTO solenoid.

Unswitched power is supplied to the A1 display panel at terminals A thru D (122 series of Red wires) on the ICC-J1 display connector. When the key switch is in the RUN or START position, switched power is supplied to the A1 display panel at terminal F (562 Red wire) on the ICC-J1 connector, powering up the display panel. For more information, see Power Circuit Operation in Section 40, Group 30.

A ground circuit path for the display panel is provided to terminal M (0050 Blk wire) on the ICC-J1 connector. The 0050 Blk wire connect to frame ground.

The S48 rear PTO switch is used as an interlock in the fuel supply circuit and in the cranking circuit, as well as engaging the rear PTO. The display panel contains control logic that determines the switch status by the input it receives from the rear PTO switch.

For operation of the fuel supply circuit and how the PTO circuit interacts, see Fuel Supply/Engine Shutoff Circuit Operation in Section 40, Group 30.

For operation of the cranking circuit and how the PTO circuit interacts, see Cranking Circuit Operation in Section 40, Group 30.

For PTO operation with operator on seat, the display panel will supply an output through the 4747 Pur wire to energize the Y03 rear PTO solenoid when it detects the following inputs:

- Battery voltage at terminal K (0539A Wht wire) on ICC-J3 connector from S38 seat switch (ON position).
- Battery voltage at terminal F (4777C Pur wire) on ICC-J4 connector from S48 rear PTO sense switch (ON position).
- Battery voltage at terminal B (4687 Pur wire) on ICC-J3 connector from S49 mid PTO sense switch (OFF position).
- Input signal at terminal B (9924A Yel wire) on ICC-J2 connector from transmission control unit (TCU) indicating engine is running.
- Battery voltage at terminal H (4574 Yel wire) on ICC-J1 connector from S03 rear PTO switch (ON position).

When the key switch is in the START or RUN position, battery voltage is provided to terminals 1 and 3 of the S03 rear PTO switch through the S1 key switch, 072 Red wire, F5 fuse, and 562 series of 562 Red wires.

When the S03 rear PTO switch is in the ON position, the contacts between terminals 1 and 4 are closed, allowing current to flow from the 0562 Red wire, through the 4574 Yel wire, to terminal H on the ICC-J1 connector of the display panel. If the operator is on the seat or if the off-seat PTO logic is activated, the display panel provides current to the fuel supply circuit. For off-seat PTO logic operation, see Fuel Supply/Engine Shutoff Circuit Operation in Section 40, Group 30.

When the logic inside the display panel determines that all requirements for rear PTO operation are met, the display panel sends current through the 4747 Pur wire to the Y03 rear PTO solenoid, energizing the solenoid.

The ground circuit for the rear PTO solenoid is provided though the 0010 Blk wire to the W01 ground circuit.

The energized rear PTO solenoid engages the rear PTO. For hydraulic operation of the PTO, see PTO Clutch Operation in Section 80, Group 20.

For the rear PTO to operate, the PTO selector lever must be in the REARWARD position (rear PTO operation only) or in the CENTER position (rear and mid PTO operation).

For mechanical operation of the PTO, see Range Transmission Power Flow in Section 60, Group 20).

With the PTO selector lever in either the REARWARD or CENTER positions, the S48 rear PTO sense switch is closed, allowing current to flow from the F5 fuse, through the 562 series of Red wires, the S48 rear PTO sense switch, and the 4777 Pur wire, to terminal F on the ICC-J4 connector of the A01 display panel. When current is detected at terminal F on the ICC-J4 connector and all other required inputs are met, the logic in the display panel will illuminate the rear PTO indicator light on the display panel.

→NOTE:

If PTO lever is at the CENTER position (rear and mid PTO operation), operator must be on the seat for the PTO to operate.

Mid PTO Function

To engage the mid PTO and illuminate a light on the display panel to alert the operator that the mid PTO is on.

Operating Conditions

- Key switch in RUN or START position.
- Operator on seat, or off-seat PTO logic activated.
- PTO selector lever at FORWARD position.
- Rear PTO switch in ON position.

Mid PTO Theory of Operation:

The S03 rear PTO switch and S49 mid PTO sense switch are used as interlocks to the fuel supply circuit.

When in the OFF (normally closed) position, the S49 mid PTO sense switch supplies current to the A01 display panel. If the mid PTO is activated and the operator leaves the seat, the logic in the display panel will remove current from the fuel supply circuit, stopping the engine. For more information, see Fuel Supply/Engine Shutoff Circuit Operation in Section 40, Group 30.

When the key switch is in the RUN or START position, battery voltage is provided to the S49 mid PTO sense switch through the S1 key switch, 072 Red wire, F5 fuse, and 0562 series of Red wires. When the PTO selector lever is at the REARWARD position (rear PTO operation only), S49 mid PTO sense switch is closed, allowing current to flow through the 4687 Pur wire to terminal B on the ICC-J3 connector of the A01 display panel. When an input is detected at terminal B on the ICC-J3 connector, the logic in the display panel determines that only the rear PTO is being requested.

For the mid PTO to operate, the following conditions must be met:

- S03 rear PTO switch in the ON position.
- S38 seat switch closed (operator on seat).
- PTO selector lever in the FORWARD position (mid PTO operation only) or in the CENTER position (rear and mid PTO operation).

For mechanical operation of the PTO, see Range Transmission Power Flow in Section 60, Group 20).

With the PTO selector lever in either the FORWARD or CENTER position, the normally closed S49 mid PTO sense switch is open, preventing current from flowing to terminal B on the ICC-J3 connector of the A01 display panel. When the display panel does not detect an input at terminal B on the ICC-J3 connector, the logic in the display panel determines that the mid PTO is being requested. When all other required inputs are met, the display panel illuminates the mid PTO indicator light.

The display panel checks for the proper inputs from the other switches. If the seat switch is closed (operator on seat) and machine is not in reverse, then the display panel will continue to provide an output to the hold-in coil of the fuel shutoff solenoid. If the operator is off the seat or reverse travel direction is selected, the display panel removes power to the hold-in coil of fuel shutoff solenoid, stopping the engine.

→NOTE:

If the machine is equipped with the optional RIO function, the mid PTO can be operated with machine in reverse if the RIO function is activated.

A ground circuit path for the display panel is provided to terminal M (0050 Blk wire) on the ICC-J1 connector to the W01 ground circuit.

Reverse Implement Option (RIO) Theory of Operation:

The RIO position of the PTO switch allows the operator to operate a mid mount implement while the tractor is traveling in the reverse direction. This function must be selected before each time the tractor is placed in reverse. When in reverse, the RIO function will stay enabled until machine is returned to neutral.

When the S03 rear PTO switch is momentarily pulled to the RIO position, current from the 562 series Red wires is supplied across the rear PTO switch (terminals 3 and 6), through the 4573 Org wire, to terminal E on the ICC-J3 connector of the A01 display panel.

When logic inside the display panel determines that all required inputs are met, the display panel will allow the mid PTO to operate while tractor is traveling in reverse direction.

Rear and Mid PTO Theory of Operation:

The rear PTO can be engaged simultaneously with the mid PTO, but only when the operator is on the seat.

When both PTOs are selected (PTO selector lever in the CENTER position), the display panel will energize the Y03 rear PTO solenoid and illuminate both the rear and mid PTO indicator lights when the display panel detects the following inputs:

- Battery voltage at terminal L (539A Wht wire) on ICC-J3 connector from S38 seat switch closed.
- Battery voltage at terminal H on ICC-J1 connector (4574 Yel wire) (S03 rear PTO switch in ON position).
- Battery voltage at terminal F on ICC-J4 connector (4777 Pur wire) (S48 rear PTO sense switch is closed).
- No signal at terminal B on ICC-J3 connector (4687 Pur wire) (S49 mid PTO sense switch is open).

The PTO indicator lights will flash or remain on constantly depending PTO selection combinations as shown in following table.

PTO Indicator Light Display Combinations:

PTO Indicator Light Display Combinations

S03 Rear PTO Switch Position	PTO Selector Lever Position (Operator Intent)	S03, S48, and S49 Switch Status	B+ Input	Rear PTO Indicator Light Status	Mid PTO Indicator Light Status
ON	Rearward (Rear PTO ON)	S03 closed (terminals 1—4)	Yes	Solid ON	OFF
		S48 closed	Yes		
		S49 closed	Yes		
ON	Forward (Mid PTO ON)	S03 closed (terminals 1—4)	Yes	OFF	Solid ON
		S48 open	No		
		S49 open	No		
ON	Center (Rear and Mid PTO ON)	S03 closed (terminals 1—4)	Yes	Solid ON	Solid ON
		S48 closed	Yes		
		S49 open	No		
RIO	Center (RIO PTO ON)	S03 closed (terminals 1—4 and 3—6)	Yes	FLASHING	FLASHING
		S48 closed	Yes		
		S49 open	No		
RIO	Forward (RIO PTO ON)	S03 closed (terminals 1—4 and 3—6)	Yes	OFF	FLASHING
		S48 open	No		
		S49 open	No		
OFF	Any lever position (All PTOs OFF)	S03 open (terminals 1—4 and 3—6)	No	OFF	OFF
		S48 —	—		
		S49 —	—		

MFWD Circuit Operation

Function

To illuminate a light on the display panel to alert the operator that the MFWD is engaged.

Operating Conditions

- Key switch in RUN position.
- MFWD lever in the engaged position, MFWD engagement sensing switch on.

Theory of Operation

The MFWD function is a mechanical system that uses a ball switch to turn a light on or off on the display panel to alert the operator that the MFWD is engaged.

With the key switch in START or RUN position, battery voltage is provided to the MFWD engagement sensing switch through the

S1 key switch, 072 Red wire, F5 fuse, and 562 series of Red wires to the S40 MFWD engagement sensing switch.

When the MFWD lever is pulled up to the engaged position, the ball of the switch is pushed in to close the contacts inside the switch. With the switch contacts closed, current flows across the MFWD engagement sensing switch to the 4555 Grn wire and ICC-J4 connector of the A01 display panel to illuminate the MFWD indicator light.

A ground circuit for the display panel is provided though the ICC-J1 connector 0050 Blk wire which is then spliced into the W01 ground circuit.

Light Circuit Operation

Function

Provides current to the headlights, tail lights, hazard lights, turn lights, and work lights in combinations depending upon the position the light switch is placed in.

Operating Conditions

- Light switch in either hazard, road, or work position.

Theory of Operation

Power for the light switch is unswitched and provided through the 0132A Red wire to the F16 Light switch fuse, 002E and 002J Red wires, F21 in-line fuse, 0062 Red wire and to the battery cable.

Light Switch Hazard Position

Pressing the hazard switch on, voltage is provided from the S02 Dash Panel Module through the 1103 Org wire to the ICC-J2 Pin (C) of the A01 display panel.

From the display panel, intermittent voltage is provided to both the 1135A and 1145A Grn wires. The 1135A Grn wire provides intermittent current to the right hazard light, while the 1145A Grn wire provides intermittent current to the left hazard light.

If the output from the display panel to the hazard lights is faulty for some reason, a fault code will appear on the display panel.

Err64 and Err65 indicate a fault on the right hazard light.

Err66 and Err67 indicate a fault on the left hazard light.

Err64 (right) and Err66 (left) indicate a short to ground. Check the 135 and 145 Grn wires for a pinch to the frame or other ground wire, or corrosion causing a short to the frame or other ground wires.

Err65 (right) and Err67 (left) indicate a short to battery voltage or open circuit on 135 and 145 Grn wires. Check for a defective bulb, a broken wire to or from the hazard lights, or the 135 or 145 Grn wire shorted to a wire with battery voltage present.

The ground path for the left rear hazard light is provided by 010AK and 010AJ Blk wires, and the ground path for the right rear hazard light is provided by the 010AJ Blk wire.

Light Switch Road Position

Voltage is provided from the S02 Dash Panel Module through the 1138A Gry wire to the splice to the F7 Taillight fuse and F8 Headlights fuse. The 1138C Gry wire is protected by the F7 Taillights fuse and the F8 Headlights fuse provides voltage to the headlghts through the 1119C Wht wire to the X07-W1/X07-W4 Interconnect, and the 1119D Wht wire to the X03-W5/X03-W4 Interconnect, to the 1119E Wht wire to the splice and the 1119B Wht wire connects to the right headlight, and the 1119A Wht wire connects to the left headlight.

The ground path for the headlights is provided by the 010 Blk series of wires to the W2 ground circuit.

The 1138C Gry wire is protected by the F7 Taillights fuse that provides voltage to the tail lights through the 1118A gry wire, to the splice, to 1118C and 1118D gry wires. The 1118C Gry wire connects to the E03 Left Position Light, and the 1118D Gry wire connects to the E04 Right Position Light.

Ground for the E3 LH tail light is provided by the 010AB Blk wire to the W2 ground circuit. Ground for the E4 RH tail light is provided by the 010AA Blk wire and W2 ground circuit.

Light Switch Work Position

Voltage is provided from the S02 Dash Panel Module through the 1137 Pur wire to the F6 Worklight fuse, to the 1147A Pur wire to the splice, and then to the 1147C and 1147D Pur wires. The 1147C Pur wire connects to the E06 Right Work Light, and the 1147D Pur wire to the E05 Left Work Light.

Turn Signal Switch Function

Provides intermittent current to the turn signal lights and hazard lights.

Operating Conditions

- Key switch in the RUN position.
- Press the left turn light signal.

- Press the right turn light signal.

Theory of Operation

Power for the light switch is unswitched and provided through the 0132A Red wire to the F16 Light switch fuse, 002E and 002J Red wires, F21 in-line fuse, 0062 Red wire and to the battery cable..

Turn Signal Switch Left Position

With the left turn signal switch pressed on, constant power is provided to the 1115A Grn wire to the ICC-J1 Pin (K) of the A01 Display Panel.

The left turn signal indicator lights on the display panel will be illuminated. The left turn indicator light will flash with the turn signal and hazard light, while the right indicator light will illuminate with constant power.

If the intermittent output from the display panel to the turn signal light and the hazard light is faulty for some reason, a fault code will appear on the display panel.

Err62 and Err63 indicate a fault on the left turn signal light.

Err66 and Err67 indicate a fault on the left hazard light.

Err62 (turn signal) and Err66 (hazard) indicate a short to ground. Check the 133 Org and 145 Grn wires for a pinch to the frame or other ground wire, or corrosion causing a short to the frame or other ground wires.

Err63 (turn signal) and Err67 (hazard) indicate a short to battery voltage or an open circuit on the 133 Org and 145 Grn wires. Check for a defective bulb, a broken wire to or from the turn signal light or hazard lights, or the 133 Org or 145 Grn wires shorted to a wire with battery voltage present.

Turn Signal Switch Right Position

With the right turn signal switch pressed on, constant power is provided to the 1125 Grn to the ICC-J1 Pin (L) of the A01 Display Panel.

The right turn signal indicator light on the display panel will be illuminated. The right turn indicator light will flash with the turn signal and hazard light, while the left indicator light will illuminate with constant power.

If the intermittent output from the display panel to the turn signal light and the hazard light is faulty for some reason, a fault code will appear on the display panel.

Err60 and Err61 indicate a fault on the right turn signal light.

Err64 and Err65 indicate a fault on the right hazard light.

Err60 (turn signal) and Err64 (hazard) indicate a short to ground. Check the 143 Org and 135 Grn wires for a pinch to the frame or other ground wire, or corrosion causing a short to the frame or other ground wires.

Err61 (turn signal) and Err65 (hazard) indicate a short to battery voltage or an open circuit on the 143 Org and 135 Grn wires . Check for a defective bulb, a broken wire to or from the turn signal light or hazard lights, or the 143 Org or 135 Grn shorted to a wire with battery voltage present.

Dome Light Function

Provides current for the dome light in either the always on or the on with the door open positions.

Operating Conditions

- Key switch in any position.
- S25 dome light switch in either the on or the on with door open position.

Theory of Operation

The S25 dome light switch has three positions:

- Always off
- Always on
- On with the S24 door switch closed (door open)

Unswitched power is delivered to the E15 dome light by the 092B and 082B Red wires. With the S25 dome light switch in the always on position, a path to ground is provided by the 010 An and 010 AP Blk wires to the X27 connector and 010K and 010B Blk wires to the W3 cab ground.

In the on with door open position, the path ground is provided by the Yel wire to the X27 connector, 255 Grn wire, through the closed S24 door switch to the 010P and 010B Blk wires to the W3 cab ground.

Beacon Light Function (Option)

Provides current for the beacon light and motor circuit.

Beacon Light Operating Conditions (Option)

- Key switch in any position.

Beacon Light Theory of Operation (Option)

With the S16 beacon lamp switch in the on position, voltage leaves the switch over the 1163A Org wire. This splices into the 1163D Org wire, which feeds back into the S16 beacon lamp switch. This circuit provides power for the indicator light on the beacon lamp switch. This circuit is grounded by the 010AF Blk wire to the W2 lower cab ground circuit. The 1163A Org wire, leading to the X52-W8 connector to the W3 upper cab wiring harness. The 1163 Org wire then leaves the X17 connector and goes to the X21 beacon lamp connector. The beacon lamp and motor are grounded to the machine cab by an internal connection. This will cause the lamp to illuminate and the reflector will rotate.

HVAC Circuit Operation

Function:

Provides power and system safety interlocks for the heating, ventilation, and air conditioning circuits.

Operating Conditions:

Key switch in the run position.

Theory of Operation:

The HVAC control circuits consist of unswitched high current and switched low current circuits. The 052 Red series wires provide the unswitched voltage and the 272 Red series wires provide the switched voltage.

Blower Low Speed Operation:

Unswitched power is provided to the K9 fan speed/right blower relay over the 052C Red wire at terminal 30. Switched power is provided to the K9 relay at terminal 86 by the 272J Red wire. This will close the relay contacts as the relay’s coil is grounded by the 010CH and 010AE Blk wires to the W01 ground. Power will then flow out of the relay over the 282C Red wire and splice into the 282A Red wire to the S28 blower switch.

With the S28 blower switch in the low position, current exits the switch over the 227B Pur wire and a splice distributes the power to the M07 leftt blower motor over the 227D Pur wire and to the M08 right blower motor over the 227E Pur wire. Fan speed is controlled by a current limiting resistor and protected by a thermal fuse. The 010CG and 010AE Blk wires ground the right motor and the 010CF and 010CR Blk wires ground the left motor. Both grounds feed into the W9 upper cab ground circuit.

With the S28 blower switch in the medium position, current exits the switch over the 221A Brn wire and a splice distributes the power to the M07 left blower motor over the 221C Brn wire and to the M08 right blower motor over the 221B Brn wire. Fan speed is controlled by a current limiting resistor and protected by a thermal fuse.

Blower High Speed Operation:

- The K9 fan speed/right blower relay provides high current to the K11 right hi-speed control relay.
- The K10 left blower relay provides high current to the K12 left hi-speed control relay.

Unswitched power is provided to the K10 left blower relay over the 062B Red wire at terminal 30. Switched power is provided to the K10 relay at terminal 86 by the 272K Red wire. This will close the relay contacts as the relay’s coil is grounded by the 010CJ, 010CH, and 010AE Blk wires to the W01 ground. Power will then flow out of the relay over the 292A Red wire to terminal 30 of the K12 left hi-speed control relay.

Power is also present at the K11 right hi-speed relay at terminal 30, via the 282B Red wire controlled by the K9 fan speed/right blower relay.

When the S28 blower switch is placed in the high position, current exits the switch over the over the 225A Grn wire and a splice distributes the power to the K11 relay (terminal 86) over the 225C Grn wire and to the K812 relay (terminal 86) over the 225B Grn wire.

The 010 Blk series of wires lead to the W01 ground and will cause the K11 and K12 relay coils to close the relay contacts. This will cause high current to flow from the K11 relay to the M07 left blower motor over the 213B Pur wire. Also, current will flow from the K812 relay to the M08 right blower motor over the 213A Org wire. Fan speed is controlled by a current limiting resistor and protected by a thermal fuse.

If the S28 blower switch is placed in any other position, power will be removed from the K11 and K12 relays and their respective contacts will open.

Air Conditioning Operation:

The air conditioning circuit consists of interlocks and switches wired in series where if one fails or parameters aren’t met, the air conditioning system will not function.

The S28 blower switch must be in any position other than the off position. This will cause an output over the 227B pur wire to a splice, and then to the S29 HVAC switch over the 227C Pur wire.

With the S29 HVAC switch in the closed position, voltage then flows to the S22 temperature sensor over the 214 Yel wire. With the temperature sensor in a closed state (temperature dependent), current will then flow to the S23 hi/lo pressure switch. If the refrigerant pressure is within specification (switch closed), voltage will exit the switch over the 216B Blu wire.

The 216B Blu wire passes through the X52 connector and provides power to the compressor clutch. The clutch is grounded to the engine by a jumper wire. The compressor will switch between the on and off states depending on input from the S22 temperature sensor.

Wiper and Washer Circuit Operation

Function

To provide power and control for the wiper and washer circuits.

Operating Conditions

- Key switch in on position.

Theory of Operation, Front Wiper and Washer

With the S20 front wiper switch in the wiper position, voltage leaves the switch over the 2226 Blu wire to the M03 front wiper motor. Ground is provided for the motor by the 0010CN Blk wire screwed to chassis ground.

With the S20 front wiper switch in the wash position, voltage leaves the switch over the 2227 and 2227A Pur wire to the M05 front washer pump motor. Ground for the pump motor is provided by the 00010AB Blk wire to W01 ground.

Theory of Operation, Rear Wiper and Washer (Option)

With the S21 rear wiper switch in the wiper position, voltage leaves the switch over the 2244A Yel wire to the X52-W8 connector to the W9 upper cab wiring harness. The 244B Yel wire then leaves the X52-W9 connector and goes to the M09 rear wiper motor. The motor is grounded by the 010CE Blk wires to the W01 ground.

With the S21 rear wiper switch in the wash position, voltage leaves the switch over the 2239 and 2239A Wht wire to the M04 rear washer pump motor. The pump motor is grounded by the 0010AA Blk wire to the W01 ground circuit.

Radio Circuit Operation

Function

Provides power for the radio and clock circuits.

Operating Conditions

- Key switch in the run position for the radio to function.
- The clock will maintain time but no display will be visible with the key switch in the off position.

Theory of Operation

Unswitched power is provided to the A02 radio by the 052D Red wire to supply constant power to maintain the correct time on the clock.

Three switched power circuits feed the radio as its power requirements vary with the function selected and volume. The 157F Pur wire splices into the 157 series wires. The 272L and 272M Red wires splice from the 272 Red series of wires. These will supply power to the A02 radio whenever the key switch is in the run position.

The system has one left speaker and one right speaker. Each speaker has its own ground circuit to the A02 radio.

Ground for the radio and clock is provided by the 230A Blk wire.

Display Panel LCD Message

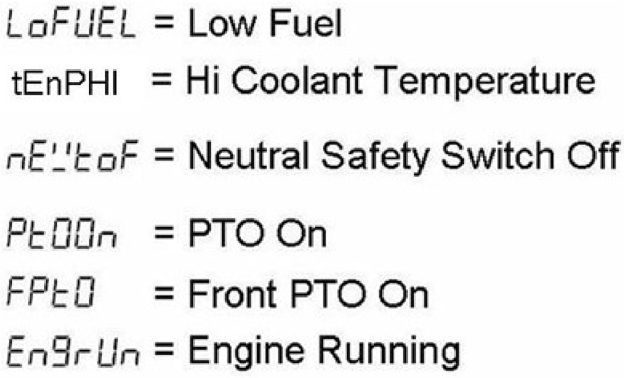
- Specific messages are displayed on the liquid crystal display (LCD) for machine operation.

LEGEND:

A LCD Display

LCD Display

- Instrument Panel LCD Display Messages



LCD Display Messages

LCD Display Messages

Representation of the Message Displayed	Description of the Message
LoFUEL	The fuel gauge needle has gone into the red zone. Appears only once during the power cycle.
tEnPHI	The coolant temperature needle has gone into the red zone. Appears only once during the power cycle.
nEUtoF	Gear Tractors - The operator is out of the seat and the transmission is in gear. HST Tractors - The neutral wire jumper cap located under the left foot deck has been removed or is loose.
PtOOn	The operator is not in the seat, the park brake was not set, and the PTO switch is on.
FPtO	The operator is not in the seat and the front PTO switch is on. (EEC only)
EnGrUn	The engine is already running and there is an attempt to start the engine.

Dash Panel Module Circuit Operation

Function

→NOTE:

See vehicle’s operating manual (OM) for instrument panel operation.

To roll the LCD display between displaying speedometer, hour meter, PTO hour, PTO speed, soot levels, regen information, and diagnostic trouble code when error is active.

This switch is also used to enter the configuration mode of the display panel to configure the display to the machine and options installed.

Operating Conditions

- Key switch in run or start position

Theory of Operation

The S02 dash panel module is used to change the display messages in the LCD and to change the configuration setting of the display panel.

The turn signal buttons are used to change and enter information when the display mode button is pressed.

Switched power is supplied from the key switch, 0072 Red wire, F5 fuse, 562 Red series of wires to the dash panel module. Fused power is supplied from F16 through the 132 Red series of wires at terminals A and B. The S02 dash panel module receives all pertinent engine information from the A09 engine control unit (ECU) through 5412 Red and 5437 Pur wires at terminals F and M.

Forward Drive Circuit Operation

Function

The forward drive circuit causes the TCU to propel the machine in a controlled forward direction.

Additionally the TCU provides for setting the following functions during a forward drive:

- Maximum travel speed.
- Cruise control.
- Motionmatch (pedal responsiveness) (option).
- LoadMatch.

Each of these additional functions has the ability to be turned on or off by the operator.

Operating Conditions

- Key switch in run position.
- Engine running.
- Operator on seat.
- Park brake unlocked.
- Forward pedal depressed.

Theory of Operation

The TCU is a pre-programmed electrical device that allows the operator to control the machine forward drive function and speed via the electrical inputs from the forward foot pedal. Under normal operating conditions, this creates an output to the forward proportional solenoid in the transmission.

Current is supplied to the TCU from the unswitched and switched power circuits.

Unswitched power to the TCU is supplied from the battery, to the M01 Starting Motor, to the 0062 Red wire, F21 In-line fuse, 0002J Red wire, splice, 0002H Red wire, F19 TCU fuse, 0142 Red wire to the TCU.

With the key switch in the run or accessory position, switched power is supplied from the S01 Key Switch to 0472A Red wire, F14 ELX fuse, 4472 Red wire to the TCU. This switch is powered off when the S01 Key Switch is in the start position.

These circuits power the TCU to allow for drive control operation. The 4673A Org wire splices to the 46773G, 4673K, 4673L, 4673M, 4673N Org wires to provide current from the TCU to the P01 Forward Pedal Sensor, and the P02 Reverse Pedal Sensor.

When the forward pedal is pressed, the P01 forward pedal sensor rotates and sends voltage back to the TCU through the 4014A Yel wire. The TCU then processes the voltage from this input command into an output command if the proper operating conditions exist. The output command (current) to the forward proportional solenoid is proportional to the pedal position.

The proper conditions for a forward function will be:

- 12.0 volt input on 0142 Red wire, power on.
- 12.0 volt input on wire 0539C Wht wire, operator on seat.
- 5.0 volt output on wire 4673A Org wire, sensor power.
- Continuity to ground on 0050H Blk wire, sensor ground.
- Continuity to ground on 0550A Blk wire, HST controller ground.
- Voltage input on the 4014A Yel wire and 4625A Grn wire, forward pedal pressed.

With the proper commands, the A2 HST controller will ramp the output to the forward proportional solenoid to allow the machine to travel forward at a speed proportional to the position of the forward pedal, based upon the engine rpm and the range gear selected.

If at any time during the drive function the HST controller detects a problem with any of the input or output commands, the HST controller will provide output current on 924 Yel series wires to the display panel. The LCD on the display panel will then display a fault code.

Reverse Drive Circuit Operation

Function

The reverse drive circuit causes the TCU to propel the machine in a controlled reverse direction.

Additionally, the TCU provides for setting the following functions during a reverse drive:

- Maximum travel speed,
- MotionMatch (pedal responsiveness) (option).
- LoadMatch.

Each of these additional functions has the ability to be turned on or off by the operator.

Operating Conditions

- Key switch in run position,
- Engine running,
- Operator on seat, and
- Park brake unlocked.
- Reverse pedal depressed.

Theory of Operation

The TCU is a pre-programmed electrical device that allows the operator to control the machine forward drive function and speed via the electrical inputs from the forward foot pedal. Under normal operating conditions, this creates an output to the forward proportional solenoid in the transmission

Current is supplied to the TCU from the unswitched and switched power circuits

Unswitched power to the TCU is supplied from the battery, to the M01 Starting Motor, to the 0062 Red wire, F21 In-line fuse, 0002J Red wire, splice, 0002H Red wire, F19 TCU fuse, 0142 Red wire to the TCU.

With the key switch in the run or accessory position, switched power is supplied from the S01 Key Switch to 0472A Red wire, F14 ELX fuse, 4472 Red wire to the TCU. This switch is powered off when the S01 Key Switch is in the start position.

These circuits power the TCU to allow for drive control operation. The 4673A Org wire splices to the 46773G, 4673K, 4673L, 4673M, 4673N Org wires to provide current from the TCU to the P01 Forward Pedal Sensor, and the P02 Reverse Pedal Sensor..

When the reverse pedal is pressed, the reverse pedal sensor rotates and sends voltage back to the TCU through the 4677A Pur wire. The TCU then counts and processes the voltage from this input command into an output command if the proper operating conditions exist. The output command (current) to the reverse proportional solenoid is proportional to the pedal position.

The proper conditions for a reverse function will be:

- 12.0 volt input on wire 552N Red wire, power on.
- 12.0 volt input on wire 539C Wht wire, operator on seat.
- 5.0 volt output on wire 673B Org wire, sensor power.
- Continuity to ground on 550N Blk wire, sensor ground.
- Continuity to ground on 050P Blk wire, HST controller ground.
- Voltage input on the 4677A Pur wire and 4166A Blu wire, reverse pedal pressed.

With the proper commands, the drive controller will ramp the output to the reverse proportional solenoid to allow the machine to travel reverse at a speed proportional to the position of the reverse pedal, based upon the engine rpm and the range gear selected.

If at any time during the drive function the drive controller detects a problem with any of the input or output commands, the drive controller will provide output current on wire 924 Yel series wires to the display panel. The LCD on the display panel will then display a fault code.

Cruise Control Module Circuit Operation

The cruise control module contains the Cruise Control, LoadMatch ™ , MotionMatch ™ , SpeedMatch ™ and eThrottle functions.

Cruise Control Function

To control the machine forward drive speed at a constant speed that can be repeated without having to hold the forward drive pedal at that speed.

Operating Conditions

- Key switch in run position.
- Engine running.
- Operator on seat.
- Park brake unlocked.
- Cruise switch on.
- Right brake pedal not depressed.
- Forward pedal pressed to desired speed while setting the drive speed.
- Set/- switch pressed momentarily when the desired drive speed is attained.

The cruise control will remain engaged until the right brake is depressed, the key switch is turned to the off position, the reverse pedal is depressed, or the cruise control switch is placed in the off position.

Theory of Operation

The cruise control uses the engine control unit (ECU) and transmission control unit (TCU) to allow the operator to set and hold a forward drive speed setting that the operator desires without having to press and hold the forward pedal.

The cruise control circuit uses the P01 forward pedal sensor, G2 alternator, ECU, and the B33 MFWD speed sensor to provide input to the TCU. The TCU then process these inputs to provide output current to the Y05 forward proportional solenoid.

Placing the cruise control switch in the on position enables the cruise control function. Momentarily pressing the Set/- switch will then set the cruise speed at the speed being traveled.

Once set, the TCU monitors the machine speed and varies the current to the forward proportional solenoid to maintain travel speed at the set point.

Switched power is provided to the cruise control module from the S01 key switch, 0212 Red wire, K05 Relay, 0312D Red wire, splice, 0312A Red wire, F9 fuse, 552A, splice, 0552C Red wire, splice, 0552W Red wire to the cruise control module connector.

Unswitched power is provided to the cruise control module from the battery cable, 0062 Red wire, F21 inline fuse, 0002A Red wire, X50 wiring harness interconnect, 0002B Red wire, splice, 0002M Red wire, F16 fuse, 0132A red wire, splice, 0132G Red wire to the J terminal on the cruise control module powering the cruise control Res/+ switch and the cruise control Set/- switch.

The next input signal needed to activate the cruise circuit is an input from the P01 forward pedal sensor. When the P01 forward pedal sensor recieves a input, 4014A Yel wire and 4625A Grn send an output to the TCU. Logic in the TCU sends an output to 4696A Blu wire, X50 wiring harness connector, 4696 Blu wire, Y05 forward proportional solenoid which in turn causes the machine to move forward.

Once the machine is traveling at the desired speed, momentarily pressing the Set/- switch to the Set/- position supplies power from the 0132G Red wire across the switch to the 4265 Grn wire to the TCU. This input will set the cruise speed at the speed being traveled.

At the moment the Set/- switch is pressed, the TCU records the inputs from the forward pedal sensor, alternator, ECU, and the B33 MFWD speed sensor. The drive controller then supplies an output current to the forward proportional solenoid to maintain the speed recorded at the B33 MFWD speed sensor.

The cruise speed setting can be increased and decreased while the machine is being driven by momentarily pressing either the Res/+ switch to increase the cruise speed or the Set/- switch to decrease the cruise speed setting.

Pressing Res/+ or Set/- position of the switch to change the cruise speed setting will become effective immediately without returning to neutral. The increase/decrease amount is a percentage of the actual machine speed.

Pressing the Res/+ side of the switch supplies power from the 0132G Red wire across the switch to the 4266 Blu wire to the TCU. Pressing the Set/- side of the switch supplies power from the 0132G Red wire across the switch to the 4265 Grn wire to the TCU.

Pressing either the left brake or reverse pedal will disengage the cruise function. The last speed setting is stored in the TCU and if the operator is pressing the forward pedal, the Res/+ switch can be pressed momentarily to ramp back to the stored speed. Turning the cruise switch off will disengage the cruise function and erase the stored setting.

If changes in machine loading or range gear position settings do not allow for return to the previous speed setting, the TCU will attempt to return to the speed setting by sending either the maximum (fastest speed possible) or minimum (slowest speed possible) current to the Y05 forward proportional solenoid. If the machine is driving either up or down a grade, the TCU will increase or decrease the output current to the Y05 forward proportional solenoid to maintain the speed at the B33 MFWD speed sensor. If the operator changes the throttle position, the TCU will again vary the output to the forward proportional solenoid to maintain the drive speed at the MFWD speed sensor.

LoadMatch Function

To prevent the engine from stalling during heavy loading situations.

Operating Condition

- Key switch in run position.
- Engine running.
- Operator on seat.
- Park brake unlocked.
- LoadMatch switch in the on position.
- Machine being driven either forward or reverse.

Theory of Operation

LoadMatch is used to eliminate operators stalling the engine during a typical application such as loader work. The ECU reads the no-load engine rpm set point.

If the engine rpm drops far enough below the set point value, the current sent to the transmission drive valve coils is reduced to allow the engine to recover. The greater the load on the engine, the greater the reduction in current.

If cruise control is active and the LoadMatch comes on, the cruise speed output is held at whatever speed it is currently operating at until LoadMatch goes back to 100%.

The LoadMatch switch can be turned on or off to allow the operator to disable the LoadMatch function if desired.

The LoadMatch feature will have no effect if the machine is not being driven when the stalling load is being placed on the engine.

Switched power is provided to the cruise control module from the S01 key switch, 0212 Red wire, K05 Relay, 0312D Red wire, splice, 0312A Red wire, F9 fuse, 552A, splice, 0552C Red wire, splice, 0552W Red wire to the cruise control module connector.

When the LoadMatch switch is in the on position, power is supplied from the 552W Red wire, across the LoadMatch switch to the 4268 Gry wire to the TCU. This enables the LoadMatch function, controlled by the TCU, to prevent the engine stalling during heavy load applications.

MotionMatch Function

To allow the operator to change how quickly the pedals respond to being pressed or released.

Operating Conditions

- Key switch in run position.
- Engine running.
- Operator on seat.
- Park brake unlocked.
- MotionMatch switch in the on position.
- Machine being driven either forward or reverse.

Theory of Operation

MotionMatch enables the operator to adjust machine acceleration and deceleration rates.

The rate of acceleration and deceleration is controlled by the TCU to smoothly ramp the speed up and down. Two different settings provide for either quicker or slower acceleration or deceleration. The change in this setting will take effect as soon as the switch is changed.

Placing the MotionMatch switch in the right position will give the transmission higher response sensitivity to drive pedal movement. Shorter starting and stopping distances can be set for applications requiring rapid changes in direction, such as operating with a loader.

Placing the MotionMatch switch in the left position will give the transmission lower response sensitivity to drive pedal movement. Longer starting and stopping distances can be set to avoid turf damage in other applications.

Placing the MotionMatch switch in the center position will give the drive pedals the sensitivity that is typical to most normal operating conditions.

With the key switch in the run position, current is supplied from the TCU to 4673A Org wire, splice, 4673B Org wire to the K terminal on the S46 connector. This circuit powers the TCU to allow for drive control operation.

The MotionMatch switch receives secondary switched power from the TCU on 4673A Org wire.

When the MotionMatch switch is in the on position, power is supplied from the 4673B Org wire, across the MotionMatch switch to the 4269 Wht series wires to the drive controller. This enables the MotionMatch function for quicker acceleration and deceleration rates.

SpeedMatch Function

To allow the operator to set desired travel speed for forward travel pedal.

Operating Conditions

- Key switch in the run position.
- Engine running.
- Operator in seat.
- Park brake unlocked.
- SpeedMatch switch on.
- Machine being driven forward or reverse.

Theory of Operation

SpeedMatch enables the operator to set the desired maximum travel speed for the machine.

Full forward or reverse pedal travel distance can be used to control machine travel speed between stop and the desired maximum travel speed.

To engage the SpeedMatch function depress forward travel pedal until desired maximum travel speed is reached.

Press SpeedMatch switch to activate speedmatch.

Press Set/- switch to set speedmatch.

Release forward travel pedal. Completely depress forward travel pedal to achieve desired maximum speed.

To adjust the maximum travel speed fully depress the res/+ switch repeatedly to increase speed by increments.

Fully depress the set/- switch repeatedly to decrease speed by increments.

To disengage the SpeedMatch switch fully depress the SpeedMatch switch.

eThrottle Function

To allow the operator to increase or decrease the speed of tractor by using the forward and reverse travel pedals.

Operating Conditions

- Key switch in the run position.
- Engine running.
- Operator in seat.
- Park brake unlocked.
- eThrottle switch on.
- Machine being driven forward or reverse.

Theory of Operation

eThrottle enables the operator to increase or decrease the speed of tractor by using the forward and reverse travel pedals.

As depression of the travel pedal increases, tractor speed increases.

Press the eThrottle switch to engage.

The LED above the switch will illuminate.

Press again to disengage.

Diverter Valve Circuit Operation (Option)

Function:

To allow the operator to activate the diverter valve to engage the third SCV function.

Operating Conditions:

- Park brake locked.
- Key switch in on position, engine running.
- Operator on seat.
- Park brake unlocked.

Theory of Operation:

The diverter valve switch has three positions; off, on, and mom-active. In the off position, the diverter valve function is deactivated.

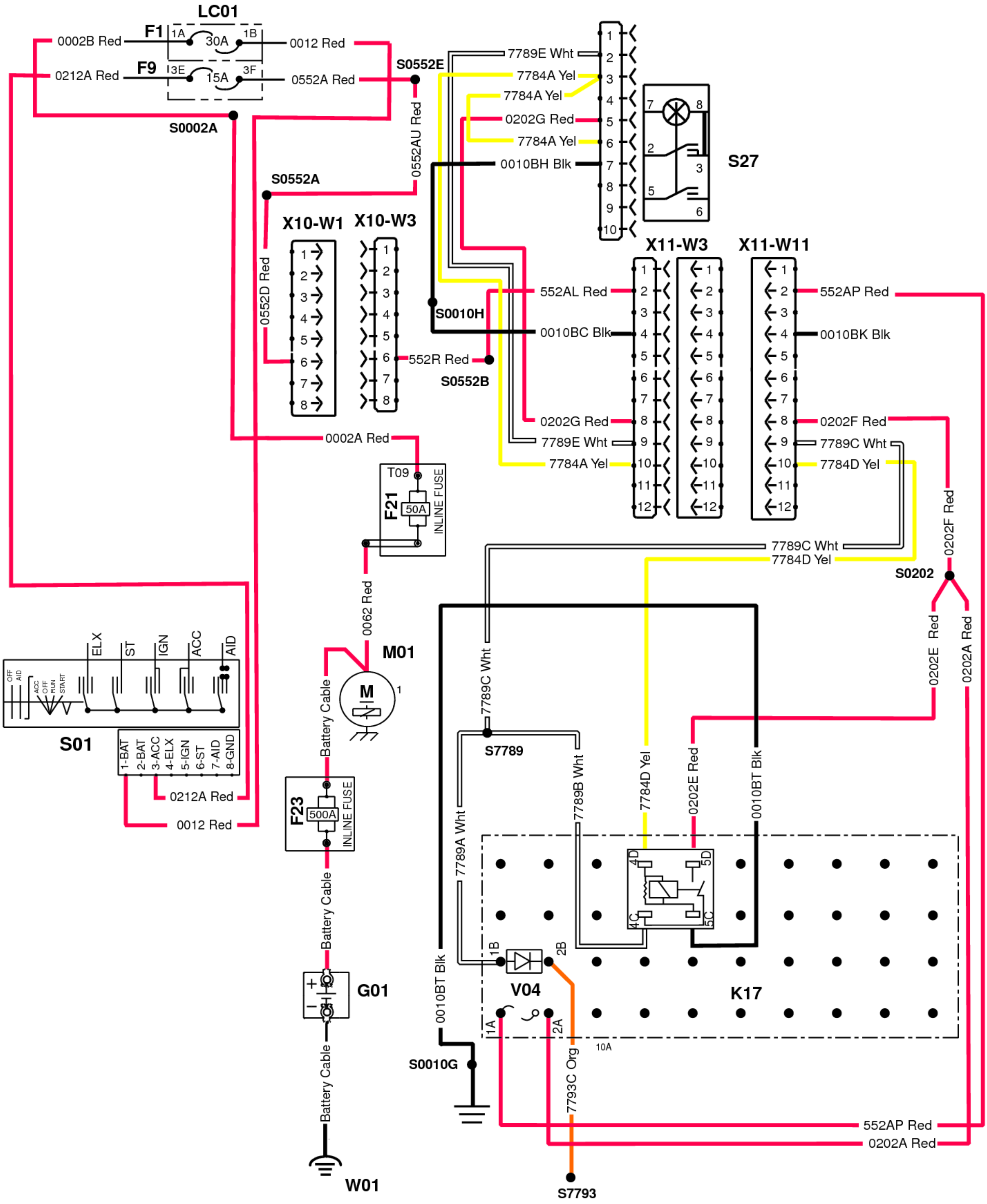
In the on position, power flows from the 0202 Red wire and splice to the diverter valve switch. Power then exits the switch over the 7784 Yel wire to the diverter valve relay. This enables the circuit, but does not activate the diverter valve relay.

In the active position, power flows through the 0202 Red wire and splice to the diverter valve switch. Power then exits the switch over the 7784 Yel wire and applies power to terminal 86 of the diverter relay. This will close the relay, and since power is already present at terminal 87 from the 0202 Red wire, voltage will leave the relay at terminal 30 on the 7789 Wht wire and feed back into the splice. This sets up a latch circuit for the relay, keeping the circuit active as the switch returns to the center on position.

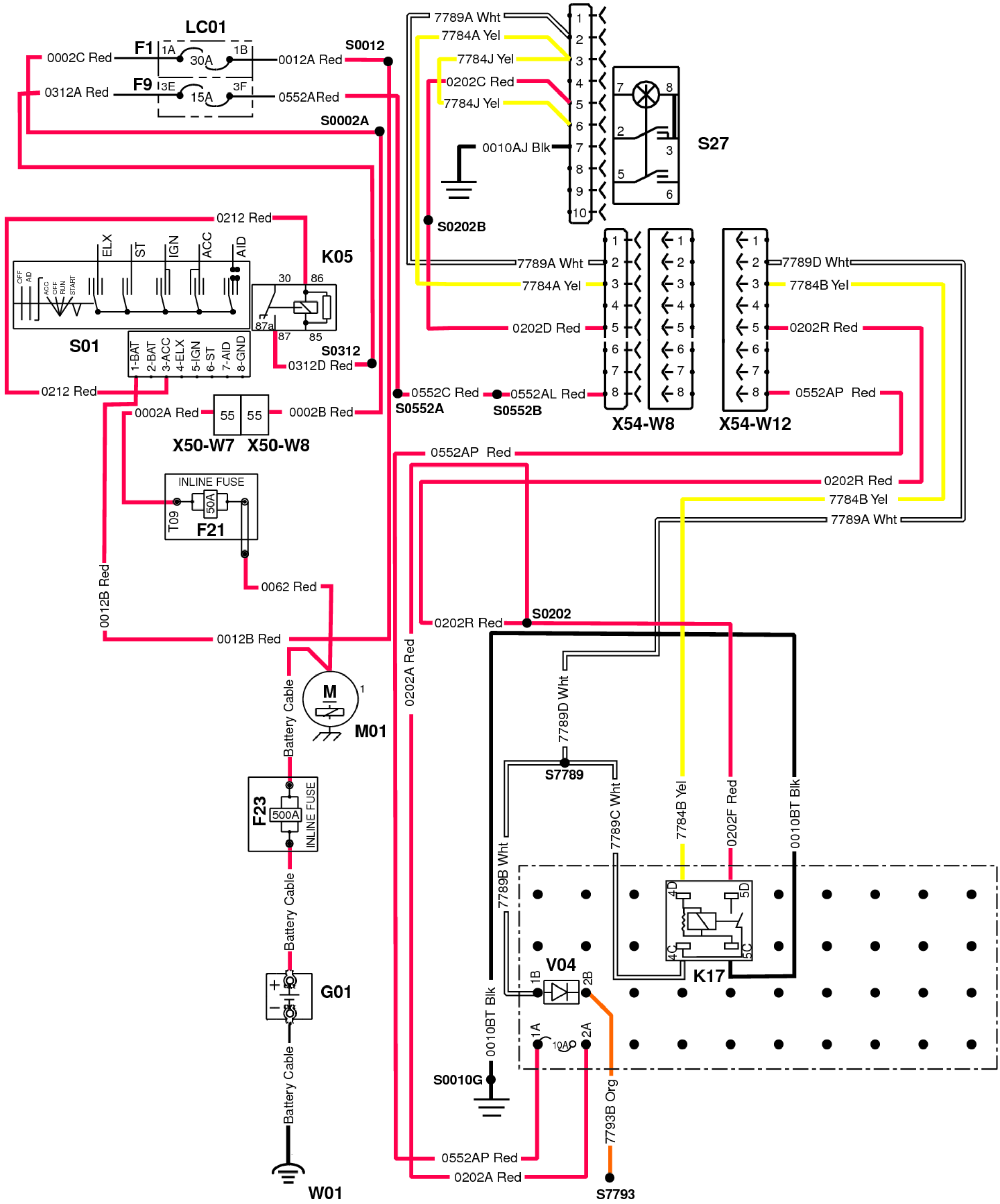
Power will leave the splice over the 7789 Wht wire and power the diverter valve solenoid. The 0010 Blk wire will ground the solenoid and activate the diverter valve.

The diverter circuit will remain active until the switch is placed in the off position.

Diverter Valve Circuit Electrical Schematic (Option)



Diverter Valve (Open Station)



Diverter Valve (Cab)

LEGEND:

F1	Key Switch Fuse (30A)
F9	Accessory Fuse (15A)
F21	Load Center Fuse (50A)
F23	Inline Fuse (500A)
G01	Battery
K05	Accessory Power Relay

K17	Diverter Valve Relay
LC01	Load Center
M01	Starting Motor
S01	Key Switch
S27	Diverter Valve Switch
V04	Diode (6A)
W01	Ground
X10-W3	Chassis to Right Fender Harness Interconnect 2
X10-W1	Right Fender to Chassis Harness Interconnect 2
X11-W3	Right Fender to 3rd EH Harness Interconnect
X11-W11	3rd EH to Right Fender Harness Interconnect
X50-W7	Chassis to Lower Cab Wiring Harness Interconnect
X50-W8	Lower Cab to Chassis Wiring Harness Interconnect
X54-W8	Rear Harness to Load Center Interconnect
X54-W12	Load Center to Rear Harness Interconnect

Air Ride Seat Circuit Operation (Option)

Function

To allow the operator to adjust the height and firmness of the seat.

Operating Conditions

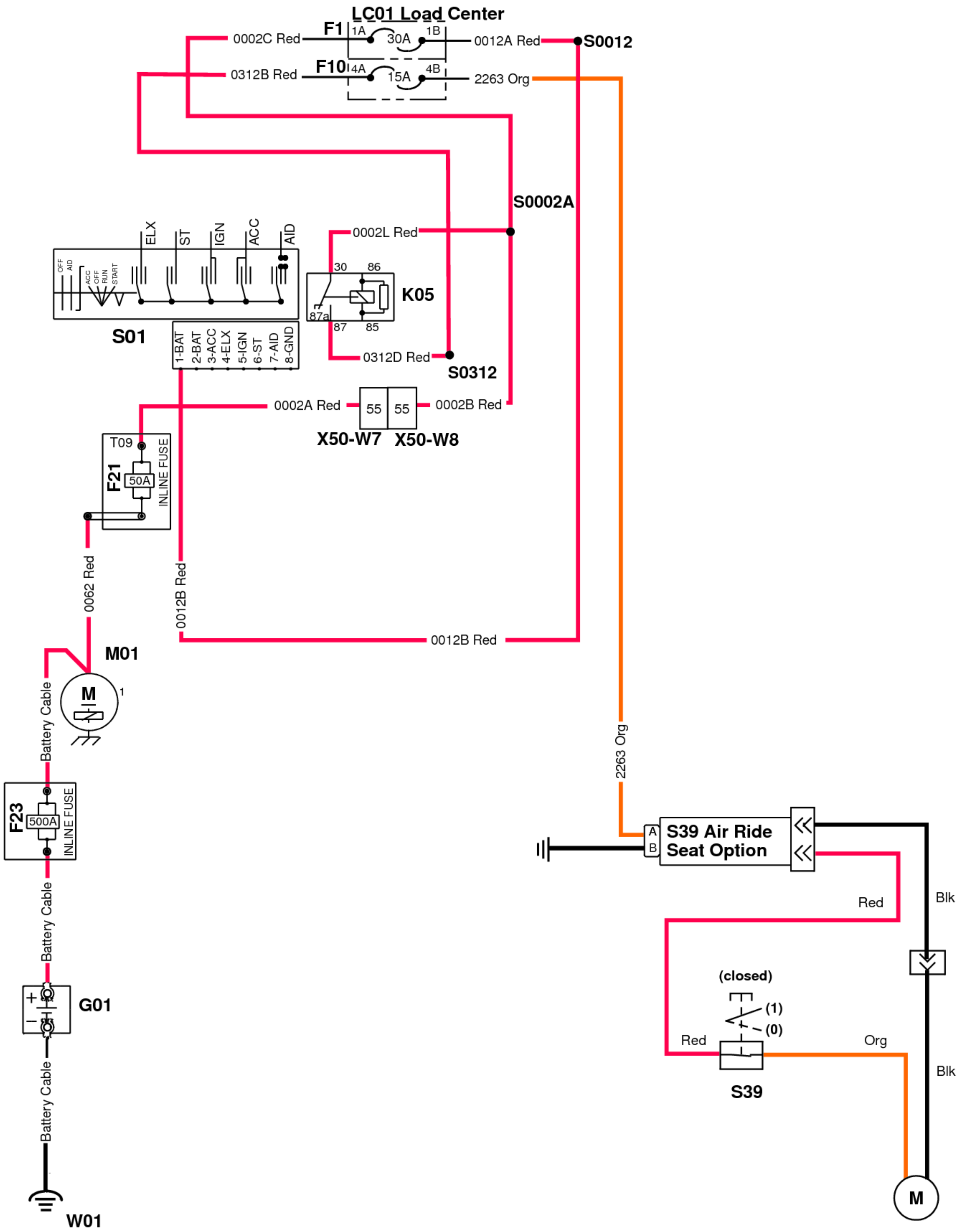
- Key switch in on position.
- Air seat switch in raise position.

Theory of Operation

Power flows from the load center through the 2263 Org wire over to the Red wire to the air ride seat switch S39. With this switch in the closed position (closed), power flows through the switch via the Org wire to the air seat compressor. The compressor is grounded by the Blk wire, though the X connector to the machine ground.

Lowering the seat is not an electrical function, as placing the air seat switch in this position simply allows air to escape from the system.

Air Ride Seat Circuit Schematic (Option)



Air Ride Seat Circuit Schematic

LEGEND:

F1	Fuse 30A
F10	Fuse 15A
F21	Inline Fuse (50A)
F23	Inline Fuse (500A)

G01	Battery
K05	Accessory Power Relay
LC01	Load Center
M01	Starting Motor
S01	Key Switch
S39	Air Ride Seat Switch
W01	Ground
X50-W7	Chassis to Lower Wiring Harness Interconnect
X50-W8	Lower Cab to Chassis Wiring Harness

Group 35 - Tests and Adjustments

Ground Circuit Test

Reason

To check for opens, loose terminal wire crimps, poor connections, or corrosion in the ground circuit. The voltmeter method checks ground connections under load.

Equipment

- Ohmmeter or Voltmeter

Ohmmeter Procedure

[1] - Turn key switch to off position. Engage park brake.

[2] - Connect ohmmeter negative (black) lead to negative (-) terminal of battery. Put meter positive (red) lead on negative terminal of battery and record reading. Reading should be 0.1 ohm or less.

[3] - Put meter red lead on ground terminal of circuit or component to be tested that is closest to the battery negative terminal. Resistance reading must be very close to or the same as the battery negative terminal reading. Work backwards from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohm. The problem is between the last two test points. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again. Maximum allowable resistance is 0.1 ohm. Check connectors closely as disconnecting and connecting may temporarily solve problem.

Voltmeter Procedure

[1] - Put transmission in neutral. Lock park brake. Put PTO switch in off position. Turn key switch to on position.

[2] - Connect voltmeter negative (black) lead to negative (-) terminal of battery.

[3] - Put meter positive (red) lead on ground terminal of component to be tested. Be sure the component circuit is activated (key switch on, switches closed) so voltage will be present at the component. Record voltage. Voltage must be greater than 0 but less than 1 volt. Some components will have a very small voltage reading on the ground side and still be operating correctly.

Results

- If resistance is above 0.1 ohm, check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.
- If voltage is 0, the component is open.
- If voltage is greater than 1 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

Battery Voltage

Reason

To check voltage and determine condition of battery.

Equipment

- Voltmeter or JT05685 Battery Tester

Procedure

CAUTION:

Avoid Injury!

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

[1] - Park machine safely with park brake locked.

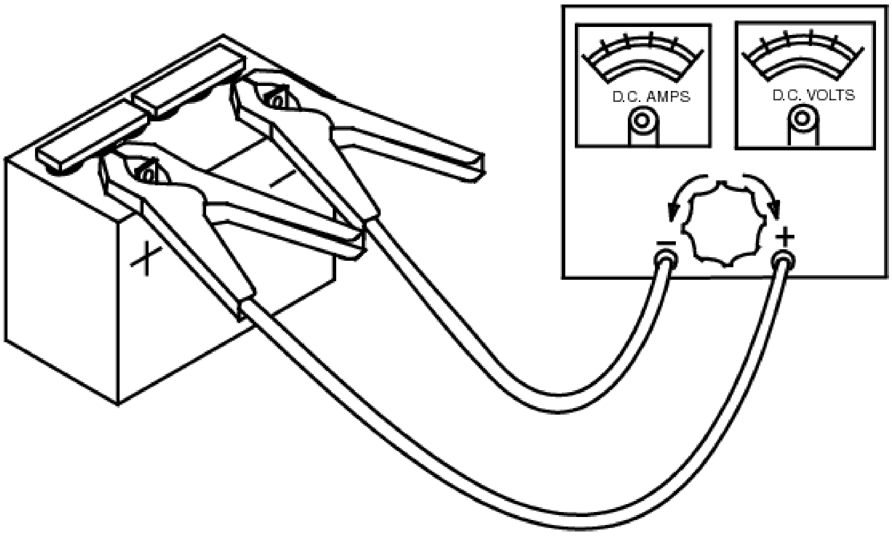
[2] - Raise hood and secure with prop rod.

[3] - Inspect battery terminals and case for breakage or cracks.

[4] - Clean battery terminals and top of battery.

[5] - Remove surface charge by placing a small load on the battery for 15 seconds.

[6] -



Battery

Check battery voltage with voltmeter or JT05685 Battery Tester.

Battery Load Tester

JT05685

Used to perform battery voltage and specific gravity test.

[7] - If using an electronic battery tester, follow user instructions.

Results

- Battery voltage less than **12.4 VDC** , charge battery.

Item	Measurement	Specification
Battery	Voltage	12.4 volts

- Battery voltage less than **9.6 VDC** , replace battery.
- Battery voltage more than **12.4 VDC** , load test battery.

Battery—Charge

Reason

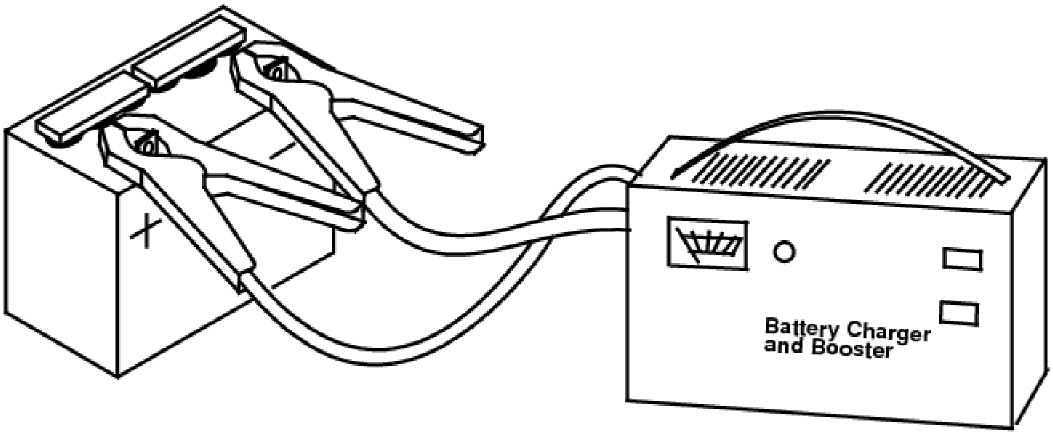
To increase battery charge after battery has been discharged.

Equipment

- Battery charger (variable rate)

Procedure

[1] -



Battery Charger

Connect variable rate charger to battery.

[2] -

> **→NOTE:**
>
> **Maximum charge time at boost setting is 10 minutes. Allow an additional 5 minutes for each 10 degrees below 70 degrees F.**

Start charger at slow rate. Increase charge rate one setting at a time. Check charger ammeter after 1 minute at each setting. Maintain 10-amp charge rate. Use boost setting as necessary.

[3] - Check if battery is accepting a 10-amp charge after 10 minutes at boost setting.

> **→NOTE:**
>
> **If battery will not accept 10-amp charge after 10 minutes at boost setting: replace battery.**

[4] -

> ***IMPORTANT:***
>
> ***Avoid Damage! Decrease charge rate if battery gases or bubbles excessively or becomes too warm to touch.***

Set charger at 15—25 amps.

[5] - Check battery after 60 minutes.

> **→NOTE:**
>
> **If battery was discharged at slow or unknown rate, charge at 10—15 amps for 12—14 hours. If battery was discharged at fast rate, charge at 20—25 amps for 4—8 hours.**

[6] - Load test battery. (See Battery—Load Test in Section 40, Group 35.)

Battery—Load Test

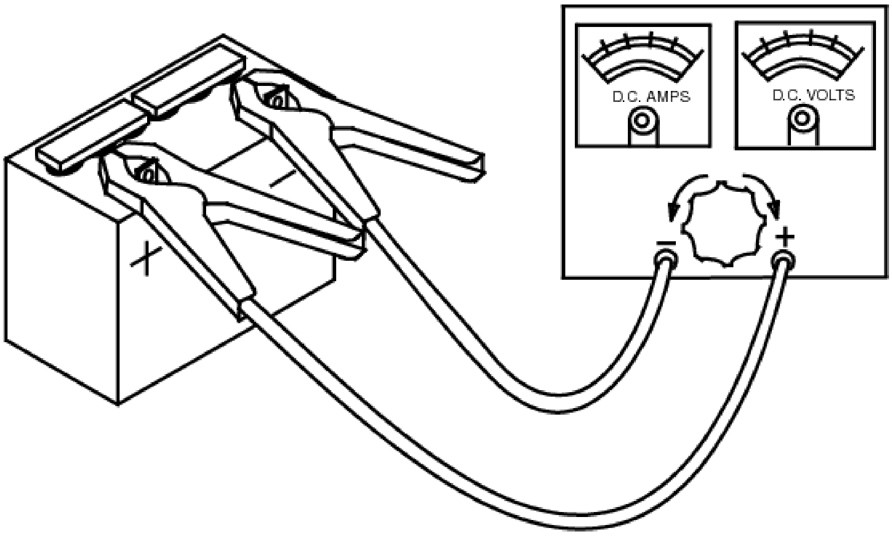
Reason

To check condition of battery under load.

→NOTE:

See Battery—Charge in Section 40, Group 35 before applying a load to battery.

Equipment



Battery Tester

- JT05685 Battery Tester or equivalent
  Battery Load Tester
  JT05685
  Used to perform battery load test.

→NOTE:

Use the procedures given with the tester.

1/2 CCA Load Test Procedure

[1] - Turn load knob of tester clockwise until amperage reading is equal to either of the following:

a. Cold cranking amperage rating (use blue scale)
b. 1/2 the rated CCA in amps (use black scale)

[2] - Hold for 15 seconds and turn load knob of tester off.

[3] - Read battery voltage.

Results:

- If the battery does not indicate 9.6 volts or more, replace battery.

Alternator Test

Reason

To determine charging output of the alternator.

Equipment

- JDG10466—Flex Probe Kit
  Flex Probe Kit
  JDG10466
  Use to connection to terminals for making electrical measurements.
- JT02153—Current Clamp-On Probe
  Current Clamp-On Probe
  JT02153
  Use to take electrical current measurements.
- JT05685—Battery Load Tester
  Battery Load Tester
  JT05685
  Use to check battery load.

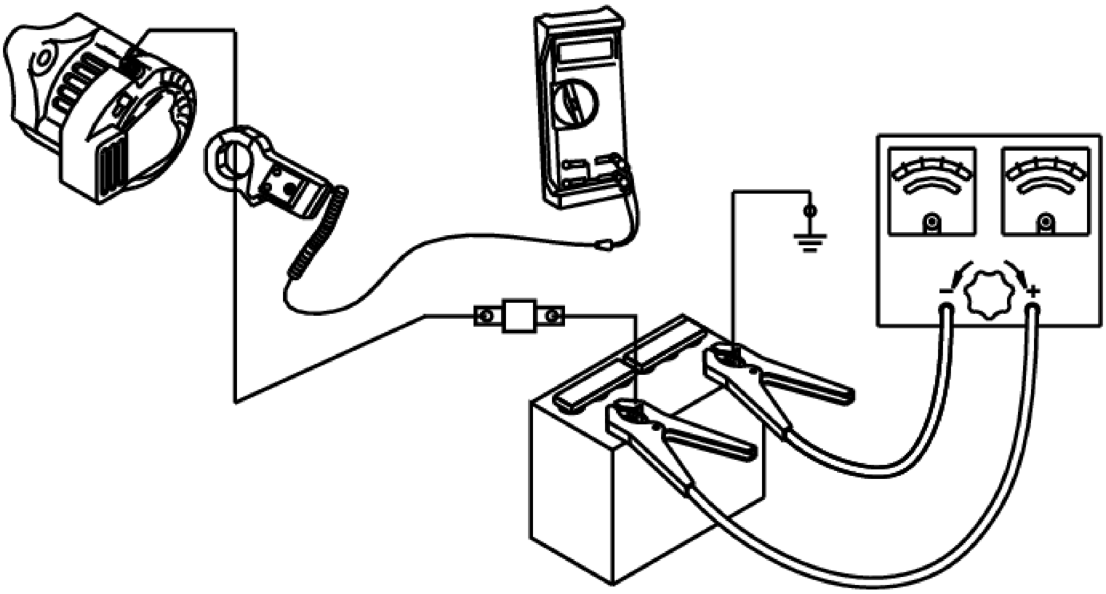
Procedure

IMPORTANT:

Avoid Damage! Perform this test quickly to prevent damage to the battery. Do not apply full load to battery for more than 10 seconds.

[1] - Park machine safely. See Park Machine Safely.

[2] -



Alternator Test

Be sure that battery is fully charged and all tractor accessories are off.

[3] - Turn load knob of load tester off (fully counterclockwise).

[4] - Connect red load tester clamp to positive (+) post of battery.

[5] - Connect black load tester clamp to negative (—) post of battery.

[6] - Put current clamp-on probe over large red cable between alternator and starter.

[7] - Start engine and run at 1800 rpm.

[8] - Slowly turn load knob clockwise until current clamp-on probe meter displays maximum current output. Battery voltage should not be below specification.

Item	Measurement	Specification
Alternator	Current Output	32A at 13.5V

[9] - Turn load knob off (fully counterclockwise).

[10] - Run engine and watch when current gun reading is 10 amps or less.

[11] - Battery voltage should not be below specification.

Item	Measurement	Specification
Regulated Battery	Voltage	14.4—15.0V

Results:

If reading does not meet specification, replace alternator.

Starting Motor Solenoid Test

Reason

To determine if the starting motor is defective.

Equipment

- Jumper wire

CAUTION:

Avoid Injury! This test will cause engine to turn over. Engine may start. Ensure fuel shutoff solenoid is disconnected, transmission is in neutral, and PTO(s) are off.

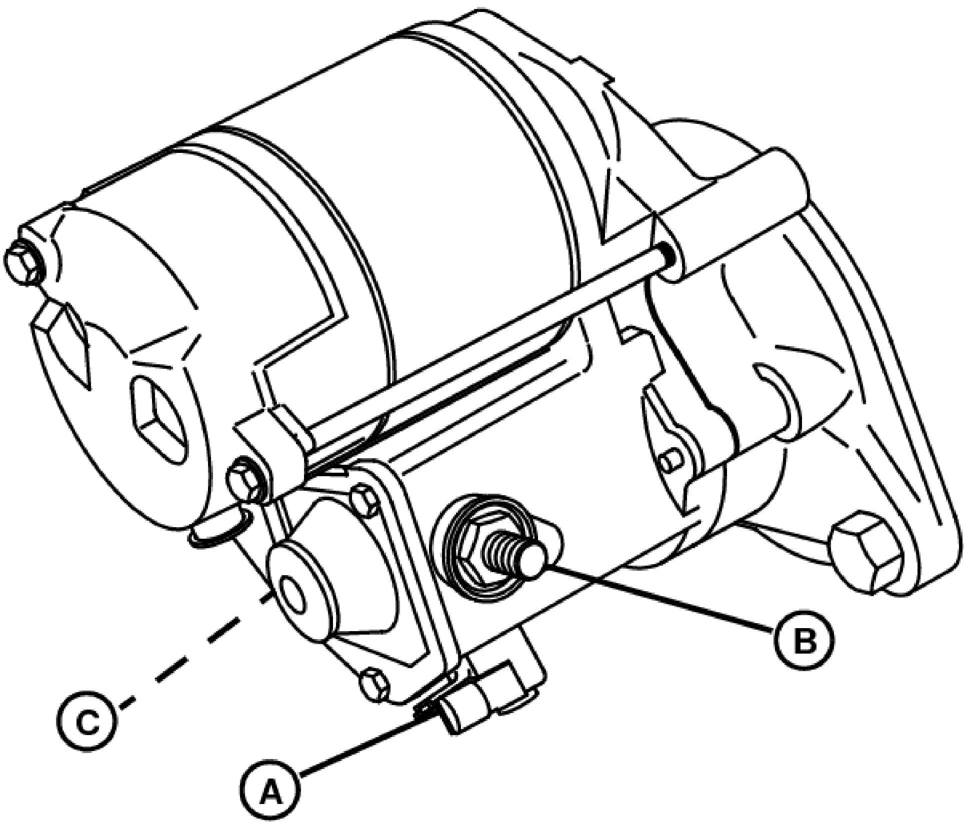
Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood and secure with prop rod.

[3] - Disconnect fuel shutoff solenoid wire connector.

[4] -



Starting Motor

LEGEND:

A	Solenoid Terminal
B	Solenoid Large Terminal
C	Solenoid Large Terminal

Disconnect Wht wire from starting motor solenoid terminal (A).

[5] - Connect jumper wire to positive (+) battery terminal and briefly jump to starting motor solenoid terminal (A).

Results:

- Starting motor runs—solenoid is good, test cranking circuit wiring.
- Starting motor does not run—go to next step.

1. Connect jumper wire between starting motor solenoid large terminals (B and C).

Results:

- Starting motor runs—replace starting motor solenoid.
- Starting motor does not run—check battery cables. If ok, replace starting motor.

Starting Motor Amperage Draw Test

Reason

To determine the amperage required to crank the engine and check starting motor operation under load.

Equipment

- JT05685 Battery Tester

Procedure

[1] - Park machine safely in neutral with park brake locked.

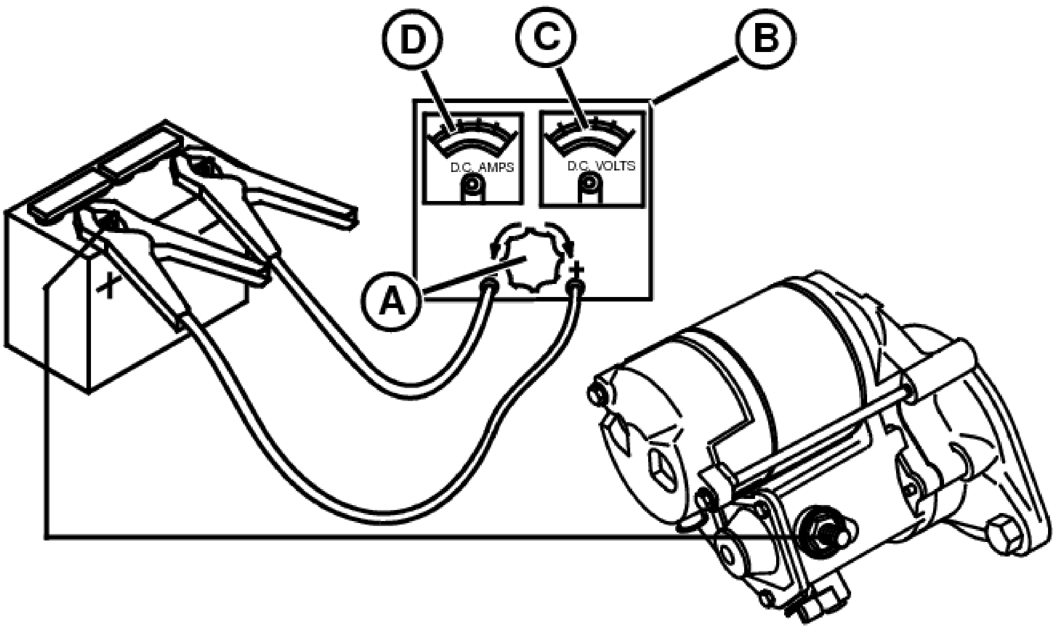
[2] - Raise hood and secure with prop rod.

[3] - Disconnect fuel shutoff solenoid wire connector.

[4] -

IMPORTANT:

Avoid Damage! Turn load knob (A) fully counterclockwise (out) into off position before making any test connections.



Battery Tester

LEGEND:

A	Knob
B	JT05685 Battery Tester

C	Meter
D	Meter

Connect JT05685 Battery Tester (B) to battery.

Battery Load Tester

JT05685

Used to test starting motor amperage draw.

[5] - Crank engine and read voltage on meter (C).

[6] - Turn key switch to the off position. Adjust load knob until battery voltage reads the same as when cranking.

[7] - Read amperage on meter (D).

[8] - Turn load knob fully counterclockwise.

Results

- If amperage is greater than 150 amps, test starting motor No-Load RPM and Amperage to determine if the starting motor is binding or damaged.
- If the starting motor is good, check internal engine components for binding or damage.

Starting Motor No-Load Amperage Draw and RPM Test

Reason

To determine if starter is binding or has excessive amperage draw under no-load.

Equipment

- JT02153 Current Clamp-On Probe

  Current Clamp-On Probe

  JT02153

  Used to test starting motor no-load amperage draw and rpm.
- JT05791 Digital Multimeter

  Digital Multimeter

  JT05791

  Used to test starting motor no-load amperage draw and rpm.
- JT05719 Hand-Held Digital Tachometer

  Hand-Held Digital Tachometer

  JT05719

  Used to test starting motor no-load amperage draw and rpm.
- Jumper cables
- Jumper wire

Procedure

→NOTE:

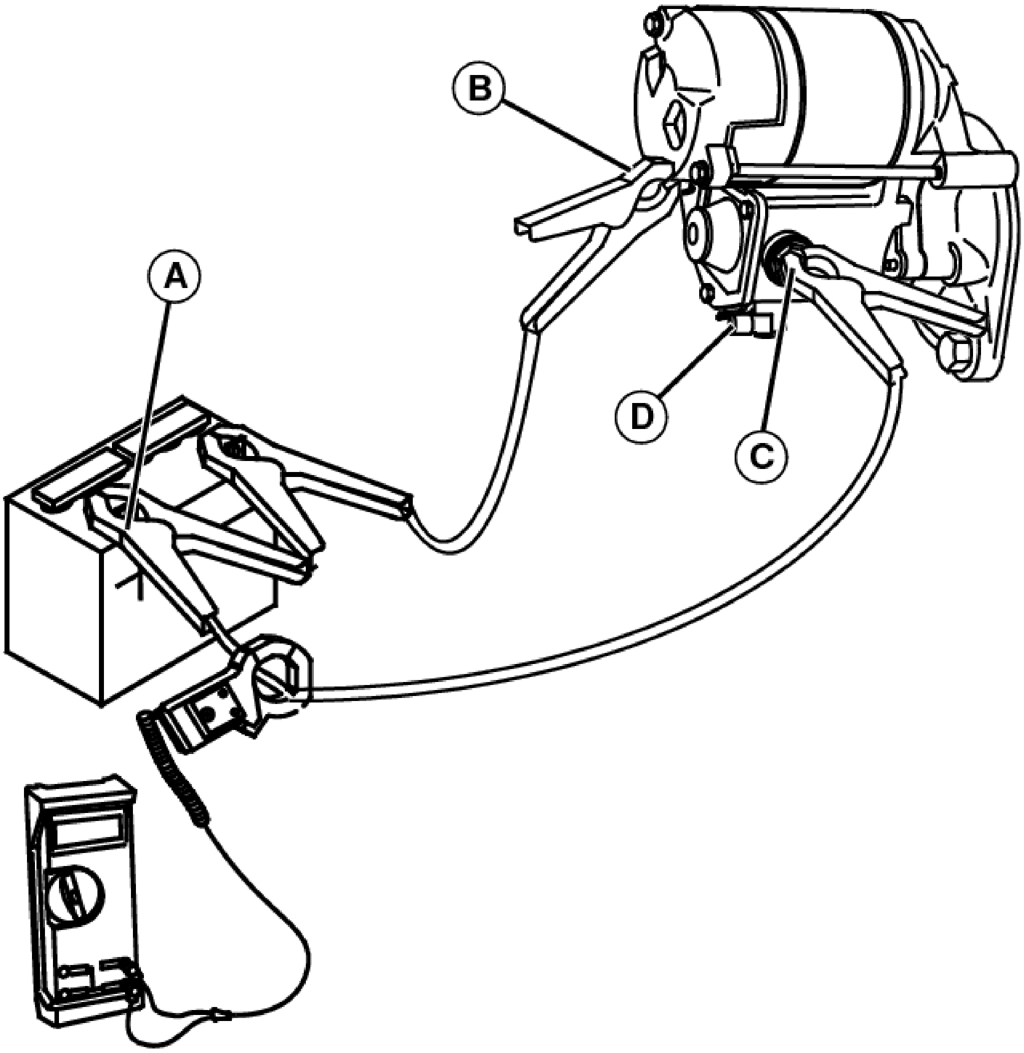
Check that battery is fully charged and of proper size to ensure accuracy of test.

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood and secure with prop rod.

[3] - Remove starting motor assembly from machine and place starting motor in vice.

[4] -



Battery

LEGEND:

A	Solenoid Battery Terminal
B	Starting Motor Body
C	Current Clamp
D	Starting Motor Terminal

Connect jumper cables to a 12- volt battery.

[5] - Connect positive (+) cable to solenoid battery terminal (A) on starting motor.

[6] - Connect negative (-) cable to starting motor body (B).

[7] - Attach current clamp (C) to positive (+) cable.

[8] -

IMPORTANT:

Avoid Damage! Perform these tests quickly to prevent damage to starting motor. Complete test in 20 seconds or less.

Use a jumper wire to briefly connect positive (+) starting motor terminal (D) to solenoid terminal (A). Starting motor should engage and run.

[9] - Read and record starting motor amperage and rpm.

Results

- If solenoid “clicks” or chatters and starting motor does not turn, replace starting motor.

- If pinion gear engages and starting motor doesn't turn, replace starting motor.
- If starting motor engages and runs, but amperage is more than 325 amps at 4440 rpm, repair or replace starting motor.
- If free-running rpm is less than 4000 rpm, repair or replace starting motor.

Fuse Test

Reason

To verify that fuse has continuity.

Equipment

- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Open plastic panel below steering column support.

[3] - Remove fuse from load center.

[4] -

LEGEND:

A	Broken Filament

Broken Filament

Check visually for broken filament (A).

[5] - Connect ohmmeter or multimeter to each end of fuse.

[6] - Check for continuity.

Results

- If continuity is not indicated, replace the fuse.

Manifold Heater Test

Reason

To test operation of manifold heater.

Equipment

- Ohmmeter

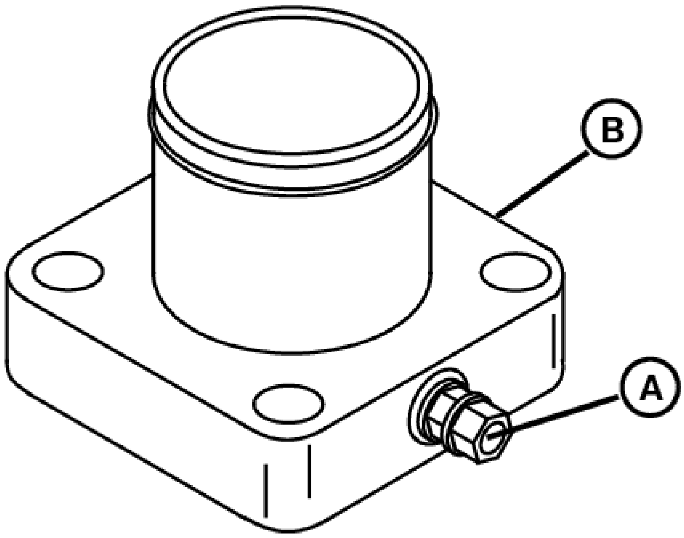
Procedure

[1] - Park machine safely with park brake locked.

[2] - Raise hood and secure with prop rod.

[3] - Remove right side engine cover.

[4] -



Manifold Heater

LEGEND:

A	Terminal
B	Manifold Heater Body

Remove manifold heater lead from terminal (A).

[5] - Check continuity across terminal (A) and manifold heater body (B). The reading should be within specification.

Item	Measurement	Specification
Manifold Heater	Resistance	0.3—0.5 Ohms

Results

If manifold heater unit does not have proper resistance or an open circuit, replace heater unit.

Engine Coolant Temperature Sensor Test

Reason

To verify coolant temperature sensor is functioning properly.

Equipment

- Ohmmeter

Procedure

→NOTE:

Perform test with engine at room temperature.

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood and secure with prop rod.

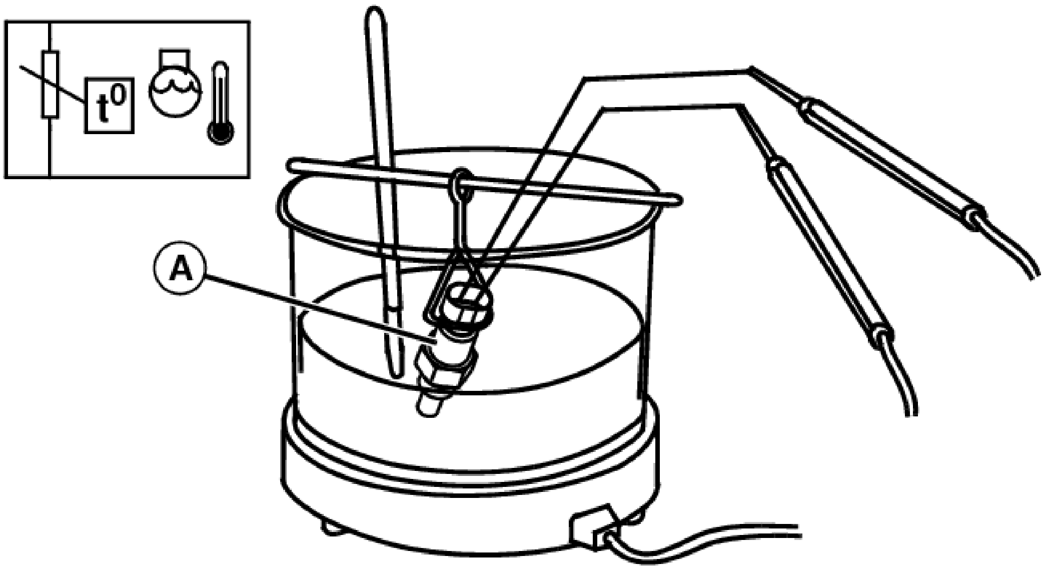
[3] - Disconnect Wht wire from engine coolant temperature sensor.

[4] - Measure resistance between terminal and sensor body.

[5] - If resistance does not meet specification, replace coolant temperature switch.

[6] - Drain engine coolant and remove coolant temperature switch.

[7] -



Antifreeze Solution

LEGEND:

A Sensor

Place sensor (A) in antifreeze solution heated to approximately 96°C (205°F). Measure resistance while sensor is heated. Reading should be approximately 64 ohms.

[8] - If resistance does not meet specification, replace coolant temperature sensor.

Item	Measurement	Specification
Variable Resistance Range		
Full Clockwise	Resistance	22 ohms @135°C (275°F)
Full Counterclockwise	Resistance	520 ohms @40°C (104°F)

Engine Oil Pressure Switch Test

Reason

To determine if engine oil pressure switch is functioning properly, to warn operator that oil pressure has dropped below minimum operating pressure.

Equipment

- Ohmmeter

Procedure

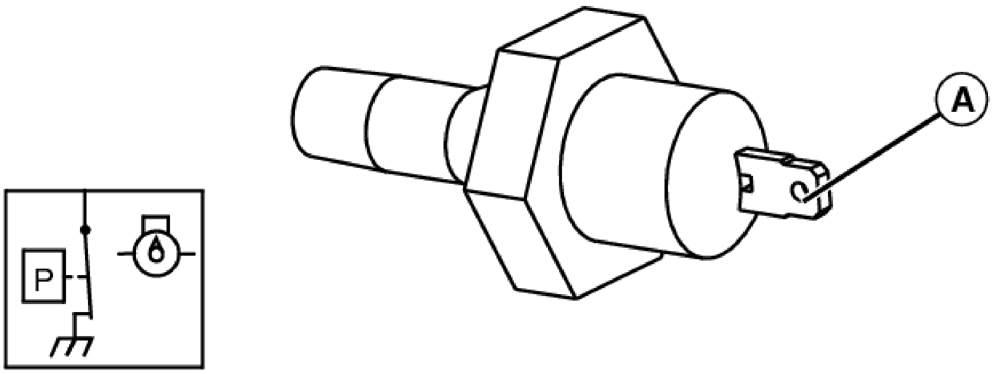
→NOTE:

Perform test with engine at room temperature.

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood and secure with prop rod.

[3] -



Oil Pressure Switch

LEGEND:

A	Oil Pressure Switch

Disconnect Pur wire from engine oil pressure switch (A).

[4] - Connect black lead of ohmmeter to engine block and red lead of ohmmeter to terminal of switch.

[5] - Measure resistance between terminal and engine block.

Results

- There should be continuity between terminal and ground.
- If there is no continuity between terminal and ground, replace the oil pressure switch.

→NOTE:

Be sure to apply pipe sealant with TEFLON ™ to threads of switch anytime it is installed.

[1] - Start and run engine.

[2] - Measure resistance between terminal and engine block.

Results

There should be no continuity between switch terminal and ground with the engine running.

- If the switch does have continuity to engine block (ground) with engine running, check engine oil pressure.
- If oil pressure meets specification, replace the oil pressure switch.

Relay Test

Results

To check relay terminal continuity in the energized and de-energized condition.

Equipment

- Ohmmeter or multimeter
- 12- volt battery and small jumper wires

Procedure

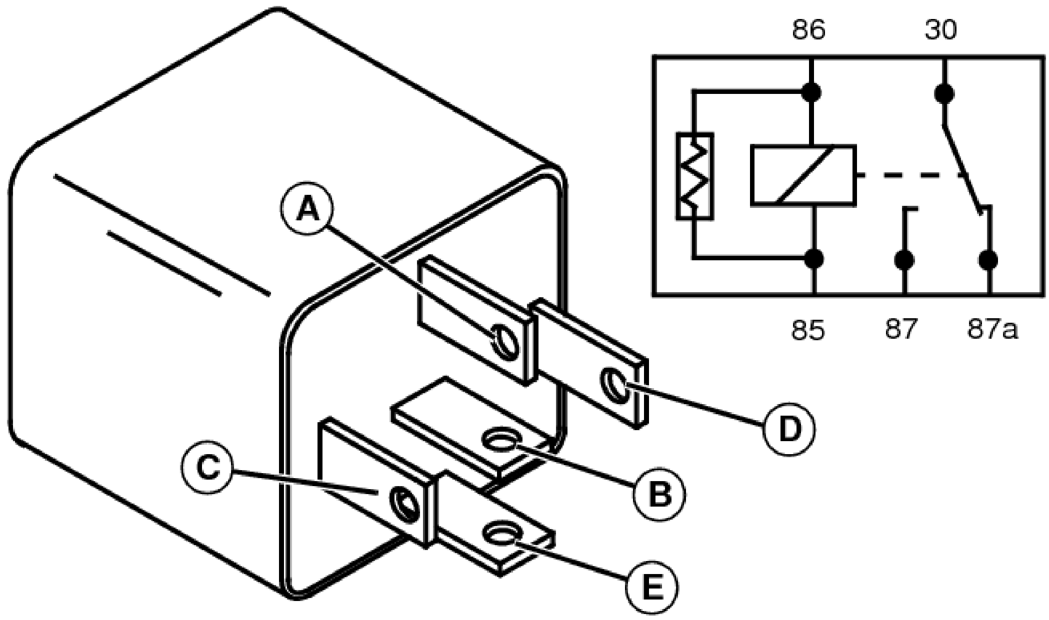
[1] - Park machine safely in neutral with park brake locked.

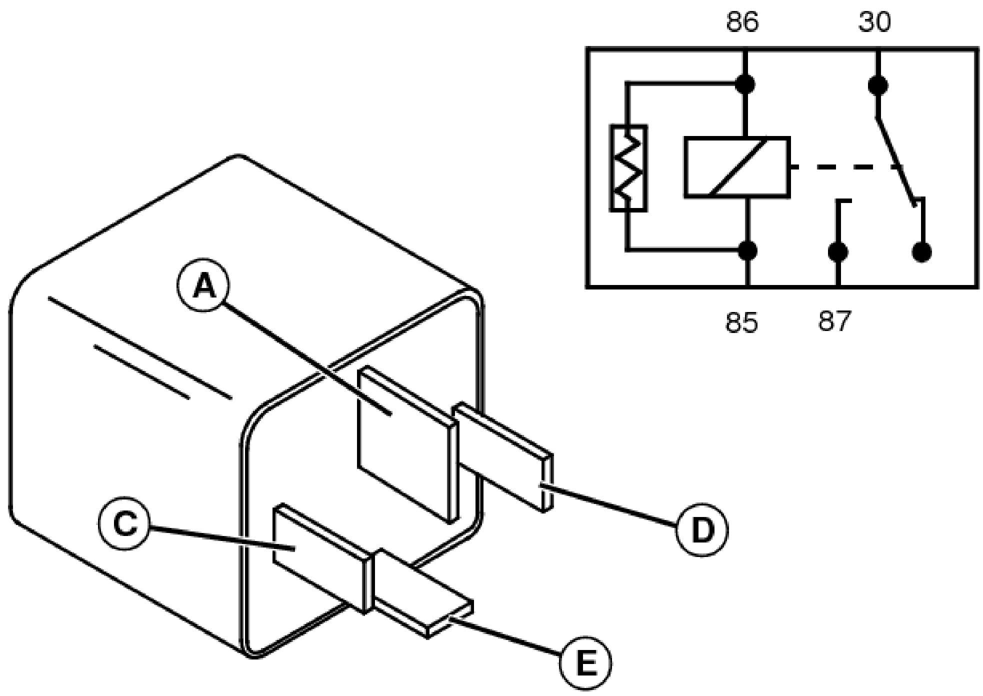
[2] - Open plastic panel below steering column support.

[3] - Remove relay from fuse and relay load center.

[4] - Check terminal continuity using an ohmmeter or multimeter.

Results





Relays

LEGEND:

A	Terminal 30
B	Terminal 87A
C	Terminal 85
D	Terminal 86
E	Terminal 87

- There should be continuity between terminals 30 (A) and 87a (B).
- There should be approximately 80 ohms resistance between terminals 85 (C) and 86 (D).
- There should not be continuity between any other terminals.

[1] - Connect a small jumper wire from battery positive (+) terminal to relay terminal 85 (C).

[2] - Connect a small jumper wire from relay terminal 86 (D) to battery negative (-) terminal.

Results:

- There should be continuity between terminals 30 (A) and 87 (E).
- If continuity is not correct, replace relay.

Key Switch Test

Reason

To verify that key switch functions properly.

Equipment

- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

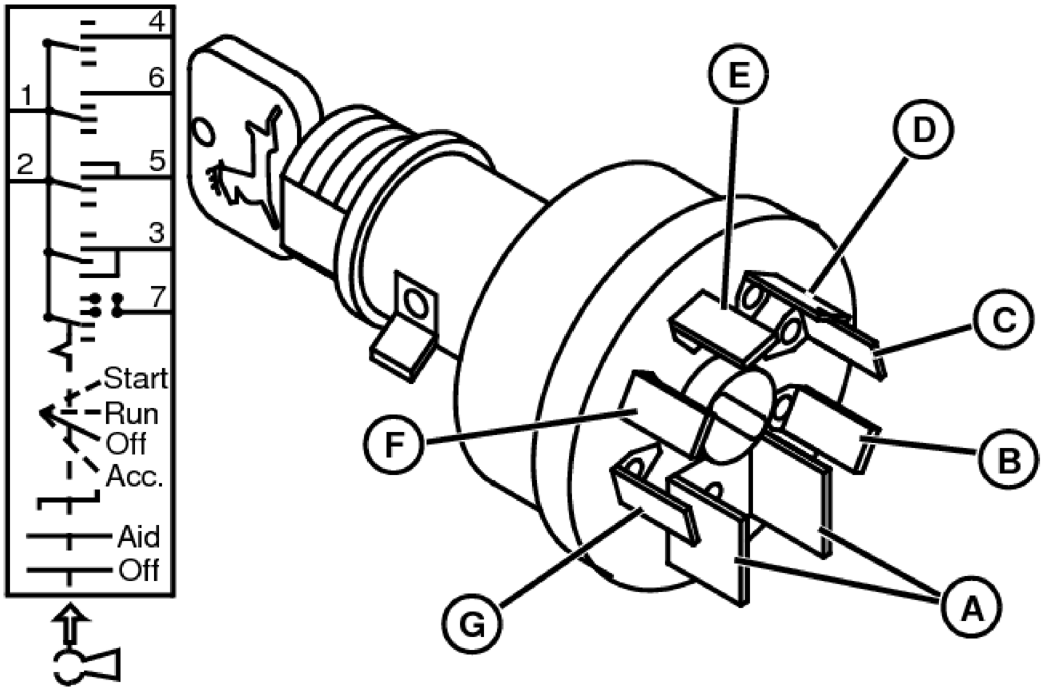
[2] - Raise hood and secure with prop rod.

[3] - Loosen left and right cowl panel and display panel enough to remove key switch. See Cowl Removal and Installation in the Miscellaneous Section.

[4] - Disconnect key switch from wiring harness.

[5] - Remove key switch and panel from machine.

[6] - Use an ohmmeter or multimeter to test switch continuity in off, run, start, and aid (key pushed in) positions.



Key Switch

LEGEND:

A	BAT: Terminal 1 and 2
B	ACC: Terminal 3
C	ELX: Terminal 4
D	IGN Terminal 5
E	ST: Terminal 6
F	AID: Terminal 7
G	Spare

Key Switch Continuity Table

Key Switch Continuity Table						
Switch Position	**Terminals**					
	A	B	C	D	E	F
OFF	•					
ACC.	•	•				

Key Switch Continuity Table						
RUN	•	•	•	•		• (*)
START	•			•	•	• (*)
* Key switch pushed IN (AID position).						

Results

- If any continuity is not correct, replace the switch.

Sensing Switch Test

Reason

To verify that sensing switches used for transmission neutral, MFWD, rear PTO, and mid PTO function sensing are operating properly.

Equipment

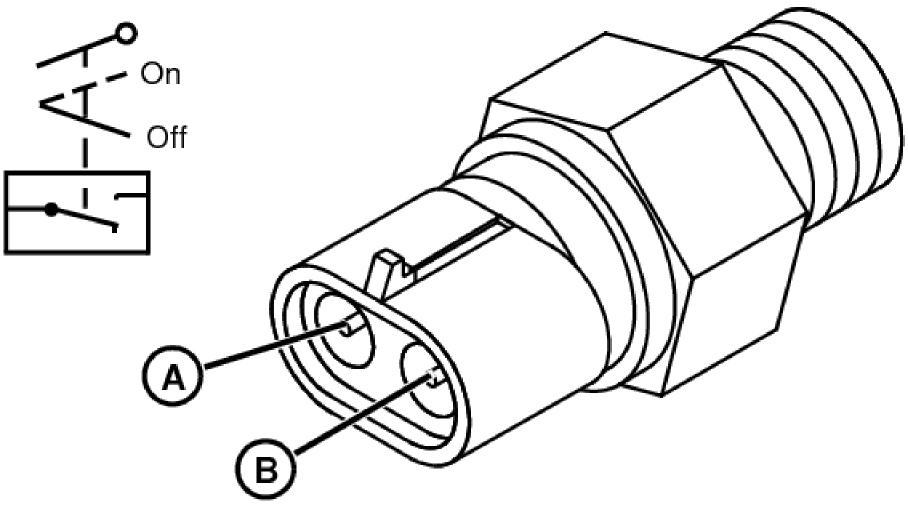
- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect switch to be tested from wiring harness.

[3] -



Sensing Switch Test

LEGEND:

A	Terminal
B	Terminal

Check continuity across switch terminals (A and B). Continuity for each circuit should exist when:

a. MFWD is on.
b. Mid PTO is off.
c. Rear PTO is engaged.

[4] - Move the lever for the circuit being tested. Check for continuity through switch. There should be no continuity when:

a. MFWD is off.
b. Mid PTO is on.
c. Rear PTO is disengaged.

[5] - If continuity does not match specifications:

a. Remove switch.
b. Test switch for continuity. The switch is normally open. Depress contact ball on end of switch and check continuity. Switch should be closed (continuity with ball depressed).

Item	Measurement	Specification
Sensing Switch—Contact Ball Pushed In	Resistance	0 ohms: Continuity between terminals A and B

Item	Measurement	Specification
Sensing Switch—Contact Ball Released	Resistance	Infinite: No continuity between terminals A and B

[6] - Replace switch if correct continuity cannot be obtained.

Rear PTO Switch Test

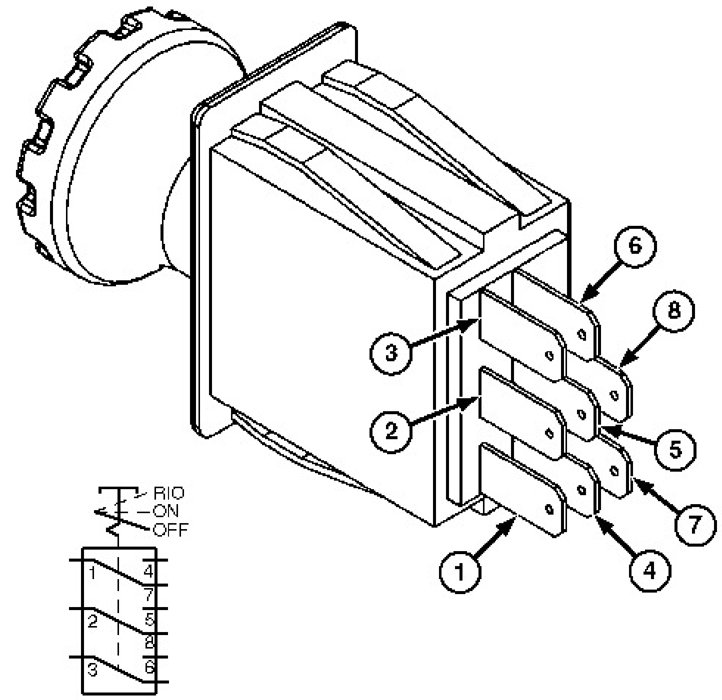
Reason

To verify proper operation or the rear PTO switch.

Equipment

• Ohmmeter

Procedure



LEGEND:

1 Common Terminal
2 Common Terminal
3 Common Terminal
4 Normally Open
5 Normally Open
6 Normally Open (Momentary)
7 Normally Closed
8 Noramlly Closed

PTO Switch

[1] - Disconnect switch.

[2] - Use ohmmeter to check continuity across switch terminals.

Ohmmeter or Continuity Tester

not applicable

Check continuity

a. If continuity is not present between terminals listed for each switch position, replace switch.
b. If continuity exists between terminals not listed for each switch position, replace switch.

Switch Continuity

Switch Continuity	
Off	1 — 7
On	1 — 4
RIO	3 — 6

Rear PTO Solenoid Test

Reason

To verify that the solenoid coil is operating properly.

Equipment

- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Access the solenoids on the left side of the machine under the operator’s floor platform.

[3] - Disconnect the solenoids from wiring harness.

[4] -

LEGEND:

A	Terminal
B	Terminal

Rear PTO Solenoid

Use an ohmmeter or multimeter to check if continuity exists between solenoid terminals.

[5] - If resistance does not meet specifications or is present in any other combination, replace solenoid.

Item	Measurement	Specification
Rear PTO Solenoid	Resistance	8.5 ohms

- Check for grounds or shorts by connecting a tester lead to one coil terminal and the other lead to bare metal of coil case.

Results

- Replace solenoid if continuity is present from either terminal to solenoid coil case.

Seat Switch Test

Reason

To verify that seat switch functions properly.

Equipment

- Ohmmeter or multimeter

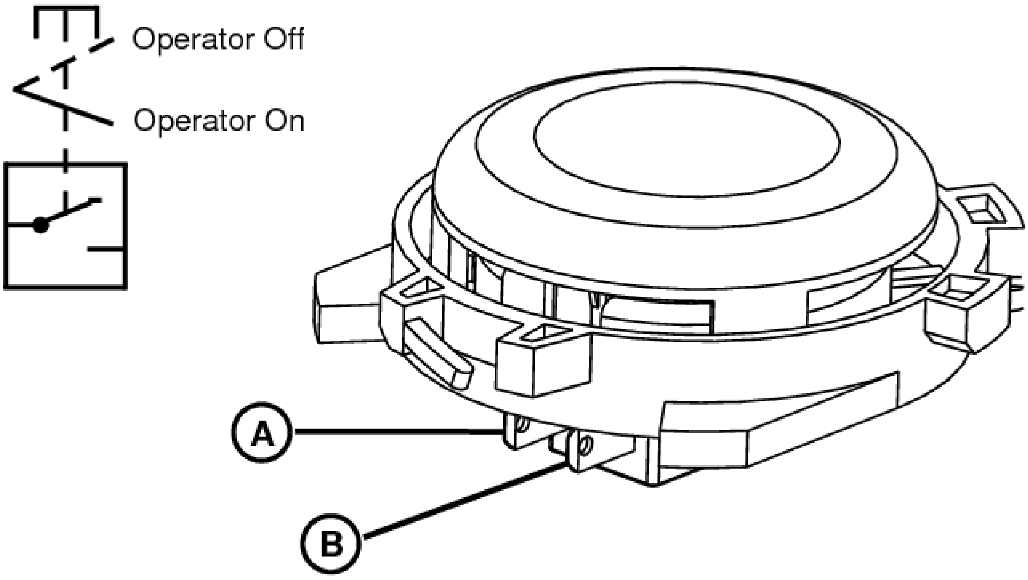
Procedure

[1] - Park machine safely in neutral with park brake locked.

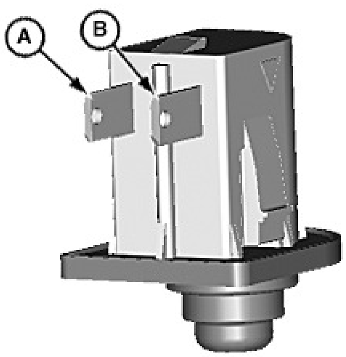
[2] - Raise seat.

[3] - Disconnect seat switch from wiring harness.

[4] -



Standard Seat Switch



Deluxe Seat Switch

LEGEND:

A	Terminal
B	Terminal

Check continuity across switch terminals (A and B). There should be no continuity.

[5] - Depress seat switch plunger. Continuity should exist between terminals A and B.

Results

- If continuity is not correct, replace seat switch.

Air Ride Seat Switch Test

Reason

To verify that the air ride seat switch functions properly.

Equipment

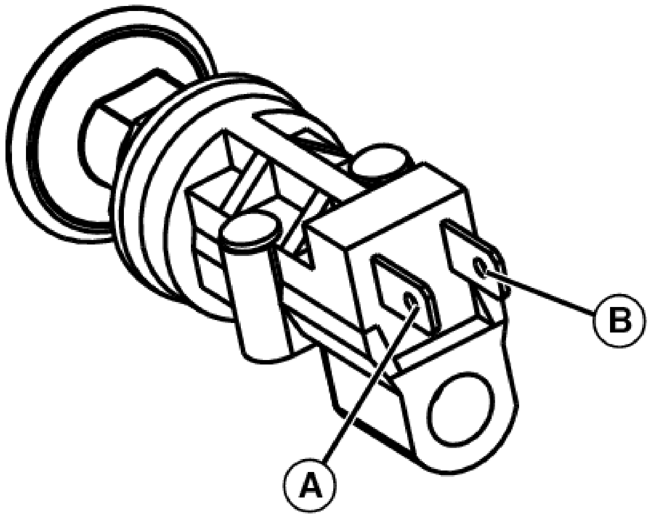
- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect wiring from air ride seat switch.

[3] -



Air Ride Seat Switch

LEGEND:

A	Terminal
B	Terminal

Use ohmmeter or multimeter to test switch continuity.

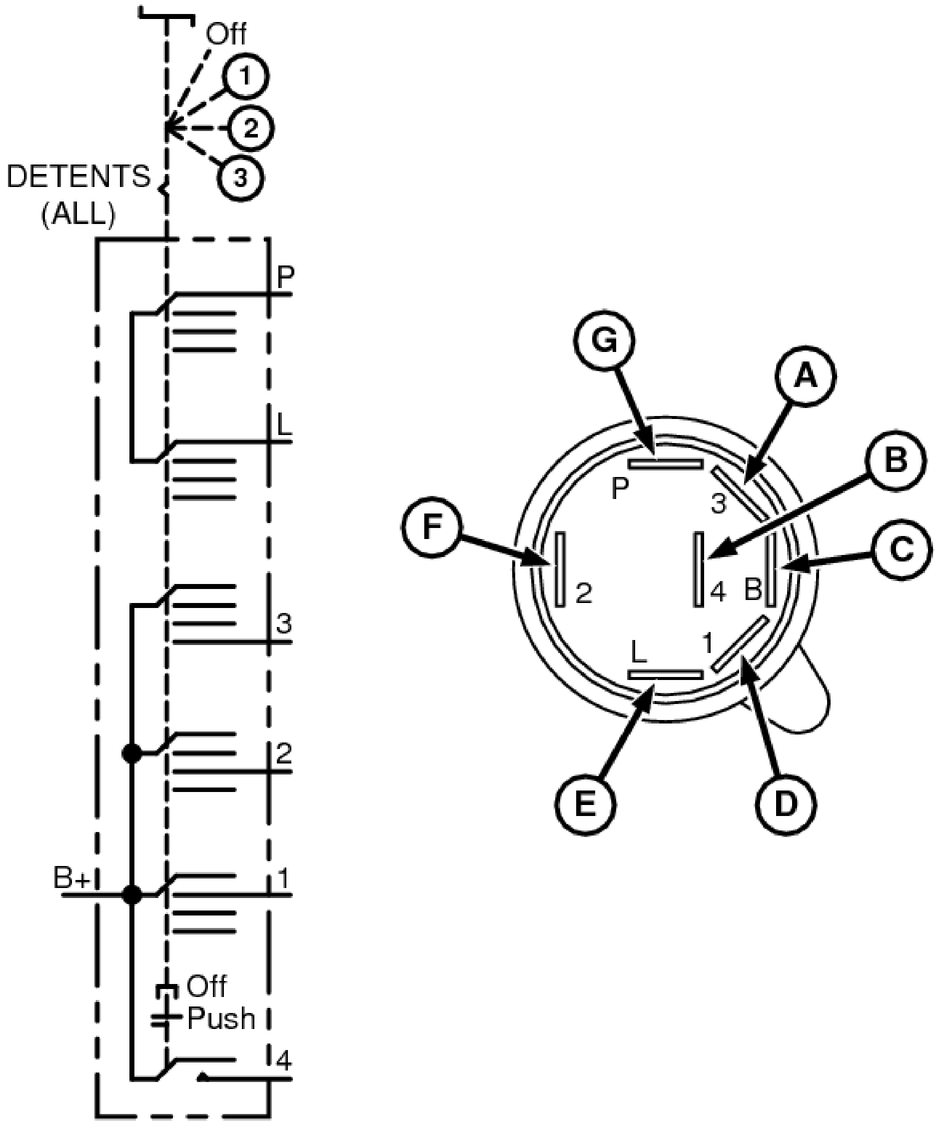
Air Ride Seat Switch Continuity

Air Ride Seat Switch Continuity	
Switch Position	Terminal Continuity
ON (Raise Seat)	A and B

Results

- If continuity is not correct or exists in any other combination than shown above, replace the switch.

Front Wiper/Washer Switch Test



Front Wiper/Washer Switch

LEGEND:

A	Terminal
B	Terminal
C	Terminal
D	Terminal
E	Terminal
F	Terminal
G	Terminal

Reason

To verify that the front wiper/washer switch functions properly.

Equipment

- Ohmmeter or multimeter

Test Procedure

[1] - Park machine safely. See Park Machine Safely .

[2] - Loosen left and right cowl panel and display panel enough to remove front wiper switch. See Cowl Panel Removal and Installation (Cab) or Cowl Panel Removal and Installation (Open Station)—eHydro Transmission or Cowl Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[3] - Disconnect front wiper switch from connector.

Front Wiper/Washer Switch Continuity

→NOTE:

Terminal A not used

Front Wiper/Washer Switch Continuity	
Switch Position	Terminal Continuity
OFF	None
Low	C and D
High	C and F
Washer press and hold	C and B

Results

- If continuity is not correct or exists in any other combination than shown above, replace the switch.

Rear Wiper/Washer Switch Test

Reason

To verify that the rear wiper/washer switch functions properly.

Equipment

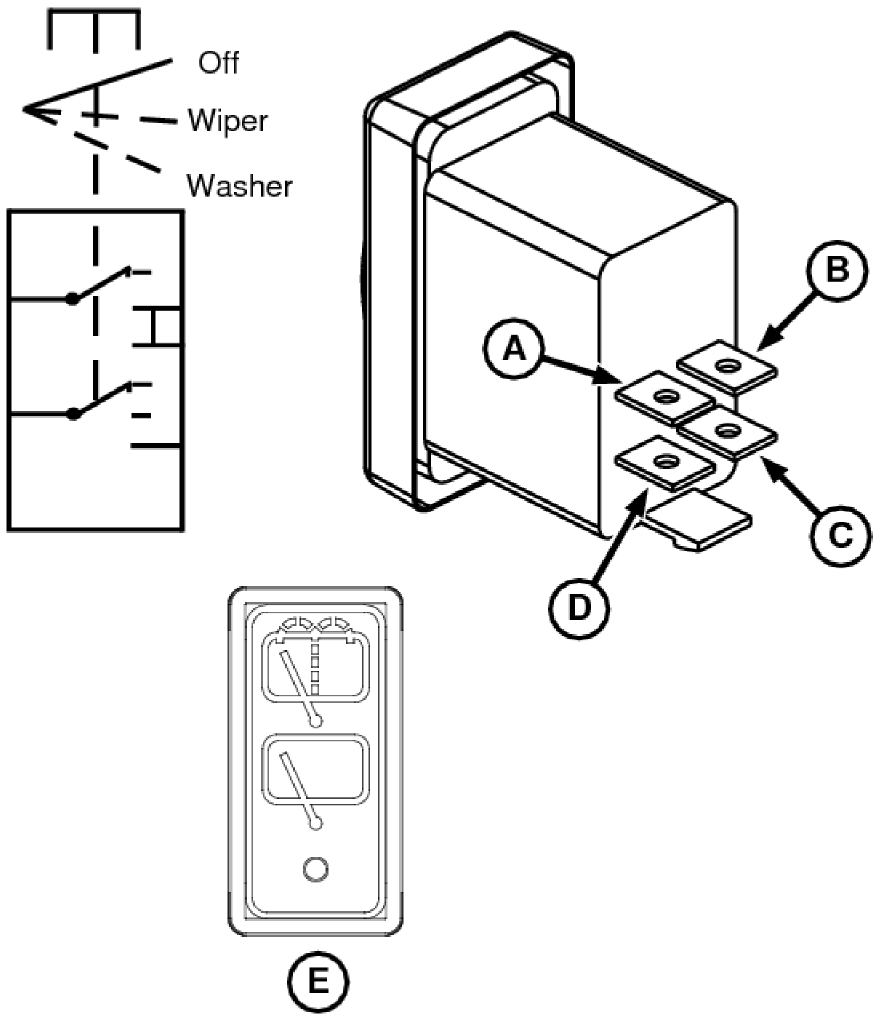
- Ohmmeter or multimeter

Test Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect washer/wiper switch from wiring harness.

[3] -



Rear Wiper Switch

LEGEND:

A	Terminal
B	Terminal
C	Terminal
D	Terminal
E	Rear Wiper/Washer Switch

Use an ohmmeter or multimeter to test switch continuity.

Wiper/Washer Switch Continuity

Wiper/Washer Switch Continuity	
Switch Position	Terminal Continuity
OFF	None
Wiper	A and D
Washer	B and C

Results

→NOTE:

This switch is a momentary switch in the wash position. The switch should return to the wiper position when released.

- If continuity is not correct or exists in any other combination than shown above, replace the switch.

Beacon Lamp Switch Test

Reason

To verify that the beacon lamp switch functions properly.

Equipment

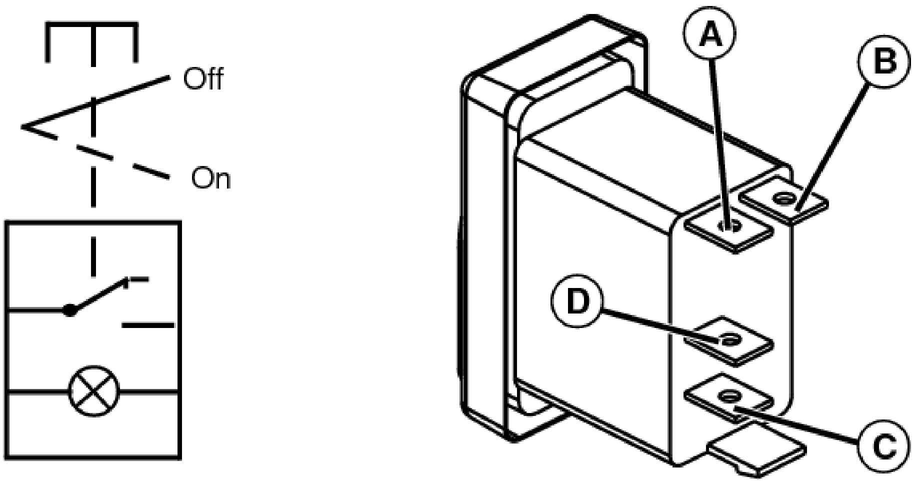
- Ohmmeter with diode check function

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect beacon lamp switch from wiring harness.

[3] -



Beacon Lamp Switch

LEGEND:

A	Terminal
B	Terminal
C	Terminal
D	Terminal

Use an ohmmeter or multimeter to test switch continuity.

[4] - Check LED with a diode tester across terminals (A and B). There should be continuity in one direction only.

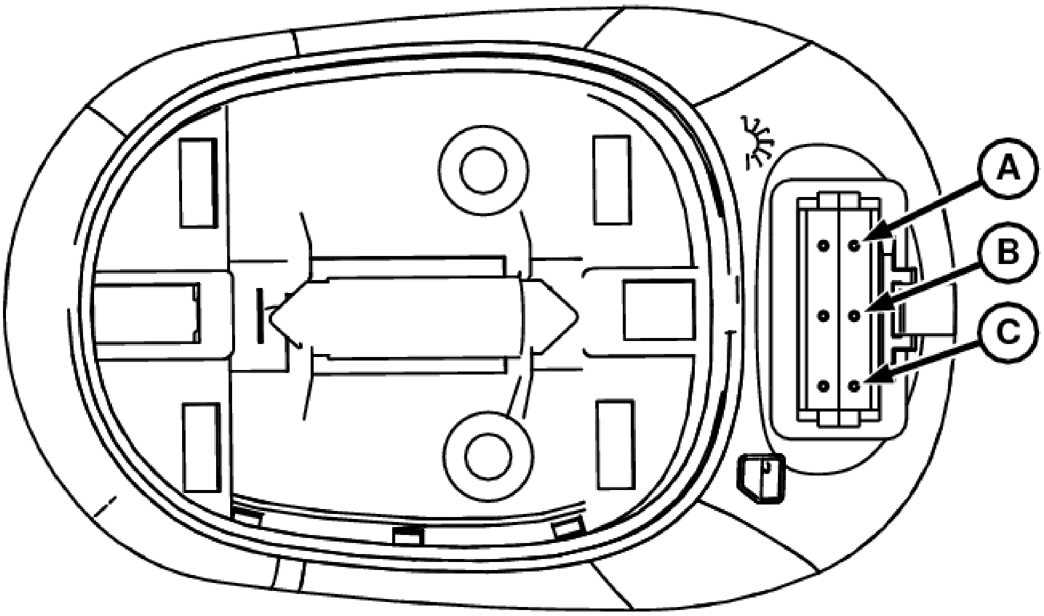
Beacon Lamp Switch Continuity

Beacon Lamp Switch Continuity	
Switch Position	Terminal Continuity
OFF	None
ON	C and D

Results

- If continuity is not correct or exists in any other combination than shown above, replace the switch.

Dome Light Switch Test



Dome Light Switch

LEGEND:

A	Terminal
B	Terminal
C	Terminal

Reason

To verify that dome light switch functions properly.

Equipment

- Ohmmeter or multimeter

Procedure

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Remove dome light cover and remove mounting screws.

[3] - Disconnect dome light from connector.

[4] - Check continuity across switch terminals (A and B) and (B and C). There should be no continuity in the off position.

[5] - Check continuity across switch terminals (B and C). There should be continuity in the on position.

[6] - Check continuity across switch terminals (A and B). There should be continuity in the door position.

Door Switch Test

Reason

To verify that the door switch functions properly.

Equipment

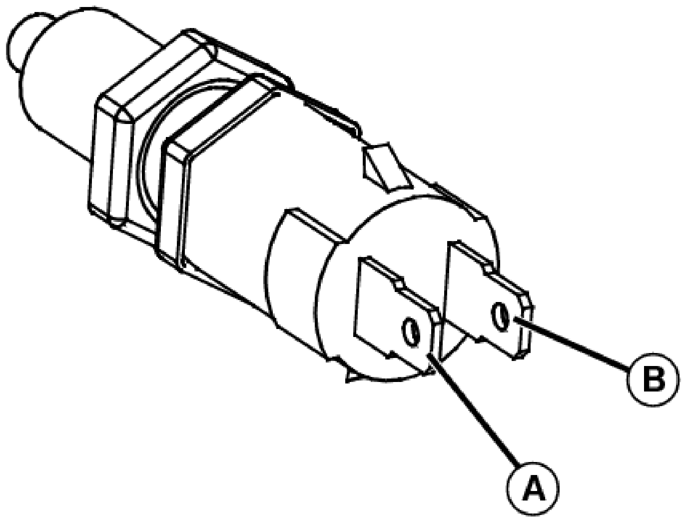
- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect door switch from wiring harness.

[3] -



Door Switch

LEGEND:

A	Terminal
B	Terminal

Use an ohmmeter or multimeter to test switch continuity.

Specification

Specification	
Switch Position	Terminal Continuity
Switch Released	A and B
Switch Depressed	No Continuity

Results

If continuity is not correct, replace switch.

Fan Speed Switch Test

Reason

To verify that the fan speed switch functions properly.

Equipment

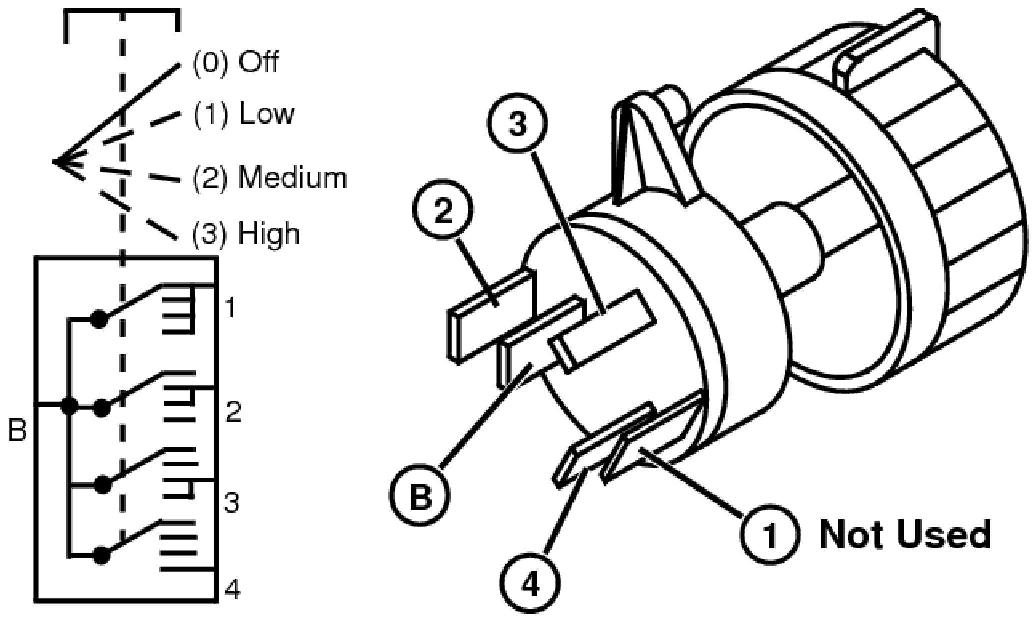
- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Remove blower switch from machine or disconnect wiring connector.

[3] -



Fan Speed Switch

LEGEND:

1	Terminal 1 (not used)
2	Terminal 2
3	Terminal 3
4	Terminal 4
B	Terminal B

Use and ohmmeter or multimeter to test switch continuity.

Fan Speed Switch Continuity

Fan Speed Switch Continuity	
Switch Position	Terminal Continuity
Off	B and 1
Low	B and 2
	B and 1
Medium	B and 2
	B and 3
	B and 1

Fan Speed Switch Continuity	
High	B and 3
	B and 4
	B and 1

Results

- If any continuity is not correct, replace the switch.

Diverter Valve Switch Test

Reason

To verify that the diverter valve switch functions properly.

Equipment

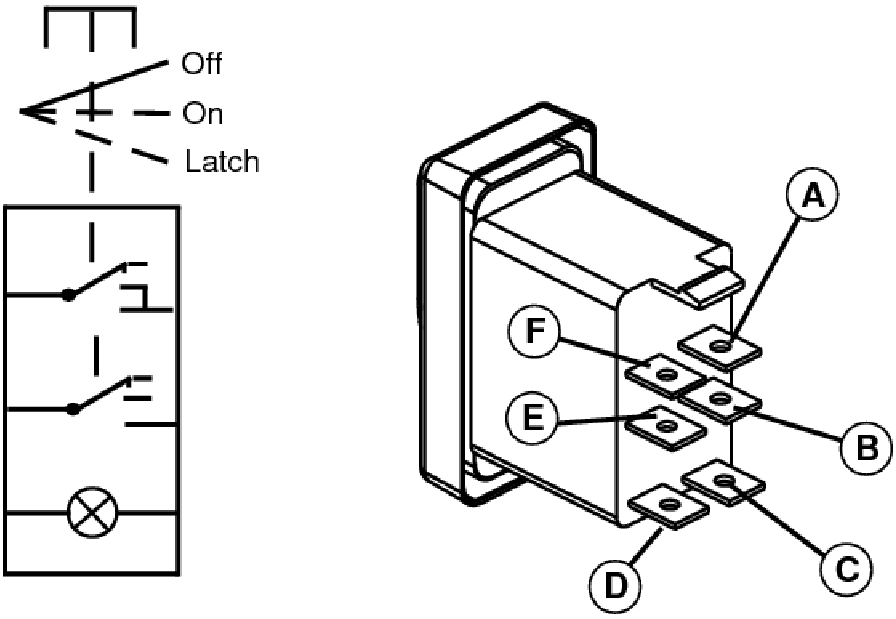
- Ohmmeter with diode test function

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Remove diverter valve from harness.

[3] -



Diverter Valve Switch

LEGEND:

A	Terminal
B	Terminal
C	Terminal
D	Terminal
E	Terminal
F	Terminal

Use ohmmeter to test switch continuity.

[4] - Check LED with a diode tester across terminals (C and D). There should be continuity in one direction only.

Diverter Valve Switch Continuity

Diverter Valve Switch Continuity	
Switch Position	Terminal Continuity
OFF	No Continuity (except terminals C and D in one direction only; see step 4).
Standby	A and B
ON	A and B
	E and F

Results

- If continuity is not correct or exists in any other combination than shown above, replace the switch.

A/C Temperature Control Switch Test

Reason

To verify that the A/C temperature control switch functions properly.

Equipment

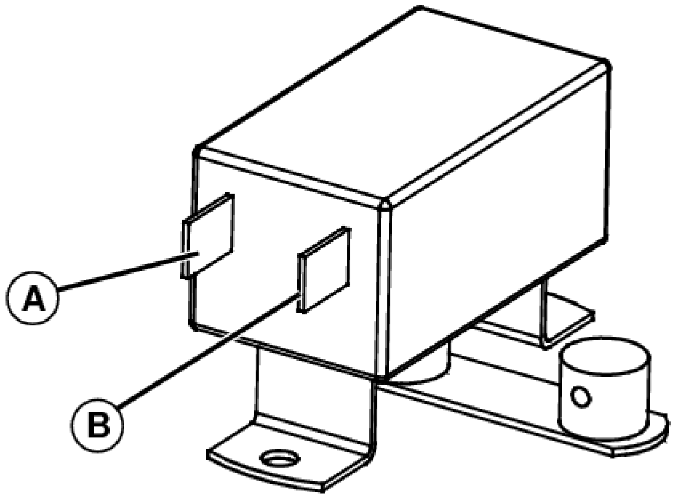
- Ohmmeter or multimeter
- Ice and saltwater solution
- Thermometer

Procedure

[1] - Disconnect switch from wiring harness.

[2] - Remove capillary tube from evaporator/heater core.

[3] -



A/C Temperature Control Switch

LEGEND:

A	Terminal
B	Terminal

Connect ohmmeter across switch terminals (A and B).

[4] - Warm end of capillary tube between hands. There should be less than 0.5 ohms across switch terminals.

Item	Measurement	Specification
A/C Temperature Control Switch	Resistance	Less than 0.5 Ohms

[5] - Insert capillary tube into ice and saltwater solution. Switch contacts should be open at -1°C (3°F) and close between 3°C (37°F) and 16°C (60°F), depending on the lever position.

Results

If continuity is not correct, replace switch.

Brake and Park Brake Switch Test

Reason

To verify that the brake and park brake switches function properly.

Equipment

- Ohmmeter or multimeter

Test Procedure

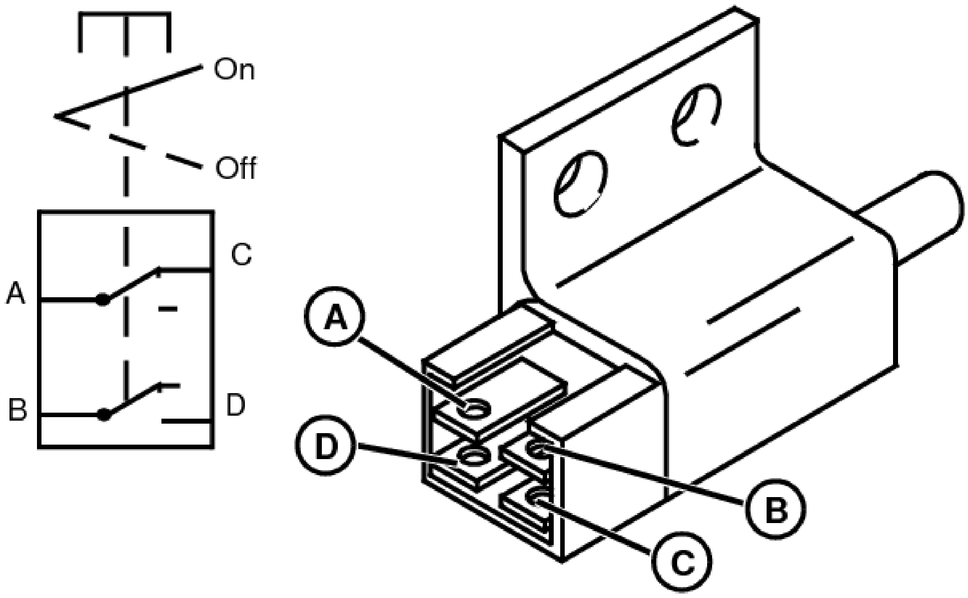
[1] - Park machine safely in neutral with park brake locked.

[2] - Access the park brake on the left side of the machine, behind the seat base close-out panel.

[3] - Access the brake switch on the left side of the machine under, the operator’s floor platform.

[4] - Disconnect switch to be tested from wiring harness.

[5] -



Brake and Park Brake Switch

LEGEND:

A Terminal
B Terminal
C Terminal
D Terminal

Use an ohmmeter or multimeter to test switch continuity.

Switch Continuity

Switch Continuity	
Switch Position	Terminal Continuity
Released	A and D
Pressed	B and C

Results

- If continuity is not correct or exists in any other combination than shown above, replace the switch.

Air Filter Restriction Switch Test

Reason

To determine if the air filter restriction switch is detecting air flow resistance through the air filter.

Equipment

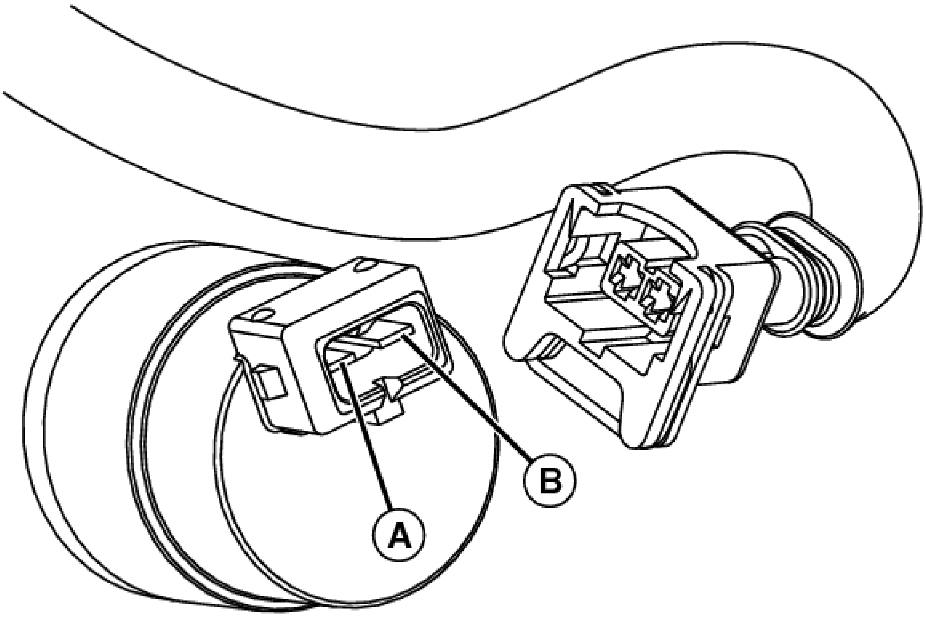
- Ohmmeter or multimeter
- A piece of cardboard or plywood to cover the air cleaner intake tube

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood and secure with prop rod.

[3] -



Air Filter Restriction

LEGEND:

A	Terminal
B	Terminal

Disconnect air filter restriction switch and connect ohmmeter test leads across switch terminals (A and B).

[4] - Start and operate engine at slow idle.

[5] - Cover the air cleaner intake tube with a piece of cardboard or plywood.

[6] - Move throttle lever to fast idle.

[7] - Observe ohmmeter reading.

Results

- There should be no continuity present when the air intake tube is open for full air flow. If continuity is present, replace air filter restriction switch.
- There should be continuity present when the air intake tube is blocked with the cardboard or plywood. If no continuity is present, replace air filter restriction switch.

Fuel Gauge Sensor Test

Reason

To verify that the fuel gauge sensor is operating properly.

Equipment

- JDG1575 Breakout Box and Speed Sensor Harness
- Multimeter

Test Procedure

[1] - Park machine safely in neutral with park brake locked.

→NOTE:

When the fuel tank is full, the fuel gauge needle will not move from the full mark until approximately four gallons of fuel are removed or consumed.

→NOTE:

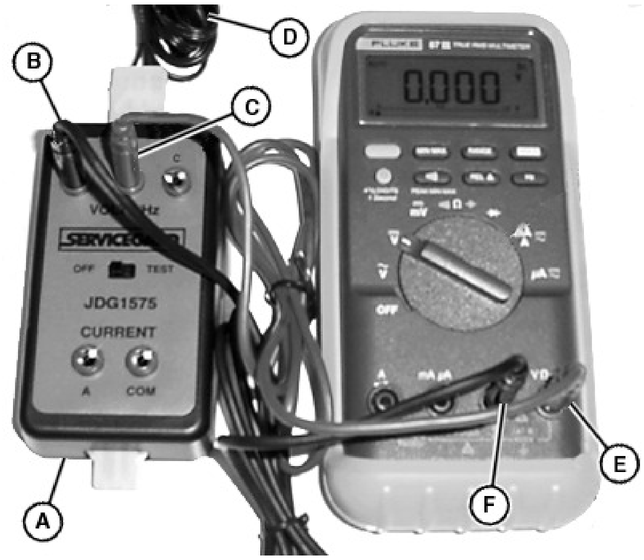
If the engine runs out of fuel and the fuel gauge shows there is fuel still in the tank, check if the fuel supply line and the fuel return line are crossed at the fuel tank.

[2] - Locate and disconnect the main harness-to-fuel sensor harness 3-pin connector.

[3] - Turn key switch to the on position.

[4] - Measure voltage across the disconnected main harness connector terminals containing the red and black wires. Battery voltage should be indicated. 12 VDC is nominal.

[5] -



LEGEND:

A	JDG1575 Breakout Box
B	A Terminal
C	B Terminal
D	3-Pin Extension Harness
E	Red Lead
F	Black Lead

Fuel Gauge Sensor

If the supply voltage and ground exists at fuel gauge sensor connector, perform the following:

a. Turn key switch to the off position.
b. If fuel tank is less than half full, drain tank completely.
c. If fuel tank is more than half full, fill tank to full level.

[6] - Connect the JDG1575 jumper harness labeled “Speed Sensors” to the main harness 3-pin connector and to the fuel sensor 3-pin connector.

[7] - Connect 3-pin extension harness (D) to JDG1575 breakout box (A) and to the JDG1575 jumper harness.

[8] - To measure voltage of fuel gauge sensor, connect multimeter leads to JDG1575 breakout box as follows:

- Connect red lead (E) to B terminal (C).
- Connect black lead (F) to A terminal (B).

[9] - Turn key switch to the on position and wait approximately 50 seconds before taking reading. Compare reading to specification.

Item	Measurement	Specification
Fuel Gauge Sensor	Voltage	0.9—1.1 VDC = Empty Tank
		3.4—3.9 VDC = Full Tank (No. 1 Diesel)
		3.7—4.1 VDC = Full Tank (No. 2 Diesel)

[10] -

→NOTE:

When the fuel level changes, the change in reading from the fuel gauge sensor will have a slight delay.

While reading fuel gauge sensor voltage, add fuel until tank is full or remove fuel until tank is empty, depending on starting point of fuel level. Voltage should go up or down, respectively.

Results

- If all voltage readings are within specification but fuel gauge still does not operate correctly, reprogramming the instrument cluster controller (ICC) may be necessary. Download the ICC payload using Service ADVISOR ™ and upload it to the ICC.
- If voltage is outside of specifications listed, measure resistance of 2353 Orange wire , 0050C Black wire , and 0562A Red wire when key switch is off. Resistance must not be more than 0.2 ohms plus resistance of multimeter leads.
- If voltage does not meet specification per amount of fuel in tank, replace fuel gauge sensor.

Fuel Shutoff Solenoid Test

Reason

To verify that the fuel shutoff solenoid is operating properly.

Equipment

- Ohmmeter

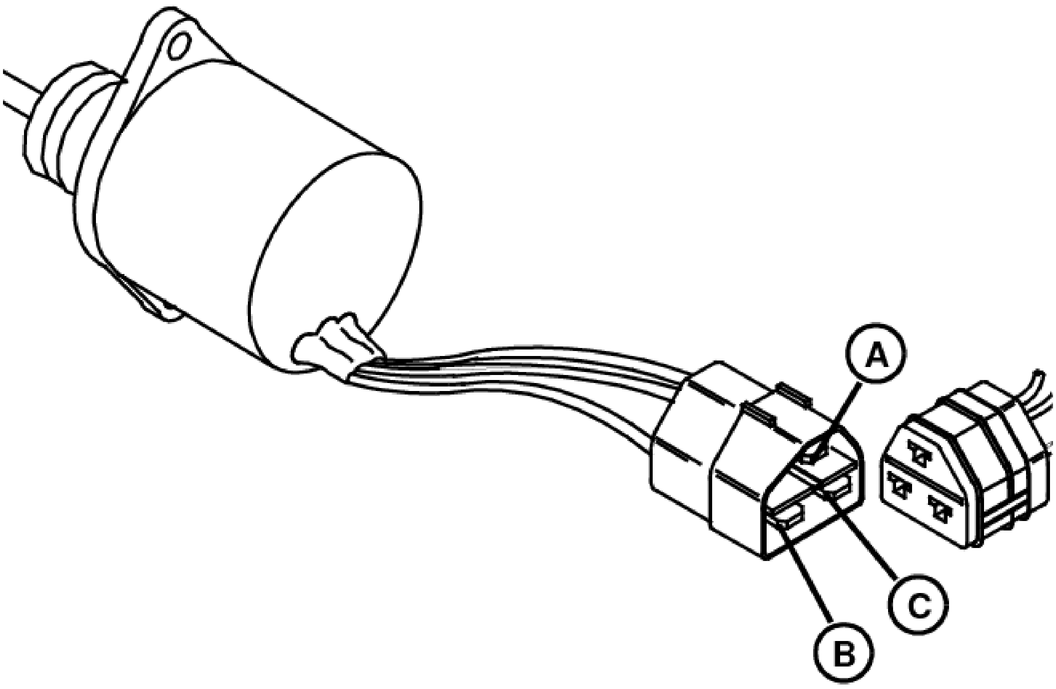
Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood and secure with prop rod.

[3] - Locate the fuel shutoff solenoid connector under the air cleaner and disconnect fuel shutoff solenoid connector.

[4] -



Fuel Shutoff Solenoid

LEGEND:

A	Terminal with Blk Wire
B	Terminal with Red Wire
C	Terminal with Wht Wire

Measure and record the resistance across each combination of terminals as listed below.

[5] - The red lead (+) position of the meter is listed down the side and the black lead (-) position of the meter is listed across the top of the chart.

Fuel Shutoff Solenoid

	Blk Wire (A)	Red Wire (B)	Wht Wire (C)
Blk Wire (A)		12	0.4
Red Wire (B)	12		12.4
Wht Wire (C)	0.4	12.4	

[6] - Connect fuel shutoff solenoid connector.

Results

If continuity is not correct, replace fuel shutoff solenoid.

A/C (HVAC) Switch Test

Reason

To verify proper operation of the A/C (HVAC) switch.

Equipment

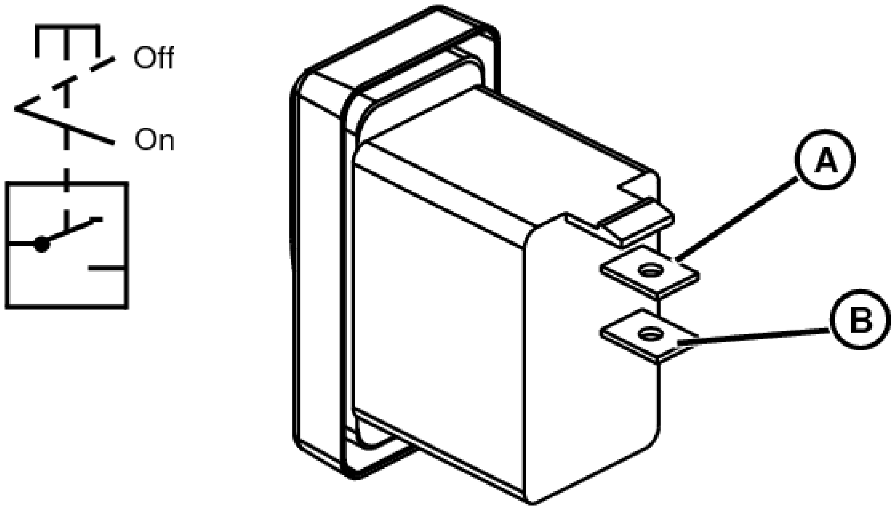
- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect A/C switch from wiring harness.

[3] -



A/C (HVAC) Switch

LEGEND:

A	Terminal
B	Terminal

Check continuity across switch terminals (A and B). There should be no continuity in the off position.

[4] - Toggle the switch to the on position. Continuity should exist between terminals (A and B).

Results

- If continuity is not correct, replace A/C (HVAC) switch.

Rear Work Light Switch Test

Reason

To verify proper operation of the rear work light switch.

Equipment

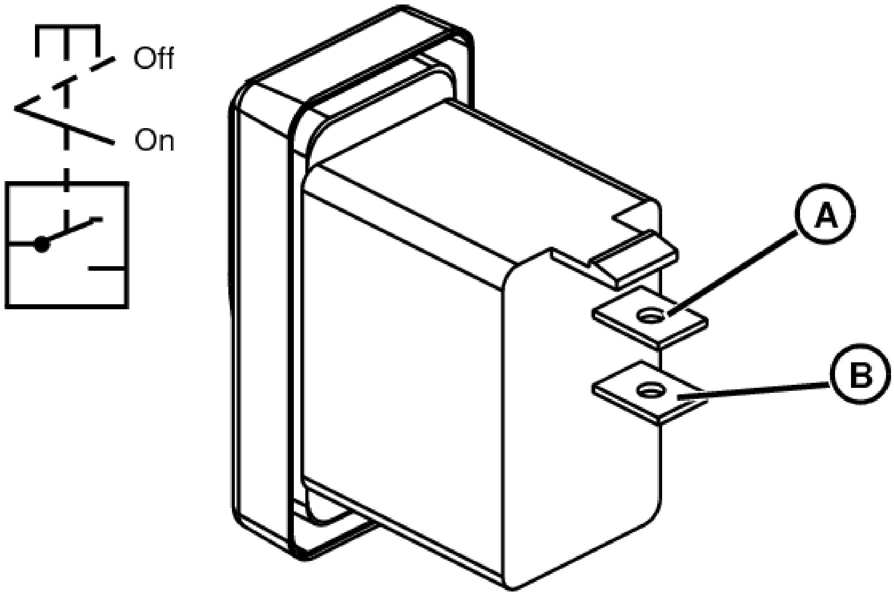
- Ohmmeter or multimeter

Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Disconnect rear work light switch from wiring harness.

[3] -



Rear Work Light Switch

LEGEND:

A	Terminal
B	Terminal

Check continuity across switch terminals (A and B). There should be no continuity in the off position.

[4] - Toggle the switch to the on position. Continuity should exist between terminals (A and B).

Results

- If continuity is not correct, replace rear work light switch.

Diode Test

Reason

To verify that diode has proper continuity.

Equipment

- Ohmmeter or multimeter

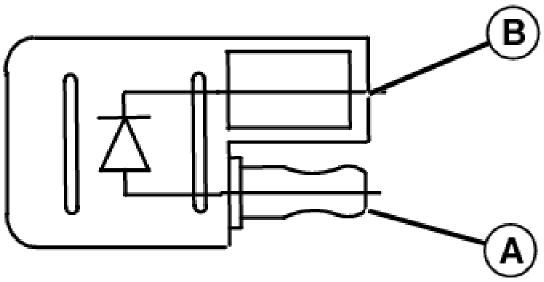
Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Raise hood.

[3] - Remove diode from connector.

[4] -



Diode Test

LEGEND:

A	Pin
B	Pin

Connect ohmmeter red (+) lead to pin (A) of diode.

[5] - Connect ohmmeter black (-) lead to pin (B) of diode. Check for continuity.

[6] - Reverse test leads. Check for continuity.

Results

Diode must have continuity in one direction only. Replace defective diode.

Proportional Drive Solenoid Test

Reason

To verify proper operation of the proportional drive solenoid coil.

Equipment

- Ohmmeter or multimeter

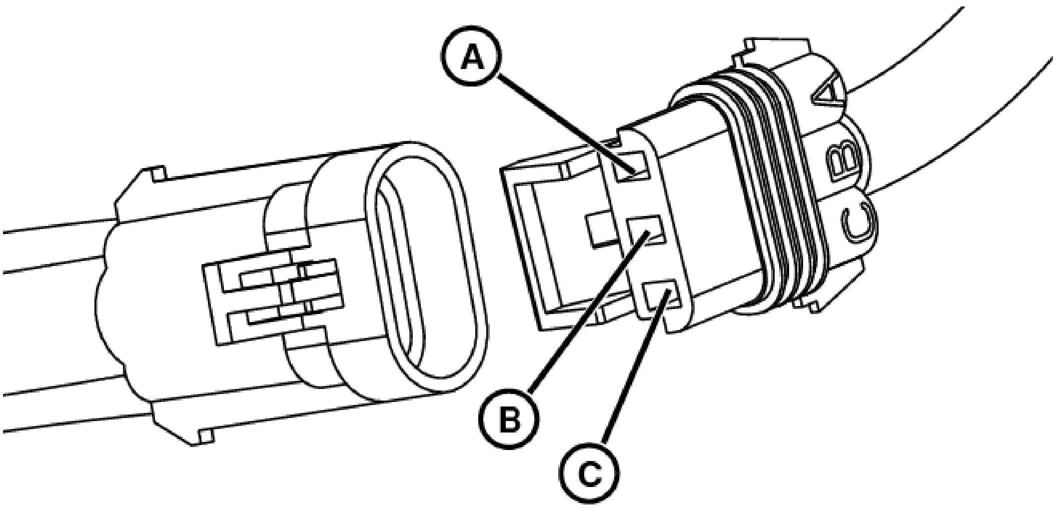
Procedure

[1] - Park machine safely in neutral with park brake locked.

[2] - Access the connector to the drive solenoids on the right side of the machine, under the operator’s floor platform.

[3] - Disconnect the valve wiring harness from the main wiring harness.

[4] -



Proportional Drive Solenoid

LEGEND:

A	Blu Wire
B	Pur Wire
C	Blk Wire

Use an ohmmeter or multimeter to check if continuity exists between connector terminals.

[5] - If resistance does not meet specifications or is present in any other combination, replace solenoid.

Item	Measurement	Specification
C (Blk wire) to A (Blu wire)	Resistance	3.85 ± 1.0 ohms
C (Blk wire) to B (Pur wire)	Resistance	3.85 ± 1.0 ohms
A (Blu wire) to B (Pur wire)	Resistance	7.7 ± 1.0 ohms

Horn Switch Test

Reason

To verify that the horn switch is operating properly.

Equipment

- Ohmmeter or multimeter

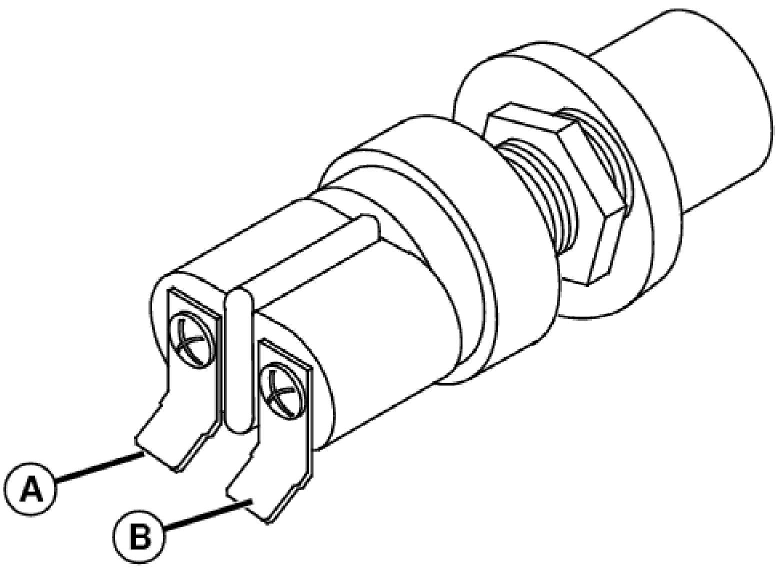
Procedure

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Remove instrument panel enough to remove horn switch.

[3] - Disconnect the horn switch connectors from the switch.

[4] -



Horn Switch Test

LEGEND:

A	Terminal
B	Terminal

With the button released, check continuity across both switch terminals (A and B). There should be no continuity.

[5] - Depress the horn switch button. Continuity should exist between both terminals (A and B).

Results

- If continuity is not correct, replace horn switch.

HST Proportional Solenoid Test

The Electronic Control Test Kit (JDG1575) can be used to test the proportional solenoids. The proportional solenoids are tested based upon the proper current flow during a drive function.

Electronic Control Test Kit

JDG1575

Test the proportional solenoids

Test Conditions

- Machine on jack stands.
- Operator on seat.
- Engine running with throttle at slow idle.
- Drive pedal for solenoid being tested in the BOT position.
- Range selector lever in neutral position.
- Park brake unlocked.
- HST Adapter (JDG1575-20) connected to proportional solenoid and connector box.

  HST Adapter

  JDG1575-20

  Connect to proportional solenoid and connector box
- Red lead connected to multimeter and connector box.
- Black lead connected to multimeter and connector box.

Procedure

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] -

CAUTION:

Avoid Injury! Position machine safely on jack stands so that ALL four wheels spin freely.

Install jack stands under machine so that ALL wheels are off the ground and are free to spin.

[3] - Disconnect throttle position sensor connector to disable the LoadMatch feature.

[4] -

LEGEND:

A	A Input Jack
B	A Terminal
C	COM Input Jack
D	COM Terminal
E	2-Pin Extender Harness
F	2-Pin Connector
G	Multimeter Selector
H	Off Position

Multimeter

Connect the red lead to the A input jack (A) of the multimeter and the current A terminal (B) of the connector box.

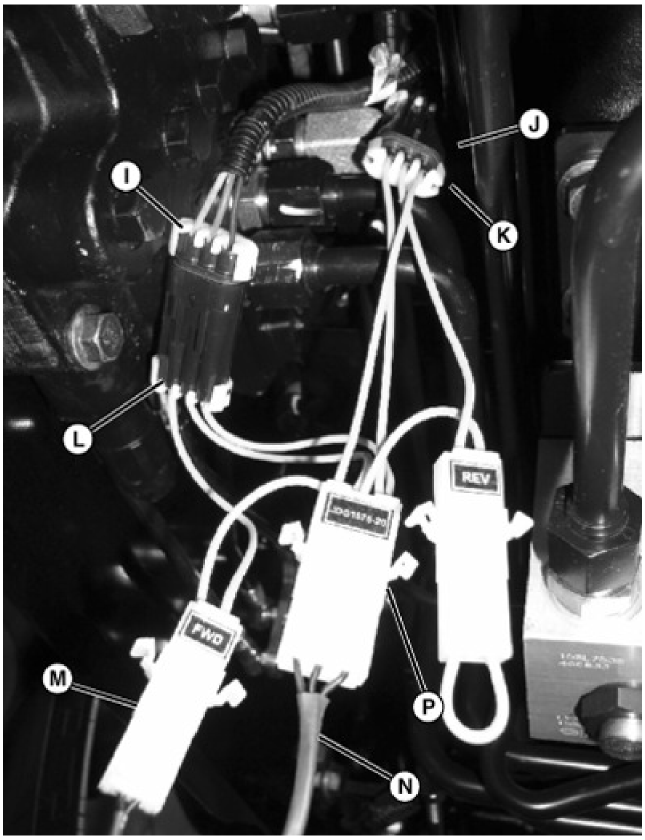
[5] - Connect the black lead to the COM input jack (C) of the multimeter and the current COM terminal (D) of the connector box.

[6] - Connect the 2-pin extender harness (E) into the 2-pin connector (F) of the connector box.

[7] - Set the multimeter selector (G) to the mA position.

[8] - Set breakout box switch to the off position (H).

[9] -



LEGEND:

I	Machine Wiring Harness
J	Proportional Solenoid Wiring Harness
K	Male Connector
L	Female Connector
M	Extender Harness Connector
N	3-Pin Extender Harness

Proportional Solenoid Harness

Disconnect the machine wiring harness (I) from the proportional solenoid wiring harness (J).

[10] - Connect the male connector (K) of the HST adapter harness (JDG1575-20) into the proportional solenoid wiring harness (J).

Electronic Control Analyzer

JDG1575

Used to test HST proportional solenoid.

[11] - Connect the female connector (L) of the HST adapter harness (JDG1575-20) into the proportional solenoid wiring harness (J).

[12] - Unplug the short jumper connector from the HST adapter harness connector (labeled FWD for the forward proportional solenoid or REV for the reverse proportional solenoid) and connect the HST adapter harness connector to the extender harness connector (M).

[13] - Start and run the engine at slow idle.

[14] - Unlock the park brake and push the forward drive pedal (when testing the forward proportional solenoid) or reverse drive pedal (when testing the reverse proportional solenoid) to the BOT position.

[15] -

→NOTE:

If the proportional solenoid or valve needs to be replaced, then the automatic calibration must also be performed after all repairs have been completed to allow the HST controller to match the new component characteristics. (See Power Train Hydrostatic (PTH) Control Unit—System Calibration .

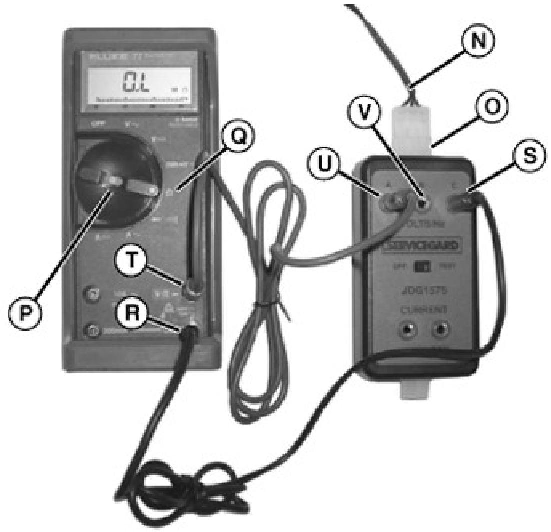
The amperage reading (BOT amperage) across the A and COM terminals of the connector box should be at specification. If the reading is out of specification, proceed to next step.

[16] - Release the drive pedal being tested, lock the park brake, and stop engine.

[17] - Disconnect the extender harness from the HST adapter harness and install a short jumper connector (REV or FWD) into the HST adapter harness.

[18] - Connect the 3-pin extender harness (N) to the 3-pin connector (O) of the connector box and the HST adapter harness 3-pin connector.

[19] -



LEGEND:

N	3-Pin Extender Harness
O	3-Pin Connector
P	Multimeter Selector
Q	Ohm Position
R	COM Input Jack
S	Volt C Terminal
T	Ohm Input Jack
U	Volt A Terminal
V	Volt B Terminal

Multimeter

Set the multimeter selector (P) to the Ohm position (Q).

[20] - Connect the black test lead to the COM input jack (R) of the multimeter and the volt C terminal (S) of the connector box.

[21] - Connect the red test lead to the Ohm input jack (T) of the multimeter and the appropriate terminal on the connector box (depending on which solenoid is being tested).

a. Red lead to volt A terminal (U) on connector box for forward proportional solenoid.
b. Red lead to volt B terminal (V) on connector box for reverse proportional solenoid.

[22] - The resistance reading across the terminals (S and U or S and V) of the connector box should be within specifications. If resistance across terminals is not within specifications, test proportional solenoid wire harness.

[23] - If necessary, repeat procedure for the other proportional solenoid.

[24] - Connect throttle position sensor connector.

Item	Measurement	Specification
BOT	Amperage	1800 mA
Proportional Drive Solenoid	Resistance	3.85 ± 1 Ohms

Test Kit

Function

An alternate method to test and set the voltage readings on the sensors.

Use the diagnostic mode within the drive controller and display panel to diagnose drive failures. (See Entering Diagnostic and Calibration Modes in Section 40, Group 35.) The diagnostic mode will provide a reading of current drive component operating values such as voltage, current, or frequency.

Equipment

- JDG1575 Test Kit

Theory

The test kit is intended to be used to adjust and diagnose the operational components used to engage and control the hydrostatic transmission.

With the proper adapter harnesses connected to connector box, the following components can be tested and/or adjusted:

Electronic Control Analyzer

JDG1575

Test Sensors

- Throttle position sensor, test for voltage.
- Forward pedal position sensor, test for voltage.
- Reverse pedal position sensor, test for voltage.
- MFWD speed sensor, test for frequency.

Throttle Position Sensor Test and Adjustment

Purpose

The throttle position sensor is tested based upon the proper voltage input and output with the throttle in the slow idle and fast idle positions.

The display panel (Diagnostic mode 2, preferred method), Service ADVISOR, or the test kit (JDG1575) can be used to test the throttle position sensor.

Test Conditions

- Key switch in run position, engine not running.
- Throttle against stop in slow idle position.
- Drive pedals in neutral position.
- Park brake locked.

Procedure—Diagnostic Mode 2

[1] - Verify that engine speed is set within specification. See Engine section.

[2] - Park machine safely and set to test conditions.

[3] - Enter Diagnostic mode 2.

[4] - Toggle the right turn signal switch to display position 24 (tP__X.X) for throttle position.

[5] - Verify that the throttle lever is in the slow idle position and note the voltage on the display panel.

[6] - Move the throttle lever to the high idle position and note the voltage on the display panel.

[7] - If the voltage readings are not within specification, see Throttle Sensor Specifications, To adjust the throttle position sensor, see Throttle Sensor Adjustment.

Test Conditions

- Key switch in run position, engine not running.
- Throttle against stop in slow idle position.
- Drive pedals in neutral position.
- Park brake locked.
- Position sensor adapter connected to throttle position sensor and 3-pin extender harness.
- Red lead connected to multimeter and connector box.
- Black lead connected to multimeter and connector box.

Procedure—Test Kit

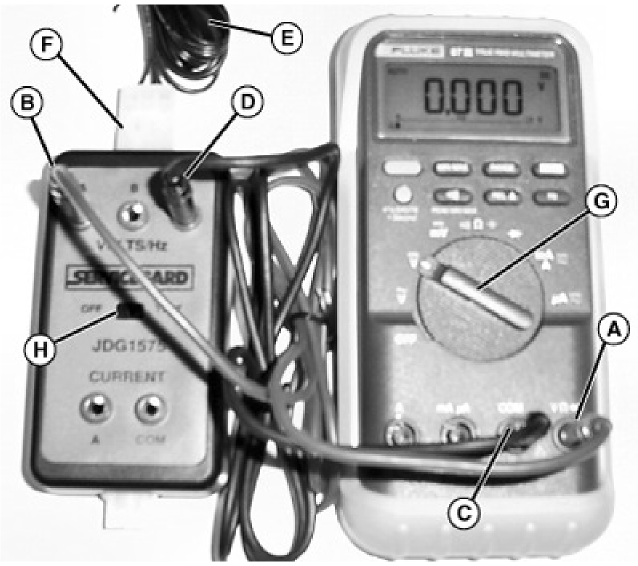
- Test equipment
- JDG1575 Test Kit

  Electronic Control Analyzer

  JDG1575

  Use to test throttle position sensor.

[1] -



LEGEND:

A	Hz Input Jack
B	Voltage A Terminal
C	COM Input Jack
D	Voltage C Terminal
E	3-Pin Extender Harness
F	3-Pin Connector
G	Multimeter Selector
H	Off Position

Multimeter

Verify that engine speed is set within specification. See Engine section.

[2] -

→NOTE:

Make sure that key switch is OFF when disconnecting sensor. If key switch is in run position and sensor connector is disconnected for longer than 3 seconds, the sensor will have to be calibrated. (See <u>Power Train Hydrostatic (PTH) Control Unit—System Calibration</u> .

Park machine safely and set to test conditions.

[3] - Connect the red lead to the Volt, Ohms, Hz input jack (A) of the multimeter and the voltage A terminal (B) of the connector box.

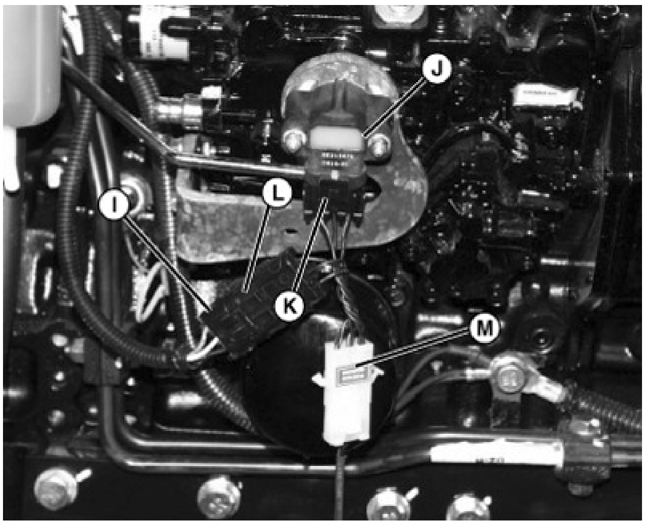
[4] - Connect the black lead to the COM input jack (C) of the multimeter and the voltage C terminal (D) of the connector box.

[5] - Connect the 3-pin extender harness (E) into the 3-pin connector (F) of the connector box.

[6] - Set the multimeter selector (G) to the DCV position.

[7] - Set breakout box switch to off position (H).

[8] -



LEGEND:

I	Machine Wiring Harness
J	Throttle Position Sensor
K	Male Connector
L	Female Connector
M	Connector

Wiring Harness

Disconnect the machine wiring harness (I) from the throttle position sensor (J).

[9] - Connect the male connector (K) of the position sensor adapter into the throttle position sensor (J) and the female connector (L) into the machine wiring harness (I).

[10] - Plug the connector (M) into the extender harness.

[11] - Turn the key switch to the run position.

[12] - The voltage reading (input voltage) across the A and C terminals of the connector box should be at specification. If not, test the power circuit.

[13] -

LEGEND:

B	A Terminal
N	B Terminal

Multimeter

Move the red lead on the connector box from the A terminal (B) to the B terminal (N).

[14] -

→NOTE:

If the sensor needs to be replaced or adjusted, perform the sensor calibration. (See Power Train Hydrostatic (PTH) Control Unit—System Calibration .

The voltage reading (slow idle position signal voltage) across the B and C terminals of the connector box should be to specification. If not, adjust the throttle position sensor to specification.

[15] - Move the throttle lever to the fast idle position. The voltage reading (fast idle position signal voltage) across the B and C terminals of the connector box should be to specification. If not, adjust the throttle position sensor to specification.

[16] -

→NOTE:

Make sure that key switch is in the off position when disconnecting sensor. If key switch is in the run position and sensor connector is disconnected for longer than 3 seconds, the sensor will have to be manually calibrated.

Turn the key switch to the off position.

[17] - Disconnect the position sensor adapter harness from the machine wiring harness and the position sensor. Connect the machine wiring harness to the position sensor.

Throttle Sensor Adjustment

[1] - If the voltage reading is not within specification, loosen the lock nuts enough that the sensor will stay in place without turning, but can be rotated by hand.

Item	Measurement	Specification
Throttle Position Sensor—Input	Voltage	5.0 ± 0.2 V
Throttle Position Sensor—Slow Idle Position Signal	Voltage	0.7—0.9 V
Throttle Position Sensor—Fast Idle Position Signal	Voltage	2.0—3.7 V greater than slow idle signal voltage

[2] - Rotate the sensor until the voltage reading is within specification. If the sensor cannot be rotated on the slots enough to meet specification, rotate the throttle adapter shaft on the throttle nut as needed to allow the sensor to meet specification. See Throttle Position Sensor Test and Adjustment, as needed to assist in rotating the throttle adapter shaft.

[3] -

IMPORTANT:

Avoid Damage! Torque specification is critical.

With the test kit still attached, tighten the two nuts to specification, being sure that the voltage reading does not change.

Item	Measurement	Specification
Lock Nut	Torque	5 N·m (44 lb.-in.)

Forward and Reverse Pedal Sensor Test and Adjustment

Purpose

The drive pedal sensors are tested based upon the proper voltage input and output with the pedal in the released and pressed positions.

The display panel (Diagnostic mode 2, preferred method), Service ADVISOR, or the test kit (JDG1575) can be used to test the drive pedal sensor.

Test Conditions

- Key switch in run position, engine not running.
- Throttle against stop in slow idle position.
- Drive pedals in neutral position.
- Park brake locked.

Procedure—Diagnostic Mode 2

[1] - Park machine safely and set to test conditions.

[2] - Enter Diagnostic mode 2.

[3] - Toggle the right turn signal switch to display position 17 (FP__X.X) for forward or position 18 (rP__X.X) for reverse.

[4] - Verify the drive pedal being tested is in the neutral position and note the voltage on the display panel.

[5] - Fully depress the drive pedal being tested and note the voltage on the display panel.

[6] - If the voltage readings are not within specification, see Power Train Hydrostatic (PTH) Control Unit—System Calibration, and adjust the throttle position sensor. (See Throttle Position Sensor Test and Adjustment in Section 40, Group 35.)

Test Conditions

- Key switch in run position, engine not running.
- Drive pedals released.
- Range transmission in neutral.
- Park brake locked.
- Position sensor adapter connected to forward or reverse pedal position sensor and 3-pin extender harness.
- Red lead connected to multimeter and connector box.
- Black lead connected to multimeter and connector box.

Procedure—Test Kit

Test Equipment JDG1575 Test Kit

Electronic Control Analyzer

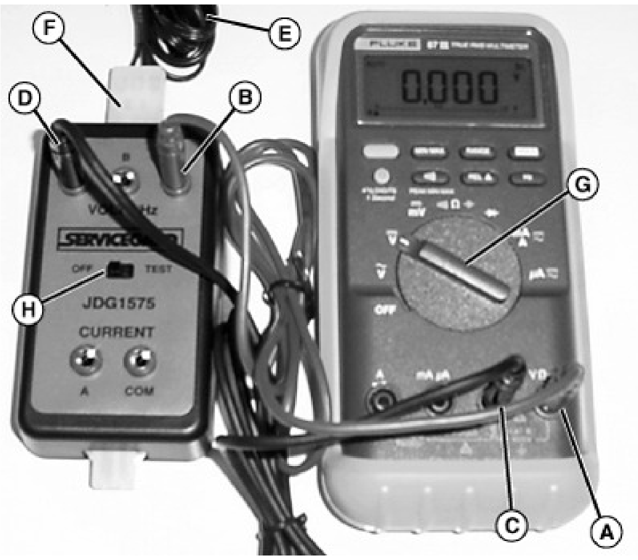
JDG1575

Used to test forward and reverse pedal sensor.

[1] -

→NOTE:

Make sure key switch is in the off position when disconnecting sensor. If key switch is in the run position and sensor connector is disconnected for longer than 3 seconds, the sensor will have to be calibrated. (See Power Train Hydrostatic (PTH) Control Unit—System Calibration.



LEGEND:

A	Volt, Ohms, Hz Input Jack
B	Voltage C Terminal
C	COM Input Jack
D	Voltage A Terminal
E	3-Pin Extender Harness
F	3-Pin Connector
G	Multimeter Selector
H	Off Position

Multimeter

Park machine safely and set to test conditions.

[2] - Locate and remove cover from forward and reverse pedal bracket located under operator’s platform.

[3] - Connect the red lead to the Volt, Ohms, Hz input jack (A) of the multimeter and the voltage C terminal (B) of the connector box.

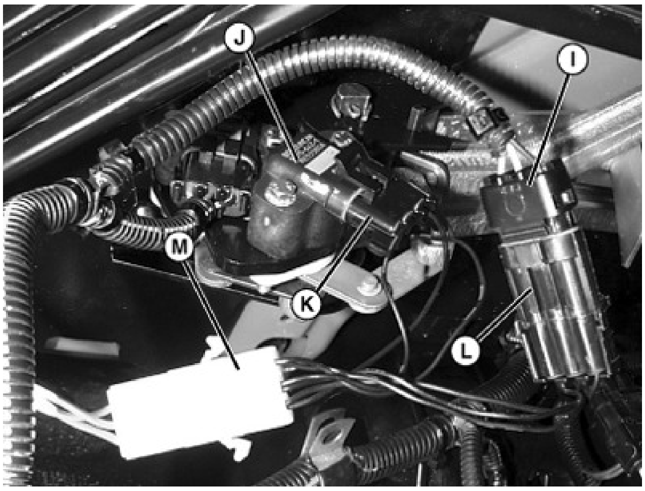
[4] - Connect the black lead to the COM input jack (C) of the multimeter and the voltage A terminal (D) of the connector box.

[5] - Connect the 3-pin extender harness (E) into the 3-pin connector (F) of the connector box.

[6] - Set the multimeter selector (G) to the DCV position.

[7] - Set breakout box switch to off position (H).

[8] -



LEGEND:

I	Machine Wiring Harness
J	Reverse Pedal Sensor
K	Male Connector
L	Female Connector
M	Connector

Machine Harness

Unplug the machine wiring harness (I) from the reverse pedal sensor (J).

[9] - Connect the male connector (K) of the position sensor adaptor into the reverse pedal sensor (J) and the female connector (L) into the machine wiring harness (I).

[10] - Plug the connector (M) into the extender harness.

[11] - Turn the key switch to the run position.

[12] - The voltage reading (input voltage) across the C and A terminals of the connector box should be at specification. If not, test the power circuit.

[13] -

LEGEND:

B	C Terminal
N	B Terminal

Multimeter

Move the red lead on the connector box from the C terminal (B) to the B terminal (N).

[14] -

→NOTE:

If the sensor needs to be replaced or adjusted, perform the sensor manual calibration. (See <u>Power Train Hydrostatic (PTH) Control Unit—System Calibration</u> .

The voltage reading (released position signal voltage) across the B and C terminals of the connector box should be at specification. If not, adjust the reverse pedal sensor to specification.

[15] - Fully press the reverse pedal. The voltage reading (pressed position signal voltage) across the B and A terminals of the connector box should be at specification. If not, and if the sensor has been adjusted correctly, replace the sensor.

[16] -

→NOTE:

Make sure key switch is in off position when disconnecting sensor. If key switch is in run position and sensor connector is disconnected for longer than 3 seconds, the sensor will have to be calibrated. (See <u>Power Train Hydrostatic (PTH) Control Unit—System Calibration</u> .

Turn key switch to off position.

[17] - Disconnect the position sensor adapter harness from the machine wiring harness and the reverse pedal position sensor, then connect the machine wiring harness to the reverse pedal position sensor.

[18] - Repeat this procedure for the forward pedal sensor.

Drive Pedal Sensor Adjustment

[1] - If the voltage reading is not within specification, loosen the lock nuts enough that the sensor will stay in place without turning, but can be rotated by hand.

Item	Measurement	Specification
Input	Voltage	5.0 ± 0.2 volts
Released Position Signal	Voltage	0.6—0.9 volts
Pressed Position Signal	Voltage	2.7—3.5 volts greater than released signal voltage

[2] - Rotate the sensor until the voltage reading is within specification.

[3] -

IMPORTANT:

Avoid Damage! Torque specification is critical.

With the test kit still attached, tighten the two nuts to specification, being sure that the voltage reading does not change.

Item	Measurement	Specification
Lock Nut	Torque	5 N·m (44 lb.-in.)

MFWD Speed Sensor Test

Purpose

The MFWD speed sensor is tested based upon the proper voltage input and frequency output during a drive function.

The display panel (Diagnostic mode 2, preferred method), Service ADVISOR, or the test kit (JDG1575) can be used to test the MFWD speed sensor.

Test Conditions

- Machine on jack stands.
- Operator on seat.
- Engine running with throttle at low idle.
- Forward pedal fully pressed.
- Transmission in gear position A.
- Park brake unlocked.

Procedure—Diagnostic Mode 2

[1] - Verify engine speed is set within specification.

[2] - Park machine safely and set to test conditions.

[3] - Enter Diagnostic mode 2.

[4] - Toggle the right turn signal switch to display position 11 (gSXXXX) for ground speed.

[5] - With the engine running at low idle and the range transmission in gear position A, fully depress the forward drive pedal and note the frequency reading on the display panel. Move the throttle lever to the high idle position and note display reading.

[6] - Release the drive pedal, move the throttle lever to the low idle position, and shift the range transmission to gear position B.

[7] - Release the drive pedal, move the throttle lever to the low idle position, and shift the range transmission to gear position C.

[8] - If the frequency readings are not within specification, see MFWD Specification, and replace the MFWD speed sensor.

Test Conditions

- Machine on jack stands.
- Operator on seat.
- Engine running with throttle at low idle.
- Forward pedal fully pressed.
- Transmission in gear position A.
- Park brake unlocked.
- Speed sensor adapter connected to MFWD sensor and 3-pin extender harness.
- Red lead connected to multimeter and connector box.
- Black lead connected to multimeter and connector box.

Procedure—Test Kit

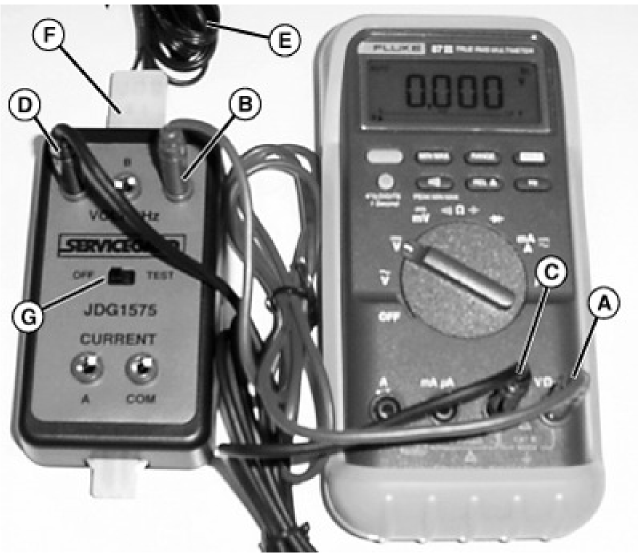
- Test equipment
- JDG1575 Test Kit

  Electronic Control Analyzer

  JDG1575

  Used to test MFWD Speed Sensor.

[1] -



LEGEND:

A	Hz Input Jack
B	Voltage C Terminal
C	COM Input Jack
D	Voltage A Terminal
E	3-Pin Extender Harness
F	3-Pin Connector
G	Off Position

Multimeter

Verify engine speed is set within specification.

[2] -

CAUTION:

Avoid Injury! Position machine safely on jack stands so that ALL four wheels spin freely.

Park machine safely and set to test conditions.

[3] - Install jack stands under machine so that ALL wheels are off the ground and are free to spin.

[4] - Connect the red lead to the volt, ohms, Hz input jack (A) of the multimeter and the voltage C terminal (B) of the breakout box.

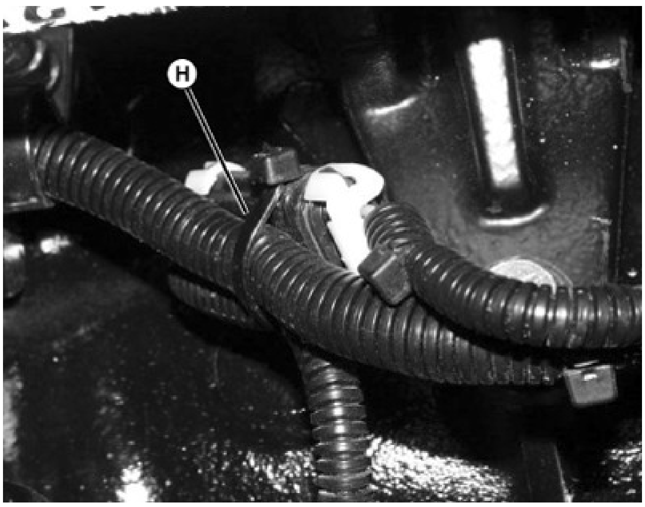
[5] - Connect the black lead to the COM input jack (C) of the multimeter and the voltage A terminal (D) of the breakout box.

[6] - Connect the 3- pin extender harness (E) into the 3- pin connector (F) of the breakout box.

[7] - Set the multimeter to measure DC volts.

[8] - Set breakout box switch to the off position (G).

[9] -



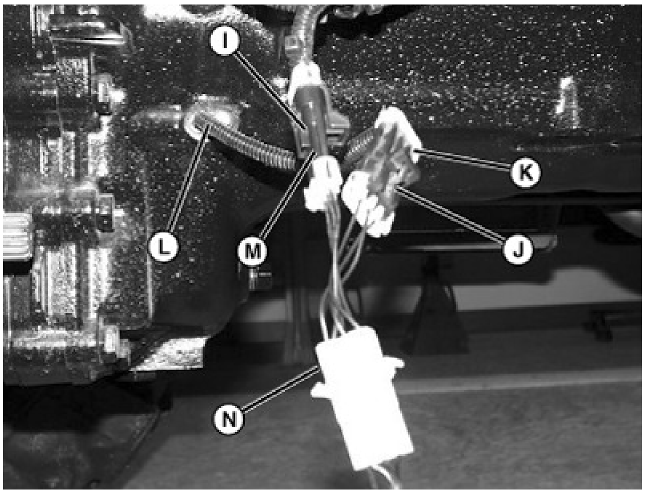
LEGEND:

H	Connector

Connector

Cut plastic tie securing MFWD connector (H).

[10] -



LEGEND:

I	Machine Wiring Harness
J	Male Connector
K	MFWD Speed Sensor Connector
L	MFWD Speed Sensor
M	Female Connector
N	Connector

Wiring Harness

Disconnect the machine wiring harness (I) from the MFWD speed sensor connector (K).

[11] - Connect the male connector (J) of the speed sensor adapter into the MFWD speed sensor (L) and the female connector (M) into the machine wiring harness (I).

[12] - Plug the connector (N) into the extender harness.

[13] - Start and run the engine at low idle.

[14] - Unlock the park brake.

[15] - Place the range transmission in gear position A.

[16] - Press and hold the forward drive pedal at the full drive position.

[17] - The voltage reading (input voltage) across the A and C terminals of the connector box should be at specification. If not, test the power circuit.

[18] - Release the forward drive pedal.

[19] -

LEGEND:

B	C Terminal
O	B Terminal

Multimeter

Set the multimeter to measure frequency (Hz).

[20] - Move the red lead on the connector box from the C terminal (B) to the B terminal (O).

[21] - Press and hold the forward drive pedal at the full drive position.

[22] - The frequency reading (terminals A to B signal Hz at low idle) should be at specification. If not, replace the MFWD speed sensor.

[23] - Move the throttle lever to the high idle position.

[24] - The frequency reading (terminals A to B signal Hz at high idle) should be at specification. If not, replace the MFWD speed sensor.

[25] - Release the forward drive pedal and move the throttle lever to the low idle position.

[26] - Place the range transmission in gear position B.

[27] - The frequency reading (terminals A to B signal Hz at low idle) should be at specification. If not, replace the MFWD speed sensor.

[28] - Move the throttle lever to the high idle position.

[29] - The frequency reading (terminals A to B signal Hz at high idle) should be at specification. If not, replace the MFWD speed sensor.

[30] - Release the forward drive pedal and move the throttle lever to the low idle position.

[31] - Place the range transmission in gear position C.

[32] - The frequency reading (terminals A to B signal Hz at low idle) should be at specification. If not, replace the MFWD speed sensor.

[33] - Move the throttle lever to the high idle position.

[34] - The frequency reading (terminals A to B signal Hz at high idle) should be at specification. If not, replace the MFWD speed sensor.

[35] - Release the forward drive pedal and move the throttle lever to the low idle position.

[36] - Lock the park brake and stop engine.

[37] - Disconnect the speed sensor adapter harness from the machine wiring harness and the MFWD speed sensor.

[38] - Connect the machine wiring harness to the MFWD speed sensor. Secure with plastic tie.

Item	Measurement	Specification
MFWD		
Input	Voltage	5.0 ± 0.2 volts
Gear A	Frequency at Low Idle	233 ± 0.1 kHz
Gear A	Frequency at High Idle	650 ± 2.0 kHz
Gear B	Frequency at Low Idle	414 ± 0.1 kHz
Gear B	Frequency at High Idle	710 ± 2.0 kHz
Gear C	Frequency at Low Idle	970 ± 0.1 kHz
Gear C	Frequency at High Idle	2923 ± 2.0 kHz

Section 50 - ELECTRICAL - EEC

Table of contents

Group 05 - European Electrical Section

European Electrical Theory

The European road machines have the same electrical circuits as the North American machines with the addition of lighting circuits required to meet EEC Machinery Directives.

The main electrical wiring harness is specific to the European models, and is identical among all of the European 3000 Twenty series machines.

Lighting additions include the hazard lights switch, flasher relay, brake lights, position lights, and additional control panel indicator lights.

The European machine wiring harness contains the same wires (both color and number) as the North American machines, with additional wires required for the additional circuits.

There are variations between the North American and European main wiring harnesses in connector to wire pin locations and numbers. While some circuits such as the Cranking Circuit may be identical, other circuits contain differences that require using the diagnosis sections specific to either North American or European machines.

Common components (such as the key switch, fuel shutoff solenoid, or park brake switch) are cross referenced to the shared Electrical Tests and Adjustments section. (See Tests and Adjustments in Section 40, Group 35.) The tests and adjustments given in this section can be used by any North American or European service technician.

Group 10 - Specifications

System Specifications

Item	Measurement	Specification
Battery:		
Voltage	Voltage	12VDC
BCI Group	BCI Group Size	34
CCA Rating (Amps @ -18° C (0° F)	Amperage	500 amps
Reserve Capacity (minutes)	Time	120
Load Test (minimum)	Amperage	325 amps for 15 seconds

Item	Measurement	Specification
Starting Motor:		
Type		Solenoid Shift
Size (3120)		1.2 kW (1.61 hp)
Size (all other models)		1.4 kW (1.88 hp)
Amp Draw (on machine)	Amperage	300 amps (max.)
No-Load Amp Draw (free running)	Amperage	325 amps (max.) @ 4440 rpm
Starting Solenoid Pull-in Amp Draw	Amperage	55.5 amps (max.)
Starting Solenoid Hold-in Amp Draw	Amperage	10.5 amps (max.)

Item	Measurement	Specification
Alternator:		
Regulated Voltage	Voltage	14.2—14.8 VDC @ 25°C (77°F)
Unregulated Voltage	Voltage	50 VAC
Amperage	Amperage	40 amps

Item	Measurement	Specification
Fuel Shutoff Solenoid:		
Voltage Range	Voltage	6—16 VDC, 12 VDC Nominal
Starting Current (maximum)	Amperage	35 amps
Operating Current	Amperage	0.3 amps

Item	Measurement	Specification
Sensors:		
Engine Coolant Temperature Resistance (variable)	Resistance	22—520 ohms
Fuel Gauge Resistance (variable)	Resistance	8—89 ohms
Engine Oil Pressure Switch Closes (light ON to OFF)	Pressure	@ 40—75 kPa (5.8—10.8 psi)

Item	Measurement	Specification
Lighting:		
Headlights (halogen)	Type	37.5 Watts
Tail/Turn Light	Type	Type 1157
Hazard Lights	Type	Type 1156
Work Lights (halogen)	Type	Type 886

Item	Measurement	Specification
Torque Specifications:		
Alternator Positive Cable Nut	Torque	13.5 N·m (120 lb.-in.)
Position Sensor Lock Nut Torque	Torque	5 N·m (44 lb.-in.)
Starting Solenoid Positive Cable Nut	Torque	13.5 N·m (120 lb.-in.)
Fuel Sensor Terminal Nuts	Torque	3.4 N·m (30 lb.-in.)

Item	Measurement	Specification
Load Center Mounting Nuts	Torque	7.5 N·m (66 lb.-in.)
Electronic Drive Controller Connector Cap Screw	Torque	2.0 N·m (17 lb.-in.)
Neutral Start Switch	Torque	27 N·m (20 lb.-ft.)
MFWD Engagement Sensing Switch	Torque	27 N·m (20 lb.-ft.)
Mid PTO Switch	Torque	27 N·m (20 lb.-ft.)

Essential or Recommended Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Electronic Control Analyzer

JDG1575

Test and adjust position sensors.

Weatherpack extraction Tool

JDG364

To remove contacts from weatherpack connectors.

Electrical Circuit Analyzer

JT07324A

To diagnose key switch and associated electrical circuits.

Analog/Digital Multimeter

JT05791

To diagnose electrical system circuits and components.

Current Clamp-on Probe

JT02153

To diagnose current amperage with in electrical wires.

Probe Light

JDG186

To test for current continuity and grounds.

Hydrometer

NA

Used to check specific gravity of electrolyte in battery cells.

Battery Tester (or Voltmeter)

JT05685

Used to measure battery voltage.

Current Gun

JT05712

Used to measure alternator output current.

Hand-Held Digital Tachometer

JTO5719

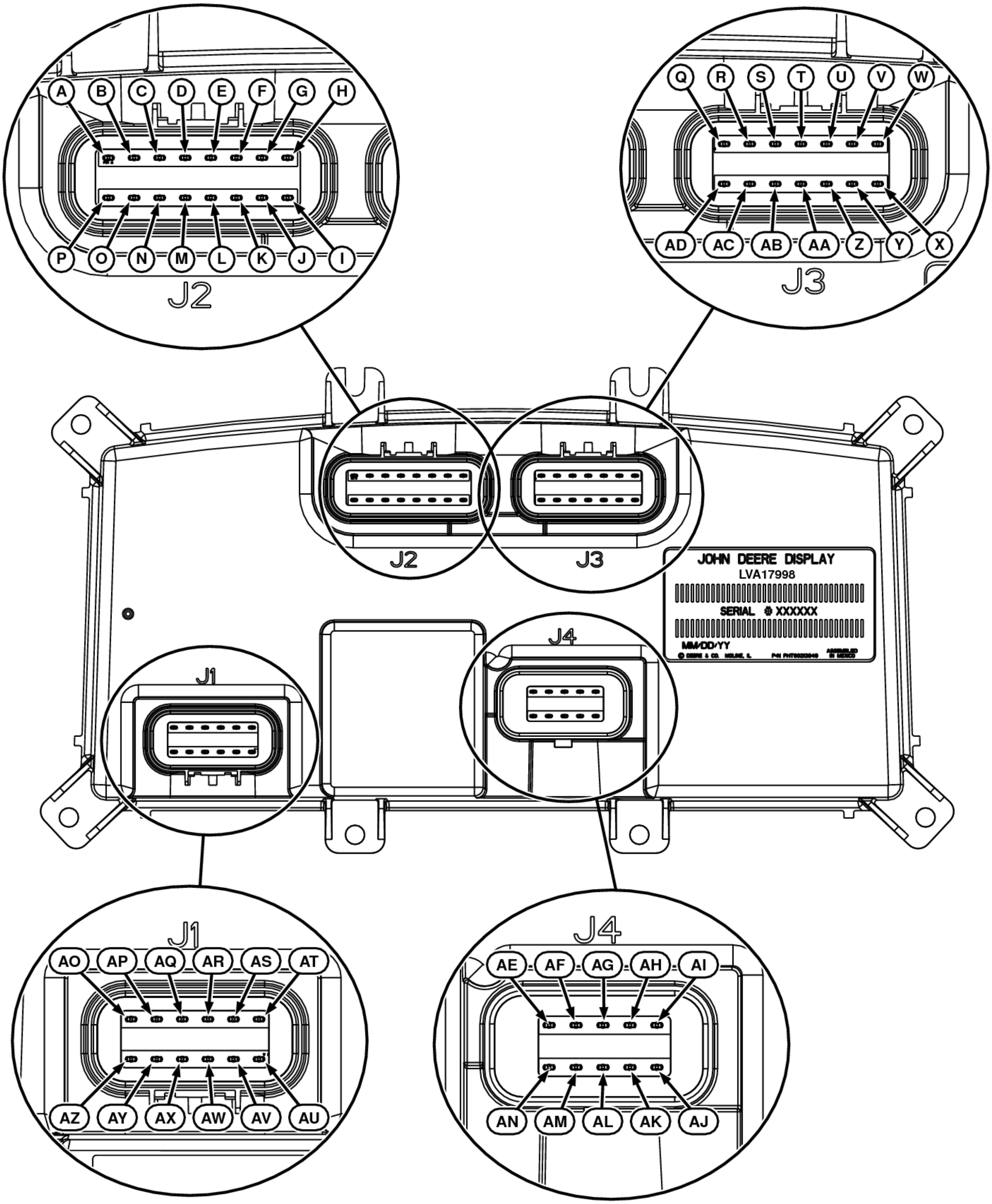
Used to measure speed of starting motor.

Other Material

Number	Name	Use
• TY9374/TY9375 (us)	Pipe sealant with TEFLON ™	Seal threads on temperature sensor and oil pressure switches.
• NA (us)	Bearing Puller Set	Used to remove pulley from alternator.
• NA (us)	400-grit Silicon Carbide Sandpaper	Used to polish slip rings.

Group 15 - Component Location

A1 Display Panel Signal Component Location—EEC



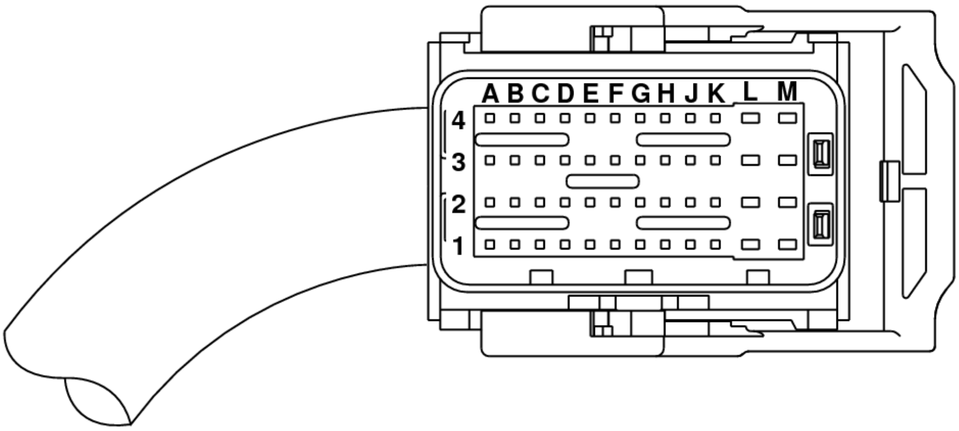
Display Panel Signal Location

LEGEND:

A J2-A CAN_LO, 9925A Grn
B J2-B CAN_HI, 9924A Yel

C	J2-C Warning / Hazard Switch, 1103 Org
D	J2-D Light Switch (Backlight), 1138D Gry
E	J2-E Audible Alarm, 2008 Gry Not Used on PowrReverser Transmission
F	J2-F Coolant Temperature Input, 5359 Wht
G	J2-G Left Turn Signal Trailer Output, 1145E Grn
H	J2-H Right Turn Signal Trailer Output, 1135E Grn
I	J2-S Right Turn Signal, 1135A Grn
J	J2-R Left Turn Signal, 1145A Grn
K	J2-P Mid Mount Proxy Sensor Input, 4006 Grn Not Used on PowrReverser Transmission
L	J2-N Front PTO Input, 4733A, Org
M	J2-M Not Used
N	J2-L Engine Oil Pressure Input, 5347C Pur
O	J2-K Not Used
P	J2-J Engine Speed, 5325, Grn
Q	J3-A Hold In Coil Output, 5302 Red
R	J3-B Mid PTO Sense In, 4687C Pur
S	J3-C Park Brake Input,4586A Blu
T	J3-D Engine Crank, 0572C Red
U	J3-E PTO On (Momentary Switch) In, 4573B Org Not Used on PowrReverser Transmission
V	J3-F Continuous Flow Input, 7793A Org Not Used on PowrReverser Transmission
W	J3-G Come Home Mode, 0592B Red Not Used on PowrReverser Transmission
X	J3-H TCU Transmission Enable, 4034 Yel Not Used on PowrReverser Transmission
Y	J3-J Glow Plug Input, 0383C Org
Z	J3-K Seat Switch Input, 0539B Wht
AA	J3-L Not Used
AB	J3-M Pull In Coil Output 5522, Red
AC	J3-N Starter Relay, 0518 Gry
AD	J3-P Not Used Neutral Sensing Switch on PowrReverser Transmission, 4529 Wht
AE	J4-E Not Used
AF	J4-D Not Used
AG	J4-C MFWD Switch Input, 4555A Grn
AH	J4-B Not Used
AI	J4-A Not Used
AJ	J4-K Not Used
AK	J4-J Prt Reverse, 5351A Brn
AL	J4-H Not Used
AM	J4-G Fuel Level Input, 2353A Org
AN	J4-F Rear PTO Input, 4777A Pur
AO	J1-M Ground, 0050F Blk
AP	J1-L Right Turn Signal In, 1125A Grn
AQ	J1-K Left Turn Signal In, 1115A Grn
AR	J1-J Display Mode Switch In, 4004 Yel
AS	J1-H PTO Switch In, 4574A Yel
AT	J1-G PTO Solenoid Out, 4747A Pur
AU	J1-A Unswitched Instrument Power, 122B Red
AV	J1-B Unswitched Instrument Power, 122C Red
AW	J1-C Unswitched Instrument Power, 122D Red
AX	J1-D Unswitched Instrument Power , 122E Red
AY	J1-E Air Intake Filter, 5404 Yel
AZ	J1-F Switched Instrument Power, 0562D Red Not Used on PowrReverser Transmission

TCU J1 Transmission Control Unit (TCU) Component Location—EEC



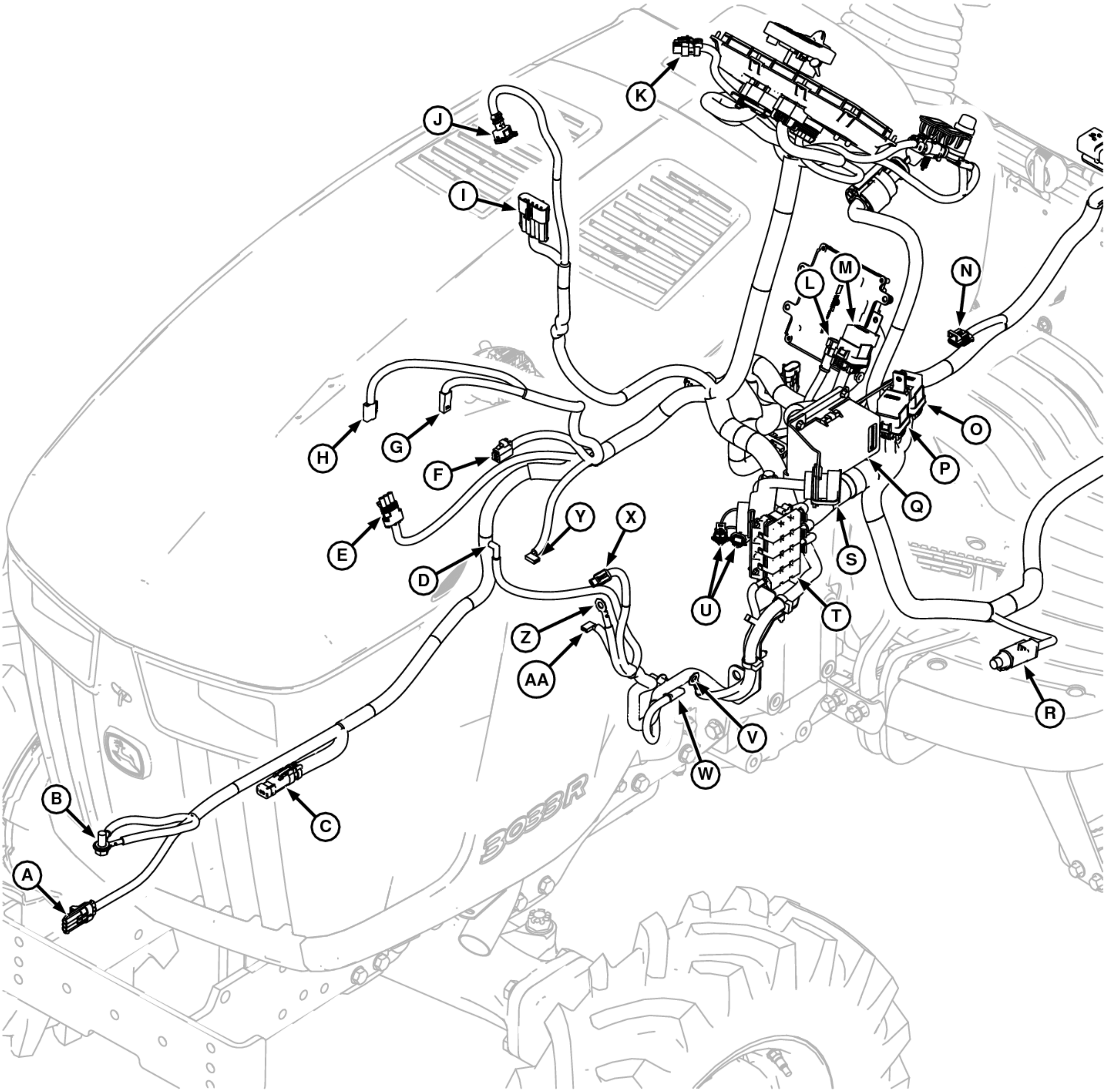
Transmission Control Unit

Transmission Control Unit

A2 Transmission Control Unit (TCU)			
Terminal	**OOS Wire Number**	**Cab Wire Number**	**Component**
A1	9924D Yel	9924B Yel	Can1—High
B1	9925D Grn	9925B Grn	Can1—Low
C1			Not Used
D1			Not Used
E1			Not Used
F1			Not Used
G1	0592C Red	0592A Red	Come Home Mode
H1	0562X Red	0562U Red	Transmission Interlock (IGN)
J1	4034 Yel	4034 Yel	Transmission Interlock (ICC)
K1	0539C Wht	0539C Wht	Operator Presence Switch
L1	0142 Red	0142 Red	Battery
M1	4472 Red	4472 Red	12V ELX
A2			Not Used
B2	4692A Red	4692A Red	FWD/REV Proportional Solenoid Valves (Supply)
C2			Not Used
D2			Not Used
E2			Not Used
F2			Not Used
G2	4268A Gry	4268 Gry	Load Match Switch
H2			Not Used
J2	4269A Wht	4269 Wht	Motion Match Switch
K2	4673A Org	4673A Org	Reference Supply (Pedals, Throttle, Sensors)
L2	0050H Blk	0050H Blk	Ground
M2	0550A Blk	0550A Blk	Reference Supply—Return
A3			Not Used
B3	4247A Pur	4247 Pur	Brake Pedal Switch
C3	4499 Wht		Throttle position Sensor
D3	4265A Grn	4265 Grn	Cruise Control Switch (Set/Decel)
E3	4166A Blu	4166A Blu	Reverse Pedal Position (A)
F3	4014A Yel	4014A Yel	Forward Pedal Position (A)
G3			Not Used

A2 Transmission Control Unit (TCU)			
H3	4625A Grn	4625A Grn	Forward Pedal Position (B)
J3			Not Used
K3			Not Used
L3			Not Used
M3			Not Used
A4			Not Used
B4			Not Used
C4	4261A Brn	4261 Brn	Auto Mode (eTHROTTLE)
D4	4266A Blu	4266 Blu	Cruise Control Switch (Res/Acel)
E4	4238A Gry	4238A Gry	Cruise Control Switch—ON
F4			Not Used
G4	4677A Pur	4677A Pur	Reverse Pedal Position (B)
H4	4267A Pur	4267 Pur	Cruise Control Max Speed—ON
J4	4203A Org	4203 Org	Backup Alarm (Output)
K4	4697A Pur	4697A Pur	Reverse Proportional Solenoid Valve (Return)
L4	4696A Blu	4696A Blu	Forward Proportional Solenoid Valve (Return)
M4	4005A Grn	4005A Grn	Primary Wheel Speed Sensor

W1 Chassis Wiring Harness Component Location (Front) (Open Station)—EEC



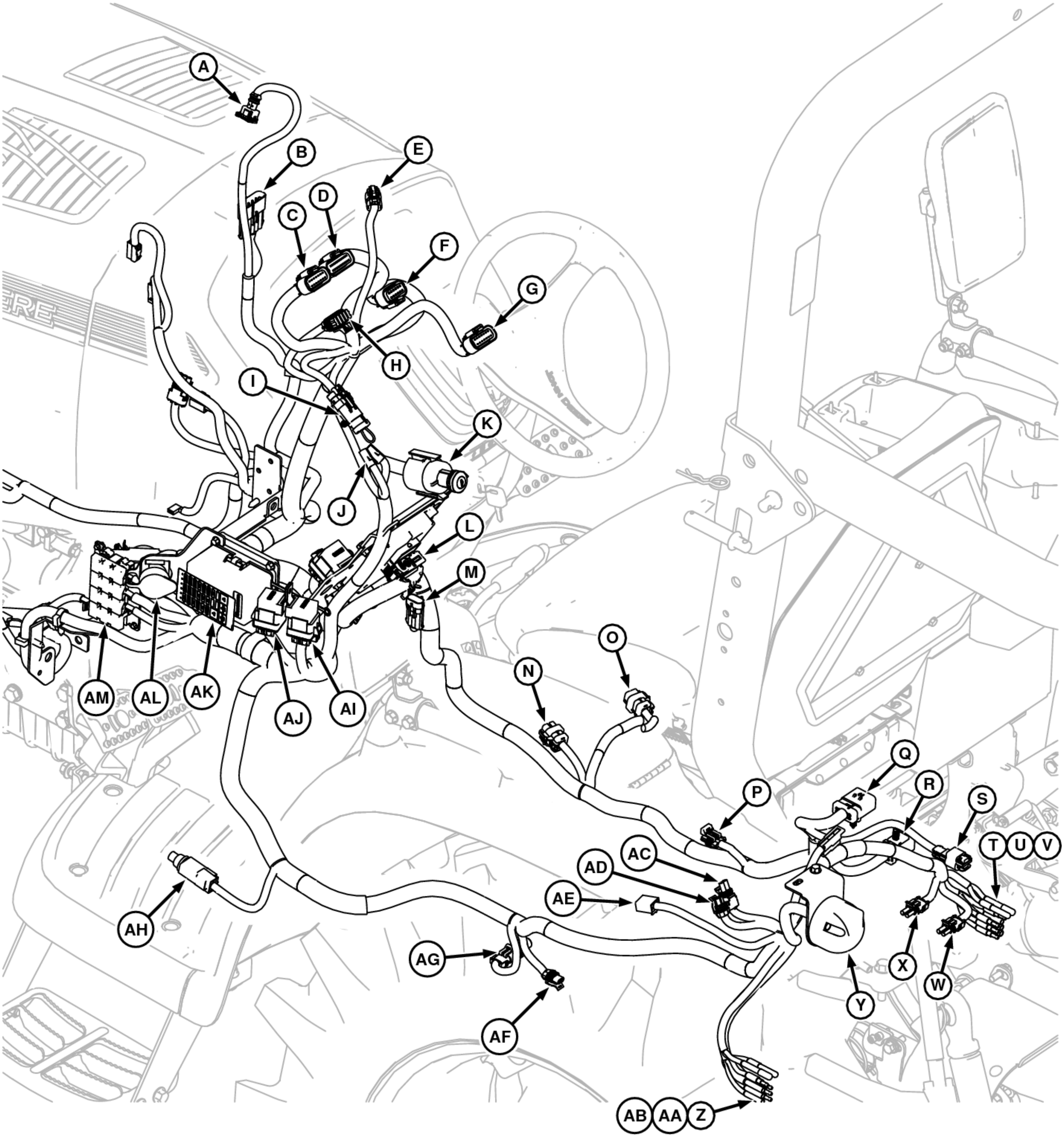
Sheet 1 of 2

LEGEND:

A	Mid Mount Prox Sensor
B	Ground Terminal
C	Front PTO Kit Harness
D	Coolant Temperature Sender
E	Throttle Sensor
F	Fuel Solenoid
G	Air Manifold Heater
H	Fuel Pump
I	Cab Chassis Connect
J	Air Restrictor Switch
K	Fuel Gauge Sensor
L	CAN Terminator

M	Fuel Shutoff Relay
N	MFWD Speed Sensor
O	Manifold Heater Relay
P	Starter Relay
Q	Load Center
R	Park Brake Switch
S	Service Advisor Diagnostic Interface
T	Fuse Block
U	Horn
V	Starter to Fuse Block Power Lead
W	Starter
X	Alternator
Y	Oil Pressure Switch
Z	Alternator B+
AA	Alternator

W1 Chassis Wiring Harness Component Location (Rear) (Open Station)—EEC



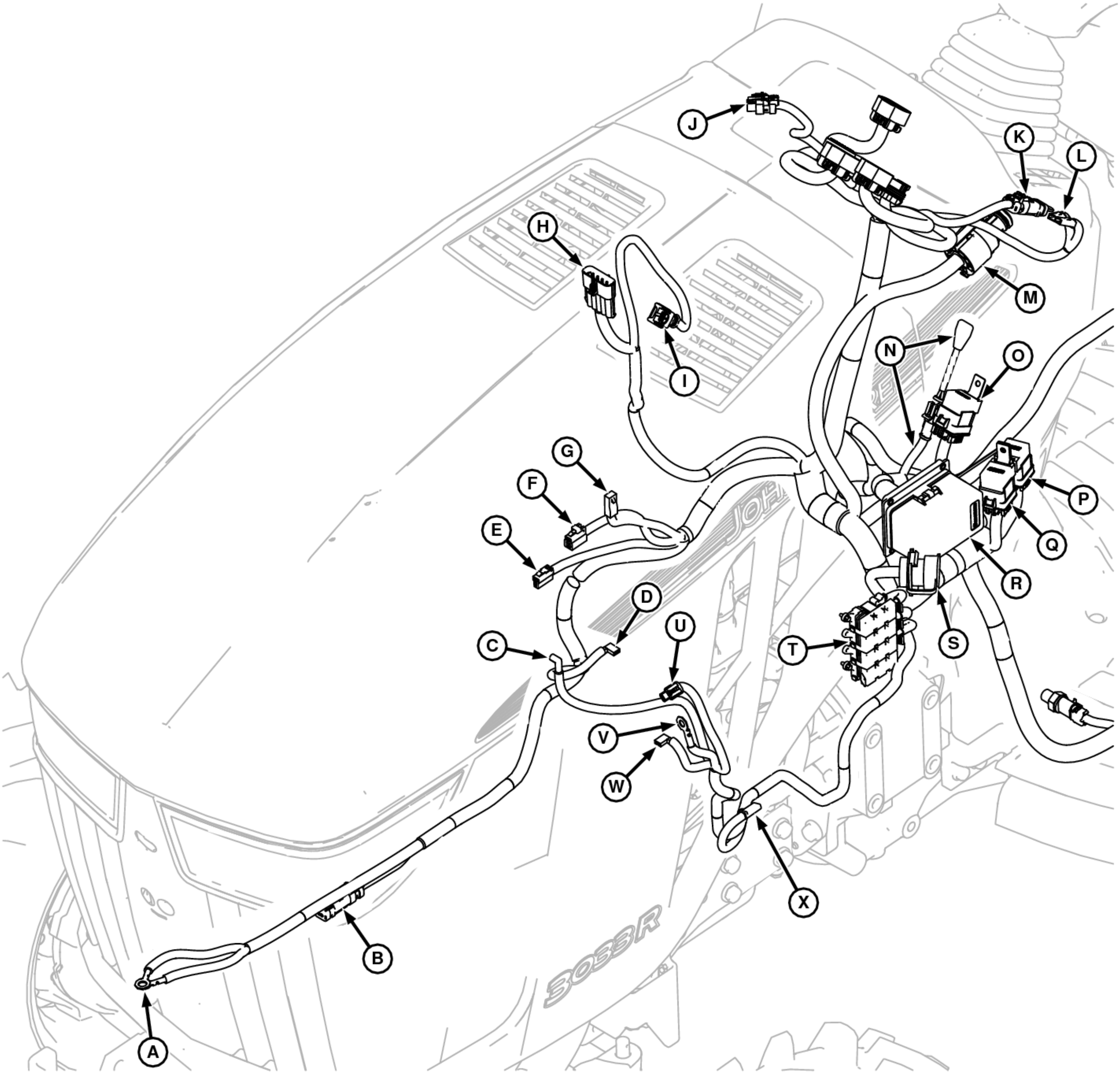
Sheet 2 of 2

LEGEND:

A	Air Restriction Switch
B	Cab Chassis Connect
C	Display J3

D	Display J2
E	Fuel Gauge Sensor
F	Display J1
G	Dash Panel Module
H	Display J4
I	Front PTO Switch
J	Horn
K	Key Switch
L	Transmission Control Unit (TCU) Connector
M	HST Connect
N	Forward Pedal Pot
O	Reverse Pedal Pot
P	MFWD Speed Sensor
Q	Right Fender Connect 1
R	Right Fender Connect 2
S	Backup Alarm
T	Right Turn Hazard Lamp & Ground
U	Right Front & Rear Marker
V	Right Stop Lamp & Left Marker Ground
W	Rear PTO Sensing Switch
X	Mid PTO Sensing Switch
Y	7 Pin Trailer Interconnect
Z	Left Turn Hazard Lamp & Ground
AA	Left Front & Rear Marker
AB	Left Stop Lamp & Marker Ground
AC	Air Ride Seat
AD	Seat Switch
AE	Park Brake Switch
AF	Rear PTO Solenoid
AG	MFWD Sensing
AH	Brake Switch
AI	Manifold Heater Relay
AJ	Starter Relay
AK	Load Center
AL	Service Advisor Diagnostic Interface
AM	Fuse Block

W2 Chassis Wiring Harness Component Location (Front) (Open Station)—PowrReverser Transmission—EEC



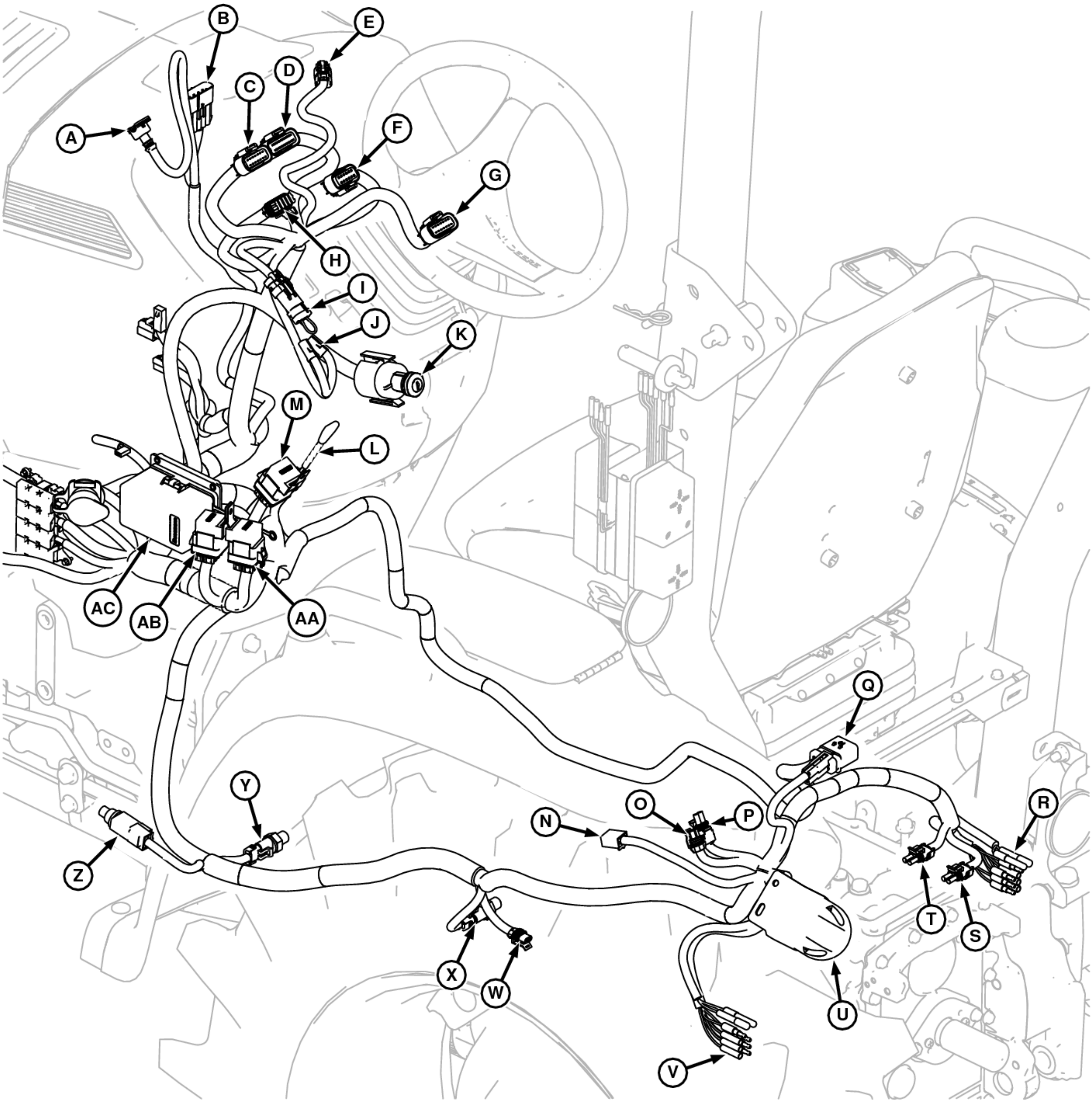
Sheet 1 of 2

LEGEND:

A	Ground Terminal
B	Front PTO Kit Harness
C	Coolant Temperature Sender
D	Oil Pressure Switch
E	Fuel Pump
F	Fuel Solenoid
G	Air Manifold Heater
H	Cab Chassis Connect
I	Air Restrictor Switch
J	Fuel Gauge Sensor
K	Front PTO Switch
L	Horn

M	Key Switch
N	CAN Terminator
O	Fuel Shutoff Relay
P	Manifold Heater Relay
Q	Starter Relay
R	Load Center
S	Service Advisor Diagnostic Interface
T	Fuse Block
U	Alternator
V	Alternator B+
W	Alternator
X	Starter

W2 Chassis Wiring Harness Component Location (Rear) (Open Station)—PowrReverser Transmission—EEC



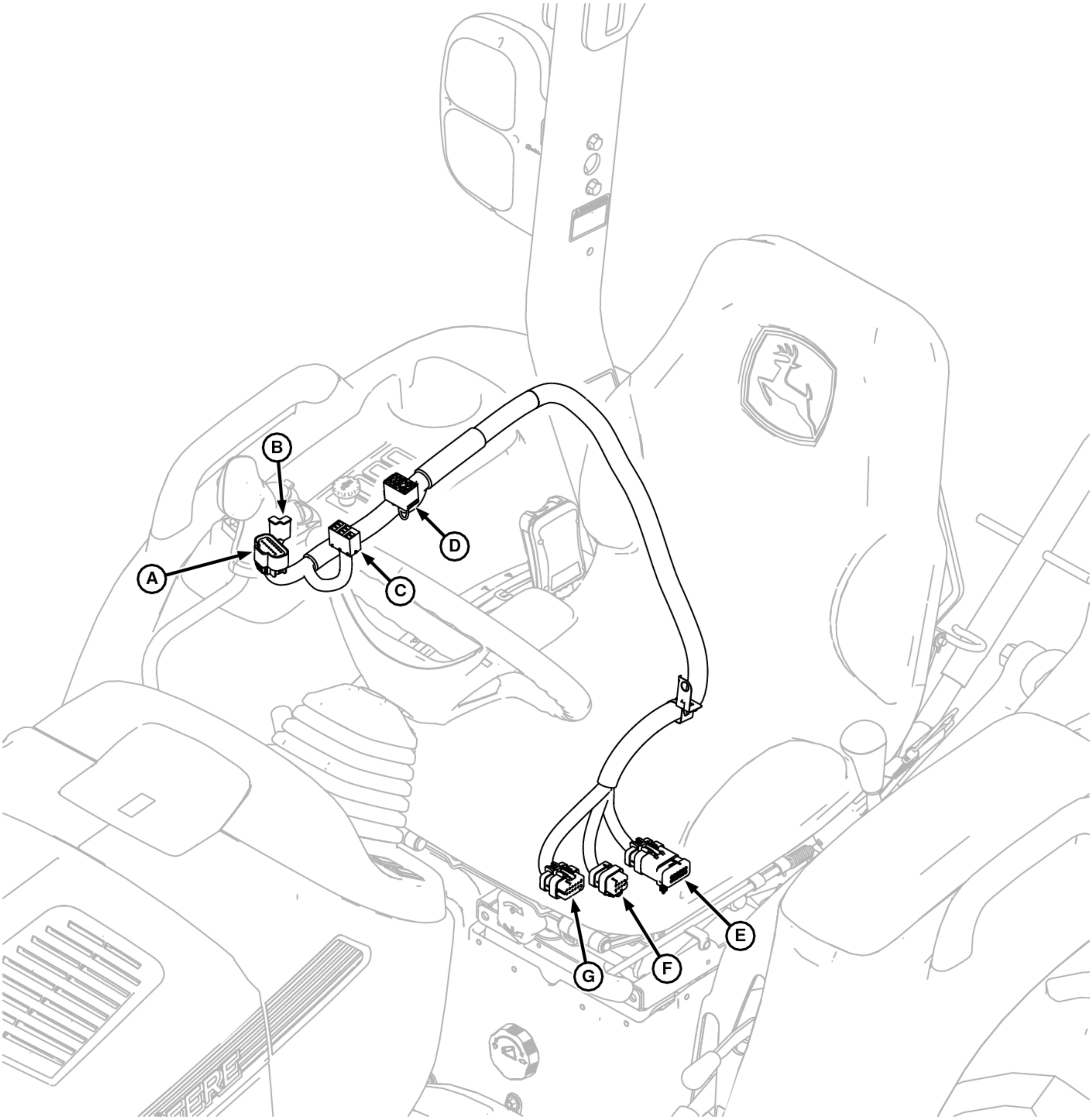
Sheet 2 of 2

LEGEND:

A	Air Restriction Switch
B	Cab Chassis Connect
C	Display J3
D	Display J2
E	Fuel Gauge Sensor
F	Display J1
G	Dash Panel Module
H	Display J4
I	Front PTO Switch
J	Horn
K	Key Switch
L	CAN Terminator

M	Fuel Shut Off Relay
N	Park Brake Switch
O	Seat Switch
P	Air Ride Seat
Q	Right Fender Interconnect
R	Right Turn Hazard Lamp & Ground, Right Front & Rear Marker, and Right Stop Lamp & Marker Ground
S	Rear PTO Sensing Switch
T	Mid PTO Sensing Switch
U	7 Pin Trailer Interconnect
V	Left Turn Hazard Lamp & Ground, Left Front & Rear Marker, and Left Stop Lamp & Marker Ground
W	Rear PTO Solenoid
X	MFWD Sensing
Y	Neutral Sensing Switch
Z	Brake Switch
AA	Manifold Heater Relay
AB	Starter Relay
AC	Load Center

W3 Fender Wiring Harness Component Location (Open Station)—EEC

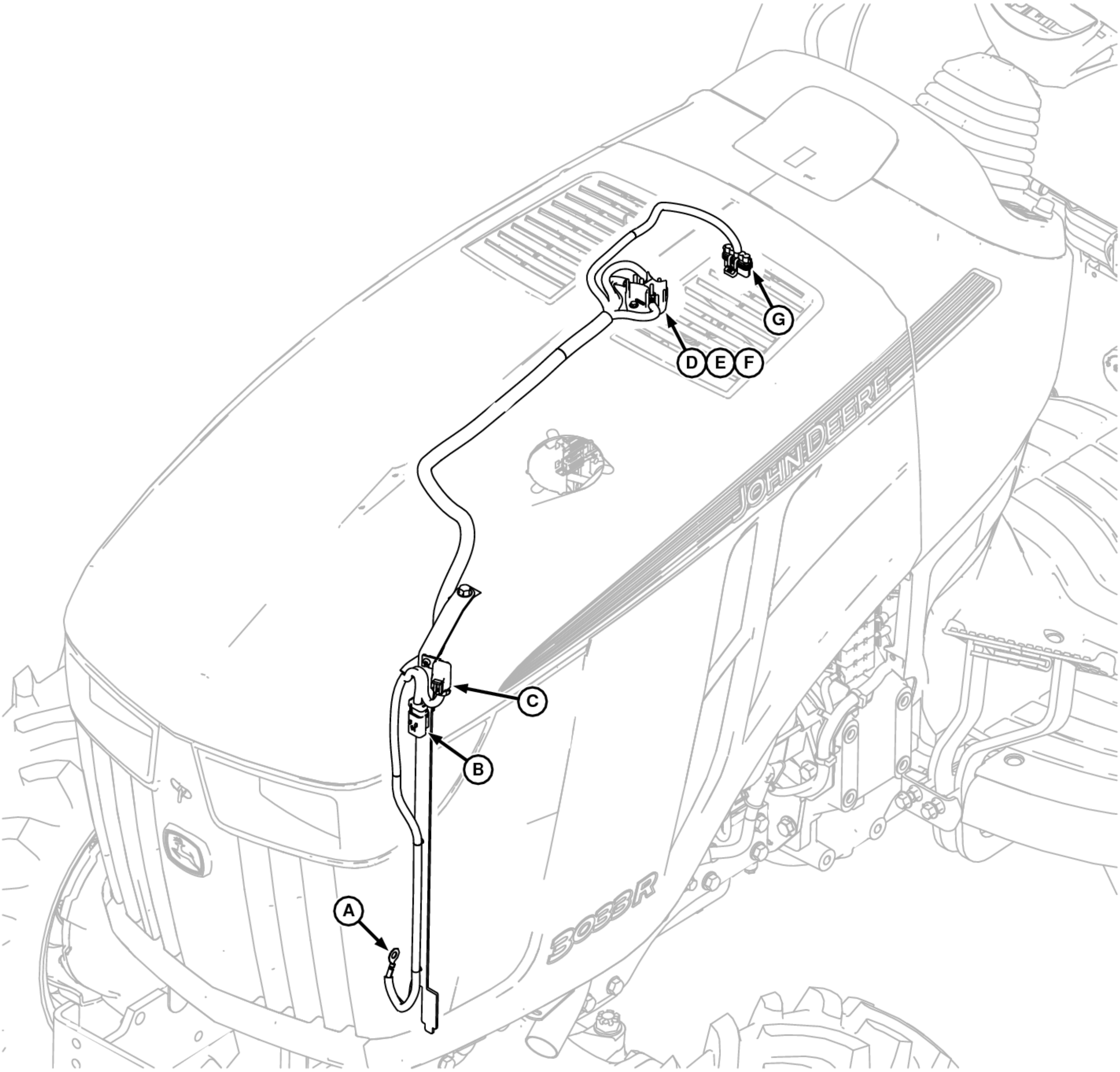


Fender Wiring Harness

LEGEND:

A	Cruise Upgrade Module
B	Power Port
C	PTO Switch
D	Diverter Switch
E	Third EH Hydraulic Kit Harness
F	Right Fender Connect 2
G	Right Fender Connect 1

W4 Hood Wiring Harness Component Location—EEC

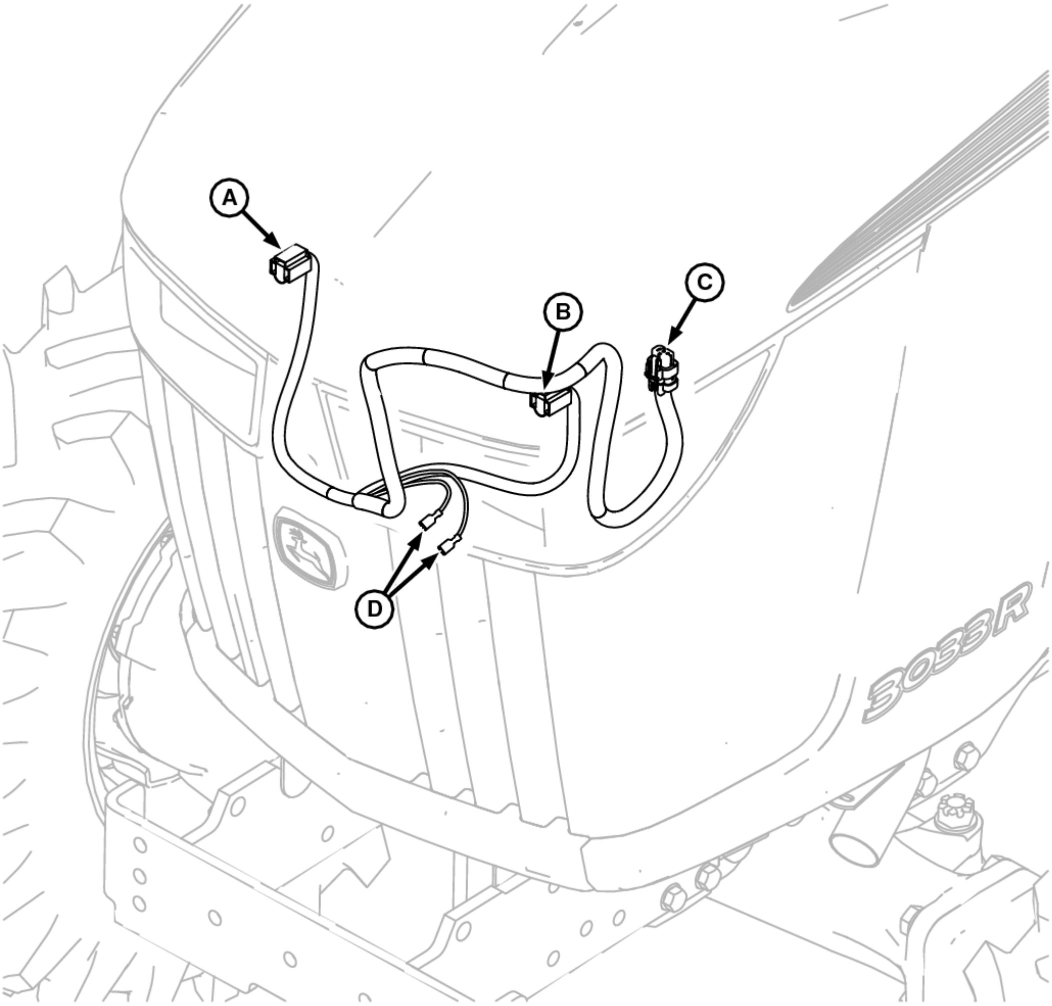


Hood Wiring Harness

LEGEND:

A	Mega Fuse 150A
B	Grille Harness Connect
C	Fuse Holder
D	Junction Block Switch Power
E	Junction Block Battery
F	Junction Block Ground
G	DPF Engine Harness Connector

W5 Grille Wiring Harness Component Location—EEC

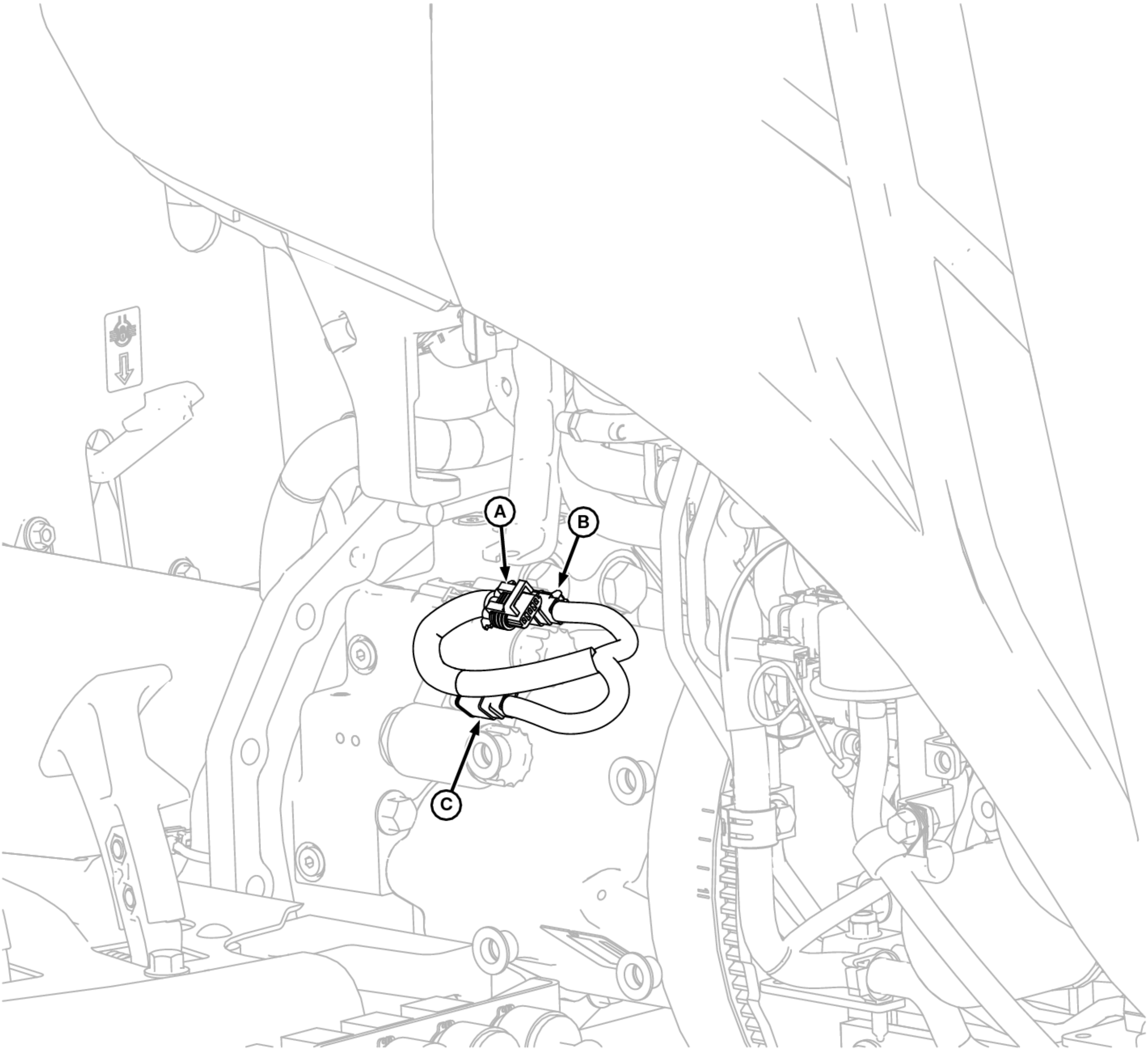


Grille Wiring Harness

LEGEND:

A	Right Headlight
B	Hood Harness Connect
C	Left Headlight
D	Horn Connector

W6 HST Valve Wiring Harness Component Location—EEC

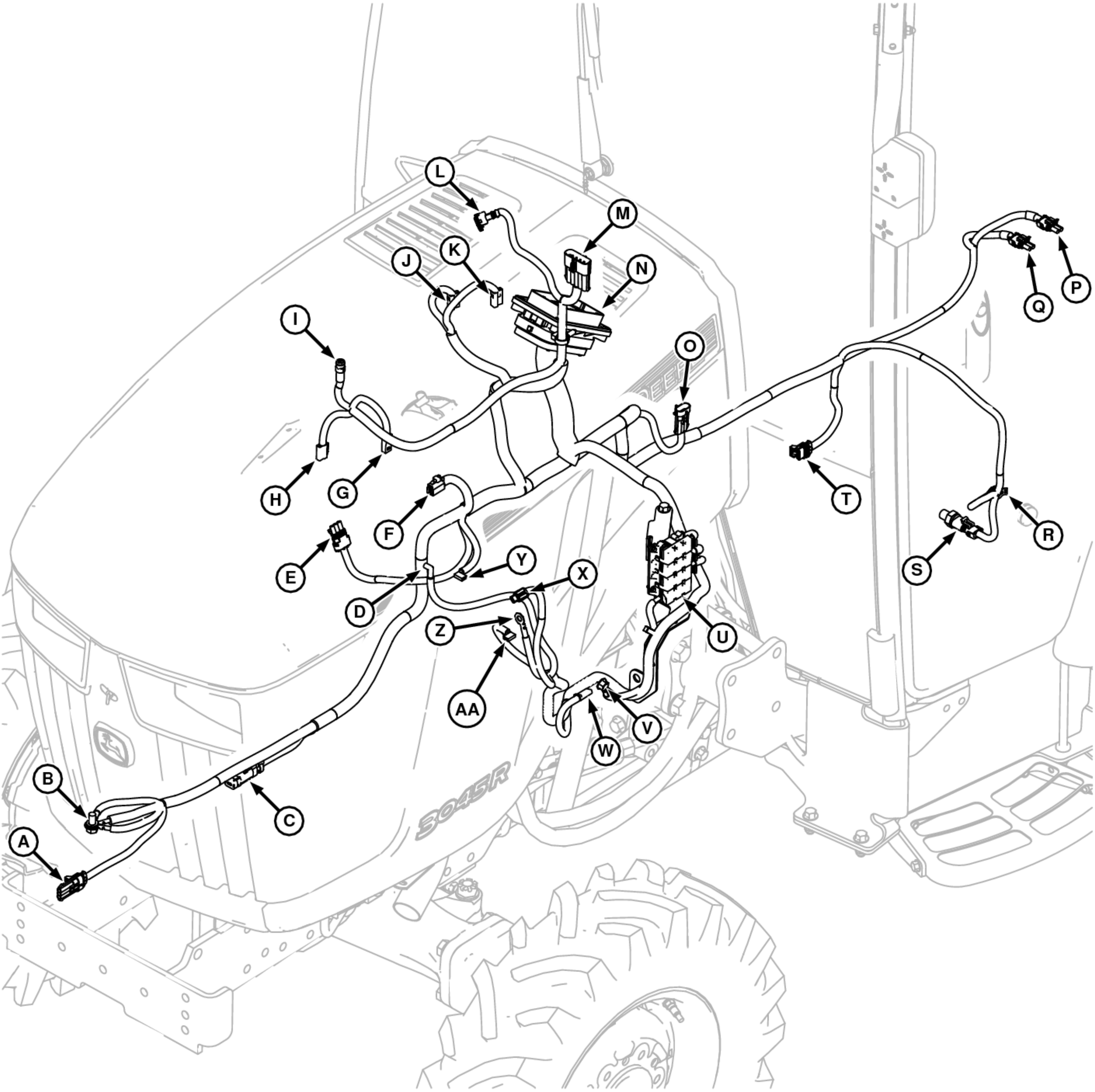


HST Valve Wiring Harness

LEGEND:

A	Reverse/Forward Solenoid Interconnect
B	Forward Proportional Solenoid
C	Reverse Proportional Solenoid

W7 Chassis Wiring Harness Component Location (Cab)—EEC



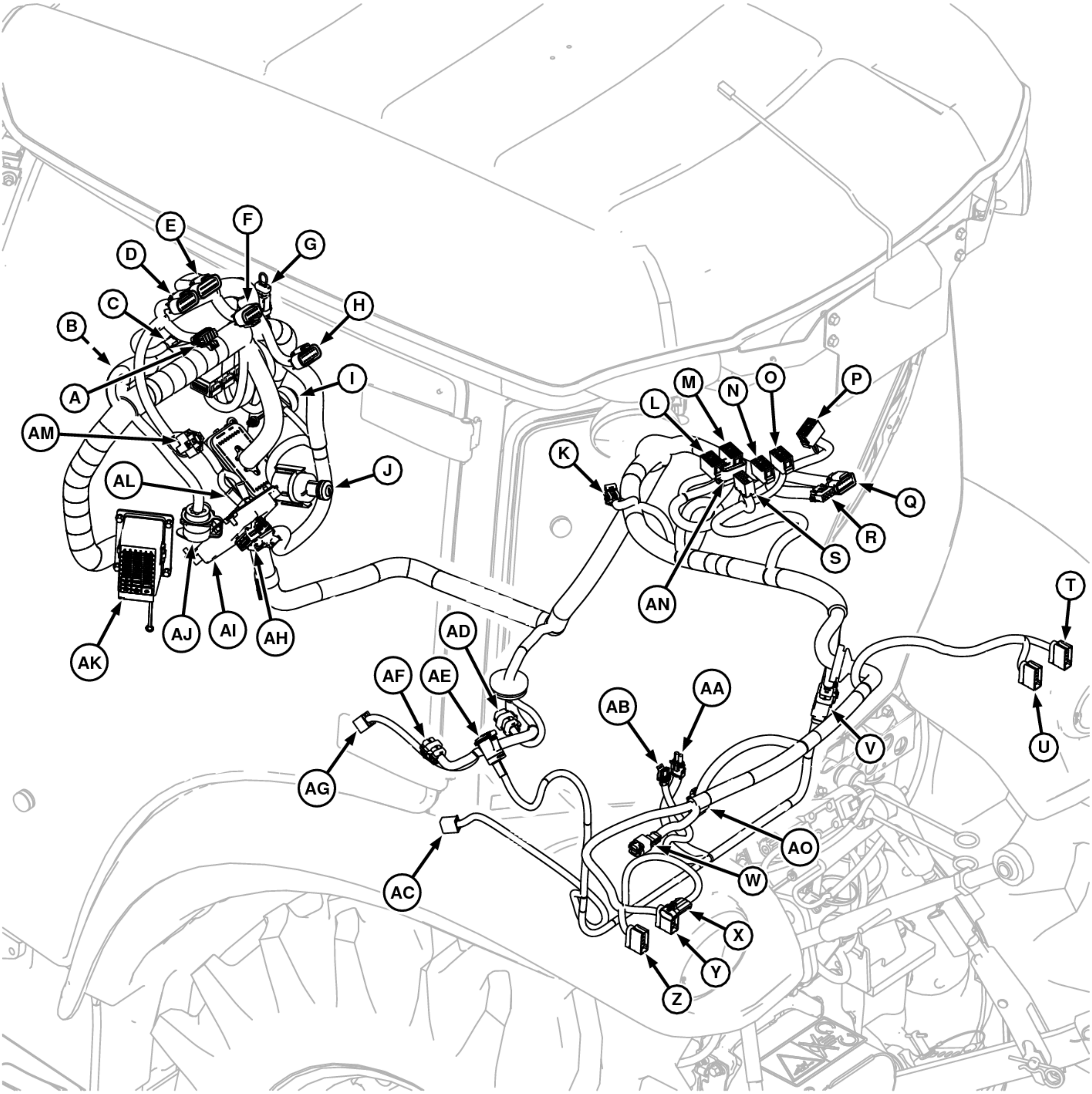
Cab Chassis Wiring Harness

LEGEND:

A	Mid Mount Proximity Sensor
B	Ground Terminal
C	Front PTO Kit Harness
D	Coolant Temperature Sender
E	Hand Throttle Sensor
F	Fuel Solenoid
G	Glow Plug
H	Fuel Pump
I	Air Conditioner Pump Clutch
J	Rear Washer Pump
K	Front Washer Pump
L	Air Restriction Switch
M	Cab Chassis Connect
N	Lower Cab Harness Interconnect

O	HST Connect
P	Rear PTO Sensing Switch
Q	Mid PTO Sensing Switch
R	Rear PTO Solenoid
S	MFWD Sensing
T	MFWD Speed Sensor
U	Fuse Block
V	Starter to Fuse Block Power Lead
W	Starter
X	Alternator
Y	Oil Pressure Switch
Z	Alternator Power
AA	Alternator

W8 Lower Wiring Harness Component Location (Cab)—EEC



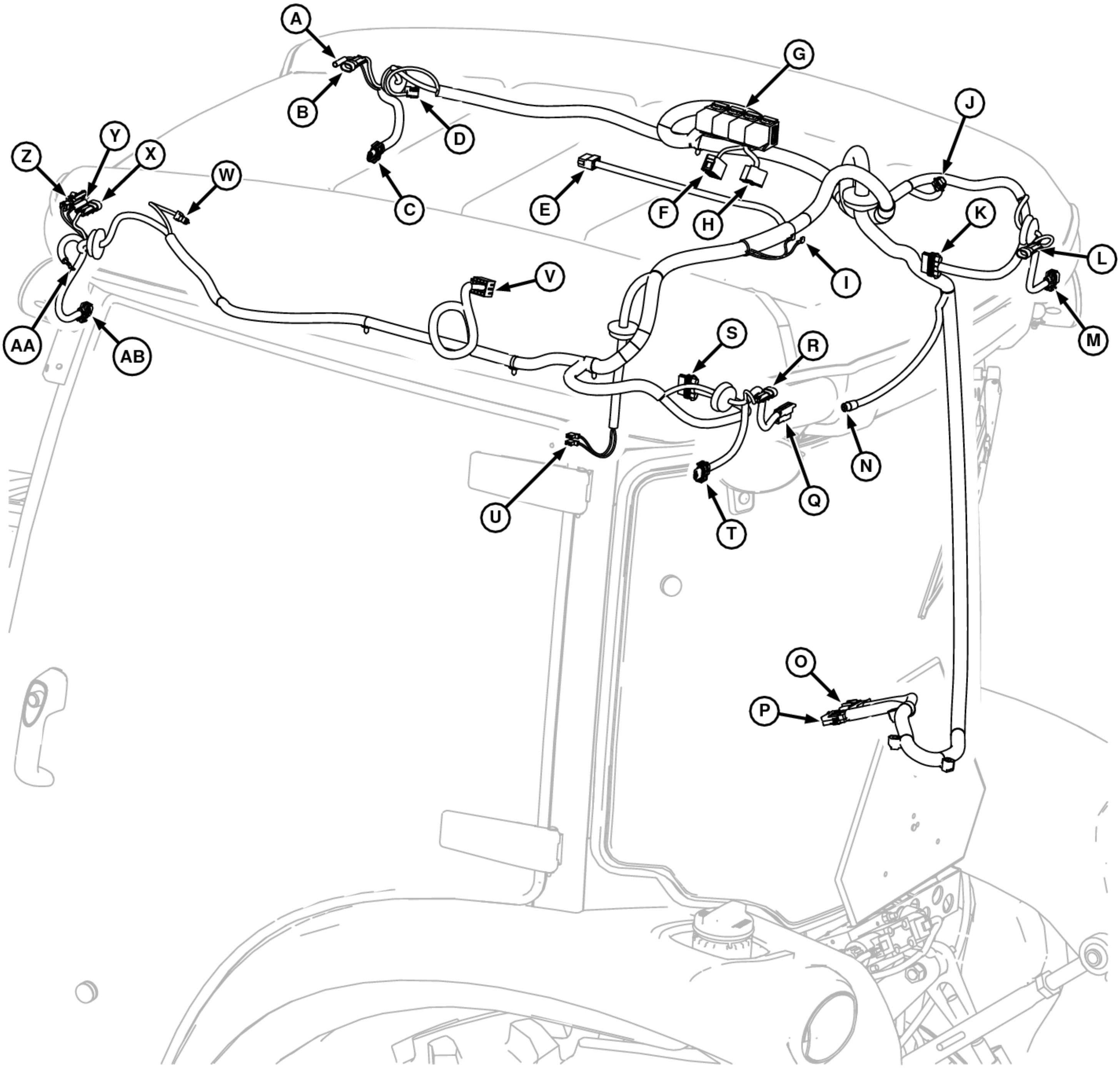
Lower Cab Wiring Harness

LEGEND:

A	Display J4
B	Front Wiper Motor
C	CAN Terminator 1
D	Display J3
E	Display J2
F	Display J1
G	Front PTO Switch
H	Dash Panel Module
I	Audilble Alarm
J	Key Switch
K	EH Handle Harness
L	Diverter Switch
M	Beacon Lamp Switch
N	Rear Wiper Switch

O	Rear Work Light Switch
P	Dual Rear Continuous Switch
Q	Roof Harness Connect
R	Roof Harness Connect
S	PTO Switch
T	Right Brake/Tail Light
U	Right Turn/Hazard Light
V	Rear Harness Connect
W	Backup Alarm
X	Fuel Sender
Y	Left Turn/Hazaed Light
Z	Left Brake/Tail Light
AA	Air Ride Seat
AB	Seat Switch
AC	Park Brake Switch
AD	Reverse Pedal Pot
AE	Power Port
AF	Forward Pedal Pot
AG	Brake Switch
AH	Transmission Control Unit (TCU) Connection
AI	Transmission Control Unit (TCU)
AJ	Service Advisor Diagnostic Interface
AK	Load Center
AL	Horn
AM	Front Wiper Switch
AN	Cruise Upgrade Module
AO	7 Pin Trailer Interconnect

W9 Upper Wiring Harness Component Location (Cab)—EEC



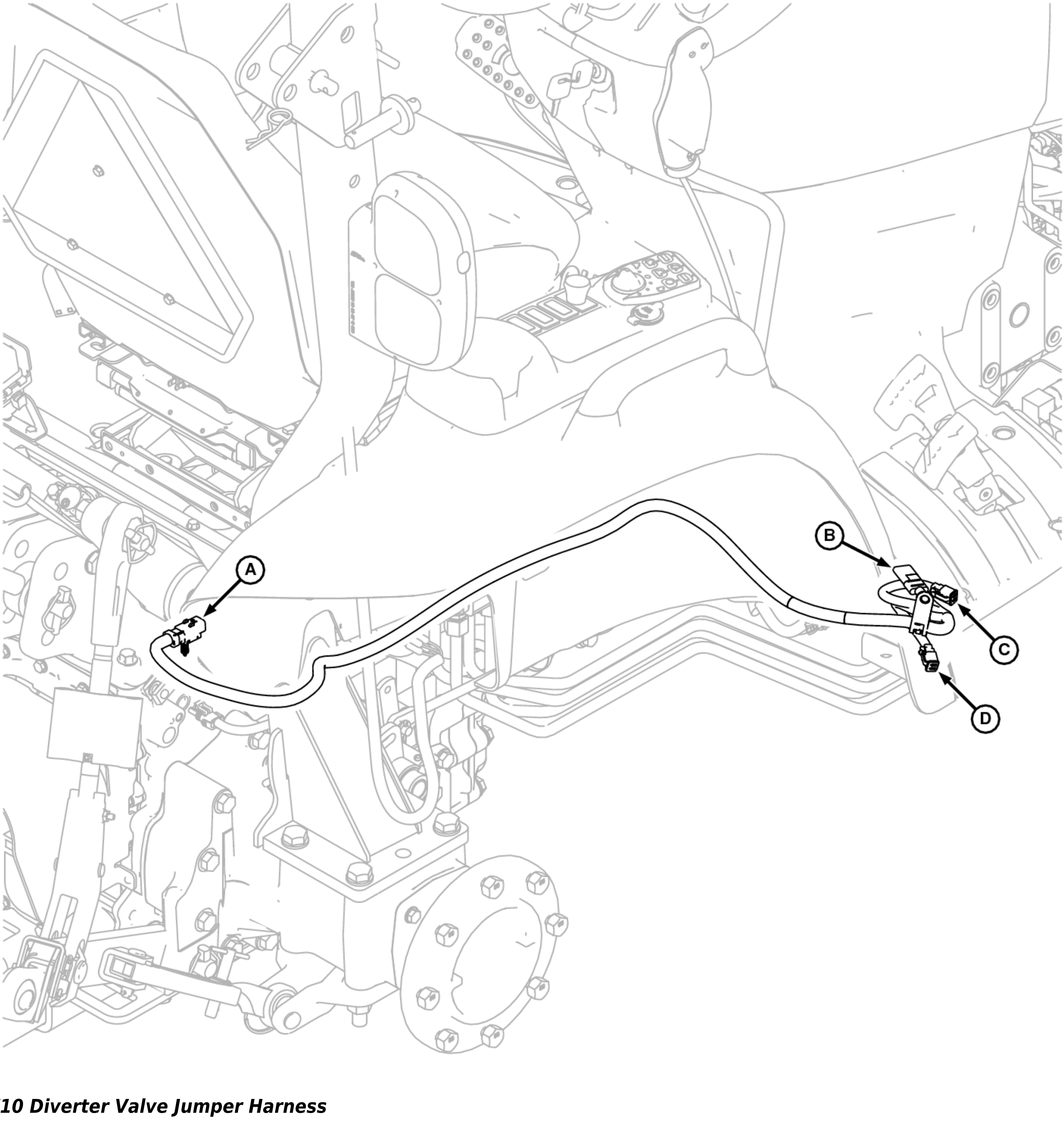
Upper Cab Wiring Harness

LEGEND:

A	Right Front Marker Light
B	Right Front Amber Light
C	Right Front Work Light
D	Right Speaker
E	Dome Light
F	HVAC Enable Switch
G	Power & Blower Relays
H	Blower Switch
I	HVAC Temp Switch
J	Hi-Lo Pressure Switch
K	Right Blower Motor
L	Right Rear Amber Light
M	Right Rear Work Light
N	Rear Wiper Motor

O	Cab Harness Connect
P	Cab Harness Connect
Q	License Plate
R	Left Rear Amber Light
S	Left Blower Motor
T	Left Rear Work Light
U	Door Switch
V	Radio
W	Left Speaker
X	Left Front Amber Light
Y	Left Front Marker Light
Z	Beacon with Cap
AA	Beacon Ground
AB	Left Front Work Light

W10 Diverter Valve Jumper Harness Component Location—EEC

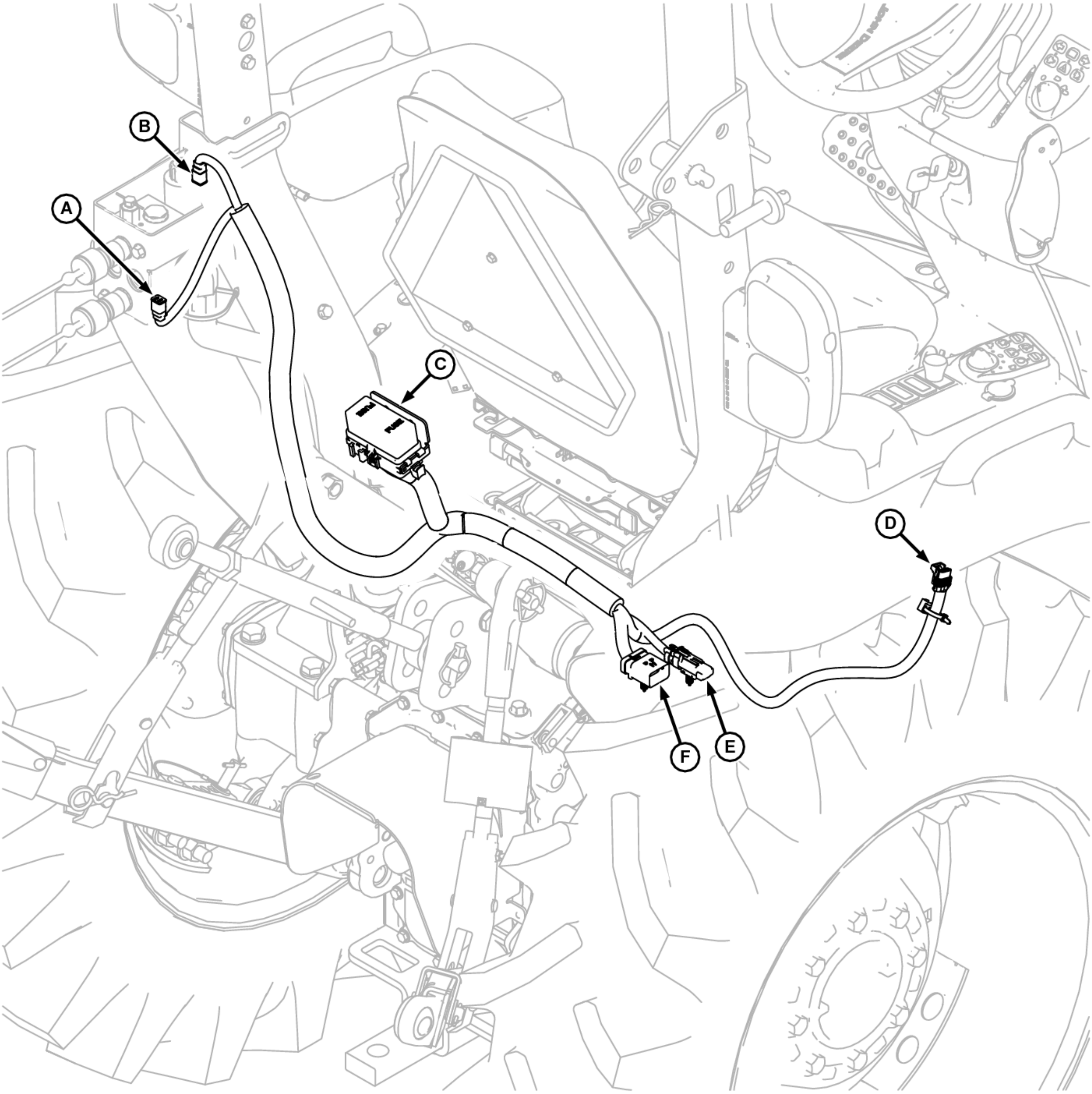


W10 Diverter Valve Jumper Harness

LEGEND:

A	3rd EH Harness Interconnect
B	Diode (5A)
C	Upper Hydraulic Solenoid Valve
D	Lower Hydraulic Solenoid Valve

W11 3rd EH Wiring Harness Component Location (Open Station)—EEC

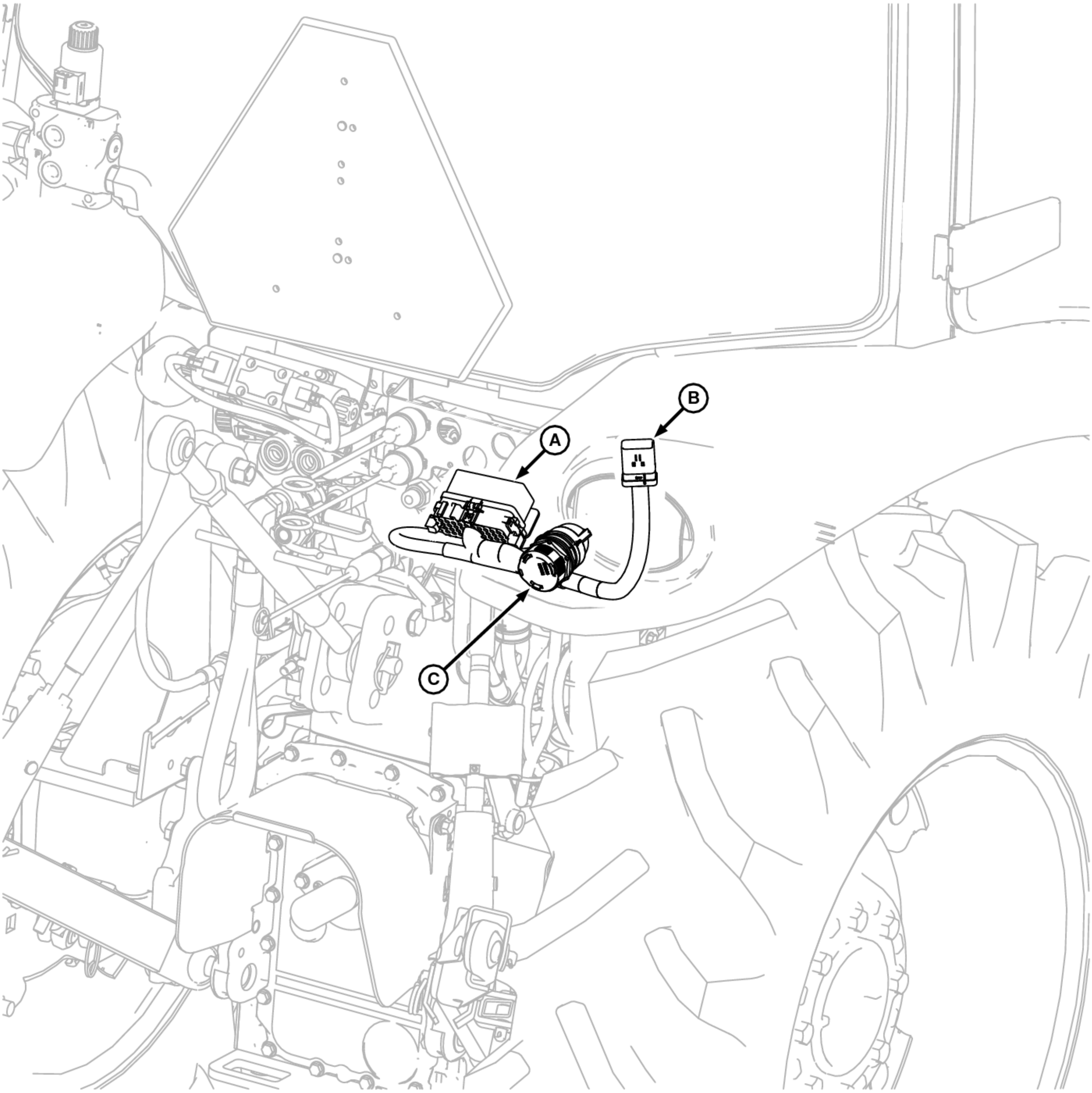


W11 3rd EH Wiring Harness (Open Station)

LEGEND:

A	3rd Function Solenoid B
B	3rd Function Solenoid A
C	Load Center
D	3rd EH Handle
E	Diverter Jumper Kit
F	3rd EH Hydraulic Kit

W12 Load Center Harness Component Location (Cab)—EEC



W12 Load Center Harness (Cab)

LEGEND:

A	Load Center
B	Rear Harness Interconnect
C	3rd EH, Diverter, Creep to REPO

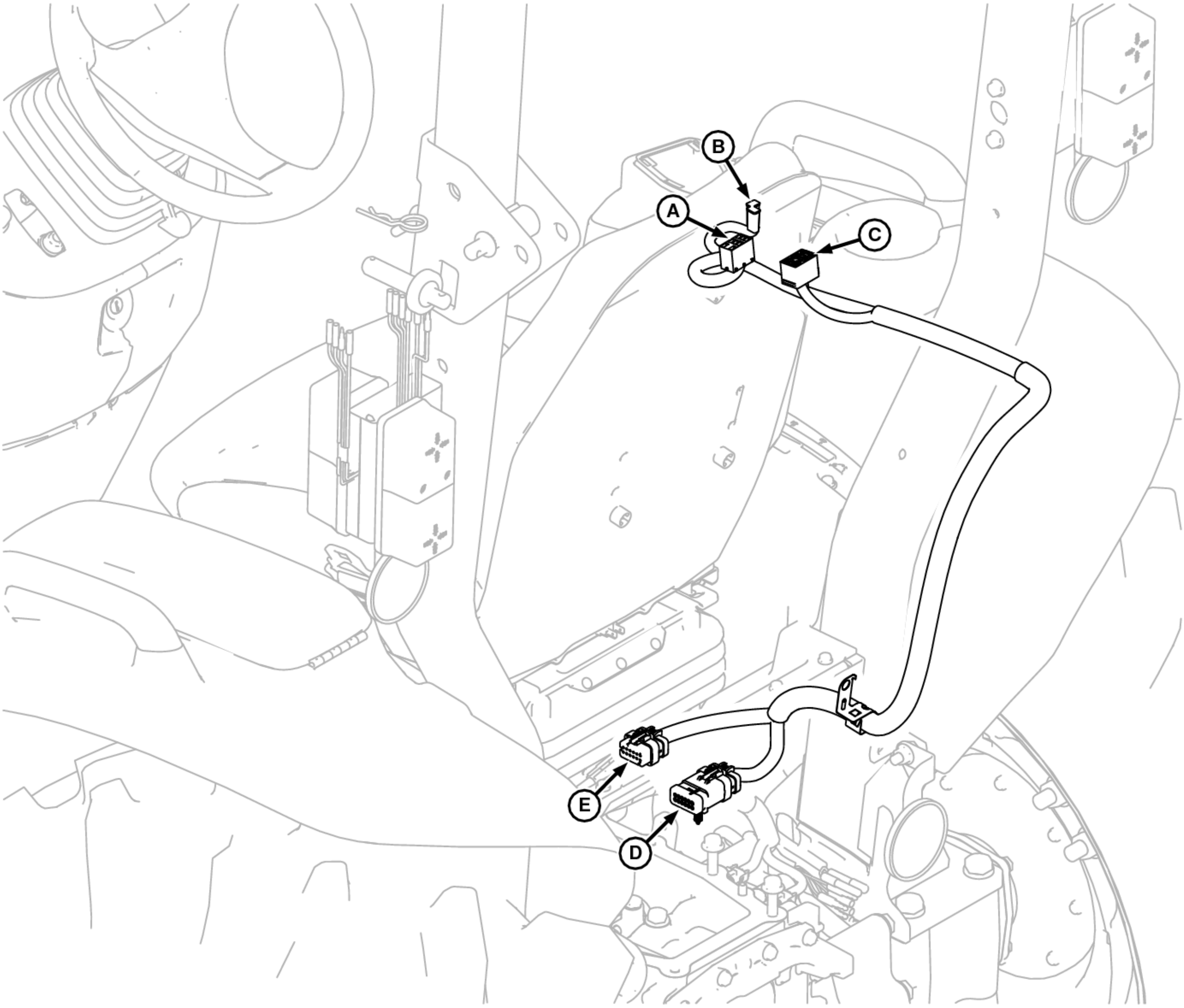
W13 3rd EH, Diverter, Creep to REPO Harness Component Location (Cab)—EEC

W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

A	3rd Function Solenoid A
B	3rd Function Solenoid B
C	Load Center Jumper Harness
D	Diverter Jumper Harness
E	Creep to REPO Harness

W16 Fender Wiring Harness Component Location (Open Station)—PowrReverser Transmission—EEC

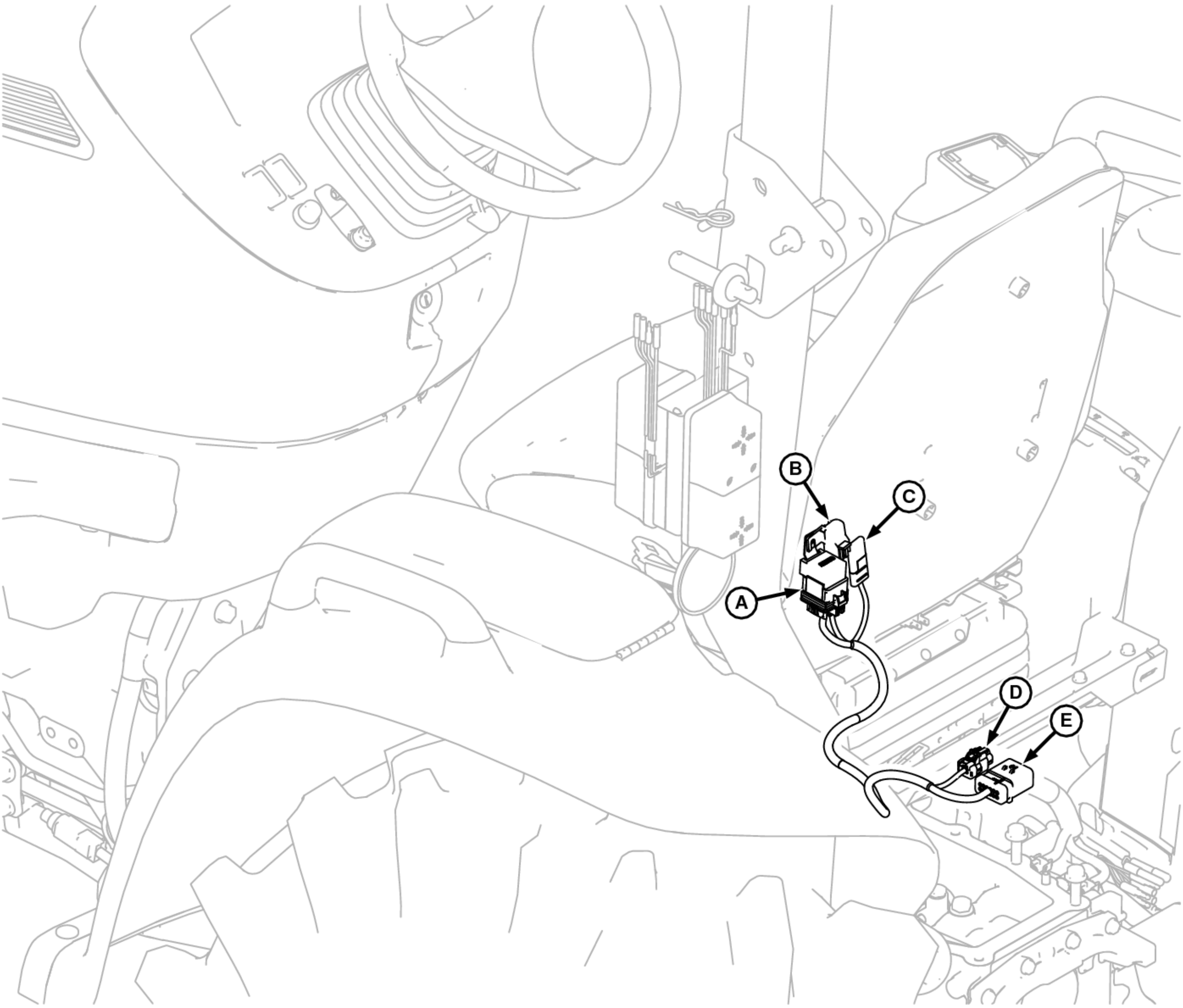


Right Fender PRT

LEGEND:

A	PTO Switch
B	Power Port
C	Diverter Switch
D	Third EH Hydraulic Kit Harness
E	Right Fender Connect

W17 Diverter Wiring Harness Component Location (Open Station)—EEC

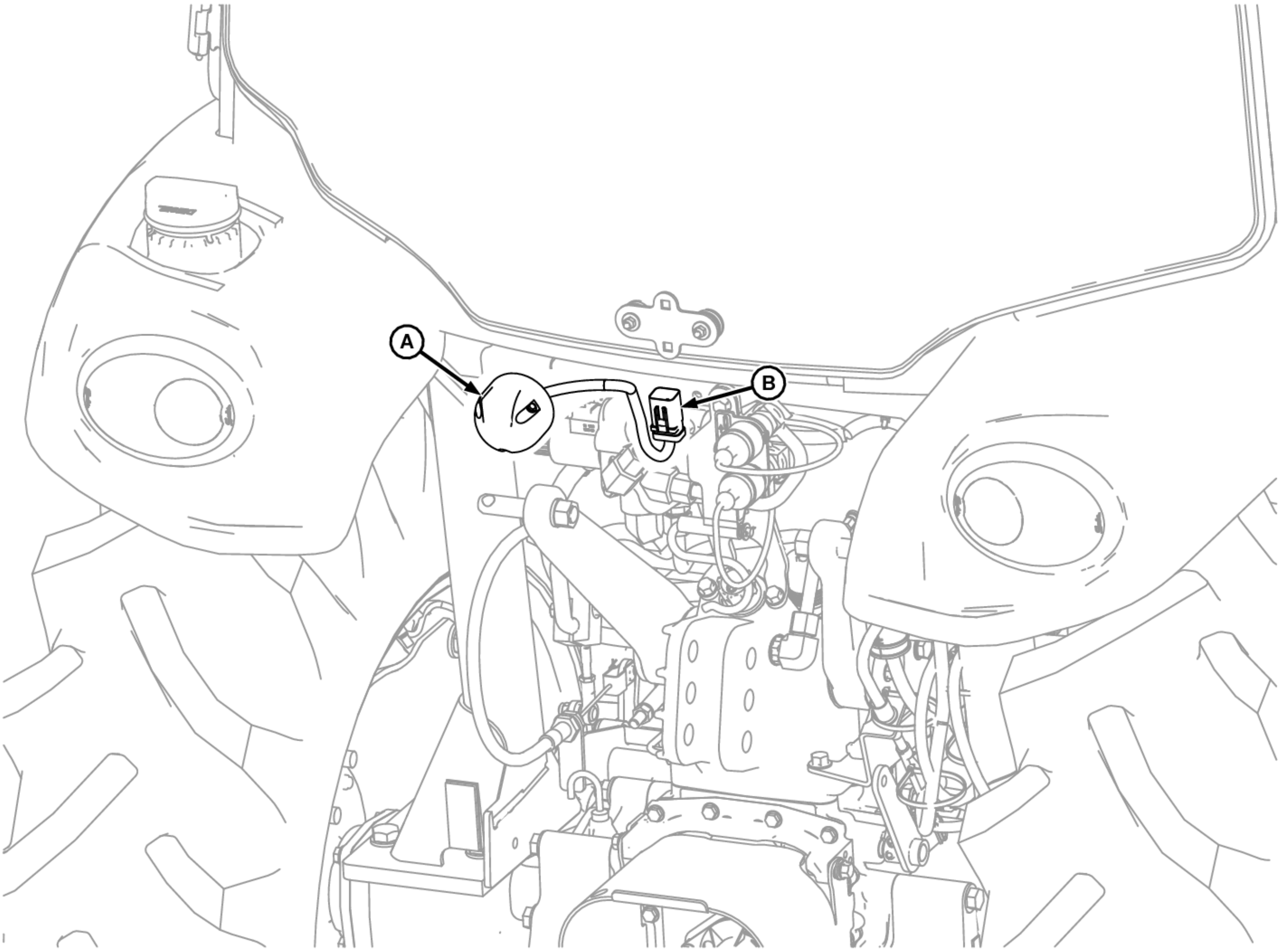


Diverter Harness PTR

LEGEND:

A	Diverter Relay
B	Diverter Fuse
C	Diverter Diode
D	Diverter Harness-to-Right Fender Harness
E	Diverter Jumper Harness Connector

W19 Seven-Pin Trailer Connector Wiring Harness Component Location (Cab)—EEC

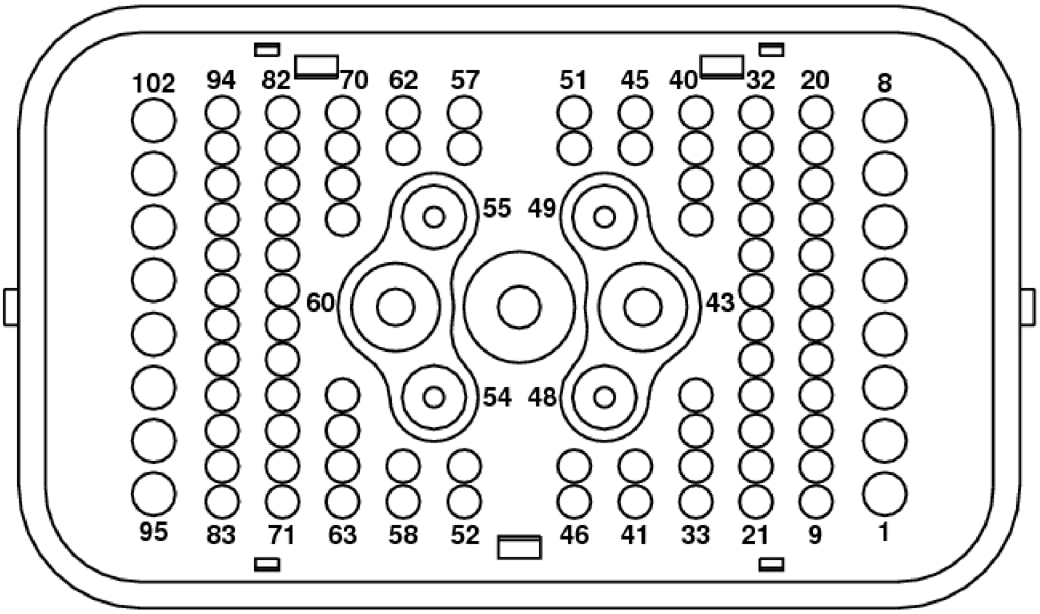


7 Pin Trailer Connector

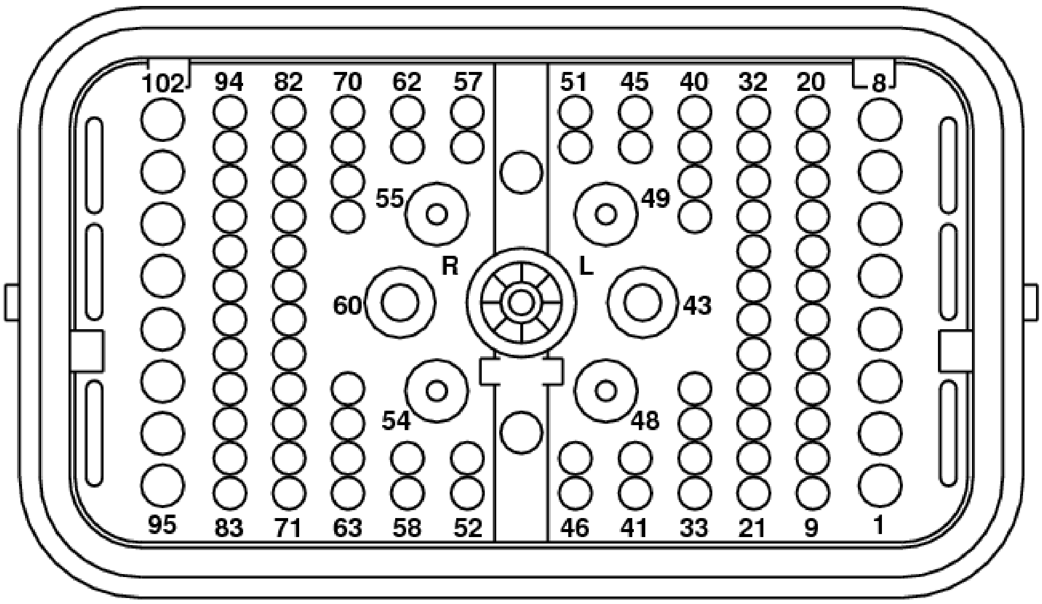
LEGEND:

A	7 Pin Trailer Connector
B	7 Pin to Lower Cab Wiring Harness

Chassis Harness Interconnect Component Location—EEC



Chassis Harness Interconnect



Lower Harness Interconnect

X50 Harness Interconnect

X50 Harness Interconnect			
		Chassis Harness Interconnect	**Lower Harness Interconnect**
Wire Pin	**Wire Color**	**Wire Number**	**Wire Number**
1		NOT USED	NOT USED
2		NOT USED	NOT USED
3		NOT USED	NOT USED
4		NOT USED	NOT USED
5		NOT USED	NOT USED

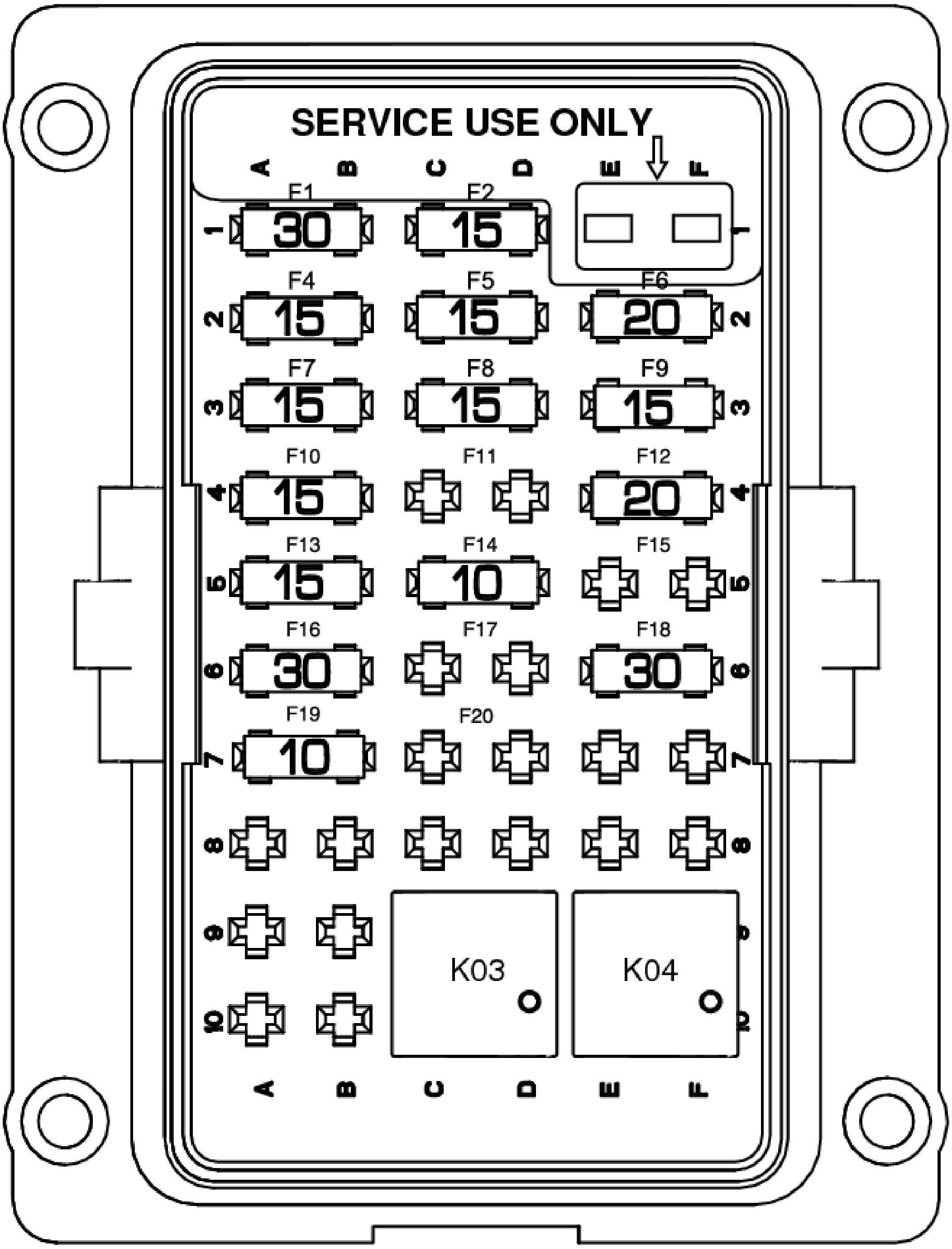
X50 Harness Interconnect			
6		NOT USED	NOT USED
7		NOT USED	NOT USED
8		NOT USED	NOT USED
9		NOT USED	NOT USED
10		NOT USED	NOT USED
11		NOT USED	NOT USED
12		NOT USED	NOT USED
13		NOT USED	NOT USED
14		NOT USED	NOT USED
15		NOT USED	NOT USED
16		NOT USED	NOT USED
17		NOT USED	NOT USED
18		NOT USED	NOT USED
19		NOT USED	NOT USED
20		NOT USED	NOT USED
21		NOT USED	NOT USED
22		NOT USED	NOT USED
23		NOT USED	NOT USED
24		NOT USED	NOT USED
25		NOT USED	NOT USED
26		NOT USED	NOT USED
27		NOT USED	NOT USED
28		NOT USED	NOT USED
29		NOT USED	NOT USED
30		NOT USED	NOT USED
31		NOT USED	NOT USED
32		NOT USED	NOT USED
33		NOT USED	NOT USED
34		NOT USED	NOT USED
35		NOT USED	NOT USED
36		NOT USED	NOT USED
37		NOT USED	NOT USED
38		NOT USED	NOT USED
39		NOT USED	NOT USED
40		NOT USED	NOT USED
41		NOT USED	NOT USED
42		NOT USED	NOT USED
43		NOT USED	NOT USED
44		NOT USED	NOT USED
45		NOT USED	NOT USED
46		NOT USED	NOT USED
47		NOT USED	NOT USED
48	Blk	0010E	0010D
49	Org	0383B	0383D
50		NOT USED	NOT USED
51		NOT USED	NOT USED
52		NOT USED	NOT USED
53		NOT USED	NOT USED

X50 Harness Interconnect			
54	Red	0002P	0002T
55	Red	0002A	0002B
56		NOT USED	NOT USED
57		NOT USED	NOT USED
58		NOT USED	NOT USED
59		NOT USED	NOT USED
60		NOT USED	NOT USED
61		NOT USED	NOT USED
62		NOT USED	NOT USED
63		NOT USED	NOT USED
64		NOT USED	NOT USED
65		NOT USED	NOT USED
66	Pur	4737C	4737A
67	Wht	5359B	5359A
68	Grn	5325B	5325A
69	Red	5302B	5302A
70	Org	4673E	4673P
71	Wht	4499B	4499A
72	Blk	0550C	0550D
73		NOT USED	NOT USED
74		NOT USED	NOT USED
75		NOT USED	NOT USED
76		NOT USED	NOT USED
77		NOT USED	NOT USED
78	Wht	2239A	2239
79	Pur	2227A	2227
80	Red	0552D	0552B
81	Org	2903A	2903B
82	Red	0562AX	0562G
83	Blu	4696B	4696A
84	Red	4692D	4692A
85	Pur	4697B	4697A
86	Brn	5351B	5351A
87	Pur	5347B	5347A
88	Blu	2216A	2216B
89	Pur	4777A	4777B
90	Pur	4687C	4687D
91	Grn	4555B	4555A
92	Pur	4747B	4747A
93	Grn	4006B	4006A
94	Grn	4005B	4005A
95	Red	0152B	0152B
96	Wht	5329A	5329A
97		NOT USED	NOT USED
98		NOT USED	NOT USED
99	Blk	0050A	0050G
100	Wht	5309B	5309A
101		NOT USED	NOT USED

X50 Harness Interconnect			
102	Wht	1119C	1119D

Load Center Component Location—EEC

eHydro Transmission Open Station



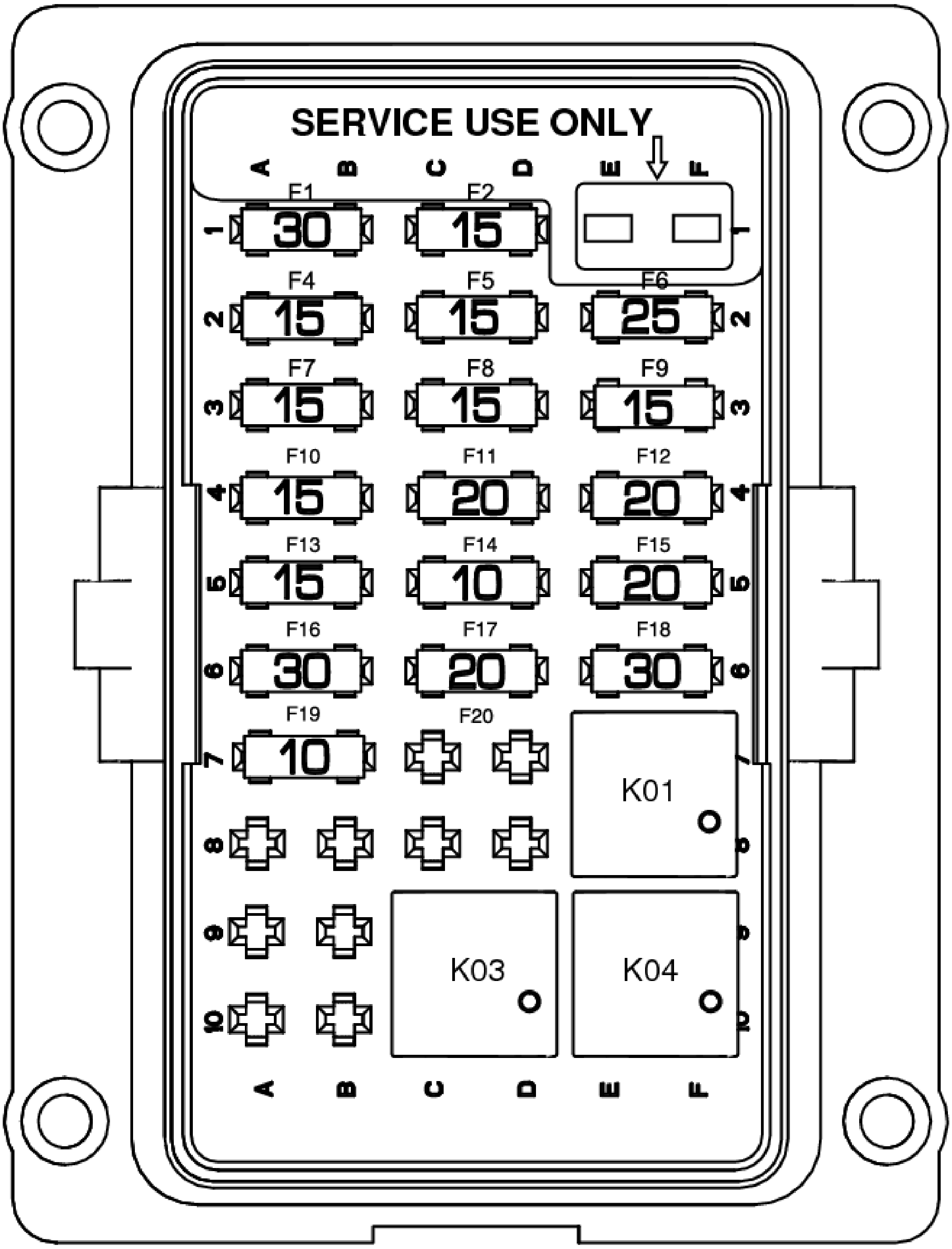
eHydro Transmission Open Station

eHydro Load Center Open Station

Component	Terminal	Wire Number/Color
F1 Fuse 30 Amp	1A	002B Red
Key Switch	1B	0012 Red
F2 Fuse 15 Amp	1C	002C Red
Right Fender Interconnect, Power Port	1D	0262A Red
Service Use Only	1E	0562E Red
	1F	0592A Red
F4 Fuse 15 Amp	2A	002E Red
Brake Lights	2B	0052A Red

Component	Terminal	Wire Number/Color
F5 Fuse 15 Amp	2C	0072 Red
Ignition Power	2D	0562A Red
F6 Fuse 20 Amp	2E	1137 Pur
Work Light 1	2F	1147A Pur
F7 Fuse 15 Amp	3A	1138C Gry
Marker light	3B	2263A Org
F8 Fuse 15 Amp	3C	1138B Gry
Headlights	3D	1119C Wht
F9 Fuse 15 Amp	3E	0212A Red
Accessory	3F	0552A Red
F10 Fuse 15 Amp	4A	0212B Red
Air Ride Seat (Option)	4B	2263A Org
F11 Spare	4C	
	4D	
F12 Fuse 20 Amp	4E	0002F Red
7 Pin Trailer	4F	0252 Red
F13 Fuse 15 Amp	5A	1138F Gry
Marker Light 2	5B	1128A Gry
F14 Fuse 10 Amp	5C	0472A Red
ELX	5D	4472 Red
F15 Spare	5E	
	5F	
F16 Fuse 30 Amp	6A	0002E Red
Light Switch	6B	0132A Red
F17 Spare	6C	
	6D	
F18 Fuse 30 Amp	6E	0002D Red
Display Panel	6F	0122A Red
F19 Fuse 10 Amp	7A	0002G Red
TCM	7B	0142 Red
K03	9C 9D	10D Blk 1136A Blu
Brake Light Relay	10C 10D	0052B Red 1116A Blu
K04	9E 9F	10CB Blk 0582A Red
7 Pin Trailer Relay (Option)	10E 10F	0252 Red 0562AL Red

eHydro Transmission Cab



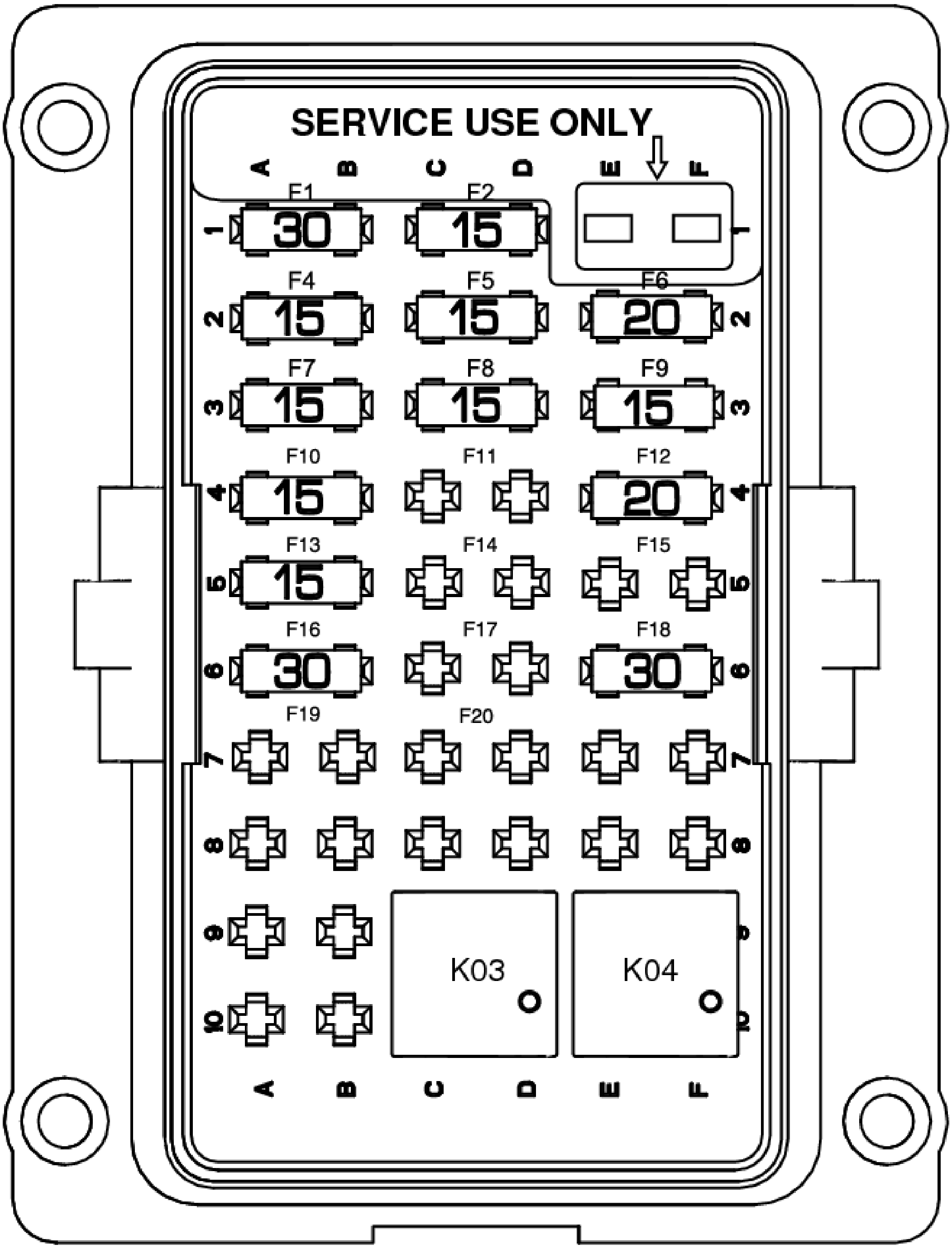
eHydro Transmission Cab

eHydro Transmission Load Center Cab

Component	Terminal	Wire Number/Color
F1 Fuse 30 Amp	1A	002C Red
Key Switch	1B	0012A Red
F2 Fuse 15 Amp	1C	002D Red
Right Fender Interconnect, Power Port	1D	0262 Red
F3 Service Use Only	1E	0562T Red
	1F	0592C Red
F4 Fuse 15 Amp	2A	0002J red
Brake Light	2B	0692 Red
F5 Fuse 15 Amp	2C	0072 Red
Ignition Power	2D	0562A Red
F6 Fuse 25 Amp	2E	0002H Red

Component	Terminal	Wire Number/Color
Work Light	2F	0162B Red
F7 Fuse 15 Amp	3A	1138E Gry
RH Tail Light	3B	1118A Gry
F8 Fuse 15 Amp	3C	1138B Gry
Headlight	3D	1119D Wht
F9 Fuse 15 Amp	3E	0312A Red
Accessory	3F	0552A Red
F10 Fuse 15 Amp	4A	0312B Red
Air Ride Seat (Option)	4B	2263 Org
F11 Fuse 20 Amp	4C	0312E Red
Wiper	4D	2272A Red
F12 Fuse 20 Amp	4E	0002F Red
7 Pin Trailer	4F	0252 Red
F13 Fuse 15 Amp	5A	1138F Gry
LH Tail Light	5B	1128A Gry
F14 Fuse 10 Amp	5C	0472 Red
ELX	5D	4472 Red
F15 Fuse 20 Amp	5E	0002K Red
Roof Harness 2	5F	0092A Red
F16 Fuse 30 Amp	6A	0002M Red
Light Switch	6B	0132A Red
F17 Fuse 20 Amp	6C	0002G red
Roof Harness 1	6D	0082A Red
F18 Fuse 30 Amp	6E	0002E Red
Display Panel	6F	0122A Red
F19 Fuse 10 Amp	7A	0002R Red
TCU	7B	0142 Red
K01	7E 7F	10V Blk 1157A Pur
Work Lights Relay	8E 8F	0162C Red 1137 Pur
K03	9C 9D	0010AS Blk 1136A Blu
Brake Light Relay	10C 10D	0052B Red 1116A Blu
K04	9E 9F	0010 Blk 0582A Red
7 Pin Trailer Relay (Option)	10E 10F	0252 Red 312C Red

PowrReverser



PowrReverser Transmission

PowrReverser Transmission Load Center Open Station

Component	Terminal	Wire Number/Color
F1 Fuse 30 Amp	1A	002B Red
Key Switch	1B	0012 Red
F2 Fuse 15 Amp	1C	002C Red
Right Fender Interconnect, Power Port	1D	0262A Red
Service Use Only	1E	0562E Red
	1F	0592A Red
F4 Fuse 15 Amp	2A	002E Red
Brake Lights	2B	0052A Red
F5 Fuse 15 Amp	2C	0072 Red
Ignition Power	2D	0562A Red
F6 Fuse 20 Amp	2E	1137 Pur

Component	Terminal	Wire Number/Color
Work Light 1	2F	1147A Pur
F7 Fuse 15 Amp	3A	1138C Gry
Marker light	3B	2263A Org
F8 Fuse 15 Amp	3C	1138B Gry
Headlights	3D	1119C Wht
F9 Fuse 15 Amp	3E	0212A Red
Accessory	3F	0552A Red
F10 Fuse 15 Amp	4A	0212B Red
Air Ride Seat (Option)	4B	2263A Org
F11 Spare	4C	
	4D	
F12 Fuse 20 Amp	4E	0002F Red
7 Pin Trailer	4F	0252 Red
F13 Fuse 15 Amp	5A	1138F Gry
Marker Light 2	5B	1128A Gry
F14 Fuse	5C	
Spare	5D	
F15 Spare	5E	
	5F	
F16 Fuse 30 Amp	6A	0002E Red
Light Switch	6B	0132A Red
F17 Spare	6C	
	6D	
F18 Fuse 30 Amp	6E	0002D Red
Display Panel	6F	0122A Red
F19 Fuse	7A	
Spare	7B	
K03	9C 9D	10D Blk 1136A Blu
Brake Light Relay	10C 10D	0052B Red 1116A Blu
K04	9E 9F	10CB Blk 0582A Red
7 Pin Trailer Relay (Option)	10E 10F	0252 Red 0562AL Red

Group 20 - Schematics and Harnesses

Schematic and Wiring Harness Legend—EEC

Components:

A01—Display Panel

A02—Radio

A09—Engine Control Unit (ECU)

A09-J1—ECU Connector

A09-J2—ECU Connector

B01—Fuel Gauge Sensor

B02—Coolant Temperature Sensor

B03—Air Filter Restriction Switch

B04—Engine Oil Pressure Switch

B33—MFWD Speed Sensing Switch

B34—Mid-Mount Proxy Sensor

E01—Left Headlight

E02—Right Headlight

E03—Left Position Light

E03_X01—Ground

E03_X02—Tail

E03_X03—Turn

E03_X04—Turn/Haz

E04—Right Position Light

E04_X01—Ground

E04_X02—Tail

E04_X03—Turn

E04_X04—Turn/Haz

E05—Left Work Light

E06—Right Work Light

E07—Right Front Amber Light

E08—Right Front Work Light

E09—Right Rear Amber Light

E10—Right Rear Work Light

E11—Left Front Amber Light

E12—Left Front Work Light

E13—Left Rear Amber Light

E14—Left Rear Work Light

E15—Dome Light

E16—License Plate Light

E17—Beacon Light

E18—Right Front Marker Light

E19—Left Front Marker Light

E20—Right Tail Light

E21—Left Tail Light

E22—Right Position Light

E22_X01—Turn

E22_X02—Brake

E22_X03—Marker

E22_X04—Ground

E22_X05—Hazard

E22_X06—Hazard

E22_X07—Ground

E23—Left Position Light

E23_X01—Turn

E23_X02—Brake

E23_X03—Marker

E23_X04—Ground

E23_X05—Hazard

E23_X06—Hazard

E23_X07—Ground

E24—Right Turn Light

E25—Right Brake Marker Light

E26—Left Brake Marker Light

E27—Left Turn Light

F1—Key Switch Fuse (30A)

F2—Power Port Fuse (15A)

F3—Service Use Only

F4—Brake Light Fuse (15A)

F5—Ignition Power Fuse (15A)

F6—Work Light Fuse (20A)

F7—Tail Light Fuse (20A)

F8—Headlight Fuse (20A)

F9—Accessory Fuse (15A)

F10—Air Ride Seat Fuse (if equipped) (15A)

F11—EGR Fuse (10A)

F12—Trailer Fuse (20A)

F13—Junction Block Fuse (30A)

F14—ELX Fuse (10A)

F15—Spare

F16—Light Switch Fuse (30A)

F17—Spare

F18—Instrument Panel Fuse (30A)

F19—TCU/TCM Fuse (10A)

F20—Glow Plug Fuse (40A)

F21—Load Center Fuse (50A)

F22—Alternator Fuse (80A)

F23—Inline Fuse (500A)

F24—Diverter Valve Fuse (10A)

F40—ECU Fuse (25A)

G01—Battery

G02—Alternator

G03—Alternator (Cab)

H01—Horn

H02—Warning Alarm

H03—Backup Alarm

H04—Left Speaker

H05—Right Speaker

H06—Power Port

ICC-J1—Display Interconnect

ICC-J2—Display Interconnect

ICC-J3—Display Interconnect

ICC-J4—Display Interconnect

K01—Work Light Relay (Cab)

K02—EGR Relay

K03—Brake Light Relay

K04—7-Pin Trailer Power Relay

K05—Accessory Power Relay

K06—Work Light Relay

K07—Start Relay

K08—Glow Plug Relay

K09—Right Power Relay

K10—Left Power Relay

K11—Right Blower Relay

K12—Left Blower Relay

K13—Control Relay A

K14—3rd Function Lockout Relay A

K15—3rd Function Lockout Relay B

K16—Control Relay B

K17—Diverter Relay

K18—Fuel Shutoff Relay

K19—Manifold Heater Relay

K20—Dual Rear Continuous Relay

LC01—Load Center

LC02—Load Center 3rd EH (Open Station)

LC03—Load Center Harness (Cab)

LC04—Fuse Holder

M01—Starting Motor

M02—Fuel Pump

M03—Front Wiper Motor

M04—Rear Washer Pump

M05—Front Washer Pump

M06—Exhaust Valve Actuator

M07—Left Blower Motor

M08—Right Blower Motor

M09—Rear Wiper Motor

P01—Forward Pedal Sensor

P02—Reverse Pedal Sensor

P03—Hand Throttle

P04—Foot Throttle Sensor

R01—Glow Plugs

R02—Manifold Heater

S01—Key Switch

S02—Dash Panel Module

S03—PTO Switch

S06—Differential Pressure Switch

S08—Inlet Temperature Sensor

S09—Mid-Temperature Sensor

S10—Dual Continuous Switch

S14—Rear Work Light Switch

S15—Horn Switch

S16—Beacon Light Switch

S20—Front Wiper Switch

S21—Rear Wiper Switch

S22—HVAC Temperature Sensor

S23—High-Low Pressure Switch

S24—Door Light Switch

S25—Dome Light Switch

S27—Diverter Switch

S28—Blower Switch

S29—HVAC Switch

S38—Seat Switch

S39—Air Ride Seat

S40—MFWD Engagement Sensing Switch

S41—Brake Switch

S42—Park Brake Switch

S46—Cruise Module

S48—Rear PTO Sensing Switch

S49—Mid PTO Sensing Switch

S50—Neutral Sensing Switch

S54—3rd Function Control Switch

T01—Ground Terminal

T02—Ground Terminal

T03—Ground Terminal

T13—Phase Terminal

T20—Ground

TCU-J1—Transmission Control Unit Interconnect

V03—Diode (5A)

V04—Diode (6A)

V05—Diode (6A)

W1—Chassis Wiring Harness (Open Station)

W2—Chassis Wiring Harness (PowrReverser)

W3—Fender Wiring Harness (Open Station)

W4—Hood Harness

W5—Grille Wiring Harness

W6—HST Valve Wiring Harness

W7—Chassis Wiring Harness (Cab)

W8—Lower Wiring Harness (Cab)

W9—Upper Wiring Harness (Cab)

W10—Diverter Valve Wiring Harness (Open Station)

W11—3rd EH Wiring Harness (Open Station)

W12—Load Center Harness (Cab)

W13—3rd EH, Diverter, Creep to REPO Harness (Cab)

W14—Seat Switch Jumper Harness (Cab)

W15—Seat Switch Jumper Harness (Open Station)

W16—Fender Wiring Harness—PowrReverser Transmission

W17—Diverter Wiring Harness (Open Station)

W01—Ground (Machine)

W02—Beacon Light Ground

X102—Service Advisor

X103—1/2 Watt Resistor

X01-W1—12-Pin Engine Interface (Yellow)

X01-W2—12-Pin Engine Interface (PowrReverser) (Yellow)

X01-W7—12-Pin Engine Interface (Yellow)

X02—Junction Block

X03-W4—Hood to Grille Harness Interconnect

X03-W5—Grille to Hood Harness Interconnect

X04-W1—8-Pin Engine Interface (Red)

X04-W2—8-Pin Engine Interface (PowrReverser) (Red)

X04-W7—8-Pin Engine Interface (Red)

X05-W1—12-Pin Engine Interface (Red)

X05-W2—12-Pin Engine Interface (PowrReverser) (Red)

X05-W7—12-Pin Engine Interface (Red)

X06-W1—12-Pin Engine Interface (Gray)

X06-W2—12-Pin Engine Interface (PowrReverser) (Gray)

X06-W7—12-Pin Engine Interface (Gray)

X07-W1—Chassis to Hood Harness Interconnect

X07-W2—Chassis to Hood Harness Interconnect (PowrReverser)

X07-W4—Hood to Chassis Harness Interconnect

X07-W7—Chassis to Hood Harness Interconnect

X08-W1—Chassis to Hood Harness Interconnect

X08-W2—Chassis to Hood Harness Interconnect (PowrReverser)

X08-W4—Hood to Chassis Harness Interconnect

X08-W7—Chassis to Hood Junction Block Interconnect

X09-W1—Chassis to Right Fender Harness Interconnect 1

X09-W2—Chassis to Right Fender Harness (PowrReverser) Interconnect 1

X09-W3—Right Fender to Chassis Harness Interconnect 1

X09-W16—Right Fender to Chassis Harness Interconnect 1 (PowrReverser)

X10-W1—Chassis to Right Fender Harness Interconnect 2

X10-W3—Right Fender to Chassis Harness Interconnect 2

X11-W3—Right Fender to 3rd EH Harness Interconnect

X11-W16—Right Fender to 3rd EH Harness Interconnect (PowrReverser)

X11-W11—3rd EH to Right Fender Harness Interconnect

X12-W10—Diverter Valve to 3rd EH Harness Interconnect (or 3rd EH, Diverter, Creep to REPO Harness (Cab)

X12-W11—3rd EH to Diverter Valve Harness Interconnect

X13-W1—Chassis to Front PTO Switch Interconnect

X13-W2—Chassis to Front PTO Switch Interconnect (PowrReverser)

X13-W7—Lower Cab Wiring Harness to Front PTO Switch Interconnect

X14-WI—Chassis to Front PTO Harness Interconnect

X14-W2—Chassis to Front PTO Harness Interconnect (PowrReverser)

X14-W7—Chassis to Front PTO Harness Interconnect

X15-W1—Chassis to Creep to Reposition Switch Harness Interconnect

X17-W17—Rear Harness Connector

X17-W18—Rear Harness Connector

X26-W1—Chassis to HST Harness Interconnect

X26-W6—HST to Chassis Harness Interconnect

X26-W7—Chassis to HST Harness Interconnect

X27-W9—Upper Cab Wiring Harness to Dome Light

X28-W9—Upper Cab Wiring Harness to Right Front Amber Light

X29-W9—Upper Cab Wiring Harness to Right Front Work Light

X30-W9—Upper Cab Wiring Harness to Right Rear Amber Light

X31-W9—Upper Cab Wiring Harness to Right Rear Work Light

X32-W9—Upper Cab Wiring Harness to Left Front Amber Light

X33-W9—Upper Cab Wiring Harness to Left Front Work Light

X34-W9—Upper Cab Wiring Harness to Left Rear Amber Light

X35-W9—Upper Cab Wiring Harness to Left Rear Work Light

X38-W1—Chassis to Seat Switch Harness Interconnect

X38-W8—Lower Cab to Seat Switch Harness Interconnect

X38-W14—Seat Switch to Lower Cab Harness Interconnect

X38-W15—Seat Switch to Chassis Harness Interconnect

X50-W7—Chassis to Lower Cab Wiring Harness Interconnect

X50-W8—Lower Cab to Chassis Wiring Harness Interconnect

X51-W1—Chassis to 7-Pin Wiring Harness Interconnect

X51-W2—Chassis to 7-Pin Wiring Harness Interconnect (PowrReverser)

X51-W8—Lower Cab to 7-Pin Wiring Harness Interconnect

X51-W19—7-Pin to Lower Cab Wiring Harness Interconnect

X52-W8—Lower Cab to Upper Cab Wiring Harness Interconnect

X52-W9—Upper Cab to Lower Cab Wiring Harness Interconnect

X53-W8—Lower Cab to Upper Cab Wiring Harness Interconnect

X53-W9—Upper Cab to Lower Cab Wiring Harness Interconnect

X54-W8—Rear Harness to Load Center Interconnect

X54-W12—Load Center to Rear Harness Interconnect

X55-W12—Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect

X55-W13—3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect

X56-W13—3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect

X56-W18—Diverter Wiring Harness to REPO Harness Interconnect

X57-W13—3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect

X65—CAN Terminator

X78-W8—Lower Cab to 3rd EH SCV Handle Harness

X78-W11—3rd EH Wiring Harness to 3rd EH SCV Handle Harness

XG02—Regulator Terminal

XG03—Output Terminal

Y01—Starter Motor Solenoid

Y02—Rockshaft/Diverter Solenoid

Y03—Rear PTO Solenoid

Y04—3rd Function Solenoid A

Y05—Forward Proportional Solenoid

Y06—Reverse Proportional Solenoid

Y07—3rd Function Solenoid B

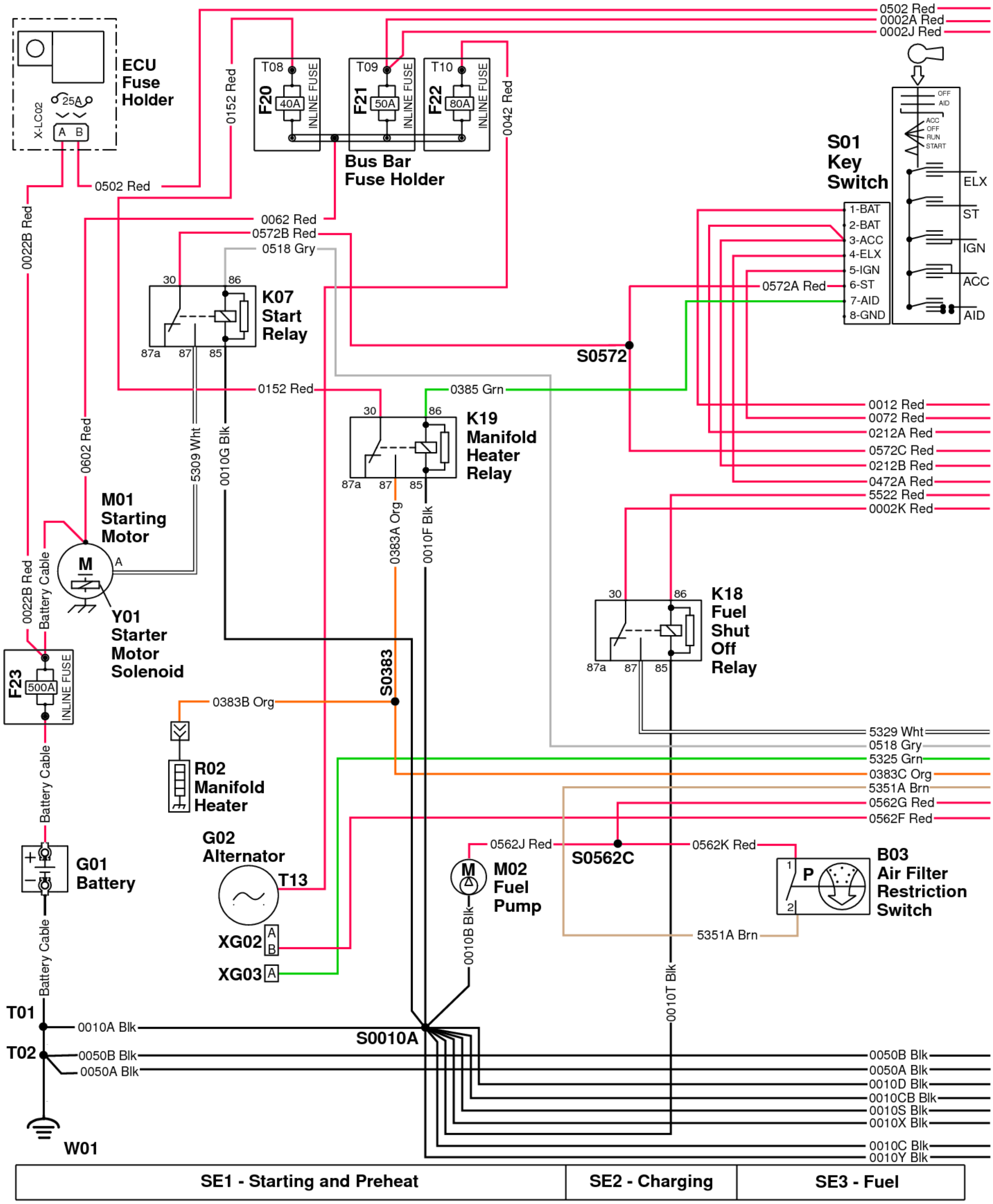
Y08—Upper Hydraulic Solenoid Valve

Y09—Lower Hydraulic Solenoid Valve

Y10—Fuel Solenoid

Y23—Air Conditioning Compressor Clutch

Main Wiring Schematic (Open Station)—EEC

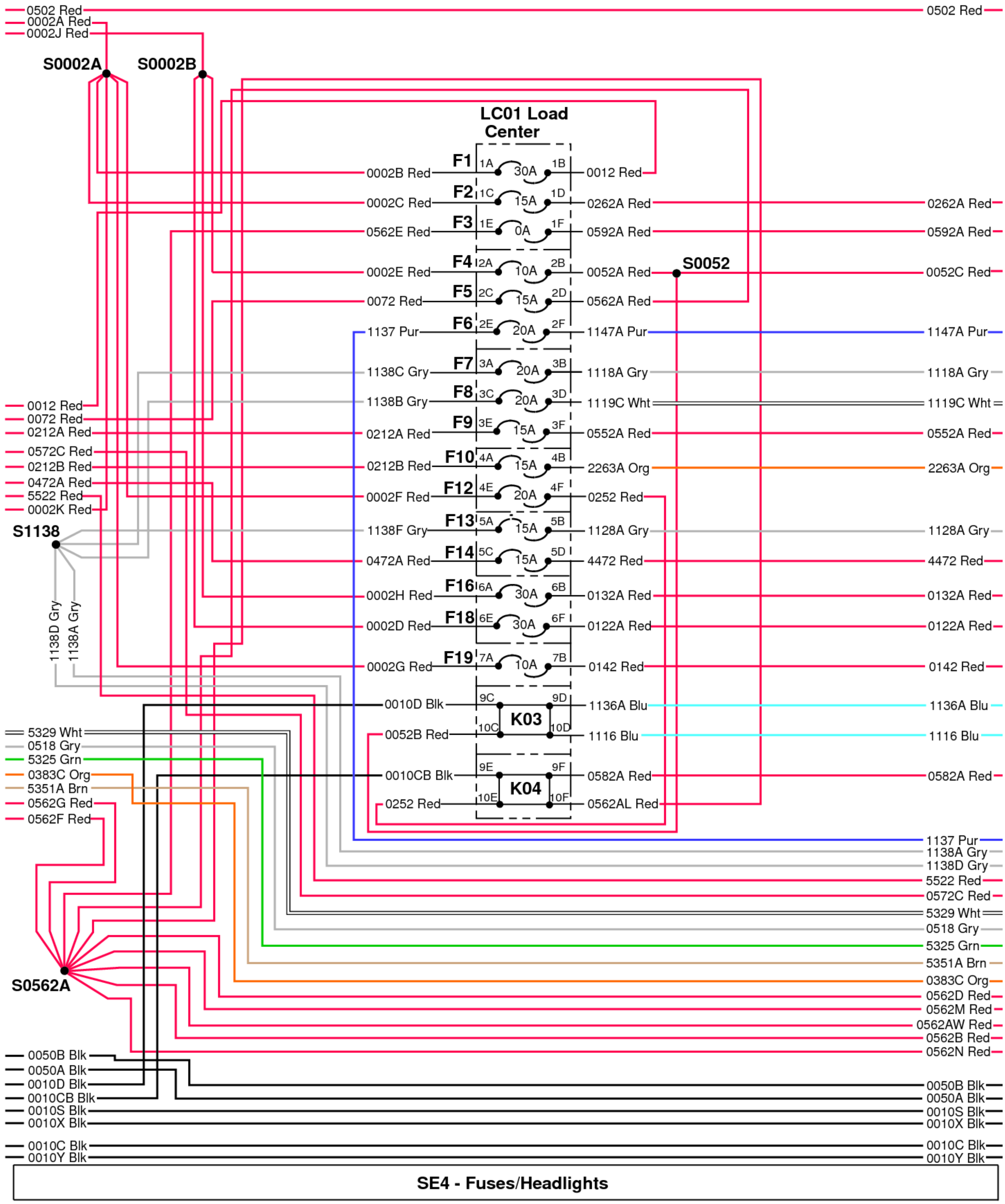


Main Wiring Schematic Open Station (1 of 10)

LEGEND:

B03	Air Filter Restriction Switch
F20	Inline Fuse (40A)
F21	Inline Fuse (50A)
F22	Inline Fuse (80A)

F23	Inline Fuse (500A)
F40	ECU Fuse (25A)
G01	Battery
G02	Alternator
K07	Start Relay
K08	Glow Plug Relay
K18	Fuel Shut Off Relay
K19	Manifold Heater Relay
M01	Starting Motor
M02	Fuel Pump
R02	Manifold Heater
S01	Key Switch
T13	Phase Terminal
W01	Ground
XG02	Regulator Terminal
XG03	Output Terminal
Y01	Starter Motor Solenoid

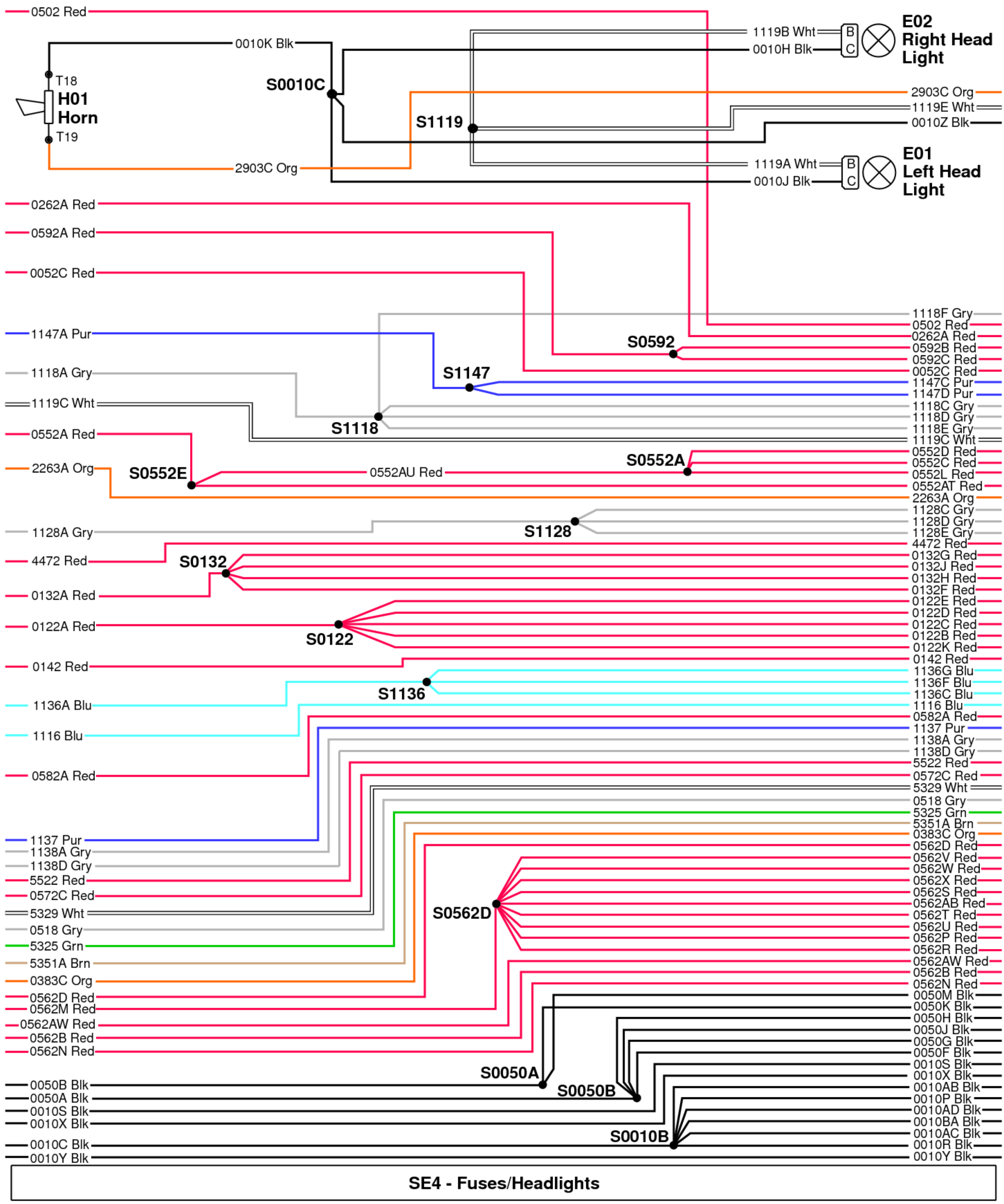


Main Wiring Schematic Open Station (2 of 10)

LEGEND:

F1	Fuse 30A
F2	Fuse 15A
F3	Service Use Only
F4	Fuse 15A
F5	Fuse 15A
F6	Fuse 20A

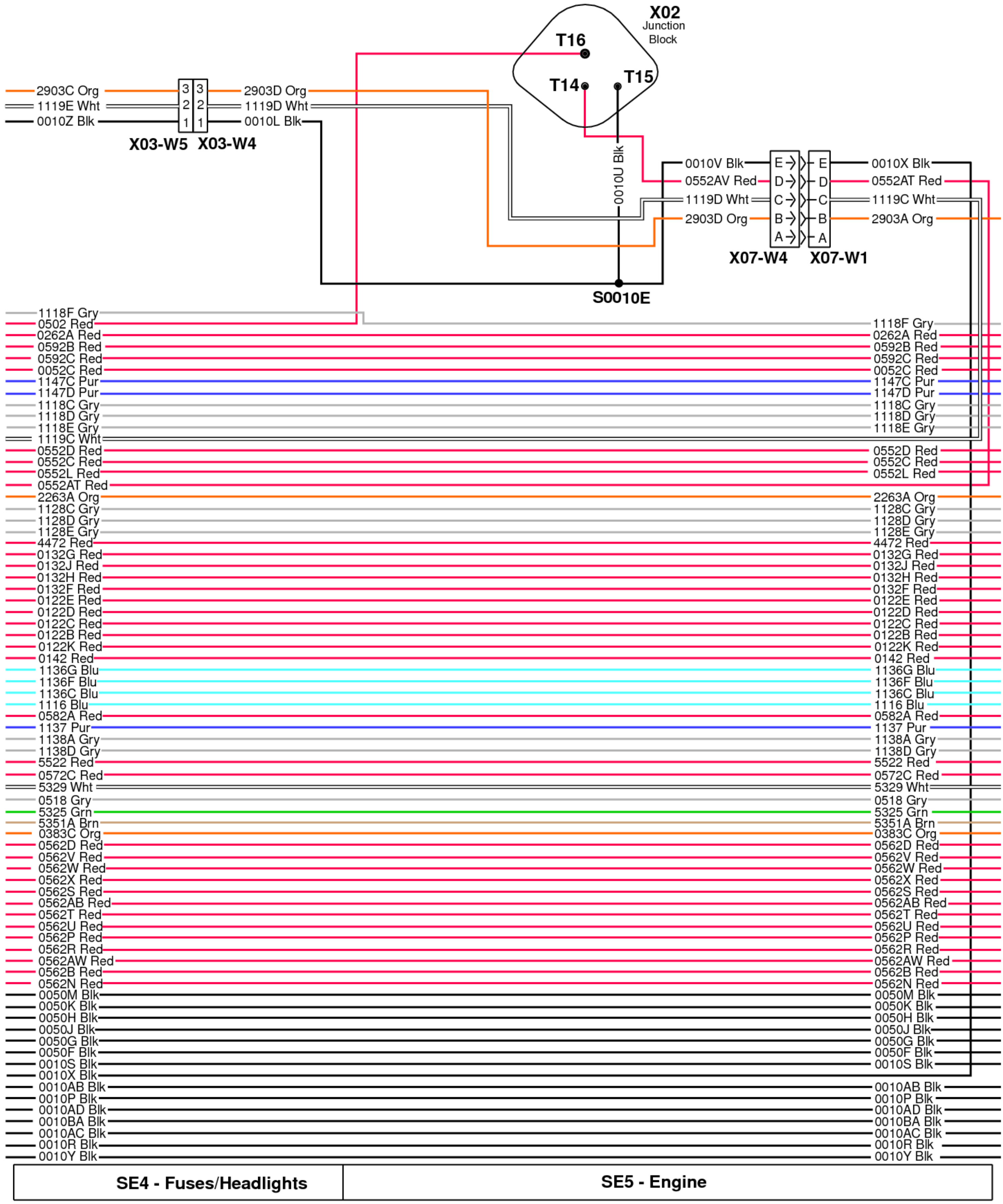
F7	Fuse 15A
F8	Fuse 15A
F9	Fuse 15A
F10	Fuse 15A
F11	Spare
F12	Fuse 20A
F13	Fuse 15A
F14	Fuse 10A
F15	Spare
F16	Fuse 30A
F17	Spare
F18	Fuse 30A
F19	Fuse 10A
K03	Brake light Relay
K04	7 Pin Trailer Relay
LC01	Load Center



Main Wiring Schematic Open Station (3 of 10)

LEGEND:

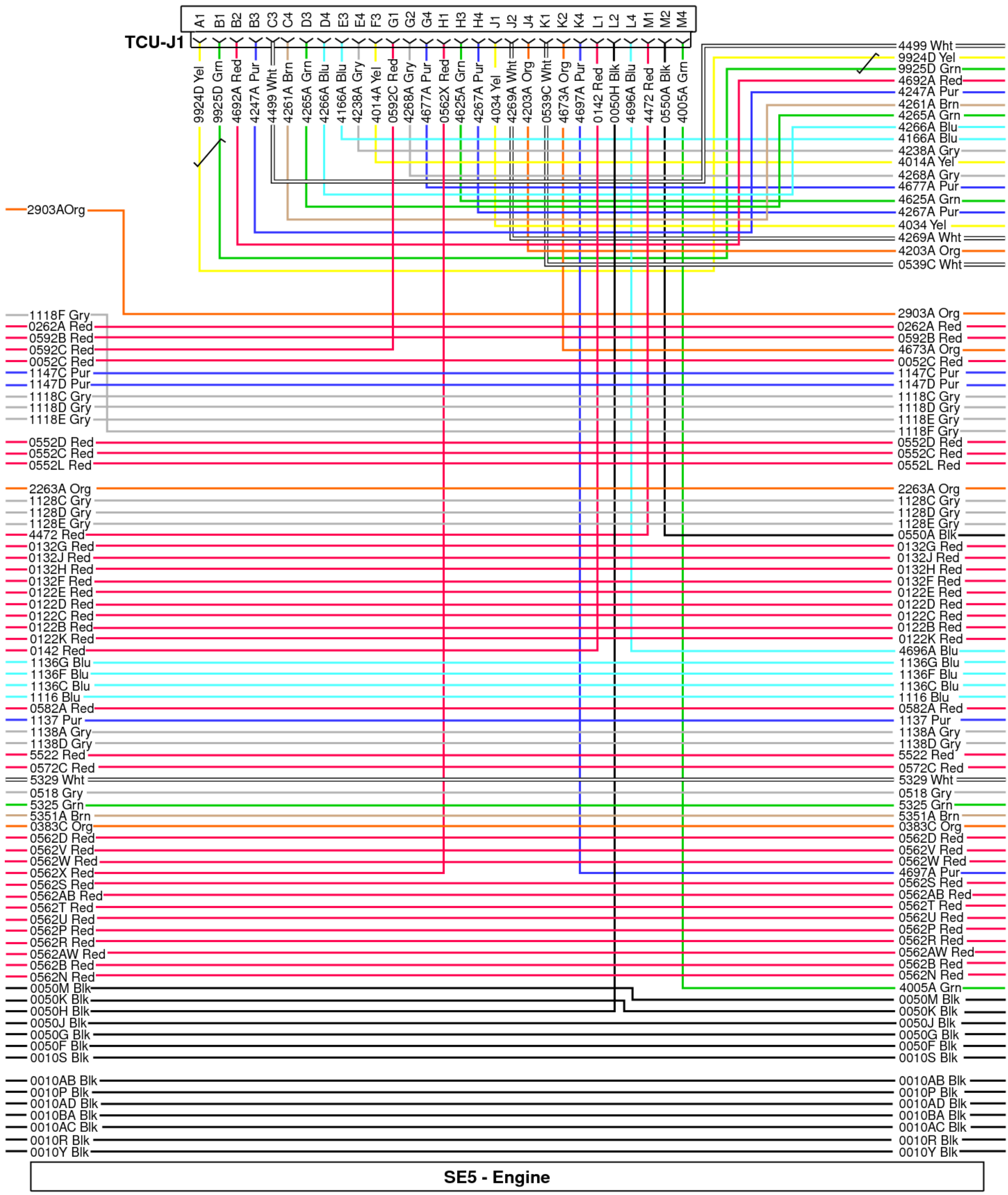
H01	Horn
E01	Left Headlight
E02	Right Headlight



Main Wiring Schematic Open Station (4 of 10)

LEGEND:

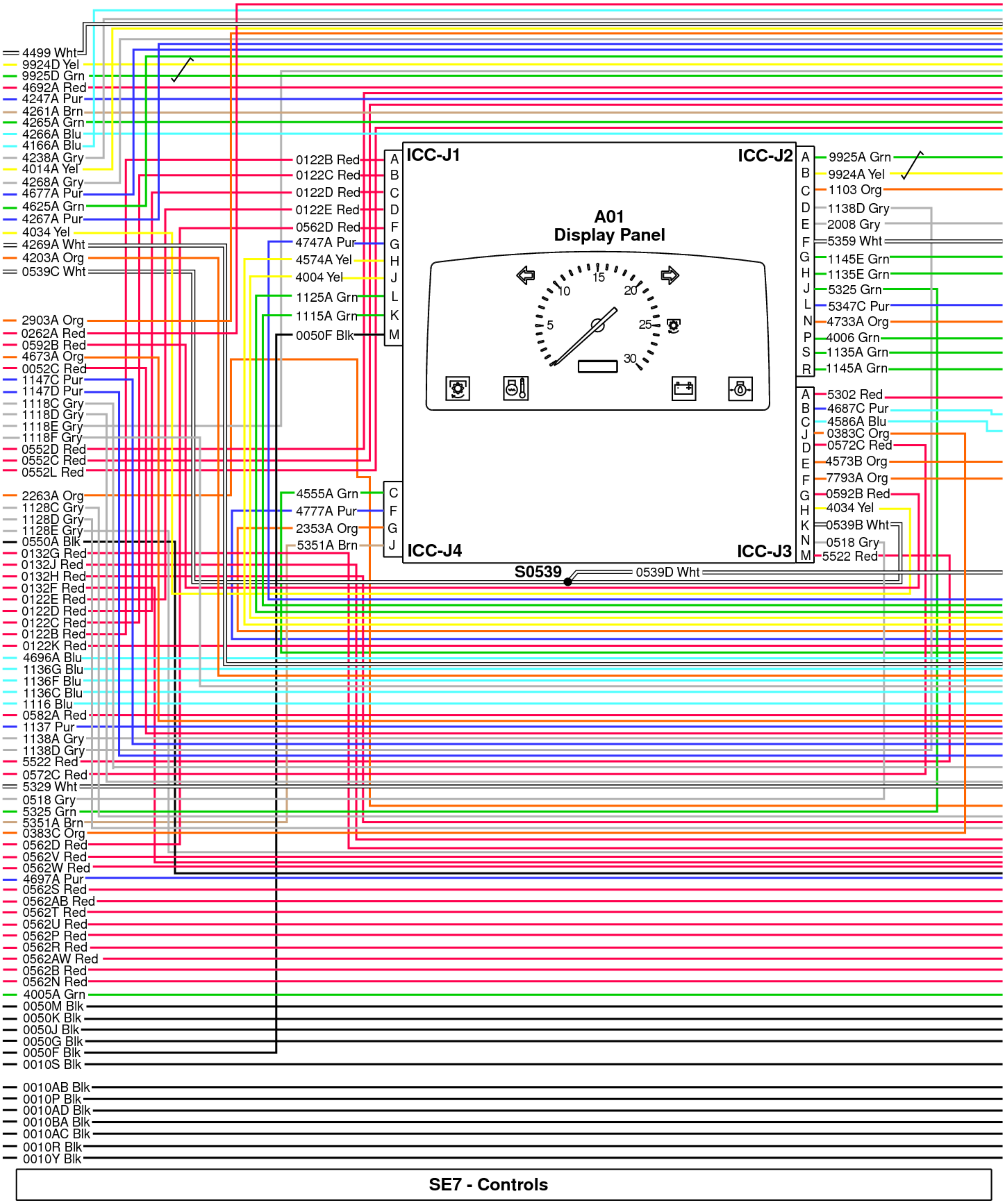
X03-W4	Hood to Grille Harness Interconnect
X03-W5	Grille to Hood Harness Interconnect
X07-W1	Chassis to Hood Harness Interconnect
X07-W4	Hood to Chassis Harness Interconnect
X02	Junction Block



Main Wiring Schematic Open Station (5 of 10)

LEGEND:

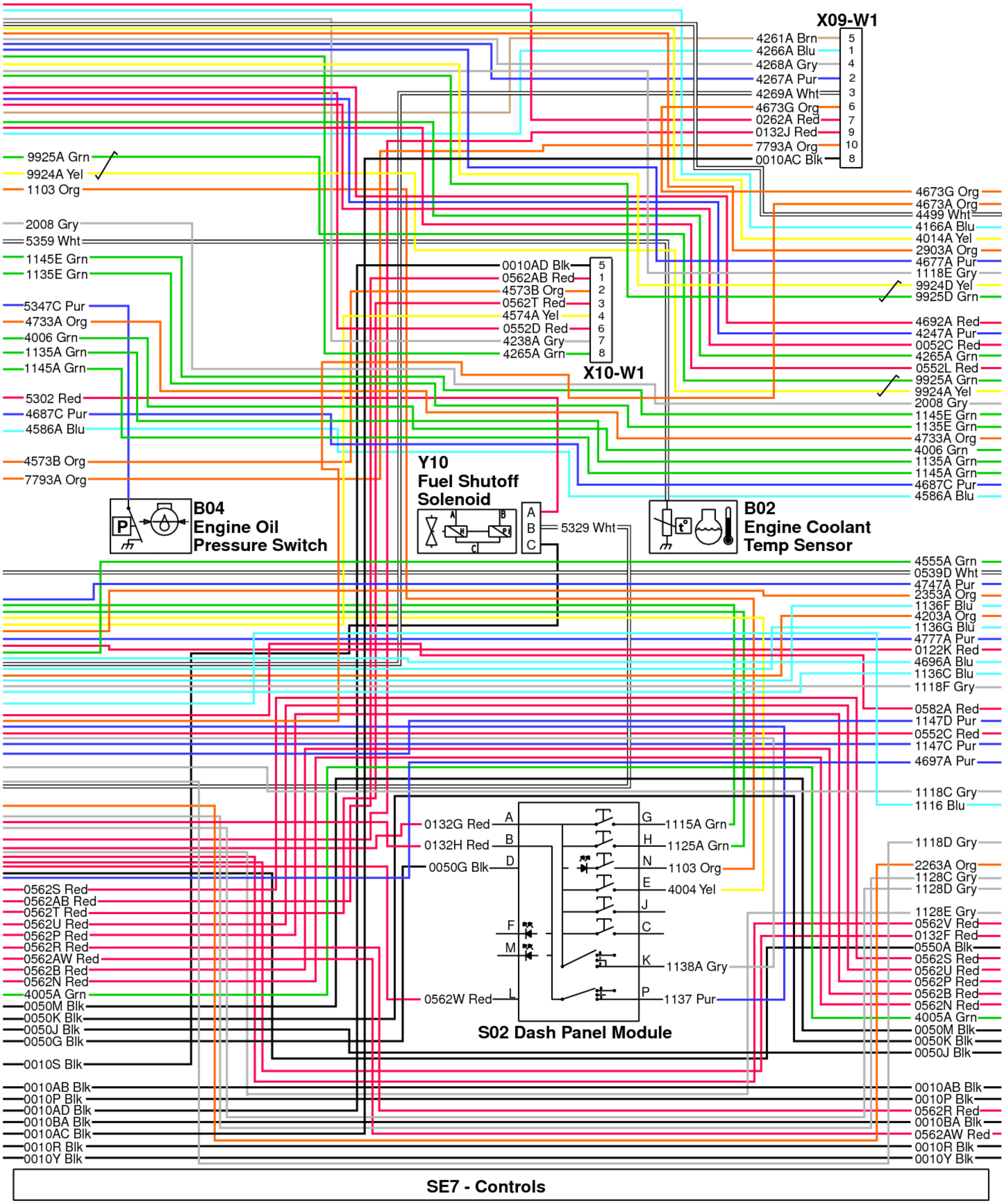
TCU-J1	Transmission Control Unit Interconnect



Main Wiring Schematic Open Station (6 of 10)

LEGEND:

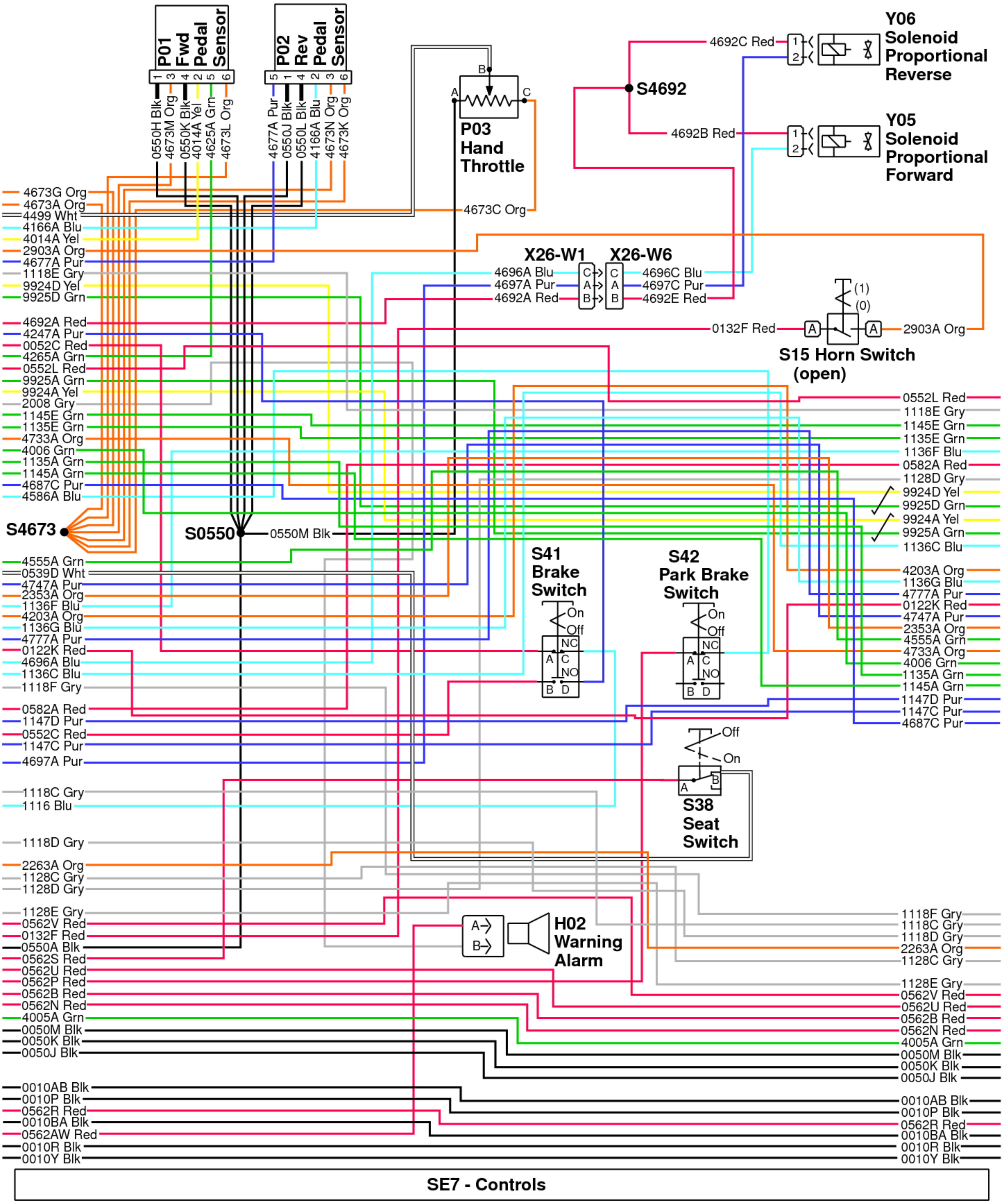
A01	Display Panel
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect



Main Wiring Schematic Open Station (7 of 10)

LEGEND:

B02	Coolant Temperature Sensor
B04	Engine Oil Pressure
S02	Dash Panel Module
X09-W1	Chassis to Right Fender Harness Interconnect 1
X10-W1	Chassis to Right Fender Harness Interconnect 2
Y10	Fuel Solenoid

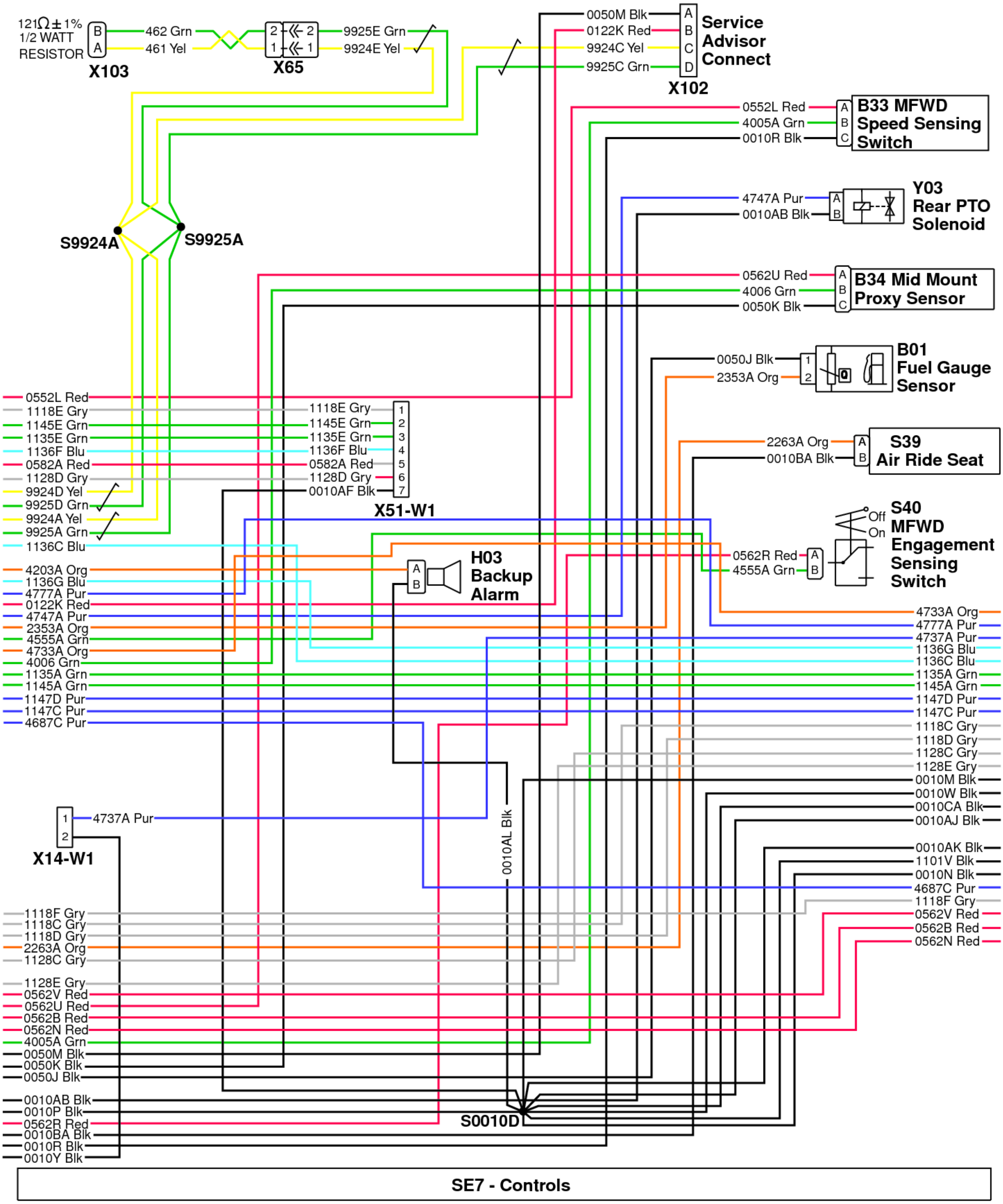


Main Wiring Schematic Open Station (8 of 10)

LEGEND:

H02	Warning Alarm
P01	Forward Pedal Sensor
P02	Reverese Pedal Sensor
P03	Hand Throttle
S15	Horn Switch
S38	Seat Switch

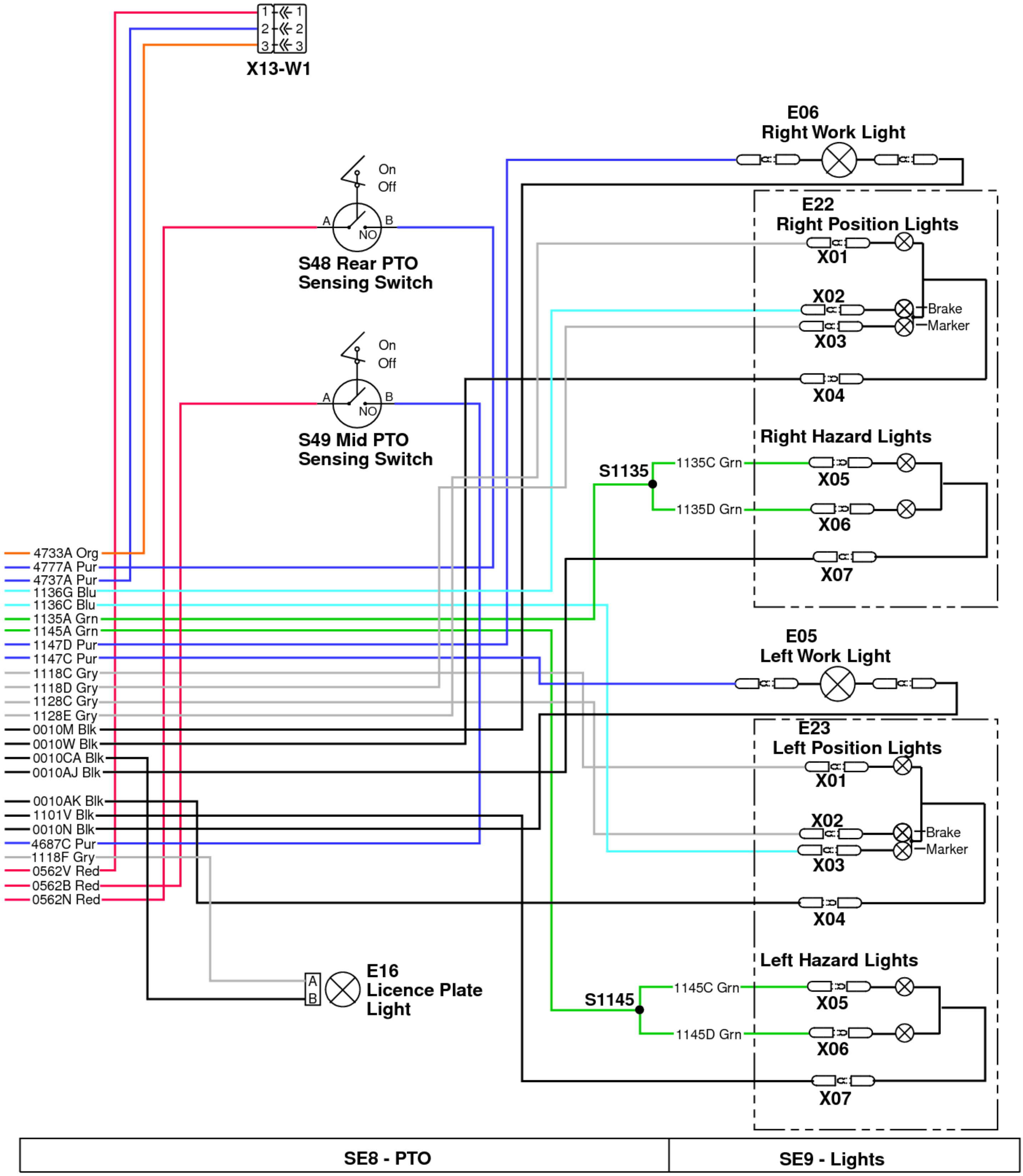
S41	Brake Switch
S42	Park Brake Switch
X26-W1	Chassis to HST Harness Interconnect
X26-W6	HST to Chassis Harness Interconnect
Y05	Forward Proportional Solenoid
Y06	Reverse Proportional Solenoid



Main Wiring Schematic Open Station (9 of 10)

LEGEND:

B01	Fuel Gauge Sensor
B33	MFWD Speed Sensing Switch
B34	Mid Mount Proxy Sensor
H03	Backup Alarm
S39	Air Ride Seat
S40	MFWD Engagement Sensing Switch
X14-W1	Chassis to Front PTO Harness Interconnect
X51-W1	Chassis to 7 Pin Wiring Harness Interconnect
X65	CAN Terminator
X102	Service Advisor
X103	1/2 Watt Resistor
Y03	Rear PTO Solenoid

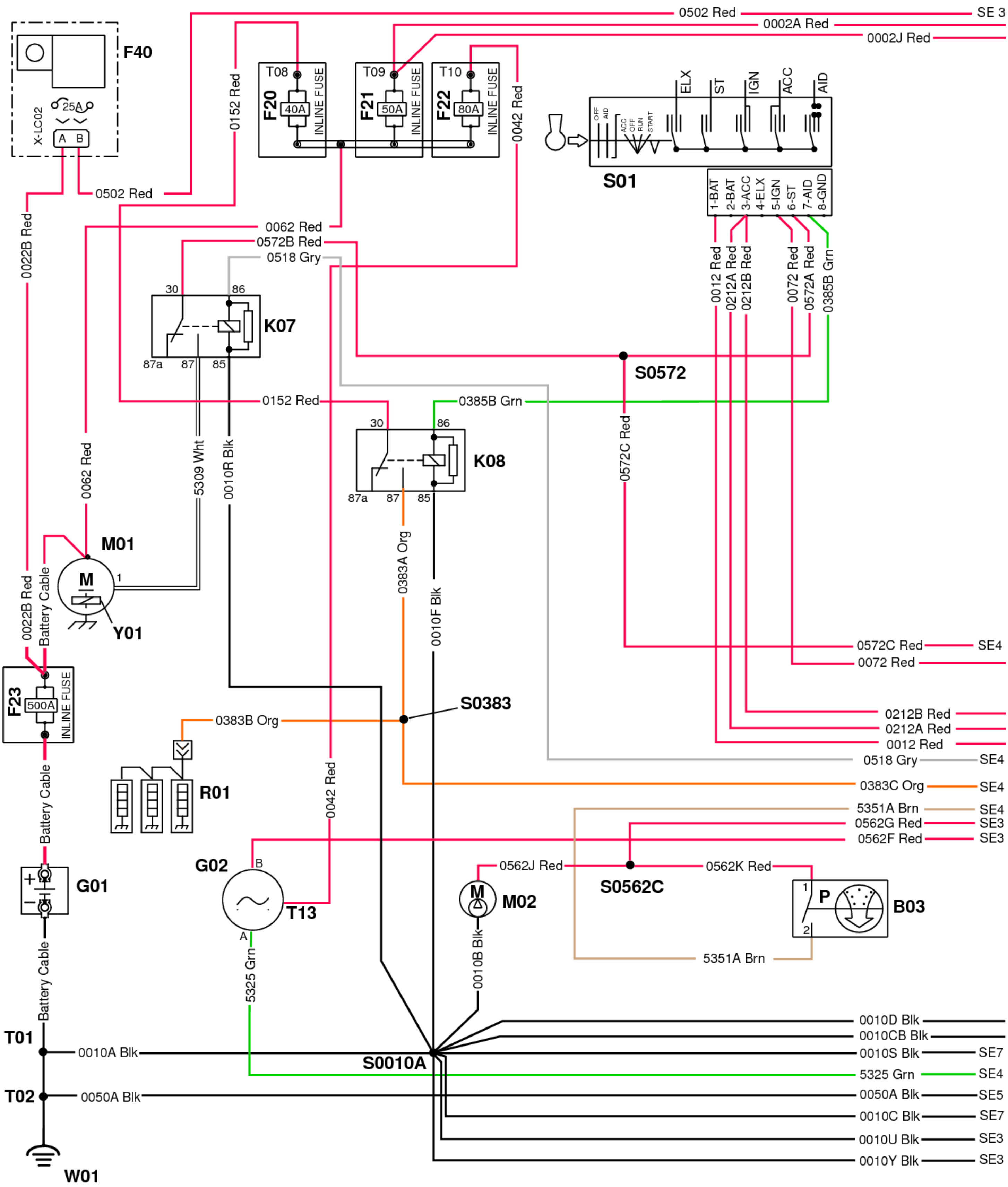


Main Wiring Schematic Open Station (10 of 10)

LEGEND:

E05	Left Work Light
E06	Right Work Light
E16	License Plate Light
E22	Right Position Light
E22_X01	Turn
E22_X02	Brake

Main Wiring Schematic (Open Station)—PowrReverser Transmission—EEC

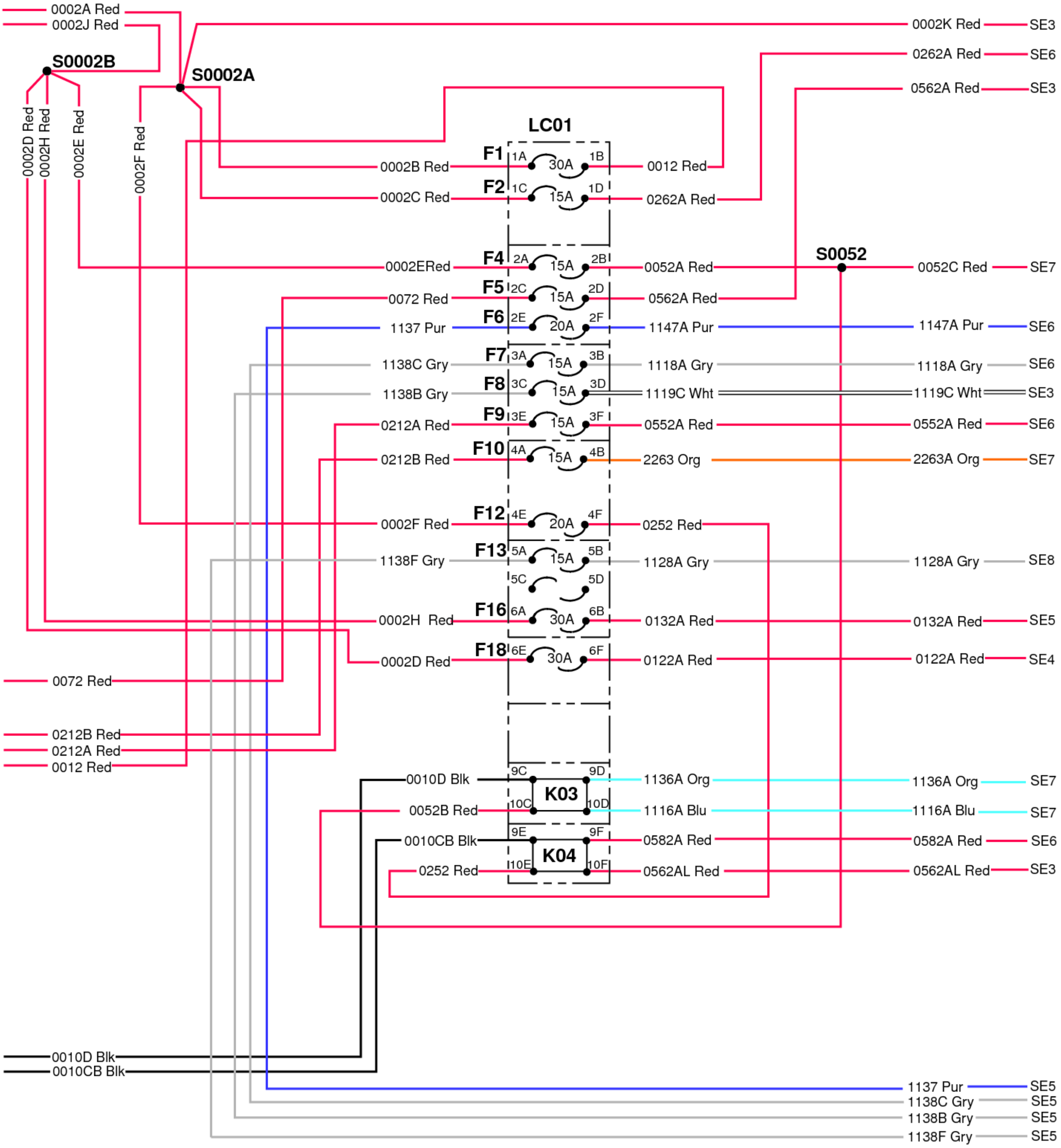


SE1—Starting and Charging

LEGEND:

B03	Air Filter Restriction Switch
F20	Inline Fuse (40A)
F21	Inline Fuse (50A)

F22	Inline Fuse (80A)
F23	Inline Fuse (500A)
F40	ECU Fuse (25A)
G01	Battery
G02	Alternator
K07	Start Relay
K08	Glow Plug Relay
M01	Starting Motor
M02	Fuel Pump
R01	Glow Plugs
S01	Key Switch
T01	Ground
T02	Ground
T13	Phase Terminal
Y01	Starter Motor Solenoid
W01	Ground

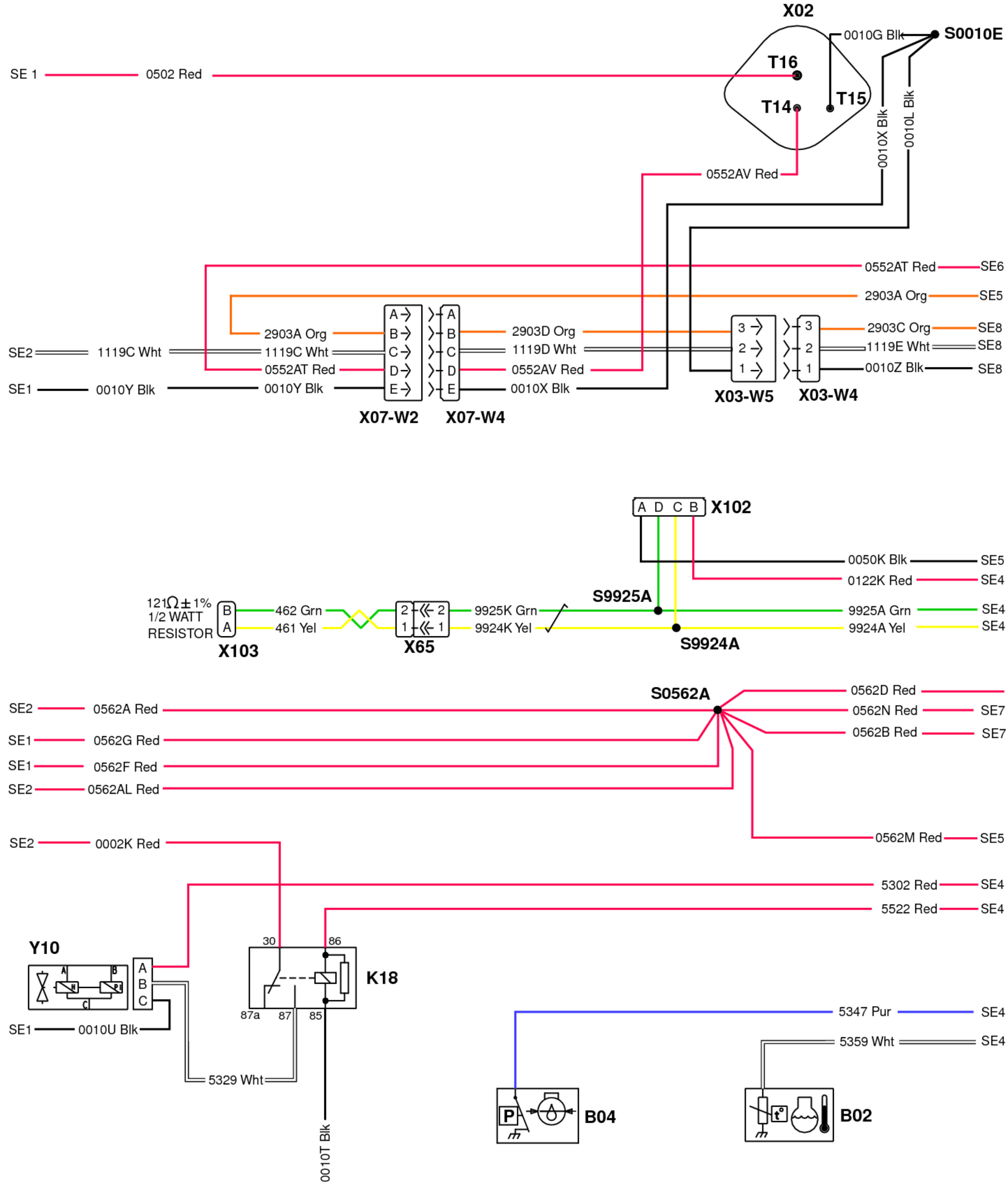


SE2—Fuses and Relays

LEGEND:

F1	Fuse 30A
F2	Fuse 15A
F4	Fuse 15A
F5	Fuse 15A
F6	Fuse 20A
F7	Fuse 15A

F8	Fuse 15A
F9	Fuse 15A
F10	Fuse 15A
F12	Fuse 20A
F13	Fuse 15 A
F16	Fuse 30A
F18	Fuse 30A
K03	Brake light Relay
K04	7 Pin Trailer Power Relay
LC01	Load Center

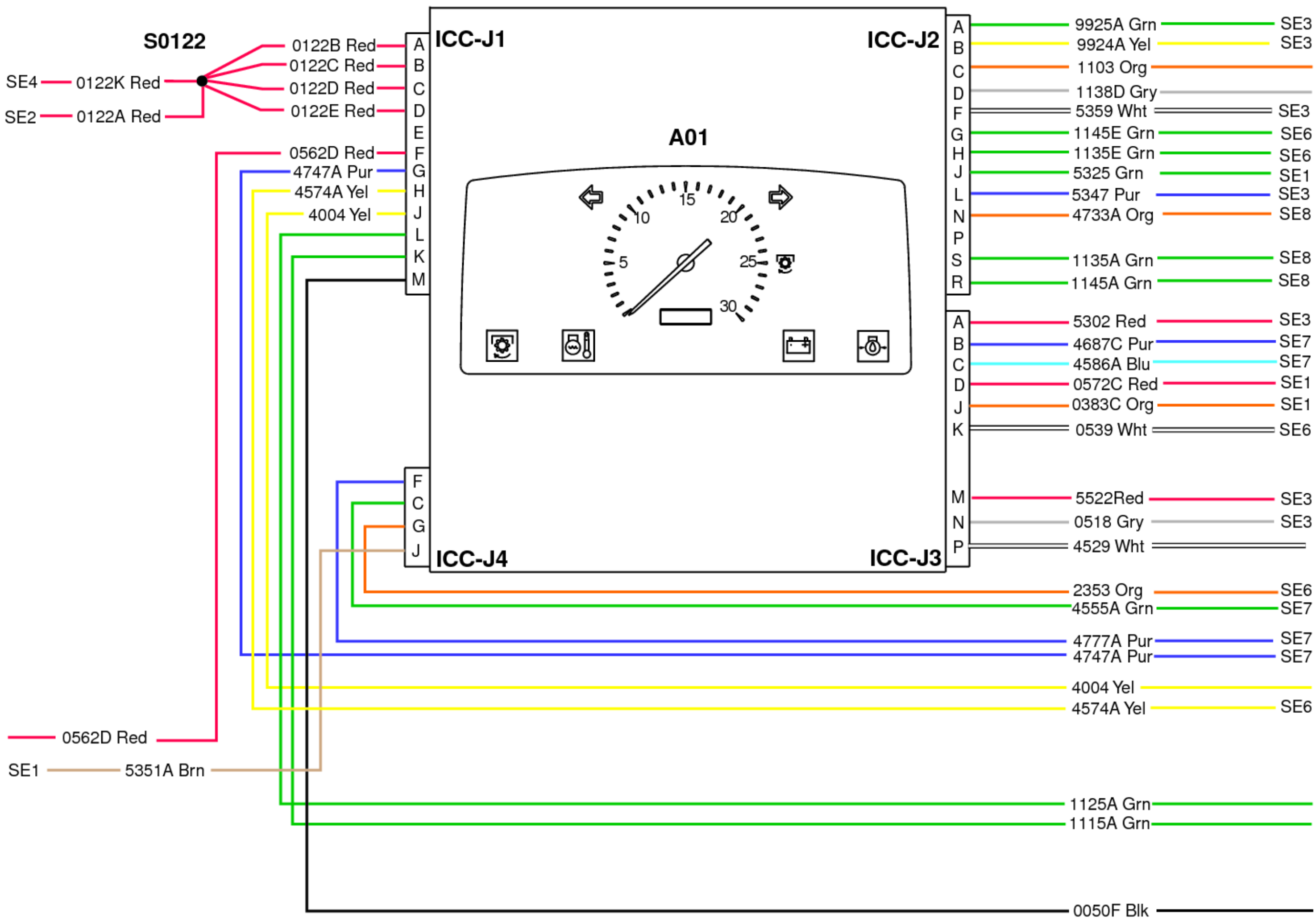


SE3—Junction Block

LEGEND:

B02	Coolant Temperature Sensor
B04	Engine Oil Pressure Switch
K18	Fuel Shutoff Relay
S06	Differential Pressure Switch
X02	Junction Block
X03-W4	Hood to Grille Harness Interconnect

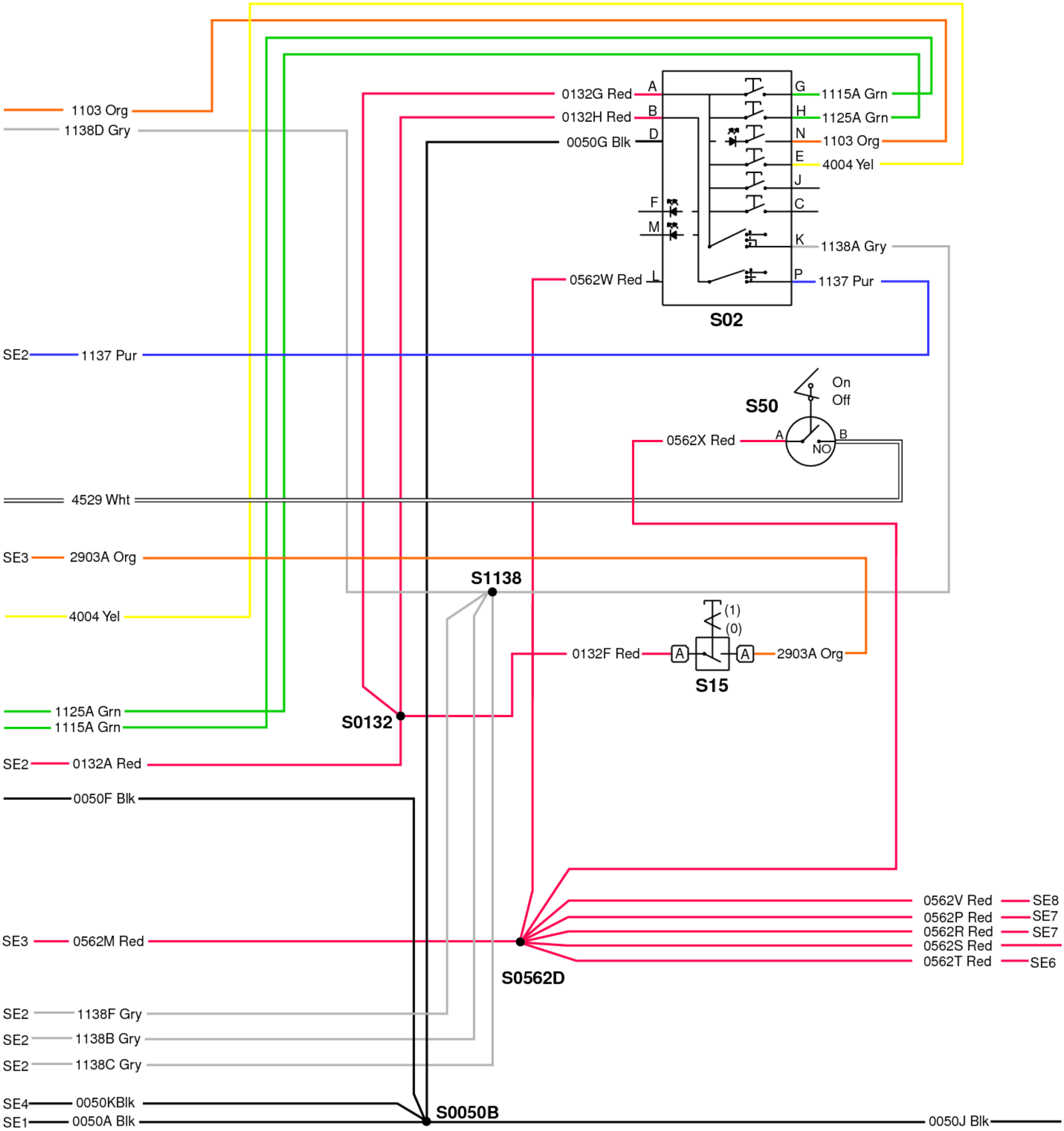
X03-W5	Grille to Hood Harness Interconnect
X07-W2	Chassis to Hood Harness Interconnect (PowrReverser)
X07-W4	Hood to Chassis Harness Interconnect
X65	CAN Terminator
X102	Service Advisor
X103	1/2 Watt Resistor
Y10	Fuel Solenoid



SE4—Display Panel

LEGEND:

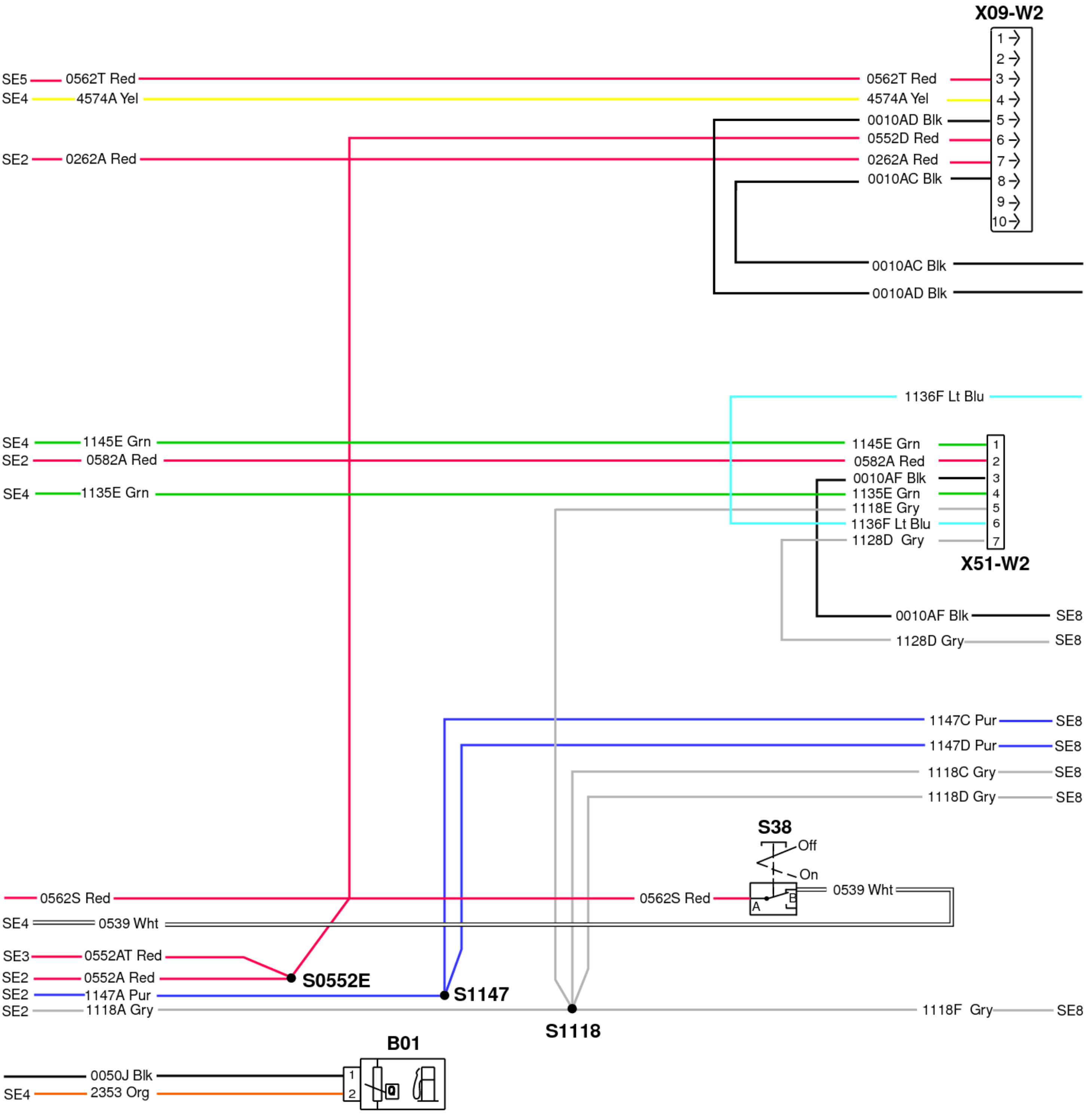
A01	Display Panel
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect



SE5—Dash Panel Module

LEGEND:

S02	Dash Panel Module
S15	Horn Switch
S50	Neutral Start Switch

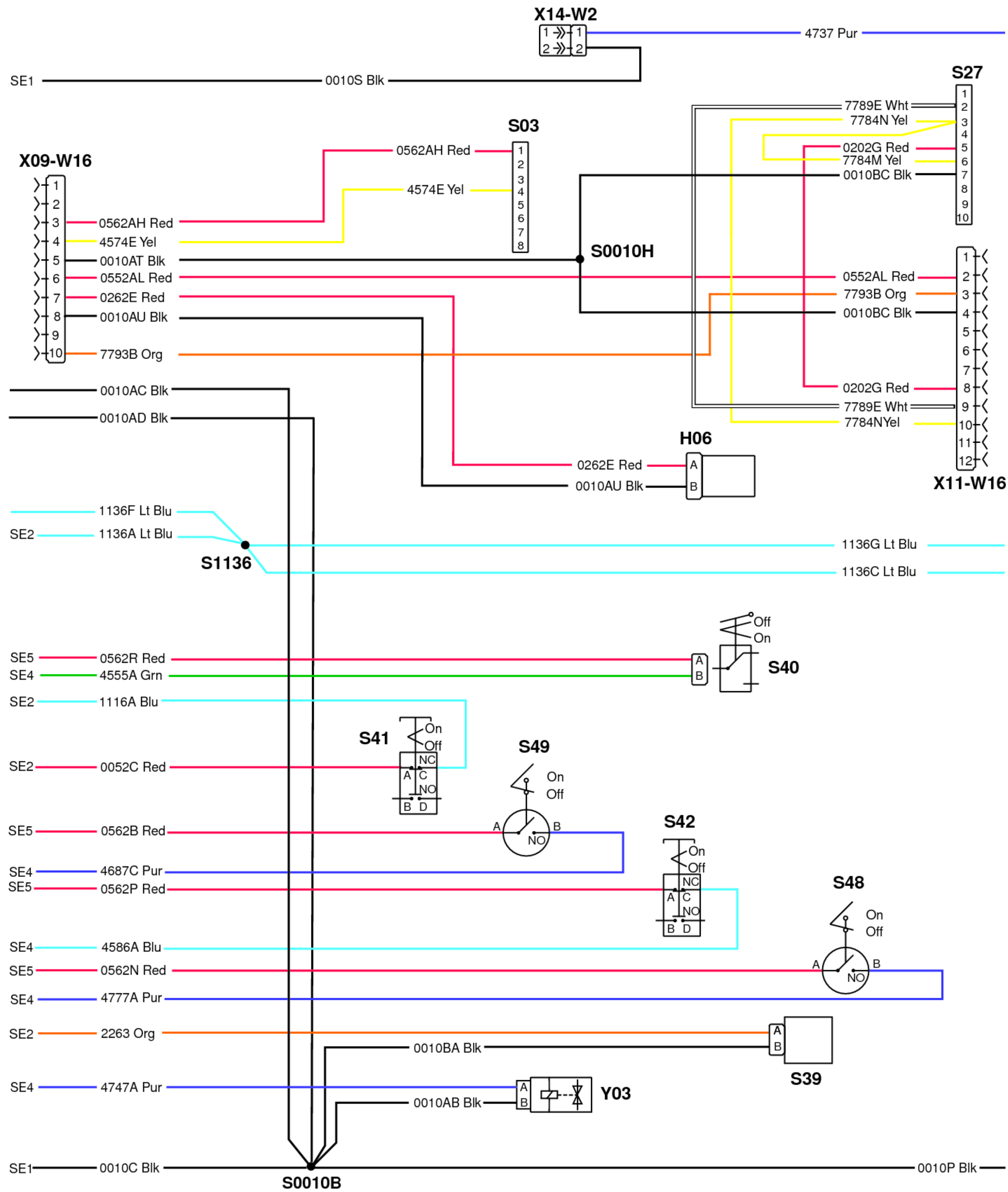


SE6—Controls

LEGEND:

B01	Fuel Gauge Sensor
S38	Seat Switch
X09-W2	Chassis to Right Fender Harness Interconnect 1

X51-W2 Chassis to 7 Pin Trailer Interconnect

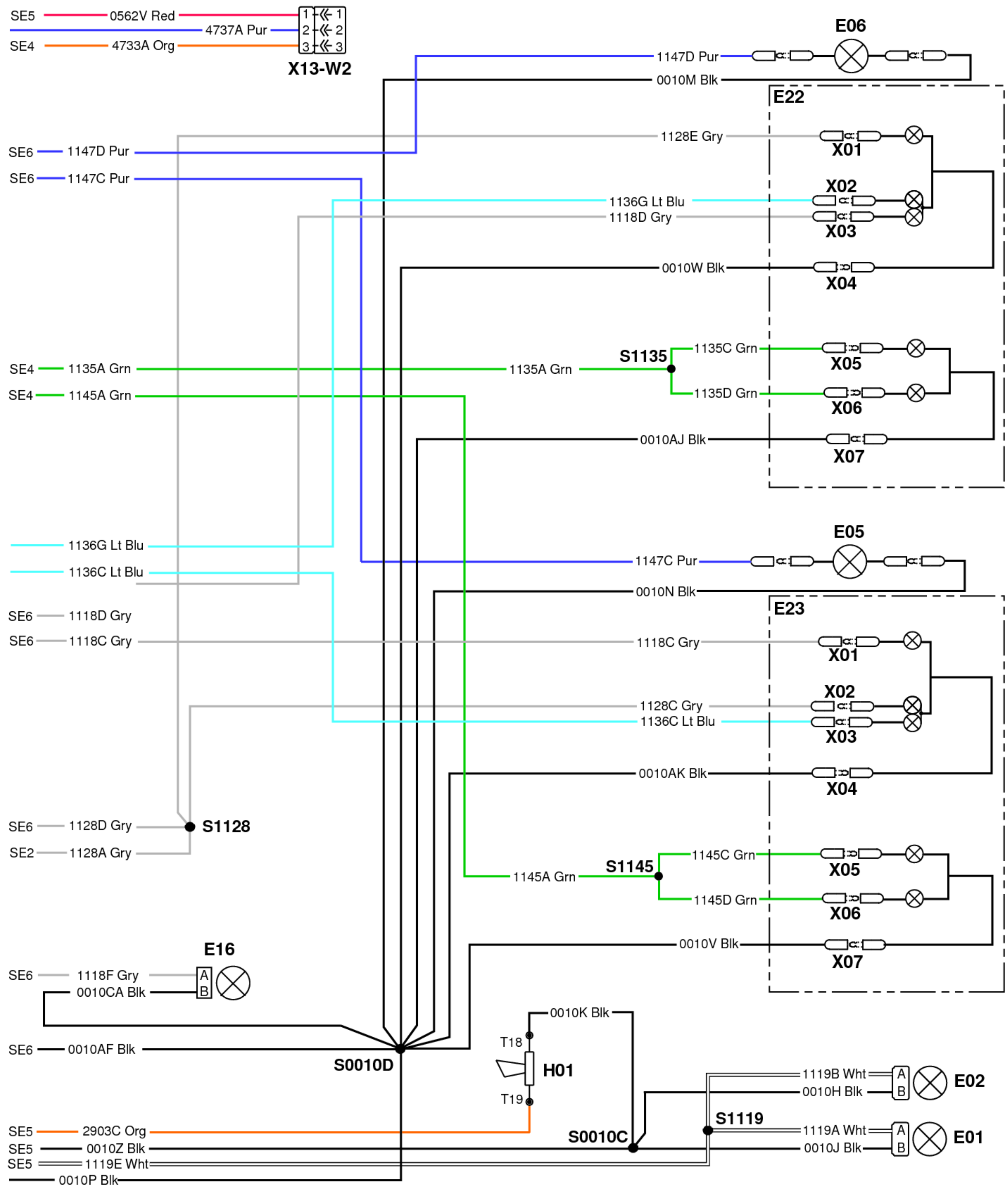


SE7—Controls

LEGEND:

H06	Power Port
S03	PTO Switch
S27	Diverter Switch
S39	Air Ride Seat (Option)
S40	MFWD Engagement Sensing Switch

S41	Brake Switch
S42	Park Brake Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
X09-W16	Right Fender to Chassis Harness Interconnect 1
X11-W16	Right Fender to 3rd EH Harness Interconnect
X14-W2	Chassis to Front PTO Harness Interconnect (PowrReverser)
Y03	Rear PTO Solenoid

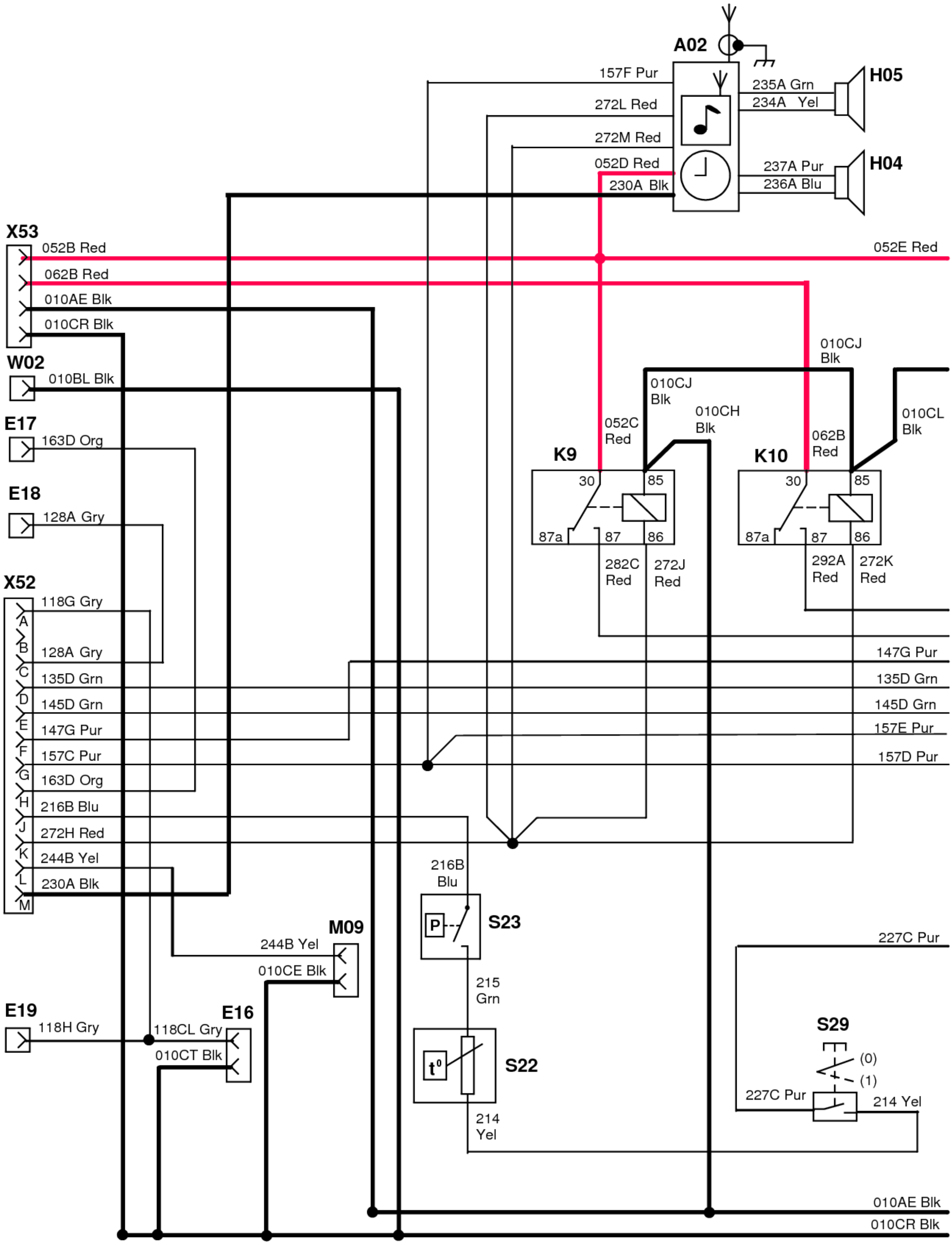


SE8—Lights

LEGEND:

E01	Left Headlight
E02	Right Headlight
E05	Left Work Light
E06	Right Work Light
E16	License Plate Light
E22	Right Position Light
E22_X01	Turn
E22_X02	Brake
E22_X03	Marker
E22_X04	Ground
E22_X05	Hazard
E22_X06	Hazard
E22_X07	Ground
E23	Left Position Light
E23_X01	Turn
E23_X02	Brake
E23_X03	Marker
E23_X04	Ground
E23_X05	Hazard
E23_X06	Hazard
E23_X07	Ground
H01	Horn
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
X13-W2	Chassis to Front PTO Switch Interconnect (PowrReverser)

Upper Wiring Schematic (Cab)—EEC

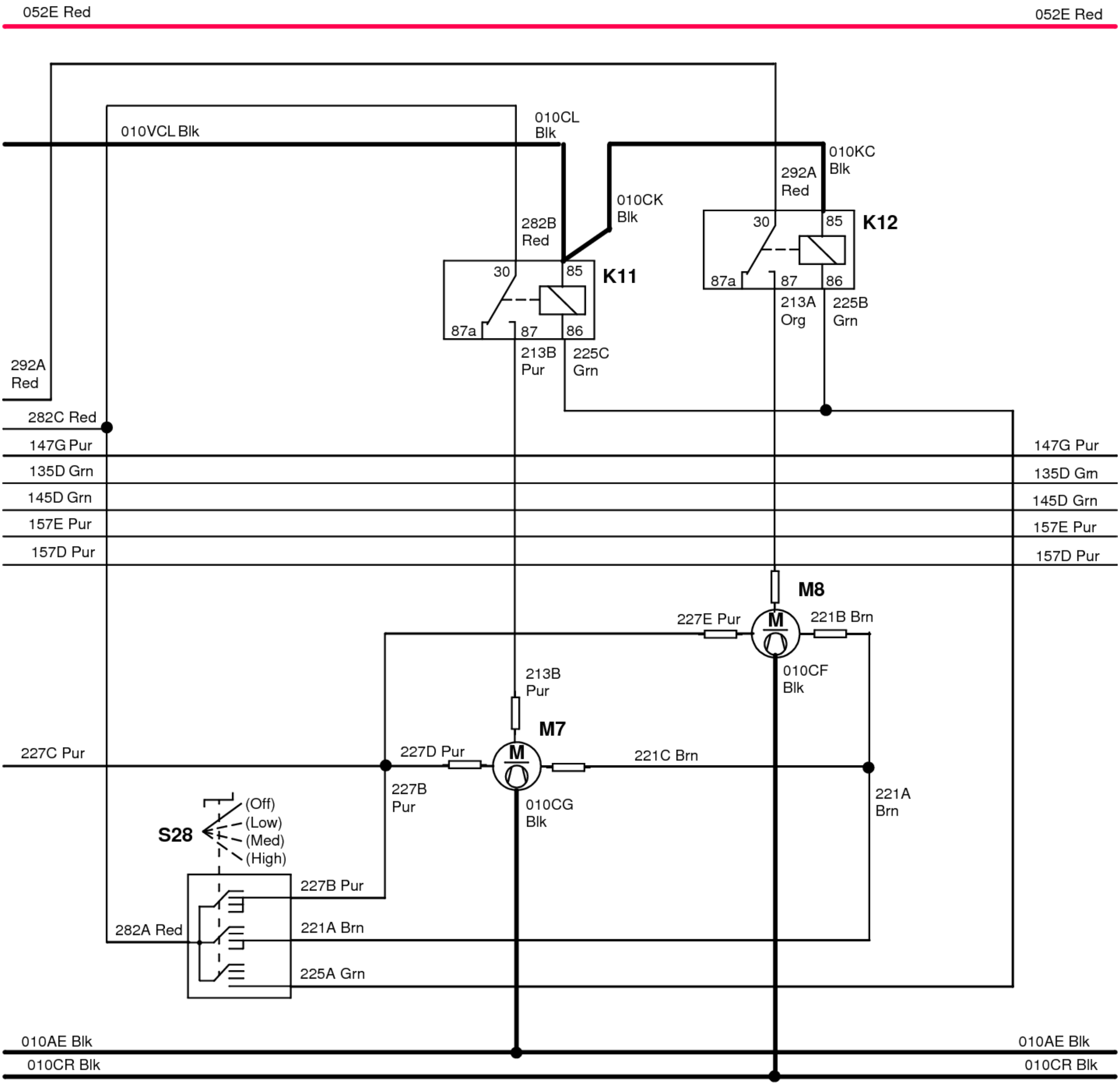


W9—Upper Cab Electrical Schematic (1 of 3)

LEGEND:

A02	Radio
E16	License Plate Light
E17	Beacon Light
E18	Right Front Marker Light

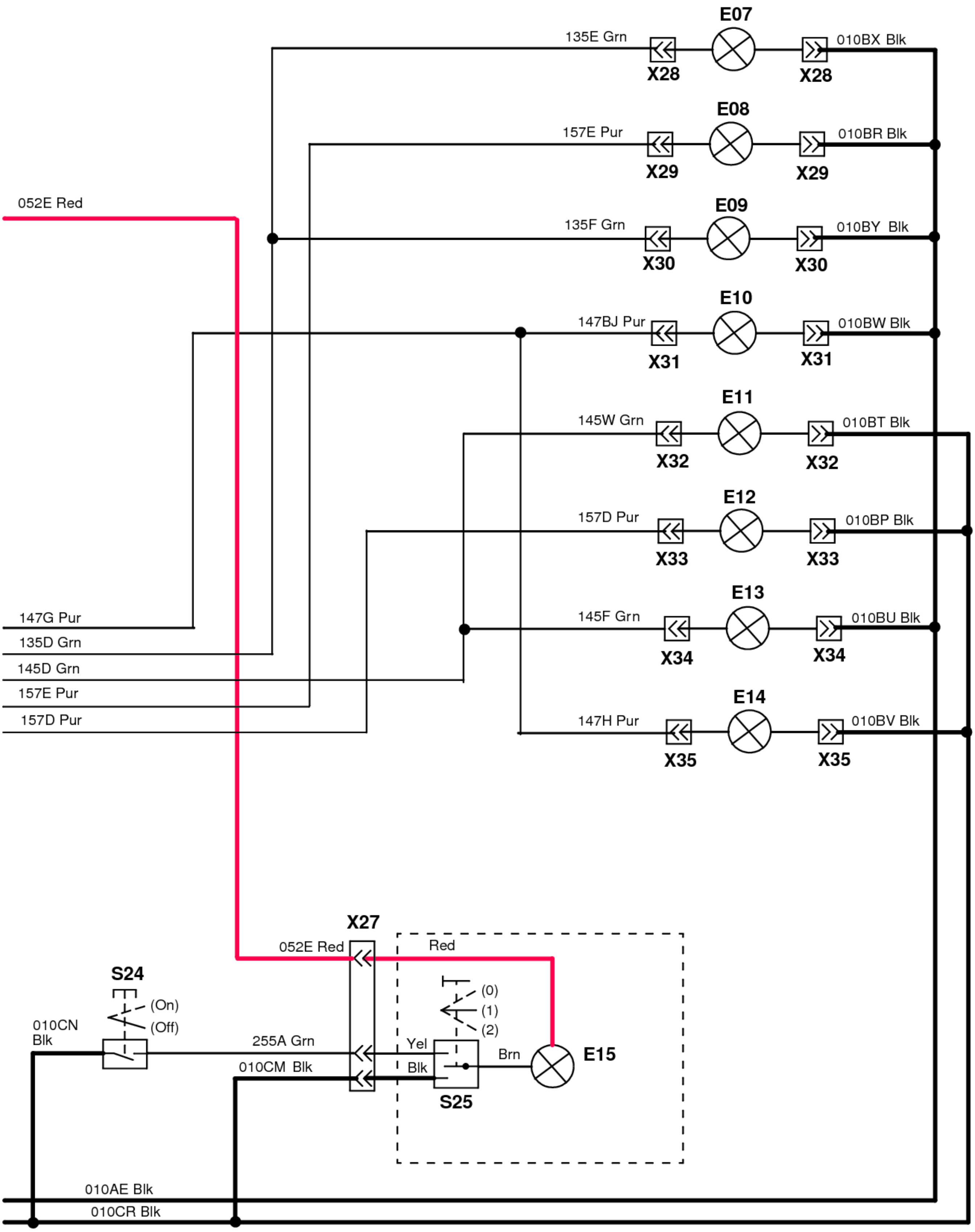
E19	Left Front Marker Light
H04	Left Speaker
H05	Right Speaker
K9	Relay
K10	Relay
M09	Rear Wiper Motor
S22	Temperature Sensor
S23	Hi/Lo Pressure Switch
S29	HVAC Switch
W02	Beacon Light Ground
X52	Lower Cab to Upper Cab Wiring Harness Interconnect
X53	Upper Cab to Lower Cab Wiring Harness Interconnect



W9—Upper Cab Electrical Schematic (2 of 3)

LEGEND:

K11	Right Blower Relay
K12	Left Blower Relay
M07	Left Blower Motor
M08	Right Blower Motor
S28	Blower Switch



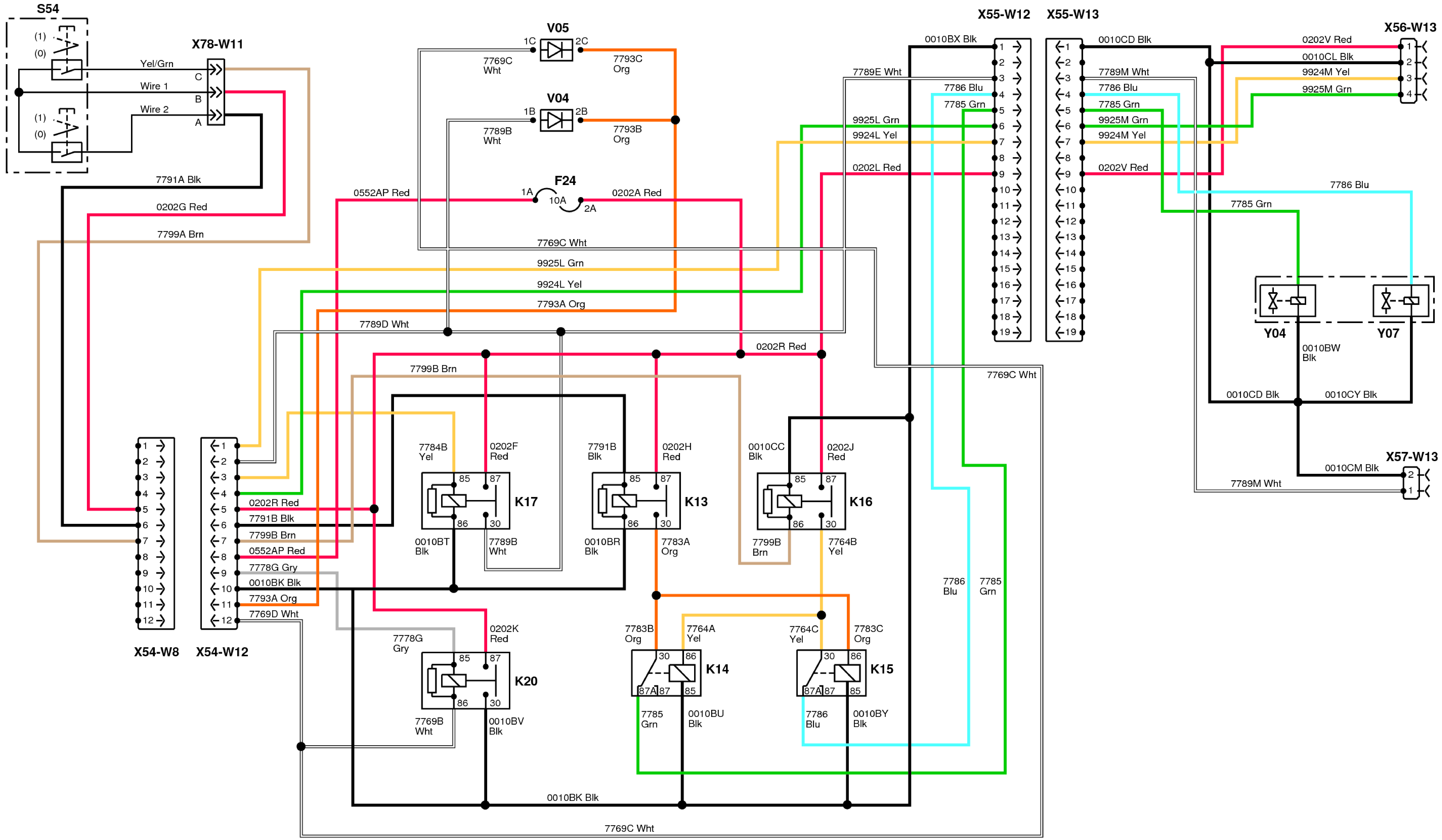
W9—Upper Cab Electrical Schematic (3 of 3)

LEGEND:

E07	Right Front Amber Light
E08	Right Front Work Light
E09	Right Rear Amber Light
E10	Right Rear Work Light
E11	Left Front Amber Light
E12	Left Front Work Light

E13	Left Rear Amber Light
E14	Left Rear Work Light
E15	Dome Light
S24	Door Light Switch
S25	Dome Light Switch
X27	Upper Cab Wiring Harness to Dome Light
X28	Upper Cab Wiring Harness to Right Front Amber Light
X29	Upper Cab Wiring Harness to Right Front Work Light
X30	Upper Cab Wiring Harness to Right Rear Amber Light
X31	Upper Cab Wiring Harness to Right Rear Work Light
X32	Upper Cab Wiring Harness to Left Front Amber Light
X33	Upper Cab Wiring Harness to Left Front Work Light
X34	Upper Cab Wiring Harness to Left Rear Amber Light
X35	Upper Cab Wiring Harness to Left Rear Work Light

3rd SCV Function Wiring Schematic (Cab)—EEC (—OCT 2014)

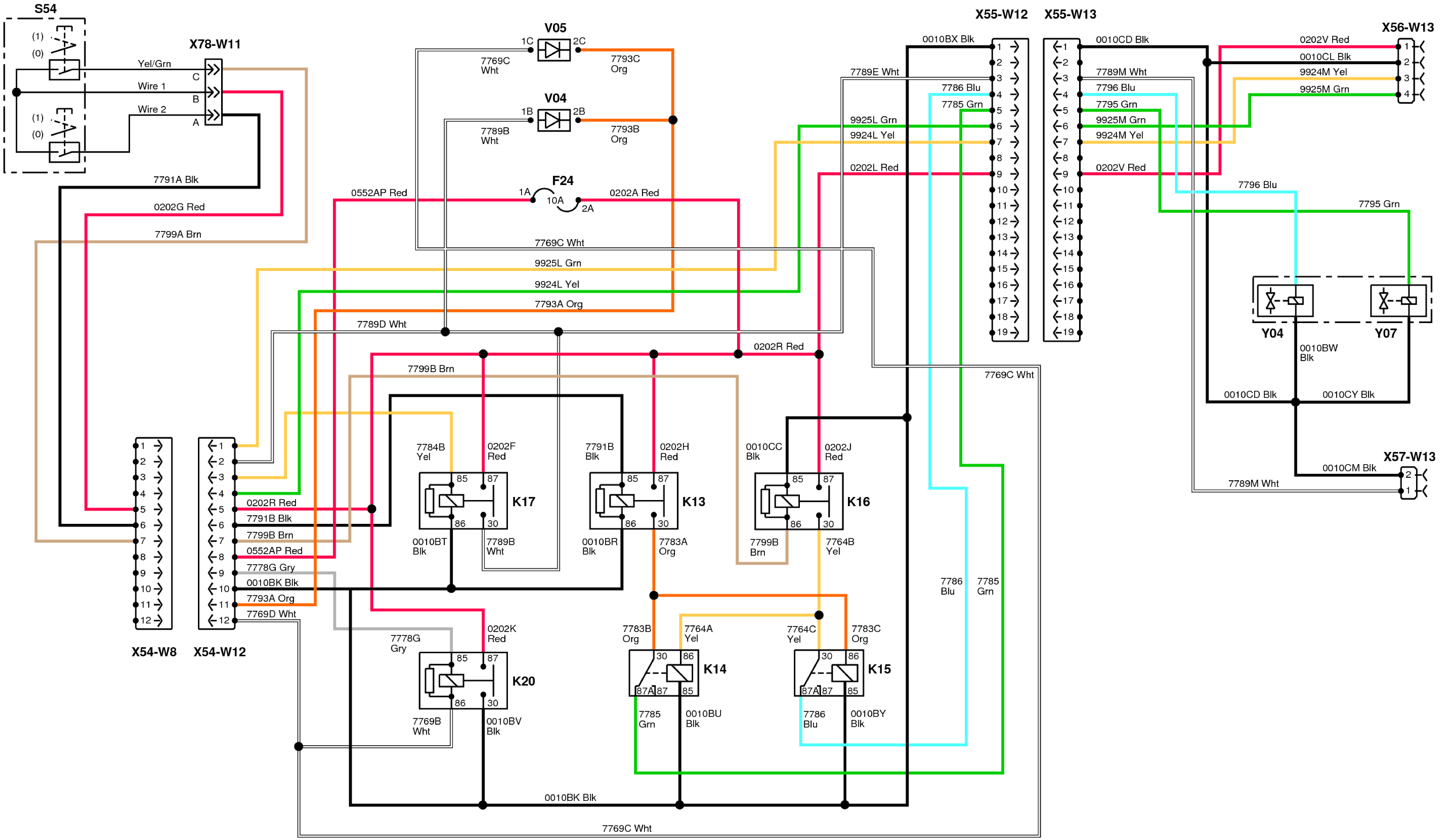


3rd Function Wiring Schematic

LEGEND:

F24	Diverter Valve Fuse (10A)
K13	Control Relay A
K14	3rd Function Lockout Relay A
K15	3rd Function Lockout Relay B
K16	Control Relay B
K17	Diverter Relay
K20	Dual Rear Continuous Relay
S54	3rd Function Control Switch
V04	Diode (6A)
V05	Diode (6A)
X54-W8	Rear Harness to Load Center Interconnect
X54-W12	Load Center to Rear Harness Interconnect
X55-W12	Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect
X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

3rd SCV Function Wiring Schematic (Cab)—EEC (OCT 2014—)

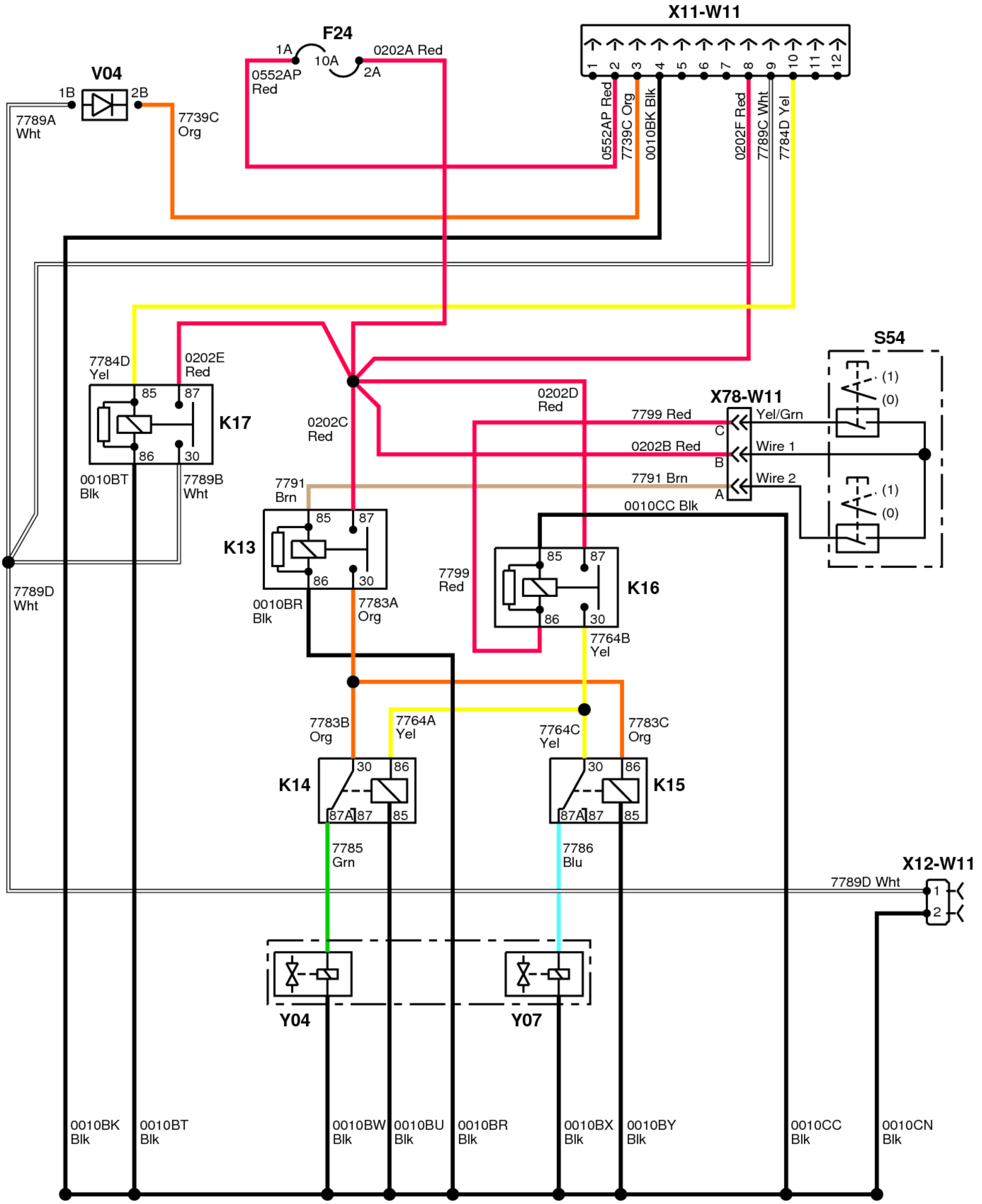


3rd SCV Function Wiring Schematic

LEGEND:

F24	Diverter Valve Fuse (10A)
K13	Control Relay A
K14	3rd Function Lockout Relay A
K15	3rd Function Lockout Relay B
K16	Control Relay B
K17	Diverter Relay
K20	Dual Rear Continuous Relay
S54	3rd Function Control Switch
V04	Diode (6A)
V05	Diode (6A)
X54-W8	Rear Harness to Load Center Interconnect
X54-W12	Load Center to Rear Harness Interconnect
X55-W12	Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect
X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

3rd SCV Function Wiring Schematic (Open Station)—EEC (—OCT 2014)



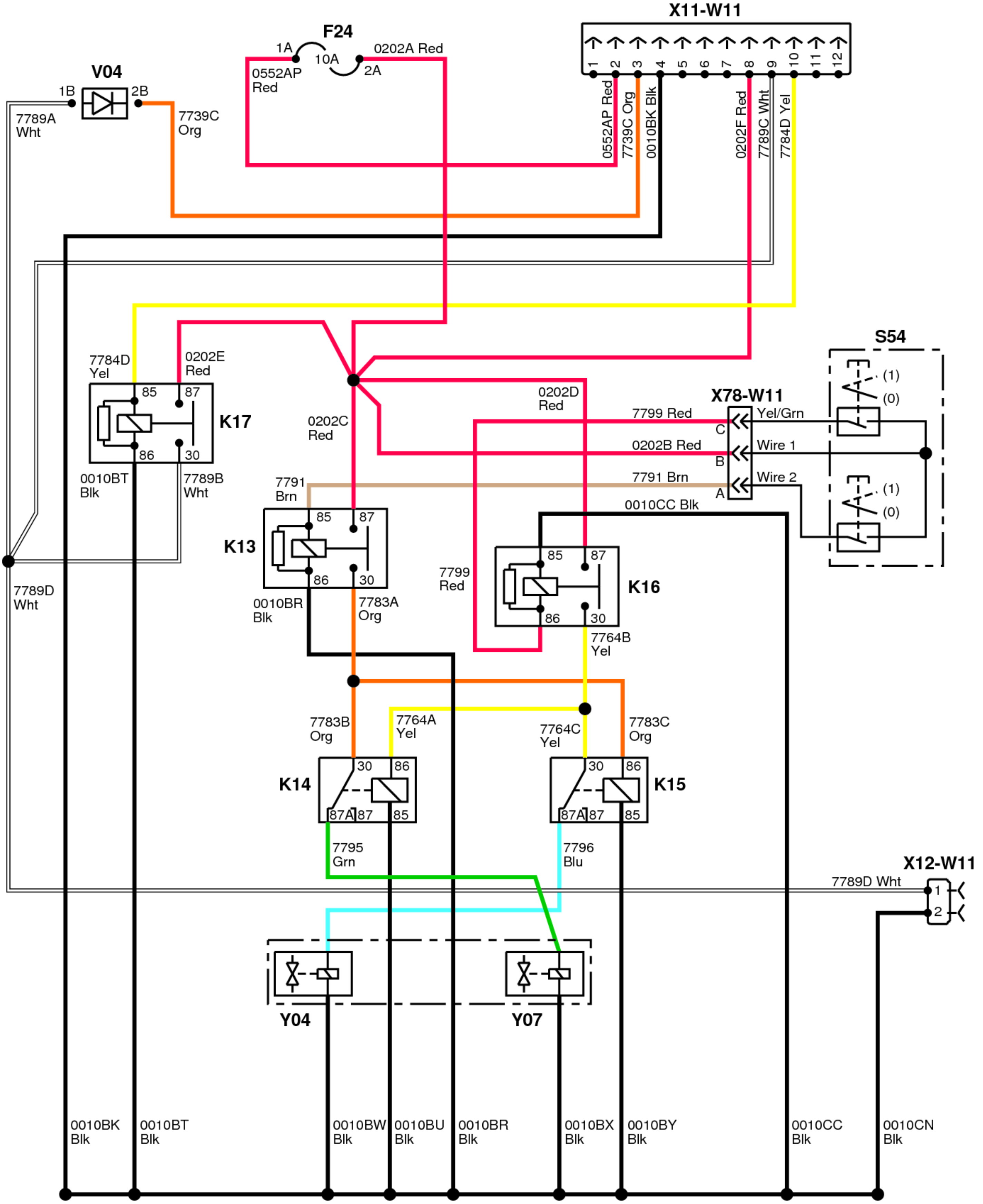
3rd SCV Function Wiring Schematic

LEGEND:

F24	10 Amp Fuse
K13	Third Function “A” Control Relay
K14	Third Function “A” Lockout Relay
K15	Third Function “B” Lockout Relay

K16	Third Function “B” Control Relay
K17	Diverter Relay
S54	Third Function Control Switch
X78-W11	EH Handle to Lower Cab Harness
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Harness
V04	Diode
Y04	Third Function Solenoid A
Y07	Third Function Solenoid B

3rd SCV Function Wiring Schematic (Open Station)—EEC (OCT 2014—)



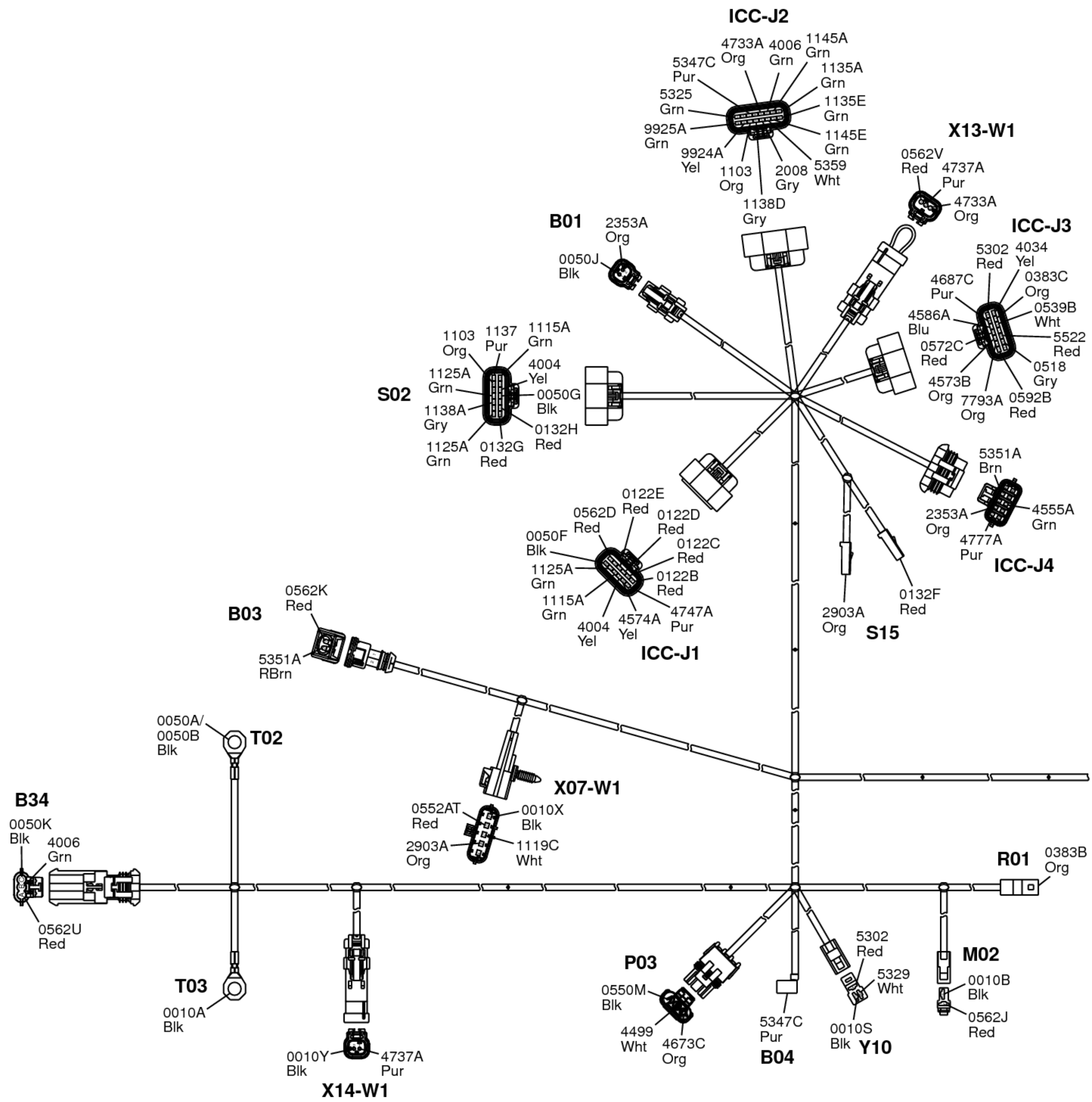
3rd SCV Function Wiring Schematic

LEGEND:

F24	10 Amp Fuse
K13	Third Function “A” Control Relay
K14	Third Function “A” Lockout Relay
K15	Third Function “B” Lockout Relay

K16	Third Function “B” Control Relay
K17	Diverter Relay
S54	Third Function Control Switch
X78-W11	EH Handle to Lower Cab Harness
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Harness
V04	Diode
Y04	Third Function Solenoid A
Y07	Third Function Solenoid B

W1 Chassis Wiring Harness (Open Station)—EEC

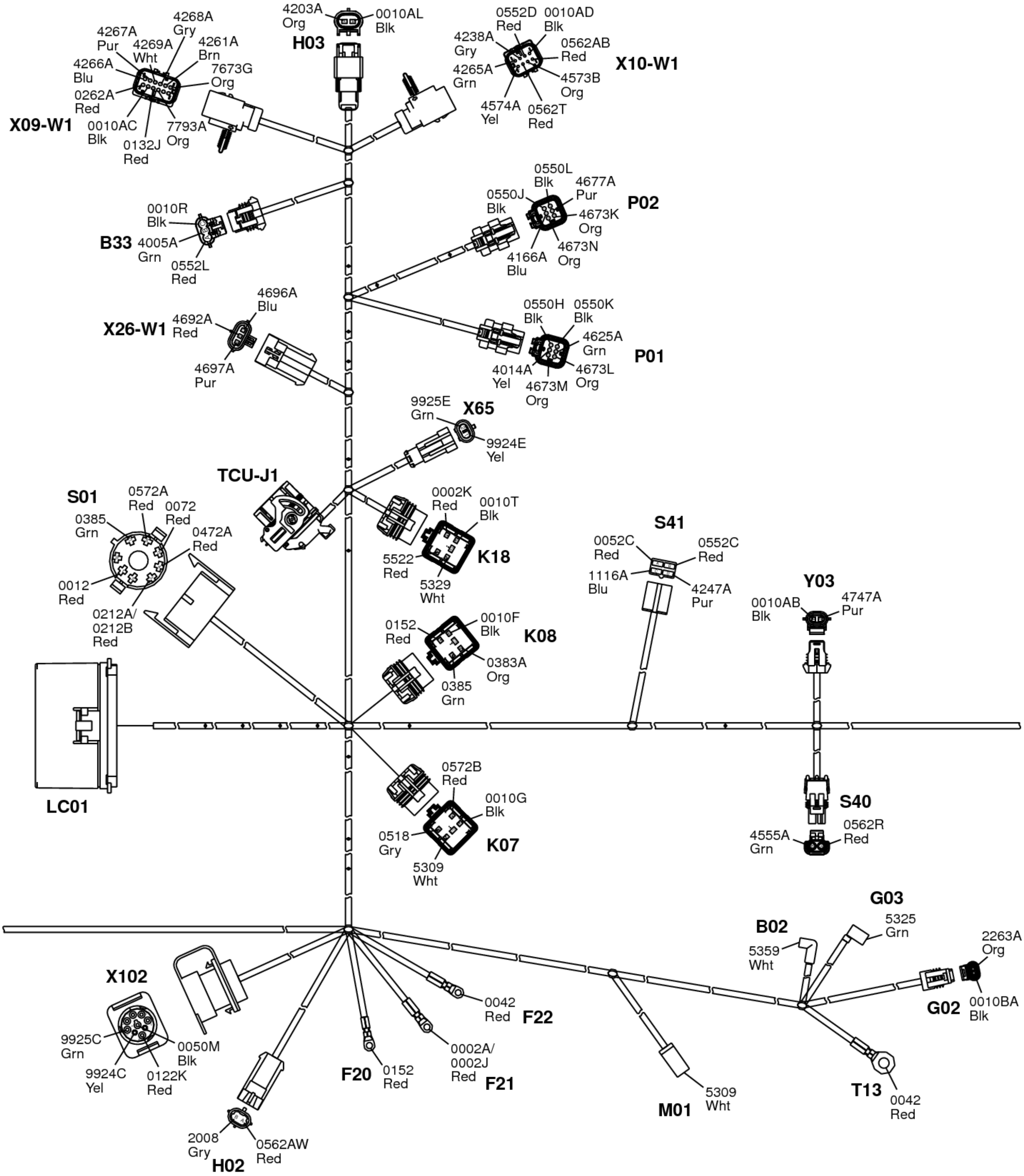


W1 Chassis Wiring Harness (1 of 3)

LEGEND:

B01	Fuel Gauge Sensor
B03	Air Filter Restriction Switch
B04	Engine Oil Pressure Switch
B34	Mid Mount Proxy Sensor

ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect
M02	Fuel Pump
P03	Hand Throttle
R01	Glow Plug
S02	Dash Panel Module
S15	Horn Switch
T02	Ground Terminal
T03	Ground Terminal
X07-W1	Chassis to Hood Harness Interconnect
X13-W1	Chassis to Front PTO Switch Interconnect
X14-W1	Chassis to Front PTO Harness Interconnect
Y10	Fuel Solenoid

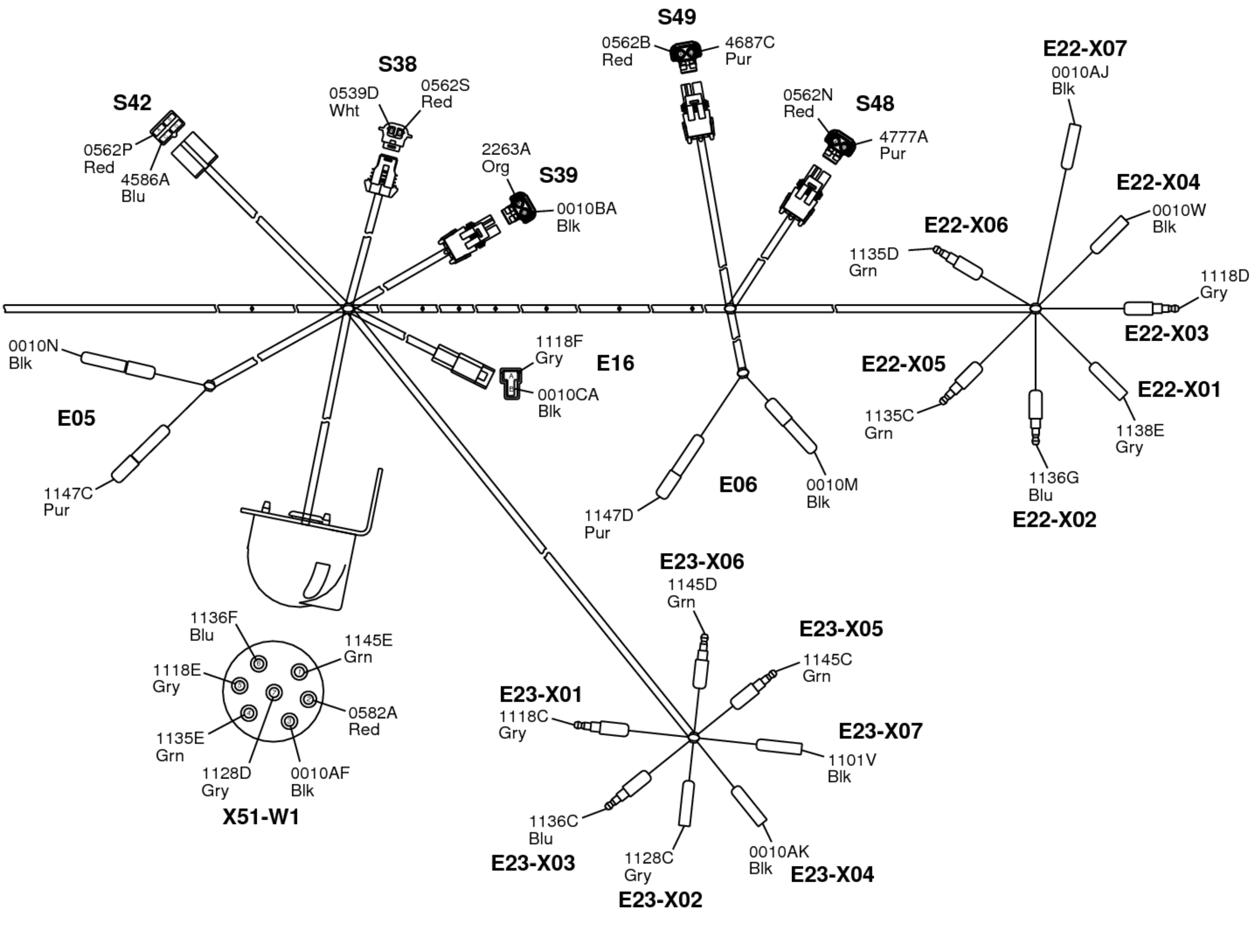


W1 Chassis Wiring Harness (2 of 3)

LEGEND:

B02	Engine Coolant Temperature Sensor
B33	MFWD Speed Sensing Switch
F20	Glow Plug Relay Fuse (40A)
F21	Load Center Fuse (50A)
F22	Alternator Fuse (80A)
G02	Alternator

G03	Alternator Cab
H02	Warning Alarm
H03	Back Up Alarm
K07	Start Relay
K08	Glow Plug Relay
K18	Fuel Shutoff Relay
LC01	Load Center
M01	Starting Motor
P01	Forward Pedal sensor
P02	Reverse Pedal sensor
S01	Key Switch
S40	MFWD Engagement Sensing Switch
S41	Brake Switch
T13	Alternator Power
TCU-J1	Transmission Control Unit Interconnect
X09-W1	Chassis to Right Fender Harness Interconnect 1
X10-W1	Chassis to Right Fender Harness Interconnect 2
X26-W1	Chassis to HST Harness Interconnect
X65	CAN Terminator
X102	Service Advisor
Y03	Rear PTO Solenoid



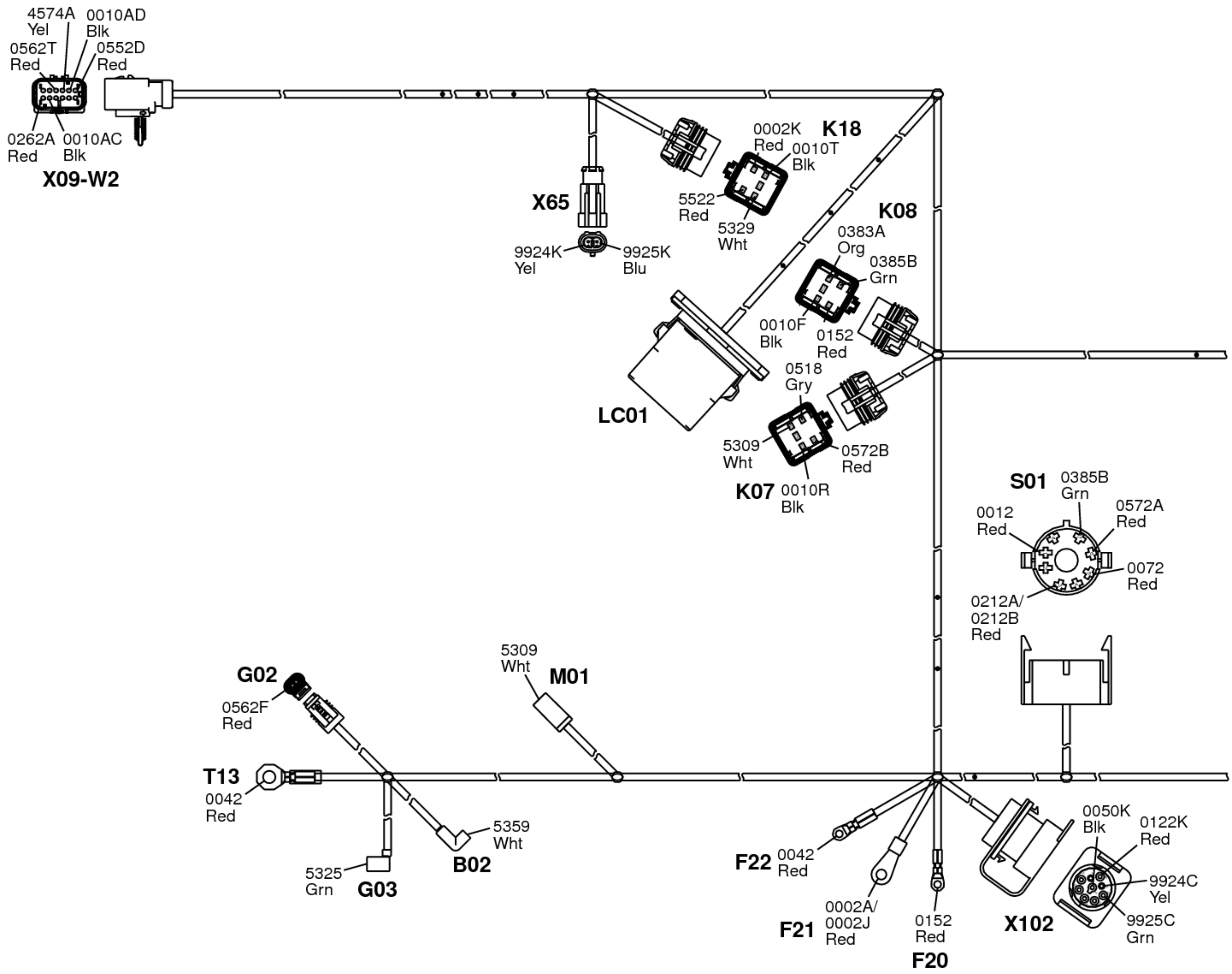
W1 Chassis Wiring Harness (3 of 3)

LEGEND:

E05	Left Work Light
E06	Right Work Light
E16	License Plate Light
E22	Right Position Light
E22_X01	Turn
E22_X02	Brake

E22_X03	Marker
E22_X04	Ground
E22_X05	Hazard
E22_X06	Hazard
E22_X07	Ground
E23	Left Position Light
E23_X01	Turn
E23_X02	Brake
E23_X03	Marker
E23_X04	Ground
E23_X05	Hazard
E23_X06	Hazard
E23_X07	Ground
S38	Seat Switch
S39	Air Ride Seat
S42	Park Brake Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
X51-W1	Chassis to 7 Pin Wiring Harness Interconnect

W2 Chassis Wiring Harness (Open Station)—PowrReverser Transmission—EEC

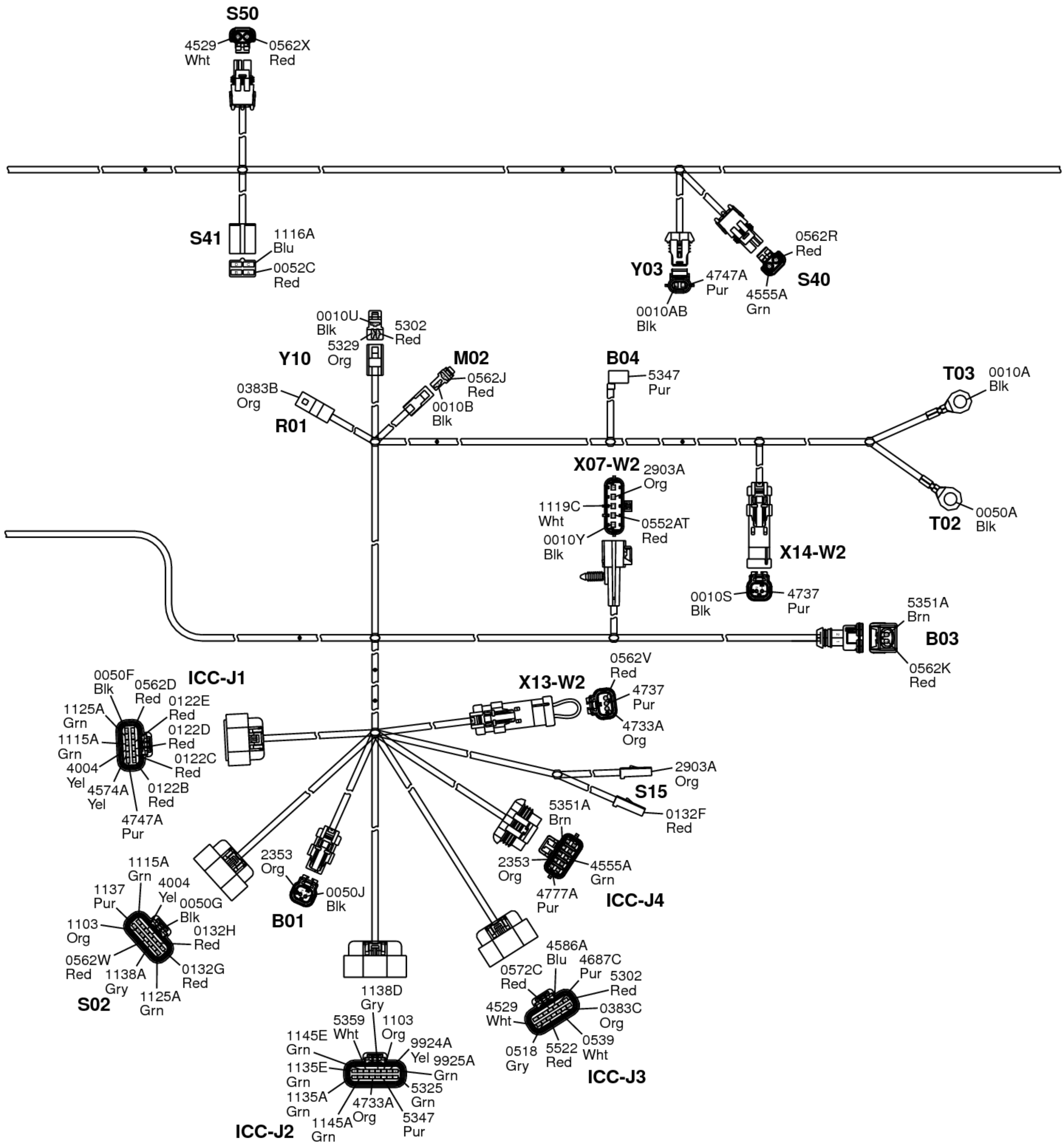


W2 Wiring Harness PowrReverser (1 of 3)

LEGEND:

B02	Engine Coolant Temperature Sensor
F20	Glow Plug Relay Fuse

F21	Load Center Fuse
F22	Alternator Fuse
G02	Alternator
G03	Alternator Cab
K07	Start Relay
K08	Glow Plug Relay
K18	Fuel Shutoff Relay
LC01	(See Load Center in Section 50, Group 15.)
M01	Starting Motor
S01	Key Switch
T13	Alternator Power
X09-W2	Chassis to Right Fender Harness Interconnect
X65	CAN Terminator
X102	Service Advisor

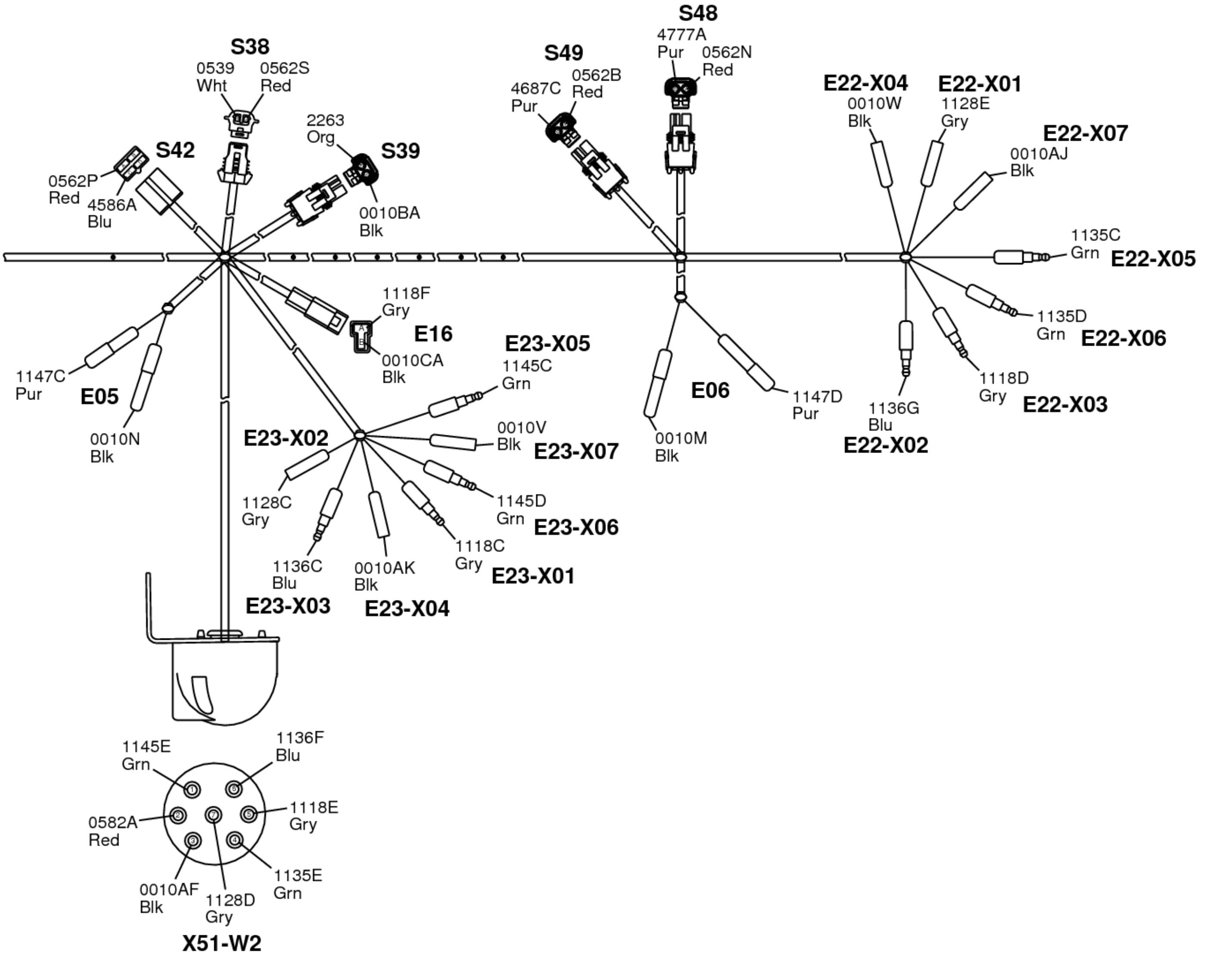


W2 Wiring Harness PowrReverser (2 of 3)

LEGEND:

B01	Fuel Gauge Sensor
B03	Air Filter Restriction Switch
B04	Oil Pressure Switch
ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect

ICC-J4	Display Interconnect
M02	Fuel Pump
R01	Glow Plug Relay
S02	Dash Panel Module
S15	Horn
S40	MFWD Engagement Sensing Switch
S41	Brake Switch
S50	Neutral Start Switch
T02	Ground Terminal
T03	Ground Terminal
X07-W2	Chassis to Hood Harness Interconnect
X13-W2	Chassis to Front PTO Switch Interconnect
X14-W2	Chassis to Front PTO Harness Interconnect
Y03	Rear PTO Solenoid
Y10	Fuel Solenoid



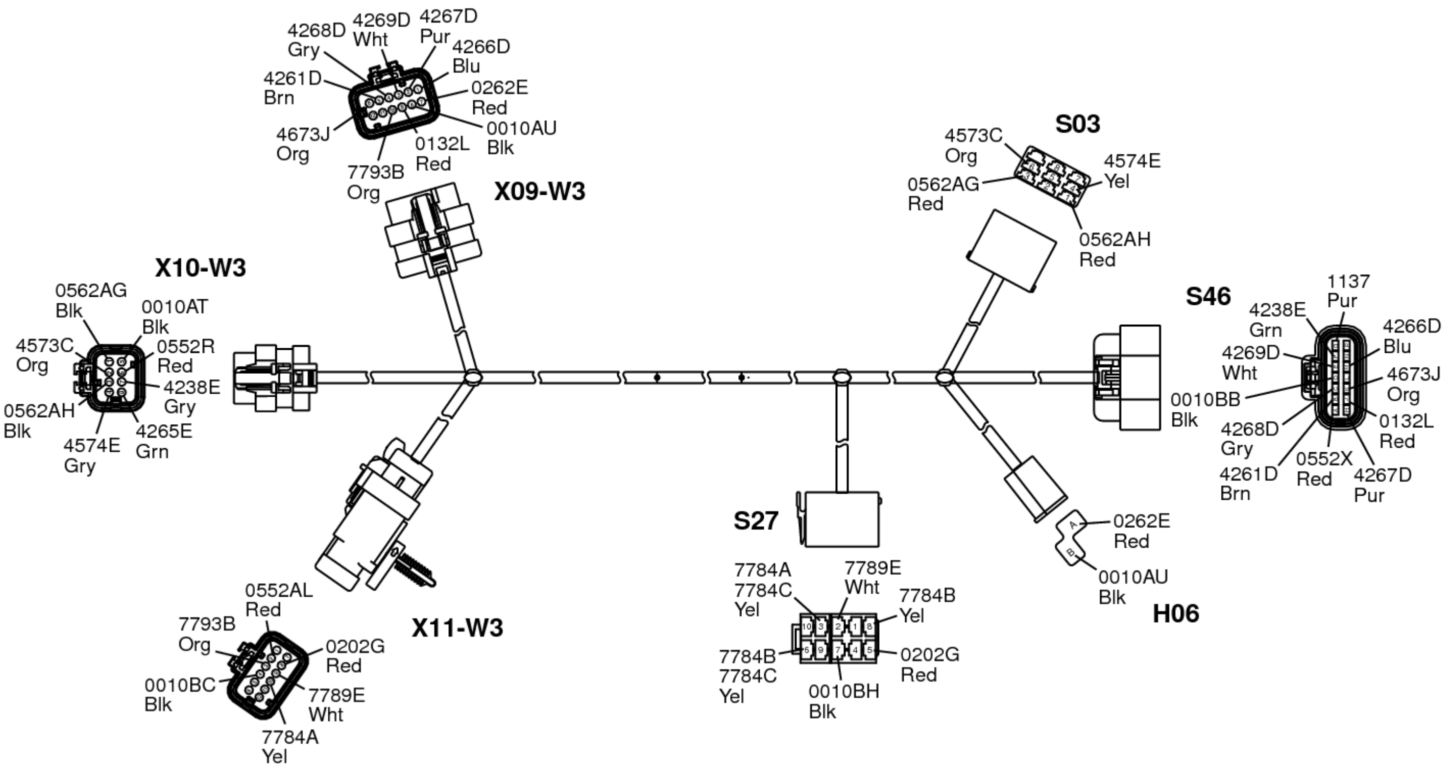
W2 Wiring Harness PowrReverser (3 of 3)

LEGEND:

E05	Left Work Light
E06	Right Work Light
E16	License Plate Light
E22-X01	Right Side Turn Light
E22-X02	Right Side Brake Light
E22-X03	Right Side Marker

E22-X04	Right Side Ground
E22-X05	Right Side Hazard Light
E22-X06	Right Side Hazard Light
E22-X07	Right Side Ground
E23-X01	Left Side Turn Light
E23-X02	Left Side Brake Light
E23-X03	Left Side Marker
E23-X04	Left Side Ground
E23-X05	Left Side Hazard Light
E23-X06	Left Side Hazard Light
E23-X07	Left Side Ground
S38	Seat Switch
S39	Air Ride Seat
S42	Park Brake Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch
X51-W2	Chassis to 7 Pin Wiring Harness Interconnect

W3 Fender Wiring Harness (Open Station)—EEC

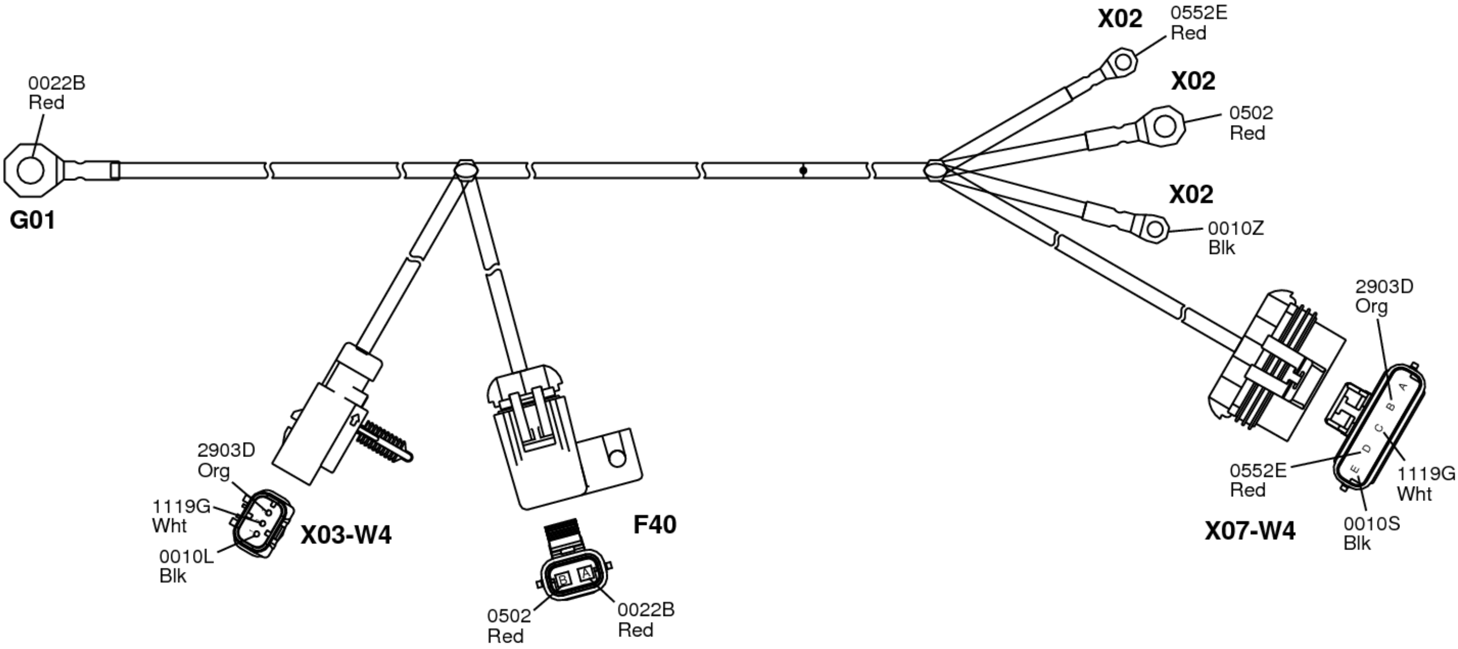


W3 Fender Wiring Harness—Open Station

LEGEND:

H06	Power Port
S03	PTO Switch
S27	Diverter Switch
S46	Cruise Module
X09-W3	Right Fender to Chassis Interconnect 1
X10-W3	Right Fender to Chassis Interconnect 2
X11-W3	Right Fender to 3rd EH Harness Interconnect

W4 Hood Wiring Harness—EEC

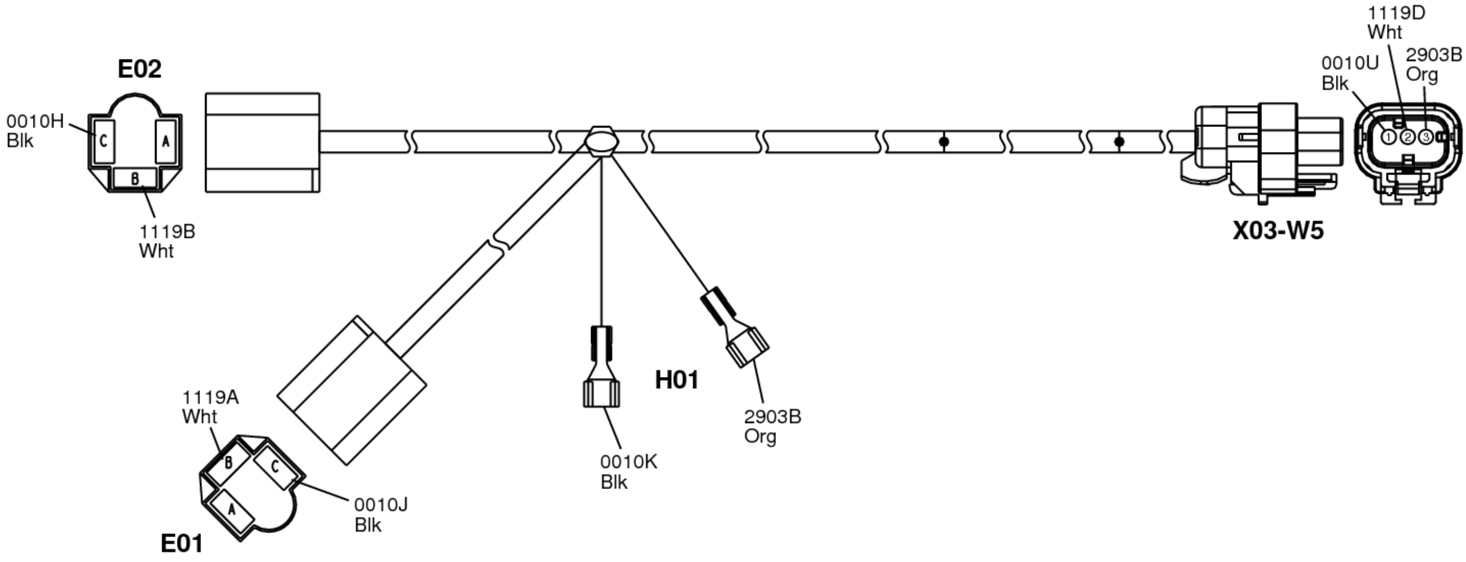


W4 Hood Wiring Harness

LEGEND:

F40	ECU Fuse (25A)
G01	Battery
X02	Junction Block
X03-W4	Hood to Grille Harness Interconnect
X07-W4	Hood to Chassis Harness Interconnect

W5 Grill Wiring Harness—EEC

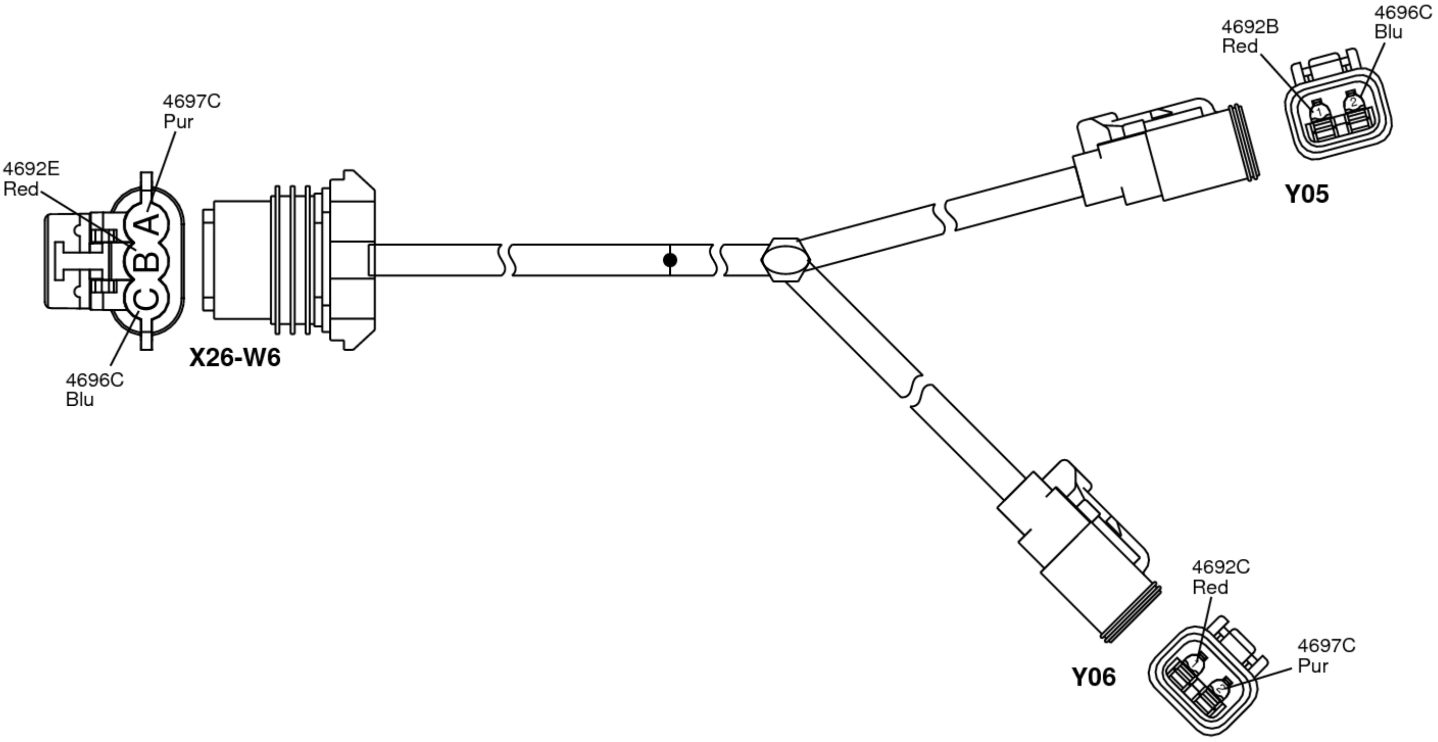


W5 Grill Wiring Harness

LEGEND:

E01	Right Headlight
E02	Left Headlight
H01	Horn
X03-W5	Grille to Hood Harness Interconnect

W6 HST Valve Wiring Harness—EEC

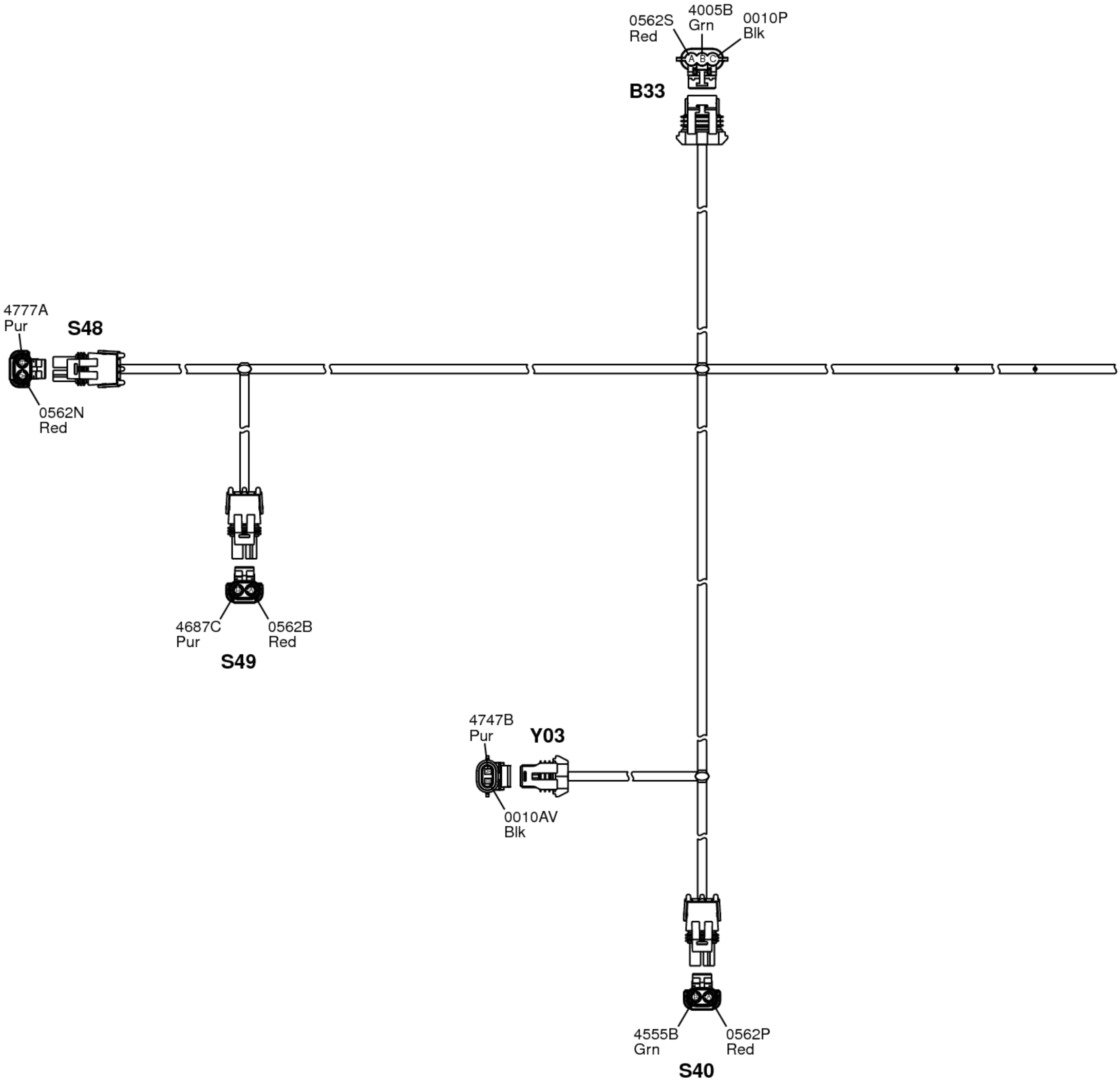


W6 HST Valve Wiring Harness

LEGEND:

X26-W6	HST to Chassis Harness Interconnect
Y05	Forward Proportional solenoid
Y06	Reverse Proportional solenoid

W7 Chassis Wiring Harness (Cab)—EEC

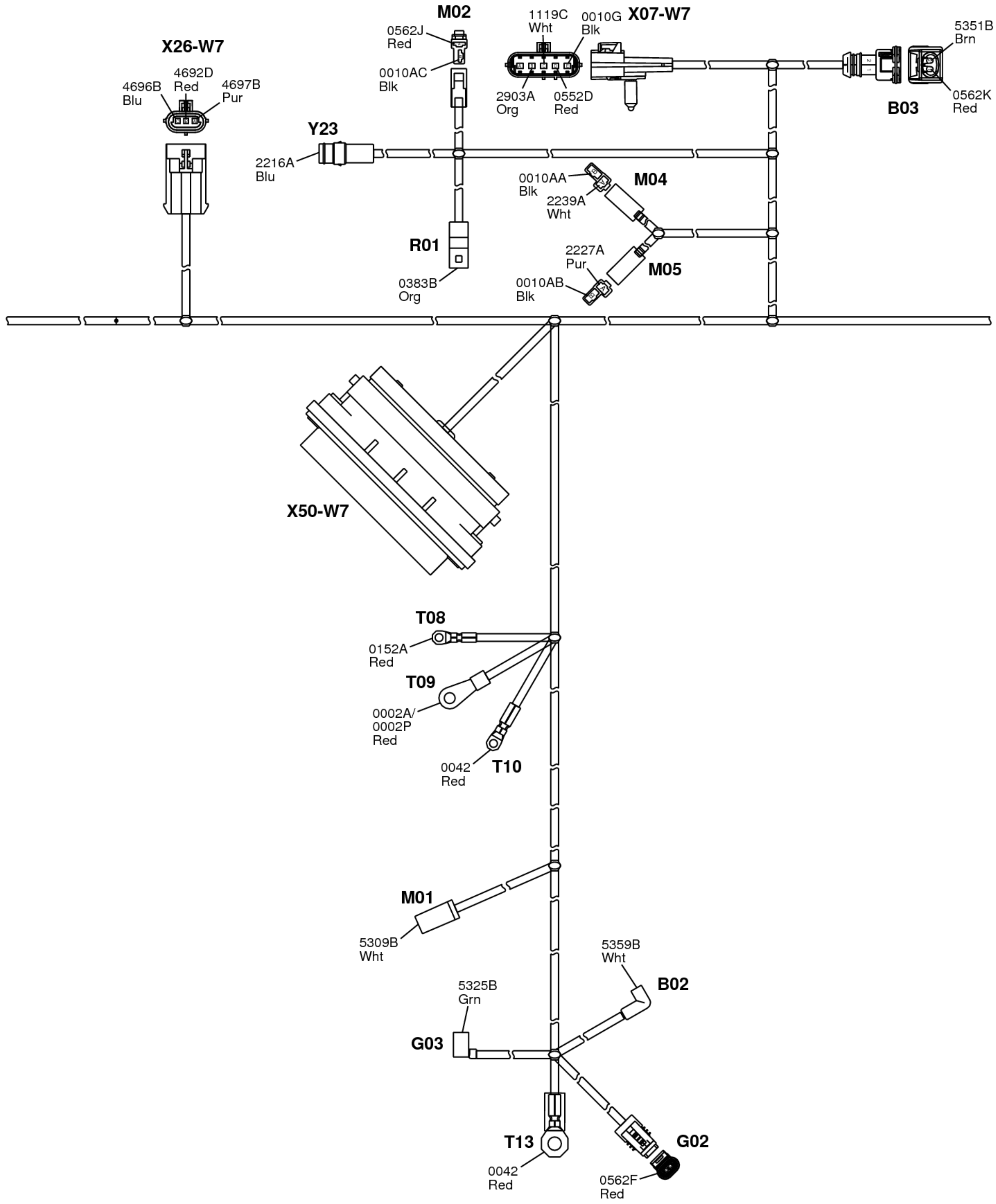


W7 Chassis Wiring Harness (Cab) (1 of 3)

LEGEND:

B33	MFWD Speed Sensing Switch
S40	MFWD Engagement Sensing Switch
S48	Rear PTO Sensing Switch
S49	Mid PTO Sensing Switch

Y01 Rear PTO Solenoid

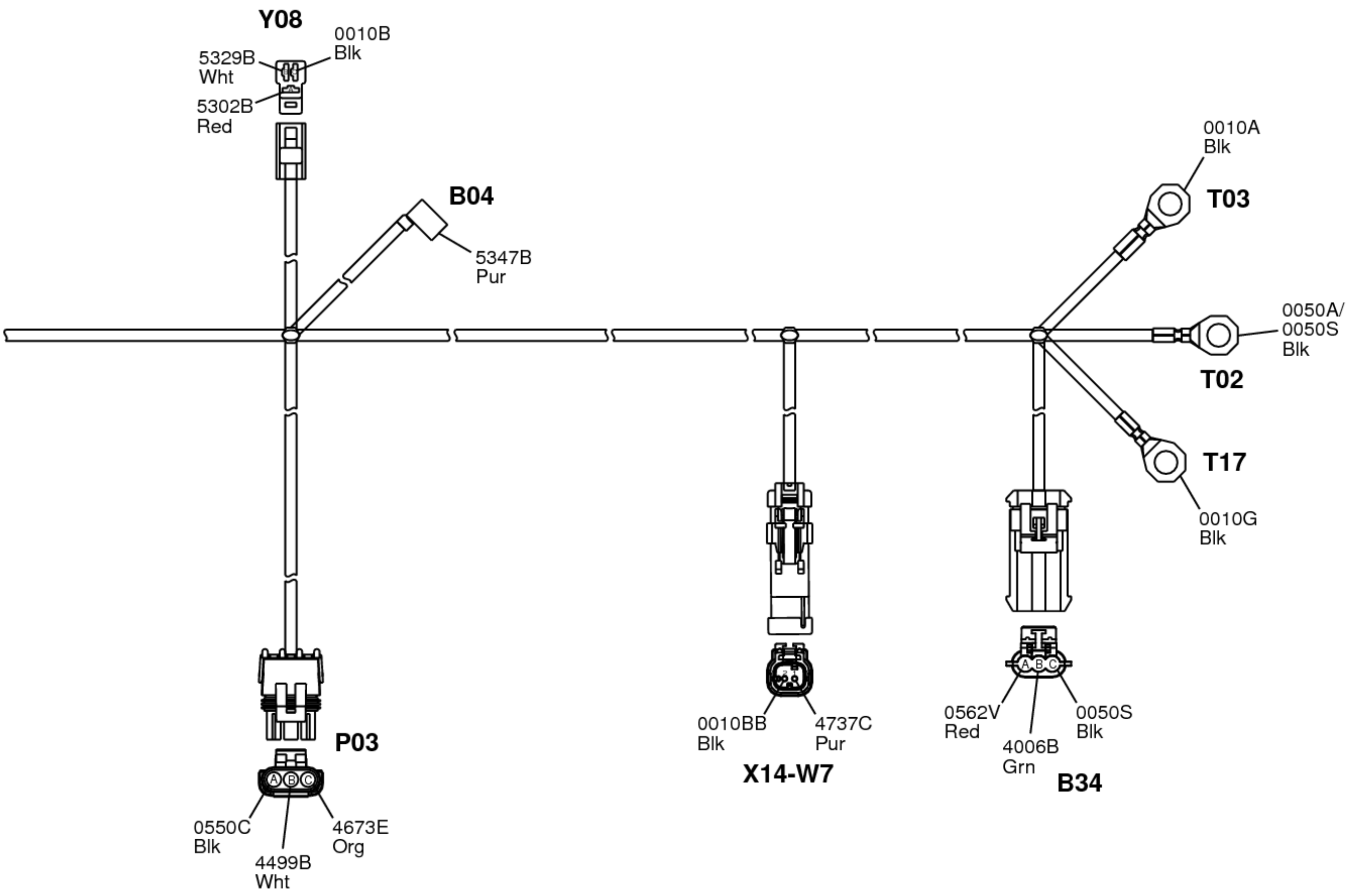


W7 Chassis Wiring Harness (Cab) (2 of 3)

LEGEND:

B02	Coolant Temperature Sensor
B03	Coolant Temperature Sensor
G02	Alternator
G03	Alternator (Cab)
M01	Starting Motor

M02	Fuel Pump
M04	Rear Washer Pump
M05	Front Washer Pump
R01	Glow Plug
T08	Glow Plug Relay Fuse
T09	Load Center Fuse
T10	Alternator Fuse
T13	Alternator Power
X07-W7	Chassis to Hood Harness Interconnect
X50-W7	Chassis to Lower Cab Wiring Harness Interconnect
X26-W7	Chassis to HST Harness Interconnect
Y23	A/C Compressor Clutch



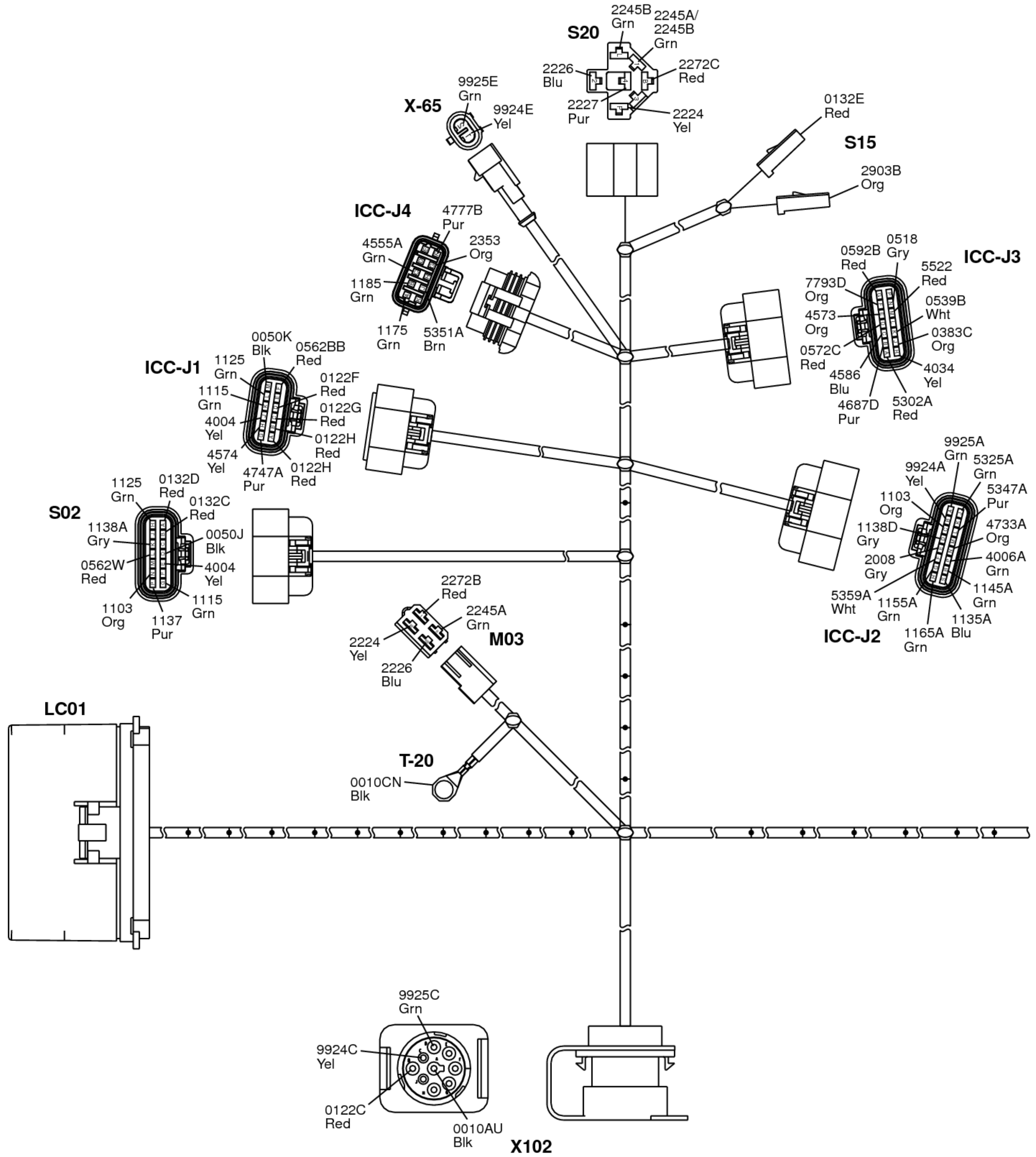
W7 Chassis Wiring Harness (Cab) (3 of 3)

LEGEND:

B04	Engine Oil Pressure Switch
B34	Mid Mount Proxy Sensor
P03	Hand Throttle
T02	Ground Terminal
T03	Ground Terminal
T17	Ground Terminal

X14-W7	Chassis to Front PTO Harness Interconnect
Y08	Upper Hydraulic Solenoid Valve

W8 Lower Wiring Harness (Cab)—EEC

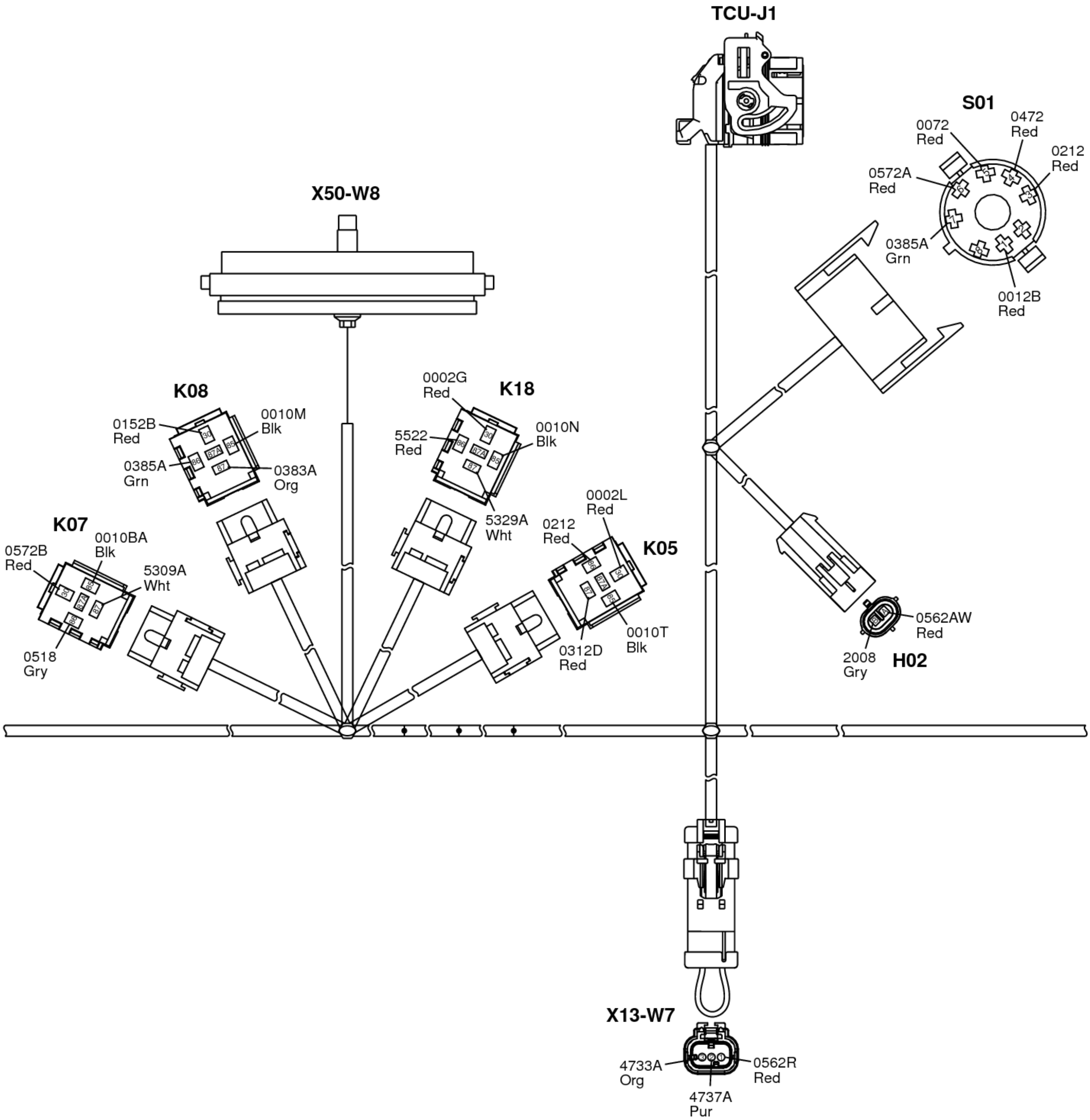


W8 Lower Cab Wiring Harness (1 of 5)

LEGEND:

ICC-J1	Display Interconnect
ICC-J2	Display Interconnect
ICC-J3	Display Interconnect
ICC-J4	Display Interconnect

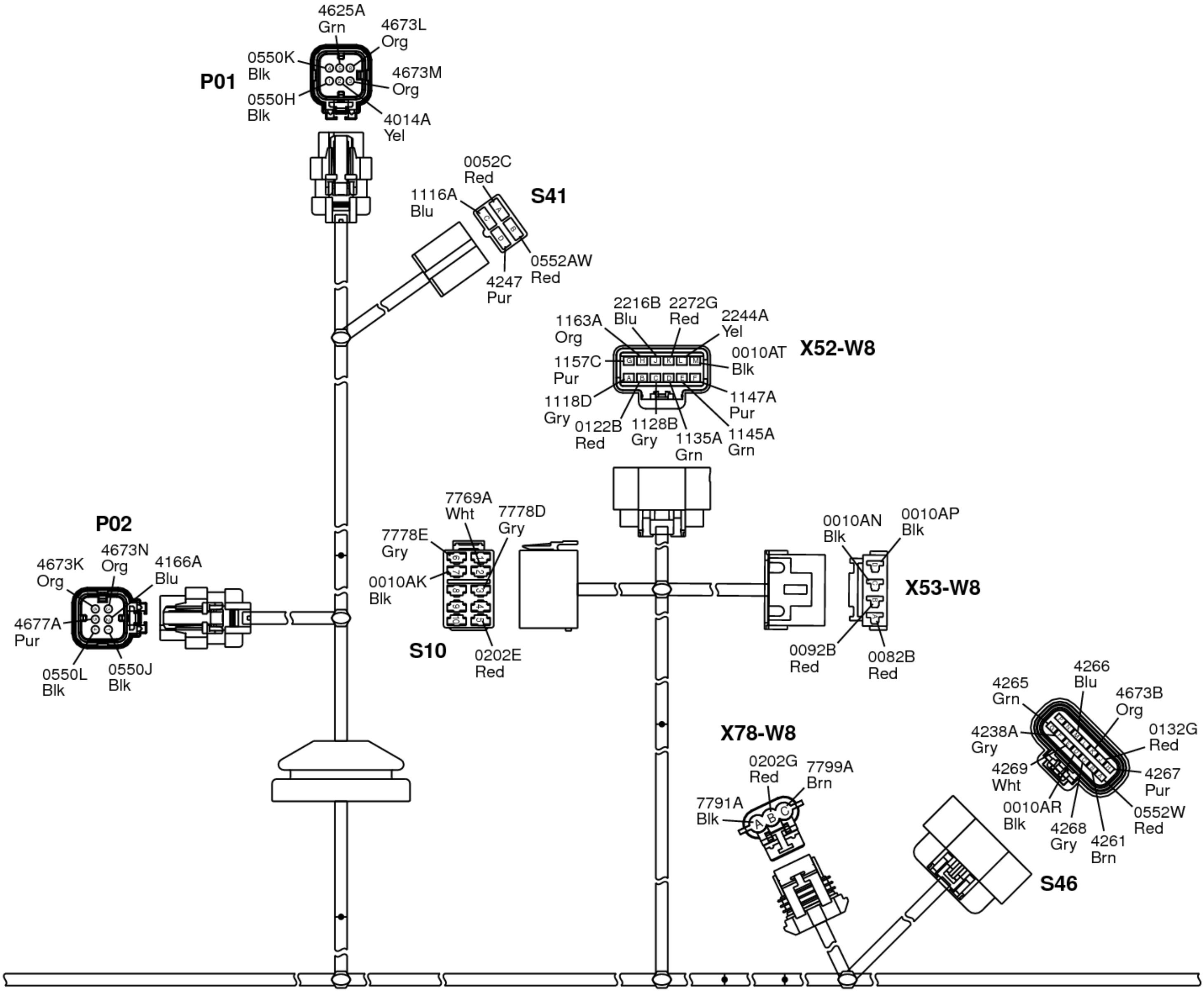
LC01	Load Center
M03	Front Wiper Motor
S02	Dash Panel Module
S15	Horn Switch
S20	Front Wiper Switch
T20	Ground
X65	CAN Terminator
X102	Service Advisor



W8 Lower Cab Wiring Harness (2 of 5)

LEGEND:

H02	Warning Alarm
K05	Accessory Power Relay
K07	Start Relay
K08	Glow Plug Relay
K18	Fuel Shutoff Relay
S01	Key Switch
TCU-J1	Transmission Control Unit Interconnect
X13-W7	Lower Cab Wiring Harness to Front PTO Switch Interconnect
X50-W8	Lower Cab to Chassis Wiring Harness Interconnect

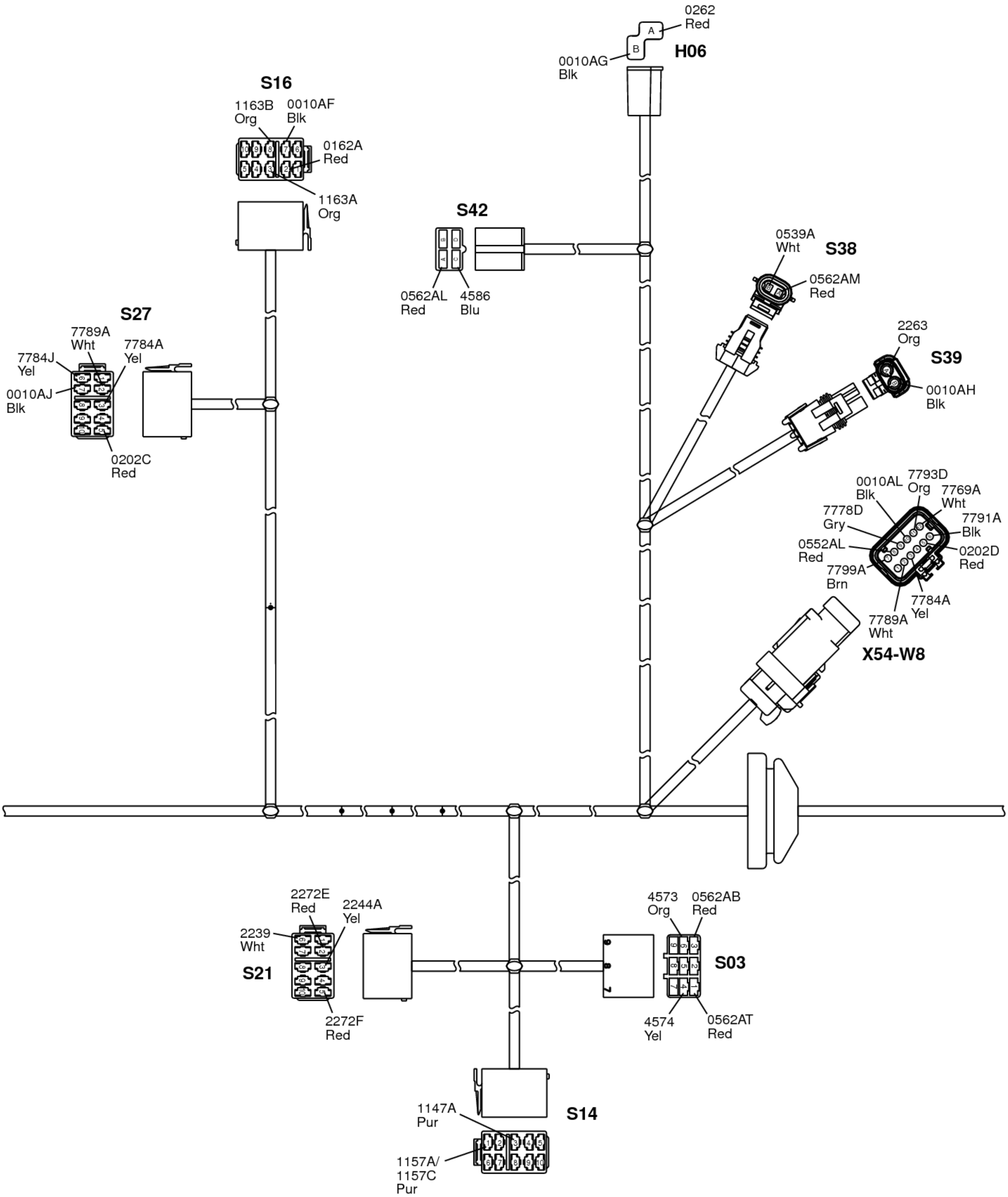


W8 Lower Cab Wiring Harness (3 of 5)

LEGEND:

P01	Forward Pedal Sensor
P02	Reverse Pedal Sensor
S10	Dual Continuous Switch
S41	Brake Switch
S46	Cruise Module
X52-W8	Lower Cab to Upper Cab Wiring Harness Interconnect

W53-W8	Lower Cab to Upper Cab Wiring Harness Interconnect
X78-W8	Lower Cab to 3rd EH SCV Handle Harness

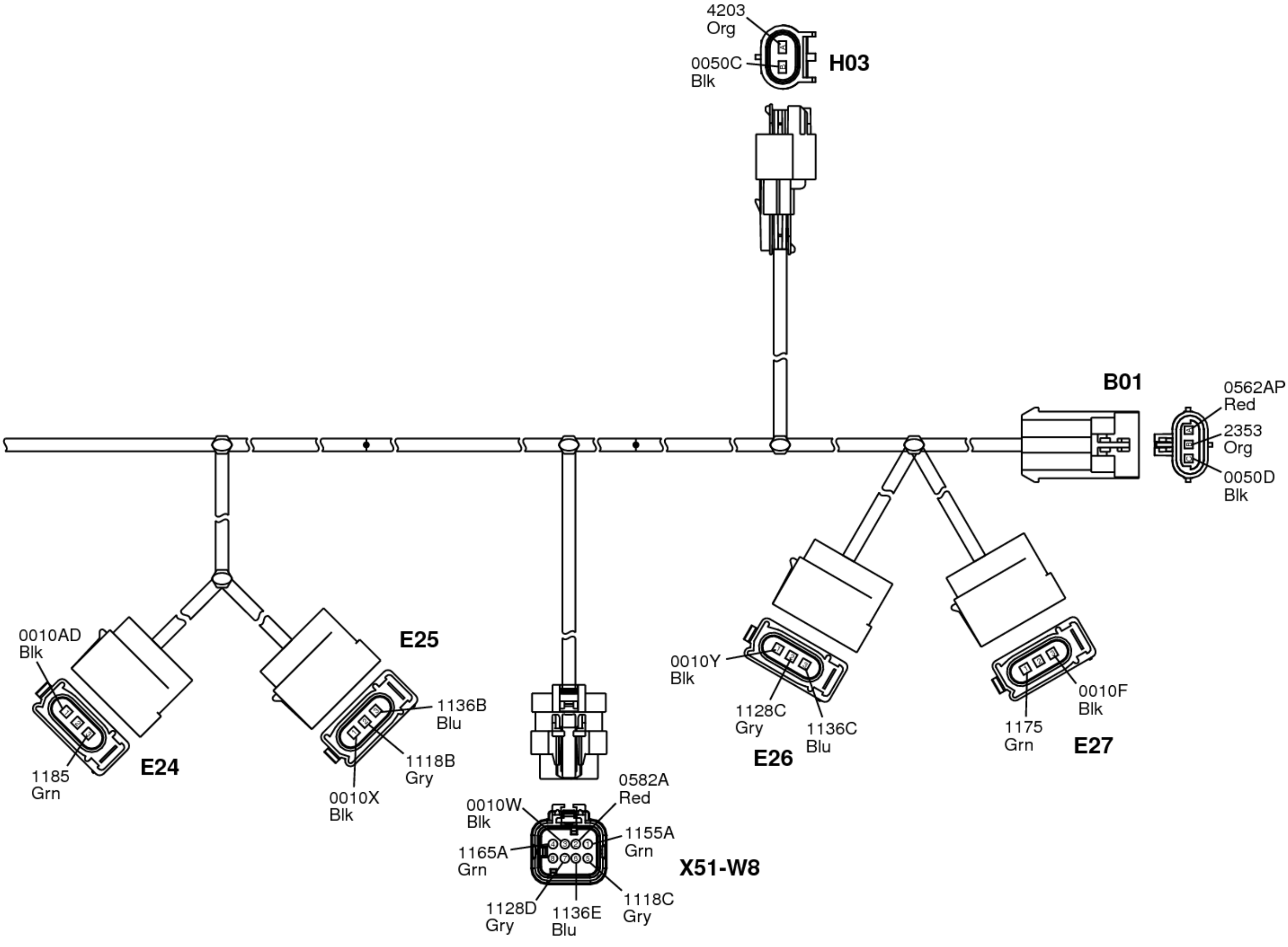


W8 Lower Cab Wiring Harness (4 of 5)

LEGEND:

H06	Power Port
S03	PTO Switch
S14	Right Work Light Switch
S16	Beacon Light Switch

S21	Rear Wiper Switch
S27	Diverter Switch
S38	Seat Switch
S39	Air Ride Seat
S42	Park Brake Switch
X54-W8	Rear Harness to Load Center Interconnect

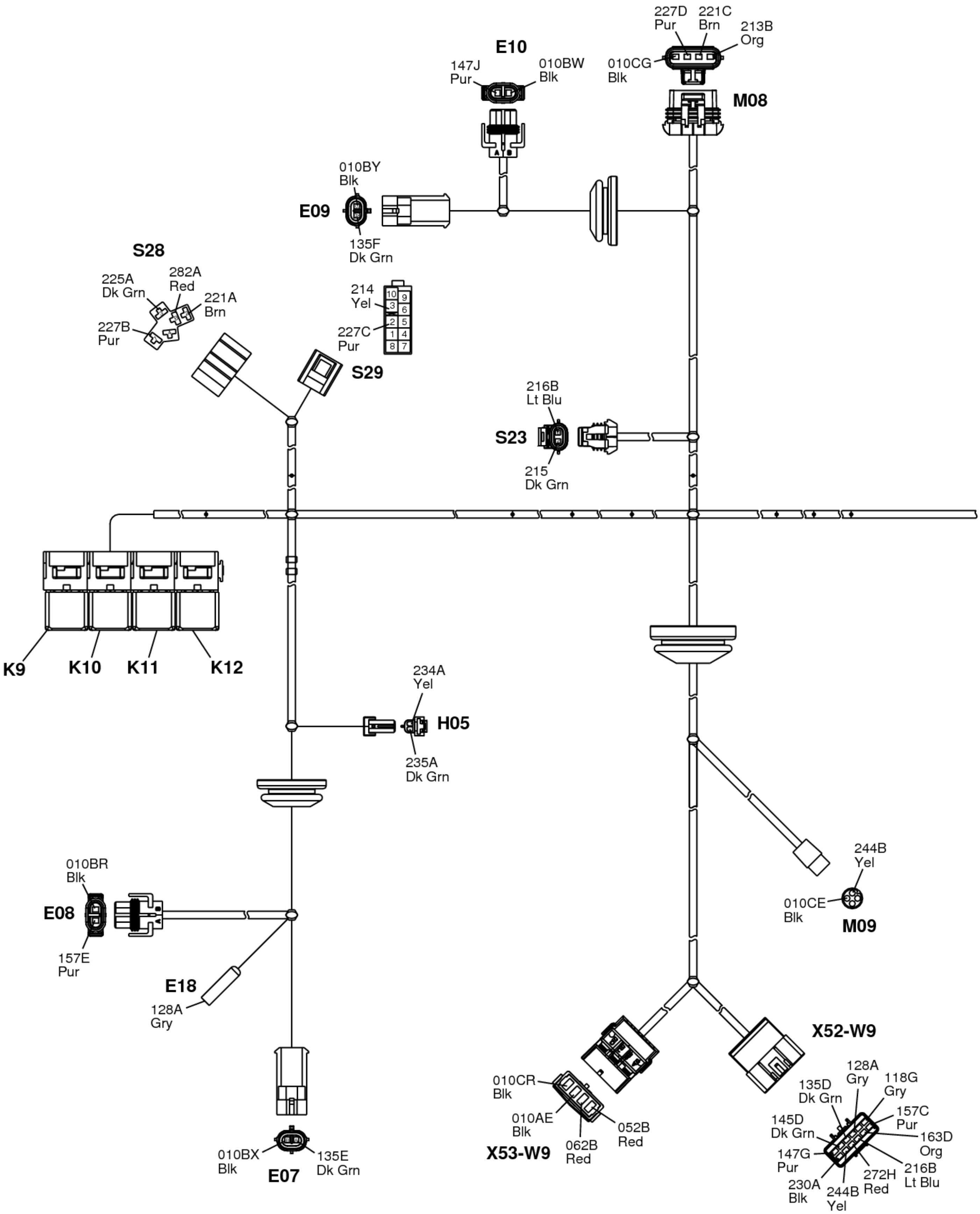


W8 Lower Cab Wiring Harness (5 of 5)

LEGEND:

B01	Fuel Gauge Sensor
E24	Right Turn
E25	Right Brake Marker Light
E26	Left Brake Marker Light
E27	Left Turn
H03	Backup Alarm
X51-W8	Lower Cab to 7 Pin Wiring Harness Interconnect

W9 Upper Wiring Harness (Cab)—EEC

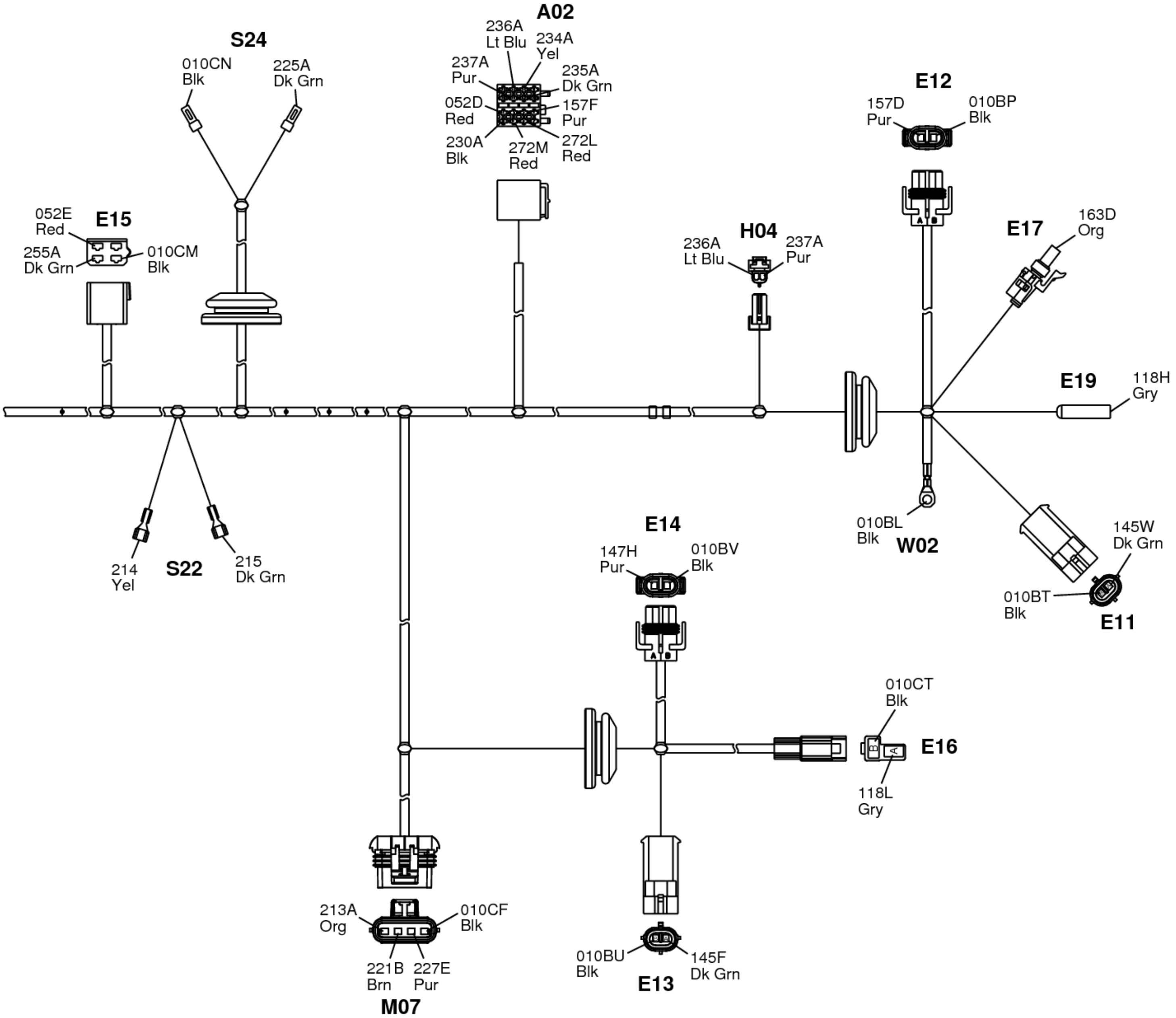


W9 Upper Cab Wiring Harness (1 of 2)

LEGEND:

E07	Right Front Amber Light
E08	Right Front Work Light
E09	Right Rear Amber Light
E10	Right Rear Work Light

E18	Right Front Marker Light
H05	Right Speaker
M08	Right Blower Motor
M09	Rear Wiper Motor
K9	Right Power Relay
K10	Left Power Relay
K11	Right Blower Relay
K12	Left Blower Relay
S23	Hi-Lo Pressure Switch
S28	Blower Switch
S29	HVAC Switch
X52-W9	Upper Cab to Lower Cab Wiring Harness Interconnect
X53-W9	Upper Cab to Lower Cab Wiring Harness Interconnect



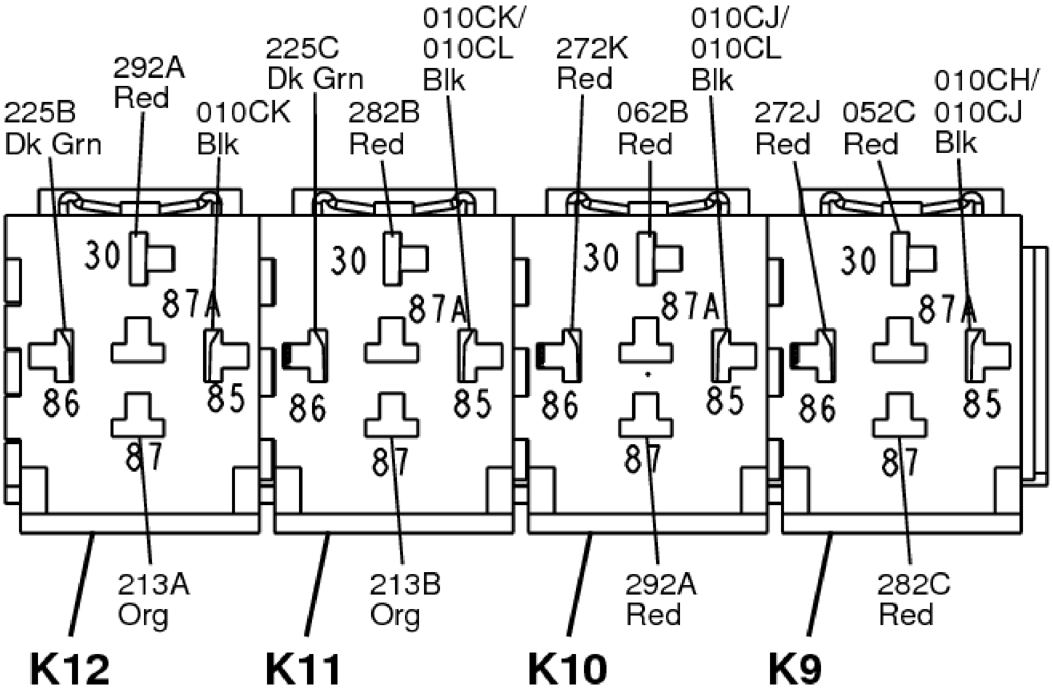
W9 Upper Cab Wiring Harness (2 of 2)

LEGEND:

A02	Radio
E11	Left Front Amber Light
E12	Left Front Work Light
E13	Left Rear Amber Light
E14	Left Rear Work Light
E15	Dome Light

E16	License Plate Light
E17	Beacon Light
E19	Left Front Marker Light
H04	Left Speaker
M07	Left Blower Motor
S22	HVAC Temperature Sensor
S24	Door Light Switch
W02	Beacon Light Ground

W9 Upper Wiring Harness Relay Block (Cab)—EEC

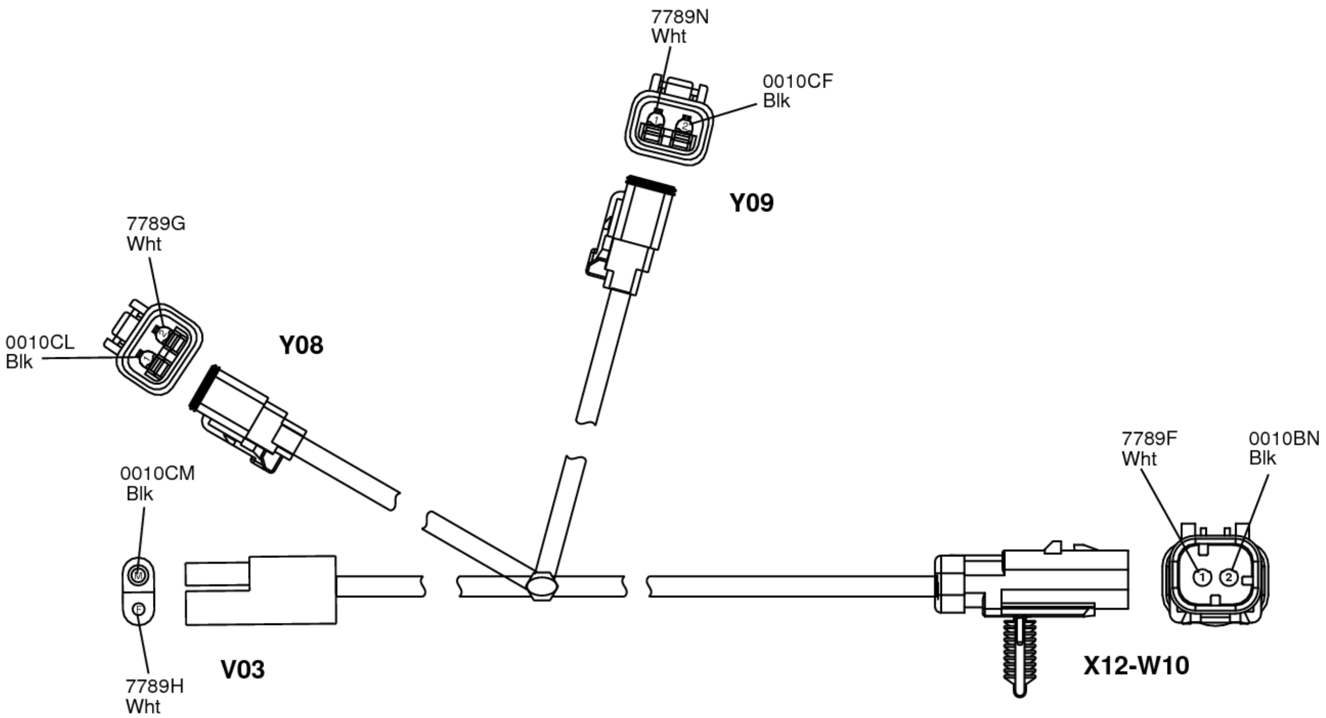


W9 Upper Cab Wiring Harness Relay Block

LEGEND:

K9	Right Power Relay
K10	Left Power Relay
K11	Right Blower Relay
K12	Left Blower Relay

W10 Diverter Valve Jumper Harness—EEC

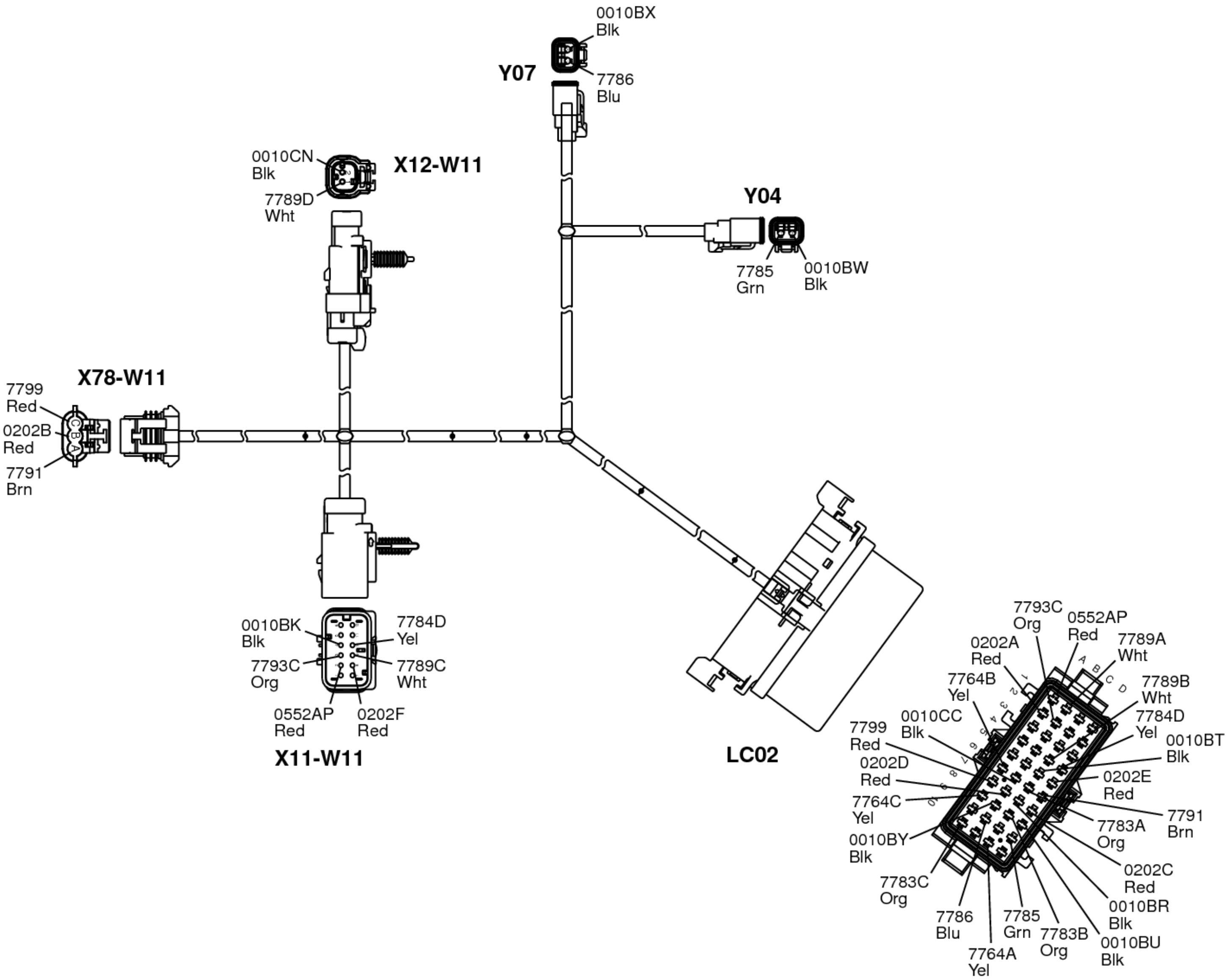


Diverter Valve Wiring Harness

LEGEND:

V03	Diode (5A)
X12-W10	Diverter Valve to 3rd EH Harness Interconnect (or 3rd EH, Diverter, Creep to REPO Harness (Cab)
Y08	Upper Hydraulic Solenoid Valve
Y09	Lower Hydraulic Solenoid Valve

W11 3rd EH Wiring Harness (Open Station)—EEC (—2014)

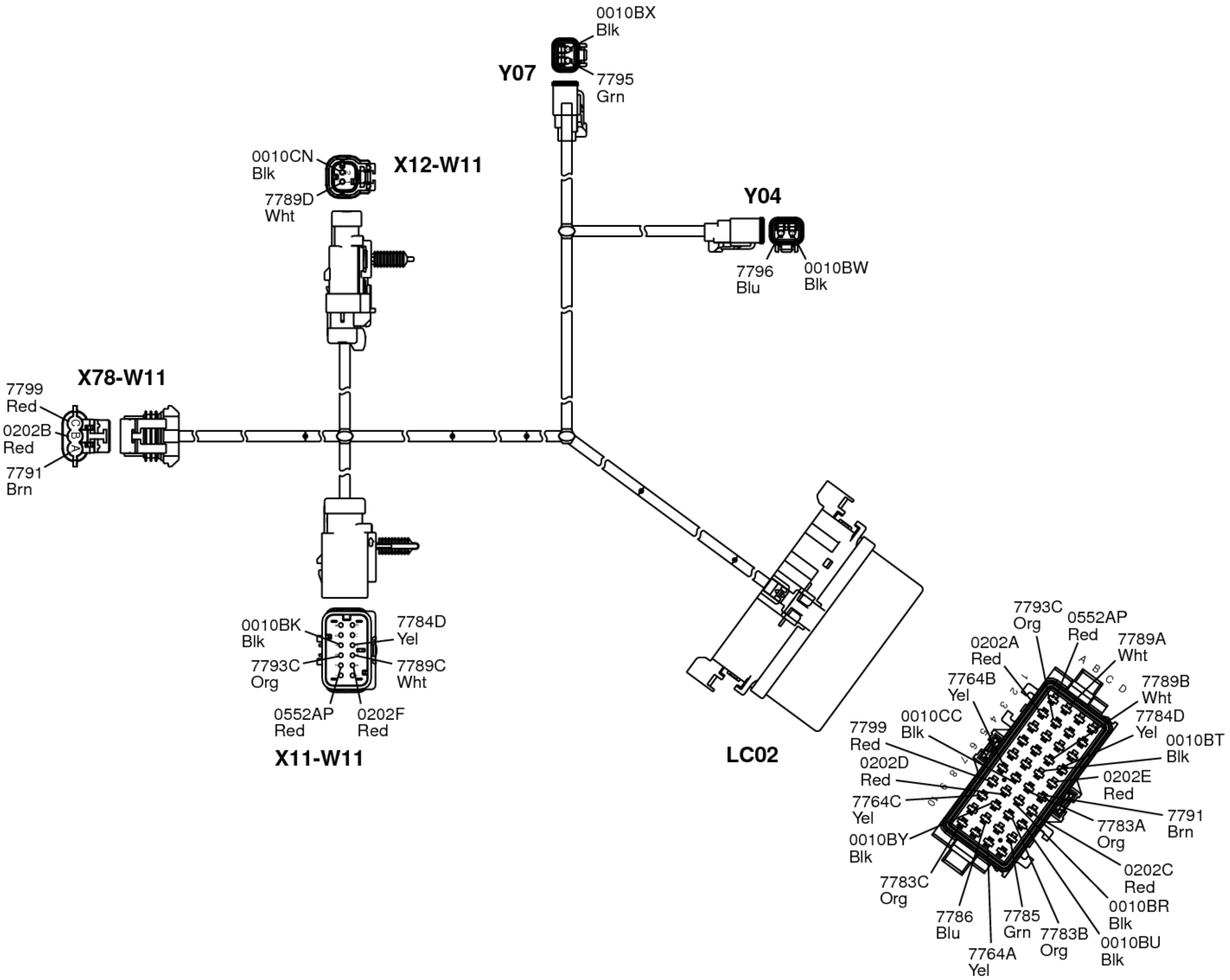


3rd EH Function Wiring Harness

LEGEND:

LC02	Load Center 3rd EH
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Jumper Harness
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W11 3rd EH Wiring Harness (Open Station)—EEC (2014—)

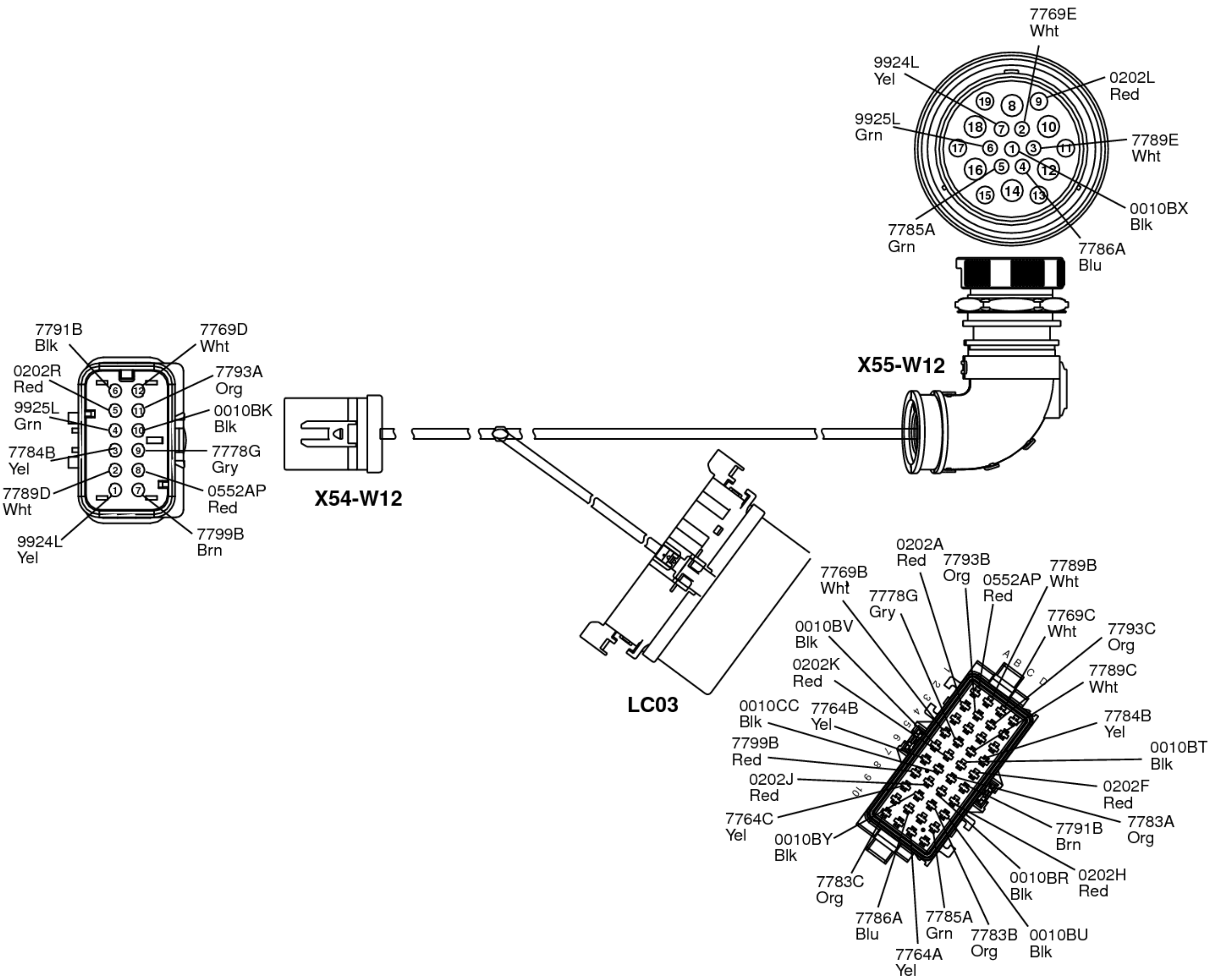


3rd EH Function Wiring Harness

LEGEND:

LC02	Load Center 3rd EH
X11-W11	3rd EH to Right Fender Harness Interconnect
X12-W11	3rd EH to Diverter Valve Jumper Harness
X78-W11	3rd EH Wiring Harness to 3rd EH SCV Handle Harness
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W12 Load Center Harness (Cab)—EEC

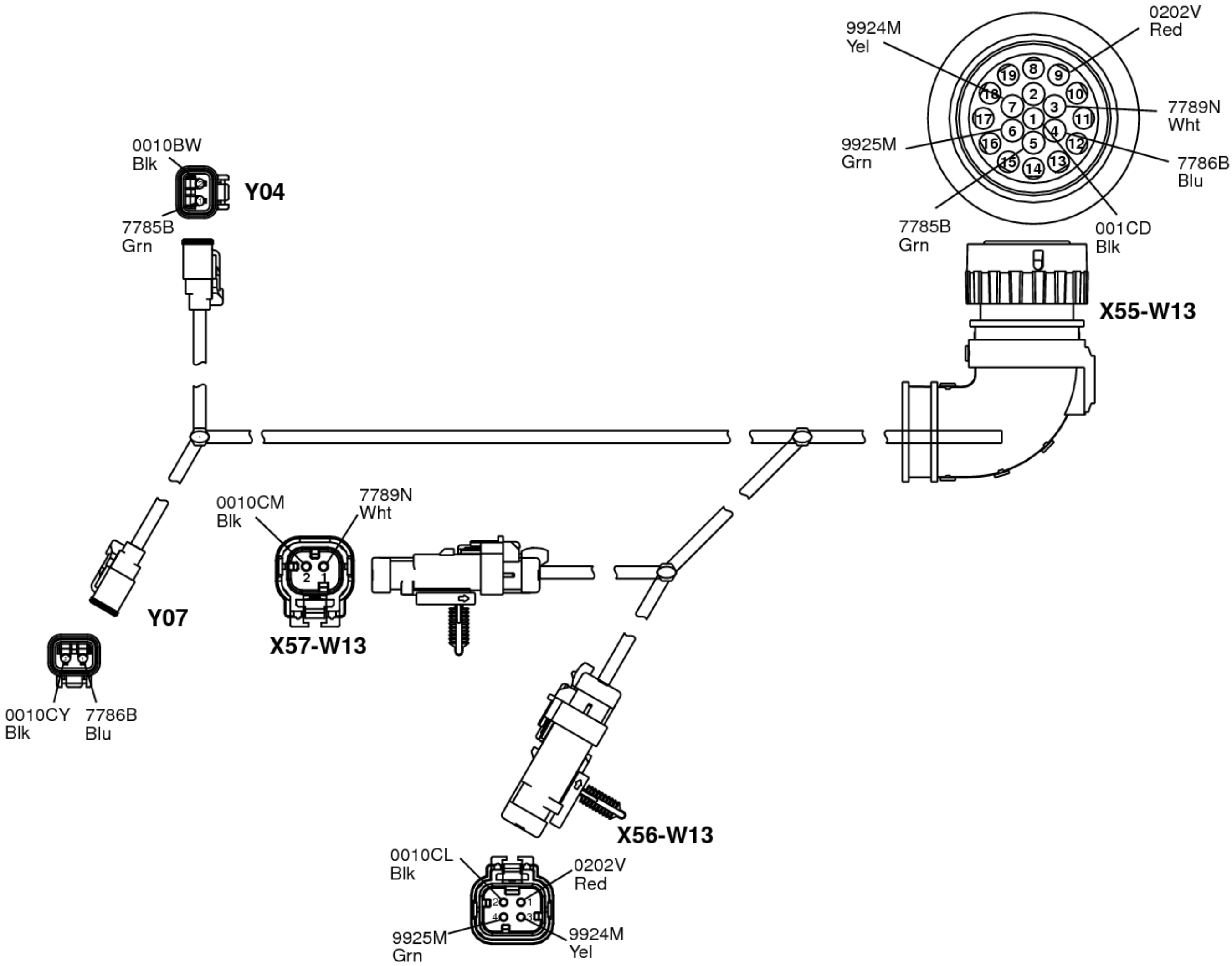


W12 Load Center Harness (Cab)

LEGEND:

LC03	Load Center Harness
X54-W12	Load Center to Rear Harness Interconnect
X55-W12	Load Center to 3rd EH, Diverter, Creep to REPO Harness Interconnect

W13 3rd EH, Diverter, Creep to REPO Harness (Cab)—EEC (—2014)

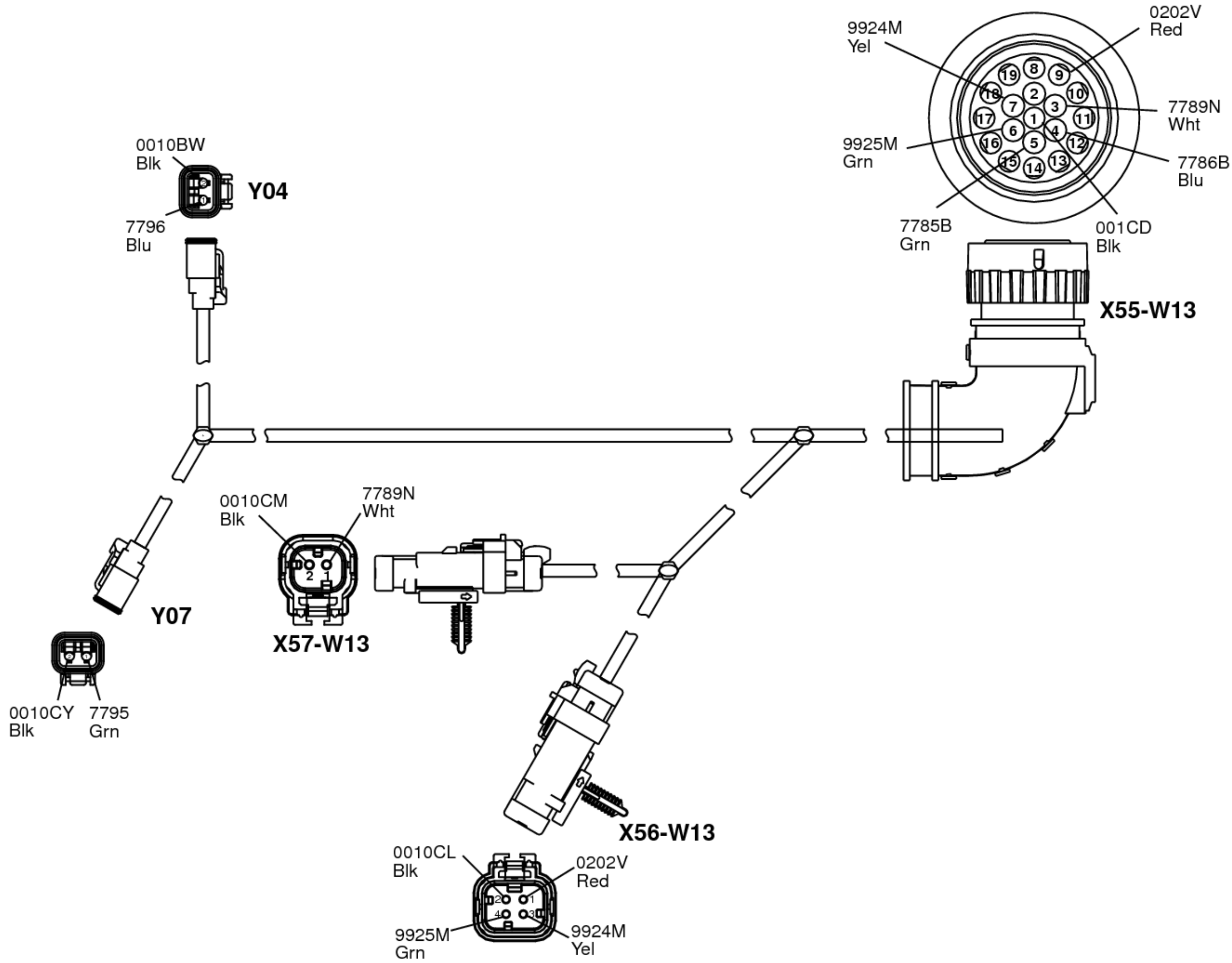


W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W13 3rd EH, Diverter, Creep to REPO Harness (Cab)—EEC (2014—)

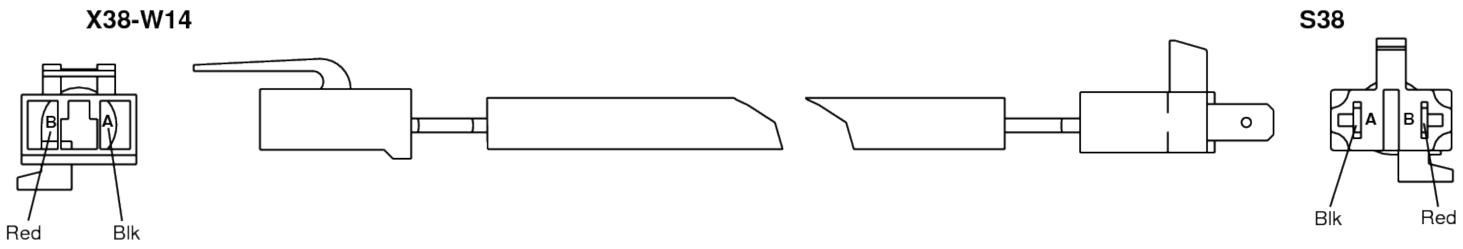


W13 3rd EH, Diverter, Creep to REPO Harness (Cab)

LEGEND:

X55-W13	3rd EH, Diverter, Creep to REPO to Load Center Harness Interconnect
X56-W13	3rd EH, Diverter, Creep to REPO to Creep to REPO Harness Interconnect
X57-W13	3rd EH, Diverter, Creep to REPO to Diverter Valve Harness Interconnect
Y04	3rd Function Solenoid A
Y07	3rd Function Solenoid B

W14 Seat Switch Jumper Harness (Cab)—EEC

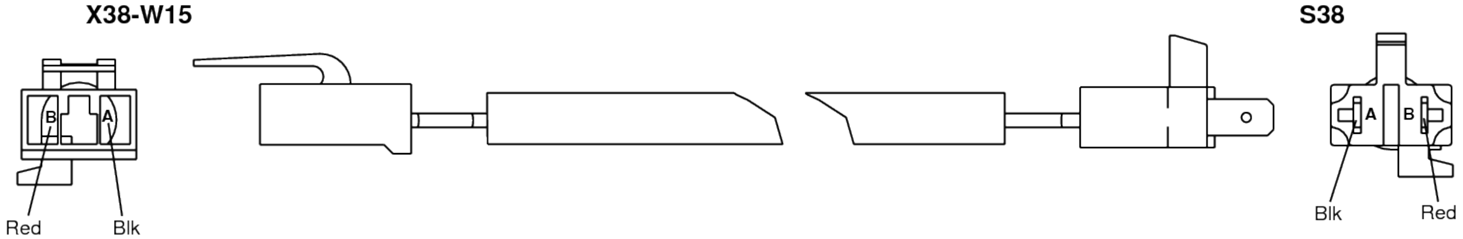


W14 Seat Switch Jumper Harness (Cab)

LEGEND:

S38	Seat Switch
X38-W14	Seat Switch to Lower Cab Harness Interconnect

W15 Seat Switch Jumper Harness (Open Station)—EEC

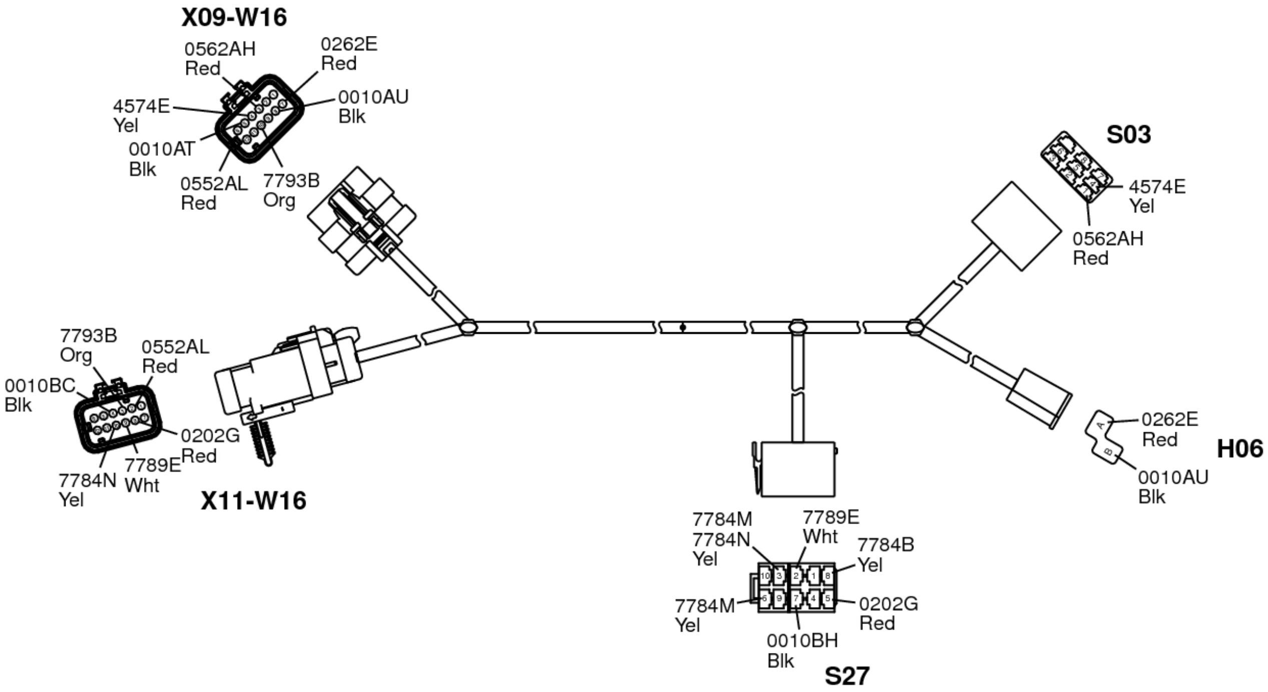


W15 Seat Switch Jumper Harness (Open Station)

LEGEND:

S38	Seat Switch
X38-W15	Seat Switch to Chassis Harness Interconnect

W16 Fender Wiring Harness (Open Station)—PowrReverser Transmission—EEC

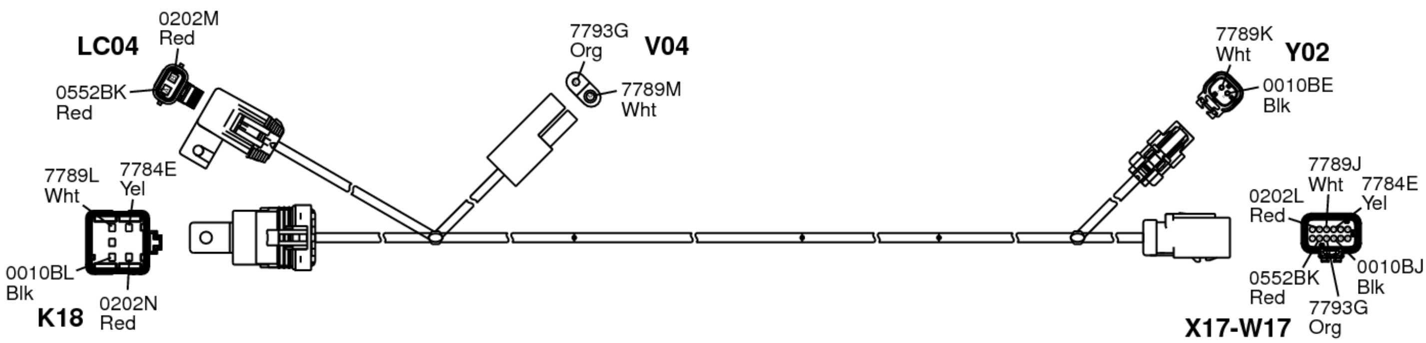


W16 Fender Wiring Harness PowrReverser

LEGEND:

H06	Power Port
S03	PTO Switch
S27	Diverter Switch
X09-W16	Right Fender to Chassis Harness Interconnect 2
X11-W16	Right Fender to 3rd EH Harness Interconnect

W17 Diverter Wiring Harness (Open Station)—EEC

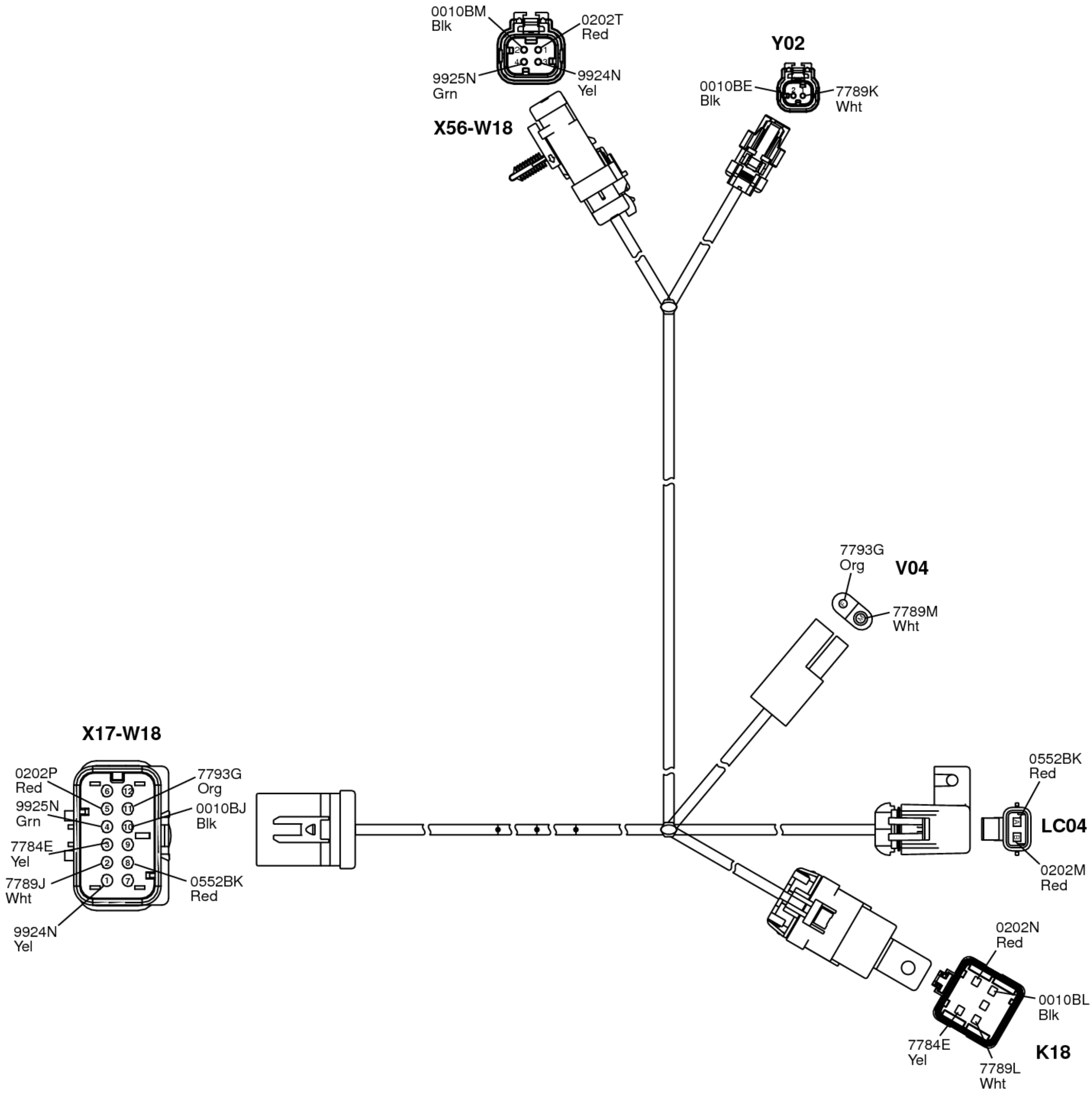


W17 Diverter Wiring Harness

LEGEND:

K18	Fuel Shutoff Relay
LC04	Fuse Holder
V04	Diode 6 Amp
X17-W17	Rear Harness Connector
Y02	Diverter Solenoid

W18 Diverter Wiring Harness (Cab)—EEC



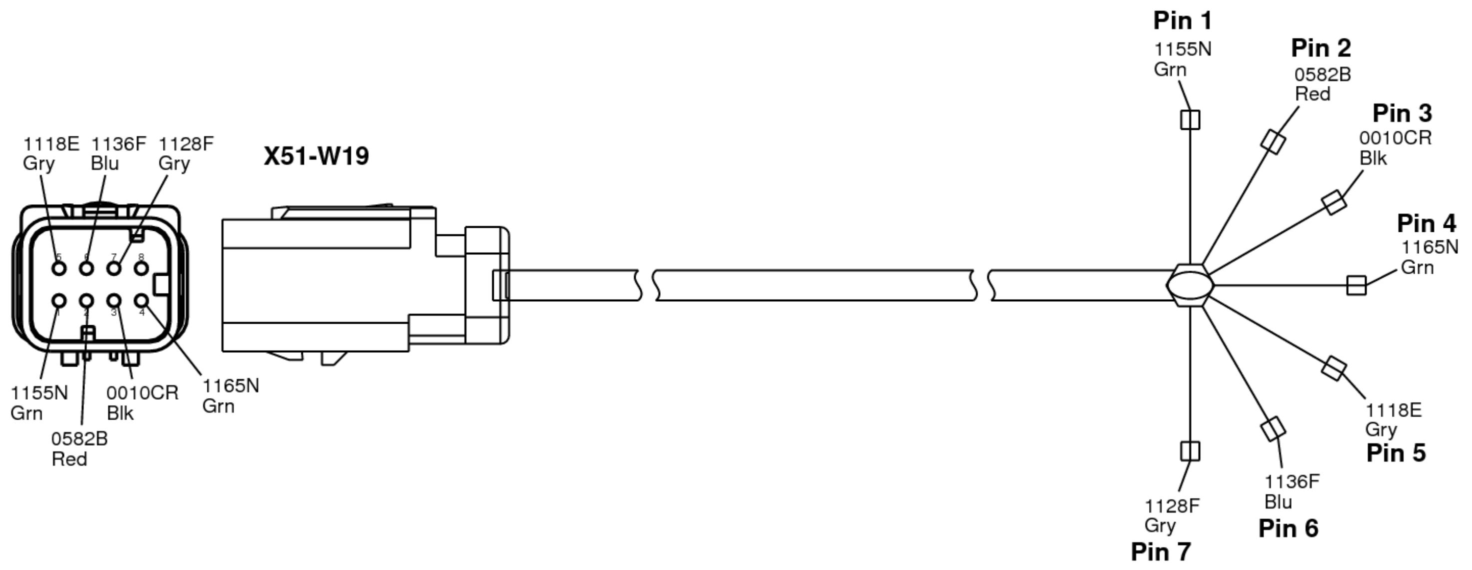
W18 Diverter Wiring Harness (Cab)

LEGEND:

K18	Fuel Shutoff Relay
LC04	Fuse Holder
V04	Diode 6 Amp
X17-W18	Rear Harness Connector

X56-W18	Diverter Wiring Harness to REPO Harness Interconnect
Y02	Diverter Solenoid

W19 Seven Pin Trailer Connector Wiring Harness (Cab)—EEC



W19 Seven Pin Trailer Connector Wiring Harness

LEGEND:

X51-W19	7 Pin to Lower Cab Wiring Harness Interconnect

Group 25 - Operation and Diagnostics

Power Circuit Operation—EEC

Function

To provide unswitched and switched power to the primary electrical components whenever the battery is properly connected.

The power circuits are divided among the unswitched power circuits, switched power circuits (key switch in Run position), and secondary power circuits. The secondary power circuits become energized when switched power circuits energize relays and/or control modules, providing current paths to the secondary circuits. The secondary power circuits will not be energized if the relay or control module controlling the current path(s) fail.

Unswitched Power

Voltage must be present at each of the following components with the key switch in the off position:

- ECU Fuse holder terminal A
- F20 Fuse 40A
- F21 Fuse 50A
- F22 Fuse 80A
- G02 Alternator T13
- ICC-J1 terminal A
- ICC-J1 terminal B
- ICC-J1 terminal C
- ICC-J1 terminal D
- ICC-J1 terminal F
- S01 Key switch terminal 1
- S02 Dash panel module terminal A
- S02 Dash panel module terminal B
- S15 Horn switch terminal A
- TCU-J1 terminal L1
- X102 Service advisor terminal B
- F2 Power port terminal 1C

The positive battery cable connects the battery to the starting motor. The starting motor bolt is used as the 12-volt DC tie point for the rest of the electrical system.

The battery cables and the starting motor tie point connections must be good for the machine electrical system to work properly. The ground cable and positive cable connections are equally important. Proper starting motor operation depends on these cables and connections to carry high current.

Switched Power

In addition to the voltage present at the locations of the unswitched power circuits, voltage must be present at the following components during the following conditions: key switch in the Run position, direction pedals not pressed, PTO(s) off, park brake locked, MFWD disengaged, and operator off seat:

- A01 Display unit ICC-J2 terminal N
- B33 MFWD speed sensing switch terminal A
- S39 Air ride seat option terminal A
- S41 Brake switch terminal B

These circuits are controlled by the key switch and are protected by the F20, F21, and F22 fused bus bar.

Cranking Circuit Operation—EEC

Function

To energize the starter motor solenoid and engage the starter motor to start the engine.

Operating Conditions

- Key switch in START position
- Transmission in any position
- Rear PTO switch in OFF position

Theory of Operation

CAUTION:

Avoid Injury! ALWAYS engage park brake when starting the engine.

The starting circuit is controlled through the A01 display panel based upon “IF” “THEN” logic. If the operating conditions are met, then the display panel will supply an output signal to the K07 start relay.

Unswitched power is supplied to the A01 display panel at terminals A—D (0122B —0122E Red wires) on the ICC-J1 connector. When the key switch is in the RUN or START position, switched power is supplied to the A01 display panel at terminal F (0562 series Red wires) on the ICC-J1 connector, powering up the display panel. For more information, see Power Circuit Operation—EEC in Section 40, Group 30.

The display panel will supply an output to 0518 Gry wire to energize the K07 start relay when it detects the following inputs:

- Battery voltage at terminal D (0572C Red wire) on the ICC-J3 connector from S1 key switch (START position).
- No voltage at terminal H (4574 series Yel wire) on the ICC-J1 connector from S03 rear PTO switch (OFF position).
- Input data at terminal R (9924A Yel wire) on the ICC-J2 connector from the A09 ECU controller indicating engine speed is less than 400 rpm.

When placed in the START position, the key switch provides power to the 0572A Red wire, which splices to the 0572B and 0572C Red wires. The 0572C Red wire supplies the input signal to the display, while the 0572B Red wire supplies power to terminal 30 on the K07 start relay.

When all cranking conditions have been met, the display panel will provide output power on 0518 Gry wire to the start relay at terminal 86, energizing the relay for up to 60 seconds per starting attempt.

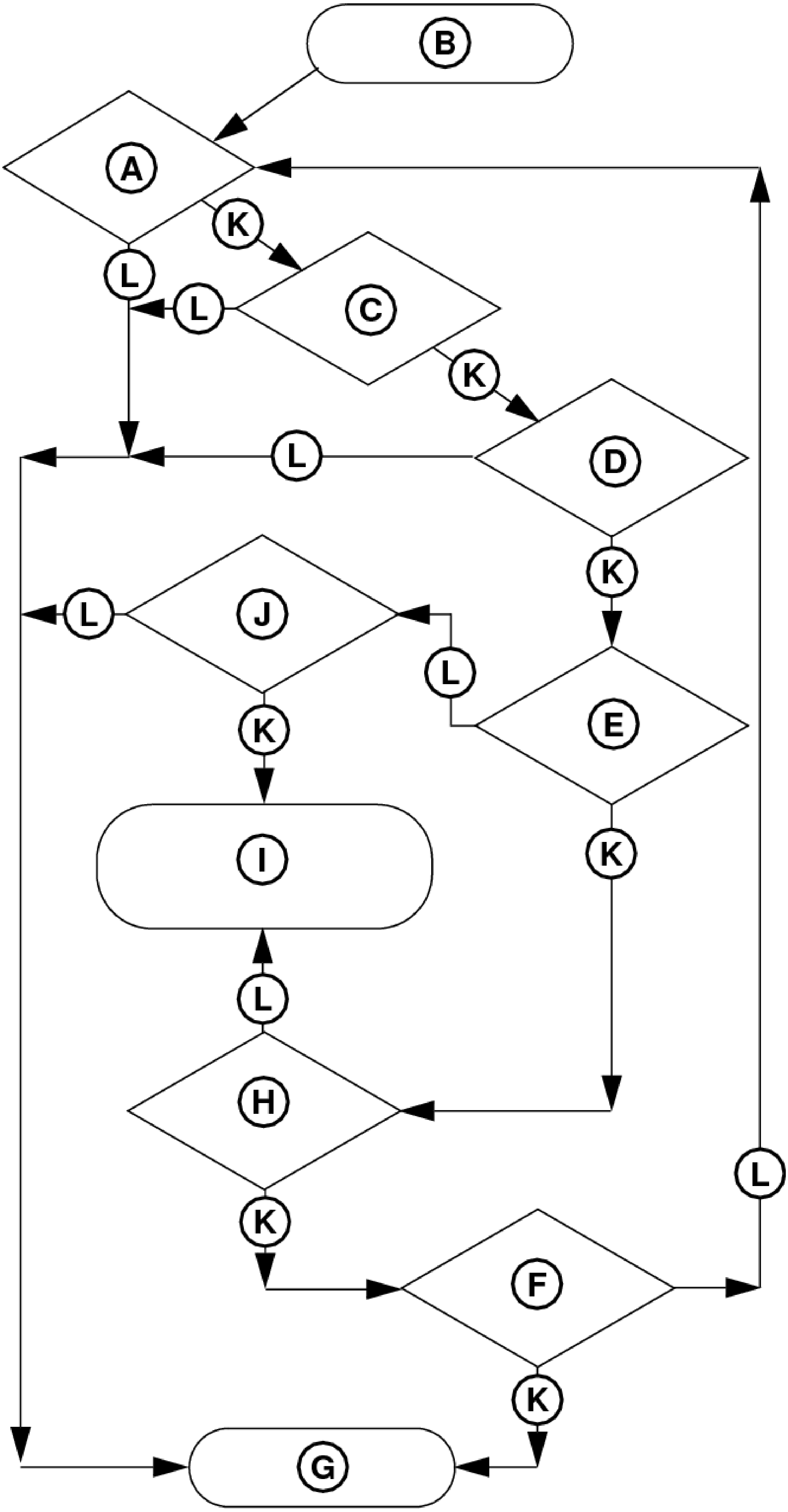
When energized, the start relay contacts are closed, allowing current to flow from the 0572D Red wire through the 5309 series Wht wires to the Y01 starting motor solenoid, energizing the starting motor solenoid. With the starting motor solenoid energized, the solenoid contacts close and high current from the battery flows through the battery cable and starter motor solenoid contacts to the starting motor. The starting motor activates and cranks the engine.

During the cranking process, the display panel monitors engine speed data provided by the A09 ECU controller. From the data, the A09 ECU controller determines the speed the engine is turning, then transmits the engine speed information across the 9924A Yel and 9924B Grn wires to the A01 display panel.

If the engine speed is greater than 400 rpm when the key switch is placed in the START position to crank the engine, the logic in the display panel will determine the engine is already running and will not provide an output signal to the start relay. If, during the cranking function, the engine speed increases to 800 rpm or greater for 3 consecutive seconds, the logic in the display panel will determine the engine is running and will remove the output signal to the start relay, even if the key switch is still in the START position.

For the engine to start, the pull-in and hold-in coils of the fuel shutoff solenoid must be energized. For operation of the fuel circuit, see Fuel Supply/Engine Shutoff Circuit Operation—EEC in Section 40, Group 30.

The following flow chart is a diagram of the display panel cranking circuit logic.


B
A
K
L
C
L
K
D
L
J
L
K
E
L
K
I
L
H
K
F
L
K
G

Flow Chart

LEGEND:

A	Park Brake Locked?
B	Attempt to Start Engine
C	Rear PTO Off?
D	Key Switch in Start Position?
E	Start Relay Already Engaged?
F	Three Consecutive Seconds?
G	No Output Signal to Start Relay
H	Engine Speed > 800 rpm?
I	Output Signal to Start Relay (maximum 60 seconds)
J	Engine Speed < 400 rpm?
K	Yes
L	No

Manifold Heater Circuit Operation—EEC

Function

To provide an added source of heat for the combustion chamber during cold starts, especially below **5°C (40°F)** and to illuminate a light on the display panel and indicate to the operator that voltage is being provided to the manifold heater.

Operating Conditions

- Key switch must be in the start or run position and pushed in to the aid position.

Theory of Operation

The ignition system is designed to inject diesel fuel into the piston cylinder where heat from compression ignites the fuel and air mixture. When starting a cold engine, compression may not provide enough heat to ignite the fuel. A manifold heater is installed to provide added heat to the combustion chamber.

The manifold heater is energized (heated) when the key switch is placed in the aid position (key pushed into switch). The key can be pushed into the aid position with the key in either the start or run position. The manifold heater may be preheated by pushing in the key, with the switch in the run position, for up to 3 seconds before turning the key to the start position.

When the key switch is in the aid position, current is provided to the K19 manifold heater relay coil (terminal 86) through the 0385 Grn wire. When the relay coil is energized, the relay contacts close and unswitched power (0152 Red wire—terminal 30) flows through the contacts and 0383A and 0383B Org wires to the manifold heater.

The engine preheat indicator light in the display panel provides a visual indication that the key is in the aid position and the manifold heater relay is being energized. In this position, battery voltage is provided to the engine preheat light through the 0383C Org wire, ICC-J3 connector terminal J, and A01 display panel circuit board. A circuit board run provides voltage to the engine preheat light.

A ground circuit path for the display panel circuit board is provided though the ICC-J1 connector, terminal M and 0050F and 0050A Blk wires.

Fuel Supply/Engine Shutoff Circuit Operation—EEC

Function

To start or stop the supply of fuel to the engine.

To cut power to the fuel shutoff solenoid and stop the machine engine when desired or in an unsafe operating condition.

Operating Conditions (Cranking)

- PTO(s) off.
- Transmission in any position.
- Key switch in the START position.

Operating Conditions (Engine on, Operator on Seat)

- Key switch in the RUN position.
- Operator on seat.
- PTO(s) off or on.
- Transmission in any position.

Operating Conditions (Engine on, Operator off Seat)

- Key switch in the RUN position.
- Park brake locked.
- Transmission in any position.
- PTO(s) off, and then.
- Operator may leave seat.

Operating Conditions (Engine on, Operator off Seat, Rear PTO Engaged)

- Key switch in the RUN position.
- Park brake locked.
- Transmission in any position.
- Mid PTO off (option).
- Operator may leave seat, and then.
- Rear PTO can be on.

Engine must stop when

- Operator places the key switch in the OFF position,

or;

- PTO(s) on, and
- Operator gets out of seat (if off seat PTO logic is not engaged),

or

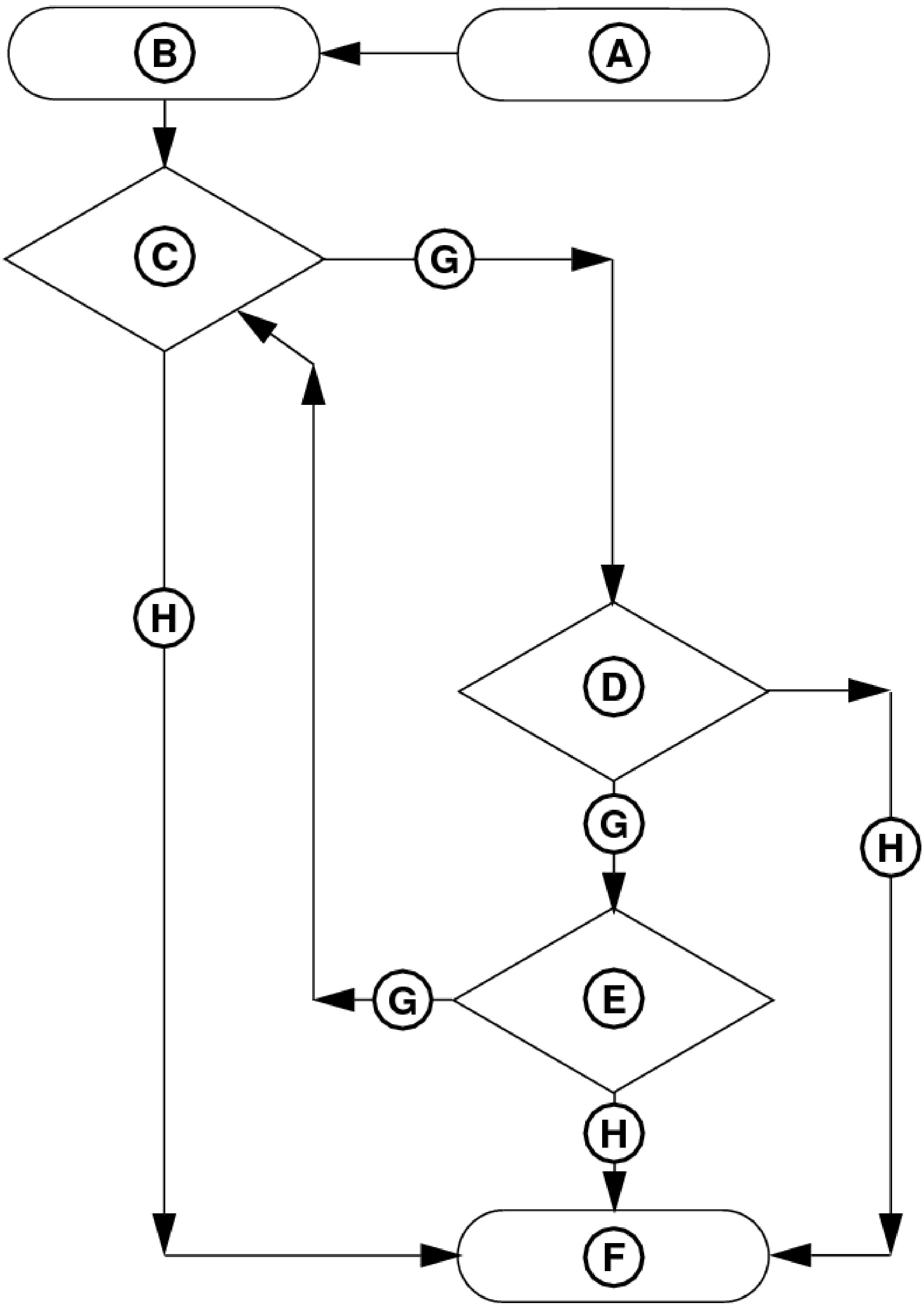
- Transmission is in any position, and
- Operator gets out of seat.

Theory of Operation—Fuel Supply Logic

The fuel system is designed to inject fuel into the piston cylinders, where heat from compression ignites the fuel and air mixture.

When the key switch is placed in either the run or start positions, current from the switched power circuit is provided to the A01 display panel through either the S38 seat switch (on seat) or the S03 rear PTO switch (off).

Fuel is supplied to the engine by the M02 fuel pump over the 0562J Red wire when the S01 key switch is placed in either the START or RUN position. Ground for this circuit is through the 0010 Series Blk wires on the W01 ground circuit.



Flow Chart

LEGEND:

A	Fuel Solenoid Off
B	Place Key Switch in RUN Position
C	Operator on Seat?
D	PTOs Off?
E	Off Seat PTO Logic On?
F	Fuel Solenoid On
G	No
H	Yes

Theory of Operation—Engine Shutoff

When the operator places the key switch in the OFF position or if an unsafe condition is created, the engine will stop by having the fuel supply to the engine shut off.

The fuel supply is shut off when voltage to the suction control valve and M02 fuel pump are removed.

→NOTE:

See relevant engine component technical manual (CTM) for detailed fuel system operation.

Engine on, Operator ON Seat Logic

The seat switch is the main and most direct circuit to provide input to the A01 display panel.

Power is provided through the key switch, 072 Red wire, F5 fuse, 562 series of Red wires, S38 seat switch (S39 with optional air ride seat) (operator on seat), 0539 Sereis Wht wires to the A01 display panel ICC-J3 connector.

Engine On, Operator OFF Seat Logic

The S03 PTO switch is the second path to provide input to the A01 display panel.

The S03 PTO switch provides power to the fuel circuit. Power is provided from the key switch to the 072 Red wire, F5 fuse, 562 series of Red wires.

The 562 series Red wire at terminal 1 provides power to the S03 PTO switch (PTO off).

If the S03 PTO is off, the transmission is in neutral, and without the operator on the seat, the display panel will then provide an input at 4574 Yel wire at ICC-J1 terminal H.

Engine On, Operator OFF Seat, Rear PTO Engaged Logic (Off Seat PTO Logic)

To operate a machine with the rear PTO engaged and allow the operator to leave the seat requires that the off seat PTO logic be activated. The off seat PTO logic is activated and deactivated automatically as the operator uses different functions of the machine.

To activate the off seat PTO logic, the A01 display panel requires proper input signals from the following circuits during the following conditions:

Engine On, Operator OFF Seat, Rear PTO Engaged Logic (Off Seat PTO Logic)

Input Circuit	Operating Condition
Seat switch	Operator on seat
Rear PTO switch	Off position
Park brake switch	Park brake locked
S49 Mid PTO ense switch	S49 Mid PTO sense switch off (if equipped)
Alternator	Engine running

Once the off seat PTO logic has been activated, the operator may leave the seat and then engage the rear PTO. With the mid PTO engaged, the operator must remain on the seat in order for the engine to remain running.

Except for the seat switch, if any of the other inputs change once the operator has left the seat and engaged the rear PTO, the engine will shut off.

If the operator returns to the seat, the engine will continue to run with the rear PTO engaged, however the off seat PTO logic will be deactivated and the engine will shut off if the operator leaves the seat, unless the off seat PTO logic is activated again.

The A01 display panel requires four constant and two changing inputs to operate the rear PTO with operator off the seat. Five inputs supply battery voltage and one input supplies a frequency signal to the display panel to activate the off seat PTO logic. The changing inputs are from the seat switch indicating that the operator has left the seat, and the rear PTO switch indicating that the operator has engaged the rear PTO.

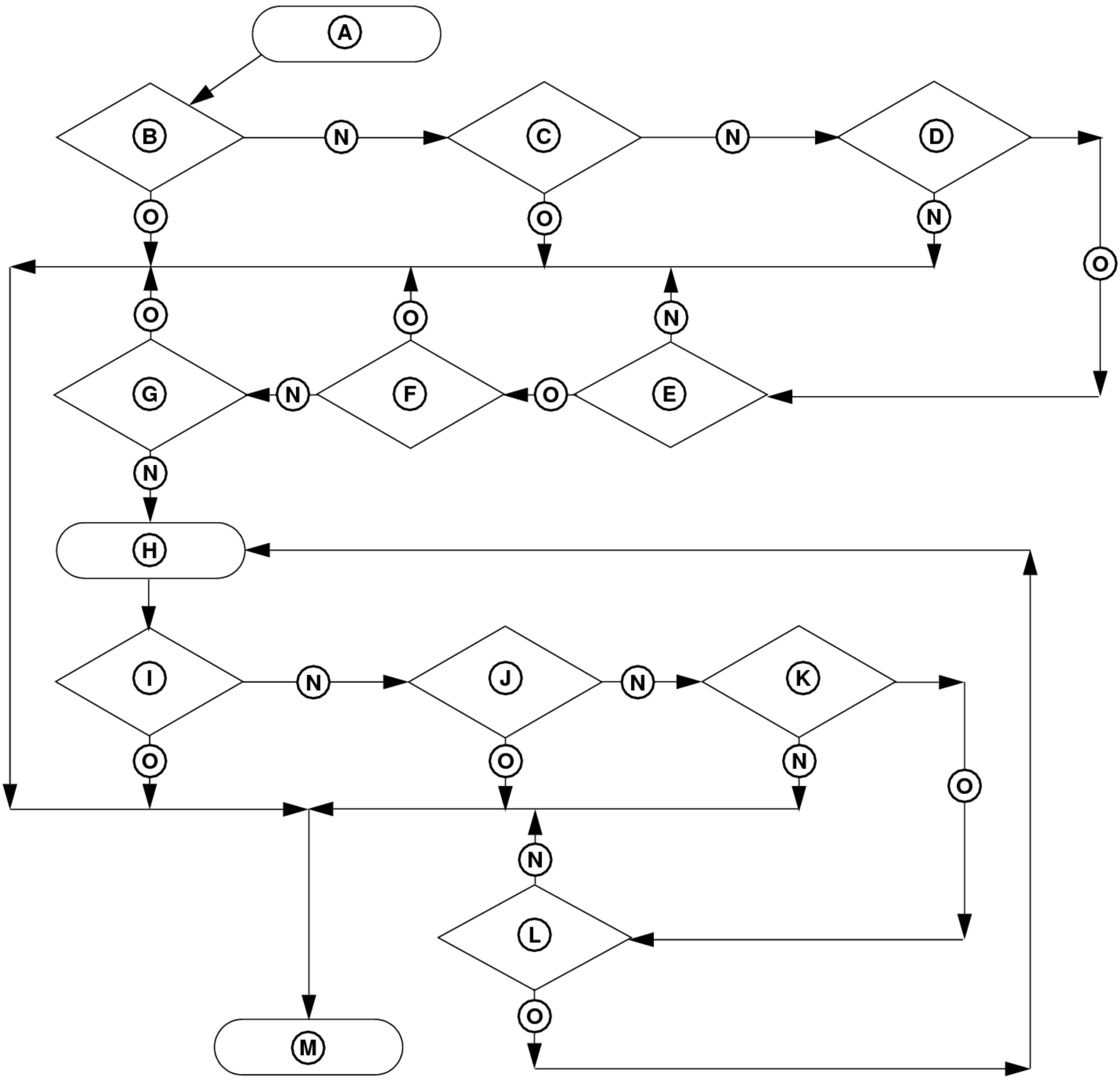
The switched power circuit provides power to the display panel through the following circuits:

- The 562 series Red wire provides power to the S42 park brake switch (park brake locked), 4586 Blu wire, A01 display panel (ICC-J3 connector).
- The 562B Red wire provides power to the S49 Mid PTO sense switch, if equipped, 4687C Pur wire, and on to the A01 display panel ICC-J3 connector.
- The frequency input is a result of the engine running and is supplied by the TCM (transmission control module).
- The 562 series Red wire provides power to the S38 seat switch (operator on seat), 0539 series Wht wires, A01 display panel ICC-J3 connector.
- The 562 series Red wire provides power through the S03 rear PTO switch (PTO on), 4574 Yel wire, and on to the A01 display panel ICC-J1 connector.

Once the inputs have been established, the operator may leave the seat, removing power from the seat switch input of the A01 display panel and engage the rear PTO inputting power from 4574 series Yel wire at the A01 display panel.

The rear PTO will remain engaged until the operator disengages the rear PTO, or unlocks the park brake, or engages the mid PTO, or places the key switch in either the OFF or START position.

It the operator returns to the seat, the rear PTO will remain engaged, however, the off seat PTO logic will be deactivated.



Flow Chart

LEGEND:

A	Off Seat PTO Logic Off
B	Mid PTO Off?
C	Park Brake Locked?
D	Operator on Seat?
E	Engine Crank Signal On?
F	Rear PTO Off?
G	Engine Cranked at Least Once?
H	Off Seat PTO Logic On?
I	Mid PTO Off?
J	Park Brake Locked?
K	Operator on Seat?

L	Engine Crank Signal On?
M	Off Seat PTO Logic Off
N	Yes
O	No

Charging Circuit Operation—EEC

Function

To maintain battery voltage between 12.4 and 13.2 volts.

Operating Conditions

- Key switch in RUN position.
- Engine running.

Theory of Operation

The charging system consists of the G02 alternator with an integrated voltage regulator/rectifier. Charging output is controlled by the regulator/rectifier. The status of the charge rate is indicated by the display panel discharge light.

With the key switch in the RUN position, battery sensing circuit current flows through the key switch to the alternator voltage regulator/rectifier over the 562F Red wire. (See Power Circuit Operation—EEC in Section 40, Group 30 for a description of the complete circuit to the battery positive terminal.) The battery sensing circuit allows the voltage regulator/rectifier to monitor battery voltage.

A rotating winding (field) in the alternator induces AC current in the alternator stator coils. The AC current flows to the voltage regulator/rectifier. The voltage regulator/rectifier converts AC current to DC current needed to charge the battery.

If battery voltage is low (sensed via the 562F Red wire), the regulator/rectifier allows DC current to flow to the battery to charge it through the battery charging circuit 0042 Red wire, Fuse F22, and 0062 Red wire. When the battery is fully charged, the voltage regulator/rectifier stops current flow to the battery.

If the alternator output current falls below system usage or is insufficient to maintain a preset voltage, the alternator/battery charging light illuminates on A01 display panel through 122 Red wires (terminals A—D on the ICC-JI connector) and the display panel circuit board.

The alternator is grounded through the mounting hardware to the engine.

If the voltage regulator is grounded to the alternator cover, the alternator produces unregulated amperage (maximum output).

Tachometer Circuit Operation—EEC

Function

To indicate engine rpm to the operator.

Operating Conditions

- Key switch in RUN position.
- Engine running.

Theory of Operation

The tachometer is integrated into the display panel and does not have any external wiring. The tachometer operates only when the engine is running. Pulsed current flows from the “P” terminal of the alternator to through the 5325 series Grn wire to A01 display panel ICC-J2 connector. When current is pulsed through the 5325 series Grn wire, the tachometer reads this input and displays the engine rpm speed.

Hour Meter Circuit Operation—EEC

Function:

To indicate engine hours of use to the operator.

Operating Conditions:

- Key switch in run position.

- Engine running.

Theory of Operation:

The hour meter is integrated into the display panel and does not have any external wiring. The hour meter operates only when the engine is running. The hour meter uses the engine tachometer circuit to indicate that the engine is running. If the tachometer is not functioning, the hour meter will not work.

Speedometer Circuit Operation—EEC

Function:

To indicate ground speed of the machine.

Operating Conditions:

- Key switch in run position.
- Engine running with machine in motion.

Theory of Operation:

The speedometer is integrated into the display panel and does not have any external wiring. The speedometer operates only when the engine is running and the machine is in motion. The speedometer uses the B33 MFWD speed sensor for a reference signal to indicate machine ground speed to the transmission control unit and then inputs this signal to the A01 display panel over the 9924 Yel and 9925 Grn series wires.

Fuel Gauge Circuit Operation—EEC

Function:

Inform the operator of the approximate fuel level in the fuel tank.

Operating Condition:

The key switch must be in run or start position.

Theory of Operation:

The fuel level in the fuel tank is measured by the B01 fuel gauge sensor. The sensor is a variable resistor. The resistance is set by movement of a float in the fuel tank. The variable resistance creates a variable voltage difference across the fuel gauge. The voltage difference ranges from approximately 3.65—3.85 VDC (fuel tank full) to approximately 1.0 VDC (fuel tank empty). The fuel gauge is part of the display panel.

PTO Circuit Operation—EEC

Function

To engage the PTO and illuminate a light on the display panel to alert the operator that the front PTO is on.

Operating Conditions

- Key switch in run or start position.
- Operator on seat, or off seat if the off seat PTO logic is activated.

Theory of Operation

The front PTO switch is used as an interlock to the fuel supply circuit as well as engaging the front PTO.

In the off (normally closed) position the PTO switch supplies current to the fuel supply circuit through the A01 display panel. If the PTO is on and the operator leaves the seat, current is removed from the fuel supply circuit unless the off seat PTO logic is activated.

With the key in start or run position, battery voltage is provided to the S03 PTO switch through the S01 key switch, 0072 Red wire, F5 fuse, and 562 series Red wires.

With the PTO on, voltage is supplied across the PTO switch (terminals 1 and 3) from the 0562 Series Red wire.

The ground circuit is provided by the 0010 Series Blk wires.

At the same time power is removed from the 4574 Yel wire which supplies current to the A01 display panel through the ICC—J3 connector (terminal H). The display panel logic reads the power being removed from this input and turns on the front PTO indicator light. Additionally, the display panel checks for the proper inputs from the other switches. If the seat switch is closed (operator on seat) then the display panel will continue to provide an output to the fuel hold-in solenoid. If the operator is off the seat, then the off seat PTO logic must be active before the front PTO switch is placed in the on position or the display panel will remove power to the fuel hold-in solenoid.

Dash Panel Module Circuit Operation—EEC

Function

→NOTE:

See vehicle’s operating manual (OM) for instrument panel operation.

To roll the LCD display between displaying speedometer, hour meter, PTO hour, PTO speed, soot levels, regen information, and diagnostic trouble code when error is active.

This switch is also used to enter the configuration mode of the display panel to configure the display to the machine and options installed.

Operating Conditions

- Key switch in run or start position

Theory of Operation

The S02 dash panel module is used to change the display messages in the LCD and to change the configuration setting of the display panel.

The turn signal buttons are used to change and enter information when the display mode button is pressed.

Switched power is supplied from the key switch, 0072 Red wire, F5 fuse, 562 Red series of wires to the dash panel module. Fused power is supplied from F16 through the 132 Red series of wires at terminals A and B. The S02 dash panel module receives all pertinent engine information from the A09 engine control unit (ECU) through 5412 Red and 5437 Pur wires at terminals F and M.

Display Panel LCD Message—EEC

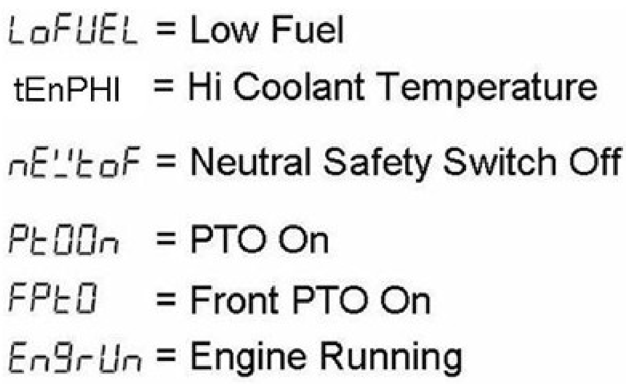
- Specific messages are displayed on the liquid crystal display (LCD) for machine operation.

LEGEND:

A LCD Display

LCD Display

- Instrument Panel LCD Display Messages



LCD Display Messages

LCD Display Messages

Representation of the Message Displayed	Description of the Message
LoFUEL	The fuel gauge needle has gone into the red zone. Appears only once during the power cycle.
tEnPHI	The coolant temperature needle has gone into the red zone. Appears only once during the power cycle.
nEUtoF	Gear Tractors - The operator is out of the seat and the transmission is in gear. HST Tractors - The neutral wire jumper cap located under the left foot deck has been removed or is loose.
PtOOn	The operator is not in the seat, the park brake was not set, and the PTO switch is on.
FPtO	The operator is not in the seat and the front PTO switch is on. (EEC only)
EnGrUn	The engine is already running and there is an attempt to start the engine.

Display Panel Operation—EEC

Function

To display operational information to the operator as to various circuit conditions, example, turn signal on, or PTO on, or fuel level, or diagnostic fault codes.

To perform logic safety interlock to control safe starting, operation and shutoff of the machine engine.

Operating Conditions

- Key switch in run or start position

Theory of Operation

The display panel is an electronic circuit board which performs various logic functions based upon input and output signals as well as being a display for the various instruments and indicator lights.

The only functions that do not provide and input to, or receive and output from the display panel are the headlights, tail lights, work lights, and fuel pump. All other electrical functions connect to the display panel for some part of their operation.

The display panel receives voltage at the ICC-J1 connector, terminals A through D, 122 series of Red wires and switched voltage at terminal D, 0562 series Red wire. This provides the voltage to power up and operate the display panel.

The display panel has a permanent ground circuit through the ICC-J1 connector terminal M, 0050 series Blk wire. The 0050 series Blk wire splices into the W01 frame ground.

The display panel operates with an IF—THEN logic where combinations of voltage inputs (IF’s) to the display panel produce combinations of output voltages and/or ground path(s) (THEN’s).

Example:

IF voltage is provided to the display panel by the key switch being in the run position, and IF the operator is on the seat;

THEN voltage is supplied to the fuel shutoff solenoid relay and fuel shutoff solenoid hold-in coil providing the requirements to keep the machine engine running.

The fuel shutoff solenoid is held in the energized state by voltage provided from the display panel. The fuel relay is initially energized, closing its contacts and providing voltage to the fuel shutoff solenoid pull-in coil. After a short delay, the display panel energizes the fuel shutoff solenoid hold-in coil circuit.

The display panel contains a 0.5 second delay timer, controlling the voltage to the fuel relay. The timer is activated if the operator rises off the seat. 0.5 seconds after the operator leaves the seat, voltage to the fuel solenoid will stop, de-energizing it, closing the fuel shutoff solenoid valve and stopping the engine.

Inputs, Outputs, and Ground

The display panel has 4 connectors (ICC-J1, ICC-J2, ICC-J3, and ICC-J4) connecting component wires to the display panel to provide the inputs, outputs, and ground. (See A1 Display Panel Signal Component Location—EEC in Group 15 Component Location for connector signal.)

→NOTE:

The results listed for each input and output, are based upon the operating conditions for that circuit being met. See the individual circuit operation for specific diagnostic procedures.

Forward Drive Circuit Operation—EEC

Function

The forward drive circuit causes the TCU to propel the machine in a controlled forward direction.

Additionally the TCU provides for setting the following functions during a forward drive:

- Maximum travel speed.
- Cruise control.
- Motionmatch (pedal responsiveness) (option).
- LoadMatch.

Each of these additional functions has the ability to be turned on or off by the operator.

Operating Conditions

- Key switch in run position.
- Engine running.
- Operator on seat.
- Park brake unlocked.
- Forward pedal depressed.

Theory of Operation

The TCU is a pre-programmed electrical device that allows the operator to control the machine forward drive function and speed via the electrical inputs from the forward foot pedal. Under normal operating conditions, this creates an output to the forward proportional solenoid in the transmission.

Current is supplied to the TCU from the unswitched and switched power circuits.

Unswitched power to the TCU is supplied from the battery, to the M01 Starting Motor, to the 0062 Red wire, F21 In-line fuse, 0002J Red wire, splice, 0002H Red wire, F19 TCU fuse, 0142 Red wire to the TCU.

With the key switch in the run or accessory position, switched power is supplied from the S01 Key Switch to 0472A Red wire, F14 ELX fuse, 4472 Red wire to the TCU. This switch is powered off when the S01 Key Switch is in the start position.

These circuits power the TCU to allow for drive control operation. The 4673A Org wire splices to the 46773G, 4673K, 4673L, 4673M, 4673N Org wires to provide current from the TCU to the P01 Forward Pedal Sensor, and the P02 Reverse Pedal Sensor.

When the forward pedal is pressed, the P01 forward pedal sensor rotates and sends voltage back to the TCU through the 4014A Yel wire. The TCU then processes the voltage from this input command into an output command if the proper operating conditions exist. The output command (current) to the forward proportional solenoid is proportional to the pedal position.

The proper conditions for a forward function will be:

- 12.0 volt input on 0142 Red wire, power on.
- 12.0 volt input on wire 0539C Wht wire, operator on seat.
- 5.0 volt output on wire 4673A Org wire, sensor power.
- Continuity to ground on 0050H Blk wire, sensor ground.
- Continuity to ground on 0550A Blk wire, HST controller ground.
- Voltage input on the 4014A Yel wire and 4625A Grn wire, forward pedal pressed.

With the proper commands, the TCU will ramp the output to the forward proportional solenoid to allow the machine to travel forward at a speed proportional to the position of the forward pedal, based upon the engine rpm and the range gear selected.

If at any time during the drive function the TCU detects a problem with any of the input or output commands, the TCU will provide output current on 924 Yel series wires to the display panel. The LCD on the display panel will then display a fault code.

Reverse Drive Circuit Operation—EEC

Function

The reverse drive circuit causes the TCU to propel the machine in a controlled reverse direction.

Additionally, the TCU provides for setting the following functions during a reverse drive:

- Maximum travel speed,
- MotionMatch (pedal responsiveness) (option).
- LoadMatch.

Each of these additional functions has the ability to be turned on or off by the operator.

Operating Conditions

- Key switch in run position,
- Engine running,
- Operator on seat, and
- Park brake unlocked.
- Reverse pedal depressed.

Theory of Operation

The TCU is a pre-programmed electrical device that allows the operator to control the machine forward drive function and speed via the electrical inputs from the forward foot pedal. Under normal operating conditions, this creates an output to the forward proportional solenoid in the transmission

Current is supplied to the TCU from the unswitched and switched power circuits

Unswitched power to the TCU is supplied from the battery, to the M01 Starting Motor, to the 0062 Red wire, F21 In-line fuse, 0002J Red wire, splice, 0002H Red wire, F19 TCU fuse, 0142 Red wire to the TCU.

With the key switch in the run or accessory position, switched power is supplied from the S01 Key Switch to 0472 Red wire, F14 ELX fuse, 4472 Red wire to the TCU. This switch is powered off when the S01 Key Switch is in the start position.

These circuits power the TCU to allow for drive control operation. The 4673A Org wire splices to the 46773G, 4673K, 4673L, 4673M, 4673N Org wires to provide current from the TCU to the P01 Forward Pedal Sensor, and the P02 Reverse Pedal Sensor..

When the reverse pedal is pressed, the reverse pedal sensor rotates and sends voltage back to the TCU through the 4677A Pur wire. The TCU then counts and processes the voltage from this input command into an output command if the proper operating conditions exist. The output command (current) to the reverse proportional solenoid is proportional to the pedal position.

The proper conditions for a reverse function will be:

- 12.0 volt input on wire 552N Red wire, power on.
- 12.0 volt input on wire 539C Wht wire, operator on seat.
- 5.0 volt output on wire 673B Org wire, sensor power.
- Continuity to ground on 550N Blk wire, sensor ground.
- Continuity to ground on 050P Blk wire, HST controller ground.
- Voltage input on the 4677A Pur wire and 4166A Blu wire, reverse pedal pressed.

With the proper commands, the TCU will ramp the output to the reverse proportional solenoid to allow the machine to travel reverse at a speed proportional to the position of the reverse pedal, based upon the engine rpm and the range gear selected.

If at any time during the drive function the TCU detects a problem with any of the input or output commands, the TCU will provide output current on wire 924 Yel series wires to the display panel. The LCD on the display panel will then display a fault code.

Section 55 - ELECTRONIC CONTROL UNITS

Table of contents

Group 05 - General References

Electronic Control Units - Summary of References

10 - Electronic Controllers

Keep Electronic Control Unit Connectors Clean

[1] -

IMPORTANT:

Keep terminals clean and free of foreign debris. Moisture, dirt and other contaminants may cause the terminals to erode over time and not make a good electrical connection.

If a connector is not in use, put on the proper dust cap or an appropriate seal to protect it from foreign debris and moisture.

[2] -

IMPORTANT:

Do not probe through the wire insulation or through the back of the connector. Do not insert items such as paper clips or wires into connector terminals.

Make measurements on a connector terminal using JDG10466 Flex Probe Kit in SERVICEGARD.

Flex Probe Kit

JDG10466

Measure connector terminal.

[3] - Observe the locking mechanism of the connector when disconnecting and reconnecting.

[4] - Do not pull on wires to disconnect.

[5] - Before reconnecting:

- Look for bent terminals; do not force connectors into each other.
- Replace any terminal where corrosion exists.
- Clean the connector of any foreign debris.
- Dry the connector of any moisture.

[6] - When reconnecting, make sure seals around the connector pairs are functional.

Approved Software for Control Units

IMPORTANT:

Avoid Damage! When reprogramming electronic control units, always comply with the relevant instructions (e.g. installation instructions, DTAC or PIP).

Do NOT reprogram the control unit if the version numbers of the new and current software are identical, or if the control unit is already programmed with a newer software version .

→NOTE:

New software always includes the properties that were newly introduced with the previous software. However, not all software versions can be used on every machine.

→NOTE:

The software for reprogramming is either supplied with the Service ADVISOR ™ data DVD, or else it must be downloaded from John Deere′s Intranet (John Deere Custom Performance (Software Delivery System)).

For the current summary of software, see PATHWAYS or DTAC.

CAN Bus Message Structure

The electronic control units consist of two elements; the electronic control unit (ECU, TCU, etc.) and interface controller. The electronic control unit is fully occupied with performing its tasks. The interface controller manages the vast amount of data that is broadcast and recalled via the CAN Bus [CAN = Controller Area Network] communication lines. The data it passes on to the electronic control unit is only the data that the control unit actually requires. The electronic control units share their monitoring, operational and display data with each other by continually “broadcasting” on the CAN Bus line. In CAN Bus systems, addresses are allocated according to the importance of the data.

In order to transmit data on the CAN Bus system, a data frame is required. The data frame consists of seven fields that follow on one from the other.

- Start signal - Indicates the start of the data frame and synchronizes all the electronic control units.
- Assignment field - Consists of identifier and control bit. The identifier indicates the priority accorded to the data. During transmission of this field, the sender checks that it has the right to transmit, or if priority should be given to another electronic control unit. The control bit indicates whether the data is a question or an answer.
- Control field - Contains information on the size of the data in the data field.
- Data field - Contains the actual data.
- Cyclic Redundancy Check (CRC) field - To recognize any errors that may occur in transmission, this field contains a CRC code name; this code name must be known by every electronic control unit.
- Acknowledgement field - Contains the acceptance signals from data that have been received without error by the various electronic control units.
- End signal - Indicates the end of the frame.

The sender (electronic control unit) initiates a data transfer by sending a data frame. However, the receiver (electronic control unit) can also request data from the sender. To do this, the receiver issues a request. Question (request) and answer both have the same identifier. The only difference lies in the control bit.

An acceptance check is carried out within the electronic control units. This means that only data with an identifier stored in a list is actually accepted by the control units. The code numbers that are otherwise required for data transmission are thus eliminated.

The identifier determines the priority with which the data is transmitted. Each electronic control unit can transmit its data, provided the CAN communication lines are free. If several want to transmit at the same time, the data sent first are the ones with the highest priority. The other electronic control units then go automatically to the "receive" mode and do not send their data until the CCD BUS communication lines are free.

If a malfunction is registered, the electronic control unit interrupts the current transmission. The electronic control units are capable of telling the difference between malfunctions that only occur occasionally and malfunctions that persist. This is achieved by making a statistical assessment of the error situation.

All the electronic control units send and receive data while the key switch is on, so the CAN communication lines are continually carrying "broadcast" data. Some is ”broadcast” more frequently than others, depending on what data it is.

A terminating resistor is located at the end of the CAN Bus communication lines. The terminating resistor is required to reduce faults in the communication lines.

Servicing Electronic Control Units

Electronic Control Unit

[1] -

IMPORTANT:

Do not open control unit and do not clean with a high pressure spray. Moisture, dirt and other contaminants may cause permanent damage.

Control units are not repairable; replace only if indicated in the diagnostic procedure.

[2] - Since control units are the components LEAST likely to fail, isolate failure before replacing by completing the diagnostic procedure.

[3] - The wiring harness terminals and connectors for electronic control units are repairable.

[4] -

IMPORTANT:

Misleading diagnostic messages and poor performance may occur if an electronic control unit is not programmed identical to the original controller.

Before putting back into service, verify the control unit is programmed identical to the original controller.

Group 10 - Theory of Operation

CAN Bus Theory of Operation

The Controller Area Network (CAN-BUS) is used to allow communication between control units on a vehicle. When the key switch is turned on, the electronic control units start to send and receive information over the CAN-BUS. Information may also continue to be transmitted by some controllers for a short time after the key switch is turned off. Some of the information is broadcast more frequently then others, depending on what the data is and which controller is sending it.

The CAN bus has a terminating resistor after the last physical controller on the bus. The terminating resistor is required to reduce faults in the communication lines.

Each control unit can send and receive digital messages to and from any other control unit via the CAN-BUS. The message sent by one control unit can be addressed to another specific control unit or broadcast for all control units to use. The receiving control units will use this information to monitor or control the machine.

In order to regulate the information being received, each electronic control unit has an interface controller built in. While the electronic control unit is fully occupied performing its own tasks, the interface controller manages the vast amount of information being broadcast on the CAN-BUS and only passes required information onto the control unit.

Diagnostic Trouble Codes (DTCs) are based on the CAN ISO and J1939 SAE Standards. These are worldwide standards for automotive and off-highway vehicles and are controlled by an ISO industry committee. There are two main parts that make up a DTC:

Group 15 - Programing and Calibrations

Programming Control Units

→NOTE:

Service ADVISOR™ allows a John Deere™ technician to manage and update embedded software in electronic control units without removal from the vehicle.

Programming Procedure

(1) Obtain Software Payload

Action:

→NOTE:

The John Deere Custom Performance™ software delivery system (SDS) is accessed via Service ADVISOR™ to update software. (perhaps because of a new dealer installed option added, a Product Improvement Program [PIP], a control unit replacement, a control unit software improvement).

IMPORTANT:

The following instructions are general instructions for connection and software payload download. Always follow procedures and pop-up directions from the SDS site or installation instruction "Download Software Payload" (PC20380).

1. Access Service ADVISOR™ from an office computer that has internet access.
2. Select the "Connect to Deere Network" tool bar button (icon of a laptop computer and globe).
3. Connect to the network using a Deere supplied RACF User ID and password.
4. Once connected to the Deere Network, select the John Deere Custom Performance™ site.
5. Enter one of the following numbers in the serial number field:· Vehicle Identification Number (VIN—alpha-numeric)· Product Identification Number (PIN)· Engine Serial Number (ESN)· Product Improvement Program (PIP) number

   →NOTE: Before programming a control unit on a vehicle, it is important to download the current versions of the payload onto Service ADVISOR™. Payload files contain Controller or Control Unit name, Payload name, Payload Version, Date Created, and Expiration date. A software payload file is a proprietary John Deere™ file containing all the data and programs required to program control units.

6. Select the current payload for the specific control units. NOTE: The software payloads can be downloaded from SDS onto Service ADVISOR™ in any order.
7. Download the selected control unit software payloads to Service ADVISOR™.

→NOTE:

The programming process creates a return file that details the status of the last control unit programming event. The file is automatically sent to the SDS website the next time Service ADVISOR™ is connected to the internet.

Result:

YES:GO TO 2.

NO: Reconnect and try download again.

NO: Contact SDS website administrator.

(2) Program Control Unit

Action:

IMPORTANT:

Specific instructions and illustrations are available in the Service ADVISOR™ HELP menu or the installation instructions with a kit.

1. Turn key switch to OFF position.
2. Connect the replacement control unit to the vehicle wiring harness.

    →NOTE: Only one unprogrammed flex box control unit at a time can be on the CAN (Controller Area Network) bus or it will error out.

3. Connect Service ADVISOR™ to vehicle.
4. Turn key switch to RUN position (engine OFF).
5. Select ”Program Controller” in Service ADVISOR™.
6. Upload the software payloads to the vehicle control units one at a time.
7. Configure the control unit diagnostic addresses according to the options on the vehicle.

    →NOTE: When control units are reprogrammed, new addresses may be made available; such addresses may be altered. Options are learned through the returned file to SDS. If an option is set through software download and the corresponding hardware is not on the vehicle, there could be an error code generated. Conversely, if hardware has been installed and software was not configured for it, the optional hardware would not work. Also, there may not be any error codes.

8. Turn key switch to OFF position for at least 30 seconds.
9. Turn key switch to START position (engine ON), run vehicle in park, at low idle.

    →NOTE: Programing may generate diagnostic trouble codes which must be cleared.

10. Calibrate the control units as necessary.
11. Confirm vehicle operation.
12. Repeat steps 1 through 12 for the next control unit.

Result:

YES: Programming complete

NO: See Troubleshooting Control Unit Programming .

Rolling Tire Circumference—Calibration

Reason:

To configure the display logic to match the circumference of the tires installed.

Equipment:

- Measuring device to measure up to 50 meters accurately.
- Functioning machine with a fully charged battery.
- At least 50m (54.68 yd) of open space to drive the machine in a straight line.

Procedure:

The following steps are used to read or modify the configuration parameters for the circumference of the rear tires.

[1] -

→NOTE:

The default tire size value is 2972 mm. This procedure will use the default value in all the examples. The actual value for the tires installed on the machine may vary.

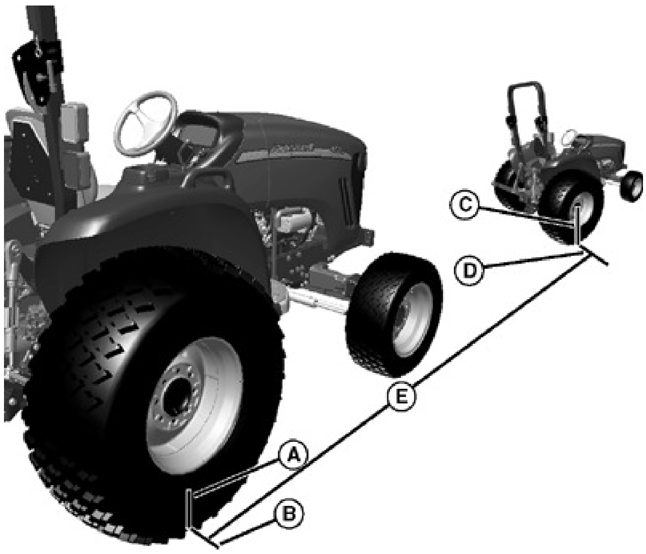
The tire size configuration value is measured and entered in millimeters.

Set rear tire pressure to specification for the type of tire installed on the machine. Be sure to use an accurate low pressure gauge. Be aware that no two tires will have the exact same circumference at the same air pressure—this is normal. Ordering new tires will not correct this situation.

[2] - Move machine to an open, flat level surface at least 50m (54.68 yd) long to drive the machine in a straight line.

[3] - Stop engine and lock park brake.

[4] -



LEGEND:

A	Tire Center Point Of Ground Contact
B	Start Ground Mark
C	10 Revolutions And The Tire
D	End Ground Mark
E	Distance Of Travel

Editing Tire Size

Mark the tire at the center of the point where it contacts the ground (A). Mark the ground at this same point (B).

[5] - Start the engine and drive the machine slowly forward until the rear tire completes 10 revolutions and the tire mark is centered on the ground again (C).

[6] - Stop engine and lock park brake.

[7] - Mark the ground at the new tire center point (D).

[8] - Measure the distance (E) between the two ground points (B and D). Divide this measurement by 10. This number is the circumference of the rear tires. The default value is 2972 mm.

[9] - Enter Diagnostic Mode 1, See Entering Diagnostic and Calibration Modes .

[10] - Access PTH—24 Wheel Circumference (power train hydrostatic transmission) or PTR—100 Wheel Circumference (power train reverser transmission).

[11] - Enter the tire circumference value calculated earlier in this procedure. See Address Edit Mode (input or calibration parameter) in Entering Diagnostic and Calibration Modes .

Power Train Hydrostatic (PTH) Control Unit—System Calibration

Reason:

To calibrate the TCU when the following conditions exist:

- Transmission drive coil has been changed.
- TCU has been changed.

Test Conditions:

- Machine on jack stands
- Operator on seat
- Range transmission in A position
- Park brake unlocked
- Engine running at low idle

Procedure:

[1] -

CAUTION:

Avoid Injury! The wheels will spin during the calibration process. Be certain that all four wheels are safely supported by jack stands and that all other persons and objects are clear of the wheels.

→NOTE:

Be sure the wheels can spin freely as the calibration process cannot detect any resistance that may be present. This will result in faulty calibration results.

Verify that both the high and low engine rpm are set to specification before starting calibration.

[2] - Place the machine on jack stands and unlock park brake.

[3] - With an operator on the seat, set the range transmission to gear range A, and disengage the MFWD.

[4] - Place the cruise control switch in the off position.

[5] -

→NOTE:

The password is different for each access mode. R = Right and L = Left on the turn signal switch.

Start and run the engine at low idle. The engine has to run during the entire calibration routine.

[6] - Enter password, LLLRLR to enter the PTH controller into calibration mode.

[7] - "Cal OFF" is displayed. When "Cal OFF" is displayed, momentarily pressing the display mode switch will cancel the calibration mode.

[8] - Use left or right turn signal switch to change the display info to "Cal ON".

[9] - When "Cal ON" is displayed, momentarily press display mode switch.

[10] - Along with address 007, the following info will be displayed prompting for action from the operator. In case of an error while calibrating, "Err" is displayed.

Diagnostic Mode 3 Calibration Table (eHydro eHydro ™ only):

Display Info	Description
E-SPD	Shows that Engine Speed needs to be Low Idle
FPEDAL	Forward Foot Pedal Sensor
release	Means “Release Pedal”
RPEDAL	Reverse Foot Pedal Sensor
release	Means “Release Pedal”
THROTL	Transition throttle from LOW to FULL/HIGH
E-SPD	Shows that Engine Speed needs to be High Idle
F_COIL	Forward Valve Coil
release	Means “Release Pedal”
R_COIL	Reverse Solenoid Valve Coil
release	Means “Release Pedal”
DonE	Done

[11] - The LCD display will display which sensor has to be calibrated next, beginning with the one for the forward pedal. As soon as a sensor is calibrated properly the corresponding code will disappear and the next code in the calibration sequence will be displayed.

[12] - When the LCD display reads “E-SPD”, verify engine is at low idle.

[13] - When the LCD display reads “FPEDAL”, press and hold the forward pedal to the full speed position until LCD shows “release”.

[14] - When the LCD display reads “RPEDAL”, press and hold the reverse pedal to the full speed position until LCD shows “release”.

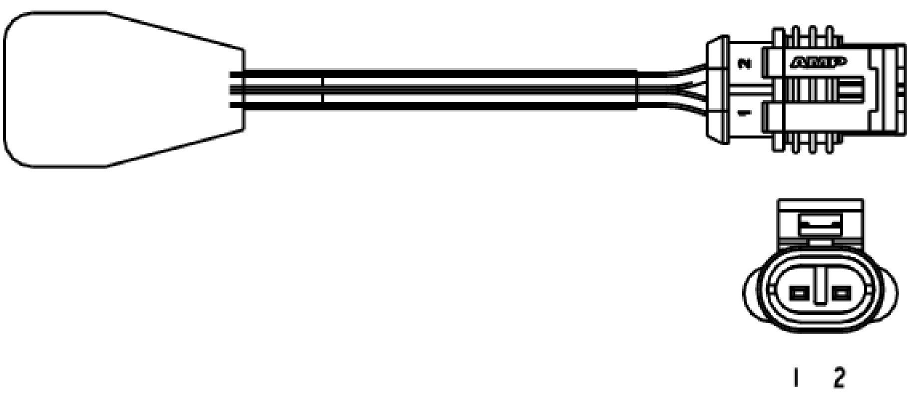
[15] - When the LCD display changes to read “F_COIL”, press and hold the forward pedal to the full speed position until LCD shows “release”.

[16] - When the LCD display changes to read “R_COIL”, press and hold the reverse pedal to the full speed position until LCD shows “release”.

[17] - When the calibration process has been successfully completed, the word “DonE” is displayed for about 2 seconds to finish calibration. When display changes to CAL, press the display mode switch to enter normal display mode.

Group 20 - Test and Adjustments

CAN Bus Terminator Test



CAN Resistor

Reason

To determine the resistance value of the CAN Bus terminator pigtail.

Equipment

- JDG1478—Digital Multimeter
- JDG10466—Flex Probe Kit

Procedure

[1] - Park machine safely. See Park Machine Safely .

[2] - Disconnect negative (—) battery cable.

[3] - Unplug the CAN connector from the harness.

[4] - Using a digital multimeter, check terminals 1 and 2 of the pigtail connector and compare to specification.

Item	Measurement	Specification
A911 CAN Terminating Resistor Connector	Resistance	121 ± 2 Ohms at 20 °C (68 °F)

→NOTE:

Readings are affected by meter accuracy and test lead resistance.

Results

- If, after accounting for equipment tolerances, the reading is not within specification, replace the terminator pigtail.

System Address Beep Test

Status/Beep Address

→NOTE:

See Control Unit Addresses—Access .

→NOTE:

Required tools:

1. **JDG1478—Digital Multimeter**
2. **JDG10466—Flex Probe Kit**

(1) Address Description

Action:

This system diagnostic (BEEP) mode can help with diagnosis in the following ways:

- Verify operation of components that are part of the control unit circuit.
- Help find instrument, harness, and connector problems.

Whenever a change in instrument operation is detected, the warning signal sounds, indicating a change in state.

→NOTE:

A “change in state” would be a switch going from open to closed or closed to open.

This audible signal verifies correct operation of a switch by sounding when the switch changes state (OFF to ON position). It also identifies a possible switch or circuit malfunction by not sounding when a switch status is changed.

The audible signal can also be used to check for connector and harness defects by moving a harnesses or connectors while in the BEEP mode. If a “beep” is heard, the display shows the address number of the circuit that caused the “beep”.

Result:

YES:GO TO 2.

(2) Operate Beep Mode Supported Controls

Action:

Operate the beep supported control and listen for a “beep” to sound when the mode is selected. Observe an address number displayed when the control is activated.

Result:

YES: To check other Beep Mode supported functions:GO TO 3.

NO: If no “beep” is heard, or address is displayed when a component is operated, access the address for that component to check for proper operation.

(3) Harness / Connection Check

Action:

For circuits that support the diagnostic “beep” modes but do not have controls that can be operated, but are sensing and monitoring circuits that the controller uses to activate system alert and / or status indicators.

If a certain circuit is creating intermittent problems, the diagnostic “beep” mode at address 002 can be used to check for intermittent malfunctions in harnesses or connectors.

Tugging on or moving connectors and / or harnesses while at address 002 may reveal a poor circuit or connection if the warning signal sounds.

Result:

YES:GO TO next address required or return to diagnosis.

NO: If a beep indicates a harness or connection problem, use a digital multimeter to check harness leads and connector terminals. Repair as needed. GO TO next address required or return to diagnosis.

CAN Network Voltage Checks

→NOTE:

These procedures should be followed in sequence until the problem is resolved.

Reason:

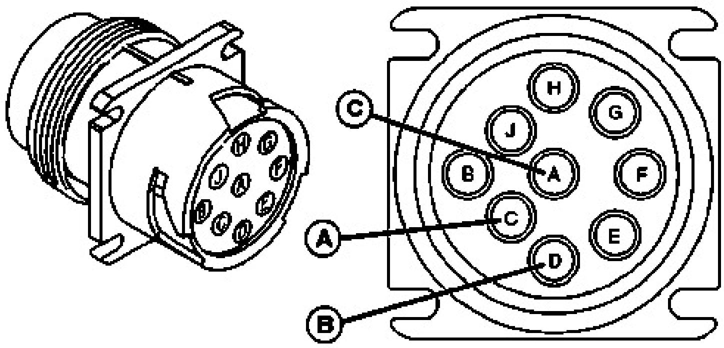
To check the CAN Hi (+) and CAN Lo (-) signals for proper voltage.

Equipment:

- Multimeter

Check for proper voltage:

[1] - Turn key to on position (engine off).



LEGEND:

A	CAN Hi
B	CAN Lo
C	CAN Ground

Check for proper voltage

[2] - Use a multimeter to measure CAN Hi (A) and CAN Lo (B) voltages at the Service ADVISOR ™ diagnostic connector.

[3] - Correct readings (desired):

a. CAN Hi: 2.50 - 3.50 V
b. CAN Lo: 1.50 - 2.49 V

[4] - Incorrect readings:

a. One or both voltages above 5 V.
b. One or both voltages below 1 V.
c. CAN Hi and CAN Lo voltages are equal.
d. Voltages out of specification but between 1 - 5 V.

Ground Checks:

[1] - Turn key to off position.

[2] - Locate and remove passive terminator.

[3] - Check resistance to ground (C).

[4] - Resistance should be less than 1 ohm.

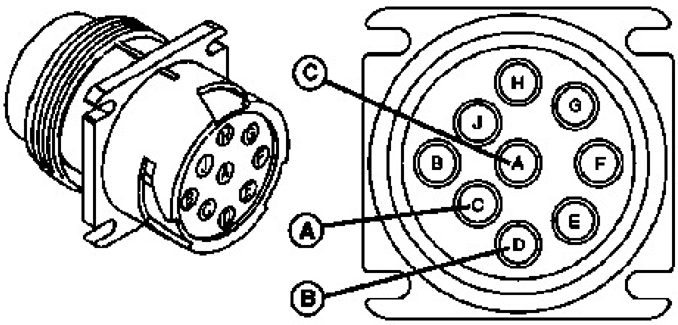
Check for Short Circuits to CAN Hi and CAN Lo:

[1] - This check should only be performed if the previous checks of CAN Hi and CAN Lo indicated:

a. Voltage at or near battery voltage.
b. Voltage above 5 volts and ground checks OK.
c. Voltage below 1 volt.
d. Voltages of CAN Hi and CAN Lo were equal.

[2] - Verify all connectors and terminators are connected.

[3] - Turn key switch to RUN position (engine OFF).



LEGEND:

A	CAN Hi
B	CAN Lo
C	CAN Ground

Check for Short Circuits to CAN Hi and CAN Lo

[4] - Use a multimeter to measure CAN Hi (A) and CAN Lo (B) voltages at the Service ADVISOR ™ diagnostic connector, from CAN ground (C) to CAN Hi and CAN Lo. Record values.

[5] - Remove CAN passive terminator.

[6] -

→NOTE:

Voltage higher than 5 V on either CAN Hi or CAN Lo indicates a short to high voltage. Voltage lower than 1 V indicates a short to ground. If CAN Hi and CAN Lo are equal, they could be shorted together.

Check for a change in voltage on CAN Hi and CAN Lo from value recorded. If voltage changed, replace passive terminator.

Compare CAN Hi and CAN Lo Voltages:

→NOTE:

The CAN bias voltage is 2.5 V. To evaluate the CAN Hi and CAN Lo circuits, the voltage recorded for each must be calculated in reference to this bias.

[1] - To calculate CAN voltage bias differential where X=CAN Hi voltage and where Y=CAN Lo voltage and:

a. CAN Hi: Recorded voltage - 2.5V=X
b. CAN Lo: 2.5V - Recorded voltage=Y

[2] - Compare results from CAN Hi and CAN Lo calculations. Values must be within 35% of each other. Use the following table to evaluate:

CAN Hi and CAN Lo Voltages Results

CAN Hi Result (X)	CAN Lo Result (Y)
0.1V	0.06 - 0.14
0.2V	0.13 - 0.27
0.3V	0.21 - 0.4

CAN Hi Result (X)	CAN Lo Result (Y)
0.4V	0.26 - 0.54
0.5V	0.33 - 0.67
0.6V	0.39 - 0.81
0.7V	0.46 - 0.94
0.8V	0.52 - 1.0
0.9V	0.59 - 1.0
1.0V	0.65 - 1.0

[3] - If results are within acceptable limits according to table:

a. CAN differential voltage is OK.

[4] - If results are not within acceptable limits according to table:

a. CAN Hi result approximately 2X CAN Lo result. Loss of CAN Lo between controller and passive terminator.
b. CAN Lo result approximately 2X CAN Hi result. Loss of CAN Hi between controller and passive terminator.

Voltages Within Range but Out of Specification:

Perform the following until voltages are within specification:

[1] - Check voltages at Service ADVISOR ™ diagnostic connector after each of the next steps. (Turn key switch to the OFF position when removing fuses or disconnecting control units and to the RUN position (engine OFF) when measuring voltages.)

a. One at a time, remove fuse or connector supplying power to each control unit and repeat voltage checks.
b. One at a time, disconnect all connectors at each control unit and repeat voltage checks.
c. Results:
d. If removing fuse to any control unit causes voltage to come within specification, check CAN Hi and CAN Lo, power and ground circuits to control unit. Replace control unit if circuits check OK.If removing fuse did not cause voltage to return to normal but disconnecting control unit resulted in voltage within specification, replace control unit.

[2] - Replace or test passive terminator.

[3] - With key switch off terminator removed, perform continuity checks on all CAN bus circuits.

CAN Communication Fault Checks

Reason:

To check the physical integrity of the CAN bus.

Equipment:

- Multimeter

Procedure:

→NOTE:

CAN related DTCs (SPN/FMI 20xx.09) usually indicate a physical problem with the CAN bus, a failed controller, or a controller that has lost it's power or ground circuits.

There are several CAN bus error conditions that may exist. Find the one that best describes the situation:

- Condition 1: More than one control unit function reports one missing message' 20xx.09 code.
- Condition 2: One or more control unit functions that should be displaying in Service ADVISOR ™ or on the ICC display do not appear. There may or may not be associated missing message' codes.
- Condition 3: More than one control unit reports multiple missing message' 20xx.09 codes.
- Condition 4: Only one unit displays multiple missing message' 20xx.09 codes.

→NOTE:

Intermittent missing message' DTCs can be caused by excessive CAN bus traffic as well as poor connections or failing wiring. It may be necessary to simulate field conditions by moving suspect wiring around or putting mild strain on connections.

Condition 1:

→NOTE:

It is rare for multiple control units to display only one missing message code without another component DTC to be present as well.

Disconnect CAN connector from all affected controllers and check continuity of CAN Hi and CAN Lo between controllers.

Condition 2:

→NOTE:

Control units only display missing messages' DTCs from other control units required for their operation. Therefore, some control units may be missing but not generate a code from other control units. Some control units may not appear as missing if they are not present on the network upon start-up.

[1] - If entire control unit is missing, check power and ground circuits for that controller.

[2] - If control unit is present but messages missing, disconnect CAN connector from control unit and check CAN Hi and CAN Lo continuity between suspect controller and controller reporting error.

[3] - If entire control unit is missing and using Service ADVISOR ™ , check can bus continuity between affected controller and diagnostic interface.

[4] - If a component based error (i.e. Left Marker Light Open) should be displayed and isn't, troubleshoot affected component circuit.

[5] - If control unit is missing using ICC, disconnect CAN connector from control unit and check CAN Hi and CAN Lo continuity between suspect controller and ICC.

Condition 3:

[1] - Disconnect CAN connector from all affected controllers and check continuity of CAN Hi and CAN Lo between controllers.

[2] - Check power and ground circuits to all affected control units.

[3] - Possible erroneous code(s). See Erroneous Diagnostic Trouble Codes .

Condition Suspect 4:

Suspect bad CAN wiring to reporting controller. Disconnect CAN connector from all affected controller and check continuity of CAN Hi and CAN Lo between reporting controller and closest CAN connector.

Troubleshooting Electronic Controllers

→NOTE:

This reference is a guideline for troubleshooting problems that still exist after standard diagnostics have been performed. These problems are typically due to specific operating conditions, intermittent failures or, in rare cases, control unit failures. Depending on the situation, some or all of the following may be important.

Problems Due to Specific Operating Conditions:

Review all recorded codes and consult with operator to determine operating and vehicle conditions when the problem occurs. Record details.

- Does code/problem occur at the same time as other problems?
- Does code/problem occur when vehicle is warm or cold?
- Does code/problem occur during field or transport operation?
- Does code/problem occur while performing a specific action such as shifting, turning, braking, operating certain hydraulics?
- When did code/problem first appear? Was there any maintenance performed recently? (If yes, inspect areas of maintenance for inadvertent damage or improper installations.)

Attempt to recreate code/problem based on conditions. If possible, repeat operational, system, electrical, hydraulic or mechanical checks under these conditions.

Problems Due to Intermittent Electrical Failures:

→NOTE:

Electrical intermittent failures are usually caused by harness, terminal or connector problems.

- Inspect all connectors and terminals of related circuits.
- Inspect mechanical linkages for interference with harnesses or connectors.
- Inspect harnesses for missing or improperly installed clamps or bands. Loose harnesses that are allowed to move too freely or harnesses that are banded too tightly may result in worn or damaged wires.
- Inspect mechanical linkages for proper operating condition.

Problems Due to Control Unit Failures:

→NOTE:

Before replacing control unit, review all tests. Control units are the least likely cause of failure!

- If all checks have been made with no problems identified, check power and ground circuits. Power inputs must be within 1 V of battery voltage and ground circuits must be less than 1.0 ohm to the vehicle single point ground.
- Inspect all connectors and terminals of associated control units.

Troubleshooting Control Unit Programming

→NOTE:

This reference is a guideline for troubleshooting problems during the programming of a control unit. If any diagnostic trouble codes are present, diagnose them before performing this trouble shooting procedure.

The following step should be performed to determine the cause of a programming issue:

1. Verify batteries are fully charged during programming sessions. During the programming session, try to reduce draw on batteries by turning off unnecessary accessories (blowers, lights). A battery charger may be needed.
2. Verify EDL is connected to laptop and vehicle. Verify that the green light is on, and orange light turns on when programming is attempted.
3. Verify Service ADVISOR ™ is running the latest version.
4. Disconnect all diagnostic cables from EDL, Service ADVISOR™, and tractor. Start tractor and run for approximately 5 minutes. Shut tractor off. Connect cables to tractor and Service ADVISOR™ and attempt programming sequence again.
5. If available, try another laptop and EDL.

   →NOTE: This step is only valid for an existing control unit, new control units are shipped blank and cannot be accessed live until they are programmed.

   Attempt to make a live connection to verify if CAN communications are working properly.

7. If live connection to control unit cannot be established, check to see if there is power and ground to the control unit and the control unit is powering up.
8. Check the following pins on Service ADVISOR™ connector for corresponding voltages:
   - Pin G to A—2.5 V
   - Pin F to A—2.5 V
   - Pin D to A—2.5 V
   - Pin C to A —2.5 V
   - Pin B to A—12 V
9. Perform CAN Network Voltage Checks .
10. Unplug each CAN-bus component one at a time to determine if it is interfering with communication. Examples may include PV-101 Murphy diagnostic gauge, after market, and/or AMS components (receiver, GS2 display) from the engine/vehicle as this may tie up or prevent CAN Communication from the EDL and control unit. Attempt to program the control unit again

If all steps above have been followed and control unit cannot be programmed, load DTAC case and attach log files using the following procedure:

1. Go to desktop on Service ADVISOR™
2. Double click on “My Computer” icon located in upper left-hand corner of screen, click “computer” in the start menu.
3. Double click on “Local Disk (C:)
4. Double click on “sds” folder
5. Double click on “logapp” folder

   →NOTE: Note: There may be more than one log file shown in the “logapp” folder. Example: JDCommonLoader.log JDCommonLoader_1.logSelect file that has latest “Date Modified.” If “Date Modified” is not displayed in folder, this can be found by placing mouse cursor on file without clicking mouse buttons. Latest date listed is the latest attempt at programming control unit.

   Under “logapp” folder, access the following files:
   - JDCommonLoader.log,
   - JDPayloadProcessor.log
   - ECULP_DL_DEALER.log.

7. Open DTAC case and attach CommonLoader.log & JDPayloadProcessor.log to case file.

Troubleshooting Unresolved Problems

→NOTE:

This reference is a guideline for troubleshooting problems that still exist after standard diagnostics have been performed. These problems are typically due to specific operating conditions, intermittent failures or, in rare cases, control unit failures. Depending on the situation, some or all of the following may be important.

Problems Due to Specific Operating Conditions

Review all recorded codes and consult with operator to determine operating and vehicle conditions when the problem occurs. Record details.

1. Does code/problem occur at the same time as other problems?
2. Does code/problem occur when vehicle is warm or cold?
3. Does code/problem occur during field or transport operation?
4. Does code/problem occur while performing a specific action such as shifting, turning, braking, operating certain hydraulics?
5. When did code/problem first appear? Was there any maintenance performed recently? (If yes, inspect areas of maintenance for inadvertent damage or improper installations.)

Attempt to recreate code/problem based on conditions. If possible, repeat operational, system, electrical, hydraulic or mechanical checks under these conditions.

Problems Due to Intermittent Electrical Failures

→NOTE:

Electrical intermittent failures are usually caused by harness, terminal or connector problems.

1. Inspect all connectors and terminals of related circuits.
2. Inspect mechanical linkages for interference with harnesses or connectors.
3. Inspect harnesses for missing or improperly installed clamps or bands. Loose harnesses that are allowed to move too freely or harnesses that are banded too tightly may result in worn or damaged wires.
4. Inspect mechanical linkages for proper operating condition.

Problems Due to Control Unit Failures

→NOTE:

Before replacing control unit, review all tests. Control units are the least likely cause of failure!

1. If all checks have been made with no problems identified, check power and ground circuits. Power inputs must be within 1 V of battery voltage and ground circuits must be less than 1.0 ohm to the vehicle single point ground.
2. Inspect all connectors and terminals of associated control units.

Group 25 - Diagnostic Addresses

Control Unit Addresses—Access

General Information

Addresses are divided by the following display types:

- **Status:** Indicates that the address parameter is for viewing status only. No parameter editing is available for that address.
- **Beep:** Indicates the address parameter is for status display and generates an audible beep when the displayed parameter value changes.
- **Configuration:** Indicates that address parameter allows status viewing and parameter editing is available for that address in diagnostic mode 1.
- **Calibration:** Indicates that address parameter allows status viewing and parameter editing is available for that address in diagnostic mode 1.

→NOTE:

Access can be gained with engine running or engine not running.

Addresses can be accessed using the following methods:

- Service ADVISOR™
- Instrument Control Cluster (ICC)
- Performance Monitor

Service ADVISOR™ Addresses Access

Access addresses through ”Connections-Readings”, ”Calibrations”, and ”Interactive Tests”.

Instrument Control Cluster (ICC) Addresses Access

The following modes can be accesses through the instrument cluster control (ICC) on-board diagnostics:

- Diagnostic Mode 1—Diagnostic Addresses Mode
- Diagnostic Mode 2—Diagnostic Trouble Codes Mode
- Diagnostic Mode 3—Calibration Mode

To enter diagnostic modes, see Entering Diagnostic and Calibration Modes

Performance Monitor Addresses Access

LEGEND:

A	Performance Monitor
B	Test Harness
C	Service ADVISOR Connector

Connect Performance Monitor

1. Connect test harness (B) to performance monitor (A).
2. Turn key switch to ON position.

   →NOTE: The performance monitor automatically performs a self test and a bulb check (which takes about 2 seconds) once connected to the Service ADVISOR™ Connector.
   →NOTE: The performance monitor receives its power via the Service ADVISOR™ connector from the battery positive terminal, not via the key switch.

   Connect test harness (B) to the Service Advisor Connector (C).

4. Performance monitor general operating instructions:

LEGEND:

A	Up Button
B	Next Button
C	Set/Save Button
D	Down Button
E	Clear Button
F	Service Button

Performance Monitor

→NOTE: The next button (B) is only used during the hitch interactive calibration.

General Operating Instructions

General Operating Instructions	
Entering diagnostic mode	Press and hold the service button (F) until DIA appears on the screen.
Selecting control units	Press the up button (A) or the down button (D) to scroll through the list of control units.
Confirming control units	Press the set/save button (C) once the desired control unit is displayed.
Leaving the control unit	Press the clear button (E) to return to the list of control units.
Selecting addresses (in increments of 1)	Momentarily press the up button (A) or the down button (D).
Selecting addresses (in increments of 10)	Press and hold the up button (A) or the down button (D).
Access an input address (Tech or INP)	Press the set/save button (C). The value then begins to flash.
Key in information (data within addresses)	Press the numbered buttons.
Saving information	Press the set/save button (C). The value will stop flashing.
Aborting a procedure	Press the clear button (E).
Starting a calibration process (CAL)	See ECU, TCU, ICC group in this section.
Clearing the diagnostic trouble codes	After CLR? is displayed, press the set/save button (C).

5. Performance monitor display

LEGEND:

A Controller ID (when viewing DTCs) or Address Number (when scrolling through the list of addresses)

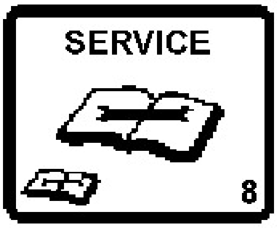
B First Three Figures of Displayed Information (if the displayed information contains more than 5 characters)

C Displayed Information

Performance Monitor Screen

The top row on the display is divided by a colon.The three figures at the left of the top row show the control unit ID (A), if in address number 1 (Diagnostic Trouble Codes). Otherwise, these three figures show the address number. If it is an input address, the display alternates between the address and ”INP”.If it is a calibration address, the display alternates between the address and ”CAL”.Displayed Information (C) is shown on the bottom line. If five figures are not enough, the first three figures of displayed information (B) are placed in the top right corner.

6. Diagnostic Mode



LX1026536

Performance Monitor—Entering Program Mode

There are two different entry modes in the diagnostic mode: operator mode and technician mode. All diagnostic trouble codes and addresses can be accessed with the engine on or off and with the tractor in park or in motion. **Operator Mode:** On this level, all the diagnostic trouble codes and operator accessible addresses are displayed. nbsp; The operator is restricted from viewing technician (TECH) addresses. The key switch must be on before connecting the performance monitor to the Service ADVISOR™ connector.Connect the performance monitor to the Service ADVISOR™ connector and wait a minimum of 5 seconds before pressing the service button. Hold the service button until the display changes to DIA.**Technician Mode:** On this level, all the diagnostic trouble codes and operator or technician accessible addresses are displayed. nbsp; The operator is restricted from viewing technician (TECH) addresses Turn the key switch to OFF position.Turn the key switch back to ON before connecting the performance monitor to the Service ADVISOR™ connector.

→NOTE: If the service button is not pressed within 5 seconds, the operator mode is automatically selected.

Connect the performance monitor to the Service ADVISOR™ connector and within 5 seconds press and hold the service button.Hold the service button until the display changes to DIA.

Entering Diagnostic and Calibration Modes

[1] - Turn the key switch to ON position.

[2] -

→NOTE:

Once the display mode switch is depressed, the password must be started to be entered within 2 seconds. The password must be completed within 30 seconds of starting.

Make sure that no error codes are displayed. If any errors are displayed, momentarily activate the display mode switch to acknowledge the error.

[3] - Press and hold the display mode switch. Within 2 seconds, start entering the password using Left and Right turn signal switch.

[4] - Press and hold the display mode switch for 2 seconds or turn the key switch to OFF position to exit any of the modes.

Diagnostic Mode 1:

→NOTE:

The password is different for each access mode. R = Right and L = Left on the turn signal switch.

Address View Mode

[1] - Enter password, RLLRLR to access diagnostic mode 1.

[2] -

→NOTE:

The diagnostic values are displayed live. The values displayed will change if the components for the item selected are changed. Example, when the forward pedal voltage is displayed, if the forward pedal is pressed, the voltage reading on the display will change also.

In this mode, Display controller communicates with the controller to get the parameters as listed in the readings table.

[3] - Use left or right turn signal switch to navigate through the parameters.

Address Edit Mode (configuration or calibration parameter)

→NOTE:

The parameter address and the parameter data will alternatively display when in view only mode. Once a parameter is selected for editing the least significant parameter data value will begin to flash, indicating the value can be edited.

[1] - Enter Diagnostic Mode 1 and navigate to desired address for editing.

[2] - Activate and deactivate the hazard switch in 2 seconds or less to enter address edit mode for selected address.

[3] - Push the right turn switch to change the flashing digit value.

[4] - Push the left turn switch to scroll to the next parameter value.

[5] - Push the display mode switch to return to exit address edit mode and return to address view mode.

Diagnostic Mode 2:

[1] - Enter password, LRRRLR to access diagnostic mode 2.

[2] - This mode displays the error code SPN.FMI number. If no codes are present, NONE will be displayed.

[3] - Use left or right turn signal switch to navigate through the codes. Codes can be cleared by scrolling with the right turn signal. After the last code is displayed, the following will options will appear:

- ClrN
- ClrY

Press the display button ClrY to clear codes and exit diagnostic mode 2.

[4] - Press ClrN to exit diagnostic 2 mode without clearing codes.

Diagnostic Mode 3 - System Calibration:

Enter password, LLLRLR to access diagnostic mode 3. The system calibration routine provides for the required machine set-up to factory specifications. It leads step by step through the calibration process of the inputs from the forward pedal sensor, reverse pedal sensor, and throttle sensor, as well as the forward and reverse coil outputs. The system calibration mode is used to match the sensors and coils to the electronic drive controller (see Power Train Hydrostatic (PTH) Control Unit—System Calibration .

Diagnostic Addresses—Power Train Hydrostatic (PTH) Controller

NOTE: The tractor must be in diagnostic mode 1 (RLLRLR) for reading or editing control unit addresses. For more information on accessing control unit address or editing address parameters, see Entering Diagnostic and Calibration Modes .

PTH Diagnostic Addresses

Number	Type	Address Name	Function or Control	Display or Range
PTH—000	Status	Initial Address	Control Unit Addresses—Access	
PTH—001	Status	Recall Trouble Codes	Recall, Record, and Clear Codes	
PTH—002	Status/Beep	System Beep Address	System Address Beep Test	
PTH—003	Status	Cruise Resume/Accelerate Switch Status	Edit Address See Entering Diagnostic and Calibration Modes	0XXXXX=Off 1XXXXX=On 2XXXXX=Unknown
		Cruise Set/Decelerate Switch Status	Edit Address See Entering Diagnostic and Calibration Modes	X0XXXX=Off X1XXXX=On X2XXXX=Unknown
		Maximum Speed On/Off Switch Status	Edit Address See Entering Diagnostic and Calibration Modes	XX0XXX=Off XX1XXX=On XX2XXX=Unknown
		Cruise On/Off Switch Status	Edit Address See Entering Diagnostic and Calibration Modes	XXX0XX=Off XXX1XX=On XXX2XX=Unknown
		Auto-Throttle Switch Status	Edit Address See Entering Diagnostic and Calibration Modes	XXXX0X=Off XXXX1X=On XXXX2X=Unknown
		LoadMatch Switch Status	Edit Address See Entering Diagnostic and Calibration Modes	XXXXX0=Off XXXXX1=On XXXXX2=Unknown
PTH—004	Configuration	MotionMatch™ Switch option	Edit Address See Entering Diagnostic and Calibration Modes	1X=Enabled, No Switch Installed 2X=Enabled, Rotary Position Switch Installed
		LoadMatch™ Switch option	Edit Address See Entering Diagnostic and Calibration Modes	X1=Not Installed X2=Installed
PTH—005	Configuration	LoadMatch™ Switch (Software)	Edit Address See Entering Diagnostic and Calibration Modes	XXXXXXX
PTH—006	Configuration	MotionMatch™ Setting	Edit Address See Entering Diagnostic and Calibration Modes	XXXXXXX
PTH—007	Status	Operating/Calibration Status	Control Unit Data	XXXXXXX
PTH—008	Status	Operation Present Switch Status	Control Unit Data	0=Off 1=On
PTH—009	Status	Brake Switch Status	Control Unit Data	0=Off 1=On
PTH—010	Status	MotionMatch™ Switch Input Status	Control Unit Data	0=Off 1=On
PTH—011	Status	Cruise Active	Control Unit Data	0=Inactive 1=Active
PTH—012	Status	Cruise Setpoint	Control Unit Data	XXXX
PTH—013	Status	Cruise Error	Control Unit Data	XXXX=dekameter
PTH—014	Configuration	Hitch Assist Option	Edit Hitch Assist Option Address See Entering Diagnostic and Calibration Modes	1=Not Installed 2=Installed
PTH—015	Configuration	Engine Type	Edit Engine Type Address See Entering Diagnostic and Calibration Modes	0=MFI 1=EFI
PTH—016	Configuration	Engine Speed	Edit Engine Speed Address See Entering Diagnostic and Calibration Modes	XXXX=RPM
PTH—017	Calibration	Calibrated Low-Idle Engine Speed	Edit Calibrated Low-Idle Engine Speed Address See Entering Diagnostic and Calibration Modes	XXXX=RPM
PTH—018	Calibration	Calibrated High-Idle Engine Speed	Edit Calibrated High-Idle Engine Speed Address See Entering Diagnostic and Calibration Modes	XXXX=RPM

Number	Type	Address Name	Function or Control	Display or Range
PTH—019	Status	Engine Speed Set Point	Control Unit Data	XXXX=RPM
PTH—020	Status	MFWD Speed Sensor Output	Control Unit Data	XXXX=dekameter
PTH—021	Status	MFWD Sensor Pulses per Axle Revolution	Control Unit Data	XXXX=Pulses Per Revolution
PTH—022	Status	C-Range Gear Sensor Pulses per Axle Revolution	Control Unit Data	XXXX=Pulses Per Revolution
PTH—023	Status	Wheel Speed	Control Unit Data	XX.XX Range=0—99.99
PTH—024	Calibration	Wheel Circumference	Edit Wheel Circumference Address See Entering Diagnostic and Calibration Modes	XXXX Measured in Millimeters
PTH—025	Configuration	Maximum Speed Limit	Edit Address See Entering Diagnostic and Calibration Modes	XX.XX=KPH
PTH—026	Status	Maximum Speed Commanded Speed	Control Unit Data	XX.XX=KPH
PTH—027	Status	Backup Alarm Output Status	Control Unit Data	0=Off 1=On
PTH—028	Status	Throttle Sensor Position Voltage	Control Unit Data	X.XX 0=Low Range 9.99=High Range
PTH—029	Status	Throttle Sensor Calibrated Minimum Voltage	Control Unit Data	X.XX=Voltage Range=0—9.99
PTH—030	Status	Throttle Sensor Calibrated Maximum Voltage	Control Unit Data	X.XX=Voltage
PTH—031	Status	Throttle Position Command	Control Unit Data	XXX=Percentage Range=0—100
PTH—032	Status	Forward Pedal Position Voltage	Control Unit Data	XXX=Percentage
PTH—033	Status	Forward Pedal Channel A Calibrated Minimum Pulse Width	Control Unit Data	XXX=Percentage
PTH—034	Status	Forward Pedal Channel A Calibrated Maximum Pulse Width	Control Unit Data	XXX=Percentage
PTH—035	Status	Forward Pedal Position Voltage	Control Unit Data	XXX=Percentage
PTH—036	Status	Forward Pedal Channel B Calibrated Minimum Pulse Width	Control Unit Data	XXX=Percentage
PTH—037	Status	Forward Pedal Channel B Calibrated Maximum Pulse Width	Control Unit Data	XXX=Percentage
PTH—038	Status	Forward Pedal Percent Command	Control Unit Data	XXX=Percentage
PTH—039	Status	Reverse Pedal Position Voltage	Control Unit Data	XXX=Percentage
PTH—040	Status	Reverse Pedal Channel A Calibrated Minimum Pulse Width	Control Unit Data	XXX=Percentage
PTH—041	Status	Reverse Pedal Channel A Calibrated Maximum Pulse Width	Control Unit Data	XXX=Percentage
PTH—042	Status	Reverse Pedal Position Voltage	Control Unit Data	XXX=Percentage
PTH—043	Status	Reverse Pedal Channel B Calibrated Minimum Pulse Width	Control Unit Data	XXX=Percentage
PTH—044	Status	Reverse Pedal Channel B Calibrated Maximum Pulse Width	Control Unit Data	XXX=Percentage
PTH—045	Status	Reverse Pedal Percent Command	Control Unit Data	XXX=Percentage
PTH—046	Status	Pedal Command	Control Unit Data	XXX=Percentage
PTH—047	Status	Direction Command Status	Control Unit Data	XXX=Percentage
PTH—048	Status	Forward eHydro Valve Crack Threshold	Control Unit Data	XXXX=mA
PTH—049	Status	Reverse eHydro Valve Crack Threshold	Control Unit Data	XXXX=mA
PTH—050	Status	eHydro Current Command	Control Unit Data	XXXX=mA
PTH—051	Status	Ramp eHydro Output Command	Control Unit Data	XXX=Percentage
PTH—052	Status	Speed control Loop eHydro Output Command	Control Unit Data	XXX=Percentage
PTH—053	Status	eHydro Output Command (before LoadMatch™	Control Unit Data	XXX=Percentage
PTH—054	Status	LoadMatch™ Output Allowance	Control Unit Data	XXX=Percentage
PTH—055	Status	LoadMatch™ eHydro Output Command	Control Unit Data	XXX=Percentage
PTH—056	Status	CAN Transmission Enable Status	Control Unit Data	0XXXX=Disabled 1XXXX=Enabled 2XXXX=Invalid or Faulted 3XXXX=Missing 4XXXX=Unrequested

Number	Type	Address Name	Function or Control	Display or Range
		Physical Transmission Enable Status	Control Unit Data	X0XXX=Disabled X1XXX=Enabled X2XXX=Invalid or Faulted X3XXX=Missing X4XXX=Unrequested
		Switch Transmission Enable Status	Control Unit Data	XX0XX=Disabled XX1XX=Enabled XX2XX=Invalid or Faulted XX3XX=Missing XX4XX=Unrequested
		Come-Home Mode Enable Status	Control Unit Data	XXX0X=Disabled XXX1X=Enabled XXX2X=Invalid or Faulted
		Transmission Enable Status	Control Unit Data	XXXX0=Disabled XXXX1=Enabled XXXX2=Invalid or Faulted
PTH—219	Status	Boot Block Customer Configuration Data Part Number	Control Unit Data	XXXXXXX
PTH—220	Status	Boot Block Customer Configuration Data Version Number	Control Unit Data	XX.XX
PTH—225	Status	Configuration Data Part Number (Software)	Control Unit Data	XXXXXXXX XXXXXXXX
PTH—226	Status	Configuration Data Version Number (Software)	Control Unit Data	XXXXXXXX XXXXXXXX
PTH—227	Status	Boot Block Program Part Number (Software)	Control Unit Data	XXXXXXX
PTH—228	Status	Boot Block Program Version Number (Software)	Control Unit Data	XXXXXXX
PTH—229	Status	EOL Data Part Number (Software)	Control Unit Data	XXXXXXXXXXXXXXXX
PTH—230	Status	EOL Data Version Number (Software)	Control Unit Data	XXXXXXXXXXXXXXXX
PTH—231	Status	Operating System Part Number (Software)	Control Unit Data	XXXXXXX
PTH—232	Status	Operating System Version Number (Software)	Control Unit Data	XXXXXXX
PTH—233	Status	Application Software Part Number	Control Unit Data	XXXXXXX
PTH—234	Status	Application Software Version Number	Control Unit Data	XXXXXXX
PTH—235	Status	Controller Hardware Part Number	Control Unit Data	XXXXXXX
PTH—236	Status	Controller Serial Number	Control Unit Data	XXXXXXX
PTH—237	Status	Software Assembly Part Number	Control Unit Data	XXXXXXX
PTH—238	Status	Software Assembly Version Number	Control Unit Data	XXXXXXX
PTH—245	Status	The number of CAN bus off retries	Control Unit Data	XXX
PTH—246	Status	Interval between CAN bus offs	Control Unit Data	XXXXX
PTH—247	Status	Vehicle Model Number (Current Vehicle)	Control Unit Data	XXXX
PTH—248	Status	Vehicle Serial Number (Current Vehicle)	Control Unit Data	XXXXXX

Diagnostic Addresses—Instrument Cluster Control (ICC) Controller

NOTE: The tractor must be in diagnostic mode 1 (RLLRLR) for reading or editing control unit addresses. For more information on accessing control unit address or editing address parameters, see Entering Diagnostic and Calibration Modes .

ICC Diagnostic Addresses

Number	Type	Address Name	Function or Control	Display or Range
ICC—000	Status	Initial Address	Control Unit Addresses—Access	
ICC—001	Status	Recall Trouble Codes	Recall, Record, and Clear Codes	
ICC—002	Status/Beep	System Beep Address	System Address Beep Test	
ICC—003	Configuration	SCV Continuous Flow	Edit SCV Continuous Flow Address See Entering Diagnostic and Calibration Modes	0X=Disabled 1X=Enabled
		Seat Alarm	Edit Seat Alarm Address See Entering Diagnostic and Calibration Modes	X0=Disabled X1=Enabled
ICC—004	Configuration	Wheel Speed Units	Edit Seat Alarm Address See Entering Diagnostic and Calibration Modes	X0=mph X1=km/h
		Mid PTO	Edit Mid PTO Address See Entering Diagnostic and Calibration Modes	0X=Disabled 1X=Enabled)
ICC—005	Configuration	MotionMatch Setting	Edit MotionMatch Setting Address See Entering Diagnostic and Calibration Modes	3=Long 5=Default 7=Short
ICC—006	Configuration	LoadMatch Setting	Edit Seat Alarm Address See Entering Diagnostic and Calibration Modes	0=Load OFF 1=Load ON
ICC—007	Configuration	Load Match and MotionMatch Option	Edit Load Match and MotionMatch Option Address See Entering Diagnostic and Calibration Modes	0=Switch Not Present 1=Switch Present 2=Feature Not Available
ICC—008	Configuration	Fuel Gauge Enable	Edit Fuel Gauge Enable Address See Entering Diagnostic and Calibration Modes	0X=Disabled 1X=Voltage Type Fuel Gauge 2X=Reed SW Type Fuel Gauge
		Wheel Speed Enable	Edit Wheel Speed Enable Address See Entering Diagnostic and Calibration Modes	X0=Disabled X1=Enabled
ICC—009	Configuration	Operator Station Type	Edit Operator Station Type Address See Entering Diagnostic and Calibration Modes	0X=Open Station 1X=Cab
		TCM Present	Edit Seat Alarm Address See Entering Diagnostic and Calibration Modes	X0=TCM Not Present X1=TCM Present
ICC—010	Configuration	Region Setting	Edit Region Setting Address See Entering Diagnostic and Calibration Modes	0X=EEC 1X=NA
		Engine Type	Edit Engine Type Address See Entering Diagnostic and Calibration Modes	X0=No ECU X1=Yes ECU
ICC—011	Configuration	540E PTO Enable	Edit 540E PTO Address See Entering Diagnostic and Calibration Modes	0X=No 1X=Yes
		Neutral Switch Enable	Edit Neutral Switch Enable Address See Entering Diagnostic and Calibration Modes	X0=No X1=Yes
ICC—012	Configuration	Tractor variant setting	Edit Tractor variant setting Address See Entering Diagnostic and Calibration Modes	00=4M 01=4R 02=3E 03=3R 99=Default
ICC—013	Configuration	Hybrid Exhaust Actuator Option	Edit Hybrid Exhaust Actuator Option Address See Entering Diagnostic and Calibration Modes	0X=Option Not Available 1X=Option Available
		Integrated Switch Present	Edit Integrated Switch Present Address See Entering Diagnostic and Calibration Modes	X0=Integrated SW Not Present X1=Integrated SW Present
ICC—014	Configuration	Front PTO	Edit Front PTO Address See Entering Diagnostic and Calibration Modes	0X=No Front PTO 1X=Front PTO
		RIO Feature	Edit RIO Feature Address See Entering Diagnostic and Calibration Modes	X0=No Rio X1=RIO PTH X2=RIO PTR
ICC—015	Status	Tachometer Input Frequency vs 3000 RPM on Display	Control Unit Data	XXX=Hz
ICC—016	Status	Engine Speed	Control Unit Data	XXXX==rpm or km/h (depending on selection from address 4)
ICC—017	Status	Right Turn Signal/	Control Unit Data	0X=Off 1X=On

Number	Type	Address Name	Function or Control	Display or Range
		Left Turn Signal	Control Unit Data	X0=Off X1=On
ICC—018	Status	Display Mode Switch	Control Unit Data	0XX=Off 1XX=On
		Head Lights	Control Unit Data	X0X=Off X1X=On
		Hazard Inputs	Control Unit Data	XX0=Off XX1=On
ICC—019	Status	Front PTO/Switch	Control Unit Data	0X=Off 1X=On
		Main PTO/Switch	Control Unit Data	X0=Off X1=On
ICC—020	Status	Mid PTO Sense	Control Unit Data	0X=Off 1X=On
		Rear PTO Sense	Control Unit Data	X0=Off X1=On
ICC—021	Status	RIO ON	Control Unit Data	0X=Off 1X=On
		Rear PTO 540 Switch	Control Unit Data	X0=Off X1=On
ICC—022	Status	MFWD Switch Input	Control Unit Data	0X=Off 1X=On
		Neutral Switch Input	Control Unit Data	X0=Off X1=On
ICC—023	Status	Regen Switch	Control Unit Data	0XX=Off 1XX=On
		Engine Oil Pressure	Control Unit Data	X0X=Off X1X=On
		Air Intake Filter	Control Unit Data	XX0=Off XX1=On
ICC—024	Status	Key Start	Control Unit Data	0X=Off 1X=On
		Pre-heat Switch	Control Unit Data	X0=Off X1=On
ICC—025	Status	Seat Switch	Control Unit Data	0X=Off 1X=On
		Park Brake Switch	Control Unit Data	X0=Off X1=On
ICC—026	Status	Continuous Flow	Control Unit Data	0=Off 1=On
ICC—027	Status	LT Belt Line Output Current	Control Unit Data	XX.XX=Current
ICC—028	Status	RT Belt Line Output Current	Control Unit Data	XX.XX=Current
ICC—029	Status	LT Fender Output Current	Control Unit Data	XX.XX=Current
ICC—030	Status	RT Fender Output Current	Control Unit Data	XX.XX=Current
ICC—031	Status	PTO Coil output current	Control Unit Data	XX.XX=Current
ICC—033	Status	Pull-in Coil Current	Control Unit Data	XX.XX=Current
ICC—034	Status	Hold-in Coil Current	Control Unit Data	XX.XX=Current
ICC—035	Status	Starter Coil Current	Control Unit Data	XX.XX=Current
ICC—036	Status	Hybrid Exhaust Output Current	Control Unit Data	XX.XX=Current
ICC—040	Status	Coolant Temperature	Control Unit Data	XXX=Degrees ° C
ICC—041	Status	Front Implement Sense Frequency	Control Unit Data	XXX=Hz
ICC—043	Status	Hybrid Exhaust Actuator Position	Control Unit Data	0=Off Position 1=On Position
ICC—067	Status	Soot Level and Last Regen Message	Control Unit Data	0= Display 1=Not Display
ICC—070	Status	EEPROM Failure	Control Unit Data	0=False 1=True

Number	Type	Address Name	Function or Control	Display or Range
ICC—081	Status	Night Time Mode Backlight Brightness Level	Control Unit Data	XXX Range=40—100 70=Default Value
ICC—085	Status	Unswitched Voltage	Control Unit Data	XX.X=Voltage
ICC—219	Status	Controller Configuration Data Part Number	Control Unit Data	XXXXXXX
ICC—220	Status	Controller Configuration Data Version Number	Control Unit Data	XX.XX
ICC—225	Status	Software Part Number Configuration	Control Unit Data	X-XXXXX
ICC—226	Status	Software Version Number Configuration	Control Unit Data	XX.XX
ICC—227	Status	Boot Block Program Part Number	Control Unit Data	XXXXXXX
ICC—228	Status	Boot Block Program Version Number	Control Unit Data	XX.XX
ICC—229	Status	EOL Data Part Number	Control Unit Data	XXXXXXX
ICC—230	Status	EOL Data Version Number	Control Unit Data	XX.XX
ICC—231	Status	Operating System Software Part Number	Control Unit Data	XXXXXXXX
ICC—232	Status	Operating System Software Version Number	Control Unit Data	XX.XX
ICC—233	Status	Base Program Part Number	Control Unit Data	X-XXXXX
ICC—234	Status	Base Program Version Number	Control Unit Data	XX.XX
ICC—235	Status	Device Part Number	Control Unit Data	XXXXXXX
ICC—236	Status	Device Serial Number	Control Unit Data	XXXXXXX
ICC—237	Status	Software Assembly Part Number	Control Unit Data	XXXXXXX
ICC—238	Status	Software Assembly Version Number	Control Unit Data	XX.XX
ICC—245	Status	CAN Bus Off Retries Number	Control Unit Data	X Range=0—7 3=Default
ICC—246	Status	CAN Bus Offs Intervals	Control Unit Data	XXXXX Range=0—65535 1000=Default
ICC—251	Status	Vehicle PIN on which display is installed	Control Unit Data	Scrolling Display

Diagnostic Addresses—Engine Control Unit (ECU) Controller

NOTE: The tractor must be in diagnostic mode 1 (RLLRLR) for reading or editing control unit addresses. For more information on accessing control unit address or editing address parameters, see Entering Diagnostic and Calibration Modes.

ECU Diagnostic Addresses

Number	Type	Address Name	Function or Control	Display or Range
ECU—000	Status	Initial Address	Control Unit Addresses—Access	
ECU—001	Status	Recall Trouble Codes	Recall, Record, and Clear Codes	
ECU—002	Status/Beep	System Beep Address	System Address Beep Test	
ECU—003	Status	Primary Throttle	Control Unit Data	X.XX Measured by Percentage
ECU—004	Status	Secondary Throttle	Control Unit Data	X.XX Measured by Percentage
ECU—006	Status	Commanded Throttle	Control Unit Data	X.XX Measured by Percentage
ECU—007	Status	Battery Voltage (ECU measured)	Control Unit Data	X.XX Measured by Voltage
ECU—012	Status	Engine Speed Sensor Status	Control Unit Data	0= Both rotational speed sensor faulted 1= Operating with only Cam rotation speed sensor 2= Operating with only Crank rotation speed sensor 3= Operating with both rotation speed sensors
ECU—014	Status	Governor Reference Speed	Control Unit Data	XXXX Measured by Revolutions Per Minute
ECU—015	Status	Engine Speed	Control Unit Data	XXXX Measured by Revolutions Per Minute
ECU—020	Status	Engine Coolant Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—021	Status	Engine Oil Pressure	Control Unit Data	0= Open 1= Close
ECU—022	Status	Fuel Mode	Control Unit Data	0= Stop 1= Start 2= Normal 3= Max (Torque Curve) 4= TSC1 Torque Limit 5= Smoke Limit 6= Protection 1 (75%) 7= Protection 2 (50%)
ECU—024	Status	Throttle Mode	Control Unit Data	0=Throttle 1=Foot throttle 2= ETCP1
ECU—025	Status	Speed Mode. (Normal, Eng Protection, Max)	Control Unit Data	0=Normal 1= Limit 1 2= Limit 2 3= Idle up 4= Stationary 5= Min (Low idle) 6= TSC1 Limit 7= TSC1 Control
ECU—029	Status	Fuel Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—030	Status	Fuel Rate	Control Unit Data	X.XX Measured by Liters/Hr
ECU—031	Status	Manifold Air Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—032	Status	Percent Load	Control Unit Data	X.XX Measured by Percentage
ECU—033	Status	Desired Fuel	Control Unit Data	
ECU—034	Status	Remaining Start Aid Time	Control Unit Data	X.XX Measured by Seconds
ECU—035	Status	Manifold Air Pressure	Control Unit Data	X.XX Measured by kPa
ECU—038	Status	Rail Pressure	Control Unit Data	X.XX Measured by mPa

Number	Type	Address Name	Function or Control	Display or Range
ECU—042	Status	Barometric Pressure	Control Unit Data	X.XX Measured by kPa
ECU—043	Status	External Shutdown Status	Control Unit Data	
ECU—044	Status	Starter Permission Status	Control Unit Data	
ECU—047	Status	Exhaust Manifold Pressure (DPF High side)	Control Unit Data	X.XX Measured by kPa
ECU—060	Status	Foot Throttle Enable	Control Unit Data	0= Disabled 1= Enabled
ECU—070	Status	EGR Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—073	Status	Fresh Air Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—087	Status	DOC Inlet Temperature	Control Unit Data	00=Do Not Activate Priming 01=Activate Priming
ECU—088	Status	DOC Outlet Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—089	Status	Exhaust Manifold Temperature	Control Unit Data	X.XX Measured by Degrees/Celsius
ECU—090	Status	DPF Delta Pressure	Control Unit Data	X.XX Measured by kPa
ECU—091	Status	DPF Soot Load	Control Unit Data	X.XX Measured by Grams Per Liter
ECU—092	Status	DPF Ash Load	Control Unit Data	X.XX Measured by Grams Per Liter
ECU—093	Status	Regeneration Mode	Control Unit Data	0= Normal 1= Assist 2= Reset 3= Stationary 10= Recovery
ECU—099	Status	Air Filter Switch	Control Unit Data	0= Normal 1= Error
ECU—100	Status	Primary Throttle Voltage	Control Unit Data	X.XX Measured by Voltage
ECU—101	Status	Secondary Throttle Voltage	Control Unit Data	X.XX Measured by Voltage
ECU—105	Status	Fuel Temperature (if used)	Control Unit Data	X.XX Measured by Voltage
ECU—106	Status	Rail Pressure	Control Unit Data	X.XX Measured by Voltage
ECU—107	Status	EGR Lo-side Pressure Sensor	Control Unit Data	X.XX Measured by Voltage
ECU—108	Status	Fuel Pressure	Control Unit Data	X.XX Measured by Voltage
ECU—109	Status	Coolant Temperature	Control Unit Data	X.XX Measured by Voltage
ECU—110	Status	Fresh Air Temp	Control Unit Data	X.XX Measured by Voltage
ECU—111	Status	DPF Hi-side Pressure Sensor	Control Unit Data	X.XX Measured by Voltage
ECU—112	Status	DPF Differential Pressure Sensor	Control Unit Data	X.XX Measured by Voltage
ECU—113	Status	EGR Hi-side Pressure Sensor	Control Unit Data	X.XX Measured by Voltage
ECU—114	Status	DOC Outlet Temperature Sensor	Control Unit Data	X.XX Measured by Voltage
ECU—115	Status	Exhaust Manifold Temperature Sensor	Control Unit Data	X.XX Measured by Voltage
ECU—116	Status	Intake Valve Position	Control Unit Data	X.XX Measured by Voltage
ECU—141	Status	External Shutdown Switch	Control Unit Data	
ECU—142	Status	Regeneration Inhibit SW	Control Unit Data	

Number	Type	Address Name	Function or Control	Display or Range
ECU—143	Status	Regeneration Request SW	Control Unit Data	
ECU—144	Status	Regeneration Interlock SW	Control Unit Data	
ECU—145	Status	Starter Permission SW	Control Unit Data	
ECU—146	Status	Air Filter SW	Control Unit Data	
ECU—147	Status	ELX SW	Control Unit Data	
ECU—200	Status	Engine Model Number	Control Unit Data	XXXXXX
ECU—201	Status	Engine Serial Number	Control Unit Data	XXXXXX
ECU—202	Status	Fuel Pump Part Number	Control Unit Data	XXXXXX
ECU—203	Status	Injector Part Number	Control Unit Data	XXXXXX
ECU—204	Status	DPF Part Number	Control Unit Data	XXXXXX
ECU—205	Status	DPF Serial Number	Control Unit Data	XXXXXX
ECU—223	Status	ECU Type Part Number	Control Unit Data	XXXXXX
ECU—229	Status	Map Part Number	Control Unit Data	XXXXXX
ECU—233	Status	Software Part Number	Control Unit Data	XXXXXX
ECU—235	Status	ECU Part Number	Control Unit Data	XXXXXX
ECU—236	Status	ECU Serial Number	Control Unit Data	XXXXXX
ECU—251	Status	17 Character PIN VIN	Control Unit Data	Scrolling Display

Section 60 - POWER TRAIN—HYDROSTATIC

Table of contents

Group 05 - Specifications

General

Item	Measurement	Specification
Hydraulic Reservoir		
Hydraulic Reservoir	Capacity	25.7 L (6.8 gal) (27.2 qt)

Hydrostatic Pump

Item	Measurement	Specification
Hydrostatic Pump		
Manufacturer		Sauer-Danfoss
Type		Piston Pump
Model		JD LVA10837
Displacement (variable) (maximum/rev)	Displacement	51 cm^3 (3.11 cu. in./rev)
Pressure Relief Valve Setting	Pressure	38 500 kPa (385 bar) (5580 psi)
Charge Pressure	Pressure	1800 kPa (18 bar) (261 psi)

Hydrostatic Motor

Item	Measurement	Specification
Hydrostatic Motor		
Manufacturer		Sauer-Danfoss
Type		Fixed Displacement Axial Piston Motor
Displacement (fixed)	Displacement	43.5 cm^3 (2.65 cu. in./rev)

Torque Specifications

Item	Measurement	Specification
Specifications		
Forward and Reverse Pressure Relief Valve Plug	Torque	78 N·m (58 lb.-ft.)
Charge Pressure Relief Valve Plug	Torque	78 N·m (58 lb.-ft.)
Charge Pressure Diagnostic Port Plug	Torque	13—16 N·m (115—142 lb.-in.)
Hydrostatic Transmission-to-Tunnel Mounting Screws	Torque	52—68 N·m (38—50 lb.-ft.)
SCV Pressure Tube-to-Pump	Torque	55—79 N·m (40—59 lb.-ft.)
SCV Pressure Tube-to-SCV	Torque	55—79 N·m (40—59 lb.-ft.)
SCV Work Port Tubes-to-SCV	Torque	40—57 N·m (30—43 lb.-ft.)
Tunnel Section-to-Differential Housing M12 Cap Screws	Torque	80—98 N·m (59—72 lb.-ft.)
Tunnel Section-to-Clutch Housing Cap Screws	Torque	126—154 N·m (95—115 lb.-ft.)
Proportional Valve Body	Torque	13—19 N·m (10—14 lb.-ft.)
Solenoid Nut	Torque	3—5 N·m (24—48 lb.-in.)
Trunnion Cover Screws	Torque	31—37 N·m (23—27 lb.-ft.)
Filter Nipple	Torque	54 N·m (40 lb.-ft.)
Charge Pressure Tubes-to-Transmission Adapters	Torque	55—79 N·m (40—59 lb.-ft.)
Charge Pressure-to-Inline Filter Nut	Torque	69 N·m (51 lb.-ft.)
Tie Bolt Seal Nut	Torque	17—23 N·m (156—204 lb.-in.)

Special or Essential Tools

→NOTE:

Order tools according to information given in the U.S. SERVICEGARD ™ Catalog or in the European Microfiche Tool Catalog (MTC).

Splitting Stands and Brackets

JT07335-1,2,3

Splitting machine.

Pressure Gauge, 2000 kPa (20 bar) (300 psi)

JT03344

Checking charge pressure.

7/16-20 M 37° X 7/16-20 M 37° Elbow

JT03240

Checking system and charge pressure.

Quick Coupler F X 7/16-20 F 37° Adapter

JT03264

Checking system and charge pressure.

Male Quick Coupler

JT05480

Used to test hydrostatic high pressure relief.

Female Quick Coupler

JT03264

Used to test hydrostatic high pressure relief.

Pressure Gauge, 68 948 kPa, (689 bar) (10 000 psi)

JT03362 Pressure Gauge

Used to test hydrostatic high pressure relief.

Hose

JT03364

Used to test hydrostatic high pressure relief.

Adapter

JT03252

Used to test hydrostatic high pressure relief.

M14 x 1.5 Male Quick Coupler

JT05480

Used to test and adjust charge pump pressure.

Pressure Gauge, 2760 kPa (27.6 bar) (400 psi)

JT07041

Used to test and adjust charge pump pressure.

JT03017

Hose

Used to test and adjust charge pump pressure.

Female Quick Coupler

JT03472

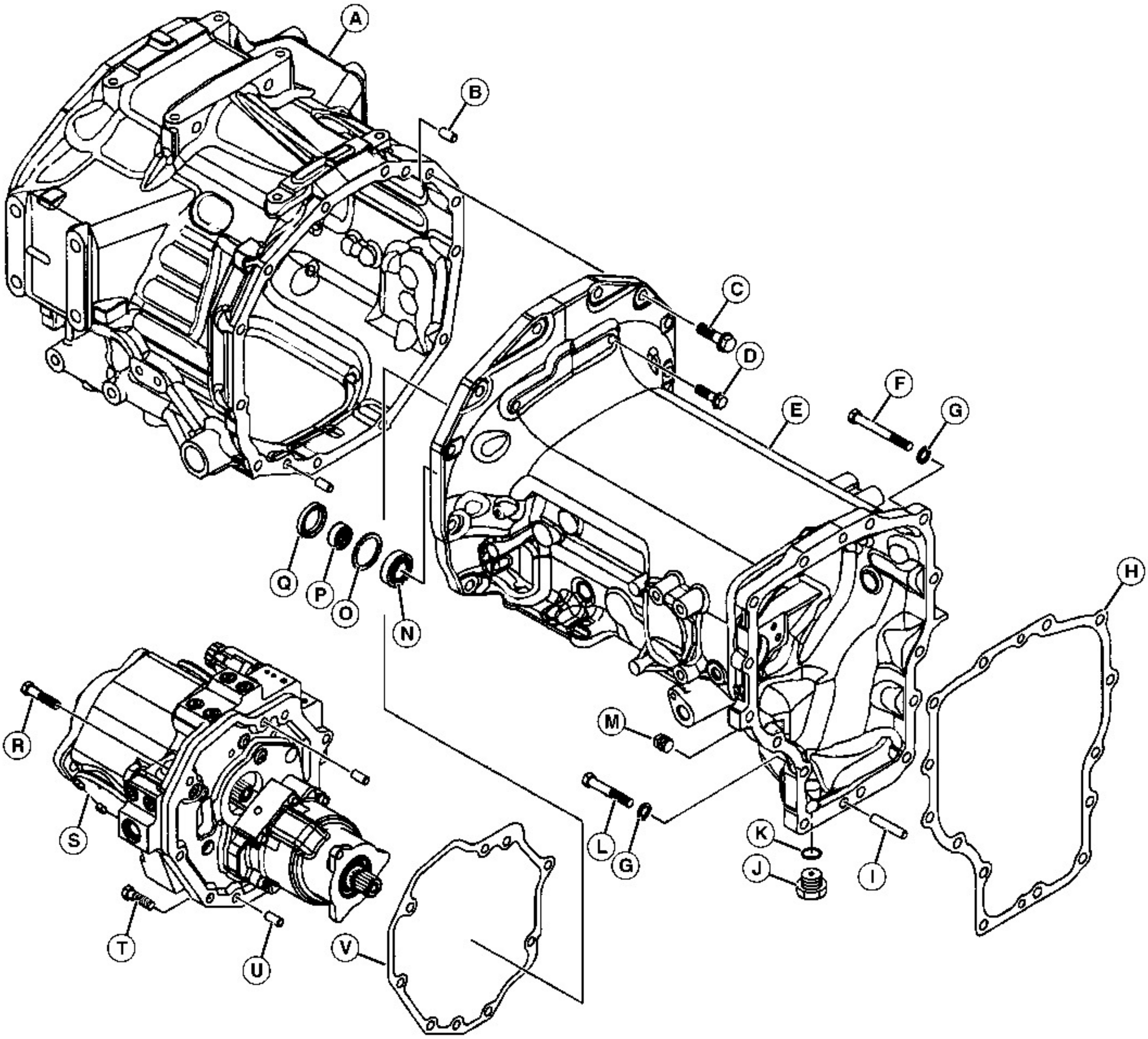
Used to test and adjust charge pump pressure.

Other Materials

Number	Name	Use
• PM37509 (us)	Klean N Prime, 4.5 oz. Aerosol	Prime gasket surfaces for faster curing of form-in-place gaskets.
• PM38657 (us)	High Flex Form-In-Place Gasket	Hydrostatic transmission to tunnel seal.
• TY15934 (us)	John Deere General Purpose Gasket Dressing	Used to seal gaskets and hoses.

Group 10 - Component Location

Transmission (eHydro™)



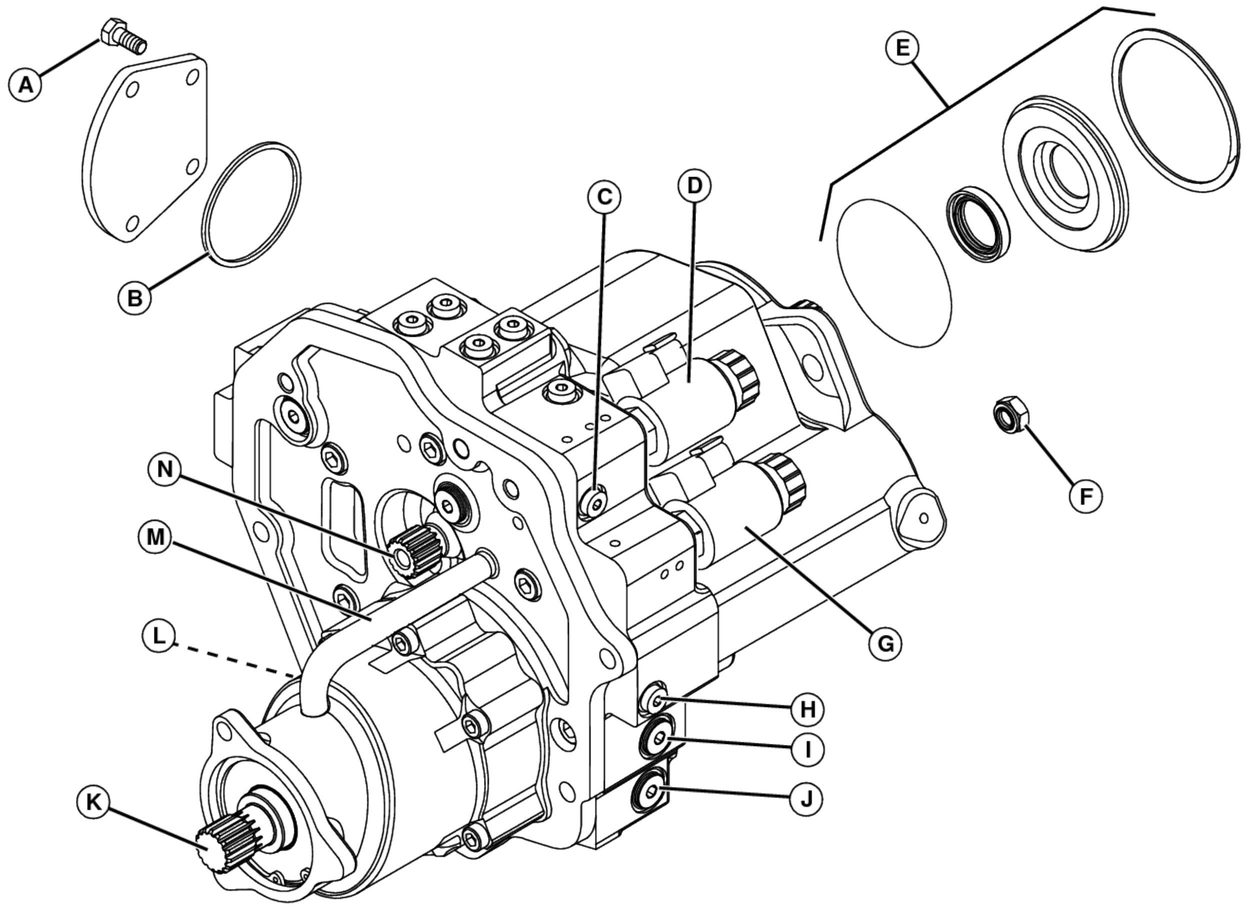
Transmission — eHydro

LEGEND:

A	Flywheel Housing
B	Alignment Pin (2 used)
C	Bolt (12 used)
D	Bolt (2 used)
E	Transmission Tunnel
F	Bolt (12 used)
G	Washer (14 used)
H	Gasket
I	Alignment Pin (2 used)
J	Drain Plug
K	O-Ring
L	Bolt
M	Plug 1/2 NPT
N	Bearing
O	Circlip
P	Sleeve 20x30x13
Q	Oil Seal

R	Bolt (3 used)
S	Transmission
T	Bolt (2 used)
U	Alignment Pin (2 used)
V	Gasket

eHydro™ Transmission Components

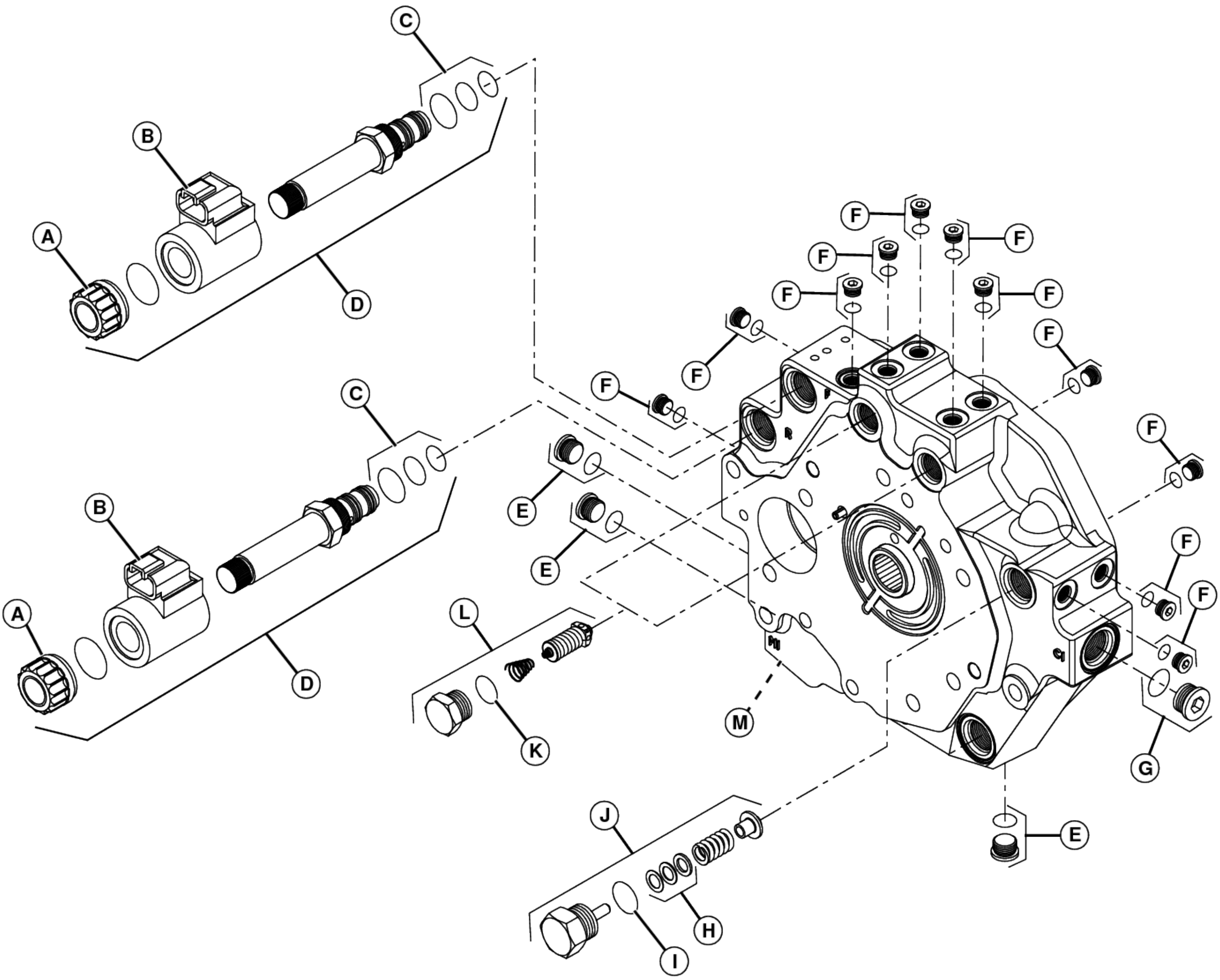


Transmission Components

LEGEND:

A	Screw
B	O-Ring
C	Forward Control Pressure Port M5
D	Forward Control Valve Solenoid
E	Input Shaft Seal Kit
F	Seal Nut
G	Reverse Control Valve Solenoid
H	Reverse Control Pressure Port M4
I	Forward System Pressure Port M2
J	Reverse System Pressure Port M1
K	Drive Output Shaft
L	Charge Pressure Gauge Port M3
M	Lubrication Tube
N	Output PTO Drive Shaft

eHydro™ Center Plate Components

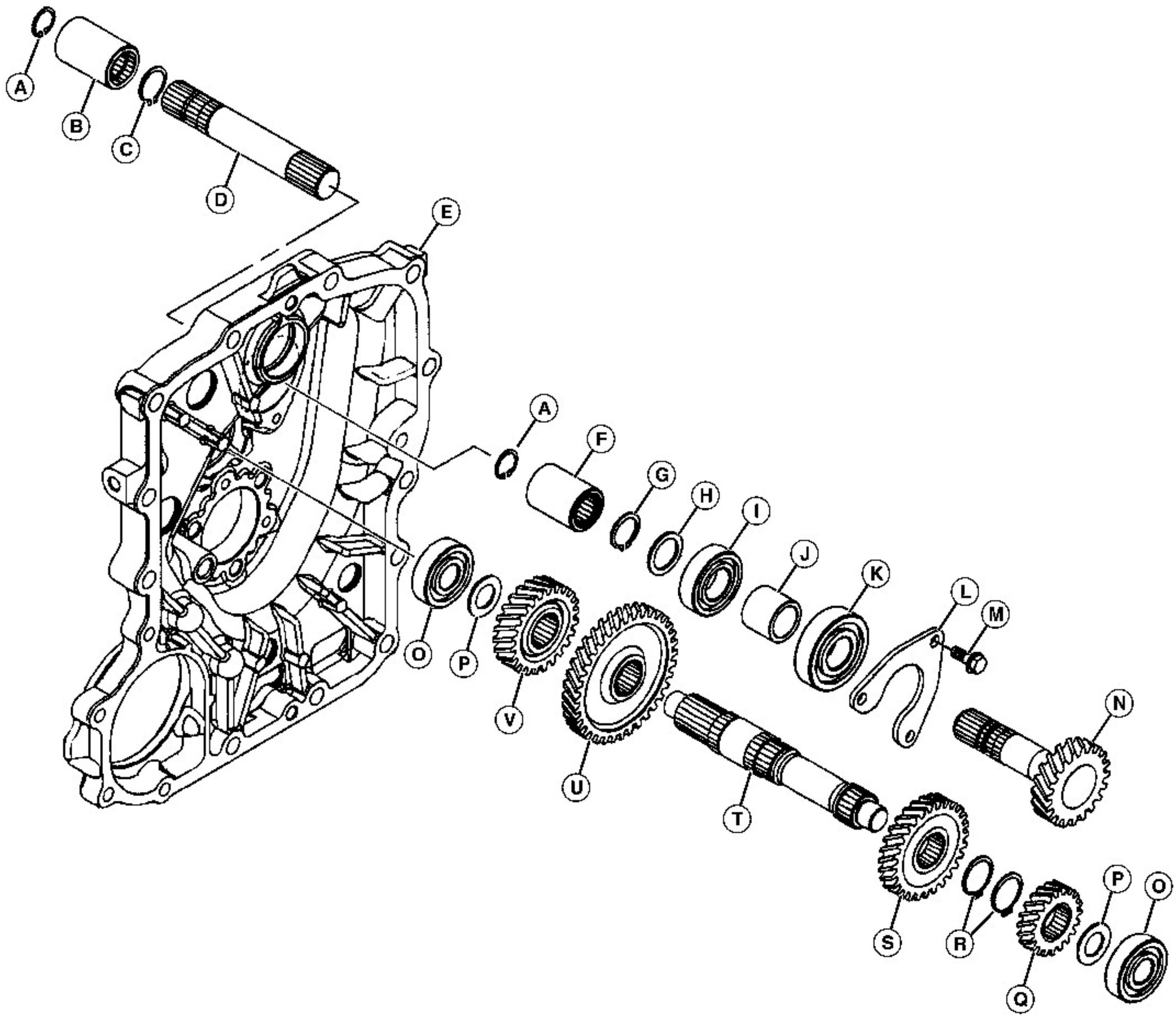


Transmission — eHydro Center Plate

LEGEND:

A	Coil Nut (2 used)
B	Coil with Connector (2 used)
C	Solenoid Seal Kit (2 used)
D	Valve Assembly (2 used)
E	Plug Assembly (3 used)
F	Plug Assembly (11 used)
G	Plug Assembly
H	Shim Kit
I	O-Ring
J	Charge Relief Valve Kit
K	O-Ring
L	System Relief Valve Kit (2 used)
M	System Pressure Port M1

Drive Shaft



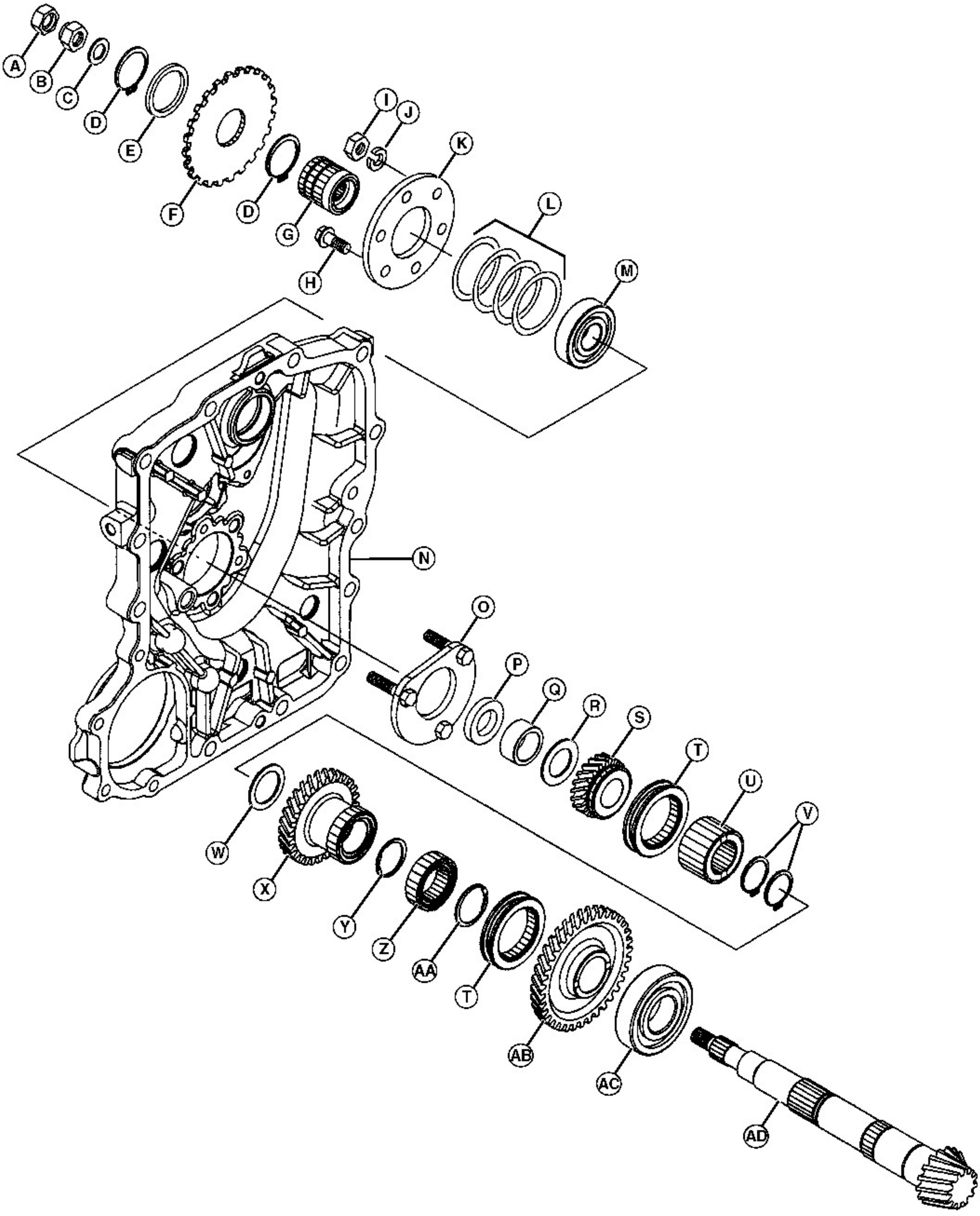
Drive Shaft Component

LEGEND:

A	Snap Ring (2 used)
B	Coupling (To Transmission)
C	Snap Ring
D	Main Drive Shaft
E	Center Plate
F	Coupling (to Main Gear)
G	Snap Ring
H	Washer 25x34x2
I	Bearing
J	Spacer 25x34x29.2
K	Bearing
L	Bearing Retainer
M	Bolt (3 used)
N	Main Gear 20T
O	Bearing (2 used)
P	Washer 20x34x2 (2 used)
Q	Range Gear 20T
R	Snap Ring (2 used)
S	Range Gear 26T
T	Driven Shaft

U	Range Gear 41T
V	Driven Gear 24T

Front Drive



Front Drive

LEGEND:

A	Nut, Upper
B	Nut, Lower
C	Spacer, 15X25X2
D	Snap Ring (2 used)

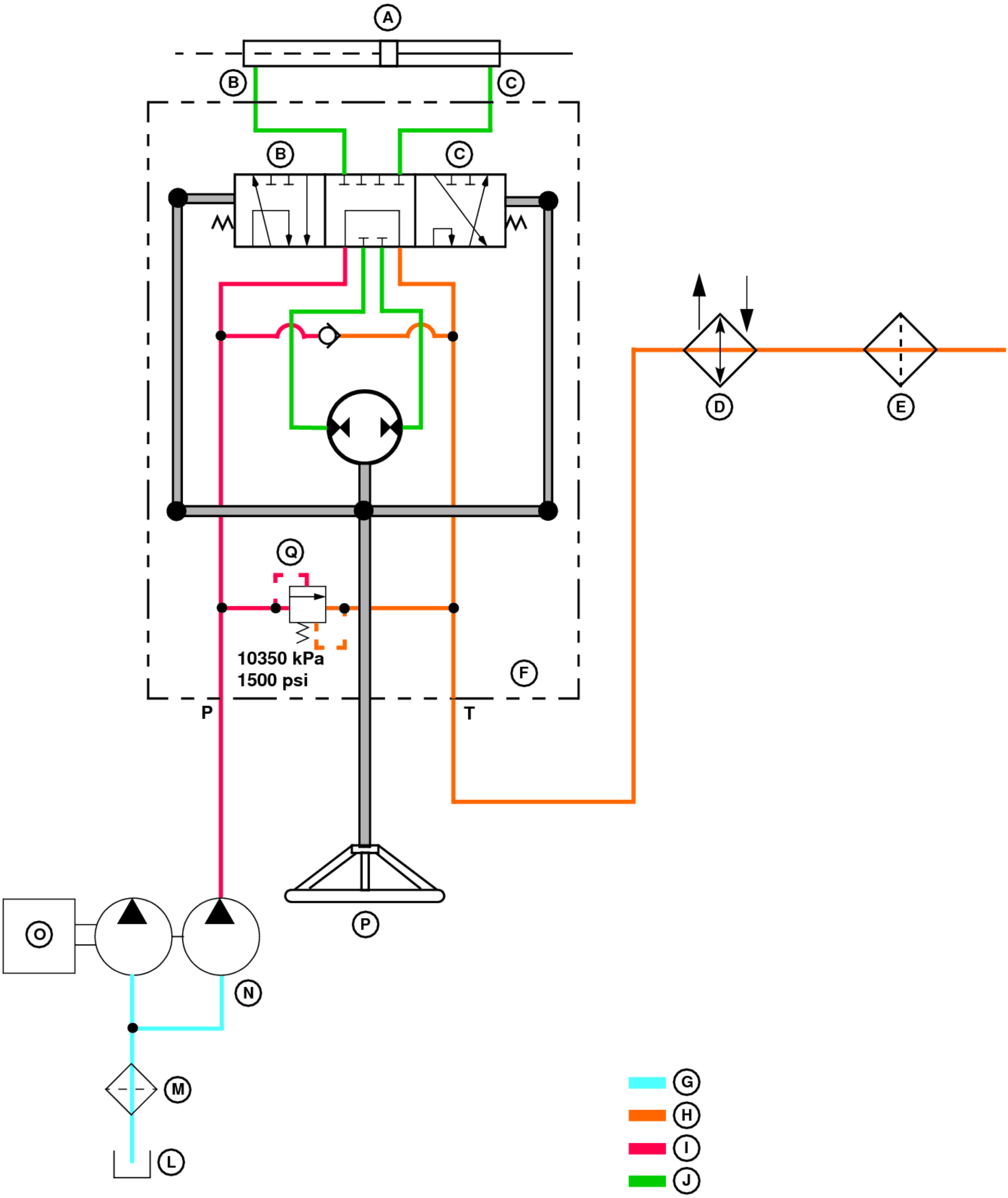
E	Collar
F	Speed Sensing Gear
G	Spline Collar (MFWD)
H	Bolt M10x25 (3 used)
I	Nut (3 used)
J	Lock Washer (3 used)
K	Retainer Plate
L	Shim Kit
M	Bearing
N	Center Plate
O	Bearing Retainer Assembly
P	Washer
Q	Collar
R	Washer 28x45x2
S	Counter Gear 20T
T	Shift Collar (2 used)
U	Spline Collar
V	Snap Ring (2 used)
W	Washer 32x44x2
X	Counter Gear 29T
Y	Circlip
Z	Spline Collar
AA	Circlip
AB	Counter Gear 44T
AC	Bearing
AD	Pinion Shaft

→NOTE:

Shim used from kit will vary for pinion shaft adjustment.

Group 15 - Schematics

Steering/Charge Pump Circuit Schematic, eHydro™ Transmission



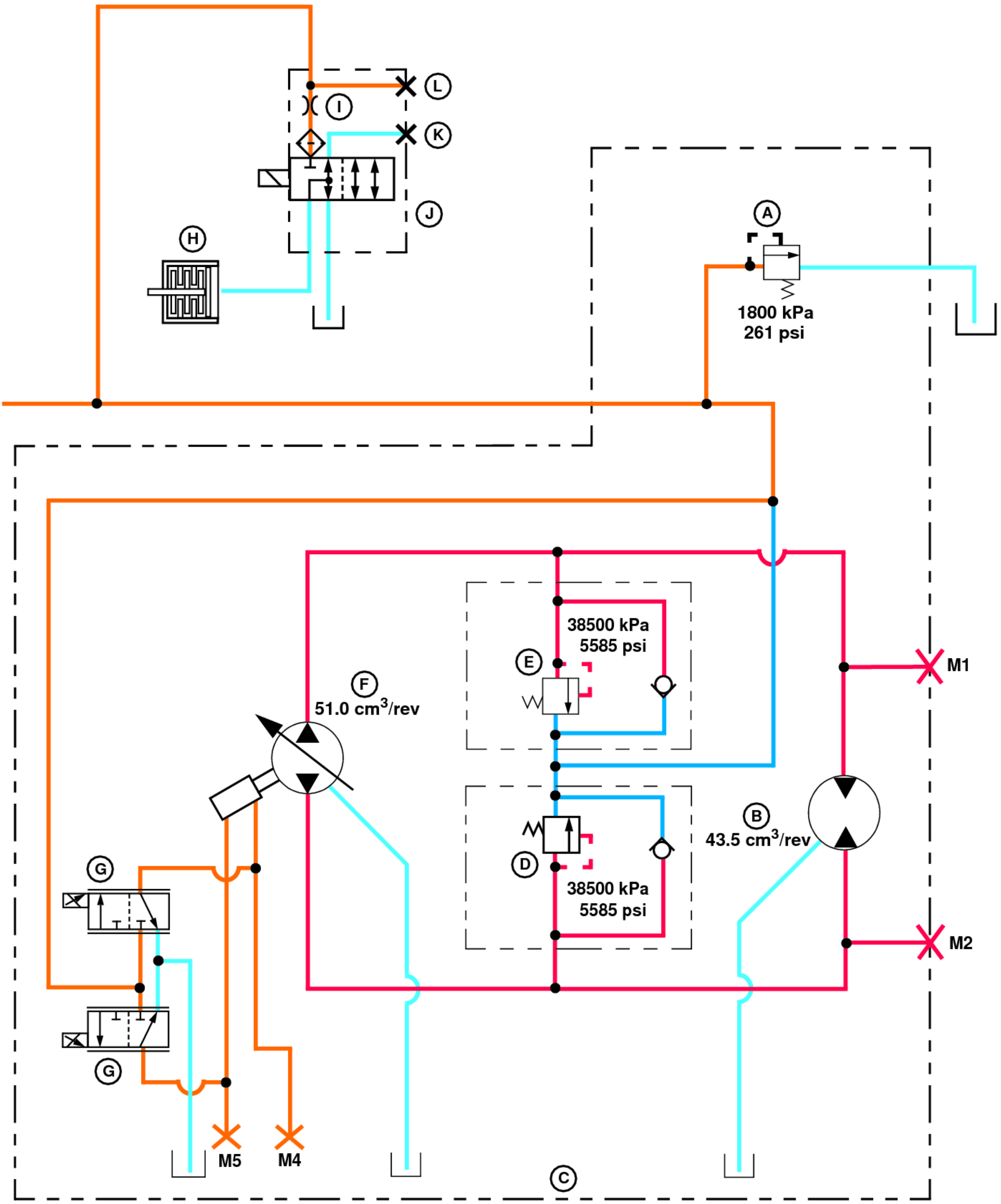
Steering/Charge Pump Circuit Schematic

LEGEND:

A	Steering Cylinder
B	Left

C	Right
D	Oil Cooler
E	In-Line Filter
F	Power Steering Valve
G	Sump Oil
H	Charge Pressure/Tunnel Lubrication Oil
I	High Pressure Oil
J	Steering Oil
K	Make Up/Closed Loop Relief Oil
L	Sump
M	Suction Filter
N	9 cm^3 /rev Gear Pump (Rear)
O	Engine
P	Steering Wheel
Q	Relief Valve

Steering/Charge Pump Schematics, eHydro



Steering/Charge Pump Circuit Schematic

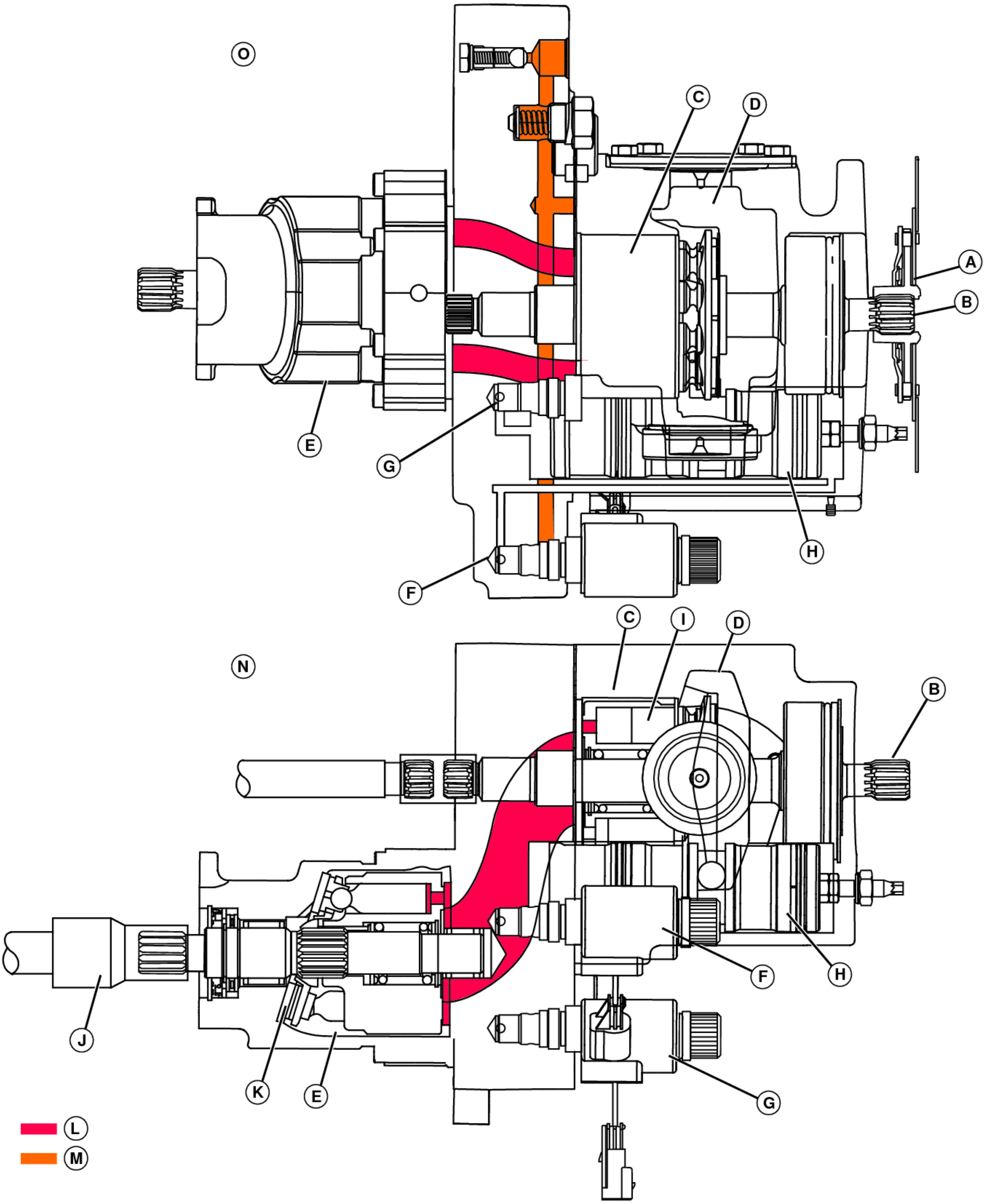
LEGEND:

A	Charge Pressure Relief Valve
B	Hydraulic Motor 43.5 cm ^{3} /rev
C	Hydrostatic Transmission
D	System Relief Valve
E	System Relief Valve
F	eHydro Hydraulic Pump 51.0 cm ^{3} /rev

G	Proportional Solenoid Valve
H	PTO Clutch
I	Orifice
J	PTO Clutch Solenoid Valve
K	Diverter Valve Port Return
L	Diverter Valve Port Out

Group 20 - Theory of Operation

eHydro Transmission Operation



eHydro transmission

LEGEND:

A	Flexible Coupler
B	Input Shaft

C	Hydrostatic Pump
D	Swash Plate
E	Drive Motor
F	Pressure Reducing Valve
G	Pressure Reducing Valve
H	Servo Piston
I	Pistons
J	Input Drive Shaft
K	Fixed Swash Plate
L	High Pressure Oil Passages (Forward/Reverse)
M	Charge Pressure Oil
N	Side View
O	Top View

Function:

The hydrostatic system transfers power from the engine to the three speed range transmission and then the final drive for the wheels. It provides infinitely variable speed control, forward or reverse, by foot pedal operation.

Principles of Operation:

The hydrostatic system is a closed loop fluid power system that consists of a charge pump on the left front side of the engine, and a piston pump/motor assembly, which is driven by a flexible coupler (A) attached to the flywheel.

Charge Pump

The charge pump is a gear type positive displacement pump mounted to the left front side of the engine.

This pump provides pressurized fluid to the SCU (Steering Control Unit). Return oil from the SCU is routed through an in-line filter, and then into the hydrostatic pump to provide replacement fluid to the closed loop of the hydrostatic transmission.

Hydrostatic Pump

The hydrostatic pump is an axial piston, variable displacement piston pump. It is mounted directly to the front of the tunnel. The input shaft (B) splines are driven by the flexible coupler attached to the engine flywheel. Any time the engine is running the input shaft is rotating (and the coupled output shaft to the PTO).

→NOTE:

The PTO drive shaft is splined to the other end of the input shaft.

The hydrostatic pump (C) is splined to the center of the input shaft. The pistons ride on the swash plate (D). As long as the swash plate is level, the pistons do not move in or out of the drive pump as it rotates.

Oil flow from the cylinder block to the drive motor (E) is controlled by changing the angle of the swash plate. This angle is changed when the forward or reverse pedals are pushed. Pushing a forward or reverse pedal will change the output of the forward or reverse position sensor. The voltage value coming from the pedal position sensor is fed into the electronic control module, which sends a variable signal to the coils on the forward or reverse proportional pressure reducing valves (F and G).

The proportional valves control the flow of hydraulic oil to each end of the servo piston (H) which is directly linked to the swash plate.

→NOTE:

The control module will only send a signal to a valve coil if all logic input signals are present within correct value ranges. Only one valve will open at a time. Oil will be provided to only one end cylinder of the servo piston at a time.

When a valve opens, hydraulic oil is routed to an end of the servo piston (H). The hydraulic oil moves the servo piston either forward or backward. A pin from the swash plate rides in a groove on the servo piston and the swash plate rotates when the servo piston moves.

As long as the forward and reverse pedals are released, the swash plate is level and no oil is being pumped.

Rotating the swash plate off center changes the distance the pistons (I) travel inside the piston bore of the rotating assembly. Because the input shaft rotates in one direction, the direction that the swash plate is rotated from center determines the direction of fluid flow to the drive motor (forward or reverse). The amount the swash plate is rotated, determines how much fluid will be displaced (speed).

The hydrostatic pump provides hydraulic fluid to the hydrostatic drive motor (E) through passages in the center section. Hydraulic fluid in the power train circulates in a closed loop. Fluid leaves the hydrostatic pump and flows through the hydrostatic motor and is returned to the hydrostatic pump, not the reservoir. Fluid that leaves this closed loop circuit, via leakage to case drain, is replenished by fluid from the charge pump. Fluid may also be dumped from the high pressure side of the loop to the low pressure side if the machine encounters a heavy load or stalls out. This happens through the high pressure relief valves.

Hydrostatic Motor

The hydrostatic motor (E) is a high torque axial piston motor. The motor is located on the rear of the center section. The hydrostatic motor drives the input shaft (J) for a three speed range gear transmission which transfers power to the wheels. See Final Drive Section.

When high pressure oil is pumped to the hydrostatic motor it is provided to one side of the motor cylinder or the other. The high pressure oil forces pistons out of the motor cylinder. The pistons follow the contour of the fixed swash plate (K) creating rotary motion of the motor cylinder. The delivery side determines rotary direction.

The pistons continue to move out of the cylinder and follow the fixed angle swash plate until they are no longer aligned with the oil delivery port. Since oil is no longer being displaced to the pistons, they no longer add to the rotary motion of the motor. But, the next pistons in line are filling with oil and the rotary motion is continued.

As the motor group continues to rotate, its pistons are pressed by the fixed angle swash plate and oil is forced from the piston bores. The displaced oil is returned to the hydrostatic pump through the center section.

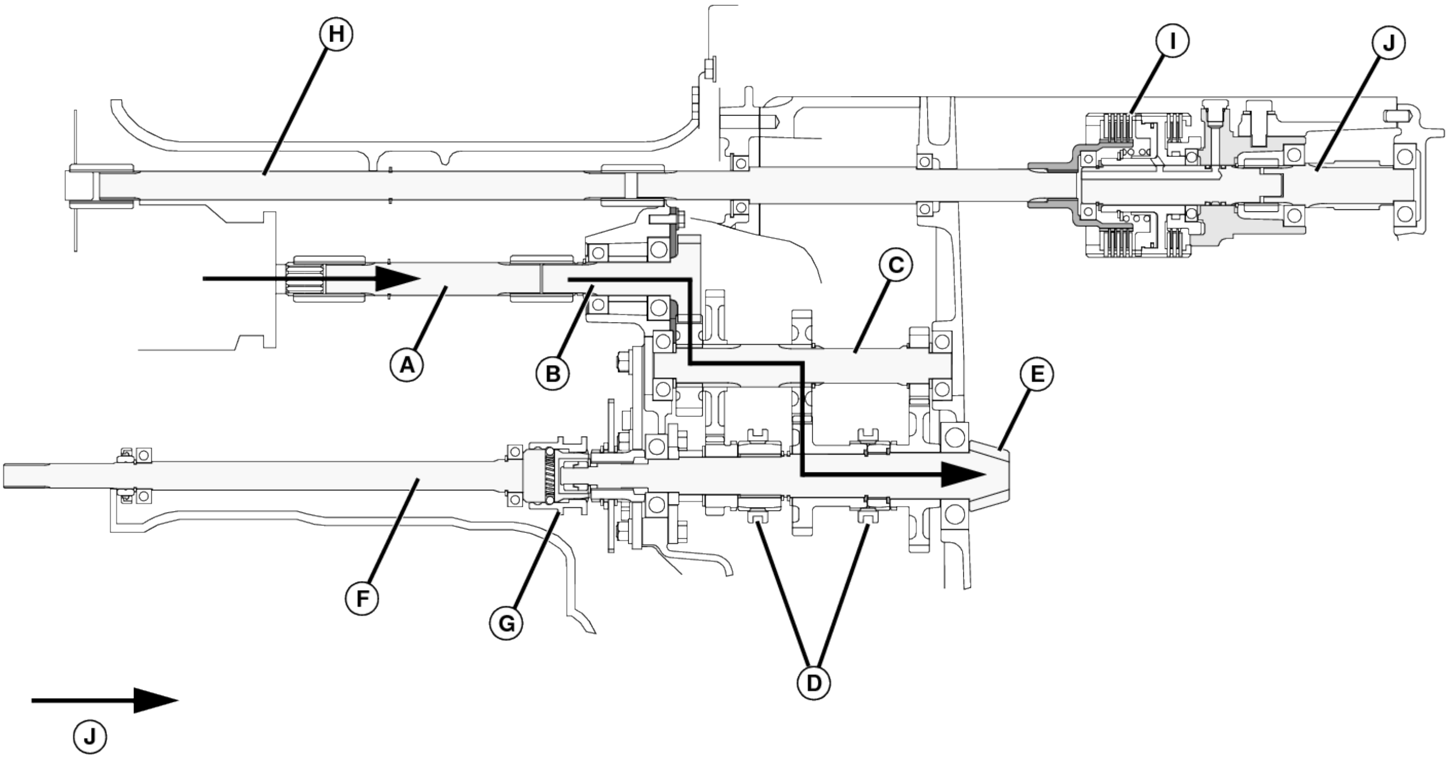
The motor output shaft is splined to the motor and rotates in the same direction as the piston block. The output shaft is splined to the rear transmission input drive shaft (J).

Range Transmission Power Flow

Function:

To transfer power from the hydrostatic transmission to the rear axles.

Theory of Operation:



Range Transmission

LEGEND:

A	Drive Shaft
B	Gear
C	Reduction Shaft
D	Shift Collars
E	Pinion Shaft
F	Front Drive Shaft
G	Collar Shift
H	PTO Drive Shaft
I	PTO Hydraulic Clutch
J	Power Flow

When the eHydro ™ transmission is engaged, there is rotation of the output shaft which is connected to the drive shaft (A) with a splined collar.

The drive shaft is splined to a gear (B) which is constantly engaged to the reduction shaft (C), and directly transfers power to the range gears.

The range transmission shift collars (D) can be shifted to one of four positions (shown in second gear—Range B). The four positions are the three gear ranges and neutral. Power is then transferred to the pinion shaft (E) and the rear axles.

Power may be provided to the front wheels through the front drive shaft (F) if the collar shift (G) is engaged to the pinion shaft.

The PTO is operated independent of the eHydro ™ transmission. The PTO drive shaft (H) is run through the hydrostatic transmission, but connected directly to the engine splined output shaft.

The PTO drive shaft is coupled to the input of the PTO hydraulic clutch (I). The PTO output shaft (J) provides power from the PTO clutch to the PTO.

The PTO is engaged through a solenoid valve. (See PTO Clutch Operation in Section 70, Group 45.)

Group 25 - Diagnostics

Hydrostatic (HST) Power Train

Test Conditions:

Operator in Seat

Engine Off

Symptom	Problem	Solution
Shift Levers and Clutch Pedal	Control pedals do not move freely and return to released position.	Check for debris/damage to pedals or broken return springs.

Test Conditions:

Operator in Seat

Engine Running at Slow Idle

Park Brake Unlocked

Symptom	Problem	Solution
Machine Movement	With the directional pedals released, machine creeps.	Adjust pedal position sensors. (See Forward and Reverse Pedal Sensor Test and Adjustment in Section 40, Group 35.)
	With the forward or reverse pedal pressed from neutral to maximum travel speed, machine does not accelerate smoothly.	Check that parking brake is fully released.
		Check that range transmission is engaged.
		Check for debris/damage to pedals. (See Forward and Reverse Pedals Assembly in Section 60, Group 40.)
		Check hydraulic oil for proper level or contamination.
		Check pedal position sensors. (See Forward and Reverse Pedal Sensor Test and Adjustment in Section 40, Group 35.)
		Check charge pressure. (See Charge Pressure Relief Valve Inspection/Replacement in Section 60, Group 40.)
		See Troubleshooting in Section 60, Group 30.

Group 30 - Troubleshooting

Troubleshooting

Symptom	Problem	Solution
Machine Will Not Move In Forward or Reverse	Hydraulic oil low.	Fill to correct level.
	Parking brake engaged or malfunctioning.	Disengage brake. Repair or replace faulty component.
	Seat switch malfunction.	Test seat switch and wiring.
	Machine operate in only one direction.	Check pedal position sensor for adjustment or calibration.
	Debris under the pedals.	Clean pedal sensor area. Test or adjust pedal position sensors.
	Charge pressure low.	(See Charge Pump Pressure Test and Adjustment in Section 60, Group 35
		Adjust charge pressure.
	Flex plate coupling between engine and hydrostatic input shaft damaged.	Repair or replace flex plate.
	Internal pump or motor damaged.	Repair or replace components as necessary.
	Transmission failure.	See Final Drive Symptom Diagnosis in Section 70, Group 30 and Final Drive Diagnosis in Section 70, Group 20..
		Repair or replace components as necessary.

Symptom	Problem	Solution
Machine Will Not Move in Forward	Machine moves in Reverse only.	Check forward pedal position sensor for calibration or malfunction. Repair or replace sensor.
	Forward proportional valve malfunctioning.	Replace valve.
	Directional relief valve stuck open.	(See Hydrostatic High Pressure Relief Test in Section 60, Group 35.)
		Repair or replace relief valve.

Symptom	Problem	Solution
Machine Will Not Move in Reverse	Machine moves in Forward only.	Check reverse pedal position sensor for calibration or malfunction. Repair or replace sensor.
	Reverse proportional valve malfunctioning.	Replace valve.
	Directional relief valve stuck open.	(See Hydrostatic High Pressure Relief Test in Section 60, Group 35.)
		Repair or replace relief valve.

Symptom	Problem	Solution
Hydraulic Pump Noisy	Hydraulic oil level low.	Fill to correct level.
	Parking brake set or not releasing.	Disengage brake. Repair or replace faulty component.
	Air in the hydraulic system.	Bleed system. (See Hydraulic System Bleed Procedure in Section 60, Group 35.)
	Charge pressure relief valve stuck open.	(See Charge Pressure Relief Valve Inspection/Replacement in Section 60, Group 40.)
		Repair or replace valve.
	Internal pump or motor damaged.	Repair or replace components as necessary

Symptom	Problem	Solution
Sluggish Response To Changes In Speed	Hydraulic oil level low.	Fill to correct level.
	Air in the hydraulic system.	Bleed system. (See Hydraulic System Bleed Procedure in Section 60, Group 35.)
	Debris under the pedals.	Clean pedal sensor area. Test or adjust pedal position sensors.
	Forward or reverse proportional valve malfunctioning.	Replace valve.
	Charge pressure low.	(See Charge Pump Pressure Test and Adjustment in Section 60, Group 35.)
		Adjust charge pressure.
	Charge pressure relief valve stuck open.	(See Charge Pressure Relief Valve Inspection/Replacement in Section 60, Group 40.)
		Repair or replace valve.
	Internal pump or motor damaged.	Repair or replace components as necessary

Symptom	Problem	Solution
Low Power	Hydraulic oil level low.	Fill to correct level.
	Air in the hydraulic system.	Bleed system. (See Hydraulic System Bleed Procedure in Section 60, Group 35.)
	Charge pressure low.	(See Charge Pump Pressure Test and Adjustment in Section 60, Group 35.)

		Adjust charge pressure.
	Directional relief valve stuck open.	(See Hydrostatic High Pressure Relief Test in Section 60, Group 35.)
		Repair or replace relief valve.
	Internal pump or motor damaged.	Repair or replace components as necessary

Symptom	Problem	Solution
Cruise Control Doesn't Work	Parking brake engaged or malfunctioning.	Disengage brake. Repair or replace faulty component.
	Transmission speed sensor malfunctioning.	Test speed sensor. Replace speed sensor as necessary.

Symptom	Problem	Solution
Load Match Doesn't Work	Transmission speed sensor malfunctioning.	Test speed sensor. Replace speed sensor as necessary.

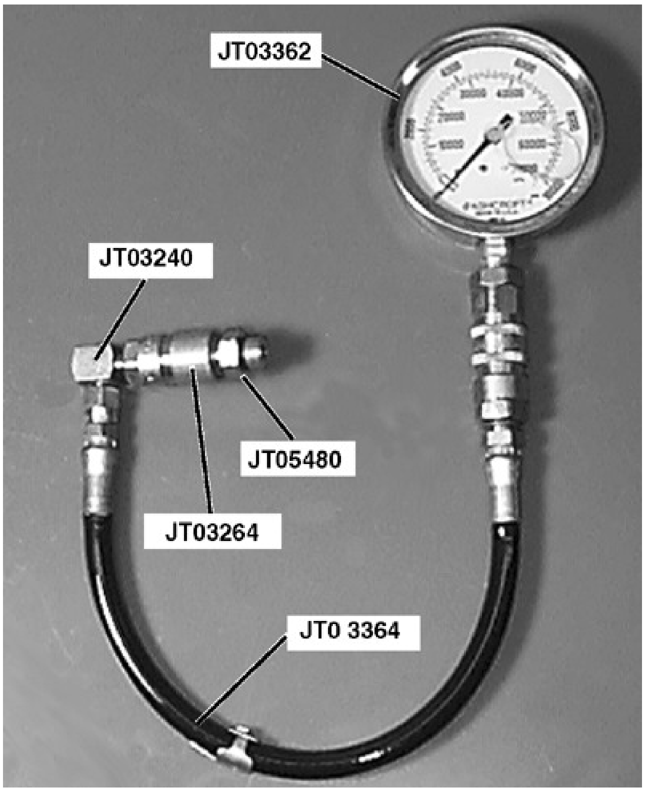
Group 35 - Tests and Adjustments

Hydrostatic High Pressure Relief Test

Reason:

To ensure that internal parts of hydrostatic pump are not worn, and the relief valves are operating properly.

Equipment:



Pressure Gauge with Hose

LEGEND:

JT03362	Pressure Gauge, 68 948 kPa, (689 bar) (10 000 psi)
JT03364	Hose
JT03240	Fitting
JT05480	Male Quick Coupler
JT03264	Female Quick Coupler
JT03252	Adapter

Procedure:

[1] -

IMPORTANT:

Avoid Damage! Make sure that the hydraulic fluid is between “ADD” and “FULL” marks on dipstick. Insufficient hydraulic fluid could damage pump and motor.

IMPORTANT:

Avoid Damage! Do not allow valves to relieve for more than 10 seconds or hydraulic oil may overheat.

Park machine on a level surface.

[2] -

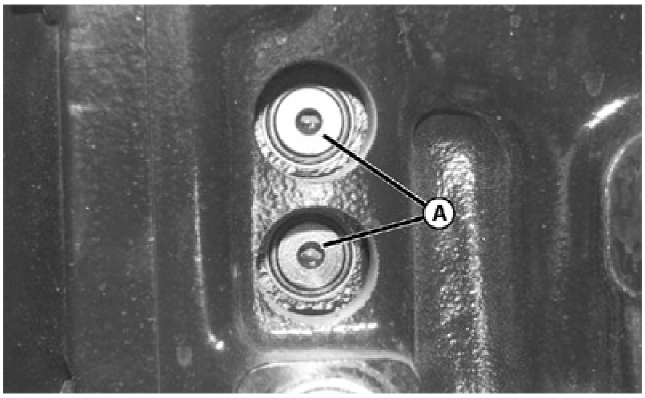
CAUTION:

Avoid Injury! Machine could move suddenly causing severe injury or damage to equipment during test procedure. Perform test in open area. Keep all personnel away from front or rear of machine.

Run machine until hydraulic oil is at operating temperature.

[3] - Stop engine.

[4] -



LEGEND:

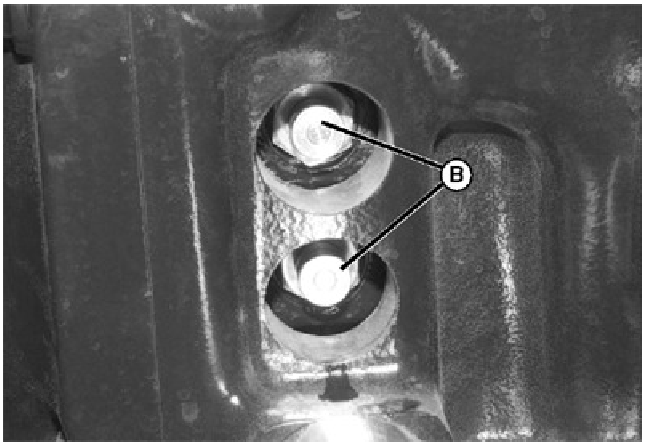
A	Test Port Plugs

Test Port Plugs

Locate test port access holes on right side of clutch housing. Remove test port plugs (A).

[5] -

> **→NOTE:**
>
> **Top test port is forward system pressure, bottom test port is reverse.**



LEGEND:

B	Test Ports

Test Ports

Install a JT05480 male quick coupler into each test port (B).

Male Quick Coupler

JT05480

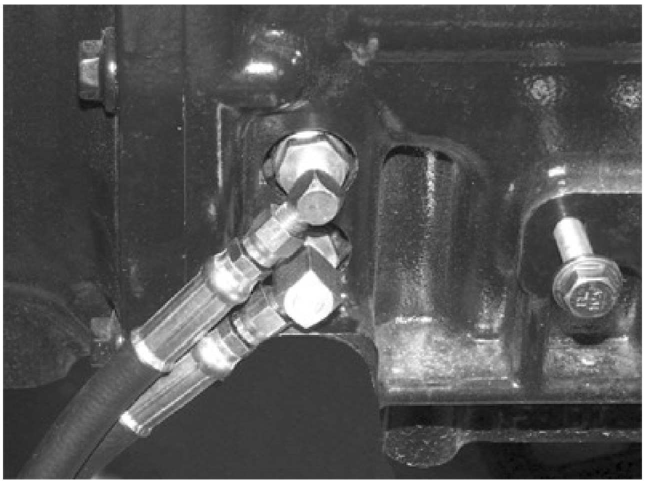
Used to test hydrostatic high pressure relief.

Female Quick Coupler

JT03264

Used to test hydrostatic high pressure relief.

[6] -



Test Ports

Attach JT03362 gauge and JT03364 hose to each test port adapter.

Pressure Gauge, 68 948 kPa, (689 bar) (10 000 psi)

JT03362 Pressure Gauge

Used to test hydrostatic high pressure relief.

Hose

JT03364

Used to test hydrostatic high pressure relief.

Adapter

JT03252

Used to test hydrostatic high pressure relief.

[7] - Position the gauges so they can be read from operator's seat.

[8] -

→NOTE:

Make sure the load match switch is OFF. Pressure reading may not get up to relief pressure if switch is ON.

Perform test from operator's seat. **Make sure the load match switch is in the OFF position.**

[9] -

CAUTION:

Avoid Injury! Make sure parking brakes are properly adjusted before test. If brakes fail to prevent wheels from turning, STOP TEST IMMEDIATELY. Repair or adjust brakes as necessary before resuming test. See Brake Section.

Apply parking brake. Place range transmission shift lever in "C" (high) position. Start engine and run at full throttle.

[10] - Slowly depress forward pedal and observe gauge. Gauge should slowly rise to approximately **38 500 kPa (385 bar) (5580 psi) and relief valve may open with an audible squealing noise** .

[11] - Repeat same procedure with reverse pedal.

Specifications:

- Pump pressure should reach **37 128—38 500 kPa (371.28—385 bar) (5385—5580 psi) in either direction and then relieve** .

Results:

- If pressure will not reach **37128 kPa (371.28 bar) (5385 psi)** in either direction, check charge pressure. (See Charge Pump Pressure Test and Adjustment in Section 60, Group 40.)
- If pressure will reach specification in one direction and not the other, one of the relief valves is defective or the seat is leaking.
- If charge pressure is good and hydrostatic pump pressure will not get up to relief pressure in both directions, hydrostatic pump is worn or damaged and must be replaced. Internal parts on hydrostatic transmission assembly are not serviceable. Remanufactured transmissions are available and must be replaced as complete units.

Charge Pump Pressure Test and Adjustment

Reason:

To ensure that charge pump is operating at specified pressure to supply oil to hydrostatic pump.

Equipment:

- JT05480—M14 x 1.5 Male Quick Coupler
- JT07041—Pressure Gauge, 2760 kPa (27.6 bar) (400 psi)
- JT03017—Hose
- JT03472—Female Quick Coupler
- RE523854—M12-to-M14 Adaptor

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission(s) to NEUTRAL.

[3] - Place PTO switch OFF.

[4] -

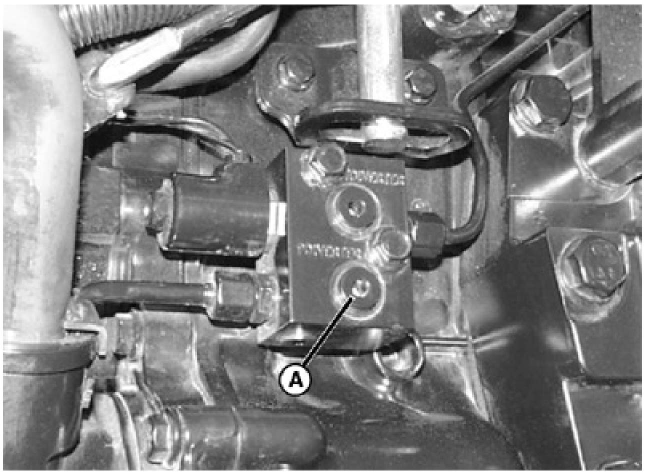
CAUTION:

Avoid Injury! Make sure to relieve system pressure before loosening any system lines or hoses.

Cycle all controls to relieve any pressure that may be in the hydraulic system.

[5] - Locate the PTO clutch solenoid valve on left side of the machine (above hydraulic suction filter).

[6] -



LEGEND:
A Solenoid Valve Pressure Port

Solenoid Valve Pressure Port

Remove plug from PTO clutch solenoid valve pressure port (A).

[7] - Install quick connect fitting. Install hose and pressure gauge to fitting.

M14 x 1.5 Male Quick Coupler

JT05480

Used to test and adjust charge pump pressure.

Pressure Gauge, 2760 kPa (27.6 bar) (400 psi)

JT07041

Used to test and adjust charge pump pressure.

JT03017

Hose

Used to test and adjust charge pump pressure.

Female Quick Coupler

JT03472

Used to test and adjust charge pump pressure.

[8] - Start engine and run at high idle.

[9] - Check pressure gauge for charge pressure.

[10] - Stop machine.

[11] - Cycle all controls to relieve any pressure that may be in the hydraulic system.

[12] - Remove test gauge and fittings.

[13] - Install plug in port (A).

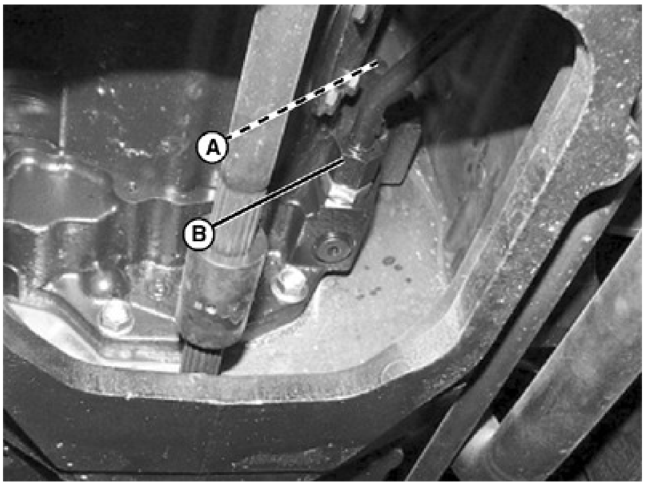
Results:

- Charge pressure should reach specification.

Item	Measurement	Specification
Charge Pump Pressure	Pressure	1500—2000 kPa (15—20 bar) (217—290 psi)

- If minimum pressure reading of 1500 kPa (15 bar) (217 psi). cannot be obtained; the mesh in-line strainer may be restricted, the suction line filter may be restricted, the front hydraulic pump may be defective, the hydraulic oil may be too hot, or the charge pressure relief valve is damaged or leaking.

Adjustment:



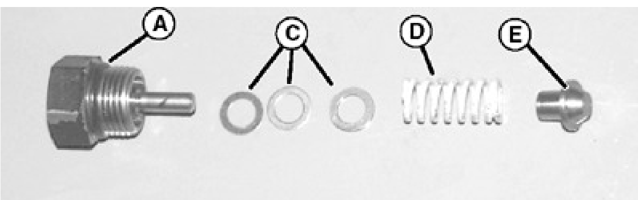
LEGEND:
A Charge Pressure Relief Valve Cap
B Charge Pressure Line

Charge Pressure Line

[1] - Remove charge pressure line (B).

[2] - Remove charge pressure relief valve cap (A).

[3] -



LEGEND:
A Cap
C Shims
D Spring
E Poppet

Charge Pressure Relief Valve

Inspect cap (A), shims (C), spring (D) and poppet (E). Carefully examine seating area of poppet and seat in transmission block. Replace worn or damaged parts.

[4] - Shims come in various thicknesses. Add shims to increase pressure, remove shims to decrease pressure.

[5] - Replace O-ring on cap when reinstalling.

Group 40 - Repair

Charge Pressure Relief Valve Inspection/Replacement

→NOTE:

Charge pressure relief valve can be accessed from bottom of machine.

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission(s) to NEUTRAL.

[3] - Place PTO switch OFF.

[4] -

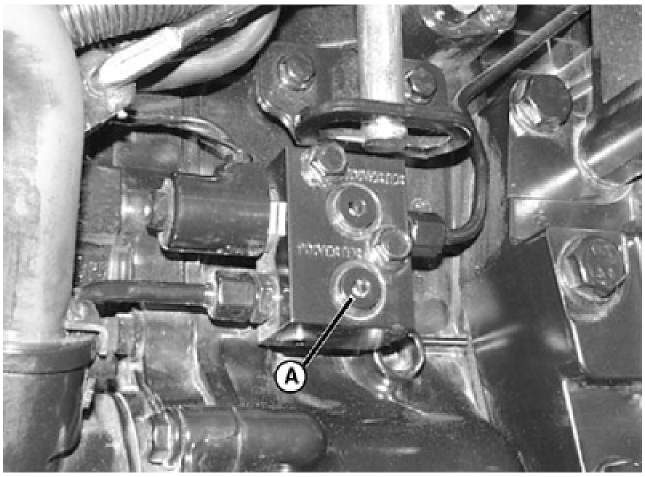
CAUTION:

Avoid Injury! Make sure to relieve system pressure before loosening any system lines or hoses.

Cycle all controls to relieve any pressure that may be in the hydraulic system.

[5] - Locate the PTO valve on the bottom of the machine.

[6] -



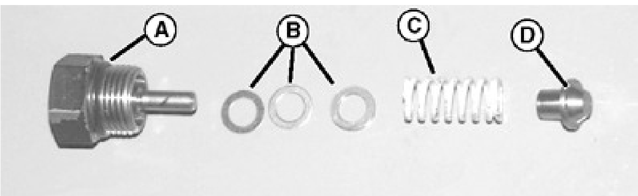
LEGEND:
A PTO Clutch Solenoid Valve Pressure Port Plug

Clutch Solenoid Valve Pressure Port

Remove plug from PTO clutch solenoid valve pressure port (A).

[7] - Remove charge pressure relief valve cap. (See Charge Pump Pressure Test and Adjustment in Section 60, Group 35.)

[8] -



LEGEND:

A	Cap
B	Shims
C	Spring
D	Poppet

Cap-Shims-Spring-Poppet

Inspect cap (A), shims (B), spring (C) and poppet (D). Carefully examine seating area of poppet and seat in transmission block. Replace any worn or damaged parts.

[9] - Replace O-ring on cap when installing cap.

Forward and Reverse Position Sensors

Removal:

This procedure applies to one or both of the position sensors.

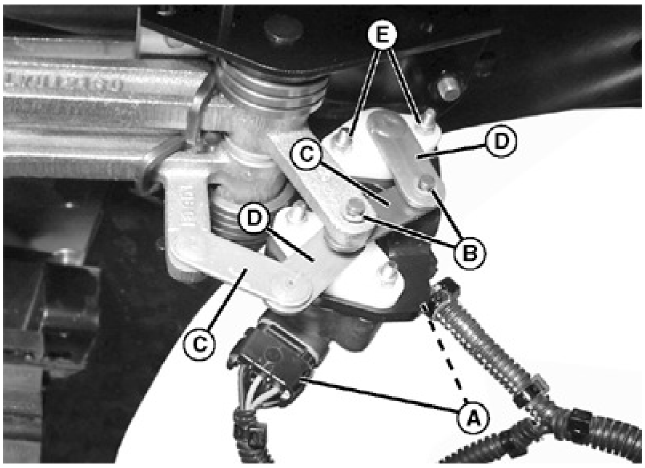
IMPORTANT:

Avoid Damage! Do not loosen or remove position sensors unless they need to be replaced. The position sensor output must be calibrated for logic controller function. If the position sensor is not set within the correct output range, the machine will not operate forward or reverse.

[1] - Safely park machine.

[2] - Locate and remove cover from forward and reverse pedal bracket located under operator's floor platform.

[3] -



LEGEND:

A	Wiring Harness Connector (2 used)
B	E-Clip (2 used)
C	Link (2 used)
D	Rotary Arm
E	Lock Nut (2 used)

Rotary Arm Assembly

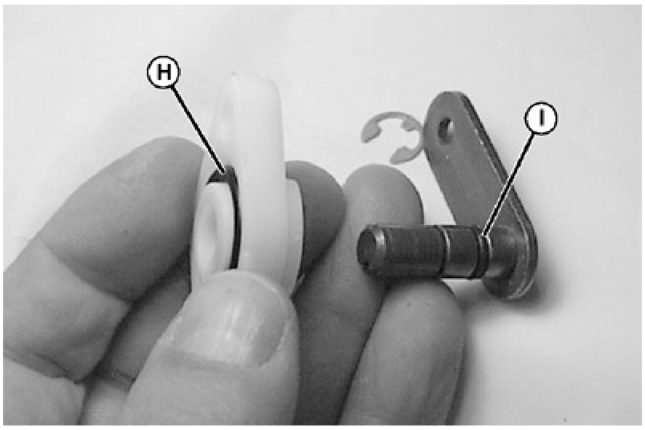
Mark wiring harness connectors (A) and forward and reverse position sensors to aide re-connection. Disconnect wiring harness connectors.

[4] - Remove E-clips (B) from link(s) (C) connecting the rotary arm (D) to the pedal arm. Disconnect the link from the rotary arm.

[5] - Remove lock nuts (E). Remove rotary arm assembly.

[6] - Remove position sensor.

[7] -



LEGEND:

H	O-Ring
I	O-Ring

Rotary Arm

Remove E-clip from rotary arm and remove arm from cover. Replace O-ring (H) and (I) before reassembly.

Installation:

→NOTE:

The forward and reverse position sensors must be accurately set after replacement.

[1] - Install cap screws through position sensor and place in bracket. Install rotary arm and cover. As needed, use a small amount of grease to hold O-ring(s) in place during assembly.

[2] - Install lock nuts. Tighten just enough that the position sensor will stay in place without turning, but can be rotated by hand.

[3] - If removed, repeat steps for second position sensor and rotary arm assembly.

[4] -

IMPORTANT:

Avoid Damage! Torque specification is critical.

Perform position sensor calibration. Tighten lock nuts to specification.

[5] - Install cover.

Item	Measurement	Specification
Lock Nut	Torque	3.4 N·m (30 lb.-in.)

Forward and Reverse Pedals Assembly

Disassembly:

[1] - Safely park machine.

[2] - Remove forward and reverse pedals.

[3] - Locate and remove cover from forward and reverse pedal bracket under floor operator’s platform.

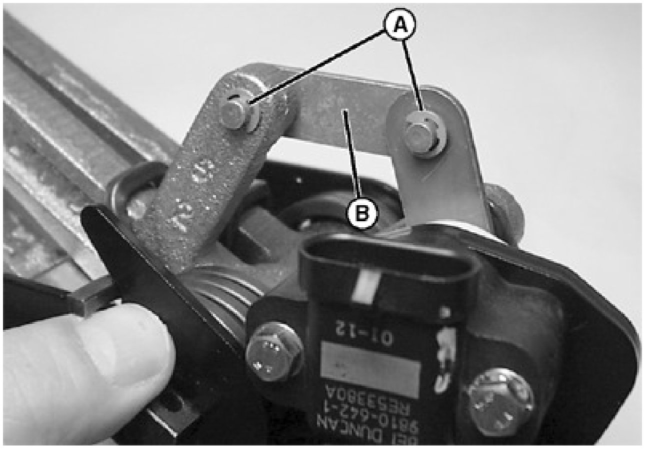
[4] - Remove operator’s platform. See procedure in Miscellaneous section.

[5] - Mark wiring harness connectors and forward and reverse position sensors for aid in installation. Disconnect wiring harness connectors from forward and reverse position sensors.

[6] - Remove socket head cap screws and forward and reverse foot pedals from arms.

[7] - Remove three cap screws securing pedal assembly to foot deck.

[8] -



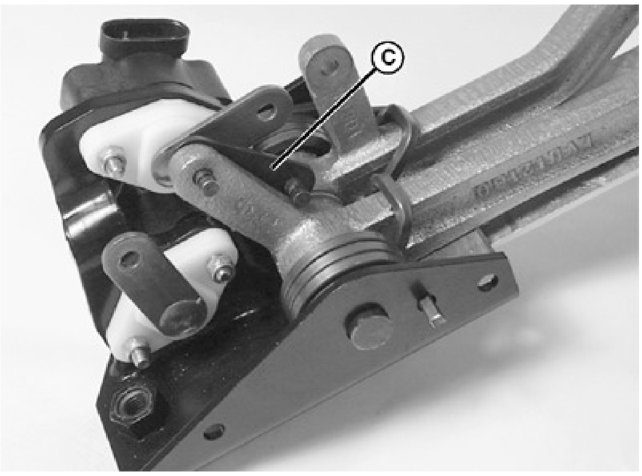
LEGEND:

A	E-Clip (2 used)
B	Reverse Pedal Link

Reverse Pedal Link

Remove E-clips (A) securing the link (B) between the reverse pedal and position sensor. Remove link.

[9] -



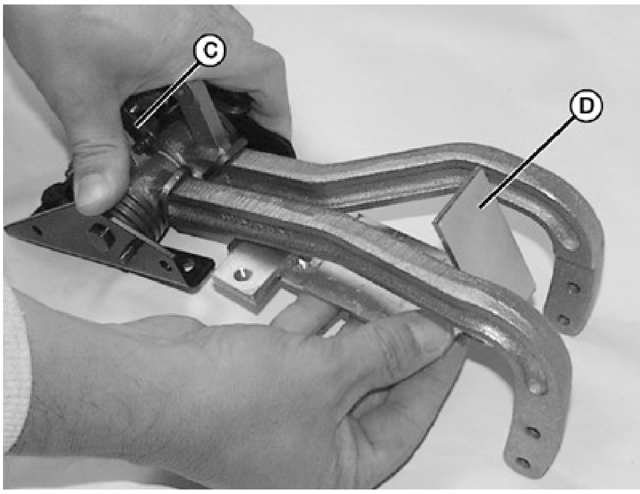
LEGEND:

C	Forward Pedal Link

Forward Pedal Link

Remove E-clips securing second link (C). Remove link end from position sensor arm and rotate the link against the forward pedal.

[10] -



LEGEND:

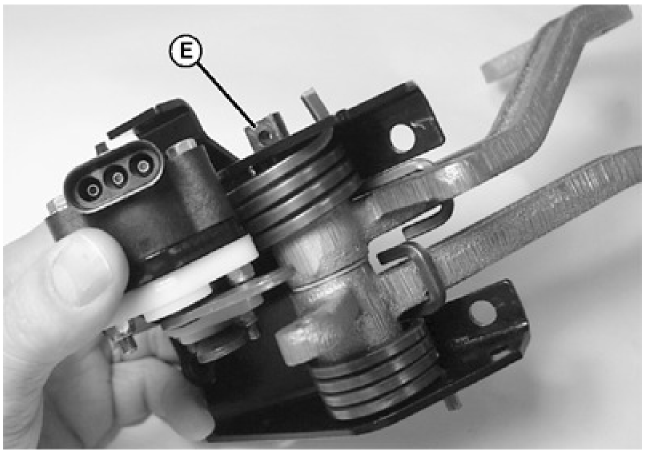
C	Second Link
D	Pedal Stop Bracket

Pedal Assembly

Place pedal assembly on a hard flat surface. Push center of assembly down (compressing springs) until pedal stop bracket (D) can be removed. Release assembly allowing springs to relax.

[11] - Remove link (C) from forward pedal.

[12] -



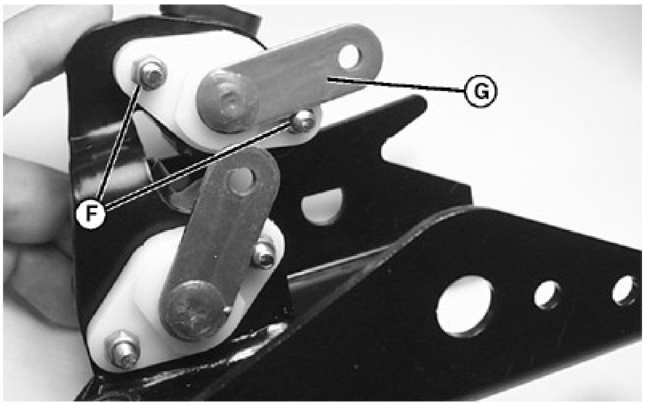
LEGEND:

E	Drilled Pedal Shaft

Pedal Shaft

Remove pin securing drilled pedal shaft (E) in bracket. Slide axle out of bracket. Remove reverse pedal, washer, forward pedal and shaft.

[13] -



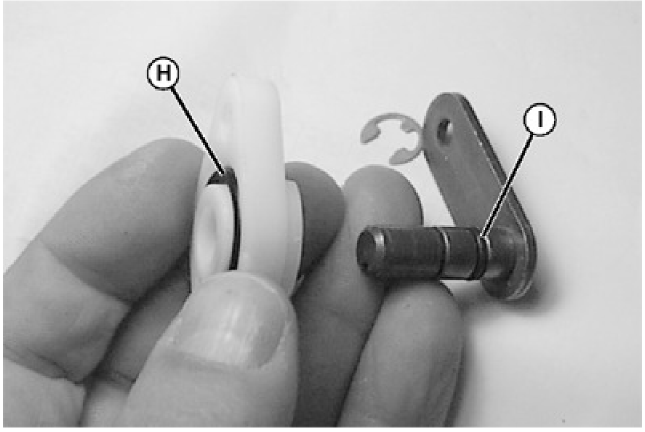
LEGEND:

F	Lock Nuts and Cap Screws
G	Rotary Arm and Cover Assembly

Position Sensor

Remove lock nuts (F) and cap screws from position sensor. Remove rotary arm and cover assembly (G).

[14] -



LEGEND:

H	O-Ring
I	O-Ring

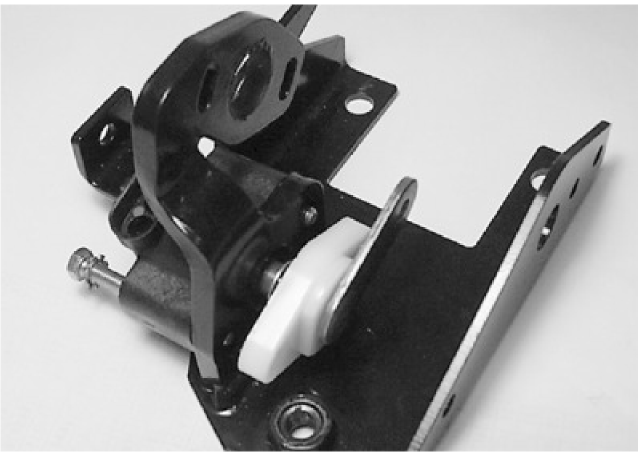
Rotary Arm

Remove E-clip from rotary arm and remove arm from cover. Replace O-ring (H) and (I) before reassembly.

Assembly:

→NOTE:

The forward and reverse position sensors must be accurately set after replacement. See “ eHydro ™ Test and Set-up Procedures in the Electrical section.



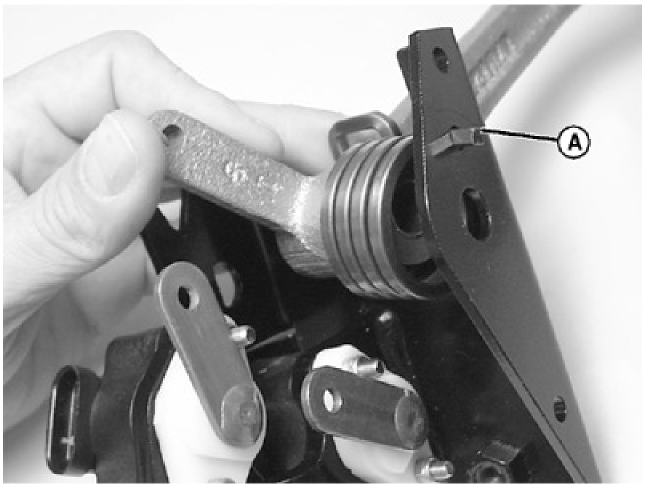
Pedal Bracket

[1] - Install cap screws through position sensor and place in bracket. Install rotary arm and cover. As needed, use a small amount of grease to hold O-ring(s) in place during assembly.

[2] - Install and tighten lock nuts enough that the position sensor will stay in place without turning, but can be rotated by hand.

[3] - Repeat steps for second position sensor and rotary arm assembly.

[4] -



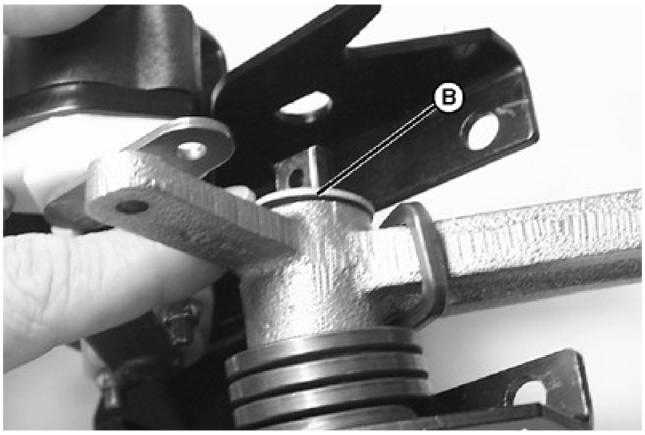
LEGEND:

A	Spring End

Forward Pedal Spring

Install springs to pedals. Hold forward pedal in bracket and place end of spring (A) through hole in bracket.

[5] -



LEGEND:

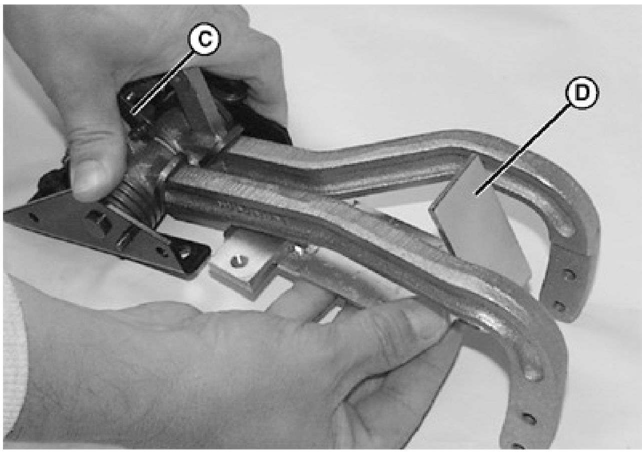
B	Washer

Pedal Shaft Washer

Slide pedal shaft through bracket and forward pedal. Install washer (B) onto shaft.

[6] - Place reverse pedal into position and pedal shaft through pedal and bracket. Secure shaft in place with pin.

[7] -



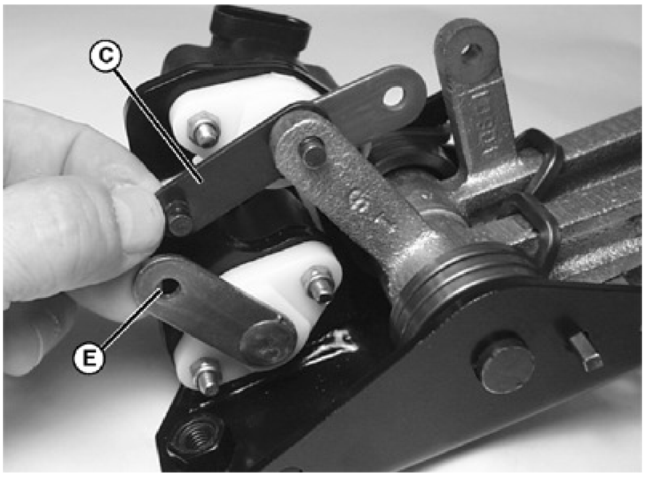
LEGEND:

C	Link
D	Pedal Stop

Pedal Assembly

Install link (C) and rotate until resting on pedal arm. Place assembly on hard flat surface and press down center until pedal stop (D) can be slid into place.

[8] -



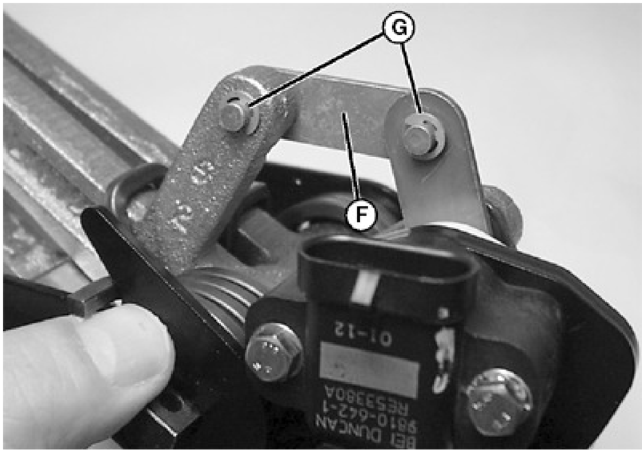
LEGEND:

C	Link
E	Rotary Arm

Link and Rotary Arm

Rotate link (C) and place it through hole in rotary arm (E). Secure link with two E-clips.

[9] -



LEGEND:

F	Second Link
G	E-Clip (2 used)

Reverse Pedal

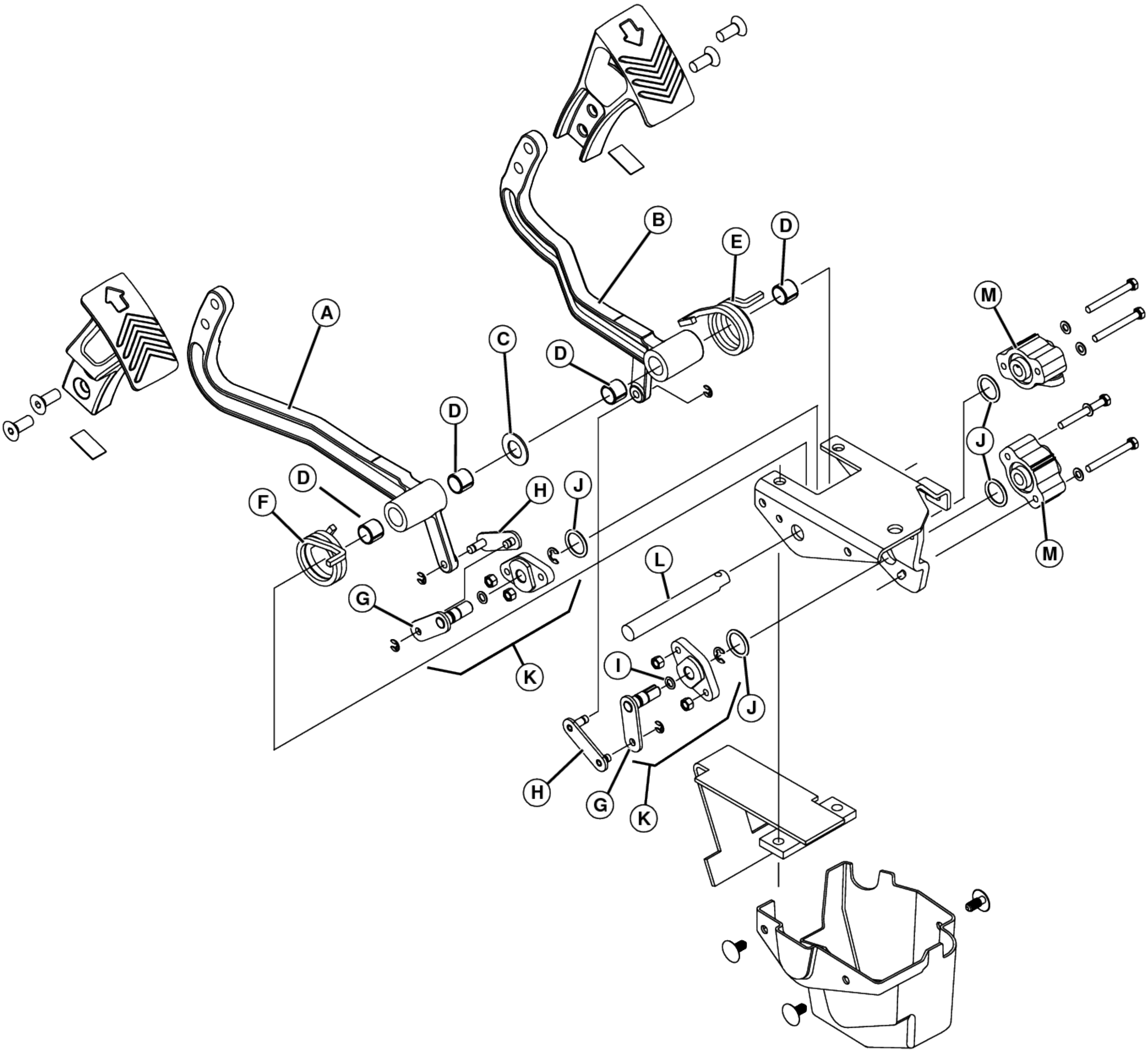
Install second link (F) between reverse pedal and rotary arm. Secure link with E-clips (G).

[10] - Secure assembly.

[11] - Calibrate position sensors to correct positions. Tighten lock nuts to specification.

Item	Measurement	Specification
Lock Nut	Torque	3.4 N·m (30 lb.-in.)

Forward and Reverse Pedals Component Exploded View



Forward and Reverse Components

LEGEND:

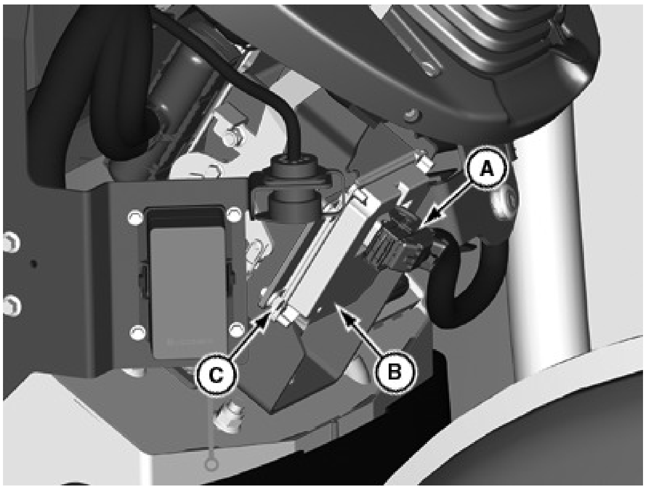
A	Forward Pedal Arm
B	Reverse Pedal Arm
C	Washer, Non-Metallic
D	Bushing (2 used per Pedal)
E	Spring, Forward Torsion
F	Spring, Reverse Torsion
G	Rotary Arm
H	Link
I	O-ring
J	O-ring
K	Rotary Arm Assembly (2 used)
L	Pedal Shaft
M	Position Sensor (2 used)

Transmission Control Unit (TCU) Removal and Installation (Cab)

[1] - Disconnect negative (—) battery terminal.

[2] - Remove cowl panel. (See Cowl Panel Removal and Installation (Cab) in Section 120, Group 10.)

[3] -



LEGEND:
A Harness Connector
B Transmission Control Unit
C Cap Screw (4 used)

Transmission Control Unit

Disconnect harness connector (A).

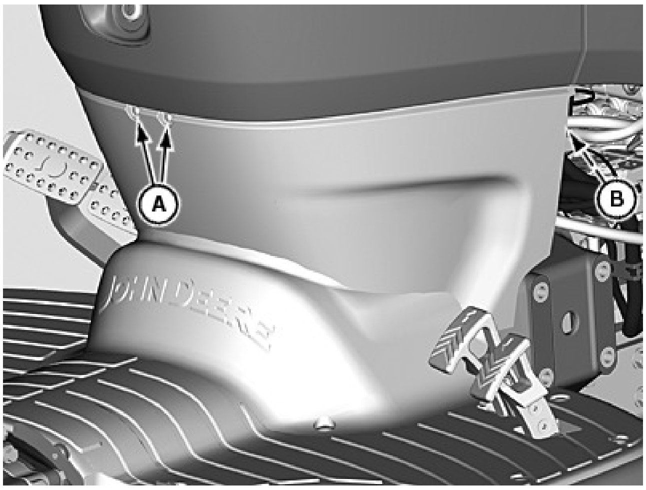
[4] - Remove four cap screws (C) and transmission control unit (B).

[5] - Installation is done in the reverse order of removal.

Transmission Control Unit (TCU) Removal and Installation (Open Station)

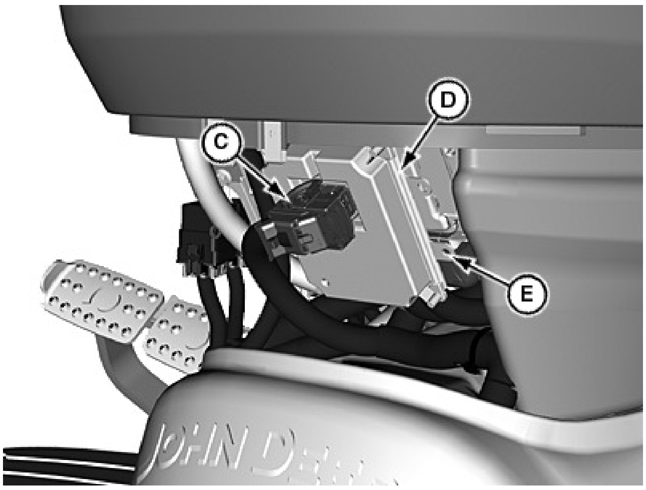
[1] - Disconnect negative (—) battery terminal.

[2] -



LEGEND:
A Screw (2 used)
B Cap Screw (2 used)
C Harness Connector
D Transmission Control Unit
E Cap Screw (4 used)

Lower Skirt



Transmission Control Unit

Remove two screws (A).

[3] - Remove two cap screws (B) and lower skirt.

[4] - Disconnect harness connector (C).

[5] - Remove four cap screws (E) and transmission control unit (D).

[6] - Installation is done in the reverse order of removal.

Section 65 - POWER TRAIN—POWRREVERSER

Table of contents

Group 05 - Specifications

Specifications

Item	Measurement	Specification
Clutch Linkage		
Adjustment	Distance (center-to-center)	232 mm (9.134 in.)
PRT Clutch Plates		
End Plate	Thickness (minimum)	4.85 mm (0.191 in.)
Separator Plate(s)	Thickness (minimum)	2.85 mm (0.112 in.)
Friction Plate(s)	Thickness (minimum)	2.7 mm (0.106 in.)
Clutch Spring	Length (minimum)	45.5 mm (1.79 in.)
General Torque Specifications		
SCV Port Tube Hydraulic Line Nut	Torque	40—57 N·m (30—43 lb-ft)
PTO Pressure Tube To PTO Valve Hydraulic Line Nut	Torque	40—57 N·m (30—43 lb-ft)
PTO Pressure Tube To Hydraulic Pump Nut	Torque	40—57 N·m (30—43 lb-ft)
Gear Case To Gear Case Cap Screw	Torque	126—154 N·m (95—115 lb-ft)
Center Plate To Housing Cap Screw	Torque	85 N·m (63 lb-ft)
Front Cover To Clutch Housing (Tunnel) Cap Screw	Torque	23—29 N·m (17—22 lb-ft)
Reverse Case To Front Cover Cap Screw	Torque	19—23 N·m (14—17 lb-ft)
Traction Clutch Mounting Cap Screw	Torque	43 N·m (32 lb-ft)
Neutral Switch	Torque	27 N·m (20 lb-ft)
Mounting Valve Block Cap Screw	Torque	24.4 N·m (18 lb-ft)
Detent Assembly Cap Screw	Torque	19 N·m (14 lb-ft)
Cover Plate Cap Screw	Torque	26 N·m (21 lb-ft)
Valve Block To Valve Block Cap Screw	Torque	24.4 N·m (18 lb-ft)
Hydraulic Line to Valve Block Nut	Torque	40—57 N·m (30—43 lb-ft)
Clutch Link Preset	Length	232 mm (9.134 in.)
Gauge Reading 2 Seconds with Pedal Released (Up)	Pressure	1792 — 2000 kPa (260 — 290 psi)
Gauge Reading with Pedal Pressed Down Fully	Pressure (Less Than)	207 kPa (30 psi)
Clutch Swivel Adjustment	Length	232 mm (9.134 in.)
Spool Cover Plate Cap Screw	Torque	26 N·m (21 lb-ft)
Detent Ball Plug	Torque	19 N·m (14 lb-ft)
Case Cap Screw	Torque	24.4 N·m (18 lb-ft)
Transmission Housing Cap Screw	Torque	24.4 N·m (18 lb-ft)
Neutral Switch	Torque	27 N·m (20 lb-ft)
Hydraulic Line Nuts	Torque	50 N·m (37 lb-ft)
Hydraulic Reservoir	Capacity	23.8 liters (6.3 gal)
Machine Sections Retaining Cap Screw	Torque	126—154 N·m (95—115 lb-ft)
Work Port Tubes	Torque	40—57 N·m (30—43 lb-ft)
Hydraulic Pressure Line	Torque	40—57 N·m (30—43 lb-ft)
PowrReverser™ Valve Supply Line	Torque	40—57 N·m (30—43 lb-ft)
Traction Clutch Mounting Cap Screw	Torque	43 N·m (32 lb-ft)
End Plate	Minimum Thickness	4.85 mm (0.191 in.)
Separator Plate(s)	Minimum Thickness	2.85 mm (0.112 in.)
Friction Plate(s)	Minimum Thickness	2.7 mm (0.106 in.)
Spring	Length (minimum)	45.5 mm (1.79 in.)
Cap Screw	Torque	19–23 N·m (14–17 lb-ft)
Jam Nut	Torque	78.5—9.8 N·m (57.9 7.2 lb.-ft.)
Filter Housing Cap Screw	Torque	44—59 N·m (32.4—43.5 lb.-ft.)
Nuts, Lockwashers, and Cap Screw	Torque	44—59 N·m (32.4—43.5 lb.-ft.)
Case to Case Cap Screws		79—98 N·m (58—72 lb.-ft.)
Oil filter Case Cap Screws		44—59 N·m (33—44 lb.-ft.)
Hydraulic Line Nuts		40—57 N·m (30—43 lb.-ft.)

Essential or Recommended Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Spring Washer Compressor

JDT 24B

To compress spring on clutch packs.

Splitting Stands and Brackets

JTO 7335-1,2,3

For splitting machine

Adapter

JTO 3349

Hydraulic pressure tests

Hose

JTO 3017

Hydraulic pressure tests

Gauge

JTO 3344

Hydraulic pressure tests

Spring Washer Compressor

JDT24B

To disassemble clutch body.

Service Equipment and Tools

→NOTE:

Order tools according to information given in the SERVICEGARD ™ Catalog. Some tools may be available from a local supplier.

Splitting Stands

JTO7335

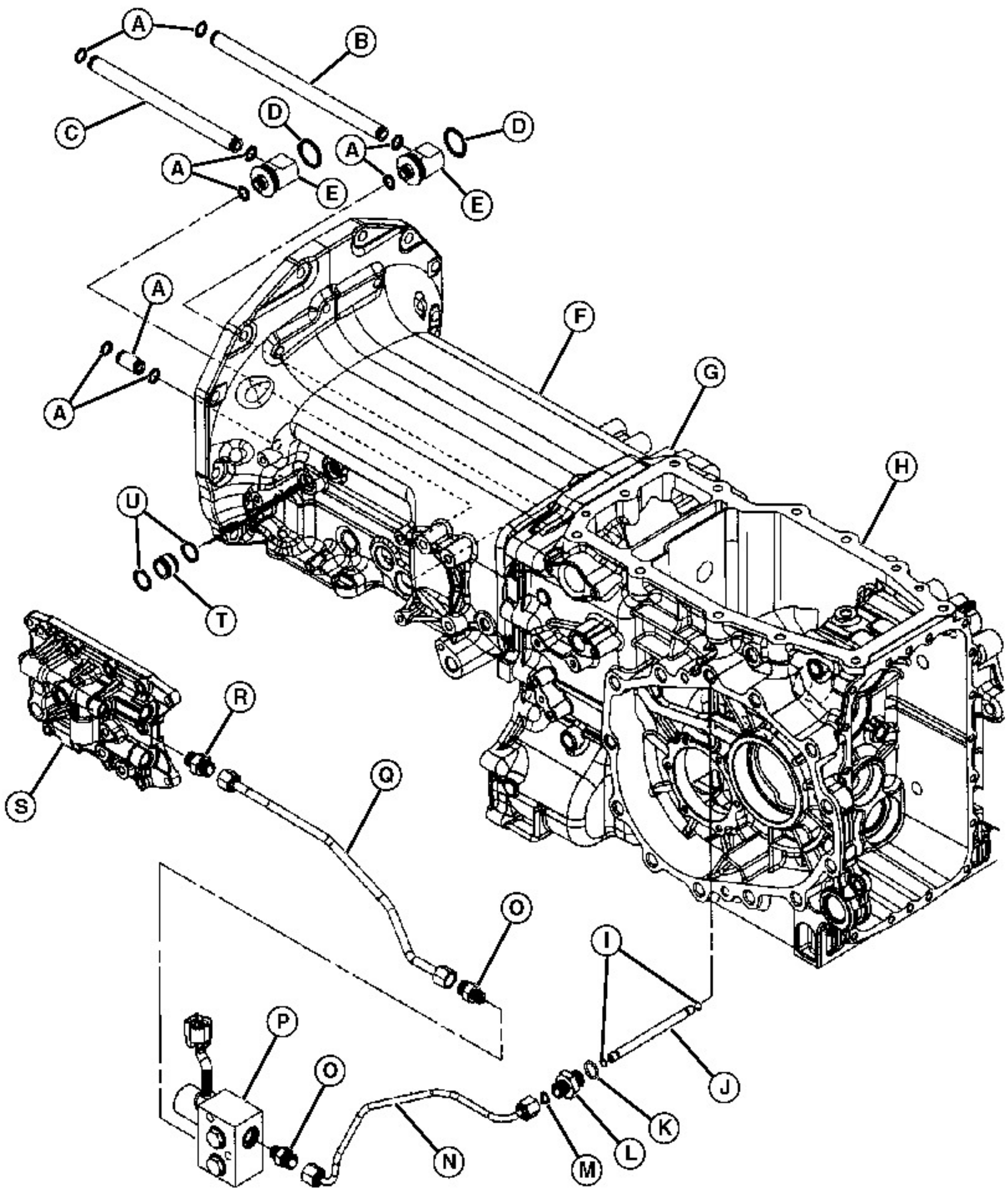
Split the Machine

Other Material

Number	Name	Use
• PM37509 (us)	John Deere Clean and Cure Primer	Clean mating surfaces; helps speed curing.
• PM37465 Canada PM38616 Loctite ™ 587 (us)	RTV Silicone Form-in-Place Gasket	Sealing non-gasketed surfaces
• TY6333 (us)	Moly High Temperature EP Grease	To lubricate synchronizers.
• PM37418 Canada PM37477 Loctite ™ 242 (us)	Thread Lock and Sealer (Medium Strength)	On dowel pins and certain cap screws.

Group 10 - Component Location

Tunnel and Transmission Case



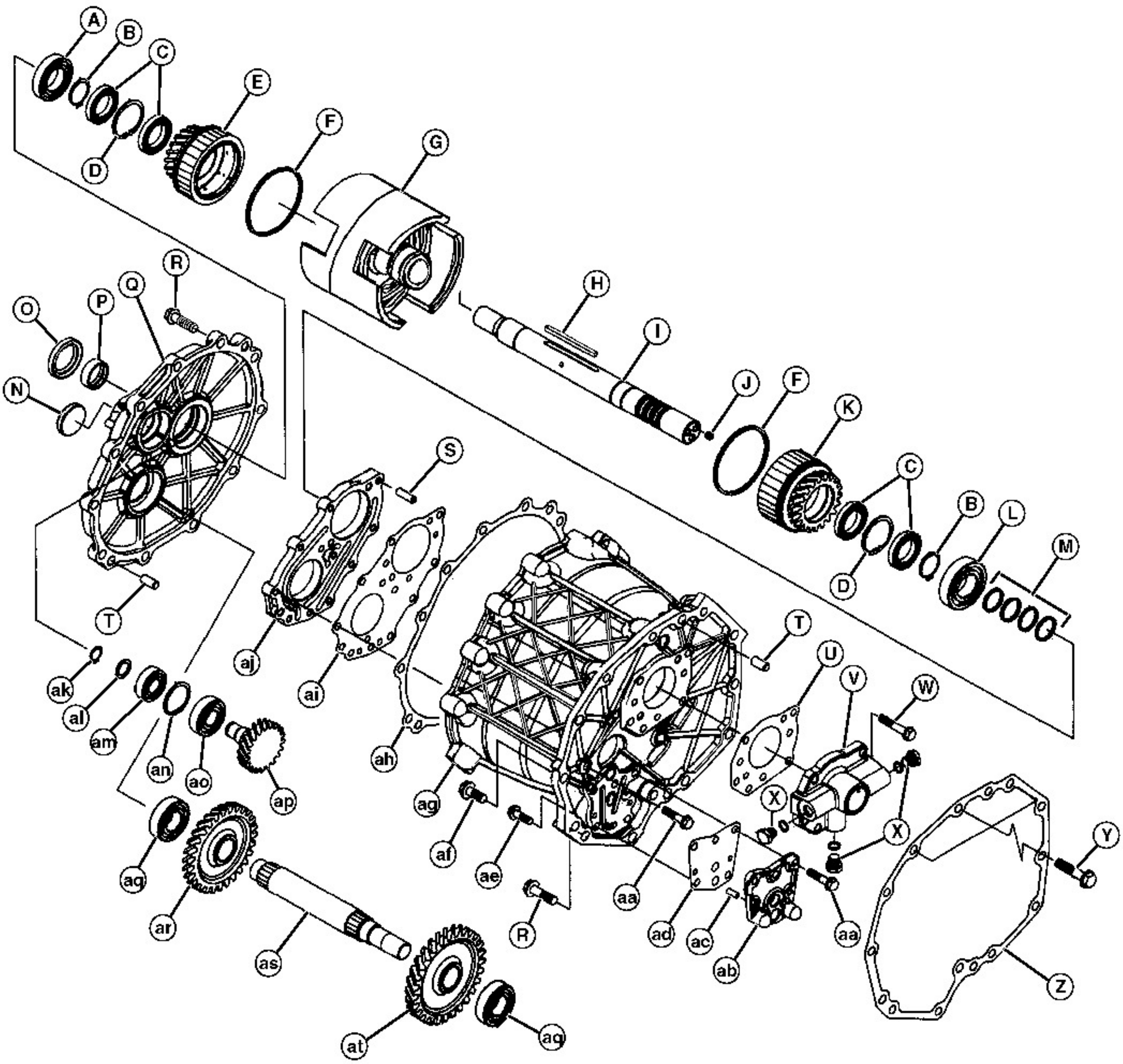
Tunnel and Transmission Case Components

LEGEND:

A	O-Ring
B	Hydraulic Tube
C	Hydraulic Tube
D	O-Ring
E	Elbow Fitting
F	Tunnel Case
G	Center Case
H	Transmission and Final Drive Case
I	O-Ring
J	Hydraulic Tube
K	O-Ring
L	Adaptor Fitting
M	O-Ring
N	Hydraulic Line
O	Adaptor Fitting
P	PTO Valve Manifold

Q	Hydraulic Line
R	Adaptor Fitting
S	PRT Valve
T	Hydraulic Tube
U	O-Ring

PRT Clutch



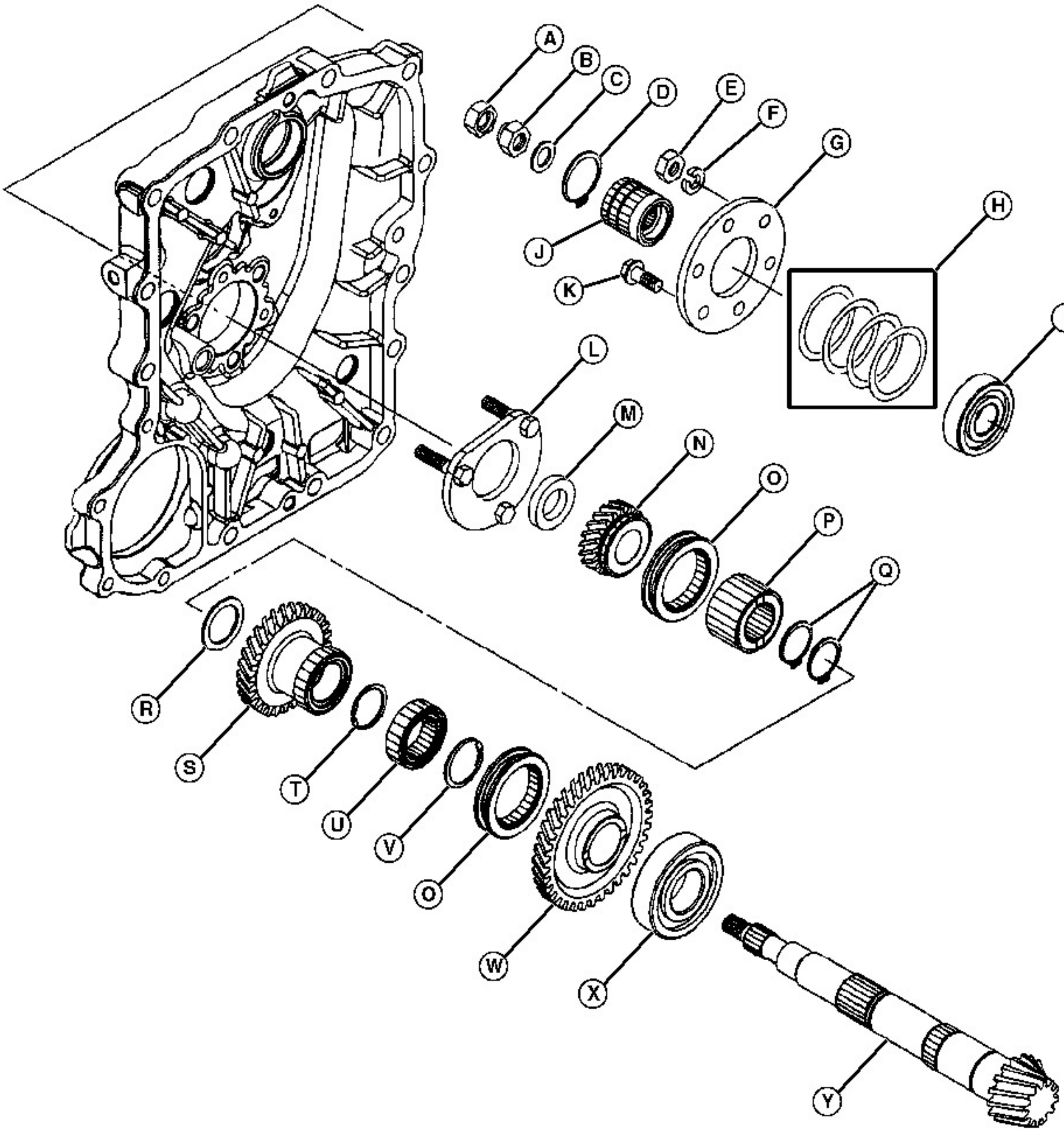
PRT Clutch Components

LEGEND:

A	Bearing
B	Retaining Ring
C	Bearing
D	Retaining Ring
E	Clutch Gear, 25T
F	Ring
G	Clutch Housing
H	Key
I	Clutch Shaft
J	Port Plug
K	Clutch Gear, 26T
L	Bearing
M	Shaft Seals
N	Plug
O	Shaft Seal
P	Sleeve

Q	Cover
R	Cap Screw M10x35
S	Alignment Dowel
T	Alignment Dowel
U	Gasket
V	Valve Case
W	Cap Screw M8x45
X	Plug and O-Ring
Y	Cap Screw M10x45
Z	Gasket
AA	Cap Screw M8x35
AB	Cover Plate
AC	Alignment Dowel
AD	Gasket
AE	Cap Screw M8x35
AF	Cap Screw M8x25
AG	Traction Clutch Case
AH	Gasket
AI	Gasket
AJ	Bearing Holder
AK	Retaining Ring
AL	Washer
AM	Bearing
AN	Retaining Ring
AO	Bearing
AP	Reverse Idler Gear, 22T
AQ	Bearing
AR	Shaft Gear, 42T
AS	Shaft
AT	Shaft Gear, 45T

Drive/Pinion Shaft



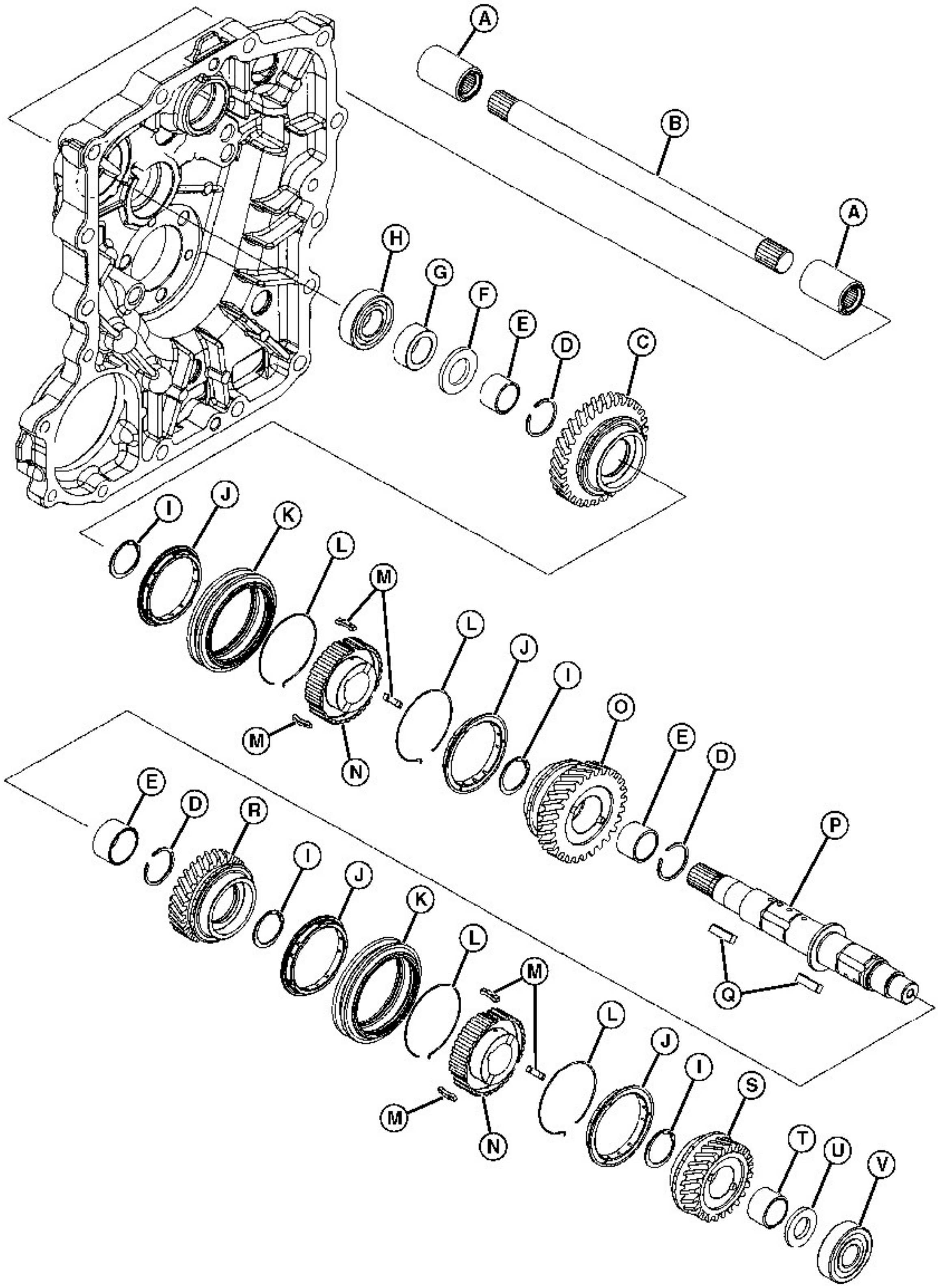
Drive/Pinion Shaft Components

LEGEND:

A	Wedge Nut
B	Collared Jam Nut
C	Spacer
D	Retaining Ring
E	Nut
F	Lock Washer
G	Outer Bearing Retainer
H	Shims (used as needed)
I	Bearing
J	Coupler Gear
K	Cap Screw
L	Inner Bearing Retainer
M	Spacer
N	Gear, 20T
O	Shift Collar
P	Long Splined Collar
Q	Retaining Ring
R	Spacer

S	Gear, 35T
T	Retaining Ring
U	Short Splined Collar
V	Retaining Ring
W	Gear, 51T
X	Bearing
Y	Drive/Pinion Shaft

4 Speed Gear Shaft



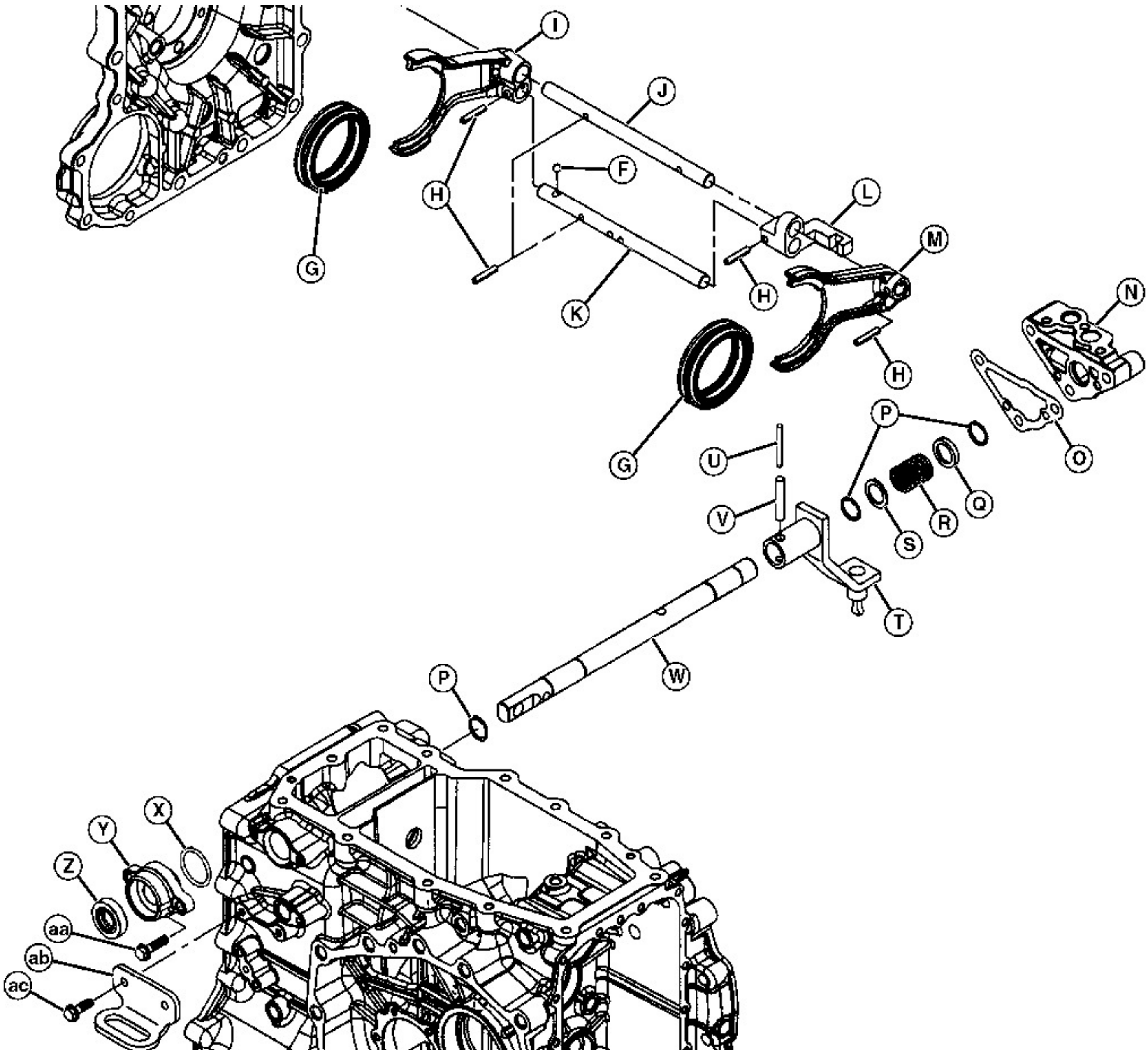
4 Speed Gear Shaft Components

LEGEND:

A	Coupler
B	Shaft
C	Gear, 33T
D	Retaining Ring
E	Needle Bearing
F	Thin Spacer
G	Wide Spacer
H	Bearing
I	Retaining Ring

J	Synchromesh Gear
K	Shift Collar
L	Wire Ring Clip
M	Ring Keys
N	Synchromesh Ring
O	Gear, 29T
P	Shaft
Q	Keys
R	Gear, 23T
S	Gear, 26T
T	Needle Bearing
U	Thin Spacer
V	Bearing

4 Speed Gear Shift



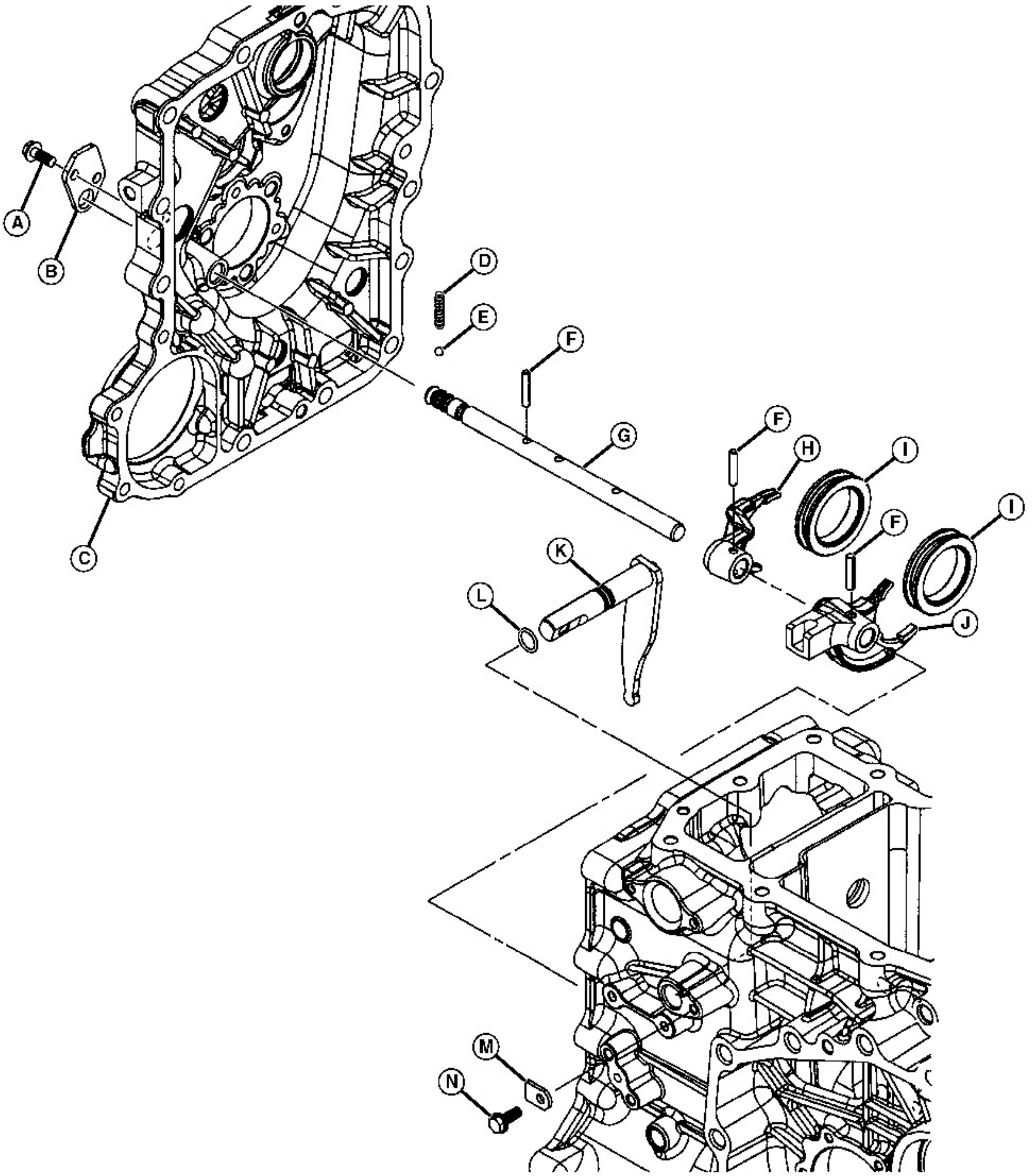
4 Speed Gear Shift Components

LEGEND:

A	Cap Screw
B	Plate, Keeper
C	Cap Screw (2 used)
D	O-Ring (2 used)
E	Detent Spring (2 used)
F	Detent Ball (2 used)
G	Shift Collar
H	Pin Fastener (5 used)
I	Shift Fork (3-4)
J	Shift Fork Shaft (1-2)
K	Shift Fork Shaft (3-4)
L	Shift Arm Retainer
M	Shift Fork (1-2)
N	Manifold/Shift Shaft Holder
O	Gasket
P	O-Ring (3 used)
Q	Spring Carrier
R	Compression Spring
S	Spring Retainer
T	Main Shift Arm
U	Pin Fastener

V	Pin Fastener
W	Main Shift Shaft
X	O-Ring
Y	Shift Shaft Holder
Z	Shaft Seal
AA	Cap Screw
AB	Shift Arm Holder
AC	Cap Screw

Range Shift



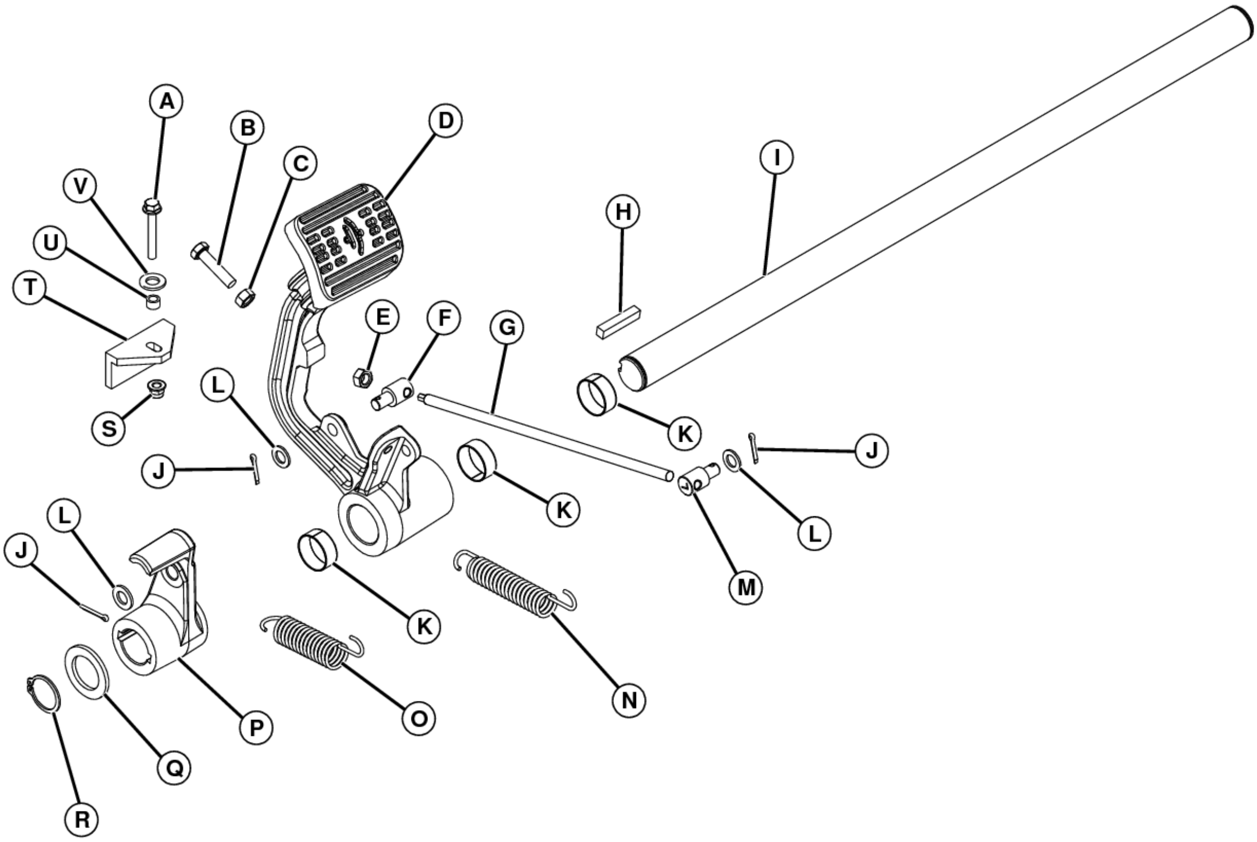
Range Shift Components

LEGEND:

A	Cap Screw
B	Plate, Fork Lock
C	Center Plate
D	Spring
E	Ball, 1/4 in.
F	Roll Pin (3 used)
G	Range Shift Shaft
H	Range Shift Fork
I	Shift Collar (2 used)
J	Range Shift Fork
K	Fork Shift Shaft
L	O-Ring

M	Plate, Keep
N	Cap Screw

PRT Pedal and Shift Linkage

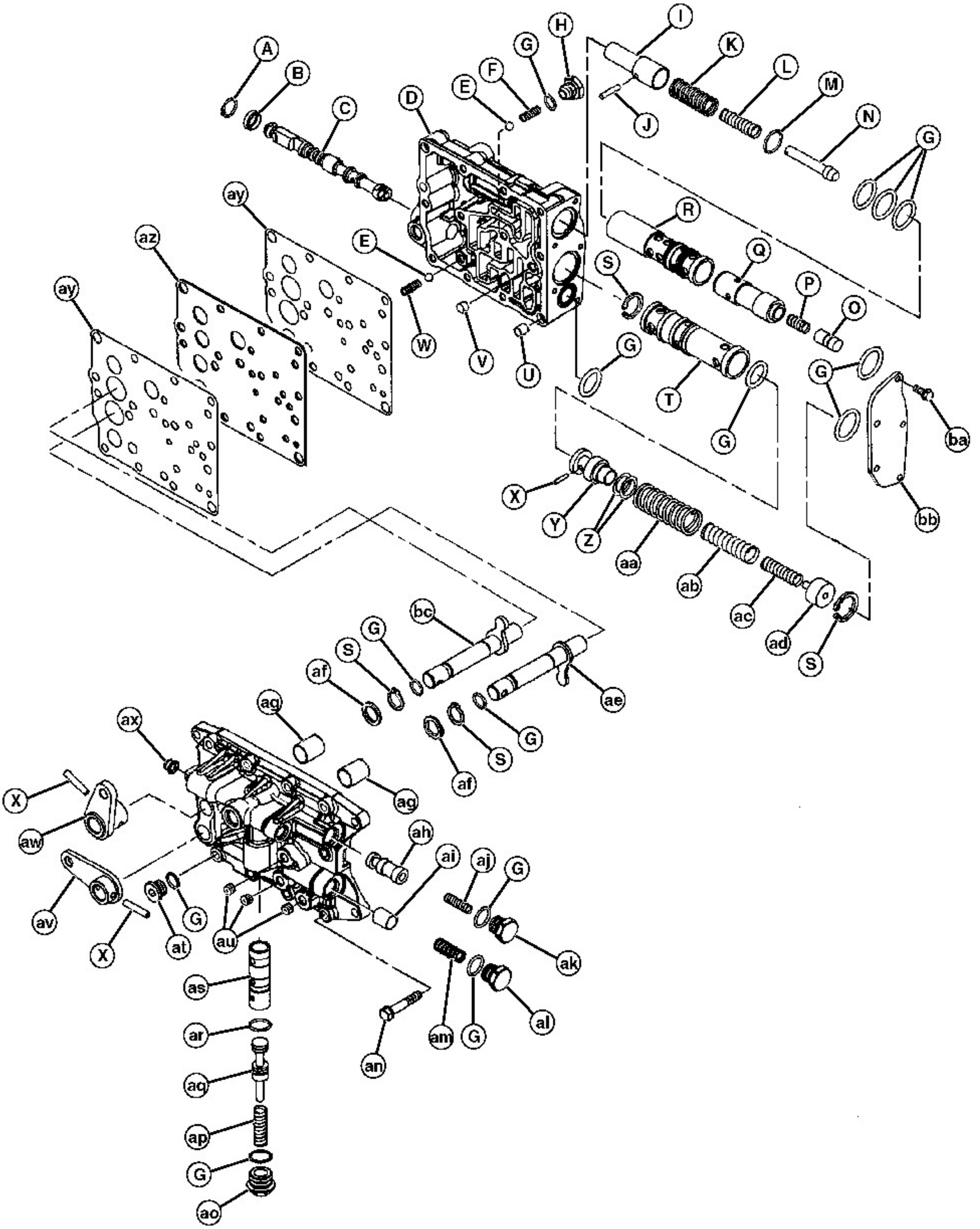


PRT Pedal and Shift Linkage Components

LEGEND:

A	Cap Screw
B	Cap Screw
C	Nut
D	Clutch Pedal
E	Jam Nut
F	Swivel (Right-hand Thread)
G	Pushrod
H	Key
I	Pedal Shaft
J	Cotter Pin
K	Bushing
L	Washer
M	Swivel (Left-hand Thread)
N	Clutch return Spring
O	Brake Return Spring
P	Bellcrank
Q	Washer
R	Snap Ring
S	Nut
T	Pedal Stop (Rubber)
U	Spacer
V	Washer

PRT Valve



PRT Valve Components

LEGEND:

A	Snap Ring
B	Plug
C	Spool (Forward/Reverse)
D	Valve Case

E	Steel Ball
F	Detent Spring
G	O-Ring
H	Detent Plug
I	Clutch Valve Spool
J	Pin
K	Outer Clutch Valve Spring
L	Clutch Valve Inner Spring
M	Washer
N	Guide Pin
O	Clutch Valve Piston
P	Clutch Valve Return Spring
Q	Clutch Valve
R	Sleeve
S	Snap Ring
T	Drive Sleeve
U	Pin
V	Orifice
W	Detent Spring
X	Spring Pin
Y	Relief Valve
Z	Shim
AA	Outer Drive Spring
AB	Center Drive Spring
AC	Inner Drive Spring
AD	Drive Valve
AE	Shift Arm
AF	Washer
AG	Bearing
AH	Cut-off Valve
AI	Relief Valve
AJ	Cut-off Spring
AK	Cut-off Plug
AL	Plug
AM	Second Spring
AN	Cap Screw
AO	Pressure Plug
AP	Pressure Spring
AQ	Pressure Valve
AR	Gasket
AS	Pressure Sleeve
AT	Plug
AU	Plug
AV	Shift Lever
AW	Clutch Lever
AX	Strainer
AY	Case Gasket
AZ	Separation Plate
BA	Screw
BB	Plate

Group 15 - Theory of Operation

PRT Control Valve Operation

Lever In Neutral, Clutch Pedal Up

Function:

The PRT control valve provides hydraulic oil to the forward and reverse PRT clutch (H), and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve (B)
- Lubrication Relief Valve (O)
- Lubrication Cut-Off Valve (M)
- Modulation Valve (P)
- Forward / Reverse Valve (C)

Theory of Operation:

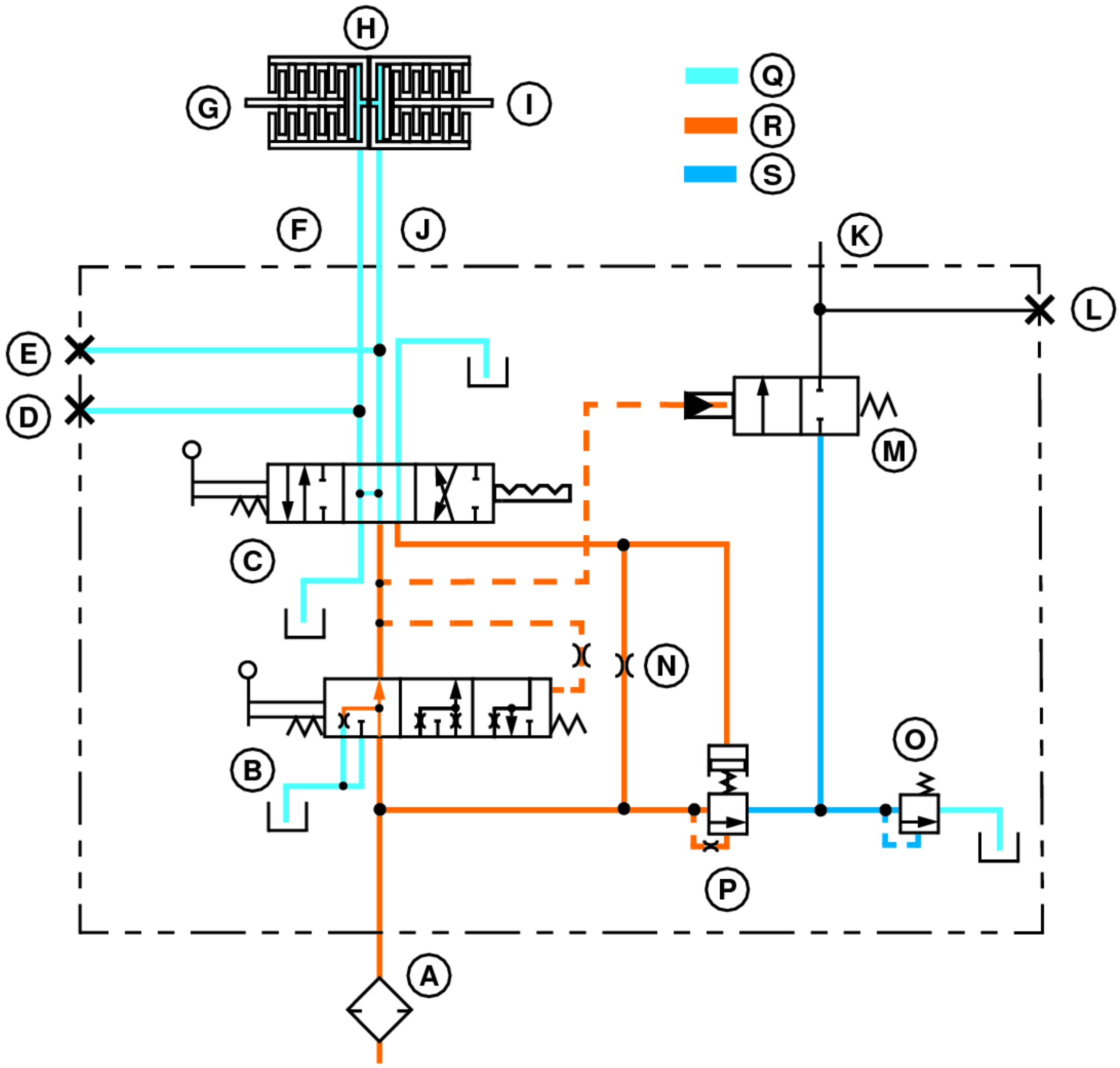
With the clutch pedal in the UP position, charge oil flows to three places; passage of clutch pedal valve, passage of modulation valve, and through 0.7 mm (N) orifice to the modulation valve.

Oil flows through the clutch pedal valve to the forward / reverse valve. With the forward / reverse valve in the NEUTRAL position, oil returns to the sump through the sump passage.

Oil entering the modulation valve does not have enough pressure to overcome the spring pressure, and the modulation valve remains closed.

Oil flowing through the 0.7 mm orifice continues, flows through the forward / reverse valve, and returns to the sump.

Oil between the clutch pedal valve and the forward / reverse valve is insufficient to overcome the spring pressure of the lubrication cut-off valve. With the lubrication cut-off valve unable to open, oil is trapped between the relief valves and the lubrication cut-off valve.



PRT Control Valve Operation

LEGEND:

A	Pressure In
B	Clutch Pedal Valve (up position)
C	Forward / Reverse Valve (neutral position)
D	Forward Test Port
E	Reverse Test Port
F	Forward Port
G	Forward Clutch
H	Forward and Reverse Clutch Assembly
I	Reverse Clutch
J	Reverse Port
K	Lubrication Oil Port
L	Lubrication Oil Test Port
M	Lubrication Cut-Off Valve
N	0.7 mm Orifice
O	Lubrication Relief Valve
P	Modulation Valve
Q	Sump Oil
R	Pressure Oil
S	Lubrication Oil (trapped)

Lever In Forward, Clutch Pedal Down

Function:

The PRT control valve provides hydraulic oil to the forward and reverse PRT clutch (H), and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve (B)

- Lubrication Relief Valve (O)
- Lubrication Cut-Off Valve (M)
- Modulation Valve (P)
- Forward / Reverse Valve (C)

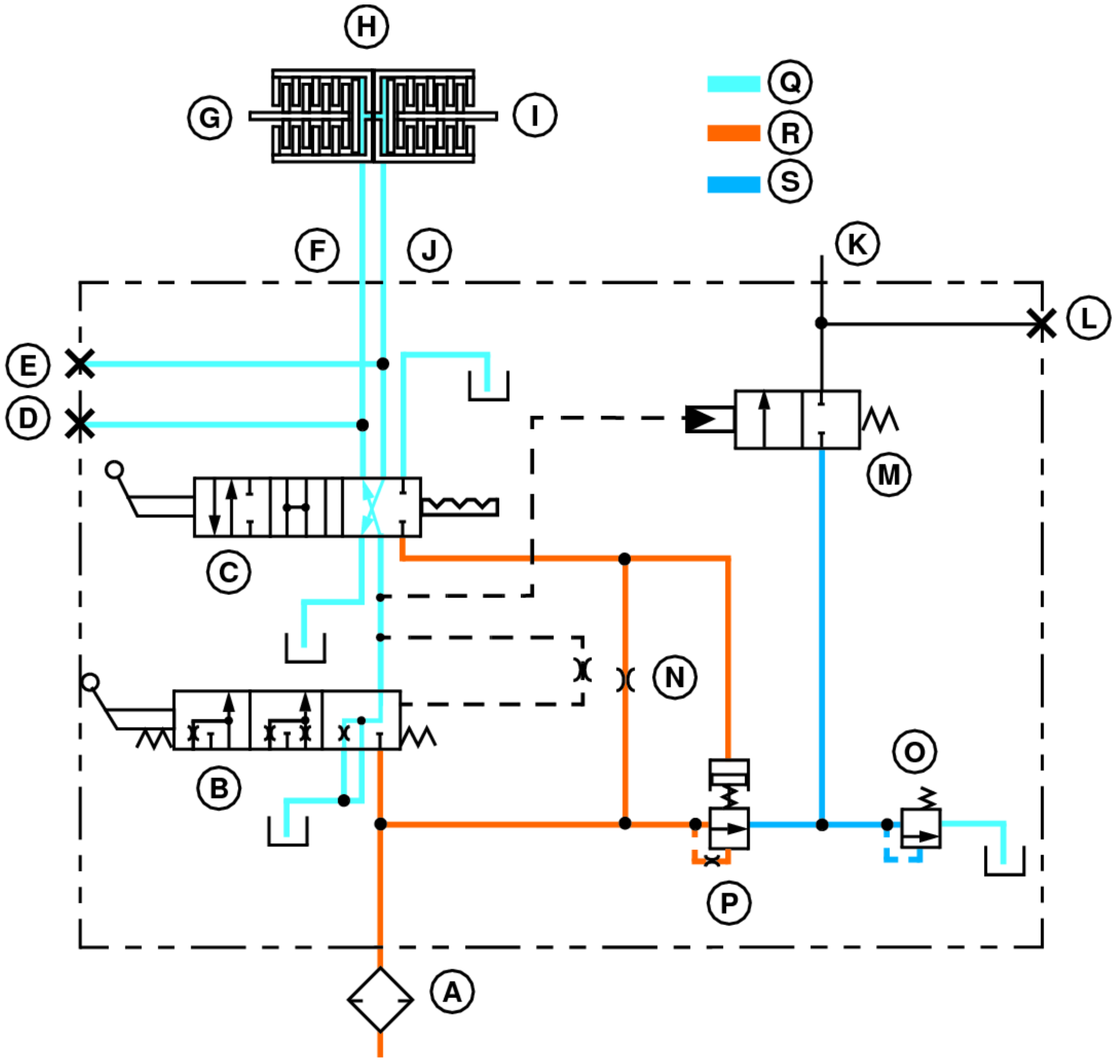
Theory of Operation:

The charge oil passage and forward / reverse valve passage are blocked by the clutch pedal valve.

Under these conditions, the modulation valve reliefs the oil to the open lubrication relief valve which returns the oil to the sump.

System pressure will be increased as the oil from the charge oil passage flows through the forward / reverse valve (forward passage), and starts clutch engagement.

Stroke adjustment of the clutch pedal is able to control machine speed.



Lever In Forward, Clutch Pedal Down

LEGEND:

A	Pressure In
B	Clutch Pedal Valve (up position)
C	Forward / Reverse Valve (neutral position)
D	Forward Test Port
E	Reverse Test Port
F	Forward Port
G	Forward Clutch
H	Forward and Reverse Clutch Assembly
I	Reverse Clutch
J	Reverse Port
K	Lubrication Oil Port
L	Lubrication Oil Test Port
M	Lubrication Cut-Off Valve
N	0.7 mm Orifice

O	Lubrication Relief Valve
P	Modulation Valve
Q	Sump Oil
R	Pressure Oil
S	Lubrication Oil (trapped)

Lever In Forward, Clutch Pedal Up

Function:

The PRT control valve provides hydraulic oil to the forward and reverse PRT clutch (H), and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve (B)
- Lubrication Relief Valve (O)
- Lubrication Cut-Off Valve (M)
- Modulation Valve (P)
- Forward / Reverse Valve (C)

Theory of Operation:

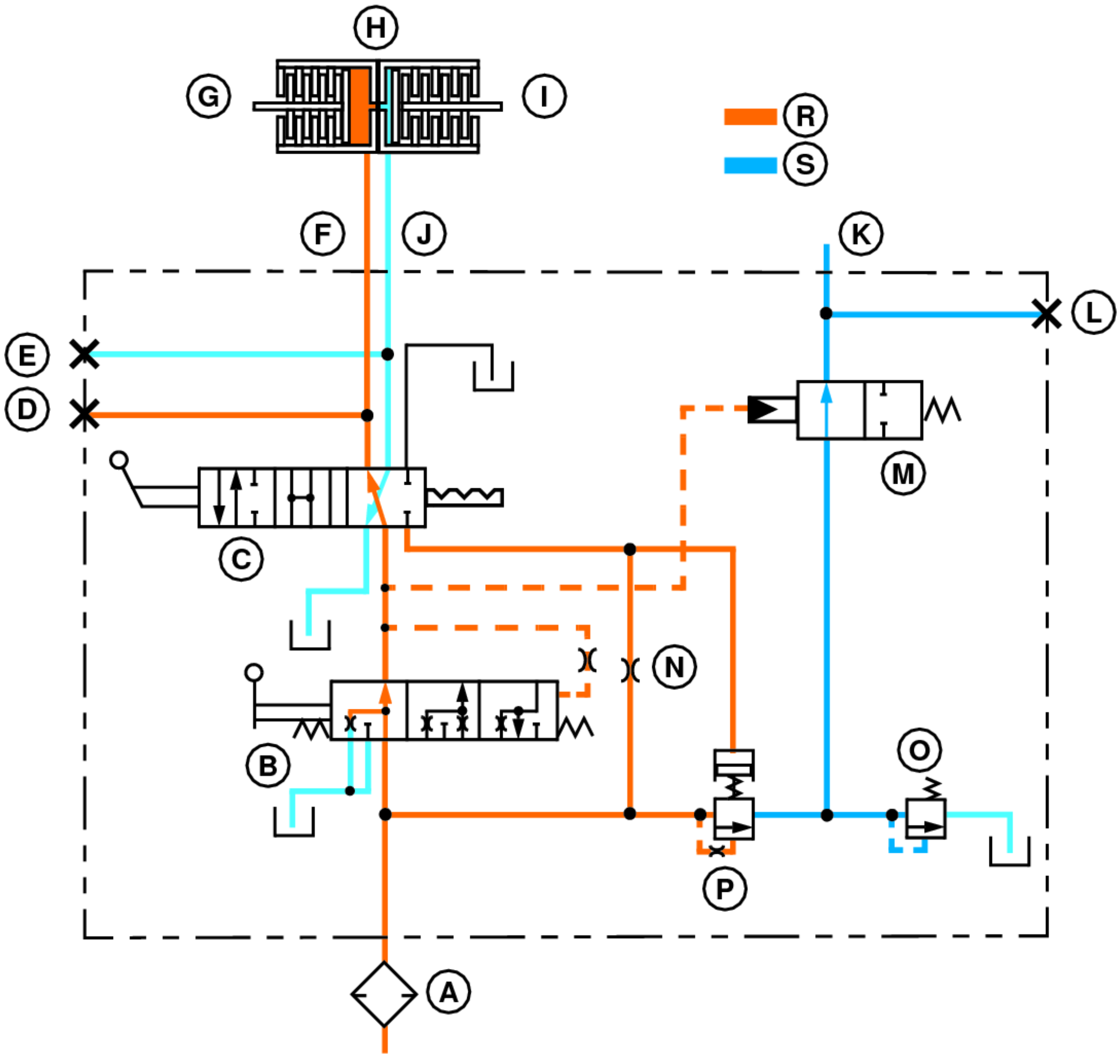
When the forward / reverse lever is moved from the NEUTRAL to the FORWARD position, system hydraulic pressure flows to three places; passage of the clutch pedal valve, passage of the modulation relief valve, and through the 0.7 mm orifice (N) to the modulation valve.

Oil pressure flowing through the orifice is blocked by the spool of the forward / reverse valve, causing pressure to push against the piston of the modulation valve. The piston pushes against the three nested springs contained in the modulation valve, closing the valve. The spring force increases the pressure at which the relief valve opens. The increased pressure flows to the forward clutch pack.

The three springs also act as an accumulator, allowing oil pressure to increase at different rates, providing modulated engagement of the clutch pack.

As the pressure modulates, the modulation relief valve opens and closes, providing lubrication oil to the clutch packs. This oil flows through the lubrication cut-off valve.

System pressure also flows from the clutch pedal valve to the forward / reverse valve. With the forward / reverse valve in the FORWARD position, the forward / reverse spool is shifted and oil flows through the valve to the hydraulic reverser forward clutch.



Lever In Reverse, Clutch Pedal Up

LEGEND:

A	Pressure In
B	Clutch Pedal Valve (up position)
C	Forward / Reverse Valve (neutral position)
D	Forward Test Port
E	Reverse Test Port
F	Forward Port
G	Forward Clutch
H	Forward and Reverse Clutch Assembly
I	Reverse Clutch
J	Reverse Port
K	Lubrication Oil Port
L	Lubrication Oil Test Port
M	Lubrication Cut-Off Valve
N	0.7 mm Orifice
O	Lubrication Relief Valve
P	Modulation Valve
R	Pressure Oil
S	Lubrication Oil (trapped)

Lever In Reverse, Clutch Pedal Up

Function:

The PRT control valve provides hydraulic oil to the forward and reverse PRT clutch, and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve (B)
- Lubrication Relief Valve (O)

- Lubrication Cut-Off Valve (M)
- Modulation Valve (P)
- Forward / Reverse Valve (C)

Theory of Operation:

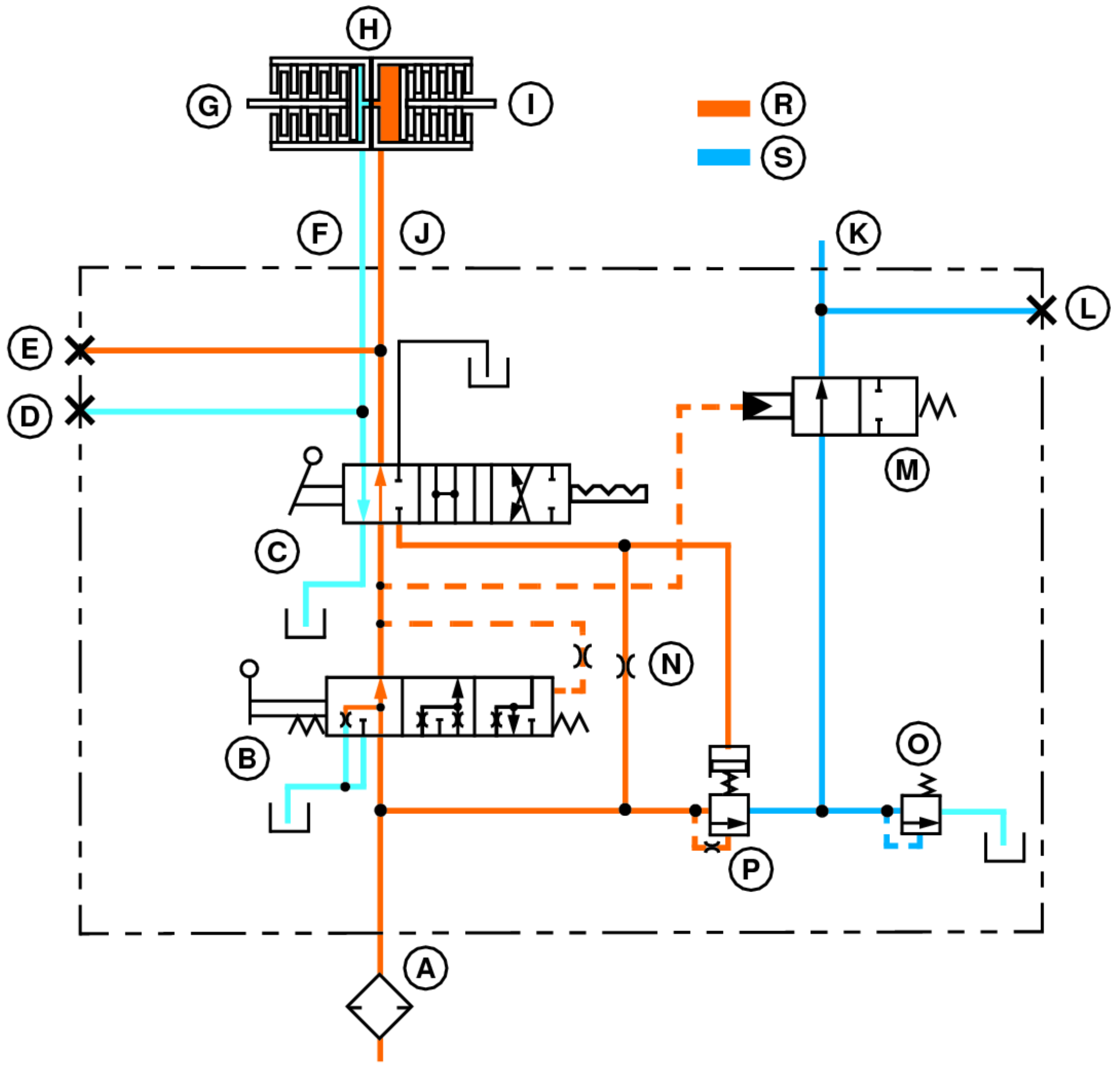
When the forward / reverse lever is moved from the NEUTRAL to the REVERSE position, system hydraulic pressure flows to three places; passage of the clutch pedal valve, passage of the modulation relief valve, and through the 0.7 mm (N) orifice to the modulation valve.

Oil pressure flowing through the orifice is blocked by the spool of the forward / reverse valve, causing pressure to push against the piston of the modulation valve. The piston pushes against the three nested springs contained in the modulation valve, closing the valve. The spring force increases the pressure at which the relief valve opens. The increased pressure flows to the forward clutch pack.

The three springs also act as an accumulator, allowing oil pressure to increase at different rates, providing modulated engagement of the clutch pack.

As the pressure modulates, the modulation relief valve opens and closes, providing lubrication oil to the clutch packs. This oil flows through the lubrication cut-off valve.

System pressure also flows from the clutch pedal valve to the forward / reverse valve. With the forward / reverse valve in the REVERSE position, the forward / reverse spool is shifted and oil flows through the valve to the hydraulic reverser reverse clutch.



Lever In Reverse, Clutch Pedal Up

LEGEND:

A	Pressure In
B	Clutch Pedal Valve (up position)
C	Forward / Reverse Valve (neutral position)
D	Forward Test Port
E	Reverse Test Port
F	Forward Port
G	Forward Clutch

H	Forward and Reverse Clutch Assembly
I	Reverse Clutch
J	Reverse Port
K	Lubrication Oil Port
L	Lubrication Oil Test Port
M	Lubrication Cut-Off Valve
N	0.7 mm Orifice
O	Lubrication Relief Valve
P	Modulation Valve
R	Pressure Oil
S	Lubrication Oil (trapped)

PRT Clutch Operation—Forward

Function:

To transfer power from the engine flywheel, through the clutch cylinder and transfer shaft to the 4 speed transmission shaft to rotate the 4 speed transmission shaft in the opposite direction of the engine flywheel.

Theory of Operation:

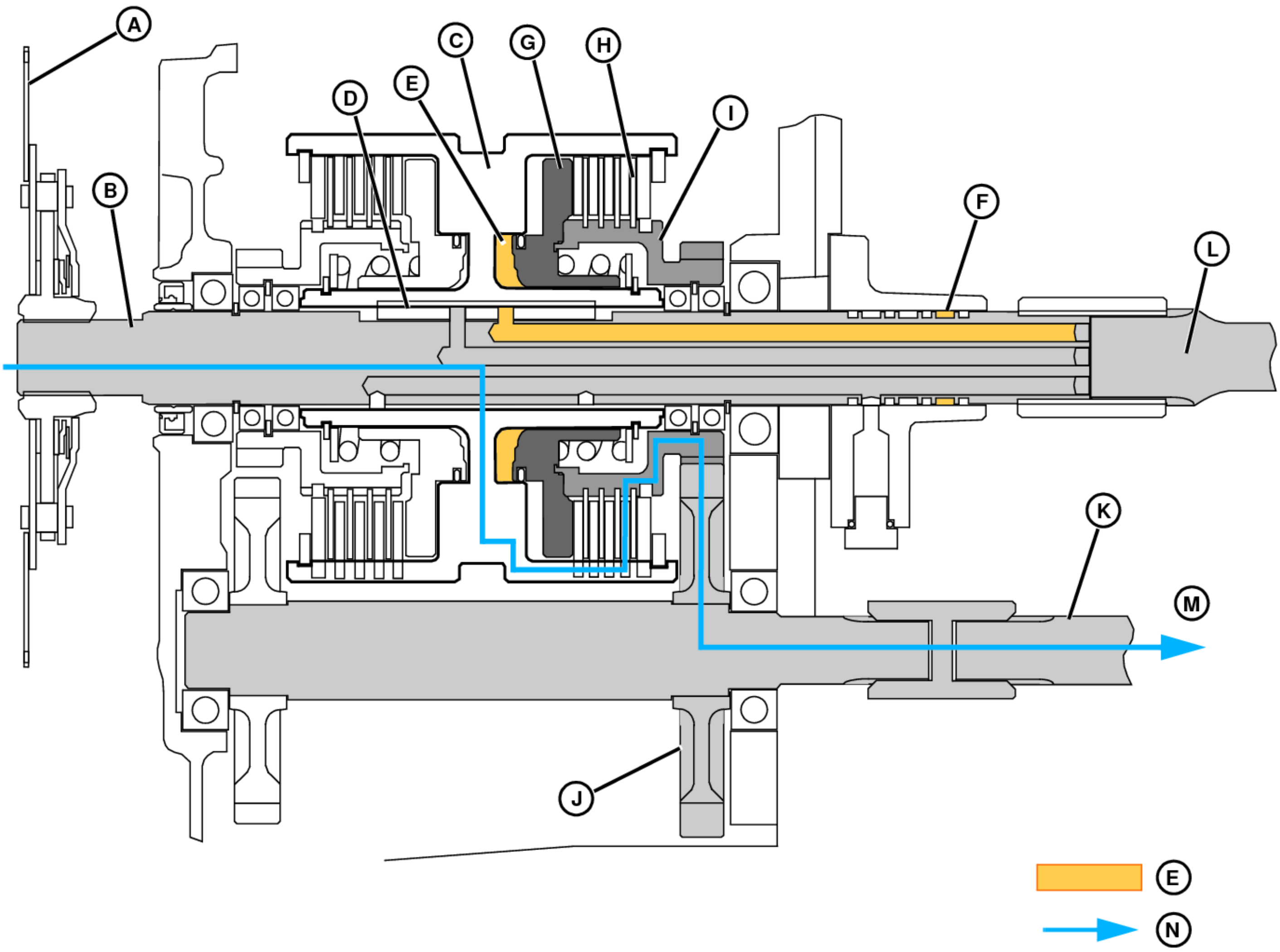
The damper disk (A) is bolted to the engine flywheel and splined to the input shaft (B). The input shaft is connected to the clutch cylinder (C) with a key (D). When the engine is running the clutch cylinder is rotating in the same direction and at the same rpm as the engine.

When the machine is placed in forward and the clutch is engaged with pressure oil (E) routed through the PRT valve to clutch cylinder through the manifold bolted on to the clutch case and through a hole (F) bored in the input shaft. See PRT Control Valve Operation “Lever In Forward, Clutch Pedal Up” on page 606.

The hydraulic oil forces the clutch piston (G) to press the clutch friction plates (H) together with the separator plates. The friction plates have tangs which fit into slots in the clutch cylinder. The separator plates are splined to the clutch gear (I). When the friction and separator plates are pressed together power is transferred from the clutch cylinder to the clutch gear.

The clutch gear teeth are engaged with the transfer shaft 45T gear (J) which is splined to the driven shaft (K) causing it to rotate. The driven shaft is connected to the 4 speed transmission using a coupler. See Transmission Operation .

Forward engagement of the PRT clutch causes the driven shaft to rotate in the opposite direction of the input shaft. It operates independently of the PTO shaft which is splined directly to the input shaft. The PTO shaft always operates in the same direction and speed of the engine flywheel.



PRT Clutch Operation—Forward

LEGEND:

A	Damper Disk
B	Input Shaft
C	Clutch Cylinder
D	Key
E	Pressure Oil
F	Bored Hole in The Input Shaft
G	Clutch Piston
H	Clutch Friction Plates
I	Clutch Gear
J	Transfer Shaft Gear, 45T
K	Transfer Shaft
L	PTO Shaft
M	To 4 Speed Transmision
N	Power Flow

PRT Clutch Operation—Reverse

Function:

To transfer power from the engine flywheel, through the clutch cylinder, idler gear, transfer shaft and then to the 4 speed transmission shaft to rotate the 4 speed transmission shaft in the same direction of the engine flywheel.

Theory of Operation:

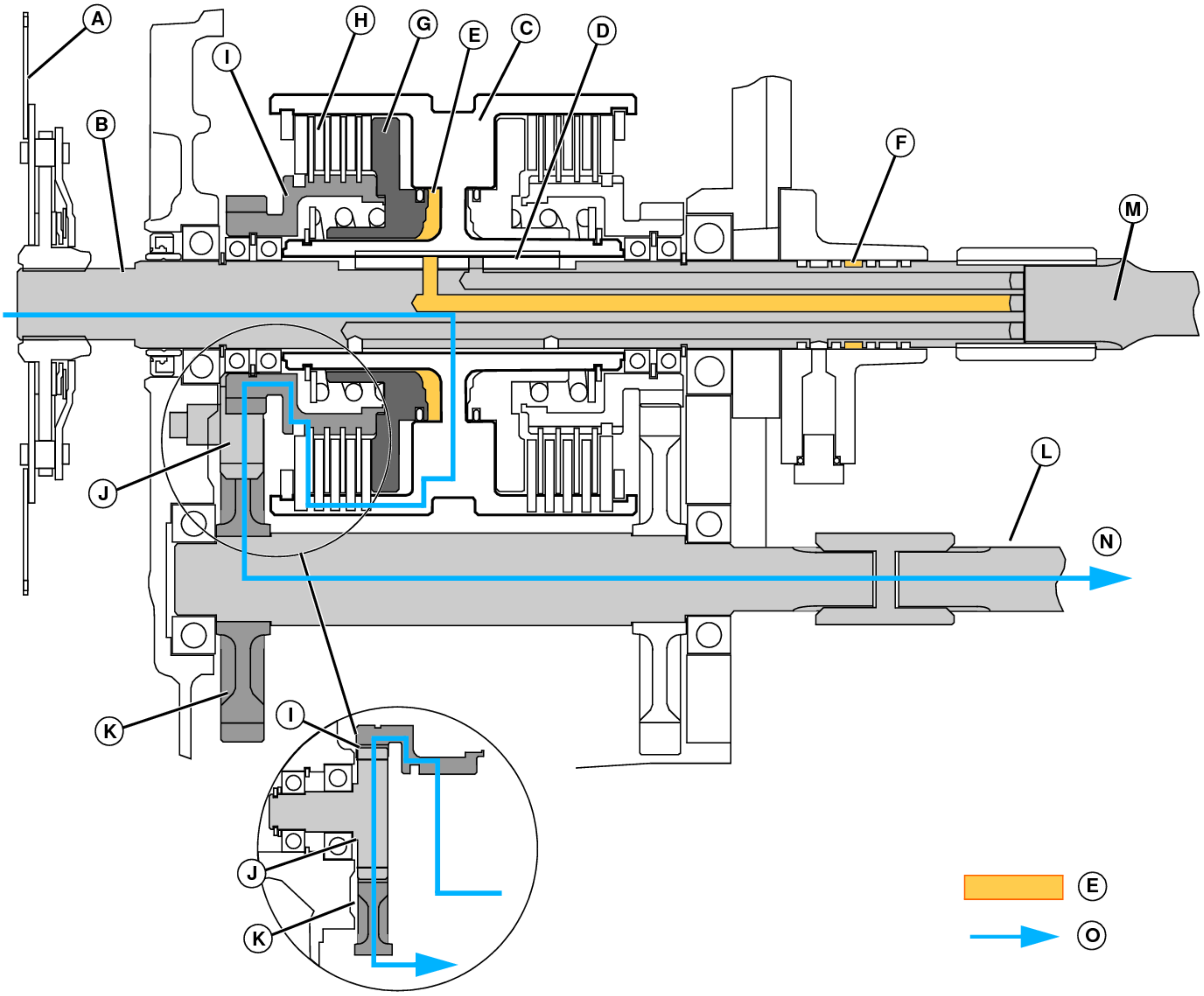
The damper disk (A) is bolted to the engine flywheel and splined to the input shaft (B). The input shaft is connected to the clutch cylinder (C) with a key (D). When the engine is running the clutch cylinder is rotating in the same direction and at the same rpm as the engine.

When the machine is placed in reverse and the clutch is engaged with hydraulic oil pressure routed through the PRT valve to clutch cylinder (E) through the manifolding bolted on to the clutch case and through a hole (F) bored in the input shaft. See PRT Control Valve Operation . And refer to “Lever In Reverse, Clutch Pedal Up”.

The hydraulic oil forces the clutch piston (G) to press the clutch friction plates (H) together with the separator plates. The friction plates have tangs which fit into slots in the clutch cylinder. The separator plates are splined to the clutch gear (I). When the friction and separator plates are pressed together power is transferred from the clutch cylinder to the clutch gear.

The clutch gear teeth are engaged with the idler gear (J) which is engaged with the transfer shaft 42T gear (K) which is splined to the drive shaft (L) causing it to rotate. The drive shaft is connected to the 4 speed transmission (M) using a coupler. See Transmission Operation .

Reverse engagement of the PRT clutch causes the driven shaft to rotate in the same direction of the input shaft. It operates independently of the PTO shaft which is splined directly to the input shaft. The PTO shaft always operates in the same direction and speed of the engine flywheel.



PRT Clutch Operation—Reverse

LEGEND:

A	Damper Disk
B	Input Shaft
C	Clutch Cylinder
D	Key
E	Pressure Oil
F	Bored Hole in The Input Shaft
G	Clutch Piston
H	Clutch Friction Plates
I	Clutch Gear
J	Idler Gear
K	Transfer Shaft Gear, 42T
L	Drive Shaft
M	To 4 Speed Transmission
N	PTO Shaft
O	Power Flow

Transmission Operation

4 Speed Function:

To transfer power from the 4 speed shaft through the mid shaft to the pinion shaft at one of four different speed ratios.

4 Speed Theory of Operation:

When the PRT transmission is engaged in either forward or reverse, there is rotation of the driven shaft (A) going into the machine tunnel which is coupled to the 4 speed shaft (B).

Two synchromesh collars (C) are splined to the 4 speed shaft and can be shifted individually forward or backward to engage the 4 speed shaft to the mid shaft (D).

There are four corresponding gears on the mid shaft that are constantly meshed to the four gears on the 4 speed shaft. The four gears on the 4 speed shaft are mounted on roller bearings (E) and turn independently from the 4 speed shaft.

Power flow is shown below with the right synchromesh collar shifted to engage 1st gear. The 4 speed shaft transfers power through the 1st gear to the mid shaft which transfers power to the range gears of the pinion shaft (F). When the range transmission is shifted into a gear range (gear range A shown), the range shift collar connects the range gear to the pinion shaft causing the pinion shaft to rotate. Power is then transferred both rearward to the rear final drive and forward to the MFWD if engaged.

Range Transmission Function:

To transfer power from the pinion shaft to the rear axles.

Range Transmission Operation:

When the transmission is engaged, power from the driven shaft (A) is transferred through a splined coupler to the 4-speed gear shaft (B). The four gears on the shaft all spin freely on the shaft. Each of the four gears is engaged to a fixed gear on the mid shaft (D). There are two shift collars (C) on the gear shaft that can engage any one of the gears to the shaft. When one of them is engaged, the mid shaft rotates. See “Theory of Operation” in the PRT Power Train section.

All of the gears on the mid shaft are splined to the shaft and rotate any time one of the 4-speed gears is engaged. There are three gears on the mid shaft that are continuously engaged to three gears on the pinion shaft (F). The three gears on the pinion shaft spin freely on the shaft.

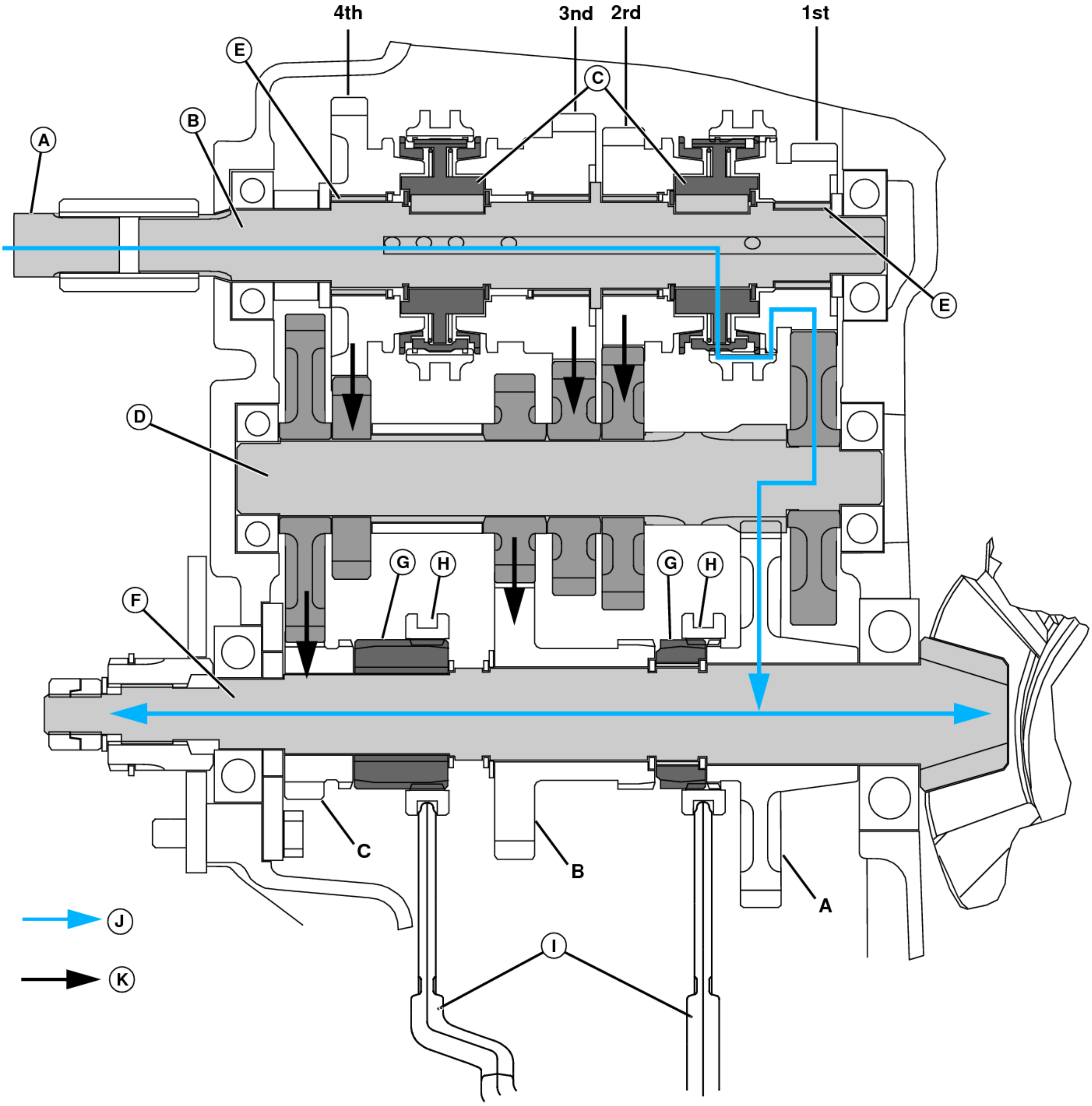
Between the three gears on the pinion shaft there are two splined sleeves (G). There are two shift collars (H) that slide forward and rearward on the splined sleeves.

The forks secured to the range shift linkage fit into the two shift collars and selection of the range shifter moves the forks and shift collars forward and rearward. The shift collars lock (only one at a time) the gears on the pinion shaft to one of the splined sleeves.

The diagram below shows the shifters in the rear most (A gear) position.

There are four positions for the shifters (from rear to front):

- Rear most—A
- Next forward—Neutral (no gear locked to sleeves)
- Next forward—B
- Most forward—C



Transmission Operation

LEGEND:

A	Driven Shaft
B	4-Speed Gear Shaft
C	Syncromesh Collars (shown in 1st gear)
D	Mid Shaft
E	Roller Bearings
F	Pinion Shaft

G	Splined Sleeves
H	Shift Collars
I	Range Transmission Collar Positions (shown in A range gear)
J	Power Flow (as described)
K	Power Flow (other possible paths)

Group 20 - Diagnostics

PowrReverser (PRT) Power Train

78

Test Conditions:

- Operator in Seat
- Engine Off

→NOTE:

Roll the machine forward and reverse slightly while checking the shift functions.

Symptom	Problem	Solution
Shift Lever and Clutch Pedal Checks	Speed transmission shift lever does not move freely and detent in all positions.	If rolling the machine forward and reverse to release the pressure on the gears does not allow for the shift lever to move freely and detent fully, See Transmission Gear Set Removal and Installation .
	Range transmission shift lever does not move freely and detent in all positions.	If rolling the machine forward and reverse to release the pressure on the gears does not allow for the shift lever to move freely and detent fully, See Transmission Gear Set Removal and Installation .
	PRT shift lever does not move freely and detent in all positions.	Check shift lever detent in shift/clutch valve. See PRT Shift/Clutch Valve Removal and Installation .
	Clutch pedal does not press and return freely.	Check for broken return springs or debris or damage to pedal and/or clutch pedal shaft. See PRT Clutch Pedal and Linkage Removal and Installation .

Test Conditions:

- Operator in Seat
- Engine Running at 2000 rpm
- Park Brake Unlocked
- Speed Transmission in 1st Gear
- Range Transmission in A Gear

Symptom	Problem	Solution
Machine Movement	With the control lever in Neutral and the clutch released, machine creeps.	Adjust linkage. See PRT Clutch Linkage Adjustment and Test .
	With the control lever in Forward and the clutch pressed down, machine creeps.	Adjust linkage. See PRT Clutch Linkage Adjustment and Test .
	With the control lever in Reverse and the clutch pressed down, machine creeps.	Adjust linkage. See PRT Clutch Linkage Adjustment and Test .
	With the control lever in Forward and the clutch pedal released, machine does not move smoothly forward.	See Troubleshooting .
	With the control lever in Reverse and the clutch pedal released, machine does not move smoothly rearward.	See Troubleshooting .

Test Conditions:

- Operator in Seat
- Engine Running at 2000 rpm
- Park Brake Locked
- Speed Transmission in 4th Gear
- Range Transmission in C Gear
- PRT Shift Lever in Forward

Safely support rear axle to suspend rear wheels off of ground.

Disengage MFWD.

With the control lever in Forward and the clutch pressed down, with the engine at 2000 rpm, release the clutch pedal quickly and check that the engine stalls quickly

If the engine does not stall, adjust linkage. See PRT Clutch Linkage Adjustment and Test .

Group 25 - Troubleshooting

PowrReverser (PRT) Troubleshooting

78

Symptom	Problem	Solution
Poor PowrReverser (PRT) Performance	Poor Transmission Performance.	Parking brake is on or misadjusted.
		Low hydraulic fluid level.
		Plugged screens filter.
		Clutch linkage misadjusted.
		Loss of charge pressure.
		Oil leakage within the valve body.
		Worn drive clutch pack.
		Ballast and/or tow load too heavily.
		Damaged gear(s).
	Complete Loss of Transmission Power.	Low hydraulic fluid level.
		Loss of charge pressure.
		Failure of valve body.
		Failure of high-pressure components in pump.
		Failure of drive clutch.
		Mechanical failure at gearbox or drive line.
	Machine Creeps In Neutral.	Clutch linkage misadjusted.
		Forward/Reverse valve is leaking.
		Drive clutch stuck or binding.
	Machine Does Not Move in Forward.	Low hydraulic fluid level.
		PRT shift lever worn, bend, or broken.
		Oil leakage within the valve body.
		Oil leakage within the drive clutch pack.
		Worn drive clutch pack.
		Drive clutch stuck or binding.
		Forward/Reverse valve is stuck or leaking.
		Mechanical failure at gearbox or drive line.
	Machine Does Not Move in Reverse.	Low hydraulic fluid level.
		PRT shift lever worn, bend, or broken.
		Oil leakage within the valve body.
		Oil leakage within the drive clutch pack.
		Worn drive clutch pack.
		Drive clutch stuck or binding.
		Forward/Reverse valve is stuck or leaking.
		Mechanical failure at gearbox or drive line.
	Loss of Charge Pressure.	Engine speed too low to develop required charge flow.
		Inefficient charge pump not providing required flow.
		Charge flow diverted to hydro (steering, PTO, and other components).
		Extreme temperature increases demand but reduces flow.
		Reduction in hydro efficiency increases charge flow demand.
		Cut or worn seal ring on servo piston.
		Leakage past the charge pressure relief valve.

Group 30 - Tests and Adjustments

PRT Clutch Linkage Adjustment and Test

Reason:

To ensure that forward and reverse clutches engage fully when the clutch pedal is against the up stop, and disengages fully when the clutch pedal is against the down stop.

Pedal Up and Down-Stop Adjustment:

[1] -

IMPORTANT:

Avoid Damage! Clutch pedal travel must be stopped by the up stop and down stop. If clutch pedal travel is stopped by the valve lever travel, damage to the PRT control valve may result.

→NOTE:

If clutch linkage is removed or replaced, set initial pushrod length to specification before installation.

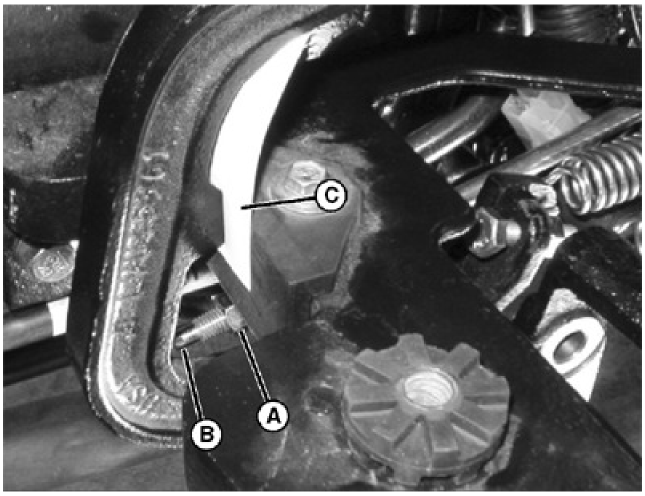
Park machine safely with the range shift and speed shift transmission levers in NEUTRAL.

[2] -

→NOTE:

Turn the clutch link clockwise to lengthen and counter-clockwise to shorten the clutch link.

Loosen the jam nut (A) and adjust the clutch link (B) so that the clutch pedal is making contact with the rubber up-stop.



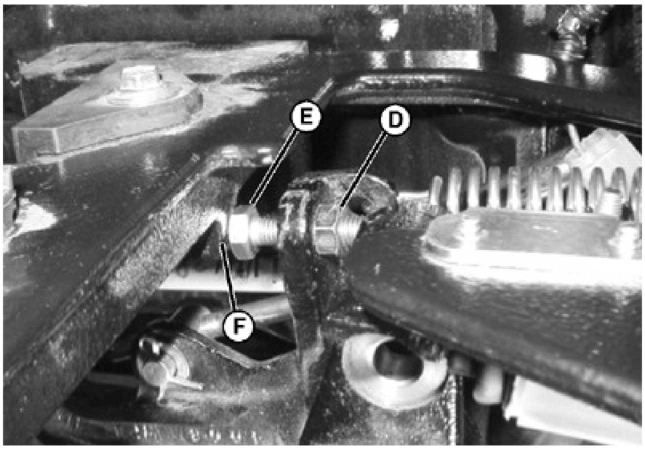
LEGEND:

A	Jam Nut
B	Clutch Link
C	Paper

Clutch Pedal Adjustment (operator platform removed for clarity)

a. Trap a piece of paper (C) between the pedal and the rubber up-stop.
b. Slowly adjust the clutch link (B) and gently pull on the paper until it slips out. Stop adjusting as soon as the paper will slip out.
c. Turn the clutch link 1-1/2 turns counter-clockwise (shorter).
d. Hold the clutch link in position and tighten the jam nut (A).

[3] - Loosen the jam nut (D) on the pedal down-stop screw (E).



LEGEND:

D	Jam Nut
E	Pedal Down-Stop Screw
F	Down Stop

Clutch Pedal Adjustment Procedure (operator platform removed for clarity)

a. Screw the pedal down-stop screw (E) all the way in to allow the maximum possible pedal down stroke.
b. Depress the clutch pedal by hand until it stops (valve lever at maximum travel).
c. Continue holding the pedal in the down position and screw out the pedal down-stop screw until it reaches the down stop (F).
d. Release the clutch pedal.
e. Screw the pedal down-stop screw out another two full turns and tighten the jam nut.

[4] - Test the clutch adjustment.

Item	Measurement	Specification
Clutch Link Preset	Length	232 mm (9.134 in.)

Clutch Test Procedure:

[1] - Park machine safely with the range shift and speed shift transmission levers in NEUTRAL.

[2] - Adjust the brake pedals and park brake before checking clutch adjustment. See Brake Pedal Adjustment—PowrReverser Transmission and Parking Brake Adjustment.

[3] - Locate PRT clutch linkage under left foot rest.

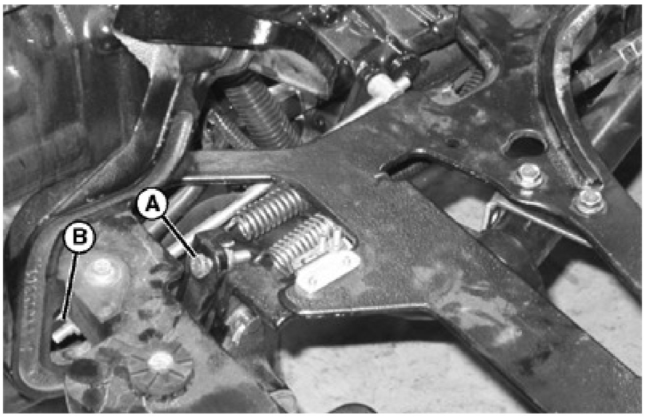
[4] - Check initial adjustment by adjusting for creep.

a. Safely support rear axle to suspend rear wheels off of ground.
b. Disengage MFWD.
c. Unlock park brake.
d. Place the PRT shift lever in forward.
e. Depress and hold the clutch pedal and place the transmission in gear position A-1.
f. With the engine at 2000 rpm and the clutch pedal depressed, rear wheels should not rotate.
g. Depress and hold the clutch pedal and shift the transmission to gear position C-4.
h. Lock the park brake.
i. With the engine at 2000 rpm, release the clutch pedal quickly and check that the engine stalls quickly.

Results:

- With the transmission in gear position A-1 and the clutch depressed, the wheels should not turn.
- If the wheels turn, adjust the down stop screw (A) (shorter) counting the flats of the hex head, until wheels stop turning.
- Do not adjust more than twelve total flats (2 full turns).
- With the transmission in gear position C-4, the engine should stall when the clutch pedal is released with the park brake set.
- If the engine continues to run, adjust clutch link (B) (longer) 1/2 turn at a time and retest for engine stall.

- Do not adjust more than 1-1/2 turns.
- If desired results cannot be obtained, verify correct function by performing hydraulic pressure test. See PRT Hydraulic Pressure Tests .



Clutch Pedal Adjustment Results (operator platform removed for clarity)

LEGEND:

A	Down Stop Screw
B	Clutch Link

PRT Hydraulic Pressure Tests

Reason:

To ensure that forward and reverse clutches engage fully, and to prevent clutch slippage which may result in damage to clutch and reduced ground speed.

→NOTE:

Be sure front gear pump is in good working order and strainer in inlet port is clean. Check PRT shift lever linkage adjustment before performing PRT hydraulic pressure tests.

Special or Required Tools:

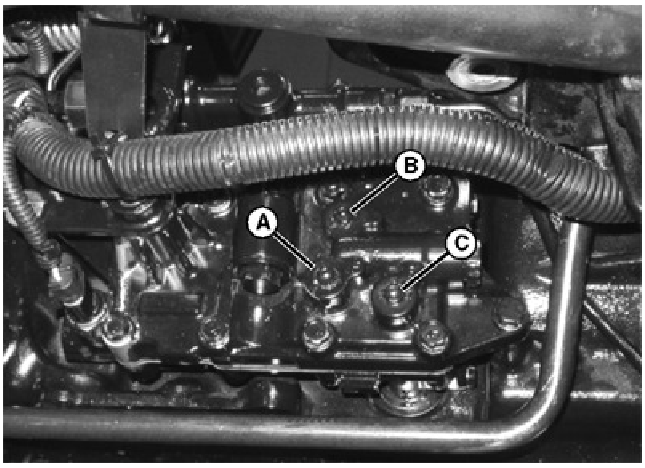
- JTO 3349 Adapter
- JTO 3017 Hose
- JTO 3344 Gauge

Procedure (Forward and Reverse Pressure):

[1] - Park machine safely. Engage park brake.

[2] - Place range shift and speed shift transmission levers in NEUTRAL.

[3] - On left side of machine, below the clutch pedal, locate the PRT transmission valve.



LEGEND:

A	Forward Clutch Pressure Test Port
B	Lubrication Oil Pressure Test Port
C	Reverse Clutch Pressure Test Port

Test Ports

[4] - Remove forward clutch pressure test port (A) plug and install test equipment.

[5] - Push in clutch pedal.

[6] -

→NOTE:

Make sure range shift and speed shift are in Neutral.

Start engine.

- Place F-N-R lever in Forward.
- Release clutch pedal.

[7] - Allow two seconds for modulation valve to fully open. Check pressure reading on gauge and record result.

[8] - Shut off engine.

[9] -

→NOTE:

When reinstalling test port plugs, seal threads using TEFLON ™ tape.

Remove test equipment and install test port plug.

[10] - Remove reverse clutch pressure test port (C) plug and install test equipment.

[11] - Push in clutch pedal.

[12] -

> **→NOTE:**
>
> **Make sure range shift and speed shift are in Neutral.**

Start engine.

- Place F-N-R lever in Reverse.
- Release clutch pedal.

[13] - Allow two seconds for modulation valve to fully open. Check pressure reading on gauge and record result.

[14] - Shut off engine.

[15] -

> **→NOTE:**
>
> **When reinstalling test port plugs, seal threads using TEFLON™ tape.**

Remove test equipment and install test port plug.

Results:

Pressure on gauge should reach specification after 2 seconds with the pedal released (up).

Pressure on gauge should be less than specification with the pedal pressed down fully.

Item	Measurement	Specification
Gauge Reading 2 Seconds with Pedal Released (Up)	Pressure	1792 — 2000 kPa (260 — 290 psi)
Gauge Reading with Pedal Pressed Down Fully	Pressure (Less Than)	207 kPa (30 psi)

- If low oil pressures (pedal pressed down) is too high:
- Decrease length of PRT clutch threaded link. See PRT Clutch Linkage Adjustment and Test .
- If high oil pressures are too low:
- Check oil filter and PRT valve hydraulic oil input filter screen for blockage.
- Measure steering pressure. See Steering Pressure Check . If steering pressure is good and filters are clear, increase length of PRT clutch threaded link. See PRT Clutch Linkage Adjustment and Test .
- If high oil pressure (pedal released) remains low:
- PRT valve may have internal leakage. See PRT Shift/Clutch Valve Removal and Installation .
- Seals/gaskets on clutches or drive shaft may be leaking. See PRT Traction Clutch Disassembly and Assembly .

Procedure (Lubrication Pressure):

[1] - Park machine on a level surface and engage park brake.

[2] - Place range shift and speed shift transmission levers in NEUTRAL.

[3] - Remove lubrication oil pressure test port (B) plug and install test equipment.

[4] - Push in clutch pedal. Start engine.

[5] - Place forward/reverse (directional) shift lever in FORWARD or REVERSE. Release clutch pedal.

[6] - Check pressure reading on gauge and record result.

[7] - Shut off engine.

[8] -

→NOTE:

When reinstalling test port plugs, seal threads using TEFLON™ tape.

Remove test equipment and install test port plug.

Results:

- If lubrication pressure is low, PRT clutch valve may need to be adjusted, lube oil relief valve may be malfunctioning. See PRT Clutch Linkage Adjustment and Test or PRT Shift/Clutch Valve Removal and Installation .

Group 35 - Repair

PRT Clutch Pedal and Linkage Removal and Installation

Removal:

[1] - Park machine safely on a level surface with park brake locked.

[2] - Disconnect battery negative cable from battery.

[3] - Remove rear fenders, if desired, to ease operator platform removal. See Rear Fenders Removal and Installation (Open Station) .

[4] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[5] - Remove seat closeout panel. See Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[6] - Remove fuse panel cover. See Fuse Panel Cover Removal and Installation .

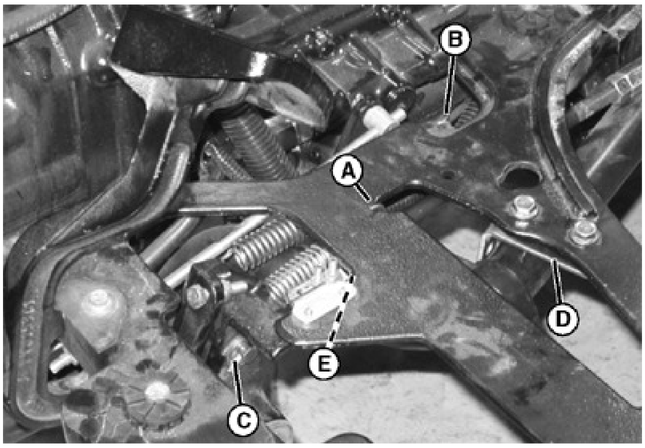
[7] - Remove operator platform. See Operator Platform Removal and Installation—PowrReverser Transmission .

[8] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

Remove the left brake return spring (A) and the clutch pedal spring (B).



LEGEND:

A	Left Brake Return Spring
B	Clutch Pedal Spring
C	Brake Rod at Bellcrank
D	Support Bracket
E	Electrical Connector

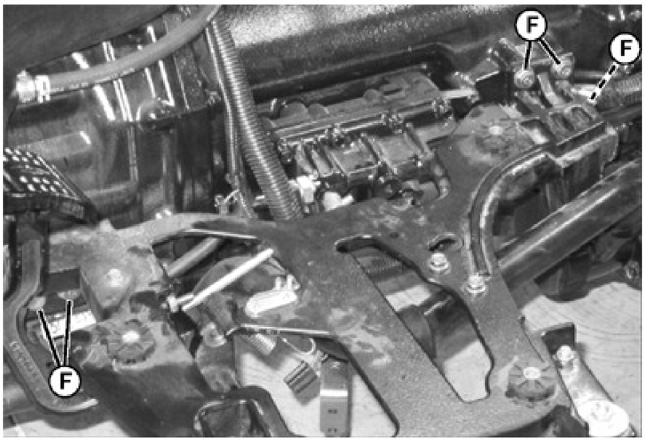
Left Brake Return Spring

[9] - Remove the cotter pin and washer from the brake rod at the bellcrank (C).

[10] - Remove the two cap screws and nuts securing support bracket (D) to foot deck support.

[11] - Disconnect the electrical connector (E) attaching wiring harness to brake switch if equipped.

[12] - Remove the five cap screws (F) securing the left foot deck support and remove the support.

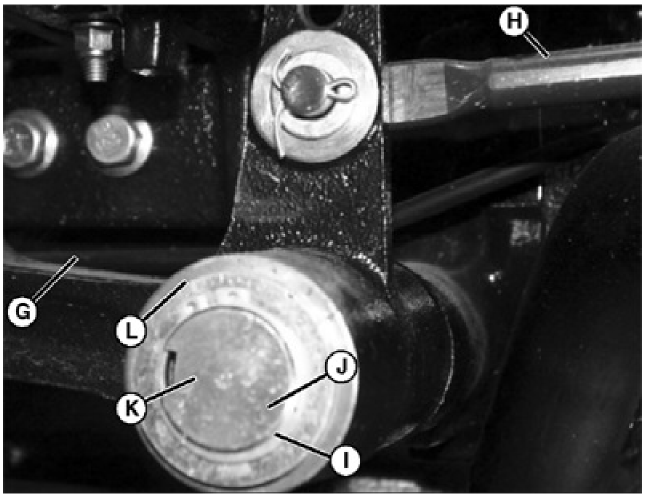


LEGEND:

F	Cap Screw (5 used)

Left Foot Deck Support

[13] - Remove the cotter pin and washer from the clutch link swivel on the clutch pedal (G) and the valve lever (H). Remove the clutch link.



LEGEND:

G	Clutch Link Swivel On Clutch Pedal
H	Valve Lever
I	Snap Ring
J	Washer
K	Left Brake Bellcrank
L	Clutch Pedal

Clutch Link Swivel

[14] - Remove the snap ring (I) and washer (J) from the end of the pedal shaft.

[15] - Remove the left brake bell crank (K), key, and clutch pedal (L) from the pedal shaft.

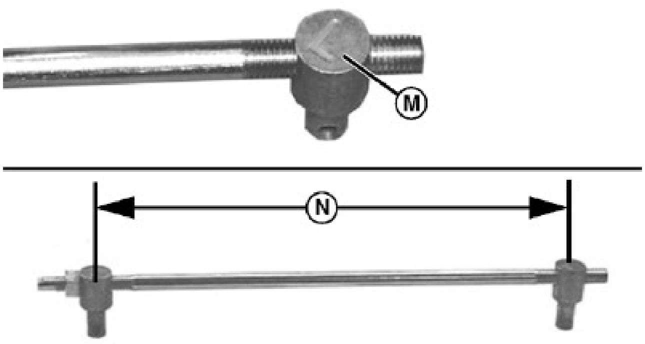
[16] - If needed, the swivels may be removed from the clutch link.

Installation:

→NOTE:

The valve swivel has left-hand threads and is marked by an "L" (M).

[1] - Install the valve swivel on the clutch link. Center the swivel on the threads.



LEGEND:

M	"L" (left-hand thread)
N	Distance From Swivel Centers

Valve Swivel

[2] - Install the clutch pedal swivel on the clutch link. Center the swivel on the threads.

[3] -

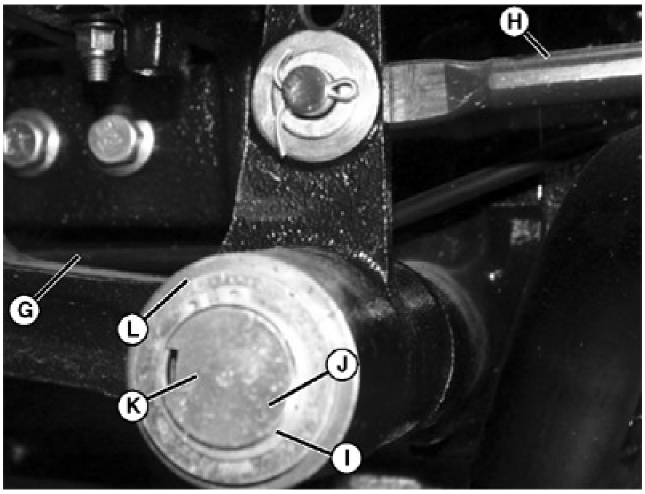
→NOTE:

Preset clutch link length to specification before installation.

Hold the swivels in place and screw the rod to adjust the distance from swivel centers (N) to specifications. Snug but do not tighten the jam nut to the clutch swivel.

Item	Measurement	Specification
Clutch Swivel Adjustment	Length	232 mm (9.134 in.)

[4] - Install the clutch pedal (L) then the key and left brake bellcrank (K) onto the pedal shaft.



LEGEND:

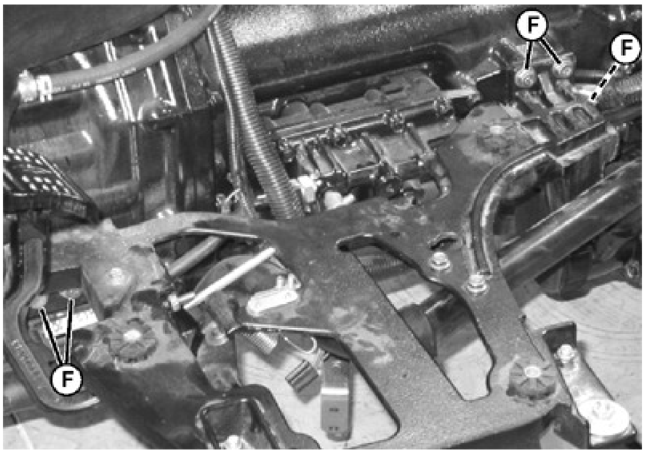
G	Clutch Link Swivel On Clutch Pedal
H	Valve Lever
I	Snap Ring
J	Washer
K	Left Brake Bellcrank
L	Clutch Pedal

Clutch Link Swivel

[5] - Install the washer (J) and snap ring (I) to the end of the pedal shaft.

[6] - Install the clutch link with the swivel marked with the letter “L” into the valve lever (H) and the swivel with the jam nut and adjustment slot into the clutch pedal (G). Install the washer and cotter pin to each swivel.

[7] - Install the left foot deck support and secure with five cap screws (F).



LEGEND:

F	Cap Screw (5 used)

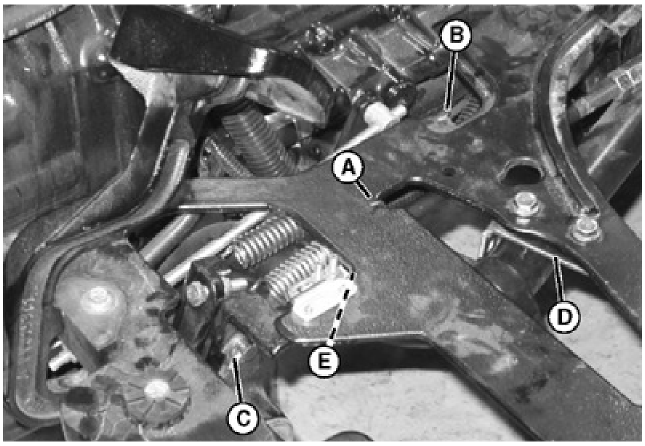
Left Foot Deck Support

[8] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

Install the left brake return spring (A) and the clutch pedal spring (B).



LEGEND:

A	Left Brake Return Spring
B	Clutch Pedal Spring
C	Brake Rod at Bellcrank
D	Support Bracket
E	Electrical Connector

Left Brake Return Spring

[9] - Install the brake rod to the left brake bellcrank and secure with washer and cotter pin (C).

[10] - Install the support bracket (D) to foot deck support and secure with two cap screws and nuts.

[11] - Connect the electrical connector (E) attaching wiring harness to brake switch if equipped.

[12] - Adjust clutch pedal. See PRT Clutch Linkage Adjustment and Test .

[13] - Install operator platform. See Operator Platform Removal and Installation—PowrReverser Transmission .

[14] - Install fuse panel cover. See Fuse Panel Cover Removal and Installation .

[15] - Install seat closeout panel. See Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[16] - Install seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[17] - Install rear fenders, if desired, to ease operator platform removal. See Rear Fenders Removal and Installation (Open Station) .

[18] - Connect battery negative cable to battery.

Item	Measurement	Specification
Clutch Link Preset	Length	232 mm (9.134 in.)

PRT Shift/Clutch Valve Removal and Installation

Removal:

[1] - Park machine on a level surface. Block wheels to keep machine stationary.

[2] - Disconnect battery negative cable from battery.

[3] - Remove rear fenders, if desired, to ease operator platform removal. See Rear Fenders Removal and Installation (Open Station) .

[4] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[5] - Remove seat closeout panel. See Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[6] - Remove fuse panel cover. See Fuse Panel Cover Removal and Installation .

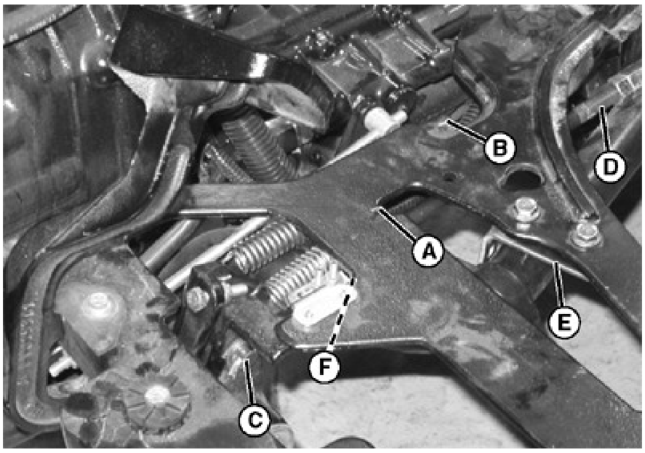
[7] - Remove operator platform. See Operator Platform Removal and Installation—PowrReverser Transmission .

[8] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

Remove the left brake return spring (A) and the clutch pedal spring (B).



LEGEND:

A	Left Brake Return Spring
B	Clutch Pedal Spring
C	Cotter Pin And Washer
D	Brake Link
E	Support Bracket
F	Electrical Connector

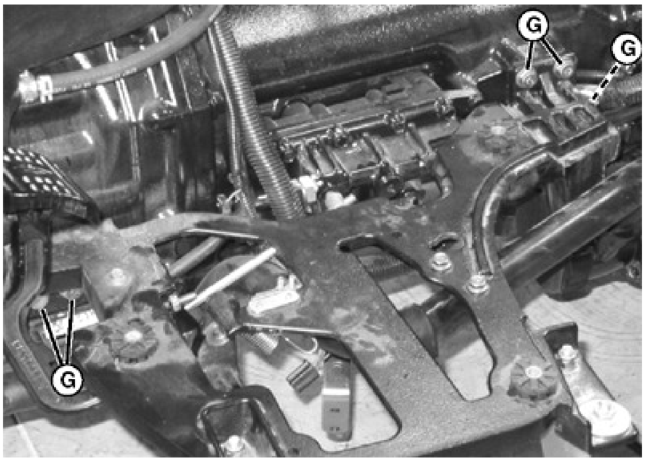
Left Brake Return Spring

[9] - Remove the cotter pin and washer (C) from each end of the brake link (D) and remove the link.

[10] - Remove the two cap screws and nuts securing support bracket (E) to foot deck support.

[11] - Disconnect the electrical connector (F) attaching wiring harness to brake switch if equipped.

[12] - Remove the five cap screws (G) securing the left foot deck support and remove the support.

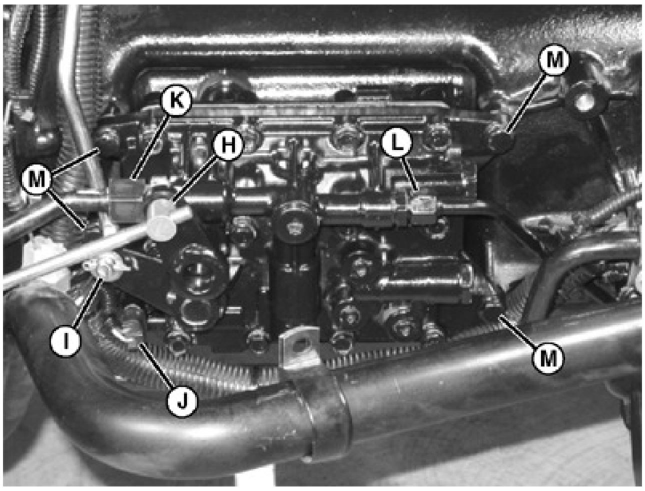


LEGEND:

G Cap Screw (5 used)

Left Foot Deck Support

[13] - Remove the cotter pin and washer (H) and disconnect the clutch linkage from the PowrReverser ™ valve clutch lever.



LEGEND:

H Cotter Pin and Washer
I Cotter Pin and Washer
J Transmission Neutral Switch Wiring Harness Connector
K Hydraulic Input Line
L Hydraulic Pressure Line
M Cap Screw (4 used)

Clutch Linkage

[14] - Remove the cotter pin and washer (I) and disconnect the shift linkage from the PowrReverser™ valve shift lever.

[15] - Disconnect transmission neutral switch wiring harness connector (J).

[16] -

→NOTE:

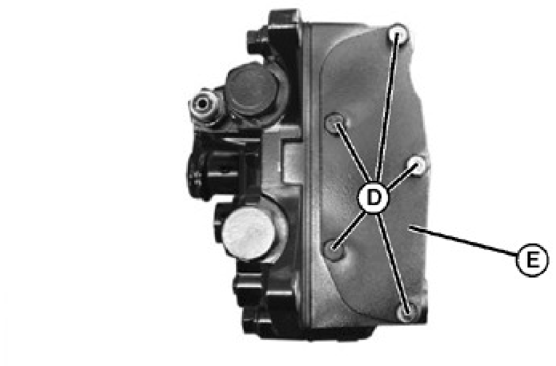
Hydraulic lines will have oil in them. Have a suitable container ready to catch oil.

Disconnect hydraulic input line (K) to PowrReverser™ valve and the hydraulic pressure line (L) to the PTO valve.

[17] - Remove four cap screws (M) and PowrReverser™ valve from transmission case.

Disassembly and Assembly:

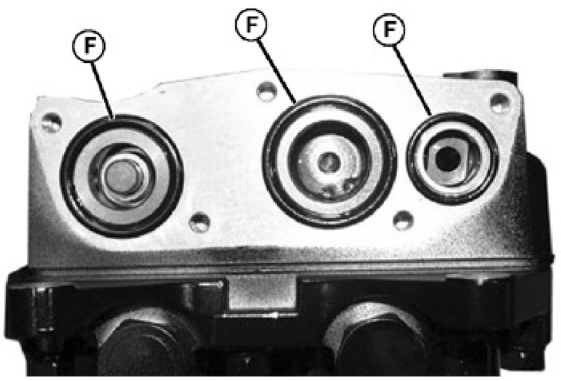
[1] - Remove five cap screws (D), side plate (E), and packing O-rings (F) from PowrReverser™ valve. Replace O-rings before reassembly.



LEGEND:

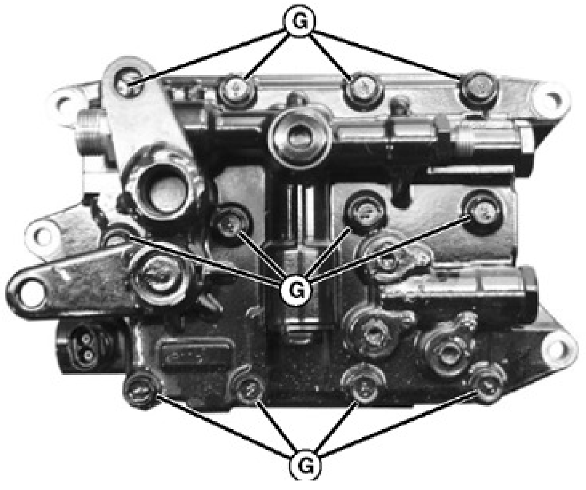
D	Cap Screw (5 used)
E	Side Plate
F	O-Ring

PowrReverser Valve



PowrReverser Valve O-Rings

[2] - Remove twelve cap screws (G) and securing PowrReverser™ valve case halves.

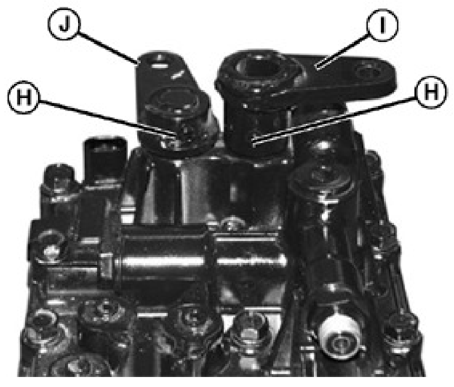


LEGEND:

G	Cap Screw (12 used)

PowrReverser Valve Case Halves

[3] - With appropriate punch, drive out spring pins (H) from clutch arm (I) and shift arm (J) and remove arms.



LEGEND:

H	Spring Pin
I	Clutch Arm
J	Shift Arm

Clutch Arm and Shift Arm

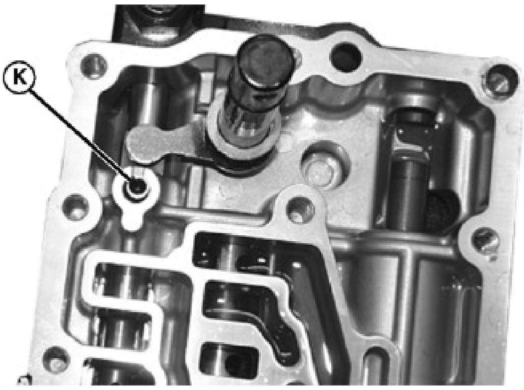
[4] -

→NOTE:

Shift spool detent spring and ball may fall out when PowrReverser™ blocks are separated.

Separate PowrReverser™ blocks, separator plate and gaskets.

[5] - Remove shift spool detent spring (K) and ball.

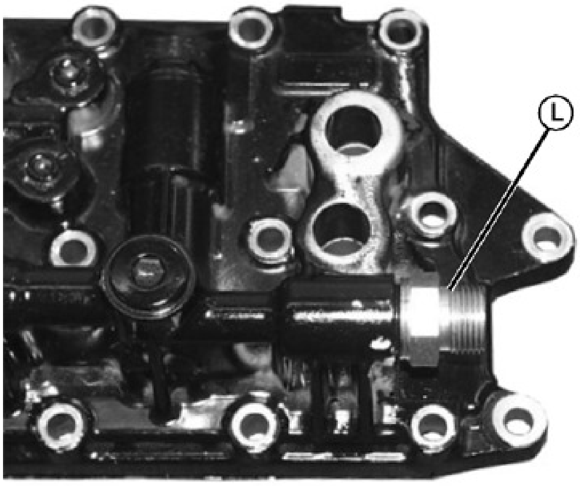


Shift Spool Detent Spring

LEGEND:

K	Shift Spool Detent Spring

[6] - Remove hydraulic inlet fitting (L).



Hydraulic Inlet Fitting

LEGEND:

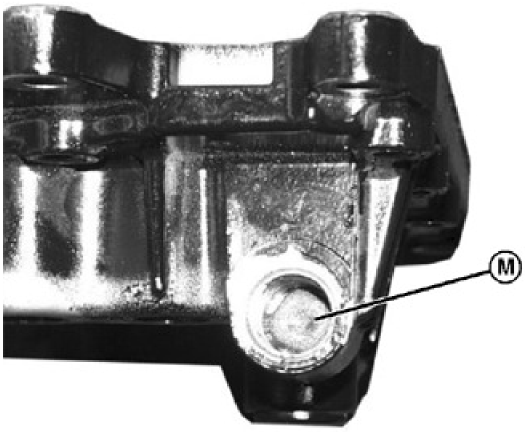
L	Hydraulic Inlet Fitting

[7] -

→NOTE:

If inlet screen is torn or damaged beyond repair, replace entire inlet case.

Inspect hydraulic oil input port filter strainer (M) for debris and to ensure mesh in strainer is intact. Clean screen by removing fitting (N) and blowing compressed air in direction shown through channel on opposite side of screen.

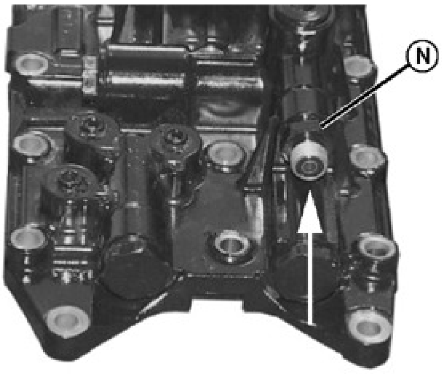


LEGEND:

M Hydraulic Oil Input Port Filter Strainer

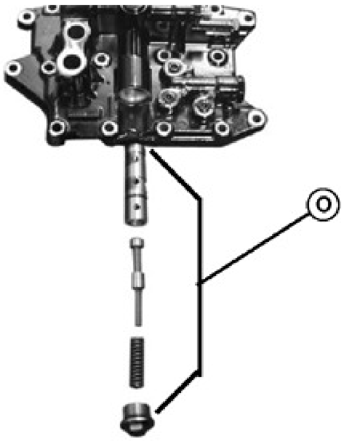
N Fitting

Hydraulic Oil Input Port Filter Strainer



Fitting

[8] - Remove pressure valve (O) from inlet case.



LEGEND:

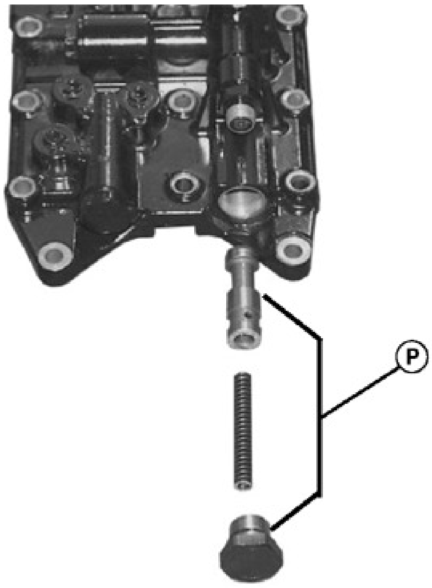
O Pressure Valve

Pressure Valve

[9] - Inspect pressure valve parts for scratching or other signs of wear. Replace as necessary.

[10] - Clean pressure valve parts, lightly coat with clean hydraulic oil, and reassemble valve.

[11] - Remove cut off valve (P) from inlet case.



LEGEND:

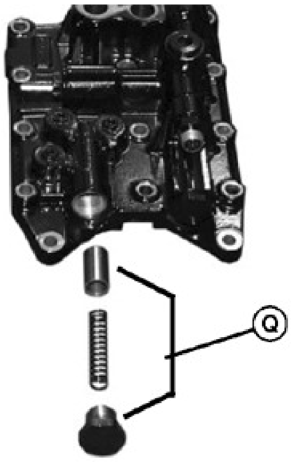
P	Cut Off Valve

Cut Off Valve

[12] - Inspect cut off valve parts for scratching or other signs of wear. Replace as necessary.

[13] - Clean cut off valve parts, lightly coat with clean hydraulic oil, and reassemble valve.

[14] - Remove pressure relief valve (Q) from inlet case.



LEGEND:

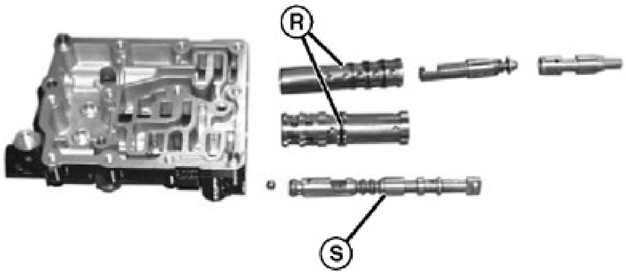
Q	Pressure Relief Valve

Pressure Relief Valve

[15] - Inspect pressure relief valve parts for scratching or other signs of wear. Replace as necessary.

[16] - Clean pressure relief valve parts, lightly coat with clean hydraulic oil, and reassemble valve.

[17] - Slide out valve assemblies (R) and shift spool (S). Inspect for scratching or other signs of wear.

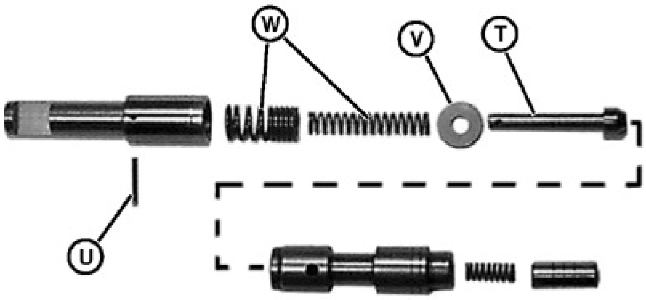


LEGEND:

R	Slide Out Valve Assembly
S	Shift Spool

Slide Out Valve Assembly

[18] - Separate clutch valve assembly halves. Depress spool guide pin (T), and remove insert pin (U).



LEGEND:

T	Spool Guide Pin
U	Insert Pin
V	Guide Pin, Spring Retention Washer
W	Springs (Qty. 2)

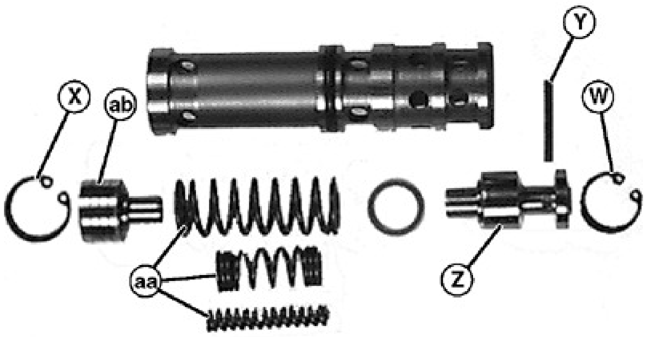
Clutch Valve Assembly

[19] - Remove guide pin, spring retention washer (V) and springs (W) from valve half.

[20] - Inspect clutch valve parts for scratching or other signs of wear. Replace as necessary.

[21] - Clean clutch valve parts, lightly coat with clean hydraulic oil, and reassemble valve.

[22] - Remove snap rings (X) from inside of drive spool.



LEGEND:

X	Snap Ring
Y	Spring Pin
Z	Relief Valve
Aa	Drive Valve
Ab	Nested Springs (3 used)

Drive Spool

[23] - Remove spring pin (Y) securing relief valve (Z) inside drive spool.

[24] - Inspect relief valve surfaces for scratching or other signs of wear. Replace as necessary.

[25] - Inspect drive valve (AA) surfaces for scratching or other signs of wear. Replace as necessary.

[26] - Inspect three nested springs (AB).

[27] - Clean relief valve parts, lightly coat with clean hydraulic oil and reassemble.

[28] - Clean PowrReverser™ blocks and separator plate in solvent and dry with compressed air.

[29] - Replace O-rings on drive spool.

[30] - If not already done, remove shift arm and clutch arm. Replace O-rings on shift and clutch arm shafts.

[31] - Install shift arm and clutch arm shafts.

[32] - Lightly coat all internal parts with clean hydraulic oil, reassemble spools and insert into PowrReverser™ block.

[33] - Install new O-rings and secure spool cover plate with lock washers and cap screws. Tighten cap screws securing cover plates to specification.

Item	Measurement	Specification
Spool Cover Plate Cap Screw	Torque	26 N·m (21 lb-ft)

[34] - Install detent assembly from outside of block and tighten detent ball plug to specification.

Item	Measurement	Specification
Detent Ball Plug	Torque	19 N·m (14 lb-ft)

[35] - Install new gaskets between PowrReverser™ cases and secure cases together with twelve cap screws and lock washers. Tighten cap screws to specification.

Item	Measurement	Specification
Case Cap Screw	Torque	24.4 N·m (18 lb-ft)

[36] - Install shift and clutch arms and secure with spring pins.

Installation:

Installation of PRT valve block is done in reverse order of removal.

[1] - Tighten cap screws securing valve to transmission housing to specification.

Item	Measurement	Specification
Transmission Housing Cap Screw	Torque	24.4 N·m (18 lb-ft)

[2] - Tighten neutral switch to specification.

Item	Measurement	Specification
Neutral Switch	Torque	27 N·m (20 lb-ft)

[3] - Tighten hydraulic line nuts to valve block to specification.

Item	Measurement	Specification
Hydraulic Line Nuts	Torque	50 N·m (37 lb-ft)

PRT Machine Splitting (Rear)

Special or Required Tools:

- JTO7335 Splitting Stands

Prepare the Machine:

[1] - Park machine on a level surface. Block wheels to keep machine stationary.

[2] - Disconnect battery negative cable from battery.

[3] - Remove hood. See Hood Removal and Installation (Cab and Open Station) .

[4] - Remove steering wheel. See Steering Wheel Removal and Installation .

[5] - Remove control panel. See Control Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[6] - Remove fuse panel cover. See Fuse Panel Cover Removal and Installation .

[7] - Remove left and right cowl panels and key switch. See Cowl Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[8] - Remove floor mat.

[9] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[10] - Remove seat closeout. See Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[11] - Remove rear wheels and tires. See Rear Wheel Removal and Installation .

[12] - Remove rear fenders. See Rear Fenders Removal and Installation (Open Station) .

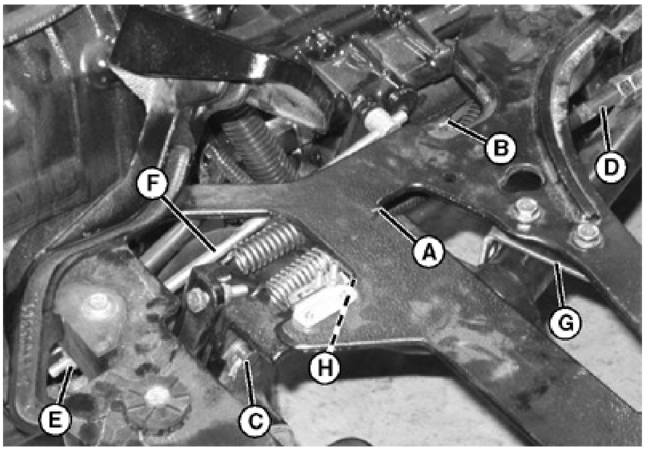
[13] - Remove operator platform. See Operator Platform Removal and Installation—PowrReverser Transmission .

[14] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

Remove the left brake return spring (A) and the clutch pedal spring (B).



LEGEND:

A	Left Brake Return Spring
B	Clutch Pedal Spring
C	Cotter Pin And Washer
D	Brake Link
E	Pedal End
F	Clutch Link
G	Support Bracket
H	Brake Switch Wiring Harness

Left Brake Return Spring

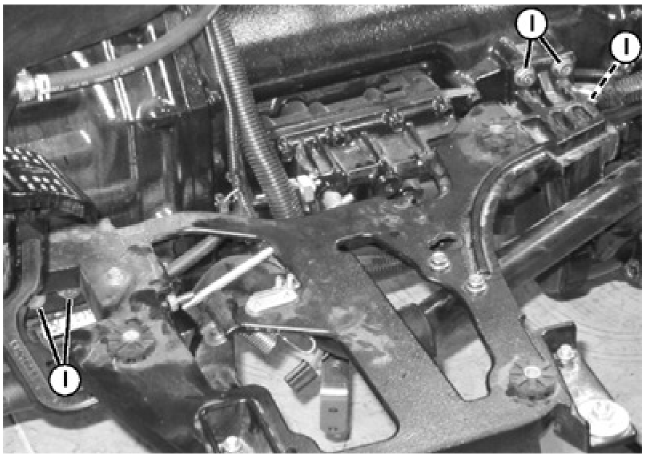
[15] - Remove the cotter pin and washer (C) from each end of the brake link (D) and remove the link.

[16] - Remove the cotter pin and washer from the pedal end (E) of the clutch link (F).

[17] - Remove the two cap screws and nuts securing support bracket (G) to foot deck support.

[18] - Disconnect the wiring harness from the brake switch (H).

[19] - Remove the five cap screws (I) securing the left foot deck support and remove the support.



LEGEND:

I Cap Screw (5 used)

Left Foot Deck Support

[20] - Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of machine. Unfasten and wire ties and/or harness clamps and route the wiring harness forward over the top of the fuel tank.

[21] -

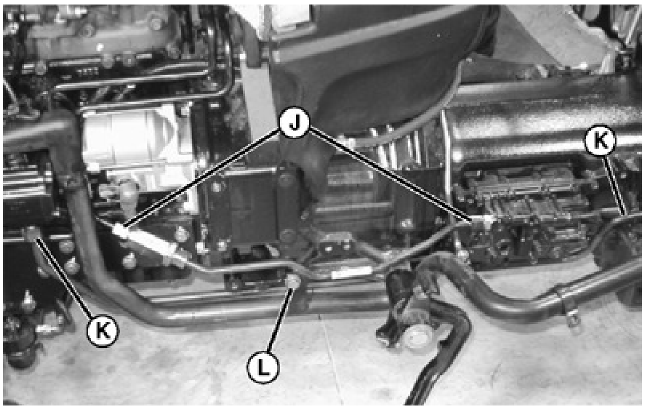
→NOTE:

Hydraulic lines will have oil in them. The suction line will have approximately 0.95 L (1 qt) of oil remaining in tube. Have a suitable container ready to catch oil.

Drain hydraulic oil from reservoir.

Item	Measurement	Specification
Hydraulic Reservoir	Capacity	23.8 liters (6.3 gal)

[22] - Remove PowrReverser ™ valve supply line (J).



LEGEND:

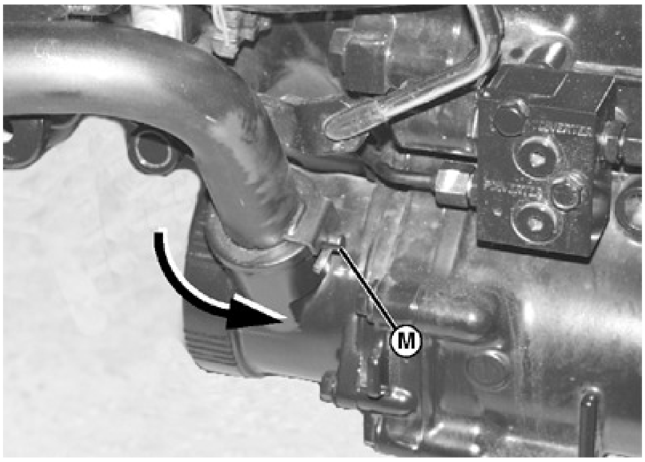
J PowrReverser™ Valve Supply Line
K Hydraulic Pressure Line
L Cap Screw

PowrReverser™ Valve Supply Line

[23] - Remove the hydraulic pressure line (K) from rear hydraulic pump on left side of engine and at the SCV valve.

[24] - Disconnect the suction line from the suction manifold at the hydraulic pump and remove the cap screw (L) securing suction line to the tunnel.

[25] - Turn suction tube counter clockwise until latch is clear of pin (M) and pull tube out of filter housing.

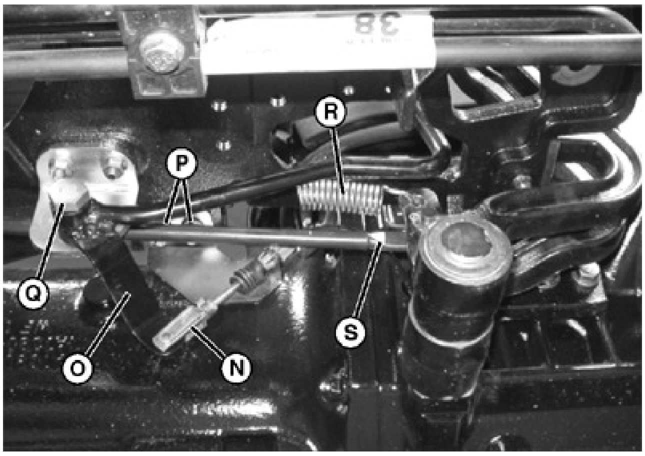


LEGEND:

M	Pin

Suction Tube

[26] - Disconnect the throttle cable (N) from the foot pedal (O).



LEGEND:

N	Throttle Cable
O	Foot Pedal
P	Cap Screw (2 used)
Q	Shoulder Screw
R	Right Brake Return Spring
S	Brake Link

Throttle Cable

[27] - Remove the two cap screws (P) securing the throttle cable bracket to the foot deck support.

[28] - Remove the shoulder screw (Q) securing the foot pedal to the pivot bracket.

[29] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

Remove the right brake return spring (R).

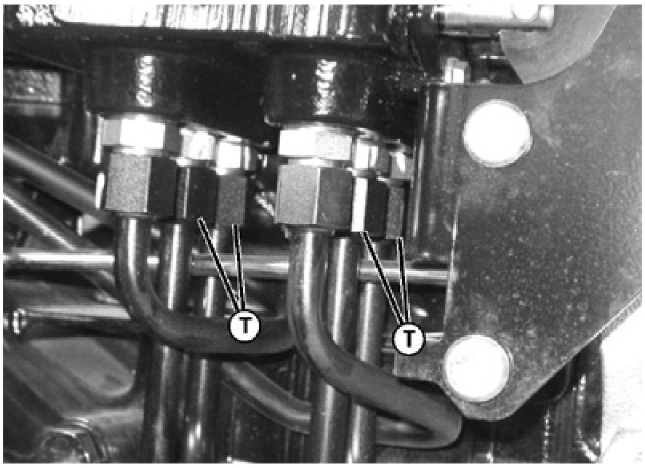
[30] - Remove the cotter pin and washer from each end of the brake link (S) and remove the link.

[31] -

→NOTE:

If optional third SCV is installed, six hydraulic tubes will be attached to valve. It is not necessary to disconnect these hydraulic lines.

Disconnect four work port tubes (T) from SCV.

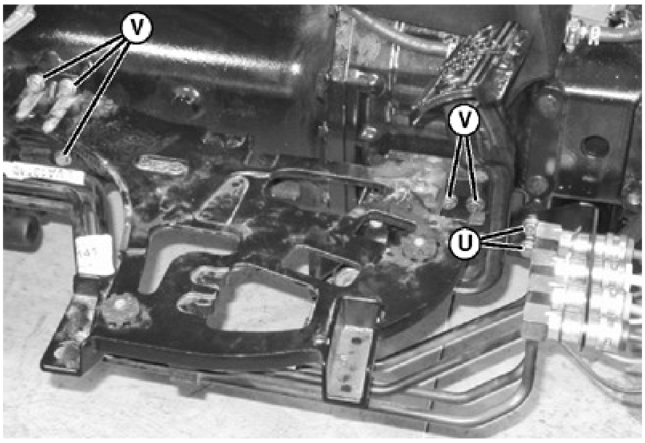


LEGEND:

T	Work Port Tube (4 used)

Work port Tubes

[32] - Remove two cap screws (U) that attach tube support bracket to frame. Remove SCV tube support bracket and SCV tubes as an assembly.



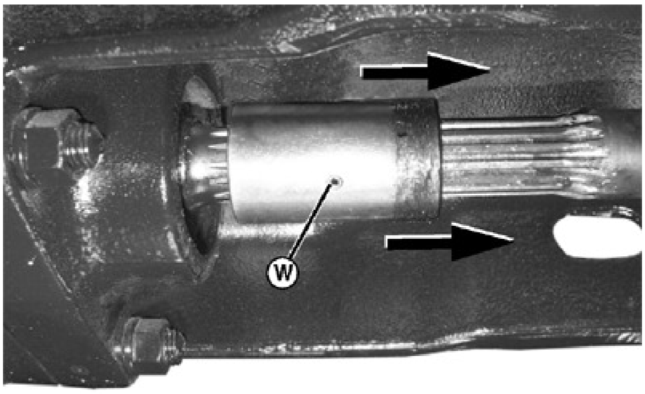
LEGEND:

U	Cap Screw (2 used)
V	Cap Screw (5 used)

Tube Support Bracket

[33] - Remove the five cap screws (V) securing the right foot deck support and remove the support.

[34] - Support drive shaft. Remove MFWD drive shaft and couplers as the machine is separated. Remove split pins (W) from couplers when couplers are off for reassembly purposes.



LEGEND:

W	Split Pin

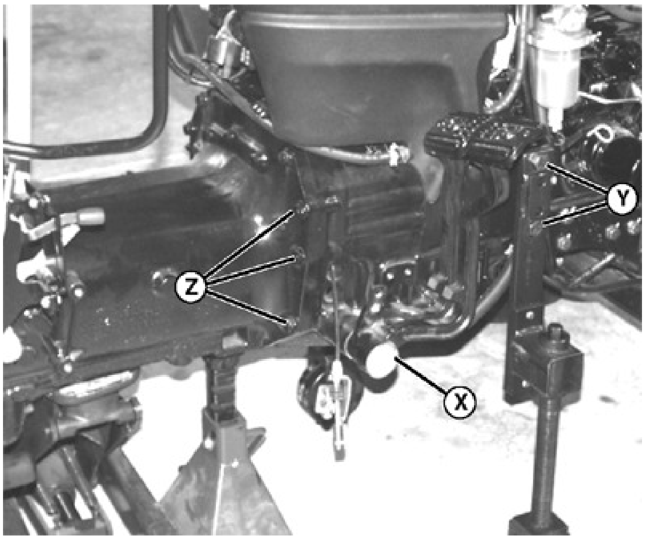
Coupler

Split the Machine:

IMPORTANT:

Avoid Damage! Check for, and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half before splitting machine.

[1] - Remove the retaining ring and washer (X). Remove the right and left brake pedals and square keys from the pivot shaft.



LEGEND:

X Retaining Ring and Washer

Y JTO 7335 Splitting Stands to Center Tunnel Section

Z Cap Screw (12 used)

Right Side Shown

[2] - From the left side of the machine, pull the pivot shaft and clutch pedal as an assembly out of the center tunnel.

[3] - Using four cap screws supplied with the splitting stands, secure JTO 7335 splitting stands to the center tunnel section as shown (Y). Repeat on other side of machine.

Splitting Stands

JTO7335

Split the Machine

[4] - Adjust splitting stands so that wheels contact the floor with light pressure, and are parallel to the machine front wheels.

[5] - Using suitable jack and stands, support the rear tunnel and differential housing.

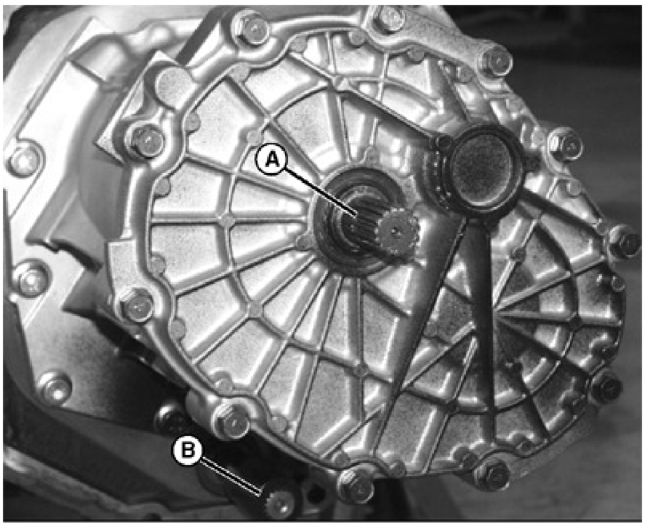
[6] - Remove twelve cap screws (Z) attaching tunnel section to engine section of machine.

[7] - If necessary, use a pry bar to separate the two machine halves. Split the machine by rolling the front section of the machine away from the rear tunnel and differential housing.

Connect the Machine:

> **→NOTE:**
>
> **Splines on all drive shafts and couplers must be aligned before machine sections are bolted together.**

[1] - Align splines on drive shaft (A), engine flywheel, and MFWD shaft (B) and coupler.



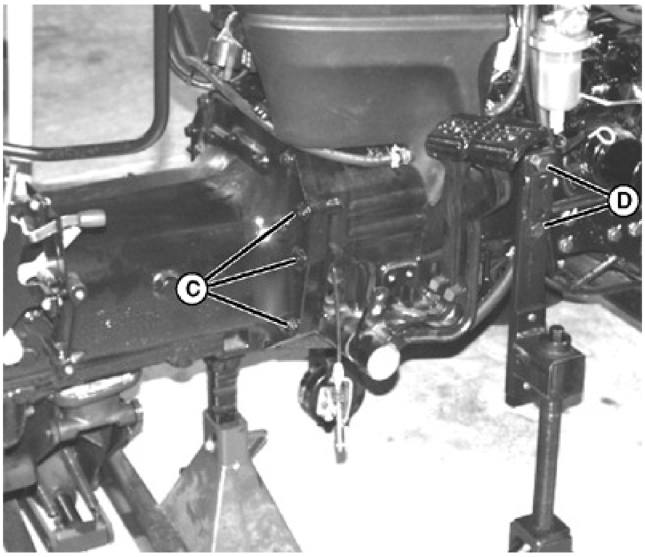
LEGEND:

A Splines on Drive Shaft

B MFWD Shaft

Splines on Drive Shaft

[2] - Move machine sections together and retain with twelve cap screws (C). Tighten cap screws to specification.



LEGEND:

C	Cap Screw (12 used)
D	Cap Screw (4 used)

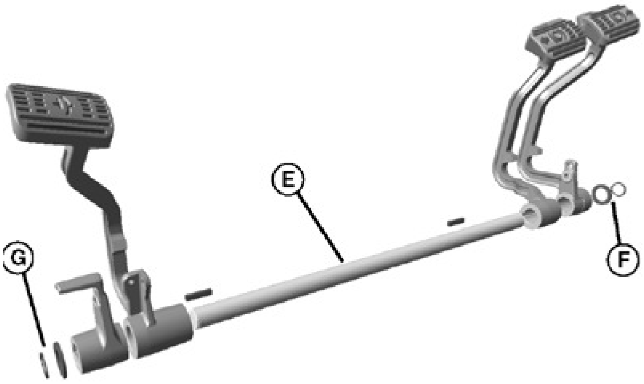
Right Side Shown

Item	Measurement	Specification
Machine Sections Retaining Cap Screw	Torque	126—154 N·m (95—115 lb-ft)

[3] - Install MFWD shaft and couplers.

[4] - Remove cap screws (D) retaining splitting stands to machine section. Remove splitting stands.

[5] - Install the pivot shaft (E) into the center tunnel.



LEGEND:

E	Pivot Shaft
F	Washer and Retaining Ring
G	Washer and Retaining Ring

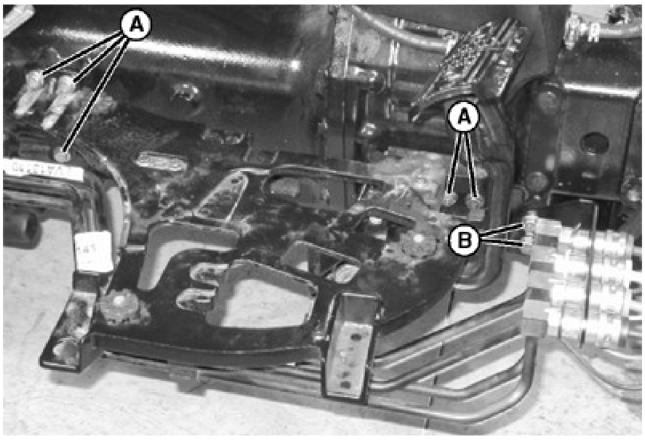
Pivot Shaft

[6] - Install the left and right brake pedals and square key onto the pivot shaft and retain with the washer and retaining ring (F).

[7] - Install the clutch and left brake actuator and square key onto the pivot shaft and retain with the washer and retaining ring (G).

Assemble Machine Sections:

[1] - Install the right foot deck support and secure with five cap screws (A).



LEGEND:

A Cap Screw (5 used)

B Cap Screw (2 used)

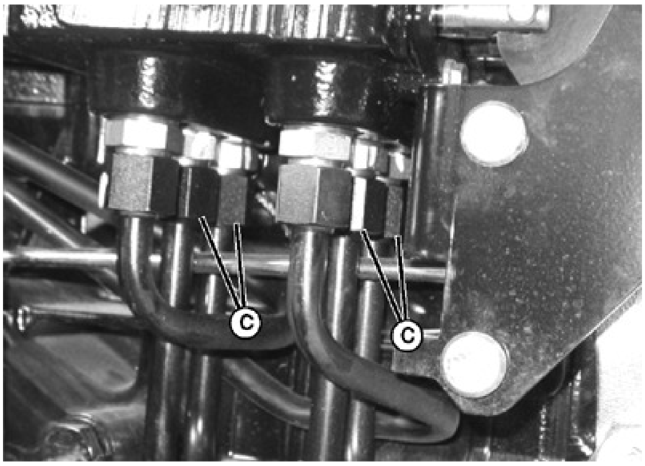
Right Foot Deck Support

[2] -

> **→NOTE:**
>
> **If optional third SCV is installed, six hydraulic tubes will be attached to valve. It is not necessary to disconnect these hydraulic lines.**

Install the SCV tube support bracket and SCV tubes as an assembly. Install two cap screws (B) to secure the tube support bracket to frame.

[3] - Connect four work port tubes (C) to SCV. Tighten to specification.



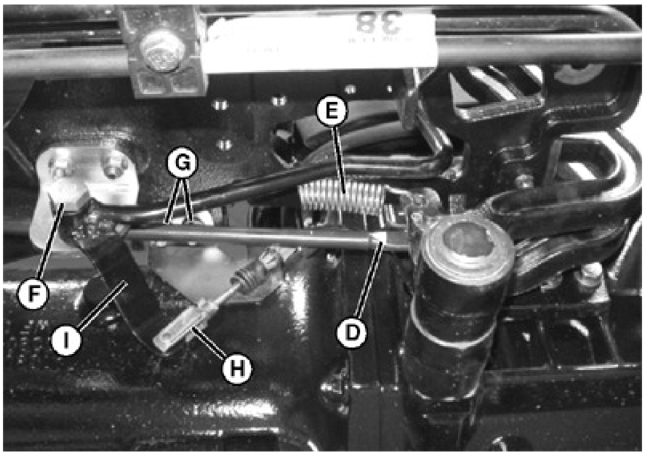
LEGEND:

C Work Port Tube (4 used)

Work Port Tubes

Item	Measurement	Specification
Work Port Tubes	Torque	40—57 N·m (30—43 lb-ft)

[4] - Install the brake link (D) and retain on each end with washer and cotter pin.



LEGEND:

D Brake Link

E Right Brake Return Spring

F Shoulder Screw

G Cap Screw (2 used)

H Throttle Cable

I Foot Pedal

Brake Link

[5] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

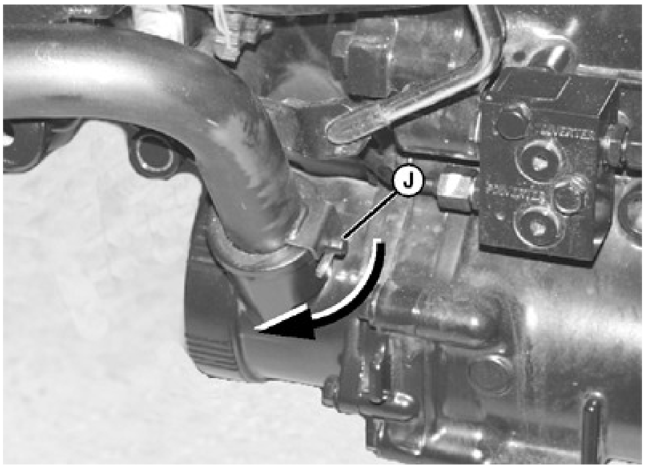
Install the right brake return spring (E).

[6] - Install the foot pedal to the pivot bracket with shoulder screw (F) and tighten.

[7] - Install the throttle cable bracket to the foot deck support with two cap screws (G) and tighten.

[8] - Connect the throttle cable (H) to the foot pedal (I).

[9] - Position the O-ring over the suction tube and press the tube into the filter housing. Rotate the suction tube as an assembly clockwise until latch is engaged over pin (J).

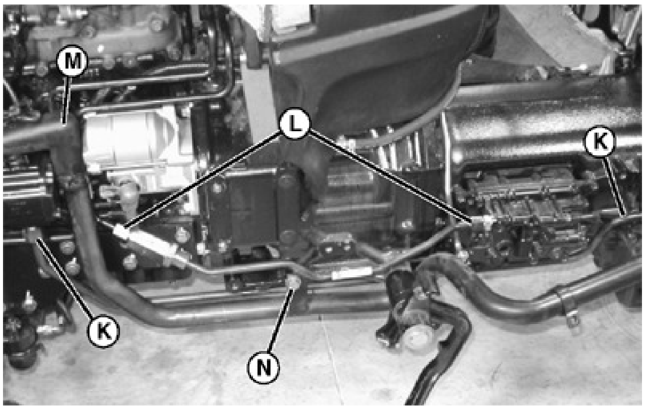


LEGEND:

J	Pin

Suction Tube

[10] - Install the hydraulic pressure line (K) onto the rear hydraulic pump on left side of engine and to the SCV valve. Tighten to specification.



LEGEND:

K	Hydraulic Pressure Line
L	PowrReverser™ Valve Supply Line
M	Suction Manifold
N	Cap Screw

Rear Hydraulic Pump

Item	Measurement	Specification
Hydraulic Pressure Line	Torque	40—57 N·m (30—43 lb-ft)

[11] - Install the PowrReverser ™ valve supply line (L) and tighten to specification.

Item	Measurement	Specification
PowrReverser™ Valve Supply Line	Torque	40—57 N·m (30—43 lb-ft)

[12] - Connect the suction line to the suction manifold (M) at the hydraulic pump and install the cap screw (N) securing suction line to the tunnel.

[13] - Route the wiring harness to the rear half of the machine along the left side of the tunnel.

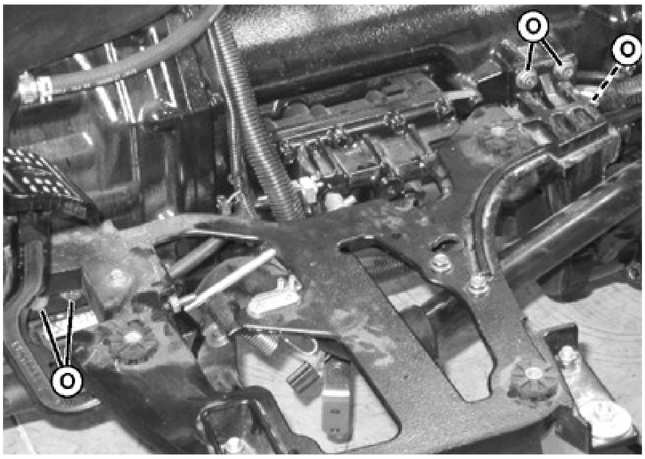
[14] -

→NOTE:

If the clutch link has been removed from the PowrReverser™ valve, it needs to be installed to the valve lever before the foot deck support is installed.

Locate and connect all electrical connectors attaching wiring harness to switches and lights on rear half of machine. Secure the wiring harness in position using wire ties as needed.

[15] - Install the left foot deck support and secure with five cap screws (O).

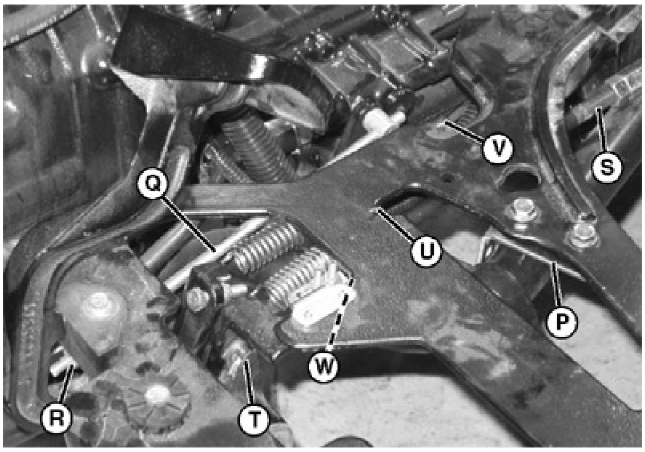


LEGEND:

O	Cap Screw (5 used)

Left Foot Deck Support

[16] - Install the suction tube support bracket (P) and install and tighten the two cap screws and nuts.



LEGEND:

P	Suction Tube Support Bracket
Q	Clutch Link
R	Washer and Cotter Pin
S	Brake Link
T	Washer and Cotter Pin
U	Left Brake Return Spring
V	Clutch Pedal Spring
W	Brake Switch

Suction Tube Support Bracket

[17] - Install the clutch link (Q) to the clutch pedal and secure with a washer and cotter pin (R).

[18] - Install the brake link (S) and retain on each end with washer and cotter pin (T).

[19] -

CAUTION:

Springs are installed under tension. Use caution when attaching or disconnecting springs. Wear eye protection.

Install the left brake return spring (U) and the clutch pedal spring (V).

[20] - Connect the wiring harness to the brake switch (W).

[21] - Install operator platform. See Operator Platform Removal and Installation—PowrReverser Transmission .

[22] - Install rear fenders. See Rear Fenders Removal and Installation (Open Station) .

[23] - Install rear wheels and tires. See Rear Wheel Removal and Installation .

[24] - Install seat closeout. See Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[25] - Install seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[26] - Install floor mat.

[27] - Install left and right cowl panels and key switch. See Cowl Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[28] - Install fuse panel cover. See Fuse Panel Cover Removal and Installation .

[29] - Install control panel. See Control Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[30] - Install steering wheel. See Steering Wheel Removal and Installation .

[31] - Install hood. See Hood Removal and Installation (Cab and Open Station) .

[32] - Fill transmission with oil.

Item	Measurement	Specification
Hydraulic Reservoir	Capacity	23.8 liters (6.3 gal)

[33] - Connect battery negative terminal.

PRT Traction Clutch Removal and Installation

Removal:

[1] - Split the machine. See PRT Machine Splitting (Rear) .

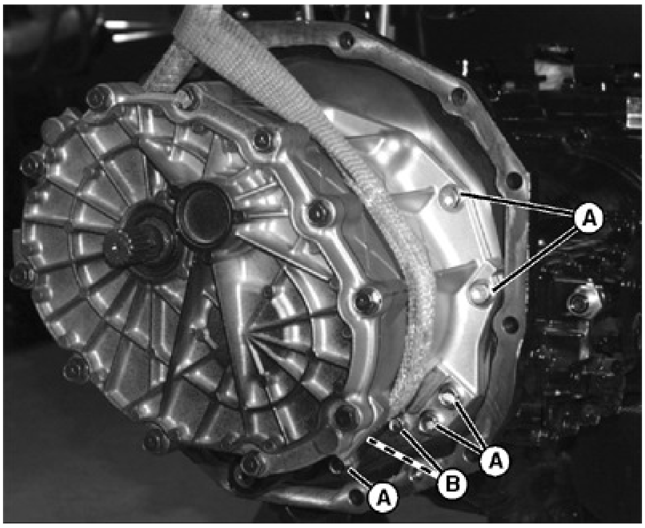
[2] - Safely support the traction clutch with a jack or hoist.

[3] -

→NOTE:

Do not remove two caps screws (B).

Remove thirteen cap screws (A) securing traction clutch to transmission case (includes three cap screws through reverse case). Do not remove the two cap screws (B) securing the valve body to the traction clutch case.



LEGEND:

A	Cap Screw (13 used)
B	Cap Screw (2 used)

Traction Clutch To Transmission Case

[4] -

→NOTE:

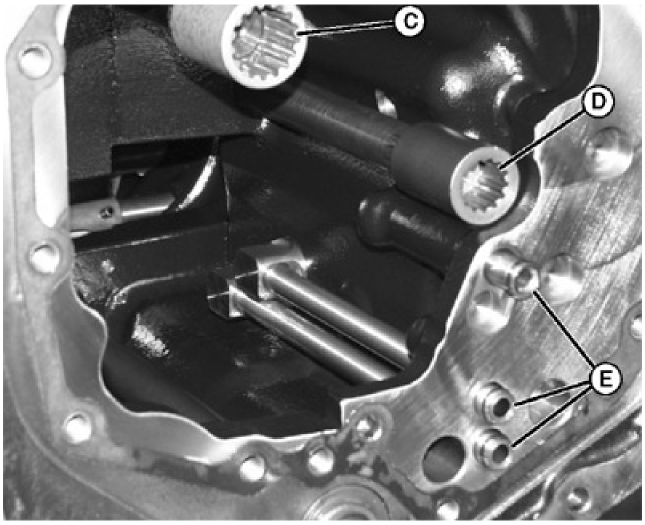
When the traction clutch is removed, the forward and reverse transfer shafts and couplers may pull out from transmission case and drop. Support the transfer shafts with one hand and pull traction clutch away from the transmission case.

Remove the traction clutch by pulling straight forward.

Installation:

[1] - Installation is the reverse of removal.

[2] - Verify that the forward (C) and reverse (D) shafts and couplers are in position and fully seated.



LEGEND:

C	Forward Shaft
D	Reverse Shaft
E	Oil Tubes

Shafts and Couplers

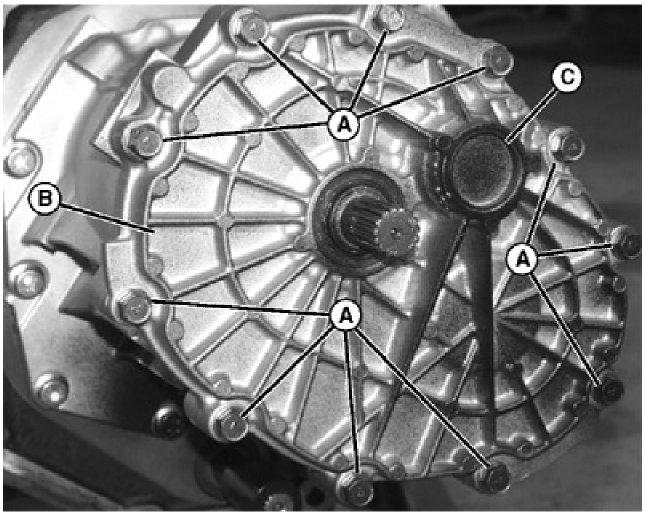
[3] - Verify that the oil tubes (E) are in position and fully seated.

Item	Measurement	Specification
Traction Clutch Mounting Cap Screw	Torque	43 N·m (32 lb-ft)

PRT Traction Clutch Disassembly and Assembly

Traction Clutch Idler Gear Removal:

[1] - Remove the eleven cap screws (A) and the front cover (B) and gasket. Remove the front cover.



LEGEND:

A	Cap Screw (11 used)
B	Front Cover
C	Idler Gear Seal Plug

Front Cover

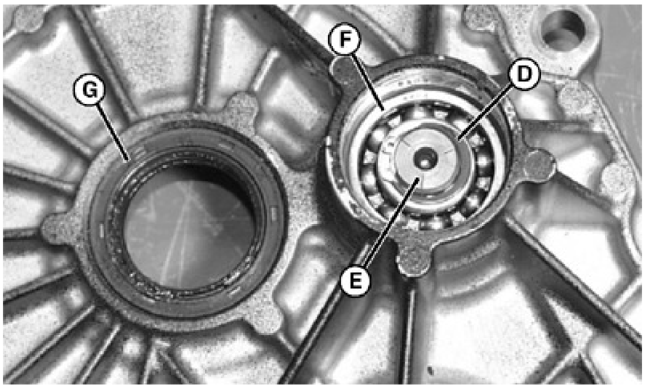
[2] -

IMPORTANT:

Avoid Damage! The seal plug will be damaged during removal. If the reverse idler gear is not damaged and spins smoothly, do not remove.

Remove idler gear seal plug (C) from front of front cover.

[3] - Remove the retaining ring (D) and washer.



LEGEND:

D	Retaining Ring
E	Idler Gear
F	Outer Bearing
G	Seal

Removing Bearing and Seals From Front Cover

[4] - Using a press, press the idler gear (E) out of the outer bearing (F).

[5] - Remove the outer bearing (F) from front cover. Use a press or puller if needed.

[6] - Remove bearing from idler gear shaft. Using a knife edge bearing puller if needed.

[7] -

IMPORTANT:

Avoid Damage! DO NOT spin bearings using compressed air. Damage to bearing balls, cage and races could result.

Clean bearings in suitable solvent. Dry with compressed air.

[8] - Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[9] - Inspect idler gear-22T for damage. Replace as required.

[10] - Inspect idler gear shaft bearing surfaces. If damaged, replace idler gear.

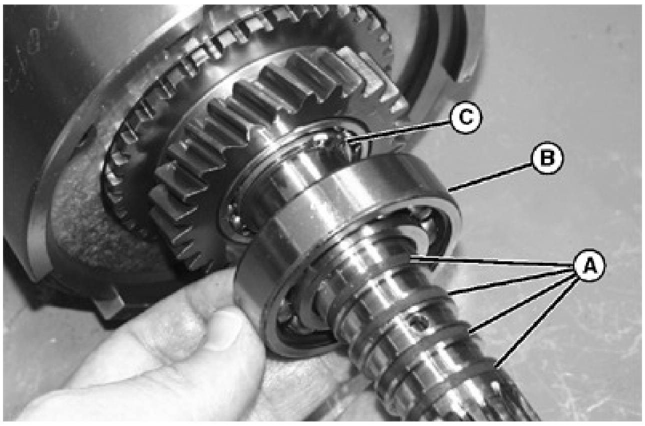
[11] - Install in reverse order of removal. Install a new shaft seal (G) and seal plug (C, if removed) during assembly.

Traction Clutch Disassembly:

[1] - Remove the traction drive shaft and clutch as an assembly, to a clean work area.

Traction Drive Shaft

[2] - Remove four split ring seals (A) from shaft.



LEGEND:

A	Split Ring Seal (4 used)
B	Bearing
C	Snap Ring

Split Ring Seals

[3] - Remove bearing (B) from shaft. Use a knife edge bearing puller if needed.

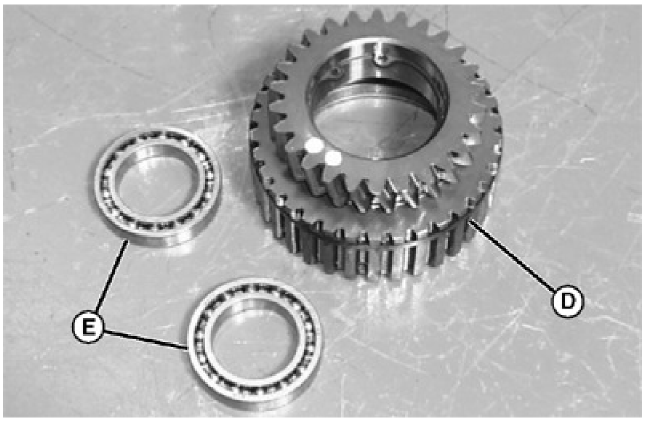
[4] - Remove snap ring (C) from shaft.

[5] -

→NOTE:

Mark the clutch gear before removal for installation to the correct end of the clutch pack and clutch drive shaft.

Remove the clutch gear-26T (D) and bearings (E) from the shaft.



LEGEND:

D	Clutch Gear-26T
E	Bearing (2 used)

Clutch Gear-26T

[6] - Remove the clutch gear-25T and bearings from the opposite end of the shaft.

[7] -

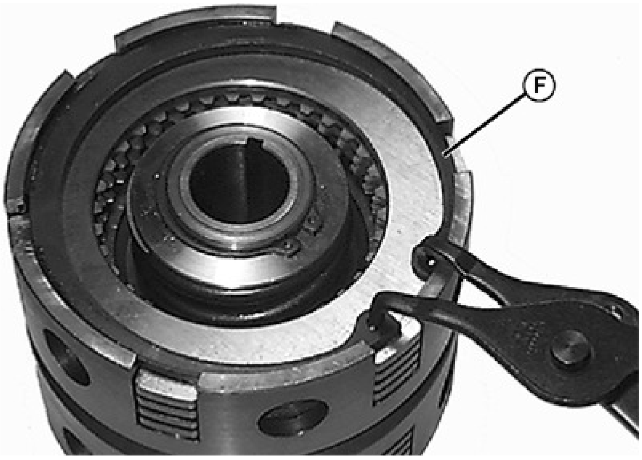
> ***IMPORTANT:***
>
> ***Avoid Damage! DO NOT spin bearings using compressed air. Damage to bearing balls, cage and races could result.***

Clean bearings in suitable solvent. Dry with compressed air.

[8] - Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[9] - Slide clutch assembly off shaft.

[10] - Remove snap ring (F) and clutch plate pack.



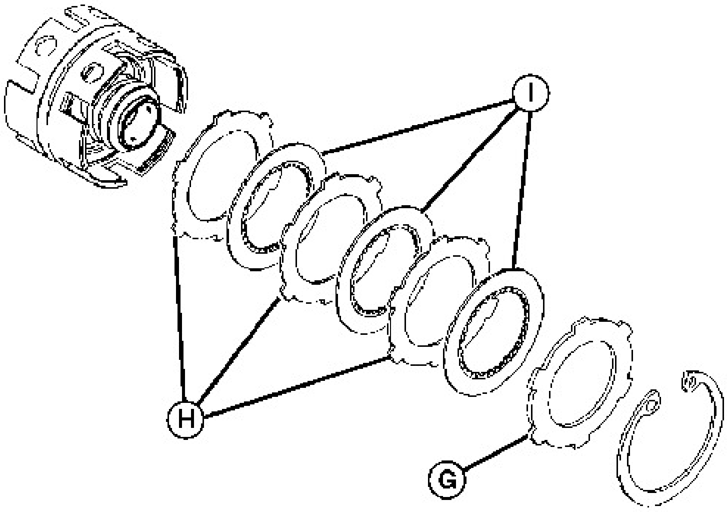
LEGEND:

F	Snap Ring

Clutch Plate Pack

[11] - Perform previous step for other side of clutch assembly.

[12] - Inspect end plate (G), separator plates (H) and friction plates (I) for wear, discoloration, scoring or warping. Measure plate thickness. If plate(s) do not meet minimum plate thickness specification, replace clutch plate pack as a unit.



LEGEND:

G	End Plate
H	Separator Plate (3 Used)
I	Friction Plate (3 Used)

Clutch Assembly

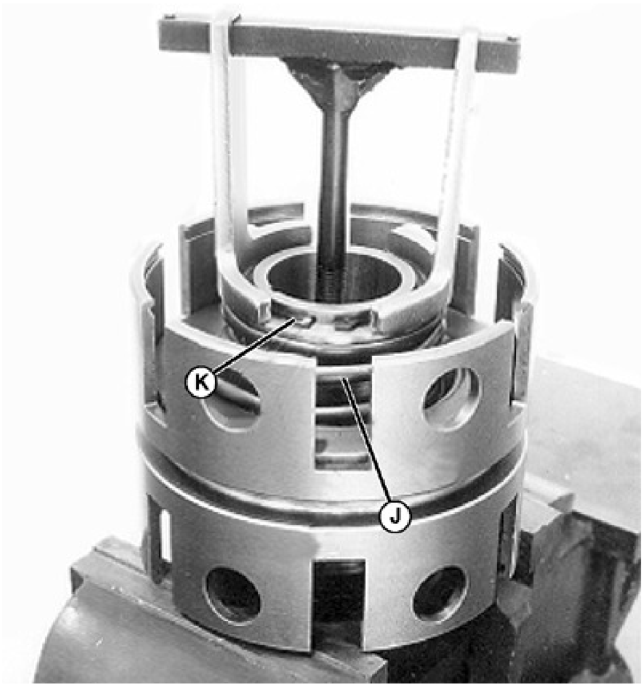
Item	Measurement	Specification
End Plate	Minimum Thickness	4.85 mm (0.191 in.)
Separator Plate(s)	Minimum Thickness	2.85 mm (0.112 in.)
Friction Plate(s)	Minimum Thickness	2.7 mm (0.106 in.)

[13] - Place clutch body and special tool JDT24B Spring Washer Compressor on a press or flat jawed vise.

Spring Washer Compressor

JDT24B

To disassemble clutch body.



LEGEND:

J	Spring
K	Retaining Ring

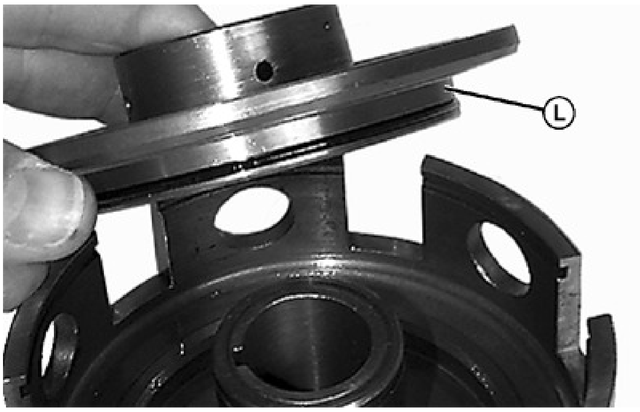
Spring Washer Compressor

[14] - Compress spring (J) and retaining ring (K).

[15] - Remove snap ring and slowly release tension on spring.

[16] - Remove snap ring, spring retention plate and spring.

[17] - Remove clutch piston (L).



LEGEND:

L	Clutch Piston

Clutch Piston

[18] - Perform steps 13 through 17 for opposite side.

[19] - Measure length (no load) of each spring. If spring length is less than specification, replace spring.

Item	Measurement	Specification
Spring	Length (minimum)	45.5 mm (1.79 in.)

[20] - Clean clutch body in solvent and dry with compressed air.

[21] - Clean and inspect pistons for wear, corrosion or pitting. Replace as necessary.

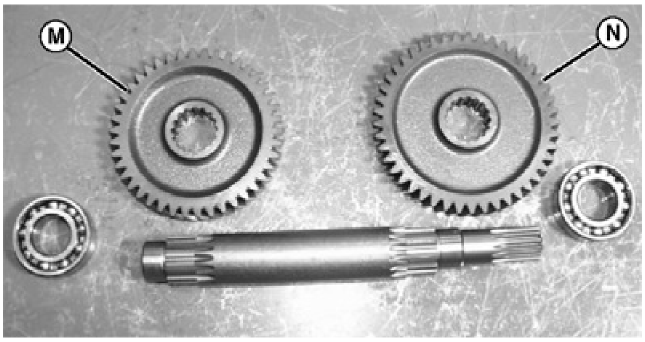
[22] - Replace packing on outside of each piston.

[23] - Lubricate all parts with clean, fresh hydraulic oil and reassemble.

Transfer Shaft Disassembly:

[1] - Remove reverse transfer shaft assembly from transmission case with traction clutch assembly.

[2] - Using a knife edge bearing puller, remove bearings, gear-42T (M) and gear-45T (N) from shaft.



LEGEND:

M	Gear-42T
N	Gear-45T

Gears

[3] -

> ***IMPORTANT:***
>
> ***Avoid Damage! DO NOT spin bearings using compressed air. Damage to bearing balls, cage and races could result.***

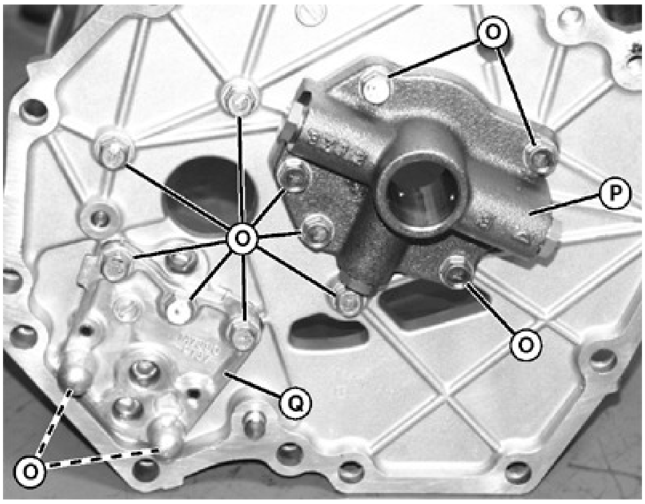
Clean bearings in suitable solvent. Dry with compressed air.

[4] - Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

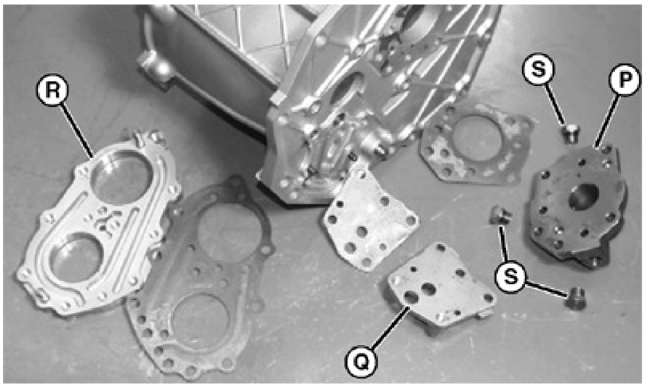
[5] - Inspect gear teeth for damage. Replace as required.

[6] - Inspect transfer shaft bearing surfaces. Replace if surfaces are damaged.

[7] - Remove the thirteen cap screws (O), and remove the manifold (P), porting plate (Q), and porting/bearing plate (R, inside).



Manifold Removal



Gasket Removal

LEGEND:

O Cap Screw (13 Used)
P Manifold
Q Porting Plate
R Porting/Bearing Plate
S O-rings (3 Used)

[8] - Mark and remove the three plug and O-rings (S).

[9] - Remove any gasket material from components.

[10] - Clean the ports and channels in all components in suitable solvent. Dry with compressed air.

[11] - Inspect drive shaft bore in the manifold for wear or scoring.

[12] - Assembly is in reverse order of disassembly.

[13] - Install new gaskets.

[14] - Install manifold, porting plate, and porting/bearing plate (inside) and cap screws. Tighten cap screws to specification.

Item	Measurement	Specification
Cap Screw	Torque	19–23 N·m (14–17 lb-ft)

Installation:

[1] - Remove any old gasket material from clutch front cover and clutch housing.

[2] - Place transfer shaft assembly (smaller gear-42T toward front cover) next to clutch, engage gears, and slide clutch assembly and transfer shaft assembly into clutch housing. Ensure transfer shaft and clutch shaft bearing are seated in bearing pocket and gear teeth are engaged.

[3] - Install front cover and reverse idler gear assembly to clutch housing. Ensure transfer shaft and clutch shaft bearing are seated in bearing pocket and gear teeth are engaged. Install cap screws and tighten to specification.

Item	Measurement	Specification
Cap Screw	Torque	19–23 N·m (14–17 lb-ft)

Transmission Gear Set Removal and Installation

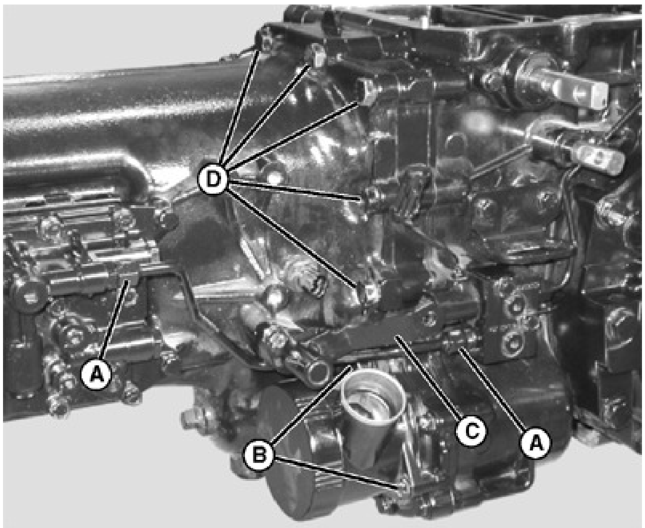
Gear Set Removal:

[1] - Split the rear half of the machine. See PRT Machine Splitting (Rear) .

[2] - Remove the rockshaft. See Rockshaft Removal and Installation (Open Station) .

[3] - Remove the SCV. See Selective Control Valve (SCV) Removal and Installation (Open Station) .

[4] -



LEGEND:

A	Hydraulic Line
B	Cap Screw (3 used)
C	MFWD Lever
D	Cap Screw (14 used)

Hydraulic Line

Remove the hydraulic line (A) at PTO valve.

[5] - Remove the three cap screws (B) and remove the hydraulic oil filter and filter case.

[6] -

→NOTE:

The MFWD coupler detent balls and spring will fall out if the coupler stays on the drive pinion shaft during separation of the transmission case. Placing and holding the MFWD lever in the disengaged position will hold the coupler over the detent balls.

Push the MFWD lever (C) down to the disengaged position.

[7] -

→NOTE:

Note the location and length of the transmission case to rear axle case cap screws.

Safely support the transmission case and remove the 14 cap screws (D) (five shown) securing the transmission case to the rear axle case.

[8] -

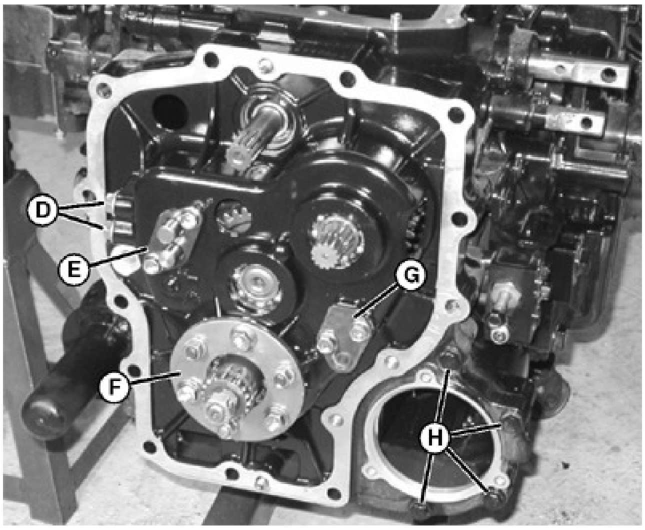
→NOTE:

The couplers for the PTO and drive shafts may stay with either the transmission case of the rear axle case. Locate the couplers, noting location and marking for assembly if needed.

Split the transmission case from the rear axle case.

[9] - Remove the PTO and drive shaft couplers.

[10] -



LEGEND:

D	Cap Screw (2 used)
E	Retainer Plate
F	Retainer Plate
G	Retainer Plate
H	Cap Screw (4 used)

Detent Springs

Remove the two cap screws (D) and the detent springs and balls.

[11] - Remove the retainer plate (E) and detent ball.

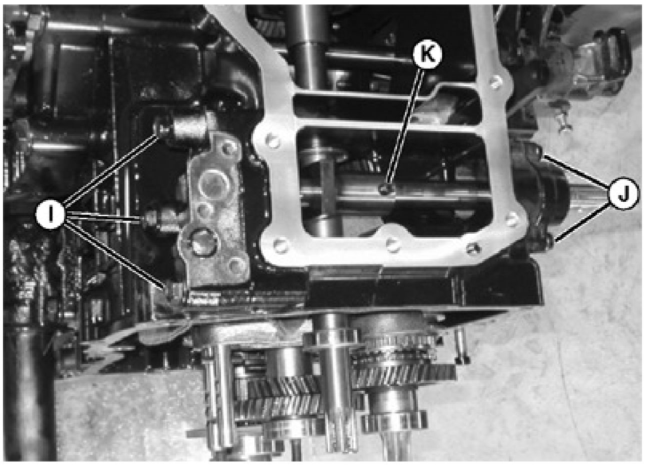
[12] - Remove the three cap screws and the three nuts and lock washers, and remove the retainer plate (F).

[13] - Remove the retainer plate (G) and the detent spring and ball.

[14] - Remove four cap screws (H) securing center plate to rear axle case.

[15] - Remove the center plate.

[16] -



LEGEND:

I	Cap Screw (3 used)
J	Cap Screw (2 used)
K	Roll Pin

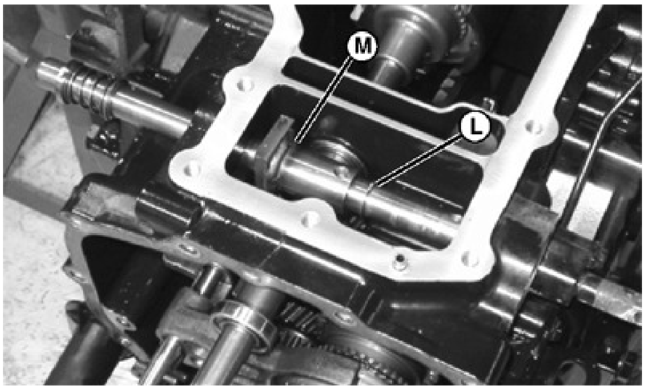
Manifold/Shift Holder

Remove the three cap screws (I) securing the manifold/shift holder to the axle case. Remove the manifold/shift holder.

[17] - Remove the two cap screws (J) securing the pivot block to the axle case. Remove the pivot block. Inspect the shaft seal and O-ring on the pivot block, replace as necessary.

[18] - Remove the roll pin (K) securing the shift lever to the shift shaft.

[19] -



LEGEND:

L	Retaining Ring
M	Shift Lever

Retaining Ring

Slide the shift shaft out of the axle case to expose the retaining ring (L). Remove the retaining ring and the shift shaft.

[20] - Remove the shift lever (M).

[21] - Remove drive gear assembly to work bench.

[22] - Visually inspect all parts for wear, cracks, or discoloration.

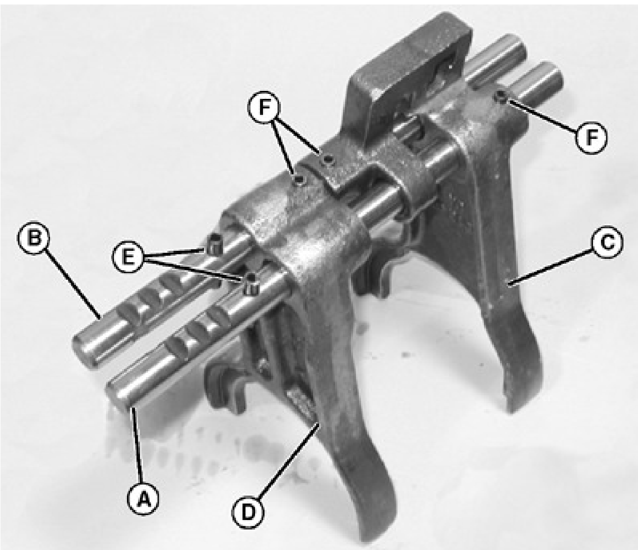
Shift Forks and Shafts Disassembly and Inspection:

[1] -

Shift Fork and Gear Assembly

Separate the shift fork and gear assemblies.

[2] -



LEGEND:

A	1st and 2nd Gear Fork Shaft

Gear Fork Shaft Inspection

Inspect 1st and 2nd gear fork shaft (A) and 3rd and 4th gear fork shaft (B) for wear.

[3] - Inspect 1st and 2nd gearshift fork (C) and 3rd and 4th gearshift fork (D) for wear.

[4] - Inspect rolled pins (E) in fork shafts for wear and proper positioning centered through shafts.

[5] - If shafts of forks need to be replaced, drive out rolled pins (F) in gear fork shafts as needed.

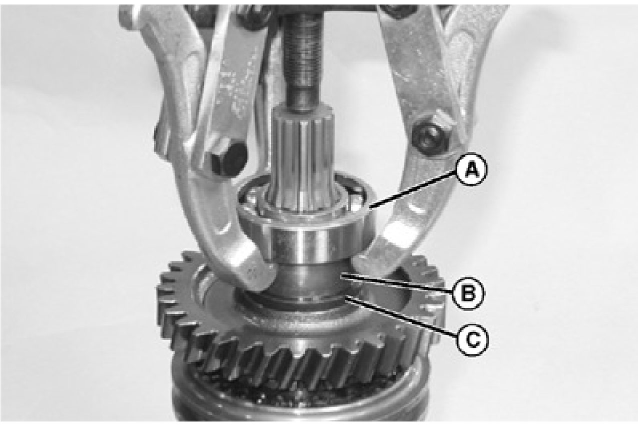
[6] - Coat all parts in fresh hydraulic oil and assemble in reverse order of disassembly.

4 Speed Gear Shaft Disassembly and Inspection:

→NOTE:

Disassembly of gear shaft is done from each end of gear shaft. Bearings on ends of gear shaft assembly are press fit on shaft and both bearings must be removed for complete disassembly.

[1] -



LEGEND:

A	End Bearing
B	Spacer
C	Spacer

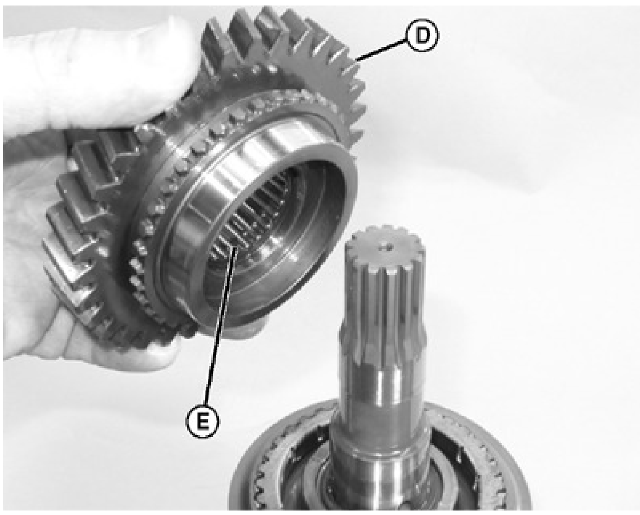
End Bearing

Using a bearing puller, remove end bearing (A) and wide (B) and thin (C) spacers from splined end of shaft.

[2] -

IMPORTANT:

Some gears have right pitched teeth and others have left pitched teeth. Mark gears if needed to be sure that they are assembled in the proper position.



LEGEND:

D	Gear-33T-RH

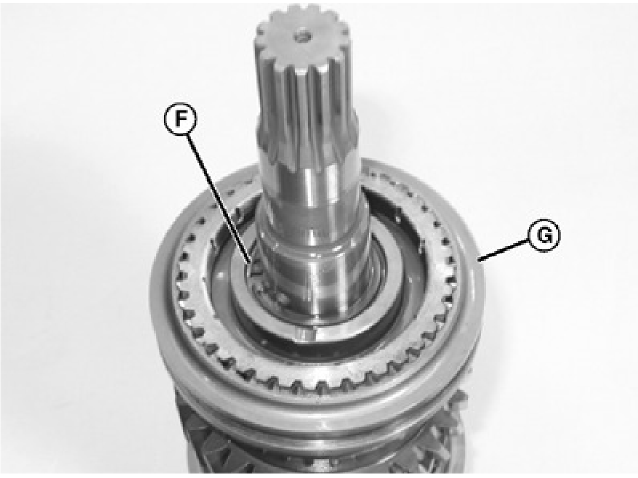
Gear Removal

Remove gear-33T-RH (D).

[3] - Inspect gear for broken or worn teeth. Inspect bearing surface for wear. Replace as required.

[4] - Inspect needle bearing (E) for wear or damage.

[5] -



LEGEND:

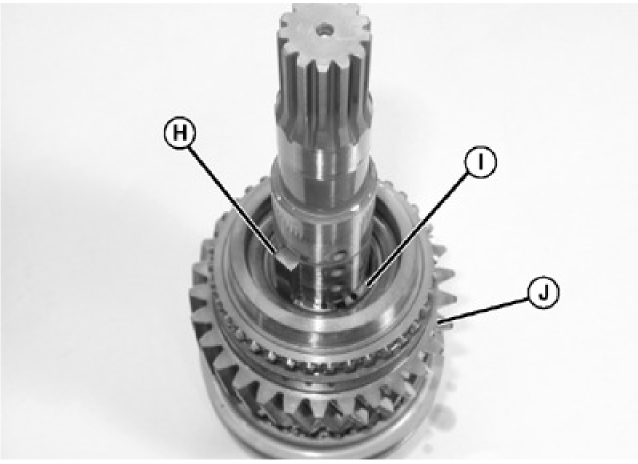
F	Snap ring

Snap Ring

Remove snap ring (F).

[6] - Remove synchromesh gears and shift collar (G) as an assembly.

[7] -



LEGEND:

H	Square Key
I	Retaining Ring

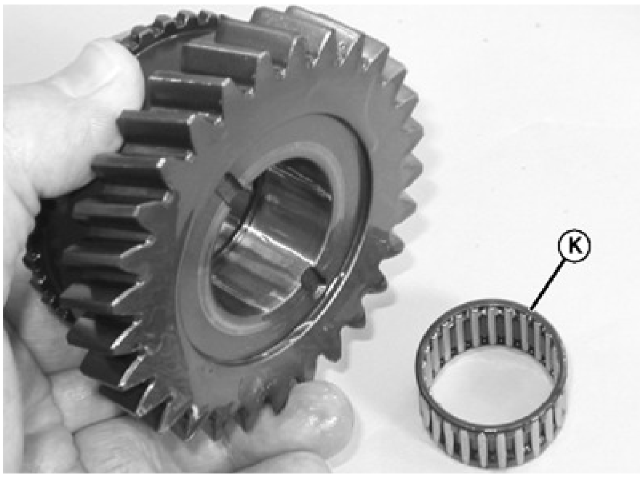
Square Key Removal.

Remove square key (H) and retaining ring (I).

[8] - Remove gear-29T-LH (J).

[9] - Inspect gear for broken or worn teeth. Inspect bearing surface for wear. Replace as required.

[10] -



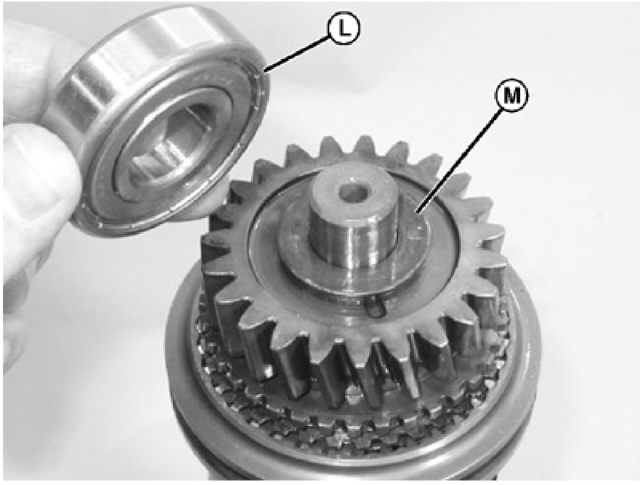
LEGEND:

K	Needle Bearing

Needle Bearing

Inspect needle bearing (K) for wear or damage.

[11] -



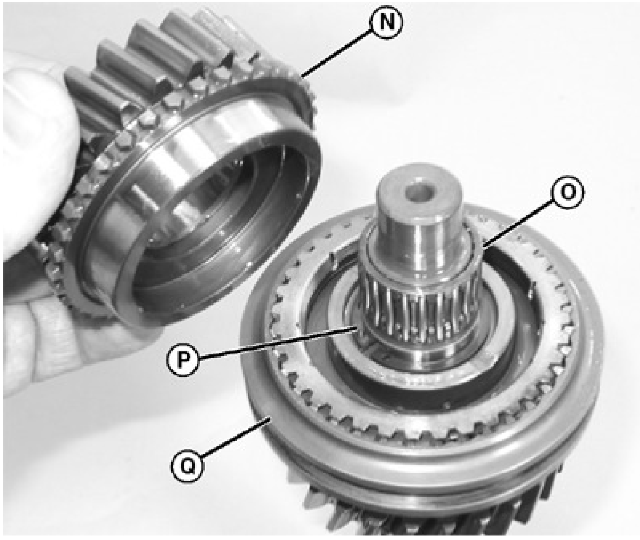
LEGEND:

L	End Bearing
M	Thrust Washer

End Bearing Removal

Using a knife edge bearing puller, remove end bearing (L) and thrust washer (M) from other (short) end of shaft.

[12] -



LEGEND:

N	Gear-23T-LH
O	Needle Bearing
P	Snap Ring
Q	Shift Collar

Gear Removal

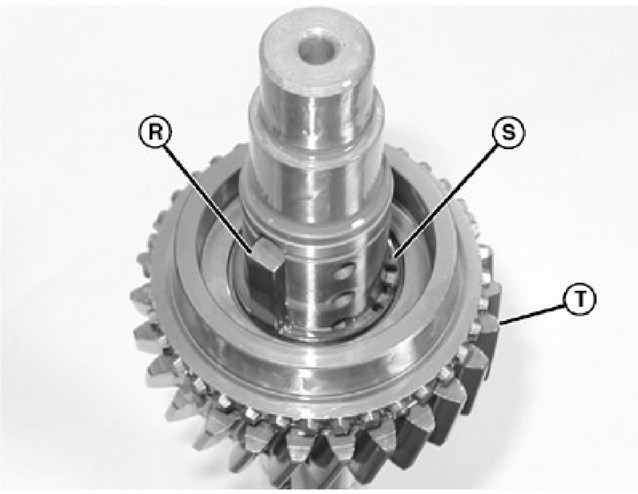
Remove gear-23T-LH (N) and needle bearing (O).

[13] - Inspect gear for broken or worn teeth. Inspect bearing surface for wear. Replace as required.

[14] - Remove snap ring (P).

[15] - Remove synchromesh gears and shift collar (Q) as an assembly.

[16] -



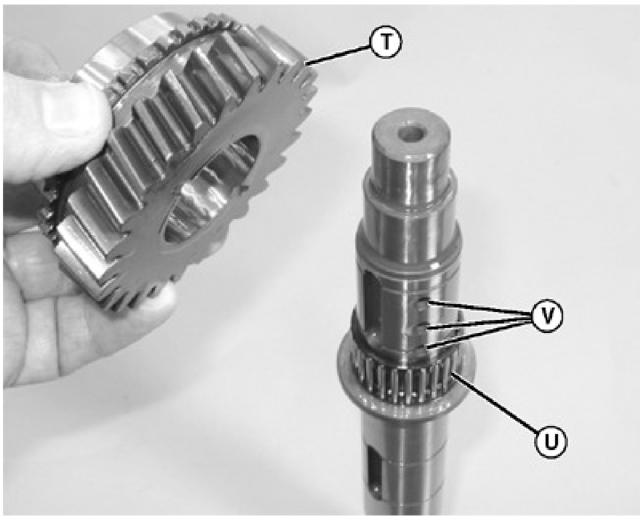
LEGEND:

R	Square Key
S	Retaining Ring

Square Key Removal

Remove square key (R) and retaining ring (S).

[17] -



LEGEND:

T	Gear-26T-RH
U	Needle Bearing
V	Lubrication Oil Passages

Gear Removal

Remove gear-26T-RH (T) and needle bearing (U).

[18] - Inspect gear for broken or worn teeth. Inspect bearing surface for wear. Replace as required.

[19] - Inspect the shaft for ware or damage. Verify that the splines are not worn. Check the lubrication oil passages (V). Replace shaft as required.

[20] - Coat all parts in fresh hydraulic oil and assemble in reverse order of disassembly.

Synchromesh Gear Disassembly, Inspection, and Reassembly:

[1] -

LEGEND:

I	Wire Ring Clip (2 used)
J	Sliding Synchromesh Ring
K	Ring Key (3 used)

Synchromesh Assembly

Disassemble synchromesh assembly by removing wire ring clips (I) from shift collar and sliding synchromesh ring (J) and ring keys (K) out of shift collar.

[2] - Clean gears, ring, and collar in suitable solvent. Dry with compressed air.

[3] - Inspect ring and collar (L) for wear, cracking, broken, or missing teeth, and plugged or filled oil lubrication passages. Replace as required.

[4] - Inspect synchromesh gears (M) for wear on tapered surfaces, plugged or filled in internal grooves, broken or missing teeth. Replace as required.

[5] -

LEGEND:

J	Synchromesh Ring
K	Ring Keys
L	Shift Collar

Ring Keys

Coat surfaces of parts with fresh hydraulic oil.

[6] - Insert three ring keys (K) and synchromesh ring (J) into shift collar (L).

[7] - Install a wire clip (I) on each side of shift collar. Ensure that wire clip engages all ring keys on each side.

[8] - Place synchromesh gear (M) on each side of shift collar with notches aligned with ring keys.

[9] - Set assembly aside.

[10] - Repeat steps 1 through 9 for second synchromesh gear assembly.

[11] - Coat all parts in fresh hydraulic oil and assemble in reverse order of disassembly.

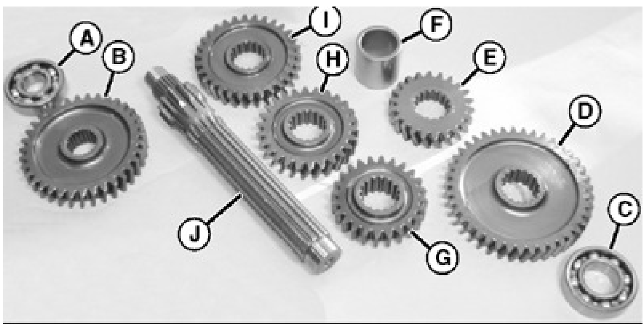
Mid Shaft Disassembly, Inspect, and Assembly:

IMPORTANT:

DO NOT spin bearings using compressed air. Damage to bearing balls, cage, and races could result.

[1] - Clean transmission top shaft, gears, and bearings in suitable solvent. Dry with compressed air.

[2] -



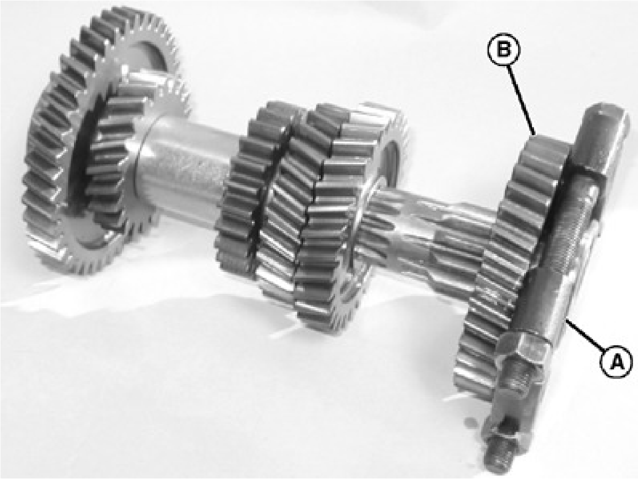
LEGEND:

A	Bearing
B	Gear-35T
C	Bearing
D	Gear-41T
E	Gear-22T
F	Spacer
G	Gear-24T
H	Gear-26T
I	Gear-30T
J	Mid Shaft

Bearing

Inspect both bearings for discolored or burned balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[3] -



LEGEND:

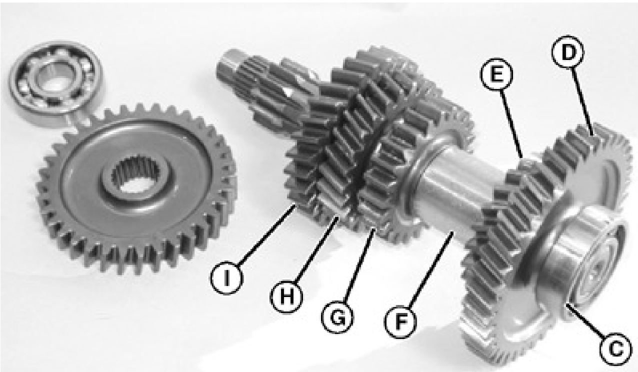
A	End Bearing
B	Gear-35T

End Bearing

Using a knife edge bearing puller, remove end bearing (A) from shaft.

[4] - Remove gear-35T (B).

[5] -



LEGEND:

C	End Bearing
D	Gear-41T
E	Gear-22T
F	Spacer
G	Gear-24T
H	Gear-26T
I	Gear-30T

Bearing

Using a knife edge bearing puller, remove end bearing (C) from shaft.

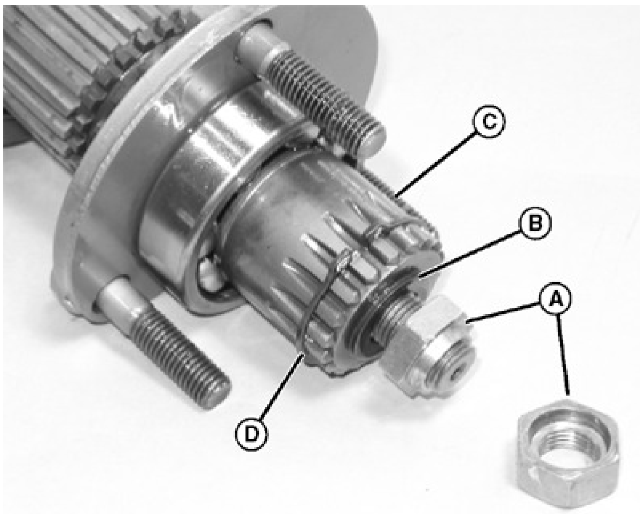
[6] - Remove gear-41T (D), gear-22T (E), spacer (F), gear-24T (G), gear-26T (H), gear-30T (I).

[7] - Inspect gear for broken or worn teeth. Inspect bearing surface for wear. Inspect the shaft for ware or damage. Verify that the splines are not worn. Replace shaft as required.

[8] - Coat all parts in fresh hydraulic oil and assemble in reverse order of disassembly.

Drive/Pinion Shaft Disassembly, Inspect, and Assembly:

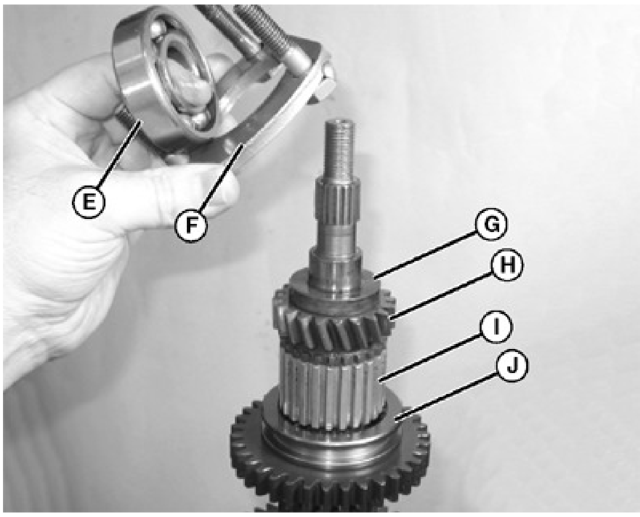
[1] -



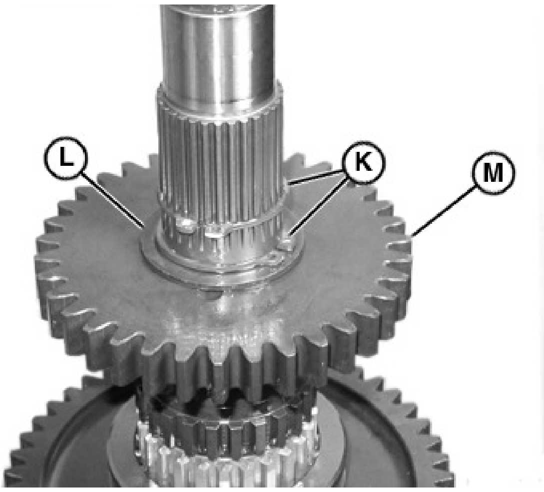
LEGEND:

A	Jam Nut
B	Spacer
C	Coupler Gear
D	Retaining Ring
E	End Bearing
F	Retainer
G	Spacer
H	Gear-20T
I	Long Splined Collar
J	Shift Collar
K	Retaining Ring
L	Spacer
M	Gear-35T

Jam Nuts



End Bearing



Retaining Ring

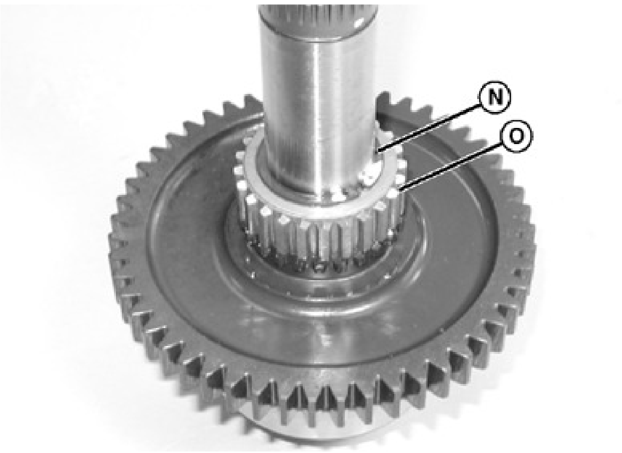
Remove the jam nuts (A), spacer (B), and coupler gear (C). It is not necessary to remove the retaining ring (D) from the coupler gear unless, the retaining ring is damaged.

[2] - Using a knife edge bearing puller, remove end bearing (E) and retainer (F) from shaft.

[3] - Remove the spacer (G), gear-20T (H), long splined collar (I), and shift collar (J).

[4] - Remove the retaining rings (K), spacer (L), and gear-35T (M).

[5] -



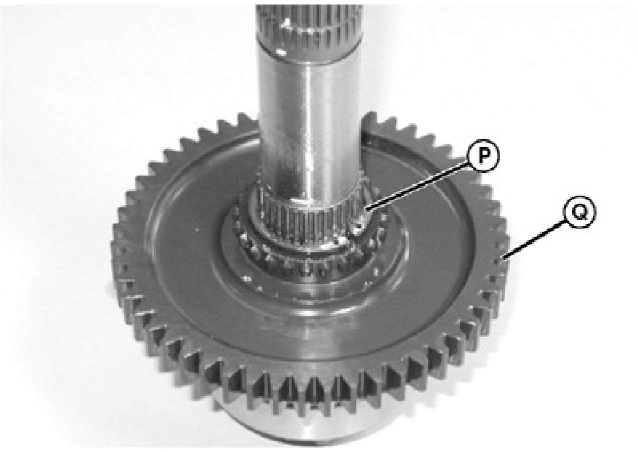
LEGEND:

N	Retaining Ring
O	Short Splined Collar

Retaining Ring

Remove retaining ring (N) and short splined collar (O).

[6] -



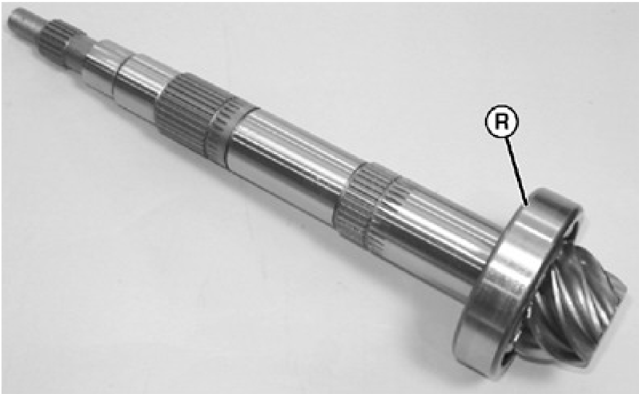
LEGEND:

P	Retaining Ring
Q	Gear-51T

Retaining Ring

Remove retaining ring (P) and gear-51T (Q).

[7] -



LEGEND:

R	End Bearing

End Bearing

Press the end bearing (R) from the shaft.

[8] - Inspect gear for broken or worn teeth. Inspect bearing surface for wear. Inspect the shaft for ware or damage. Verify that the splines are not worn. Replace shaft as required.

[9] - Coat all parts in fresh hydraulic oil and assemble in reverse order of disassembly. Tighten jam nuts to specification.

Item	Measurement	Specification
Jam Nut	Torque	78.5—9.8 N·m (57.9 7.2 lb.-ft.)

Gear Set Installation:

[1] - Remove any gasket material from components.

[2] - Clean the ports and channels in all components in suitable solvent. Dry with compressed air.

[3] - Assembly is done in reverse order of disassembly. Coat all parts with clean hydraulic oil during assembly.

[4] - Install new gaskets.

[5] - Fully assemble gear shaft assemblies.

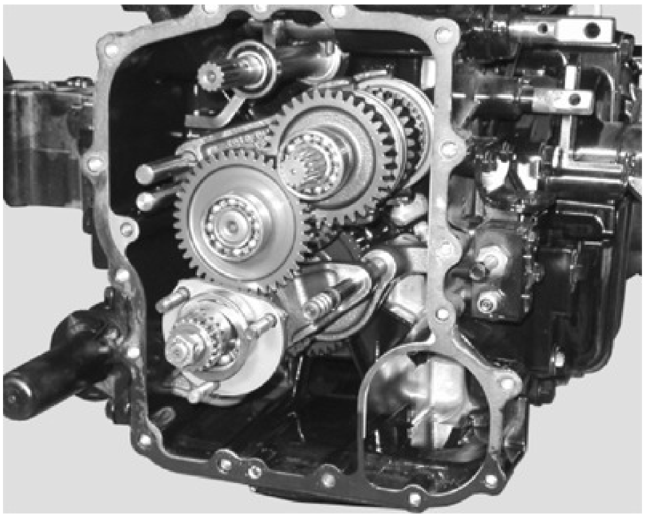
[6] -

CAUTION:

Machine component is heavy. Use a safe lifting device or get an assistant to help lift and hold component into lace for installation.

→NOTE:

Gear set and shift forks must be installed as an assembly.



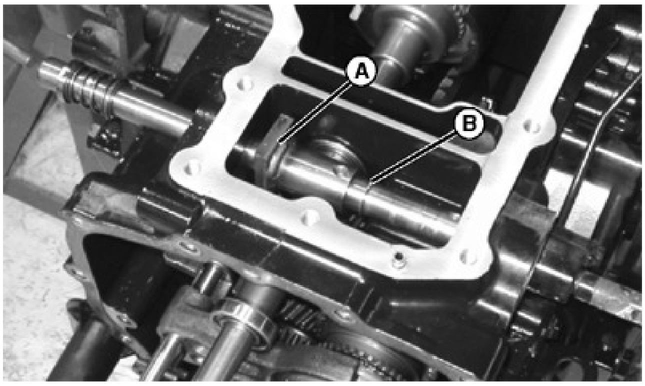
Gear Shaft Assembly

Install gear shaft assembly part way into transmission case, align shift forks with shift collars and shift levers.

[7] - Align shaft bearing and shift fork shafts with bearing pockets and shift fork journals, and fully seat all parts into transmission case.

[8] - Verify that PTO shaft bearing is fully seated in rear axle case and engaged into PTO clutch.

[9] -



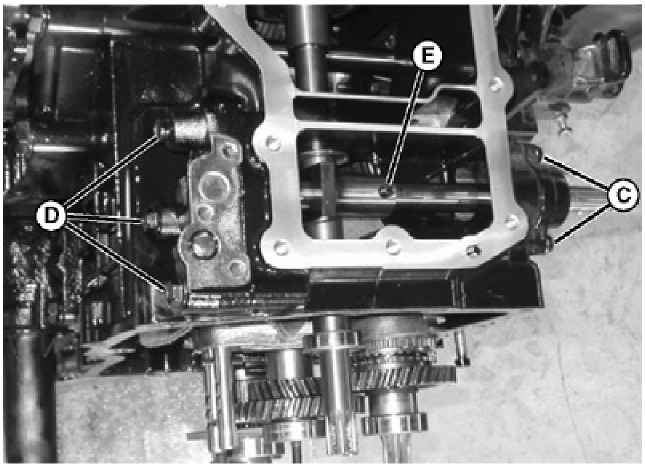
LEGEND:

A	Shift Lever
B	Retaining Ring

Shift Shaft

Slide the shift shaft into the axle case and install the shift lever (A) and retaining ring (B).

[10] -



LEGEND:

C	Cap Screw (2 used)
D	Cap Screw (3 used)
E	Roll Pin

Pivot Block

Install pivot block and secure with two cap screws (C).

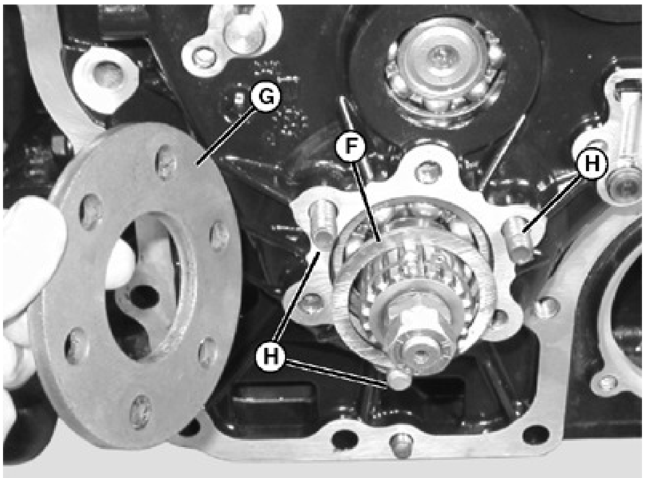
[11] - Install manifold/shift holder and secure with three cap screws (D).

[12] - Install the roll pin (E) securing the shift lever to the shift shaft.

[13] - Align the shift shafts and gear shafts and install center plate and four cap screws around the filter housing. Tighten cap screws to specification.

Item	Measurement	Specification
Filter Housing Cap Screw	Torque	44—59 N·m (32.4—43.5 lb.-ft.)

[14] -



LEGEND:

F	Shim (as required)
G	Retainer Plate
H	Stud (3 used)

Shims

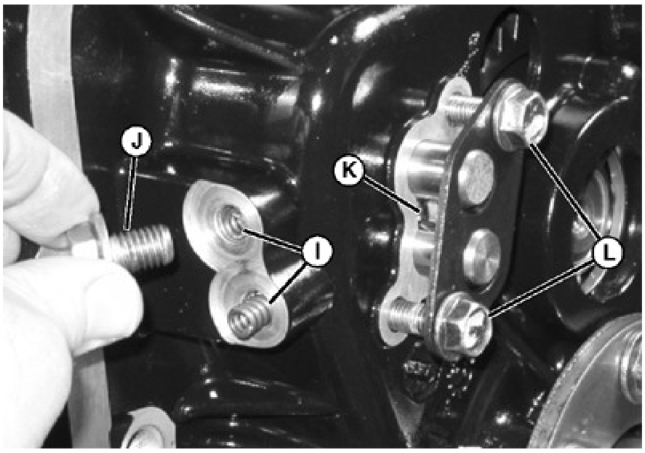
Install shim(s) (F) and position retainer plate (G) over drive/pinion shaft and inner retainer plate studs. See Differential Pinion Shaft Adjustment of Final Drive Section to check for shims to be installed.

[15] - Apply medium strength thread lock to the studs (H) and the three cap screws.

[16] - Install the three nuts and lock washers onto the studs and install the three cap screws. Tighten all to specification.

Item	Measurement	Specification
Nuts, Lockwashers, and Cap Screw	Torque	44—59 N·m (32.4—43.5 lb.-ft.)

[17] -



LEGEND:

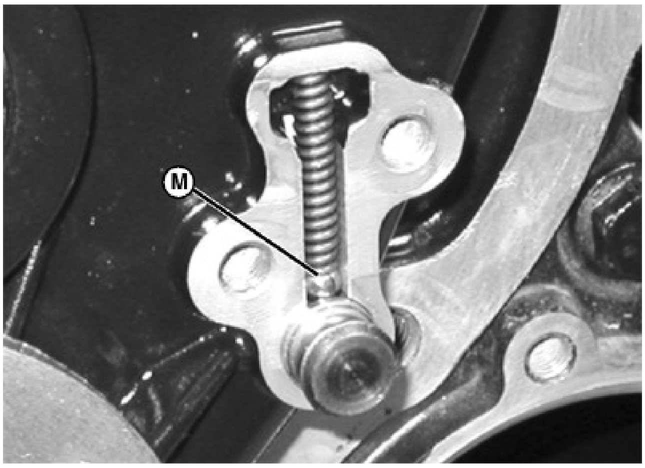
I	Detent Ball and Spring
J	Cap Screw (2 used)
K	Detent Ball
L	Cap Screw (2 used)

Detent Balls and Springs

Install the detent balls and springs (I). Install and tighten the two cap screws (J).

[18] - Install the detent ball (K) and retainer plate and secure with two cap screws (L).

[19] -



LEGEND:

M	Detent Ball and Spring

Retainer Plate and Cap Screws

Install the detent ball and spring (M) and retainer plate and secure with two cap screws.

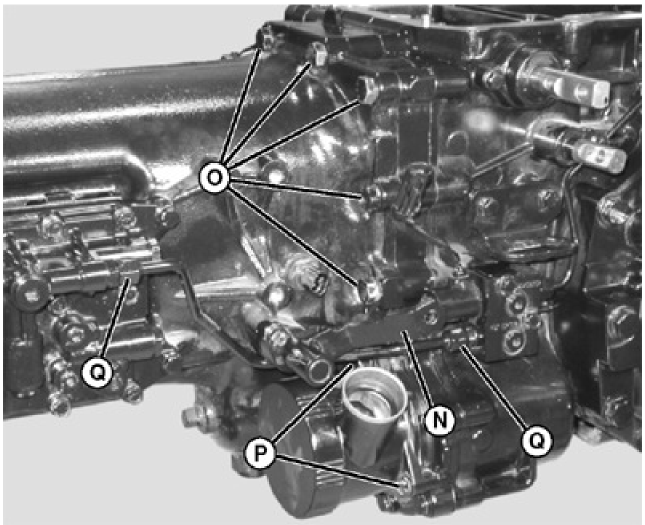
[20] - Install the PTO and drive shaft couplers.

[21] - Align the transmission case with the rear axle case.

[22] -

→NOTE:

The MFWD coupler detent balls and spring will fall out if the coupler stayed on the drive/pinion shaft during separation of the transmission case. Placing and holding the MFWD lever in the disengaged position will hold the coupler over the detent balls.



LEGEND:

N	MFWD Lever
O	Cap Screw (12 used)
Q	Hydraulic Line

MFWD Detent Balls and Springs

Check that the MFWD detent balls and spring have remained in place. The MFWD lever (N) should not move up and down easily. If the detent balls need to be installed, See MFWD Output Shaft .

[23] - Place the MFWD lever (N) in the disengaged position.

[24] -

→NOTE:

Note the location and length of the transmission case to rear axle case cap screws.

Install the 12 cap screws (O) securing the transmission case to the rear axle case. Tighten to specification.

[25] - Install the hydraulic oil filter case and oil filter. Tighten the cap screws to specification.

[26] - Install the hydraulic line (Q) to the PTO valve. Tighten to specification.

[27] - Install the rockshaft. See Rockshaft Removal and Installation (Open Station) .

[28] - Install the SCV. See Selective Control Valve (SCV) Removal and Installation (Open Station) .

[29] - Assembly the rear half of the machine to the front half. See PRT Machine Splitting (Rear) .

Item	Measurement	Specification
Case to Case Cap Screws		79—98 N·m (58—72 lb.-ft.)
Oil filter Case Cap Screws		44—59 N·m (33—44 lb.-ft.)
Hydraulic Line Nuts		40—57 N·m (30—43 lb.-ft.)

Section 70 - POWER TRAIN—FINAL DRIVE

Table of contents

Group 05 - Specifications

General Specifications

Item	Measurement	Specification
Transaxle Oil:		
John Deere J20C		
Hydraulic Reservoir	Capacity	25.7 L (6.8 gal.)

Item	Measurement	Specification
PTO Speeds (at rated engine speed):		
Rear PTO	Speed	540 rpm
Mid PTO	Speed	2100 rpm

Item	Measurement	Specification
MFWD Oil:		
John Deere J20C	Capacity	5.5 L (5.8 qt.)

Repair Specifications

Item	Measurement	Specification
PTO Clutch/Brake Specifications:		
Clutch/Brake Plate (End Plate)	Thickness	3.18 mm (0.125 in.)
Minimum Clutch/Brake Plate (Friction Plates)	Thickness	1.4 mm (0.055 in.)
Clutch/Brake Plates (Steel)	Thickness	2.3 mm (0.091 in.)
Interlock Pin	Length	19.5 mm (0.768 in.)

Item	Measurement	Specification
Pinion and Ring Gear:		
Differential Ring Gear	Backlash	0.1—0.2 mm (0.004—0.008 in.)

Item	Measurement	Specification
Front Wheel Alignment:		
Toe In Measurement	Distance	0—3 mm (0.0—0.12 in.)
Inclination	Angle	13°
Swing	Angle	10°

Item	Measurement	Specification
Steering Angle:		
Inward	Angle	54°
Outward	Angle	62°

Torque Specifications

Item	Measurement	Specification
Specifications:		
PTO Cover Cap Screws	Torque	28 N·m (20 lb.-ft.)
Final Drive-to-Transmission Housing Cap Screws	Torque	145 N·m (107 lb.-ft.)
Plug (with TEFLON* tape)	Torque	34.8—41.7 N·m (26—30 lb.-ft.)
Ring Gear Cap Screws	Torque	78 N·m (58 lb.-ft.)
Differential Bearing and Shim Carrier	Torque	28 N·m (21 lb.-ft.)
Rear Wheel Cap Screws	Torque	140 N·m (103 lb.-ft.)
M8 (7T) Cap Screws	Torque	23—29 N·m (17—21 lb.-ft.)
M10 (7T) Cap Screws	Torque	44—59 N·m (33—43 lb.-ft.)
M12 (7T) Cap Screws	Torque	79—98 N·m (58—72 lb.-ft.)
Eccentric Lock Nut (Lower and Upper)	Torque	78—98 N·m (58—72 lb.-ft.)
PTO Valve Pipe End	Torque	25 N·m (18 lb.-ft.)
Transmission Housing Port Plugs	Torque	26 N·m (19 lb.-ft.)

Item	Measurement	Specification
Front Axle MFWD:		
Front Wheel cap screws	Torque	140 N·m (103 lb.-ft.)
Final Drive Cover Cap Screw	Torque	30—38 N·m (22—28 lb.-ft.)
Differential Carrier Housing- to-MFWD Housing Cap Screw**	Torque	102—108 N·m (75—80 lb.-ft.)
Tie Rod Nut	Torque	115—129 N·m (85—95 lb.-ft.)
Differential Ring Gear Cap Screws	Torque	79—88 N·m (58—65 lb.-ft.)
Differential Bearing Retainer Cap Screws	Torque	54—68 N·m (40—50 lb.-ft.)
Pinion Retaining Nut	Torque	258—285 N·m (190—210 lb.-ft.)
Hub Shaft Retaining Nut**	Torque	447—488 N·m (330—360 lb.-ft.)
MFWD Housing-to-Spindle Housing Cap Screw**	Torque	286—316 N·m (211—233 lb.-ft.)

* TEFLON ™ is a registered trademark of DuPont

** NOTE: Use thread locking compound

Special or Essential Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Clutch Spring Compressor

JDG1169

To compress spring on clutch packs.

Splitting Stands and Brackets

JT07335-1,2,3

For Splitting Machine

Pinion Depth and Backlash Setup

JDG1395A

Used to calculate MFWD pinion depth if carrier housing is replaced

Transaxle Pinion Depth Gauge

JDG2023

Used to calculate shim thickness for proper pinion depth

Differential Lock Spring Compressor

JDG2025

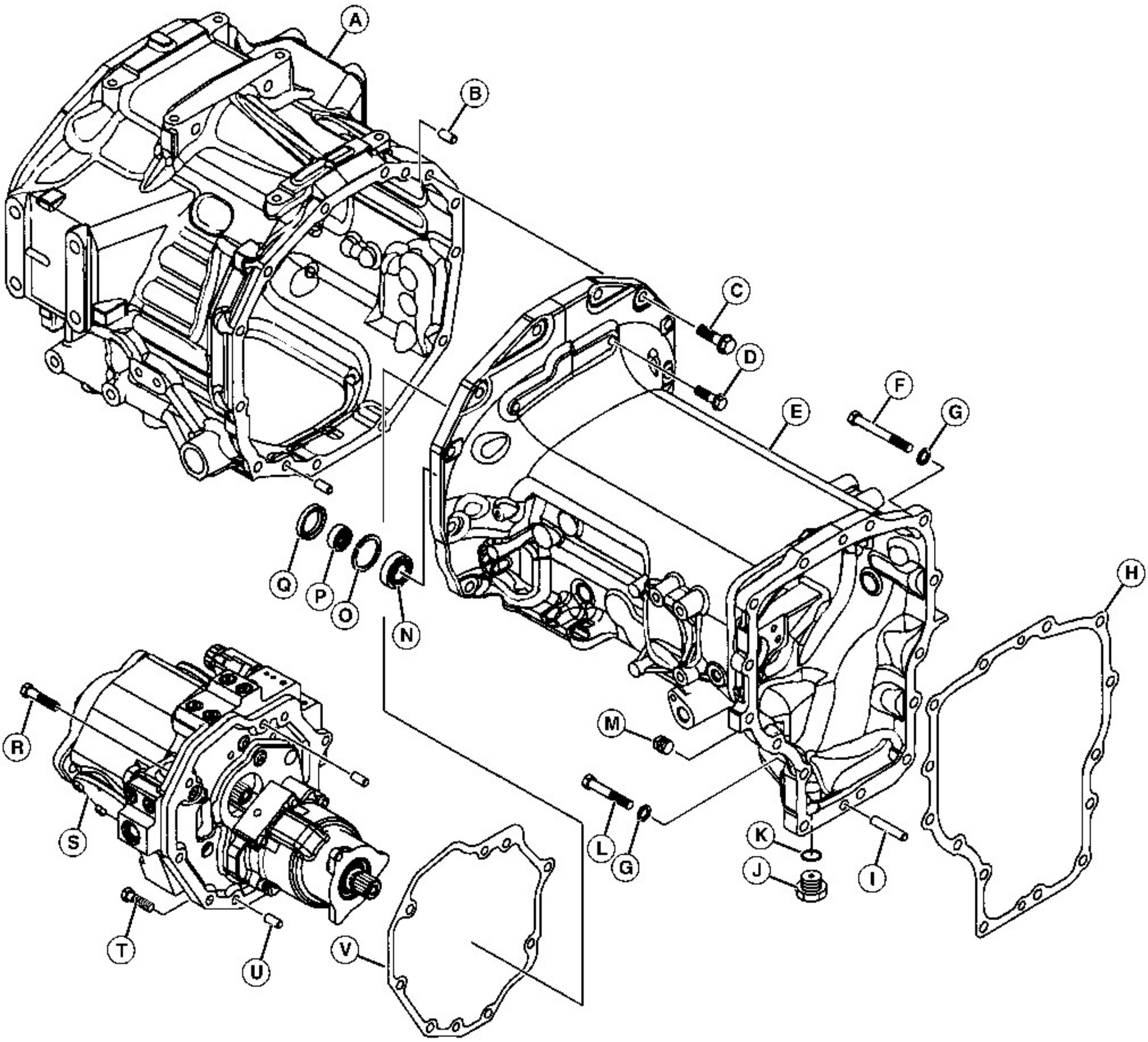
Compress spring on differential lock shaft for retaining ring removal/installation

Other Material

Number	Name	Use			
• J20C (us)	Oil	MFWD oil	Coat parts for assembling.		
• PM37418 (us)	Thread Lock and Sealer	To secure and seal the differential carrier housing cap screws.			
• PM38652 (us)	Retaining Compound	Secures and seals drive housing cap.			
• PM38654 (us)	Loctite ™ High Strength Thread Lock and Sealant	Apply to torque prevailing nut.	Apply to spindle housing cap screws		
• PM38655 (us)	Loctite ™ Flexible Form-in-Place Gasket	Coat new hub outer surface.	Seals the mating surface of final drive cover.	Seals the mating surface of MFWD housing and spindle housing.	Seals the mating surface of MFWD differential cover.

Group 10 - Component Location

Transmission



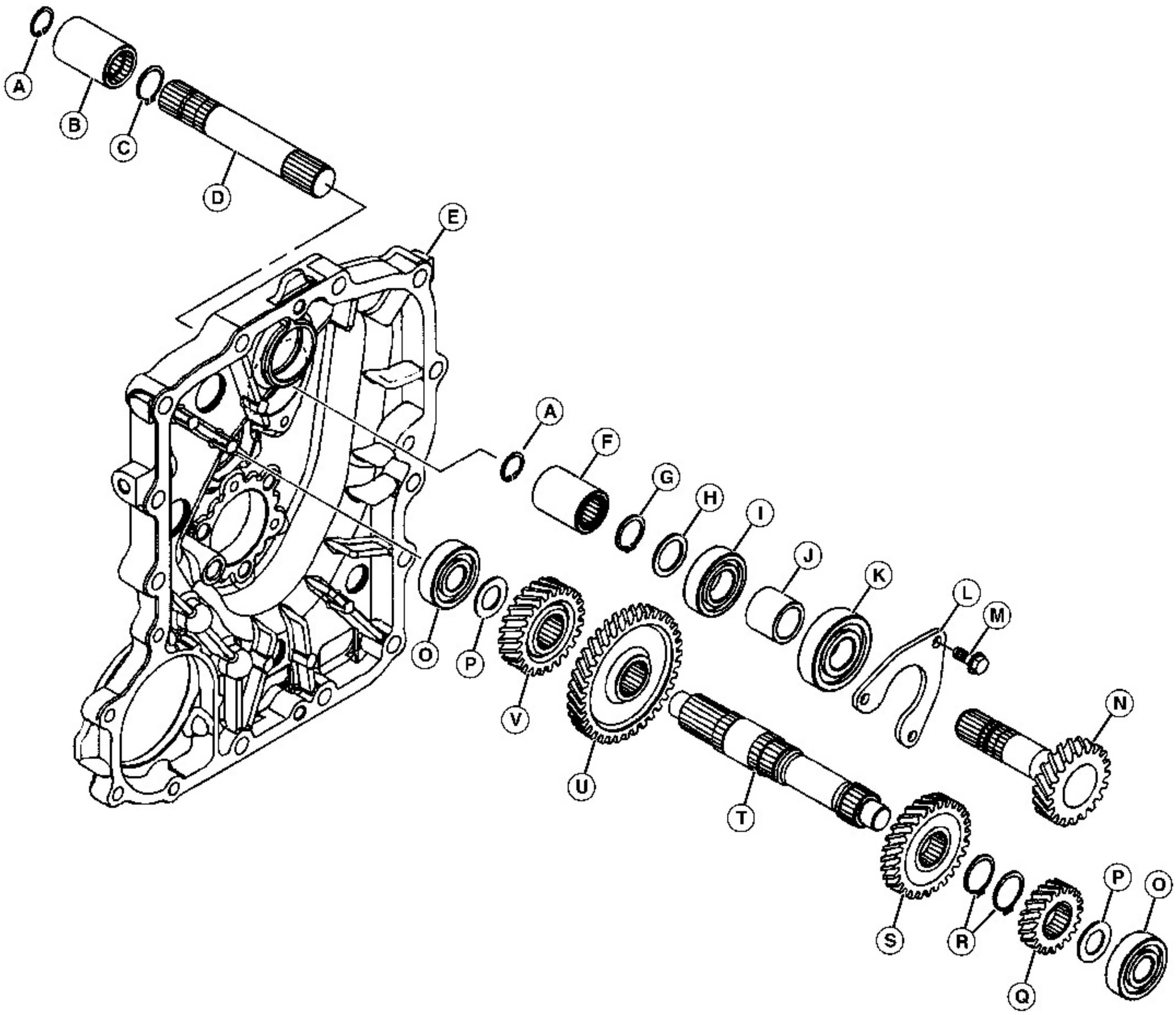
Transmission Clutch and Transmission Housing

LEGEND:

A	Clutch Housing
B	Alignment Pin (2 used)
C	Cap Screw (12 used)
D	Cap Screw (2 used)
E	Transmission Housing
F	Cap Screw (12 used)
G	Washer (14 used)
H	Gasket
I	Alignment Pin (2 Used)
J	Plug
K	O-ring
L	Cap Screw
M	Plug (1/2 NPT)
N	Bearing
O	Circlip
P	Sleeve 20x30x13
Q	Oil Seal
R	Cap Screw (3 used)
S	Transmission

T	Cap Screw (2 used)
U	Alignment Pin (2 used)
V	Gasket

Main and Driven Shafts



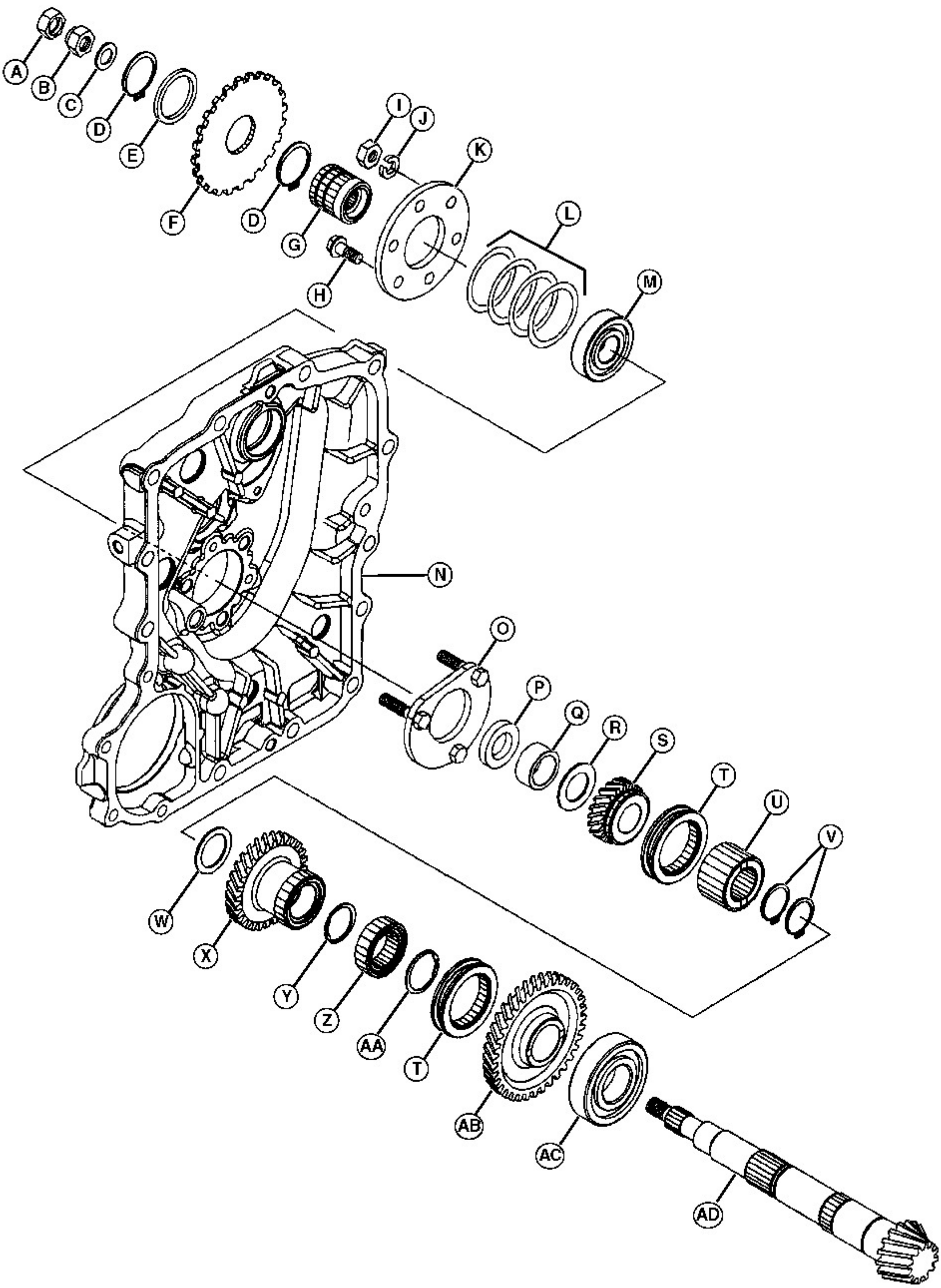
Main and Driven Shafts

LEGEND:

A	Circlip (2 used)
B	Coupling (To Transmission)
C	Snap Ring
D	Main Drive Shaft
E	Center Plate
F	Coupling (to Main Gear)
G	Circlip
H	Washer 25x34x2
I	Bearing
J	Spacer 25x34x29.2
K	Bearing
L	Bearing Retainer
M	Cap Screw (3 used)
N	Main Gear 20T
O	Bearing (2 used)
P	Washer 20x34x2 (2 used)
Q	Range Gear 20T
R	Snap Ring (2 used)
S	Range Gear 26T
T	Driven Shaft

U	Range Gear 41T
V	Driven Gear 24T

Drive/Pinion Shaft (eHydro™)



Drive/Pinion Shaft (eHydro™) Components

LEGEND:

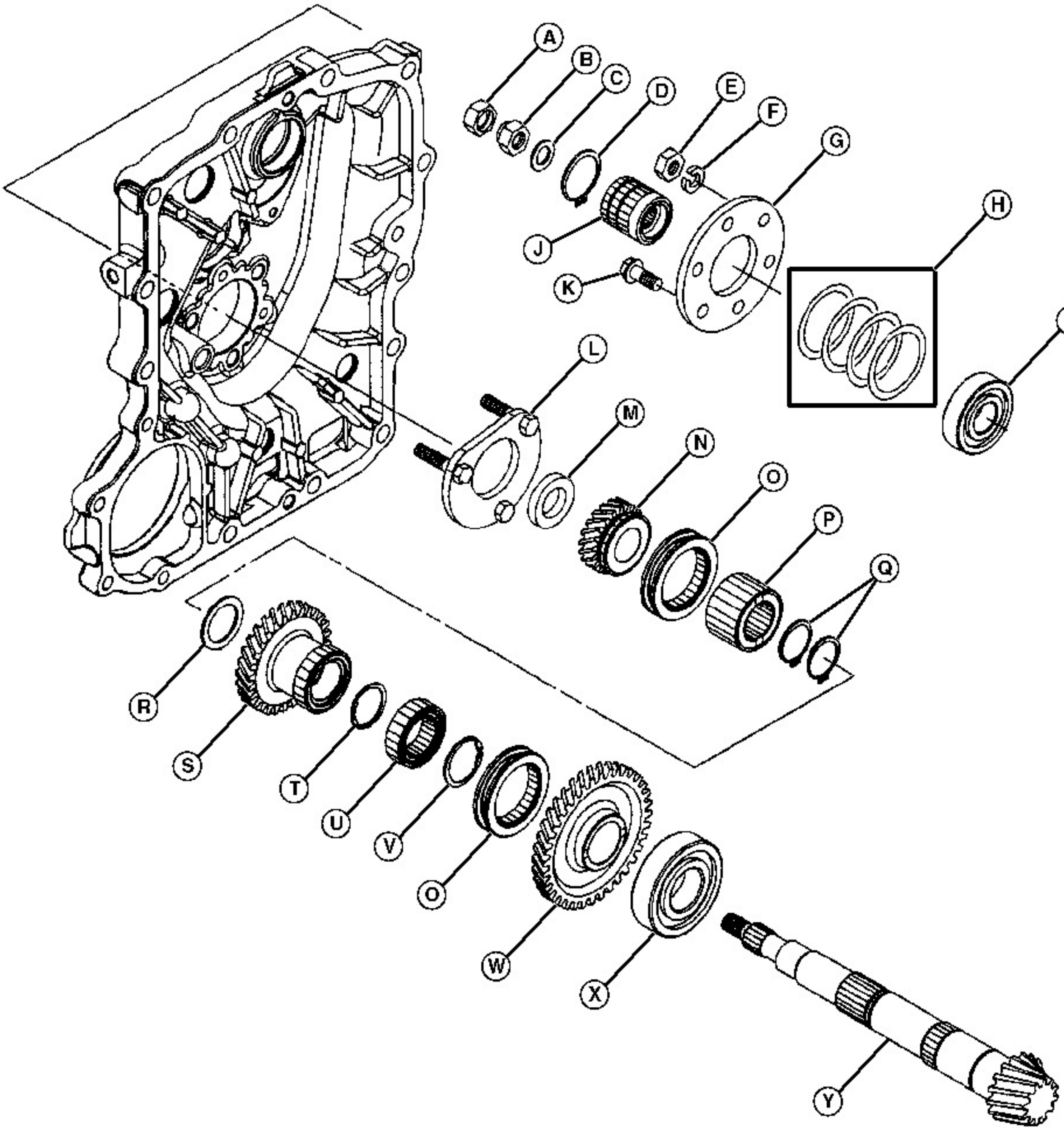
A	Nut, Upper
B	Nut, Lower
C	Spacer, 15X25X2
D	Snap Ring (2 used)

E	Collar
F	Speed Sensing Gear
G	Spline Collar (MFWD)
H	Bolt, M10x25 (3 used)
I	Nut (3 used)
J	Lock Washer (3 used)
K	Retainer Plate
L	Shim Kit
M	Bearing
N	Center Plate
O	Bearing Retainer Assembly
P	Washer
Q	Collar
R	Washer, 28x45x2
S	Counter Gear, 20T
T	Shift Collar (2 used)
U	Spline Collar
V	Snap Ring (2 used)
W	Washer, 32x44x2
X	Counter Gear, 29T
Y	Circlip
Z	Spline Collar
AA	Circlip
AB	Counter Gear, 44T
AC	Bearing
AD	Pinion Shaft

→NOTE:

Shim(s) used from kit will vary for pinion shaft adjustment. (See Differential Pinion Shaft Adjustment in Section 80, Group 35.)

Drive/Pinion Shaft (PRT)



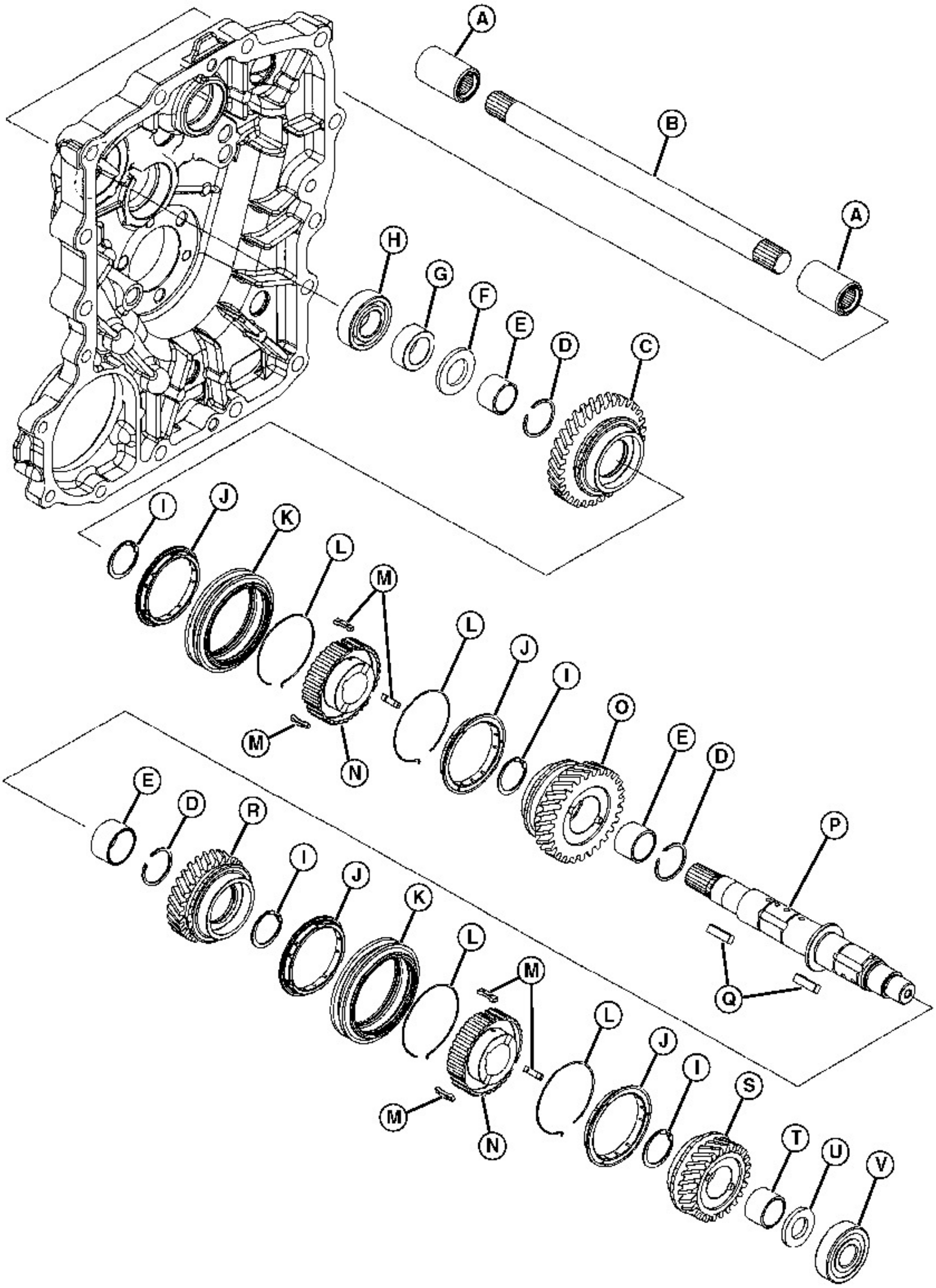
Drive/Pinion Shaft (PRT) Components

LEGEND:

A	Wedge Nut
B	Collared Jam Nut
C	Spacer
D	Retaining Ring
E	Nut
F	Lock Washer
G	Outer Bearing Retainer
H	Shims (used as needed)
I	Bearing
J	Coupler Gear
K	Cap Screw
L	Inner Bearing Retainer
M	Spacer
N	Gear, 20T
O	Shift Collar
P	Long Splined Collar
Q	Retaining Ring
R	Spacer

S	Gear, 35T
T	Retaining Ring
U	Short Splined Collar
V	Retaining Ring
W	Gear, 51T
X	Bearing
Y	Drive/Pinion Shaft

4 Speed Gear Shaft (PRT)



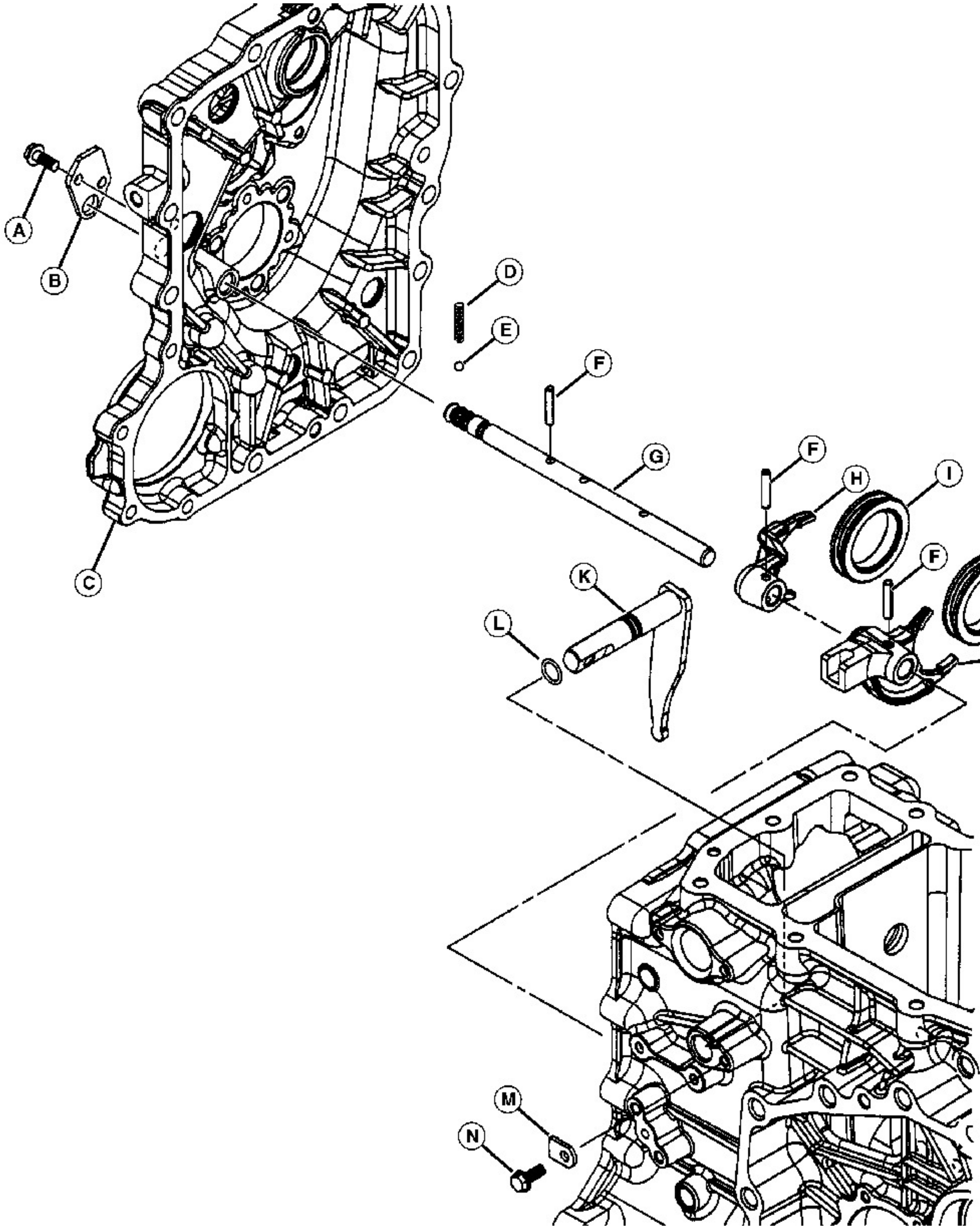
4 Speed Gear Shaft (PRT) Components

LEGEND:

A	Coupler
B	Shaft
C	Gear, 33T
D	Retaining Ring
E	Needle Bearing
F	Thin Spacer
G	Wide Spacer
H	Bearing
I	Retaining Ring

J	Synchromesh Gear
K	Shift Collar
L	Wire Ring Clip
M	Ring Keys
N	Synchromesh Ring
O	Gear, 29T
P	Shaft
Q	Keys
R	Gear, 23T
S	Gear, 26T
T	Needle Bearing
U	Thin Spacer
V	Bearing

Range Shift



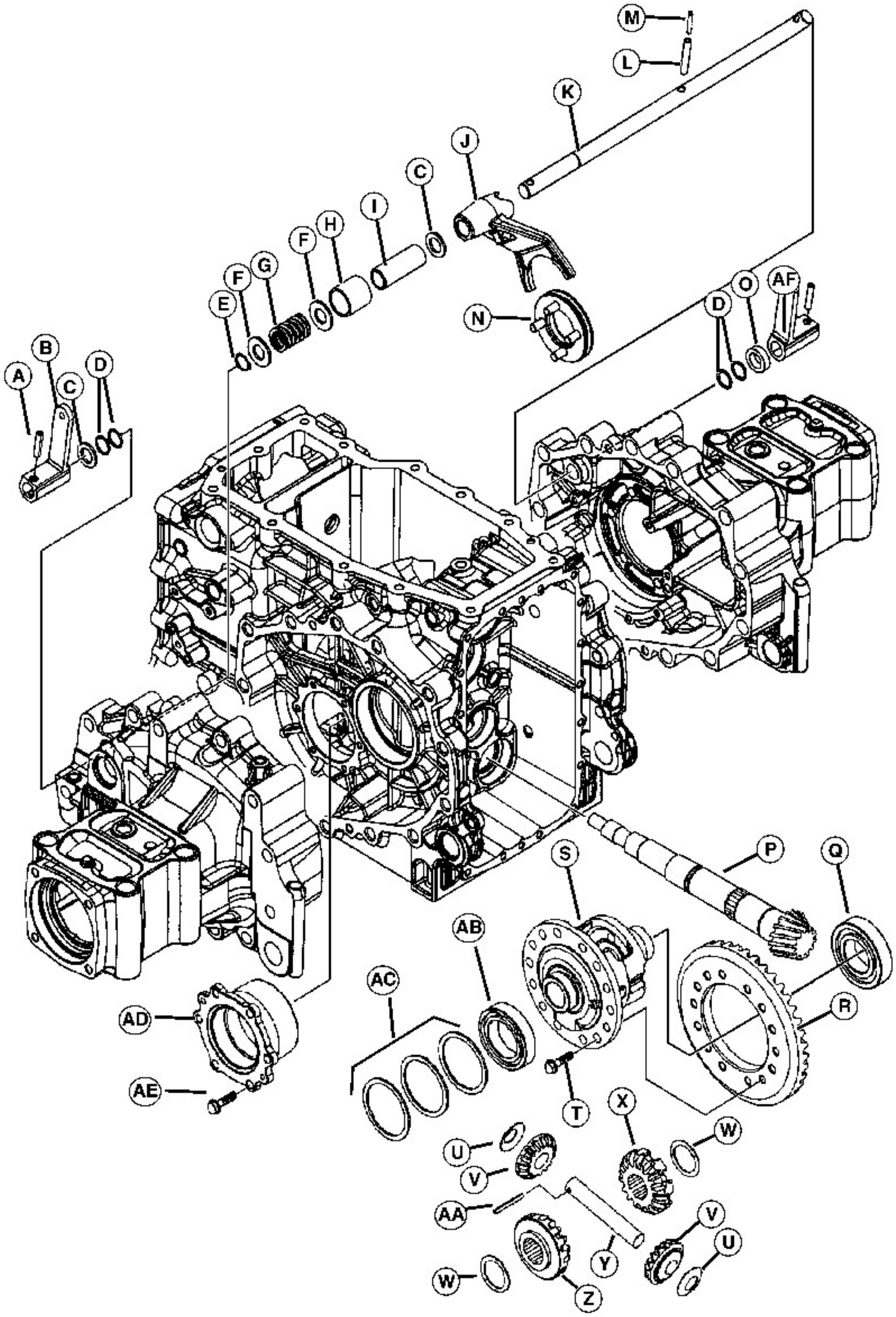
Range Shift

LEGEND:

A	Cap Screw
B	Plate, Fork Lock
C	Center Plate
D	Spring
E	Ball, 1/4 in.
F	Roll Pin (3 used)
G	Range Shift Shaft
H	Range Shift Fork

I	Shift Collar (2 used)
J	Range Shift Fork
K	Fork Shift Shaft
L	O-ring
M	Plate, Keep
N	Cap Screw

Differential Assembly



Differential Assembly

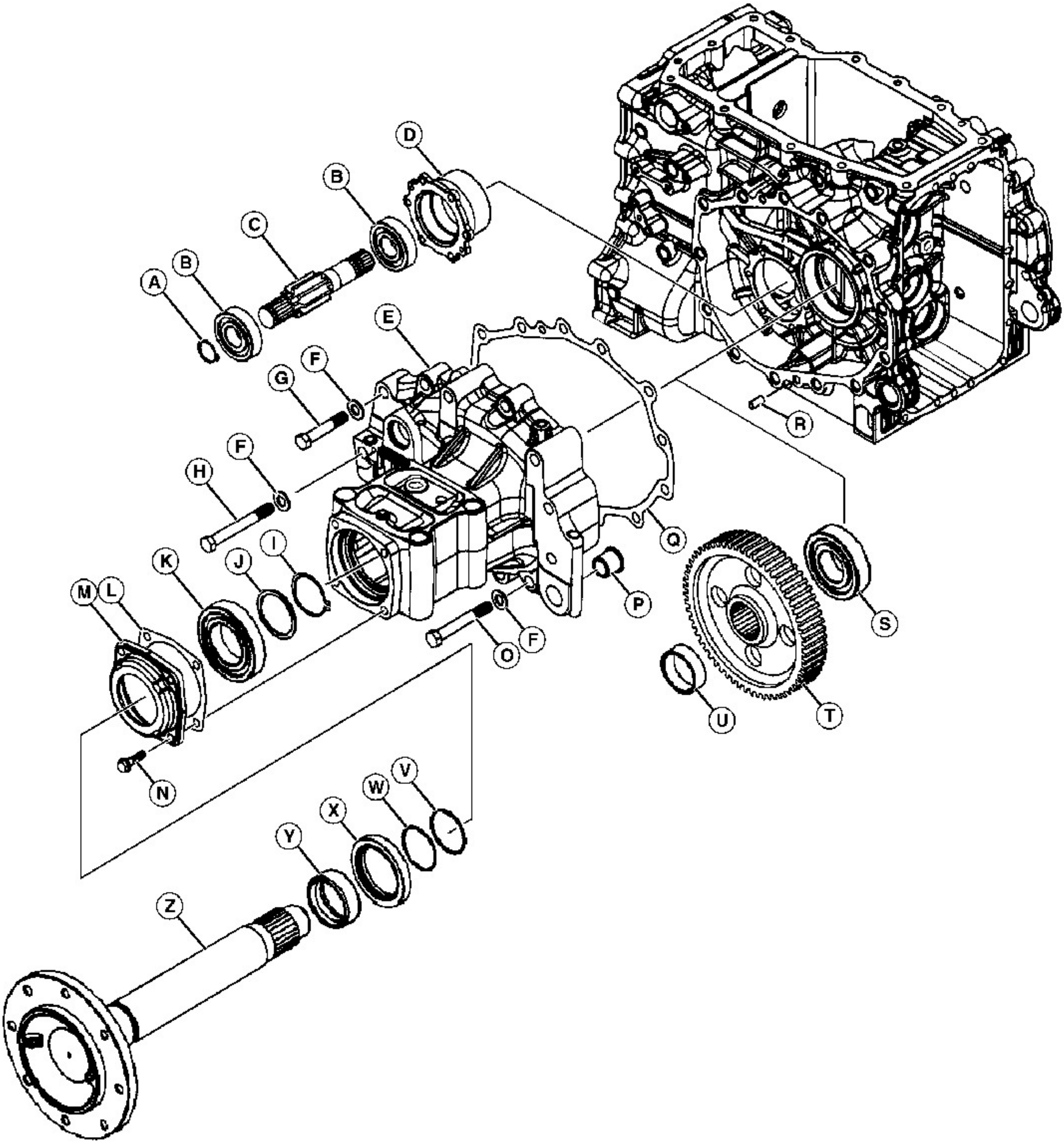
LEGEND:

A	Spring Pin
B	Differential Lock Arm (2 used)
C	Spacer 20x30x3.2 (2 used)
D	O-ring (4 used)

E	Circlip
F	Washer 20x38x3.2 (2 used)
G	Spring
H	Collar
I	Spacer
J	Differential Shift Fork
K	Differential Lock Fork Shaft
L	Spring Pin
M	Spring Pin
N	Locking Collar
O	Spacer
P	Pinion Shaft
Q	Bearing
R	Ring Gear
S	Differential Case Assembly
T	Cap Screw (14 used)
U	Washer, Differential (2 used)
V	Pinion Gear (2 used)
W	Washer, Differential (2 used)
X	Differential Side Gear
Y	Pinion Shaft, Differential
Z	Differential Side Gear
AA	Spring Pin
AB	Bearing
AC	Shims*
AD	Differential Carrier
AE	Cap Screw (6 used)
AF	Spacer

*NOTE: Shims used will vary for backlash adjustment. (See Differential Backlash Adjustment in Section 70, Group 35.)

Rear Axle and Final Drive



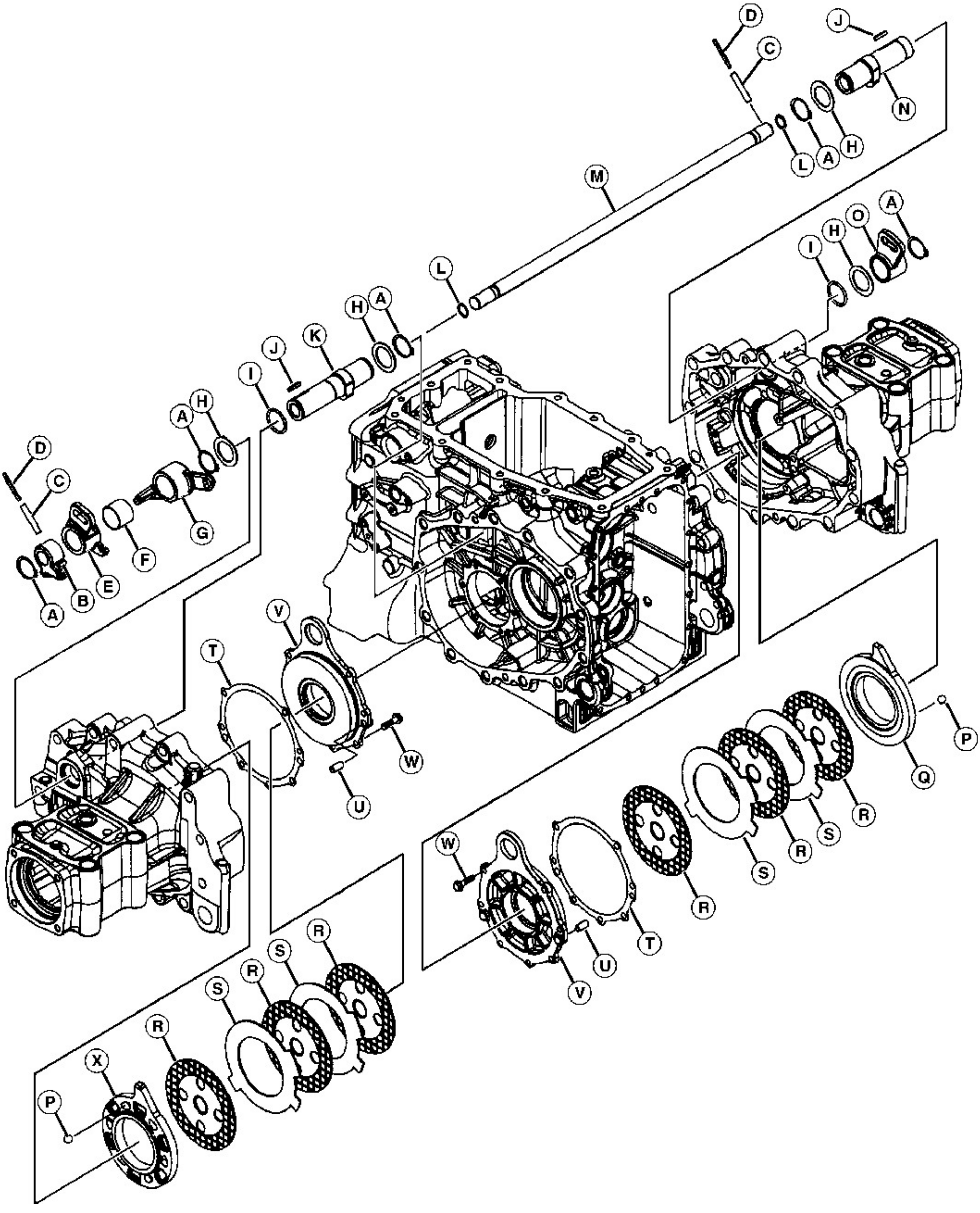
Rear Axle and Final Drive

LEGEND:

A	Snap Ring (1 per side)
B	Bearing (2 per side)
C	Final Pinion (Left)
D	Differential Carrier
E	Axle Housing (Left)
F	Washer 15x28x2.5 (13 per side)
G	Cap Screw M14x75 (6 per side)
H	Cap Screw M14x110 (5 per side)
I	Snap Ring (1 per side)
J	Washer 60x72x3 (1 per side)
K	Bearing (1 per side)

L	Gasket (1 per side)
M	Cover, Oil Seal (1 per side)
N	Cap Screw M10x35 (4 per side)
O	Cap Screw M14x95 (2 per side)
P	Bushing (1 per side)
Q	Gasket (1 per side)
R	Pin (2 per side)
S	Bearing (1 per side)
T	Final Gear (1 per side)
U	Collar (1 per side)
V	Snap Ring (1 per side)
W	Washer 60x72x3 (1 per side)
X	Seal (1 per side)
Y	Seal Collar (1 per side)
Z	Rear Axle Shaft (1 per side)

Brake Assembly



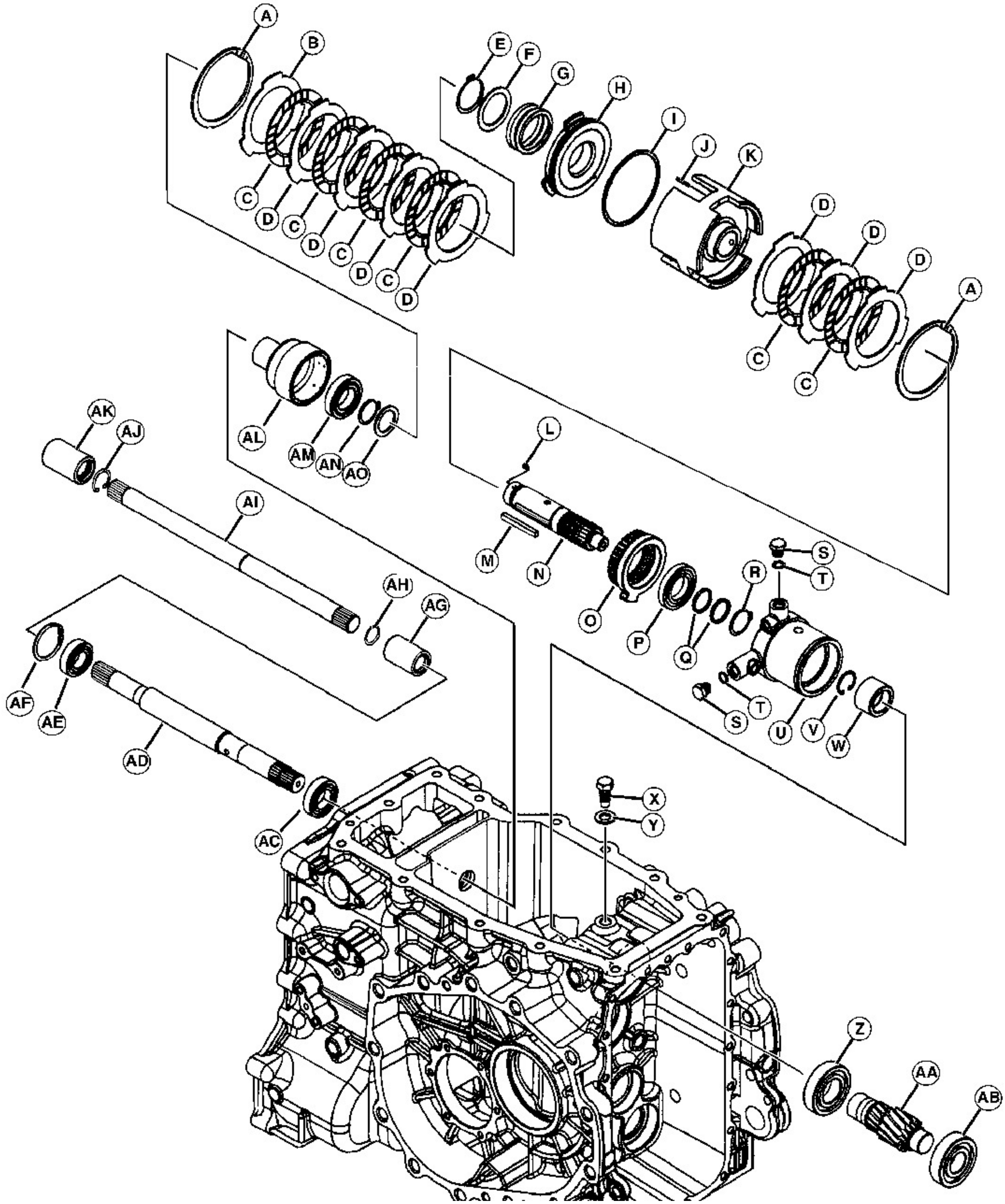
Brake Assembly

LEGEND:

A	Snap Ring (5 used)
B	Park Brake Arm
C	Spring Pin 8x50 (2 used)
D	Spring Pin 5x50 (2 used)

E	Brake Arm (Left)
F	Bushing
G	Park Brake Arm (Left)
H	Washer 35x50x2 (4 used)
I	O-ring (2 used)
J	Key (2 used)
K	Brake Cam (Left)
L	O-ring (2 used)
M	Shaft, Brake Pedal
N	Brake Cam (Right)
O	Brake Arm (Right)
P	Ball 1/2 (6 used each side)
Q	Brake Actuator Plate (Right)
R	Plate, Friction (3 used each side)
S	Plate, Brake (2 used each side)
T	Gasket (2 used)
U	Pin (2 used)
V	Brake Cover (2 used)
W	Cap Screw (7 used each side)
X	Brake Actuator Plate (Left)

PTO Clutch/Brake Assembly



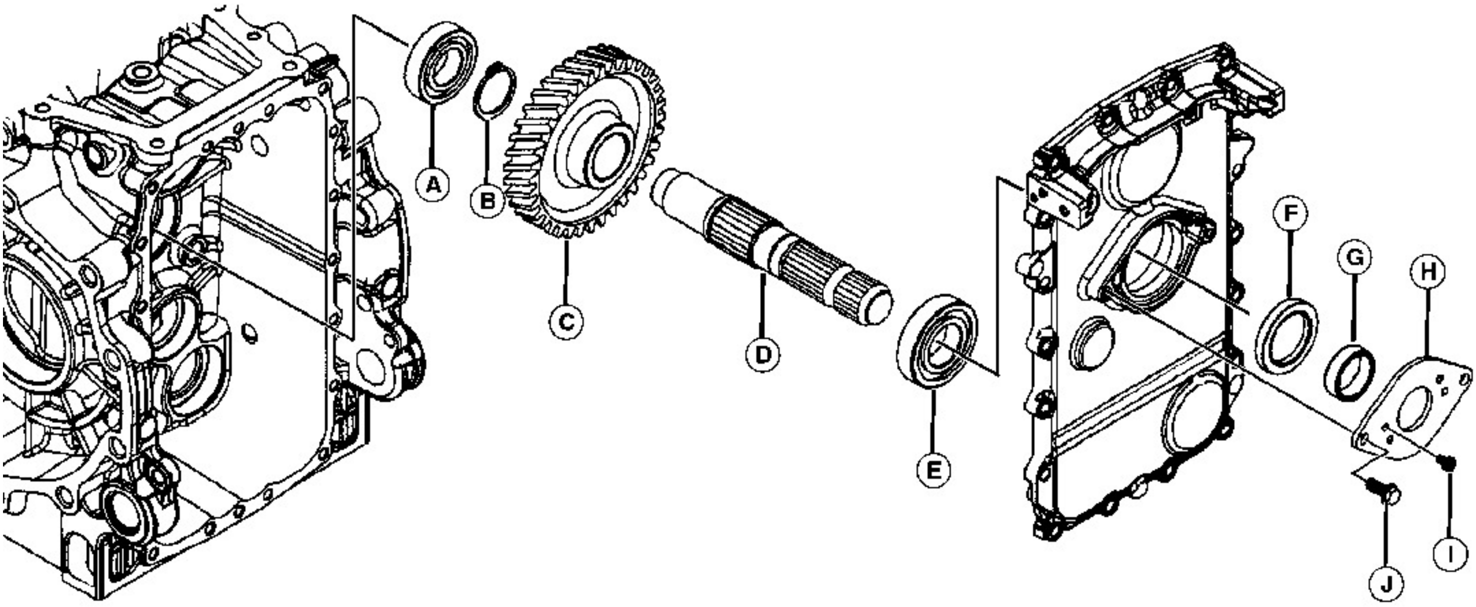
PTO Clutch and Brake Assembly

LEGEND:

A	Circlip (2 used)
B	Plate, Steel
C	Plate, Friction (6 used)
D	Plate, Steel (7 used)

E	Snap Ring
F	Spring retainer
G	Spring
H	Clutch Piston
I	O-ring
J	Pin (3 used)
K	Clutch Cylinder
L	Plug
M	Key, 7x5.8x55
N	PTO Clutch Shaft
O	PTO Brake Boss
P	Bearing
Q	Seal Ring (2 used)
R	Snap Ring
S	Plug (2 used)
T	O-ring (2 used)
U	PTO Adaptor
V	Circlip
W	Coupling
X	Cap Screw
Y	Washer
Z	Bearing
AA	PTO Gear, 13T
AB	Bearing
AC	Bearing
AD	PTO Drive Shaft
AE	Bearing
AF	Circlip
AG	Coupling, Splined
AH	Snap Ring
AI	PTO Drive Shaft
AJ	Circlip
AK	Coupling
AL	Boss
AM	Bearing
AN	Snap Ring
AO	Washer

Rear PTO Shaft



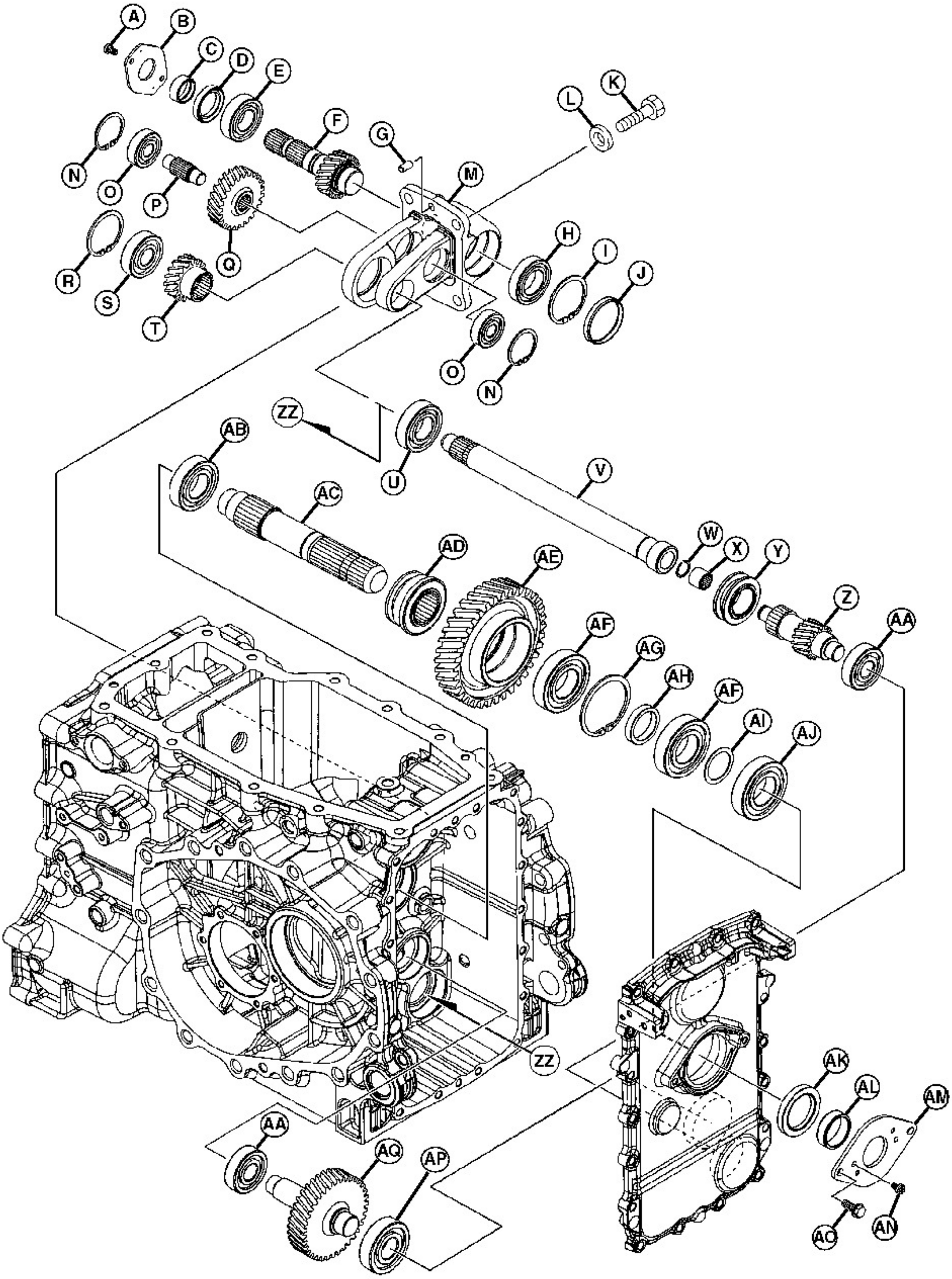
Rear PTO Shaft

LEGEND:

A	Bearing
B	Snap Ring
C	PTO Gear 62T
D	PTO Stub Shaft
E	Bearing

F	Seal
G	Collar
H	PTO Shield Plate
I	Pin, Cover Hook (2 used)
J	Cap Screw (2 used)

Rear and Mid PTO Shafts



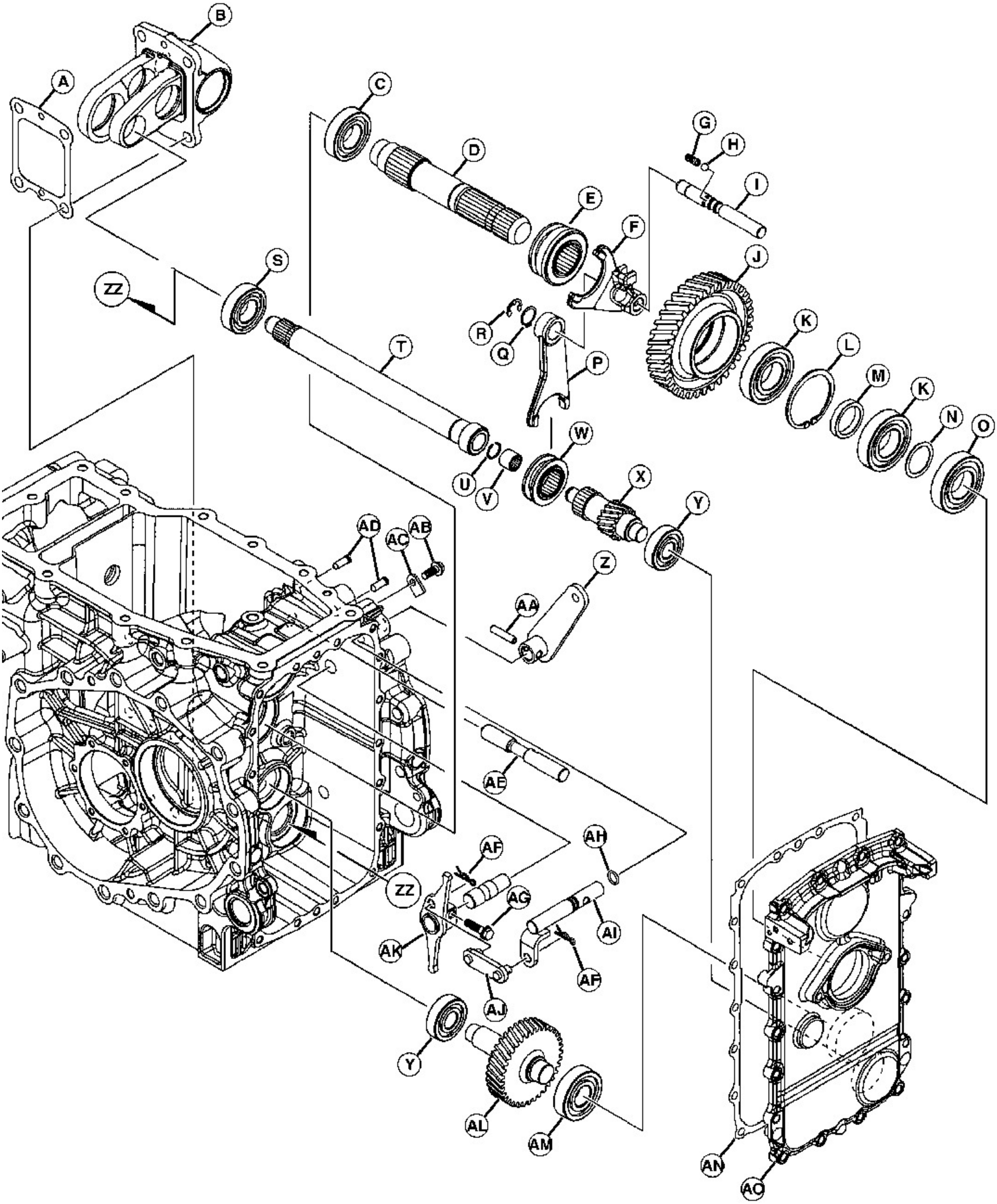
Rear and Mid PTO Shafts

LEGEND:

A	Pin, Cover Hook (2 used)
B	Mid PTO Shield Plate
C	Collar
D	Seal

E	Bearing
F	Mid PTO Shaft
G	Pin (2 used)
H	Bearing
I	Circlip
J	Cover
K	Cap Screw (4 used)
L	Washer (4 used)
M	Mid PTO Case
N	Circlip (2 used)
O	Bearing (2 used)
P	Mid PTO Shaft
Q	Gear, 25T
R	Circlip
S	Bearing
T	Mid PTO Gear, 17T
U	Bearing
V	Mid PTO Coupling Shaft
W	Ring
X	Needle Bearing
Y	Mid PTO Shift Collar
Z	Mid PTO Shaft, 15T
AA	Bearing (2 used)
AB	Bearing
AC	PTO Shaft
AD	Mid PTO Shift Collar
AE	PTO Gear, 62T
AF	Bearing (2 used)
AG	Circlip
AH	Spacer 35x43x9
AI	Washer
AJ	Bearing
AK	Seal
AL	Collar
AM	PTO Shield Plate
AN	Pin, Cover Hook (2 used)
AO	Cap Screw (2 used)
AP	Bearing
AQ	Mid PTO Gear Shaft 41T

Rear and Mid PTO Shift Assembly



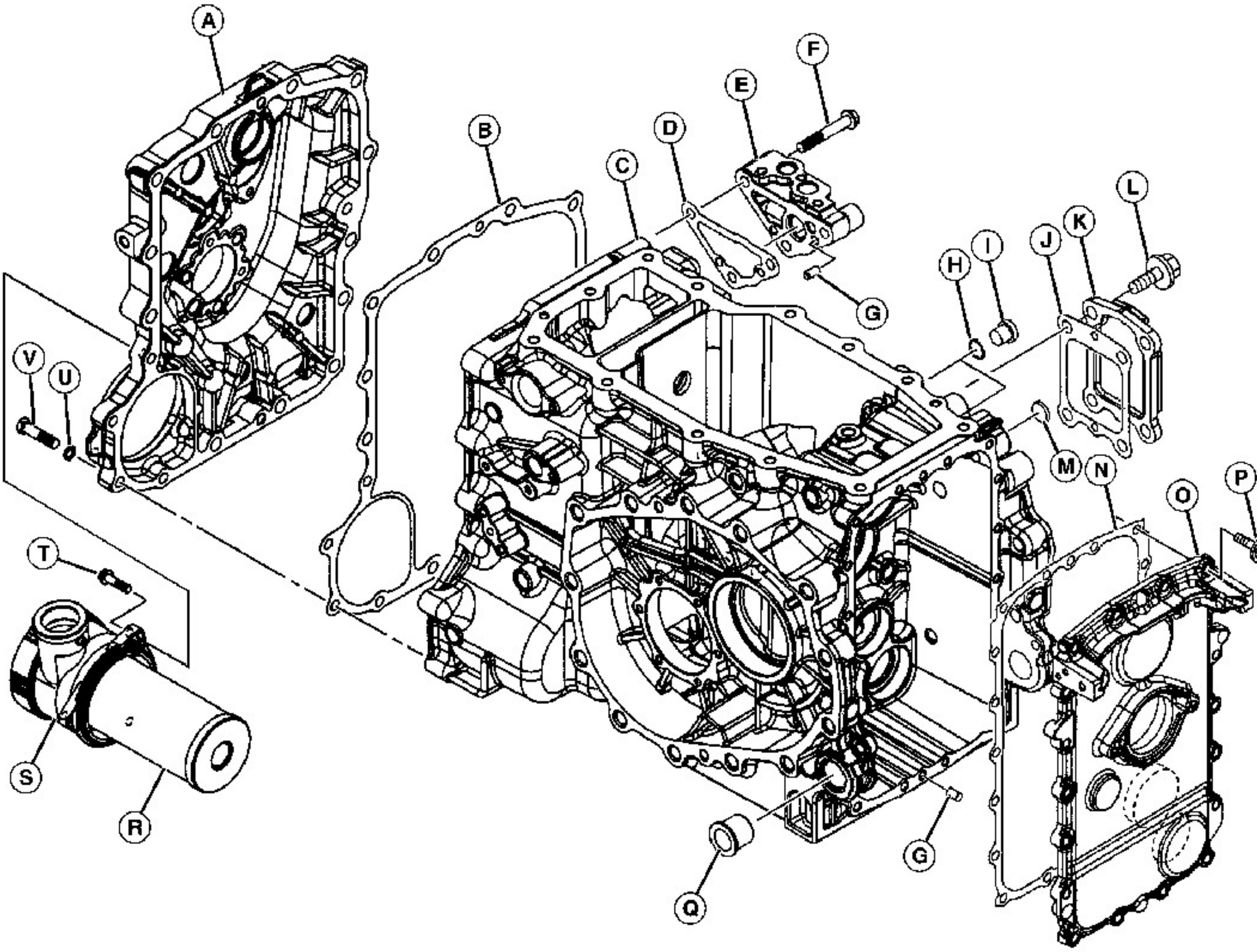
Rear and Mid PTO Shift Assembly

LEGEND:

A	Gasket, Mid PTO
B	Mid PTO Case
C	Bearing
D	PTO Shaft

E	Mid PTO Shift Collar
F	Shift Fork, Rear PTO
G	Spring
H	Ball, 5/16
I	Fork Shaft
J	PTO Gear, 62T
K	Bearing (2 used)
L	Circlip
M	Spacer 35x43x9
N	Washer
O	Bearing
P	Shift Fork, Mid PTO
Q	Circlip
R	C-Clip
S	Bearing
T	Mid PTO Coupling Shaft
U	Ring
V	Needle Bearing
W	Mid PTO Shift Collar
X	Mid PTO Shaft, 15T
Y	Bearing (2 used)
Z	Shift Arm
AA	Spring Pin
AB	Cap Screw
AC	Keeper Plate
AD	Push Pin (2 used)
AE	Switch Shaft
AF	Spring Clip (2 used)
AG	Cap Screw
AH	O-ring
AI	Arm, Link
AJ	Link Plate
AK	Arm, Shift
AL	Mid PTO Gear Shaft 41T
AM	Bearing
AN	Gasket
AO	Rear Cover

Transmission Housing

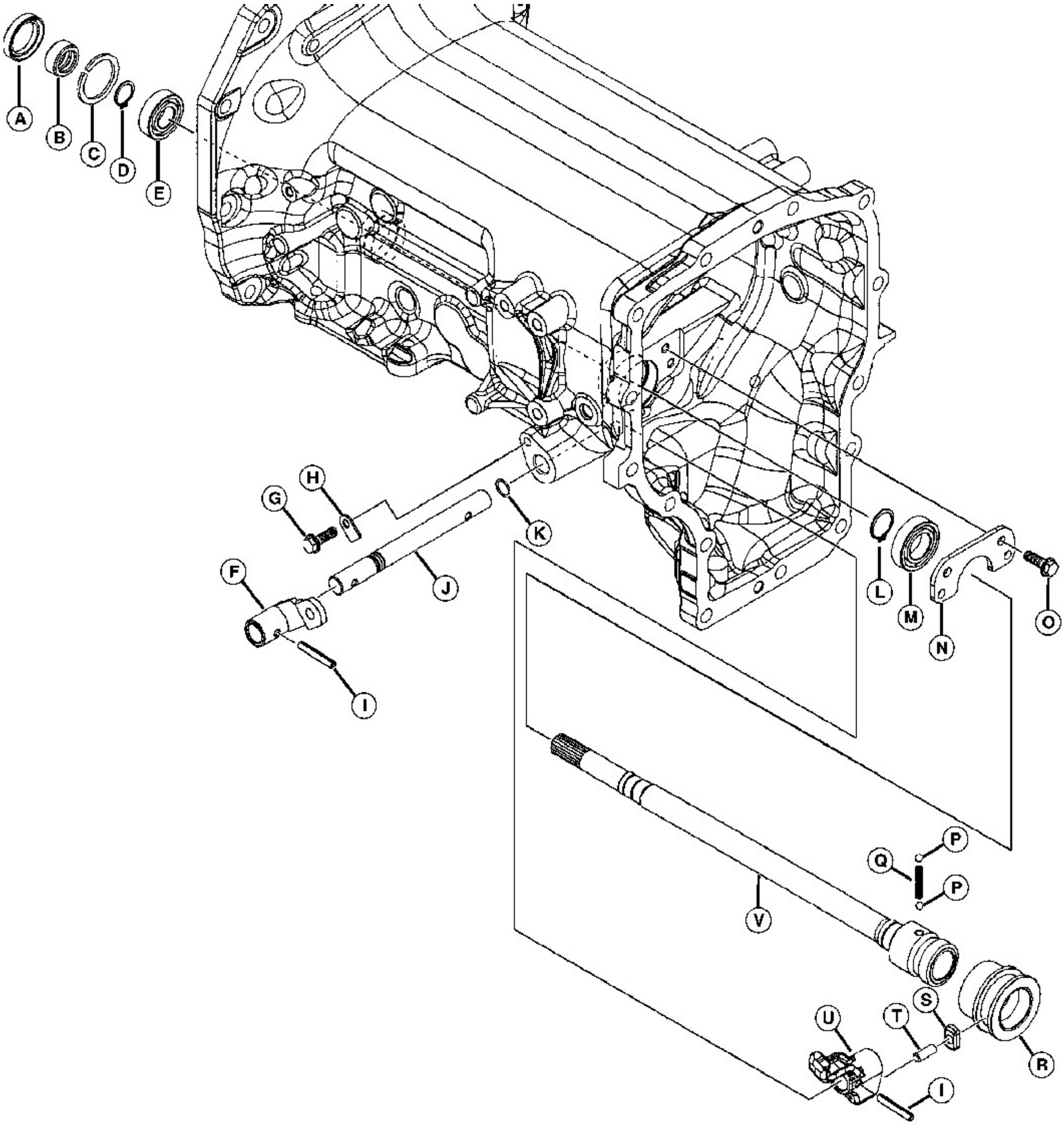


Transmission Housing

LEGEND:

A	Center Plate
B	Gasket
C	Transmission Case
D	Gasket
E	Main Shift Holder
F	Cap Screw (3 used)
G	Pin (4 used)
H	O-ring (2 used)
I	Plug (2 used)
J	Gasket
K	Side Cover [Replaced with Mid PTO case when Mid PTO option is installed.]
L	Cap Screw (4 used)
M	Plug, Bore
N	Gasket
O	Rear Cover
P	Cap Screw (18 used)
Q	Bushing (2 used)
R	Suction Filter
S	Filter Housing Assembly
T	Cap Screw (3 used)
U	Washer (4 used)
V	Cap Screw (4 used)

Front Drive (For MFWD)



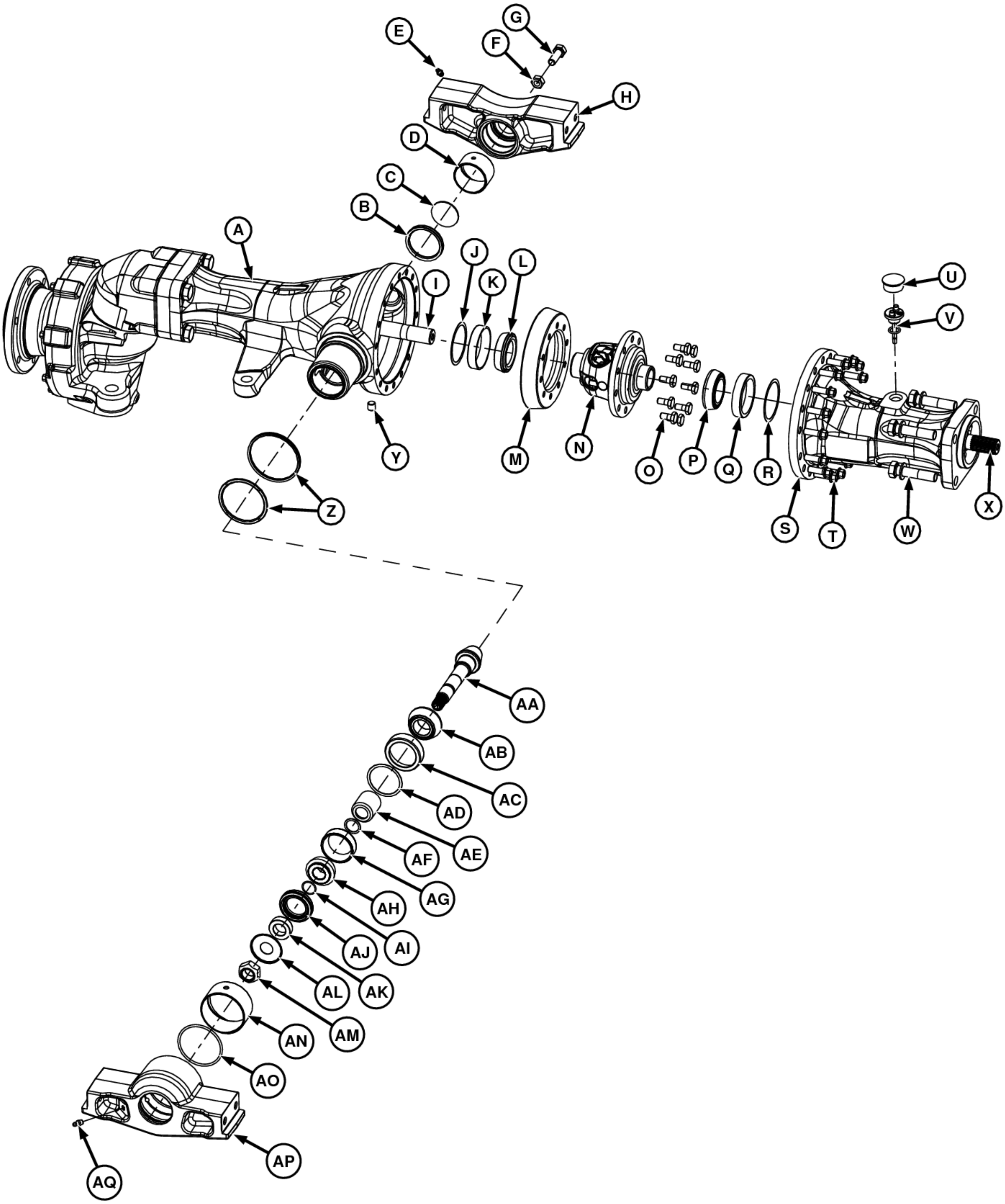
Front Drive for MFWD

LEGEND:

A	Oil Seal
B	Sleeve 20x30x13
C	Circlip
D	Snap Ring
E	Bearing
F	Shift Arm
G	Cap Screw
H	Keep Plate
I	Spring Pin (2 used)
J	Shift Shaft
K	O-ring

L	Snap Ring
M	Bearing
N	Bearing Retainer
O	Cap Screw (4 used)
P	Ball, 1/4 in. (2 used)
Q	Spring
R	Shift Collar
S	Shift Shoe
T	Pin
U	Shifter
V	MFWD Drive Shaft

MFWD Front Axle Housing and Differential



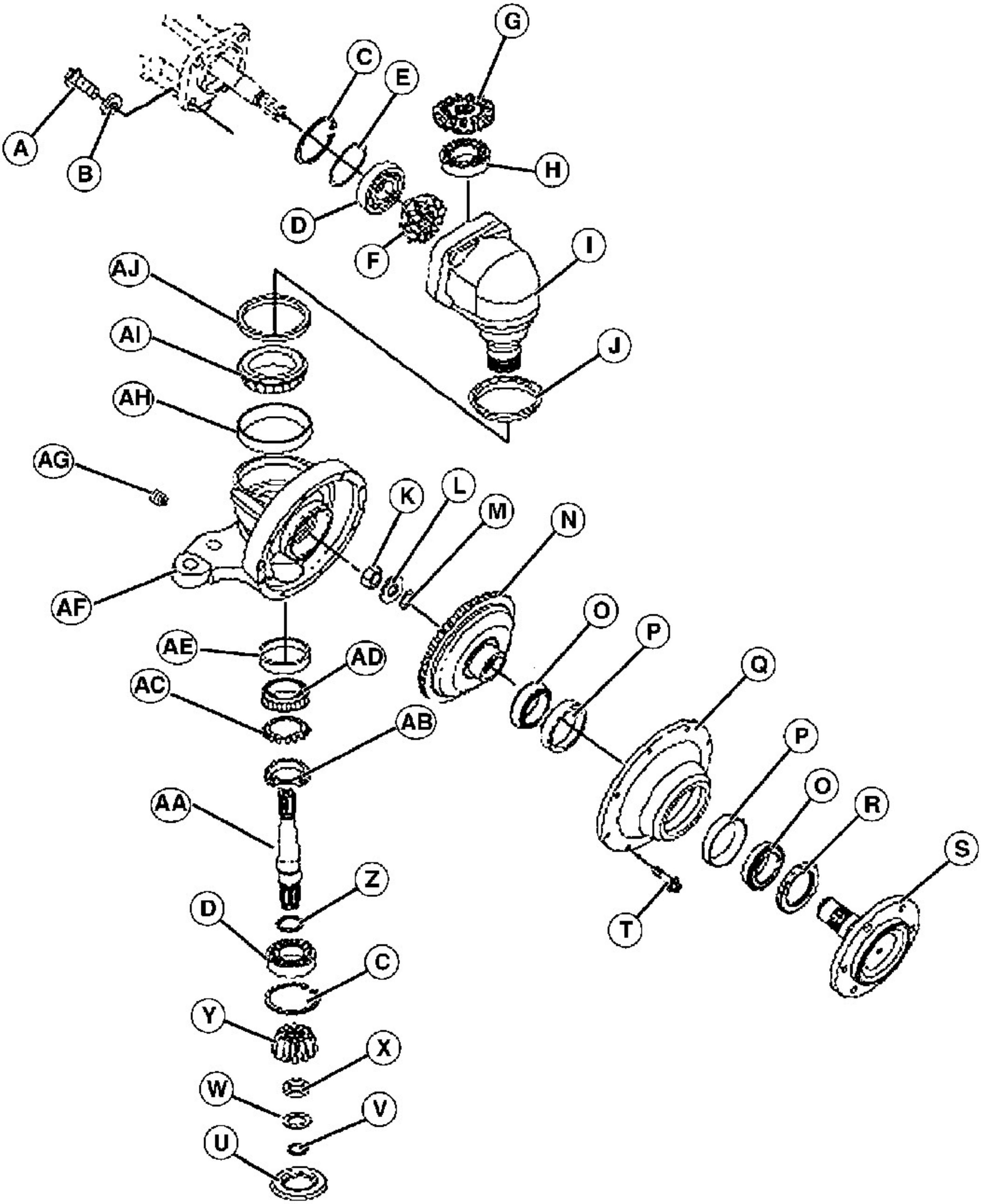
Front Axle Housing and Differential for MFWD

LEGEND:

A	Housing, Axle
B	V-ring Seal, Front
C	Thrust Plate
D	Bushing

E	Grease Zerk Fitting
F	Nut, M8
G	Cap Screw, M8 x 30
H	Trunnion
I	Left Side Axle Shaft
J	Shim, Differential Bearing Preload
K	Bearing Cup
L	Bearing Cone
M	Ring Gear
N	Differential
O	Cap Screw (10 used)
P	Bearing Cap
Q	Bearing Cup
R	Shim, Pinion Bearing Preload
S	Right Side Axle Housing
T	Axle Housing Cap Screw (16 used)
U	Dipstick/Filler Cover
V	Dipstick/Filler Cap
W	Cap Screw, M16 x 40 (4 used)
X	Right Side Axle Shaft
Y	Drain Plug
Z	V-Ring Seal (2 used)
AA	Pinion
AB	Bearing Cone
AC	Bearing Cup
AD	Shim, Inner Pinion
AE	Spacer, Pinion Bearing
AF	Preload Shim, pinion Bearing
AG	Bearing Cup
AH	Bearing Cone
AI	O-Ring
AJ	Oil Seal
AK	Spacer
AL	Slinger
AM	Pinion Nut
AN	Rear Bushing
AO	O-Ring
AP	Rear Trunnion
AQ	Grease Zerk Fitting

MFWD Final Drive



MFWD Final Drive

LEGEND:

A	Cap Screw, M16 x 40
B	Washer
C	Snap Ring
D	Bearing

E	Shim
F	Gear (12T)
G	Gear (15T)
H	Bearing
I	Housing, Spindle
J	Sleeve
K	Lock Nut
L	Washer
M	Shim
N	Gear
O	Bearing Cone
P	Bearing Cup
Q	Cover, Outer Drive
R	Seal
S	Shaft, Hub
T	Screw, M8 x 30
U	Cap
V	Snap Ring
W	Shim
X	Spacer
Y	Gear (12T)
Z	Snap Ring
AA	Shaft, Spindle
AB	Nut
AC	Lock Washer
AD	Bearing Cone
AE	Bearing Cup
AF	Steering Knuckle
AG	Plug, 1/8 in.
AH	Bearing Cup
AI	Bearing Cone
AJ	Seal

Group 15 - Theory of Operation

Range Transmission—eHydro

Operation:

When the transmission is engaged, power from the driven shaft (A) is transferred through a constantly engaged gear (B) to a reduction shaft (C). There are three gears on the reduction shaft that are continuously engaged to three gears on the pinion shaft (D). The three gears on the pinion shaft spin freely on the shaft.

Between the three gears on the pinion shaft there are two splined sleeves (E). There are two shifters (F) that slide forward and rearward on the splined sleeves.

The forks secured to the range shift linkage fit into the two shifters (F) and selection of the range shifter moves the forks and shifters forward and rearward. The shifters lock (only one at a time) the gears on the pinion shaft to one of the splined sleeves (E).

The diagram below shows the shifters in the rear most (A gear) position.

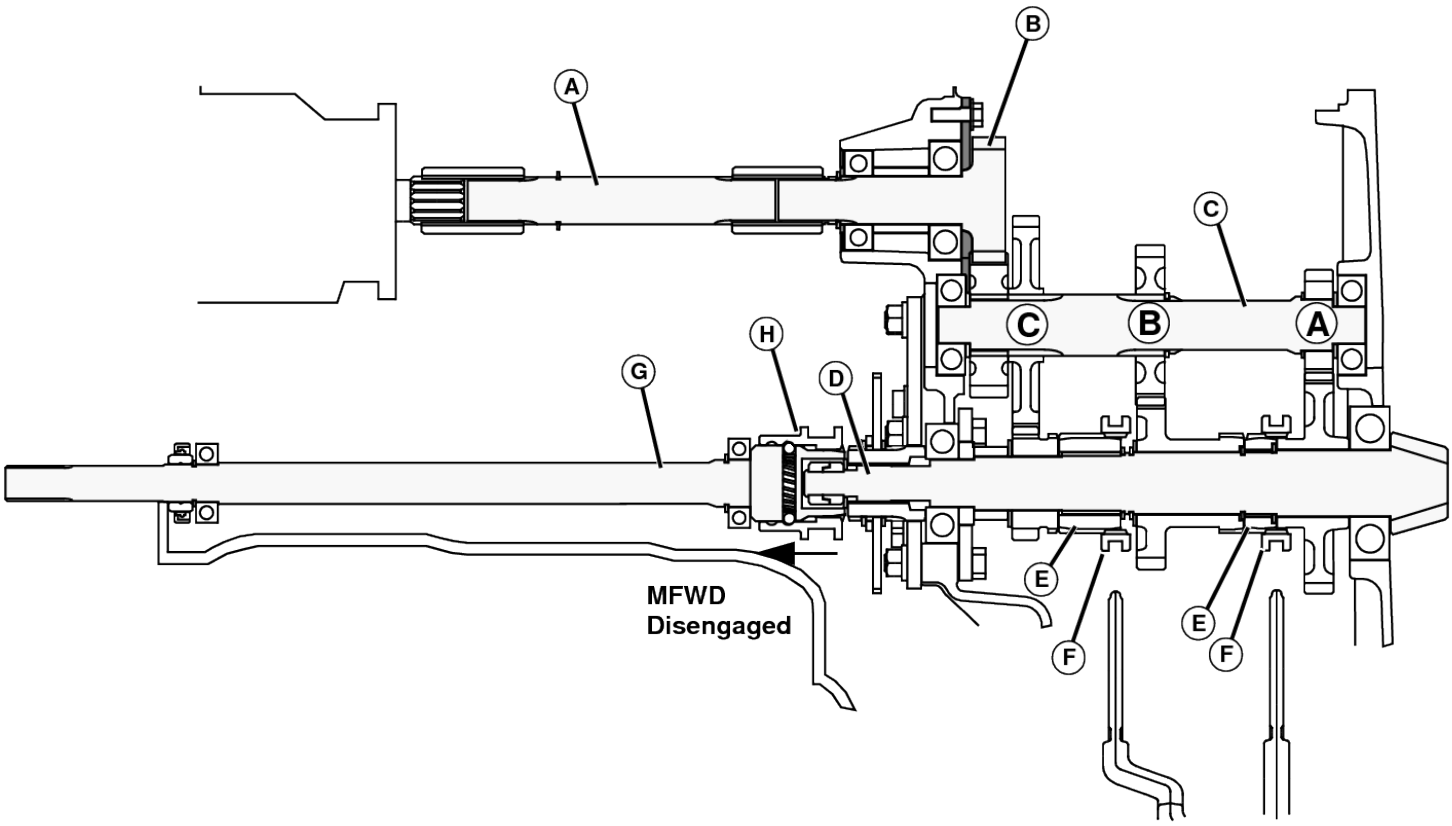
There are four positions for the shifters (from rear to front):

- Rear most—A
- Next forward—Neutral (no gear locked to sleeves)
- Next forward—B
- Most forward—C

MFWD Drive:

The MFWD drive shaft (G) has a rear hub that fits over the front end of the pinion shaft (D). A splined shift collar (H) can be moved toward the pinion shaft which locks the MFWD drive shaft to the pinion shaft. The collar is shown disengaged from the pinion shaft. (See MFWD Power Operation in Section 70, Group 45.)

eHydro ™ Range Transmission:



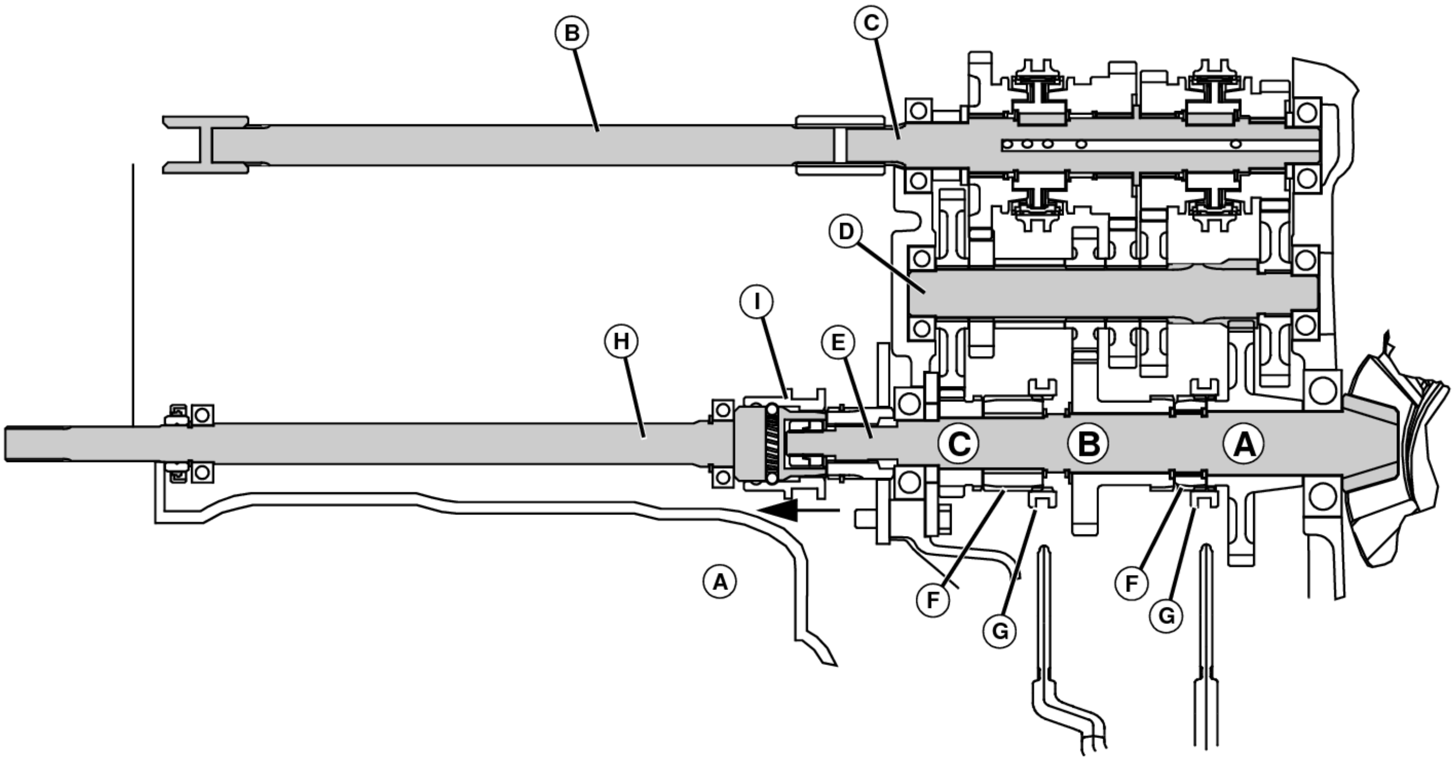
MFWD Disengaged

LEGEND:

A	Driven Shaft

B	Constantly Engaged Gear
C	Reduction Shaft
D	Pinion Shaft
E	Splined Sleeves
F	Two Shifters
G	MFWD Drive Shaft
H	Splined Shift Collar

Range Transmission—PRT



PRT Range Transmission Operation

LEGEND:

A	MFWD Disengaged
B	Driven Shaft
C	4-Speed Gear Shaft
D	Mid Shaft
E	Pinion Shaft
F	Splined Sleeves (2 used)
G	Shifters (2 used)
H	MFWD Drive Shaft
I	Splined Shift Collar

Operation:

When the transmission is engaged, power from the driven shaft (B) is transferred through a splined coupler to the 4-speed gear shaft (C). The four gears on the shaft all spin freely on the shaft. Each of the four gears is engaged to a fixed gear on the mid shaft (D). There are two shift collars on the gear shaft that can engage any one of the gears to the shaft. When one of them is engaged, the mid shaft rotates. (See Transmission Operation in Section 60, Group 15.)

All of the gears on the mid shaft are splined to the shaft and rotate any time one of the 4-speed gears is engaged. There are three gears on the mid shaft that are continuously engaged to three gears on the pinion shaft (E). The three gears on the pinion shaft spin freely on the shaft.

Between the three gears on the pinion shaft there are two splined sleeves (F). There are two shifters (G) that slide forward and rearward on the splined sleeves.

The forks secured to the range shift linkage fit into the two shifters (G) and selection of the range shifter moves the forks and shifters forward and rearward. The shifters lock (only one at a time) the gears on the pinion shaft to one of the splined sleeves (F).

The diagram below shows the shifters in the rear most (A gear) position.

There are four positions for the shifters (from rear to front):

- Rear most—A

- Next forward—Neutral (no gear locked to sleeves)
- Next forward—B
- Most forward—C

MFWD Drive:

The MFWD drive shaft (H) has a rear hub that fits over the front end of the pinion shaft (E). A splined shift collar (I) can be moved toward the pinion shaft which locks the MFWD drive shaft to the pinion shaft. The collar is shown disengaged from the pinion shaft. (See MFWD Power Operation in Section 80, Group 15.)

Differential Power Flow and Lock

Function:

To transmit power from the counter shaft to the axle shaft.

Power Flow Operation:

Power from the transmission pinion drive shaft is transmitted through the differential assembly to the final pinion shaft (A). The left axle final drive pinion shaft is in constant mesh with the differential assembly.

The differential assembly is a ring gear (B) bolted to the carrier (C). Inside the carrier are two bevel gears (D) and two bevel pinions (E).

When the machine turns sharply, one axle is held stationary. The result is that the bevel pinions rotate on their own axis and walk around the stationary bevel gears. The turning ring gear transmits power through the pinion to the opposite bevel gear.

Differential Operation:

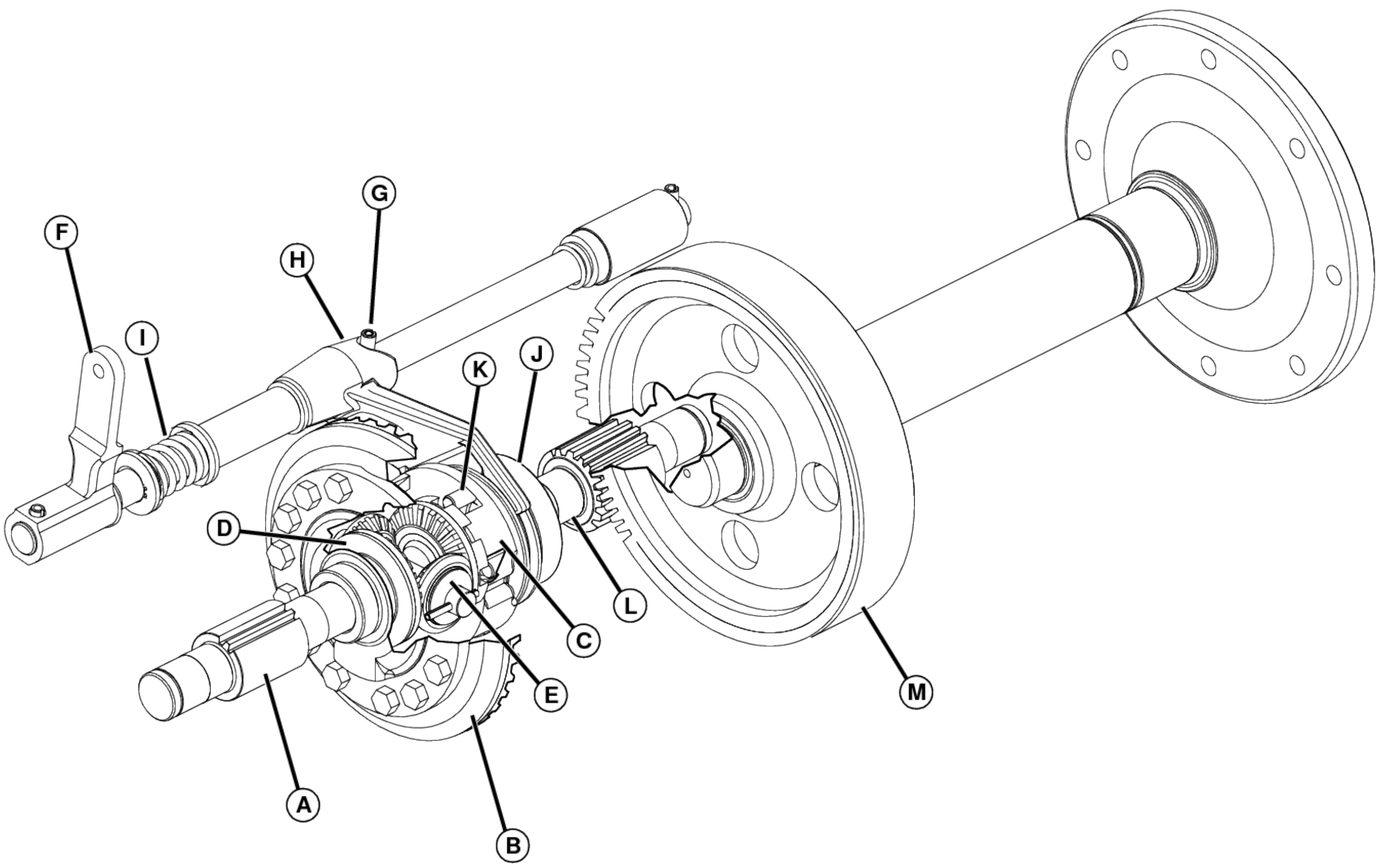
Engaging the differential lock locks the two differential output shafts together and keeps an equal amount of power to both axles (eliminates differential action).

Depressing the pedal pulls the differential shaft lever (F) and rotates a pin (G) that sits in the ramp on the fork (H). As the pin rotates it forces the fork to the left. This compresses the spring (I) and forces the differential lock collar (J) toward the differential carrier (C).

When the pins (K) on the collar align with the holes in the carrier, the pins will slip into the holes. Since the collar is splined to the right differential output shaft, no differential action will take place and both output pinion shafts (A and L) turn equally.

The output pinion shafts (A and L) are meshed in gear to the axle bull gears (M-right axle shown). The bull gears are splined to the axles and wheel hubs.

When the pedal is released the spring will disengage the differential lock once the torsional forces on the axles are reduced.



Differential Operation

LEGEND:

A Final Pinion Shaft

B	Ring Gear
C	Differential Carrier
D	Bevel Gear (2 used)
E	Bevel Pinion (2 used)
F	Differential Shaft Lever
G	Pin
H	Fork
I	Spring
J	Differential Lock Collar
K	Pins
L	Output Pinion Shafts
M	Right Axle Bull Gear

MFWD Power Operation

Operation:

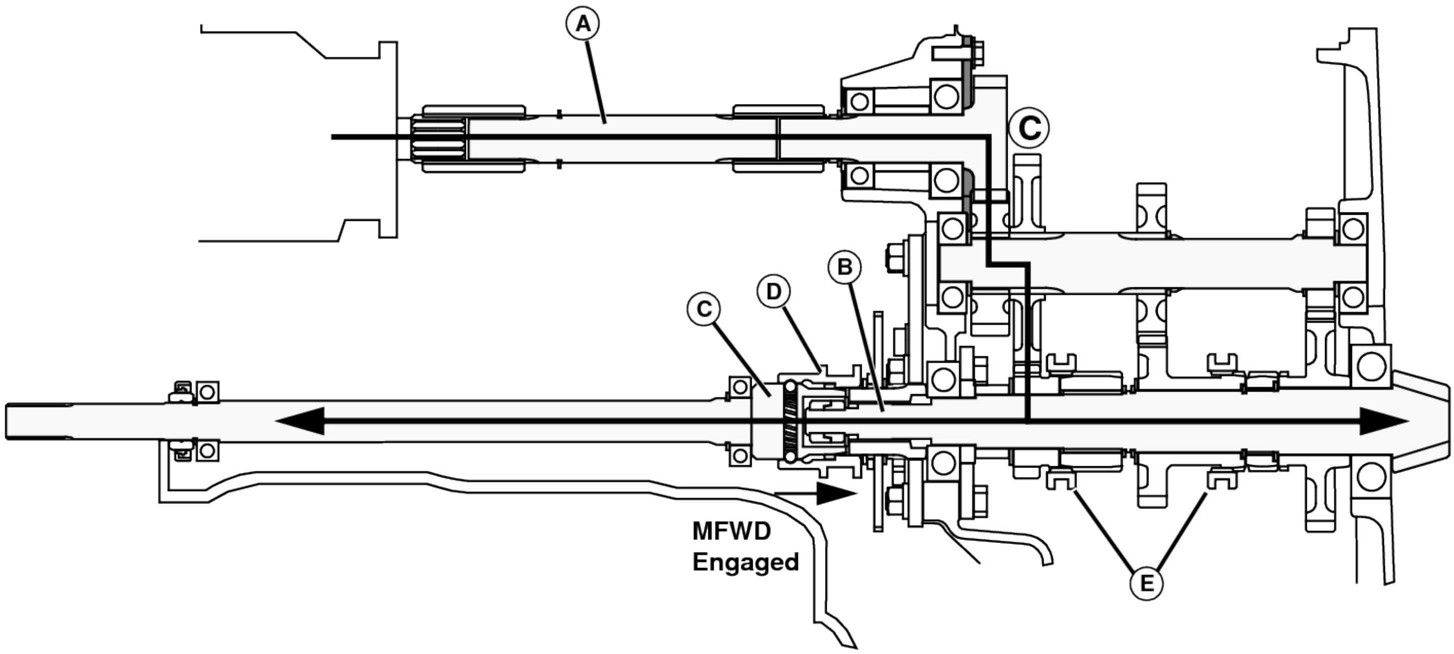
When the transmission is engaged, power from the driven shaft (A) is transferred to the pinion shaft (B). (See Range Transmission—eHydro in Section 70, Group 15.)

When the pinion shaft is powered, it spins freely inside the hub (C) of the MFWD drive shaft.

When the front wheel drive is engaged, linkage moves a fork that is fitted into the shift collar (D). The mid shift collar is splined to the front drive shaft and moves rearward engaging the front drive gear locking the gear to the shaft. This provides power to the front axle transmission.

The diagram below shows the range shifters (E) in the front (3rd gear-C Range) position, and the MFWD is shown engaged. Power flow is shown with the solid arrow.

MFWD:



MFWD Engaged

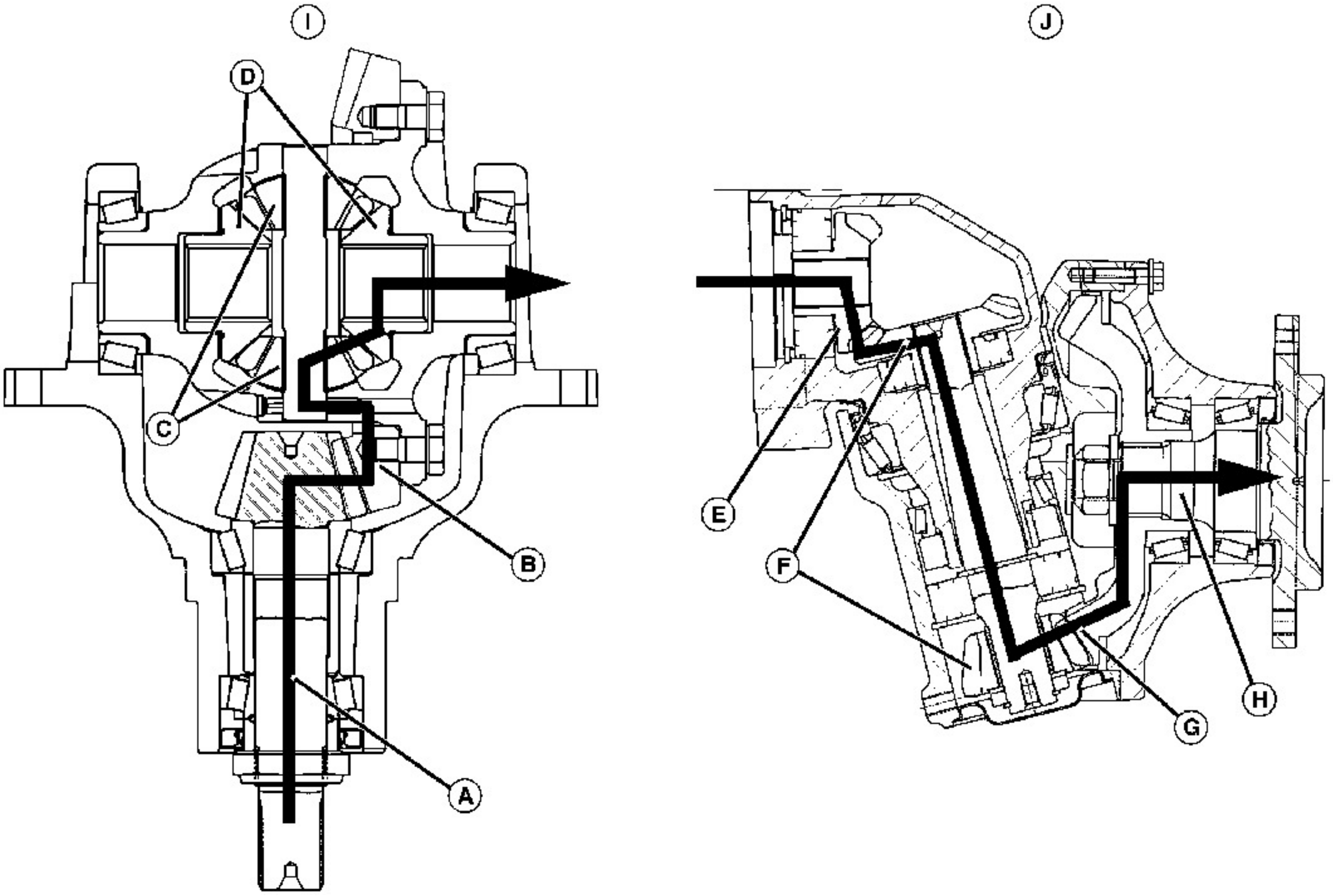
LEGEND:

A	Driven Shaft
B	Pinion Shaft
C	Hub
D	Shift Collar
E	Range Shifters

MFWD Power Flow

Power from the transaxle is directed through the drive shaft to pinion shaft (A) and ring gear (B). Power then goes from the differential carrier through pin and spider gears (C), to axle drive gears (D).

Power travels out through the axle shaft to drive gear (E). Spindle drive gears and shaft (F), turn final drive gear (G), and axle (H).



MFWD Power Flow

LEGEND:

A	Pinion Shaft
B	Ring Gear
C	Pin and Spider Gears
D	Axle Drive Gears
E	Drive Gear
F	Shaft
G	Final Drive Gear
H	Axle
I	Top View
J	Rear View

Group 20 - Diagnostics

PTO Diagnostics Table

Symptom	Problem	Solution
PTO Problems	PTO Does Not Engage.	Low hydraulic oil pressure. (See PTO Clutch Pressure Test in Section 80, Group 30.)
		PTO shaft, gear, or bearing failure.
		PTO clutch worn or damaged.
		PTO solenoid will not engage. (See Rear PTO Solenoid Test in Section 40, Group 35.)
	Rear PTO Operates, but Mid PTO Will Not Engage.	PTO shaft, gear, or bearing failure.
		MId PTO shift mechanism damaged.
	Engine Stalls When PTO Engaged.	PTO shaft, gear, or bearing failure.
		Use higher engine rpm Check engine performance.
		Use higher engine rpm Check engine performance.
		Excessive load on PTO output shaft (implement too large). Remove load.
	PTO Will Not Stay Engaged.	PTO shaft, gear, or bearing failure.
		PTO clutch worn or damaged.
	PTO Shaft Slows Down.	Use higher engine rpm Check engine performance.
		Excessive load on PTO output shaft (implement too large). Remove load.
	PTO Shaft Will Not Stop or Slow Down.	PTO brake worn or damaged.

Final Drive Diagnosis

Differential Pinion Shaft

Test/Check Point	Normal	If Not Normal
Range Shift Lever	Smooth operation; engages gear.	Replace damaged parts.
Rear Wheels	Smooth, quiet operation in forward, or reverse motion; wheels do not scrub when turning.	Check that differential locking lever disengages when not depressed. Replace damaged parts in differential.
Differential Lock Pedal	Smooth operation; engages differential lock.	Lubricate linkage. Replace damaged parts.
Front Wheels (MFWD)	Smooth, quiet operation in forward, or reverse motion; wheels do not scrub excessively when turning.	Replace damaged parts in front differential.
MFWD Lever	Smooth operation; engages MFWD.	Lubricate linkage or replace damaged parts.

Group 25 - Troubleshooting

Troubleshooting Table

Troubleshooting Table

Problem or Symptom	Possible Cause
Wheels On Machine Will Not Rotate	Hydraulic oil level low in transaxle. Parking brake engaged or malfunctioning. Electrical problem. Hydrostatic transmission problem. Mechanical failure at range transmission, differential, or final drives.
Range Transmission Hard to Shift or Won’t Shift	Hydraulic oil level low in transaxle. Machine not completely stopped when attempting to shift. Hydrostatic transmission not going completely into neutral, keeping pressure on gears. Mechanical failure inside range transmission, such as bent shift forks or damaged detent shaft or parts.
Differential Lock Does Not Work	Hydraulic oil level low in transaxle. Pedal or linkage problem. Mechanical failure of differential lock fork, slider, or differential.

Group 30 - Final Drive Troubleshooting

Final Drive Symptom Diagnosis

Symptom	Problem	Solution
Machine Will Not Move	Hydraulic oil low.	Fill to correct level.
	Parking brake engaged or malfunctioning.	Disengage brake. Repair or replace faulty component.
	Flex plate coupling between engine and hydrostatic input shaft damaged.	Replace flex plate.
	Hydrostatic unit failed.	Repair or replace components as necessary.
	Electrical problem . (hydro only)	See Forward and Reverse Pedal Sensor Test and Adjustment in Section 60, Group 40.)
	Mechanical failure of range transmission, differential, or final drives.	Repair or replace components as necessary.

Symptom	Problem	Solution
Range Transmission Hard to Shift or Won't Shift	Hydraulic oil level low.	Fill to correct level.
	Hydrostatic transmission not going fully into neutral causing machine to creep.	Adjust neutral.
	Shift forks, shift arm, detent shaft, or ball damaged.	Repair or replace components as necessary.

Differential Lock

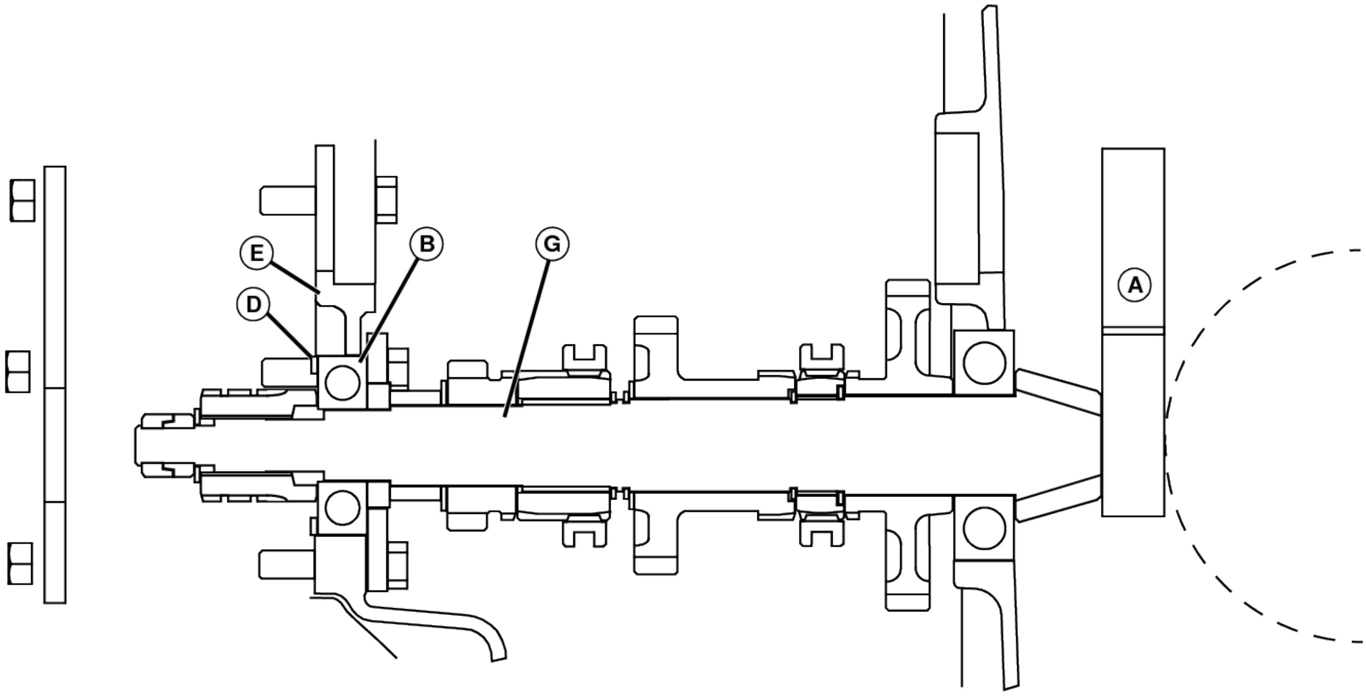
Symptom	Problem	Solution
Differential Lock Does Not Work	Pedal or link damaged/binding.	Adjust cable. See Differential Lock Cable Adjustment in Section 70, Group 35. Repair or replace components as necessary.)
	Mechanical failure of differential lock fork, slider, or differential.	Repair or replace components as necessary.

Group 35 - Tests and Adjustments

Specifications

Item	Measurement	Specification
M10 Cap Screws and Nuts	Torque	44—59 N·m (33—43 lb.-ft.)
Differential Backlash	Backlash	0.10.2 mm (0.004—0.008 in.)

Differential Pinion Shaft Adjustment



Pinion Shaft Cross Section

LEGEND:

A	Block Tool
B	Bearing
D	Shim Washer
G	Pinion Shaft Assembly
I	Center Plate

Reason:

To ensure proper gear engagement.

→NOTE:

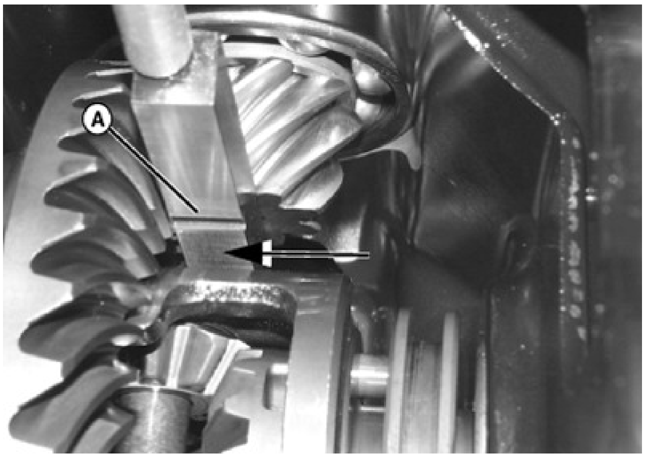
Center plate (I) must be bolted in place with a new gasket and two cap screws on each side for accurate measurement.

Procedure:

[1] - Install pinion shaft assembly (G). Do not install outer bearing retainer plate.

[2] - Install center plate gasket and center plate (I). Install a few cap screws on each side of center plate to clamp center plate to proper position.

[3] -



LEGEND:

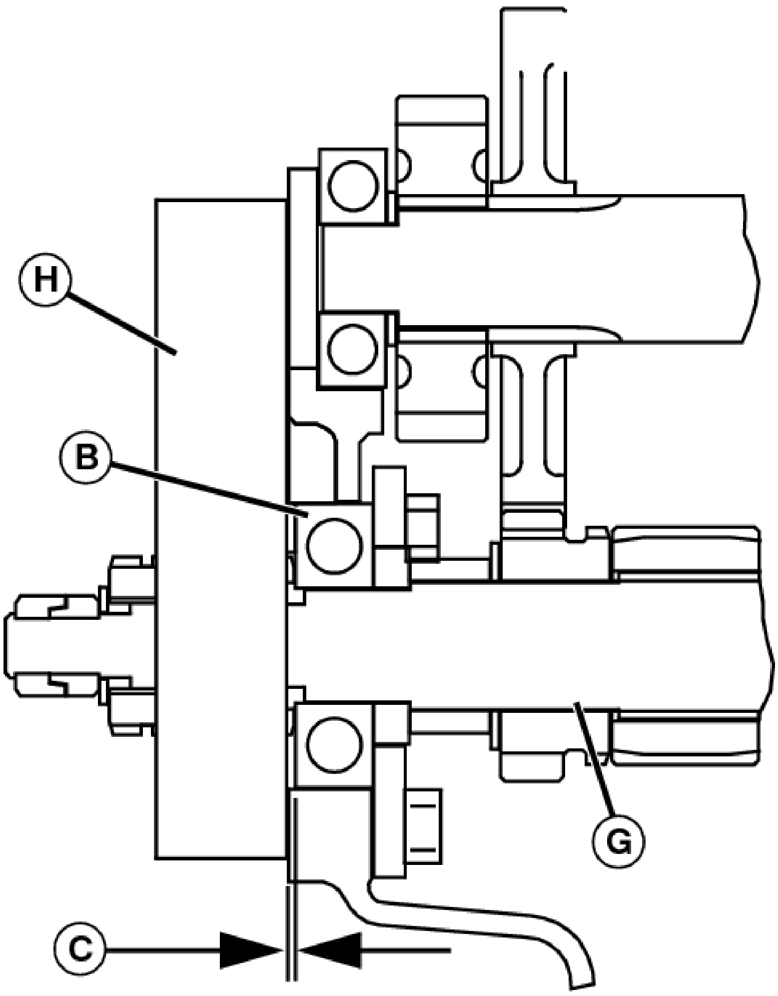
A	15.5 mm (0.610 in.) Block Tool

Block Tool

Turn differential assembly to align closed portion of differential housing with pinion shaft. Place 15.5 mm (0.610 in.) block tool (A) in space between end of pinion shaft and differential housing. Make sure that tool is also against ring gear. This positions tool on largest machined portion of differential housing closest to ring gear. Seat pinion shaft assembly (including bearing (B) firmly against block.

[4] - Place a straight edge across the face of the center plate.

[5] -



Center Plate Face

LEGEND:

B	Bearing
C	Distance Between Face of Center Plate and Bearing Face

G Pinion Shaft Assembly
H Straight Edge

Measure the distance (C) between the straight edge (H) (face of center plate) and the bearing face.

[6] - Based on the value of the measurement, refer to Table 1 to determine the adjustment shim to use.

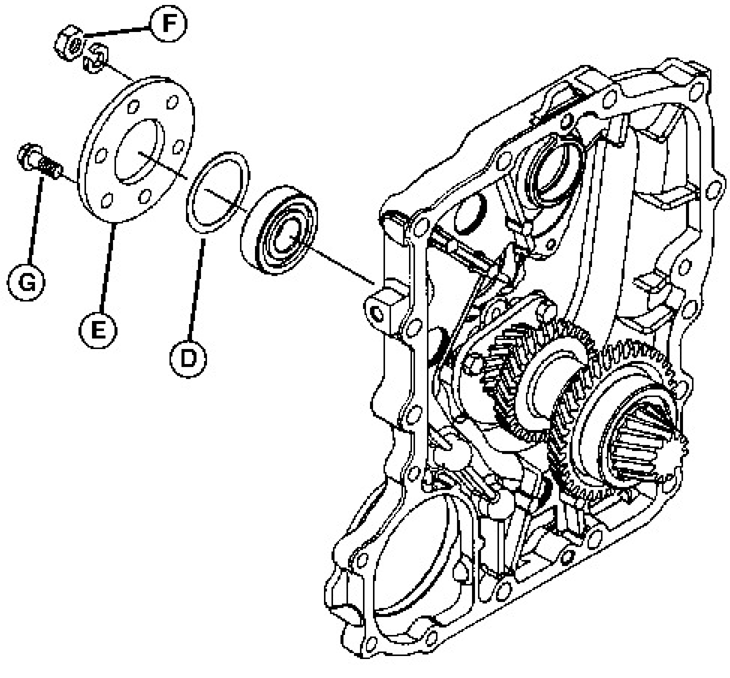
Table 1: Shim Washers

Dimension	Number of Shims
2.2 mm (0.087 in.)	1
2.3 mm (0.091 in.)	1
2.4 mm (0.094 in.)	1
2.5 mm (0.098 in.)	1
2.6 mm (0.102 in.)	1
2.7 mm (0.106 in.)	1
2.8 mm (0.110 in.)	1
2.9 mm (0.114 in.)	1
3.0 mm (0.118 in.)	1

→NOTE:

Adjustment shim washers are available in 0.1 mm (0.004 in.) size differences. Use closest shim washer to measurement.

[7] -



LEGEND:
D Shim
E Retainer Plate
G Cap Screw (3 used)
F Lock Washer and Nut (3 used)

Differential Bearing Retainer Plate

Install shim (D) and retainer plate (E).

[8] -

→NOTE:

Apply thread lock compound to nuts and cap screws before installation.

Install three cap screws (G). Tighten to specification.

[9] - Install three lock washers and nuts (F). Tighten to specification.

Item	Measurement	Specification
M10 Cap Screws and Nuts	Torque	44—59 N·m
		(33—43 lb.-ft.)

Differential Backlash Adjustment

Reason:

To place the differential ring gear in proper relationship with the differential pinion shaft.

IMPORTANT:

Avoid Damage! Always check and adjust backlash after pinion shaft adjustment has been made. Adjust backlash when the gearset or bearings were replaced or the amount of shims are in question.

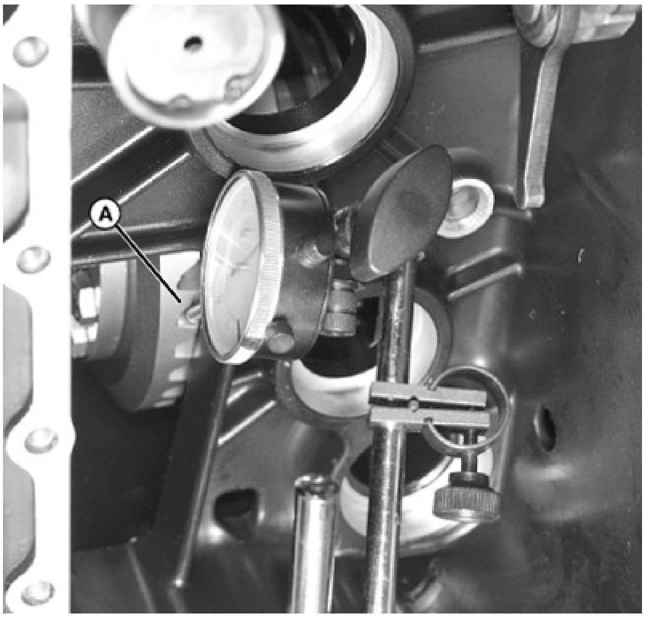
Procedure:

[1] - While slowly rotating the differential housing carrier, use a soft faced mallet to lightly tap the face of the ring gear to move it and the carrier toward the left-side bearing cover.

[2] -

→NOTE:

This is to ensure that the carrier and bearing are seated against the shim.



LEGEND:
A Ring Gear Movement

Dial Indicator Tool

Set up a dial indicator to measure ring gear movement (A).

[3] - While holding the differential pinion shaft stationary at the pinion, rotate the ring gear back and forth and note the backlash reading on the dial indicator.

Item	Measurement	Specification
Differential Backlash	Backlash	0.10.2 mm (0.004—0.008 in.)

To Adjust Backlash:

[1] - If not already off, remove left axle housing.

[2] -

LEGEND:

B Shim

Bearing Cover Shim

Remove and measure thickness of shim (B) located inside bearing cover. Install thinner shim to increase backlash, or install thicker shim to decrease backlash.

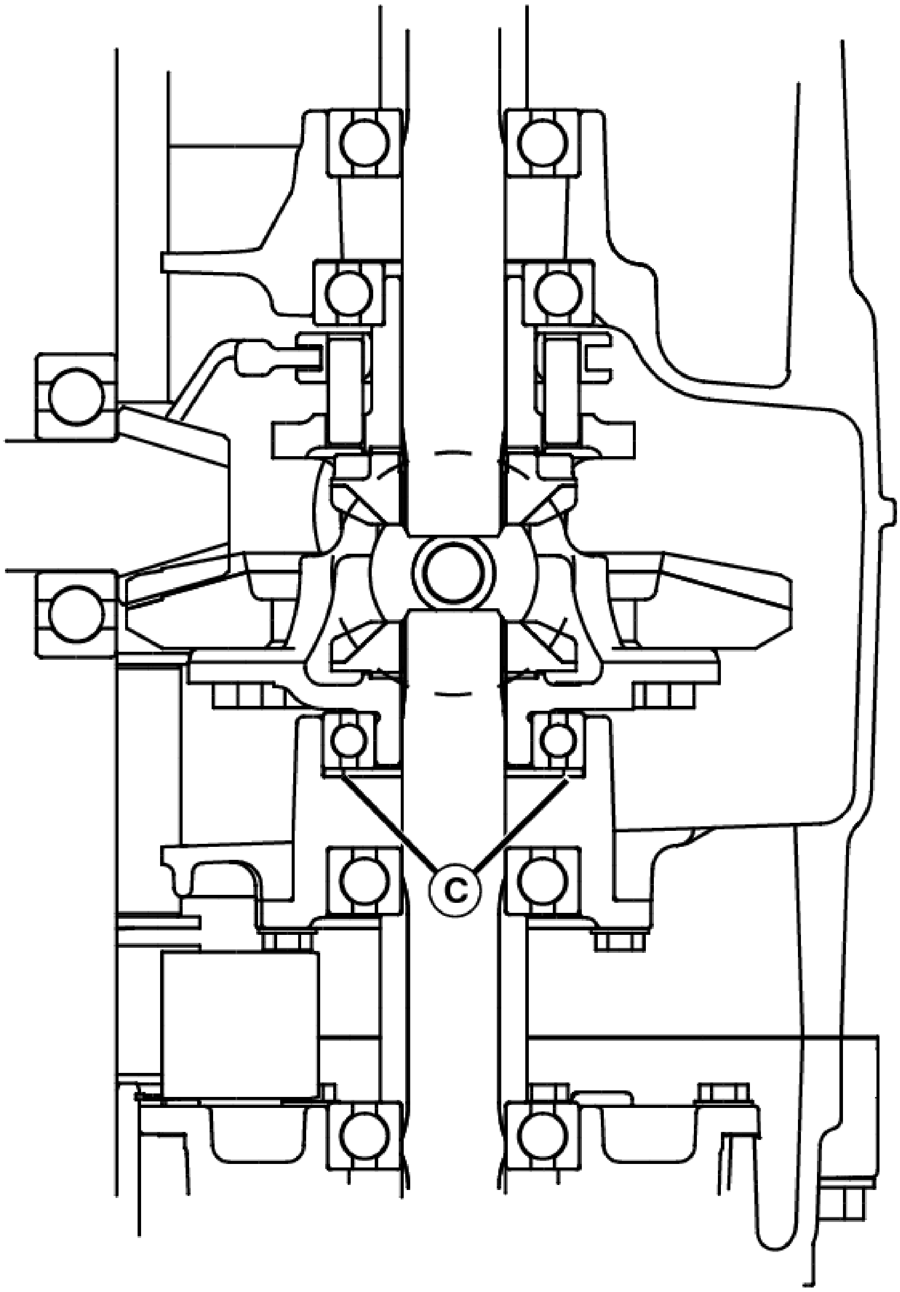
Table 1: Shims

Dimension	Number of Shims
2.0 mm (0.079 in.)	1
2.1 mm (0.083 in.)	1
2.2 mm (0.087 in.)	1
2.3 mm (0.091 in.)	1
2.4 mm (0.094 in.)	1
2.5 mm (0.098 in.)	1
2.6 mm (0.102 in.)	1

[3] -

→NOTE:

Refer to Table 1 to determine the shims to use.



Shown from top

LEGEND:

C Shims

Install differential carrier and recheck backlash after removing or installing shims (C).

Transmission Range Adjustment

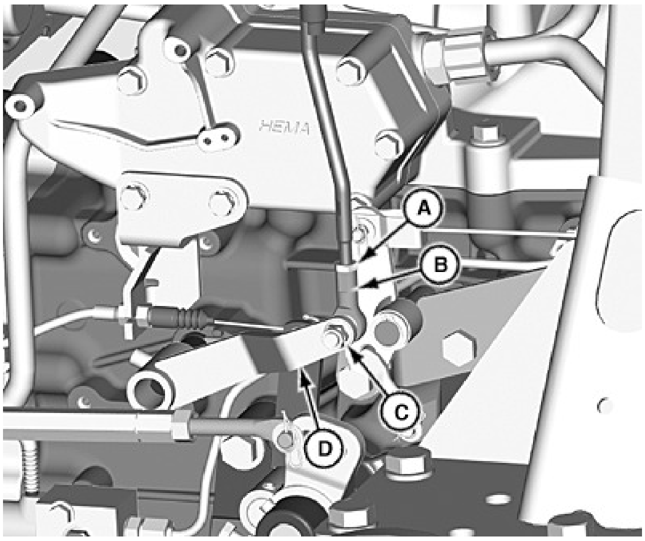
Reason:

To confirm full travel of range lever and transmission lever for proper engagement of all range gears. Procedure must be performed after range lever has been replaced.

Procedure:

[1] - Park machine safely with park brake locked. (See Park Machine Safely in Section 10, Group 05.)

[2] -



LEGEND:

A	Jam Nut
B	Tie Rod
C	Lock Nut
D	Range Shift Lever

Range Shift Lever

Loosen jam nut (A) and remove lock nut (C).

[3] -

→NOTE:

The top detent in the transmission/axle case is A and then is stepped down into N, B, and then C.

Move shift range lever (D) up into position A.

[4] - Rotate tie rod (B) until the range shift lever knob is in alignment with position A in the cab.

a. Install tie rod (B) fully into range shift lever (D).
b. Check knob alignment in the cab.
c. Repeat the procedure until a proper alignment has been achieved.

[5] - Install lock nut (C) and tighten jam nut (A).

[6] - Check operation of range shift when finished. Readjust if needed.

PTO Selector Cable Adjustment

Reason:

To confirm full travel of PTO selector lever and transmission PTO lever for proper engagement of PTO gears. Procedure must be performed after cable replacement.

Tools:

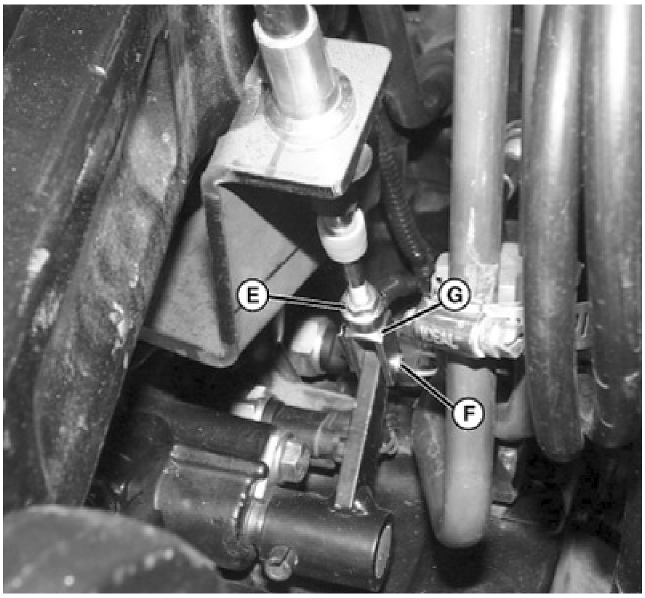
- 10 mm open-end wrench

Procedure:

[1] - Park machine safely with park brake locked. (See Park Machine Safely in Section 10, Group 05.)

[2] - Place the PTO selector lever and the PTO lever on transmission are in the “rear” position.

[3] -



LEGEND:

E	Jam Nut
F	Pin
G	Turn Yoke

PTO Selector Cable Adjustment

Loosen jam nut (E) and remove pin (F).

[4] - With the PTO selector lever and the PTO lever on transmission in the “rear” position, turn yoke (G) as needed to align hole in yoke with hole in PTO arm.

[5] - Install pin and tighten jam nut.

[6] - Operate the PTO selector lever and make sure that all positions operate properly.

Differential Lock Cable Adjustment

Reason:

To adjust travel of differential lock lever for full engagement of differential lock. Procedure must be performed after cable replacement.

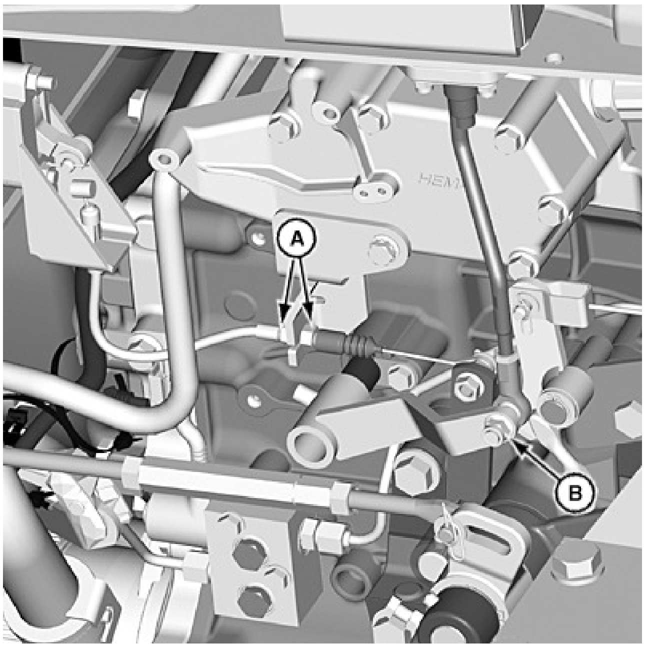
Tools:

- 13 mm open-end wrenches

Procedure:

[1] - Park machine safely with park brake locked. (See Park Machine Safely in Section 10, Group 05.)

[2] -



LEGEND:

A Jam Nut (2 used)

B Differential Lock Lever

Differential Lock Cable Adjustment

Make sure that the differential lock pedal inside the cab is in the disengaged “UP” position and the differential lock lever (B) is in the disengaged position (toward rear of machine).

[3] - Loosen jam nuts (A). Pull on cable housing until any slack has been taken out of cable and tighten jam nuts against bracket.

MFWD Cable Adjustment

Reason:

To confirm full travel of MFWD lever and transmission lever for proper engagement of MFWD. Procedure must be performed after cable replacement.

Tools:

- 10 mm open-end wrench
- Pliers
- 13 mm socket and wrench

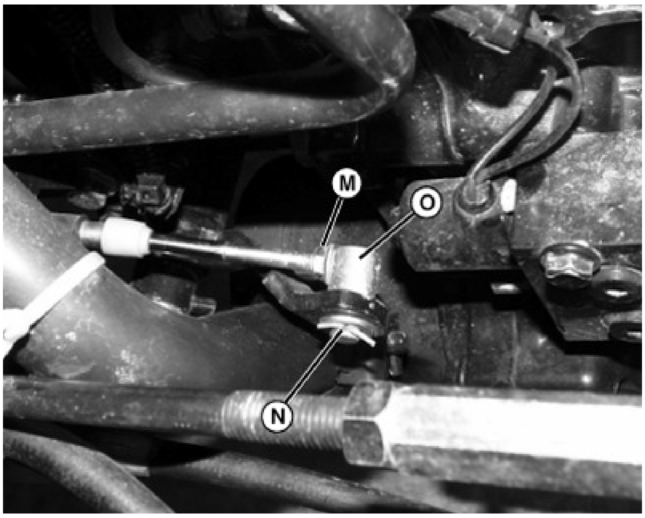
Procedure:

[1] - Park machine safely with park brake locked. (See Park Machine Safely in Section 10, Group 05.)

[2] - Jack up left rear of machine and place a jackstand under axle.

[3] - Remove left rear wheel.

[4] -



LEGEND:

M	Jam Nut
N	Cotter Pin and Washer
O	Swivel

MFWD Cable Adjustment

Make sure MFWD lever in cab and transmission MFWD lever are in the disengaged position.

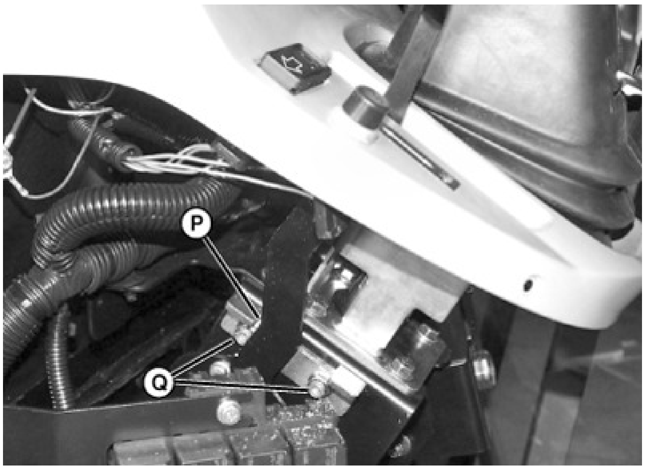
[5] - Loosen jam nut (M).

[6] - Remove cotter pin and washer (N).

[7] - Turn swivel (O) until pin on swivel aligns with hole in MFWD lever on transmission.

[8] - Install washer and cotter pin, then tighten jam nut.

[9] -



LEGEND:

P	Gap
Q	Locknut (2 used)

Lower Dash panel removed for photo

Shift MFWD lever up unto the engaged position and check the gap (P) between the shift lever and the stop bracket. Gap should be 1—3 mm.

[10] - If gap is not correct loosen two locknuts (Q) and adjust bracket to proper position. Tighten lock nuts.

Group 40 - Repair

Specifications

Item	Measurement	Specification
Eccentric Lock Nut	Torque	78—97 N·m (58—72 lb.-ft.)
Keeper Plate Cap Screws	Torque	28 N·m (21 lb.-ft.)
Front Bearing Plate Cap Screws	Torque	56 N·m (41 lb.-ft.)
Bearing Plate Cap Screws and Nuts	Torque	56 N·m (41 lb.-ft.)
Cap Screws and Nuts	Torque	56 N·m (41 lb.-ft.)
Final Drive Cap Screw	Torque	145 N·m (106 lb.-ft.)
Final Drive Cap Screw Torque	Torque	145 N·m (106 lb.-ft.)
Oil Seal Housing-to-Final Drive Housing	Torque	28 N·m (21 lb.-ft.)
Brake Assembly-to-Final Drive Housing	Torque	28 N·m (21 lb.-ft.)
Final Drive Housing-to-Transmission Housing	Torque	145 N·m (107 lb.-ft.)
Ring Gear Cap Screws	Torque	78 N·m (58 lb.-ft.)
Differential Carrier Cap Screws	Torque	28 N·m (21 lb.-ft.)
USED Torque Prevailing Nut	Torque	447—488 N·m (330—360 lb.-ft.)
NEW Torque Prevailing Nut	Torque	447—488 N·m (330—360 lb.-ft.)
Cap Screws	Torque	30—38 N·m (22—28 lb.-ft.)
End Play	Distance	0.64—0.76 mm (0.025—0.030 in.
Backlash	Distance	0.13—0.18 mm (0.005—0.007 in.)
Spanner Nut	Torque	40.7 N·m ± 2.7 N·m (30 lb.-ft. ± 2 lb.-ft..)
Spindle Gear	End Play	0.15—0.28 mm (0.006—0.011 in.)
Spindle Gear	Backlash	0.10—0.20 mm (0.004—0.008 in.)
Spindle Housing Cap Screws	Torque	286—316 N·m (211—233 lb.-ft.)
Old Pinion Nut	Torque	257—285 N·m (190—210 lb.-ft.)
Pinion Rotation	Torque	0.8—1.4 N·m (7—12 lb.-in.)
New Pinion Nut	Torque	257—285 N·m (190—210 lb.-ft.)
Ring Gear Cap Screws	Torque	79—88 N·m

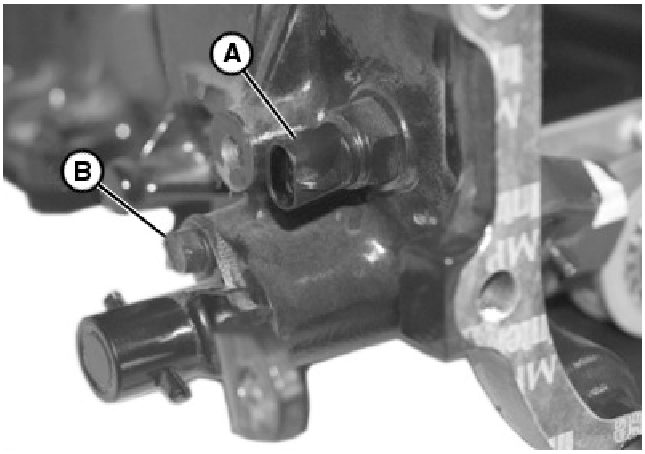
Item	Measurement	Specification
		(58—65 lb.-ft.)
Bearing Cap Screws	Torque	54—68 N·m
		(40—50 lb.-ft.)
Differential Case Bearings	Preload	0.03—0.09 mm
		(0.001—0.004 in.)
Differential Gear	Backlash	0.08—0.18 mm
		(0.003—0.007 in.)
Differential Carrier Housing Cap Screw	Torque	102—108 N·m
		(75—80 lb.-ft.)
Tool Value	Distance	0.64—0.86 mm
		(0.026—0.034 in.)
Acceptable Tool Value	Distance	0.45—0.96 mm
		(0.018—0.038 in.)
Ring Gear Measurement	Backlash	0.10—0.20 mm
		(0.004—0.008 in.)
Bearing Cap Screws	Torque	54—68 N·m
		(40—50 lb.-ft.)

MFWD Output Shaft

Removal:

[1] - Split machine at rear of tunnel.

[2] -



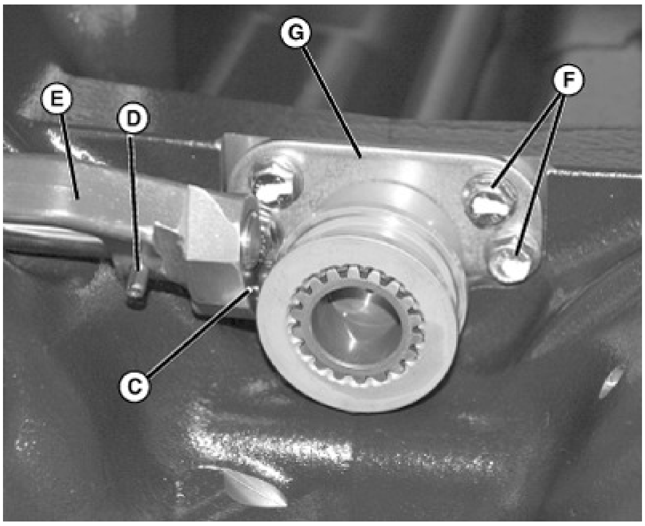
LEGEND:
A MFWD Switch
B Cap Screw and Keeper Plate

Final Drive Case

Unscrew and remove MFWD switch (A).

[3] - Remove cap screw and keeper plate (B).

[4] -



LEGEND:
C Shift Arm Shoe
D Roll Pin
E Shift Arm
F Cap Screw (4 used)
G Keeper Plate

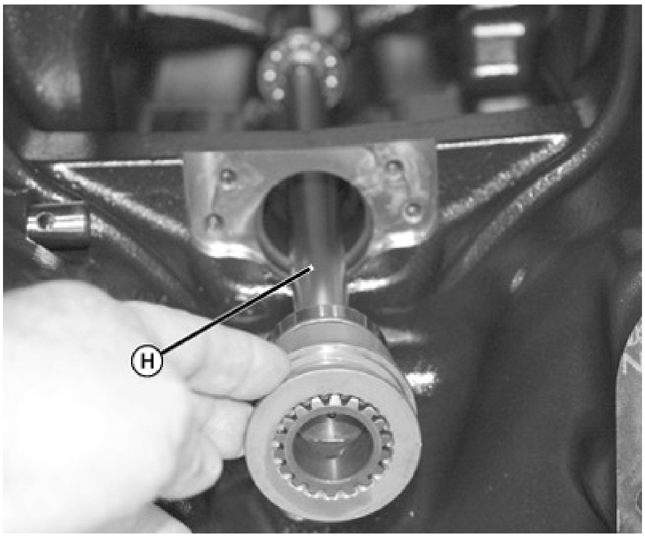
Shift Shaft

Slide shift shaft out far enough to remove shift arm shoe (C).

[5] - Remove roll pin (D) and slide shaft out and remove shift arm (E).

[6] - Remove four cap screws (F) on keeper plate (G).

[7] -



LEGEND:

H	Shaft Assembly

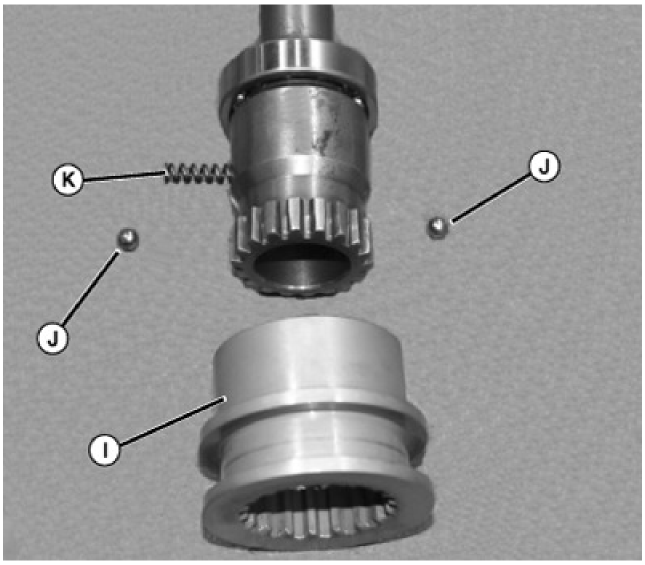
Shaft Assembly

Pull shaft assembly (H) out of tunnel.

Disassembly:

→NOTE:

Front drive shaft has two spring loaded detent balls located under shift collar (I). Place collar in a box or wrap with shop cloth when removing to avoid losing parts. Use care when removing shift collar from shaft.



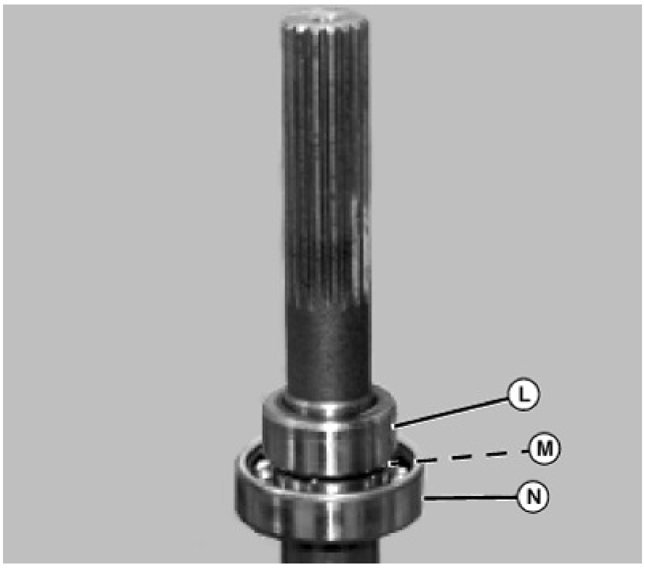
LEGEND:

I	Shift Collar
J	Detent Balls (2)
K	Spring

Front Drive Shaft Assembly

[1] - Remove shift collar (I), detent balls (J), spring (K) from front drive shaft.

[2] -



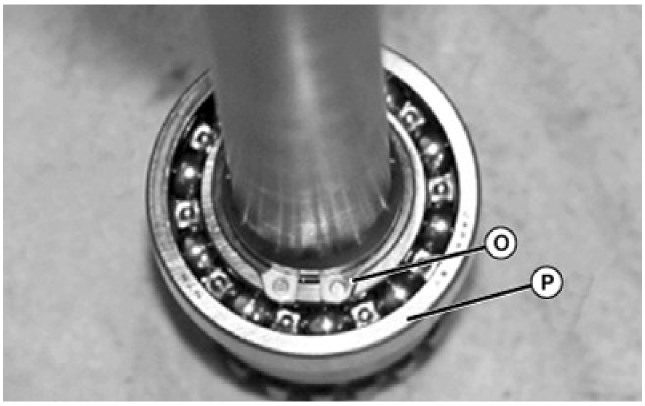
LEGEND:

L	Seal Collar
M	Snap Ring
N	Output Shaft Bearing

Output Shaft Bearing

Remove seal collar (L), snap ring (M), and bearing (N).

[3] -



LEGEND:

O	Snap Ring
P	Bearing

Snap Ring and Bearing

Remove snap ring (O), and bearing (P).

[4] -

IMPORTANT:

Avoid Damage! DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

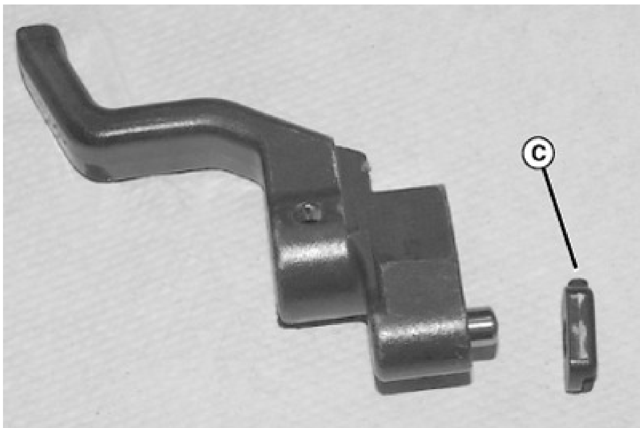
Clean all parts. Inspect bearings for discolored, burned balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[5] - Inspect bearing surfaces on shaft for wear or damage.

[6] - Inspect spines on front drive shaft and shift collar for damaged splines.

[7] - Inspect groove in shift collar for scoring or damage. Replace any worn or damaged parts.

[8] -



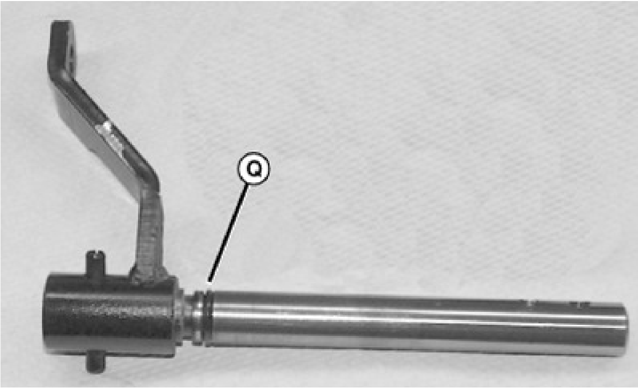
LEGEND:

C	Shift Arm Shoe

Shift Arm Shoe

Inspect shift arm shoe (C) for wear. Replace as required.

[9] -



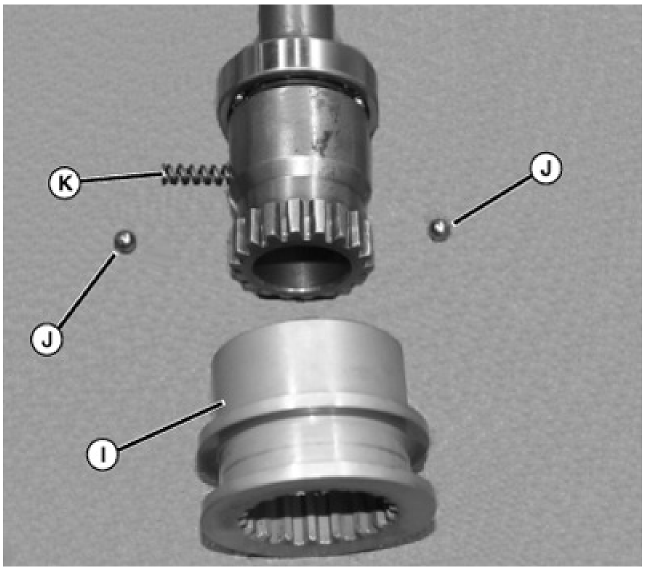
LEGEND:

Q	Shift Shaft O-ring

Shaft Assembly and Tunnel

Replace O-ring (Q) on shift shaft before reassembly.

Assembly:



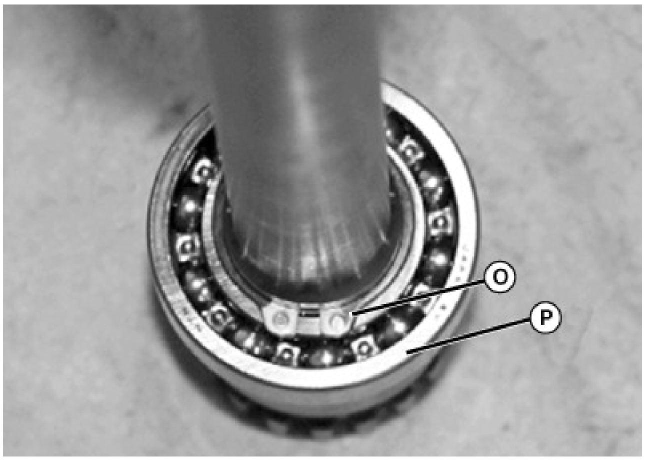
LEGEND:

I	Shift Collar
J	Detent Ball (2 used)
K	Spring

Front Drive Shaft Assembly

[1] - Apply grease to detent balls (J) and spring (K) to help hold them in place during assembly. Assemble spring, detent balls, and shift collar (I) on front drive shaft. Install shift collar with groove toward gear side as shown.

[2] -



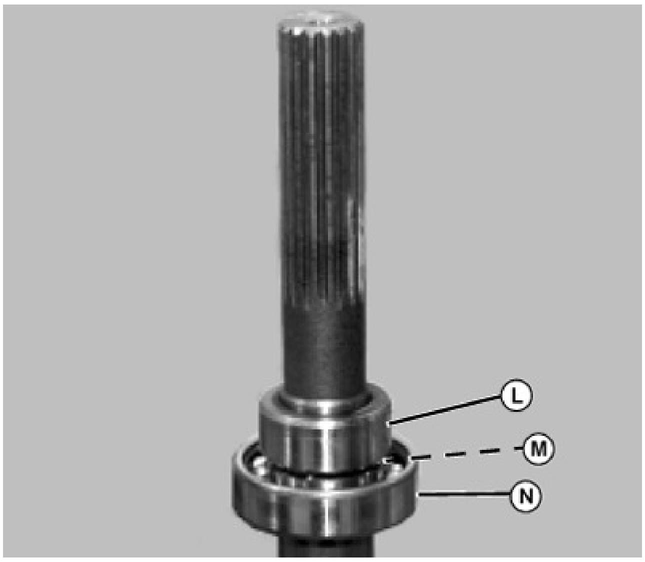
LEGEND:

O	Snap Ring
P	Bearing

Snap Ring and Bearing

Install bearing (P), and snap ring (O).

[3] -



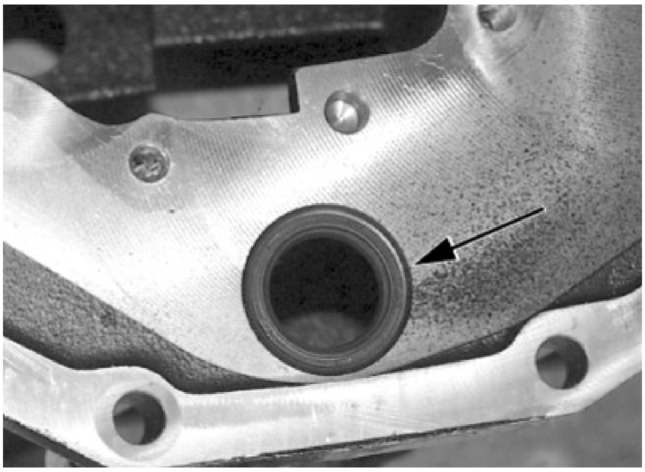
LEGEND:

L	Seal Collar
M	Snap Ring
N	Bearing

Output Shaft Bearing

Install bearing (N), snap ring (M) and new seal collar (L).

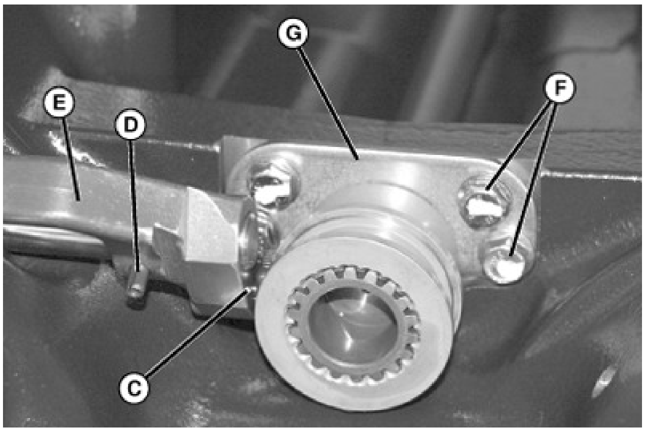
[4] -



Tunnel Oil Seal

Install new oil seal in tunnel.

[5] -



LEGEND:

C	Shoe
D	Roll Pin
E	Shift Arm
F	Cap Screws
G	Keeper Plate

Shaft Assembly and Tunnel

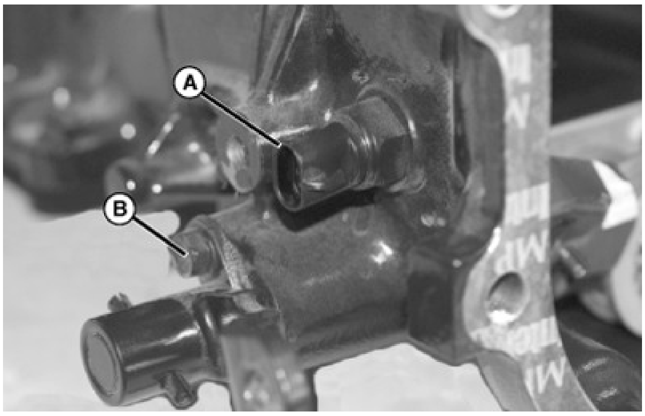
Install shaft assembly into tunnel using care not to damage oil seal.

[6] - Install keeper plate (G). Apply Loctite to cap screws (F) and install cap screws.

[7] - Install shoe (C) on shift arm (E).

[8] - Slide shift shaft into shift arm. Align holes and retain with roll pin (D).

[9] -



LEGEND:

A	Switch
B	Keeper Plate

Final Drive Case

Install switch (A) and keeper plate (B).

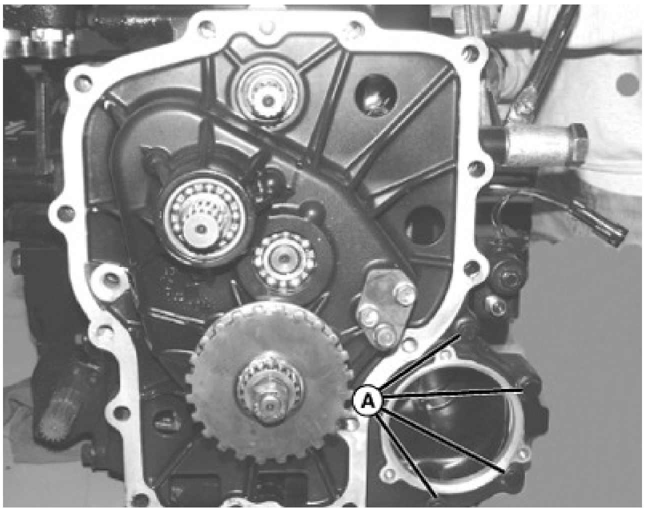
Speed Range Transmission—eHydro™

Removal:

[1] - Split machine at rear of tunnel.

[2] - Remove rockshaft.

[3] -



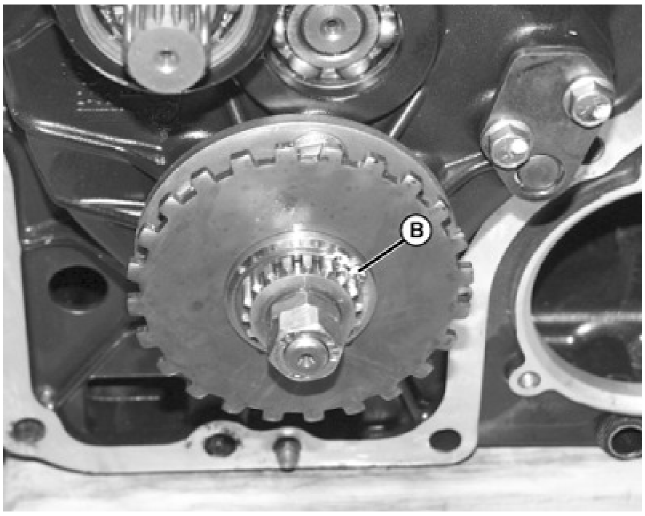
LEGEND:

A	Cap Screw (4 used)

Range Transmission Cover

Remove the four remaining cap screws (A) from range transmission cover.

[4] -



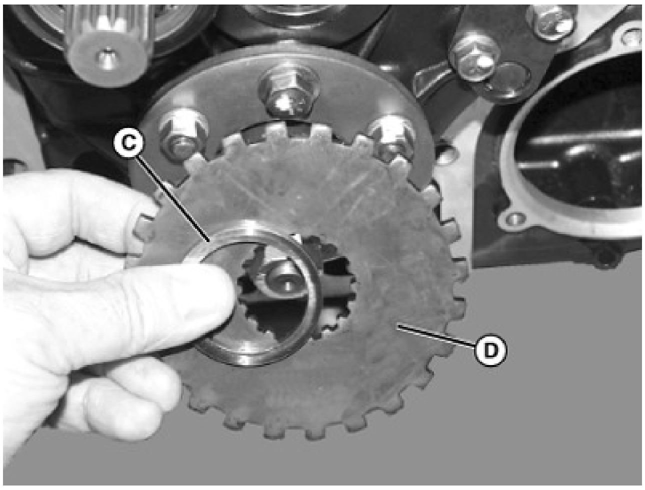
LEGEND:

B	Snap Ring

Outer Pinion Shaft

Remove snap ring (B) from pinion shaft.

[5] -



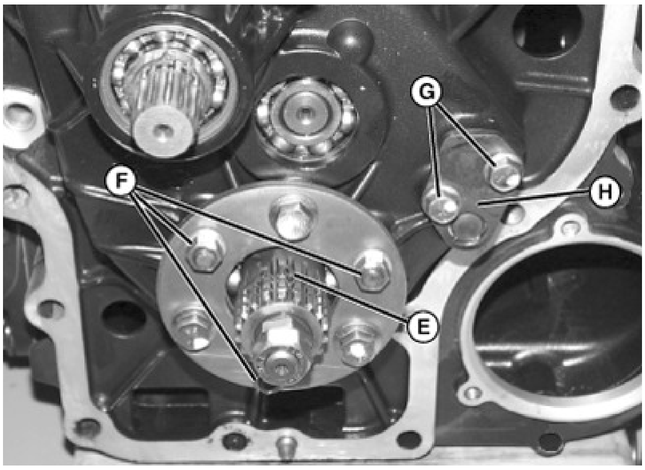
LEGEND:

C	Spacer
D	Speed Sensor Gear

Speed Sensor Gear

Remove spacer (C) and speed sensor gear (D).

[6] -



LEGEND:

E	Snap Ring
F	Nut (3 used)
G	Cap Screws
H	Detent Ball Cover

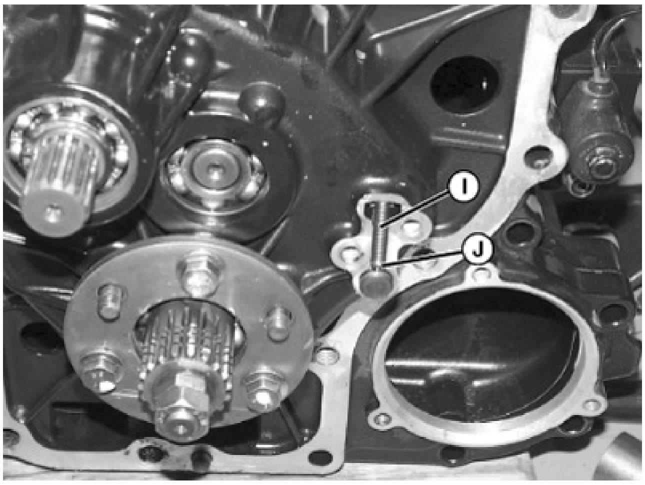
Pinion Shaft Bearing Retainer

Remove remaining snap ring (E) from pinion shaft.

[7] - Remove three nuts (F) from bearing retainer plate.

[8] - Remove cap screws (G) and detent ball cover (H).

[9] -



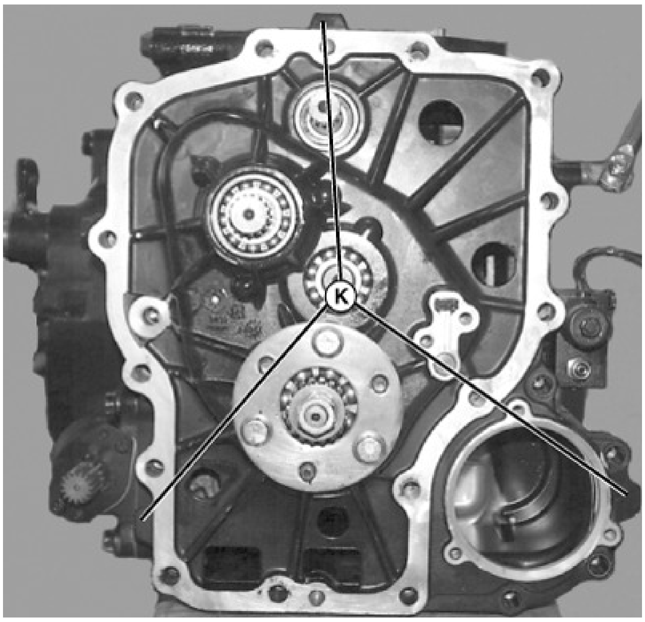
LEGEND:

I	Spring
J	Detent Ball

Spring and Detent Ball

Remove spring (I) and detent ball (J).

[10] -



LEGEND:

K	Tabs

Transmission Cover

Alternately tap on the tabs (K) to remove transmission cover. As the cover comes forward, tap the shafts in to keep them in place in the main housing. Remove the cover.

Disassembly:

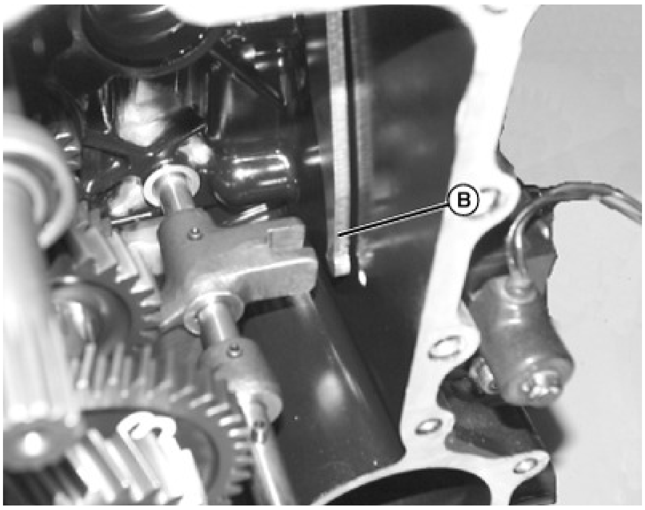
LEGEND:

A	Cap Screw and Keeper

Cap Screw and Keeper

[1] - Remove cap screw and keeper (A) from range shift shaft.

[2] -



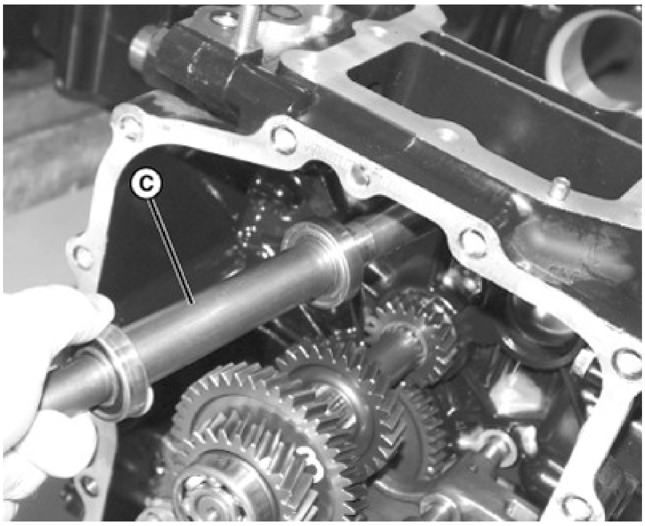
LEGEND:

B	Shift Lever

Shift Lever

Slide shift lever (B) out toward case to disengage from shift fork.

[3] -



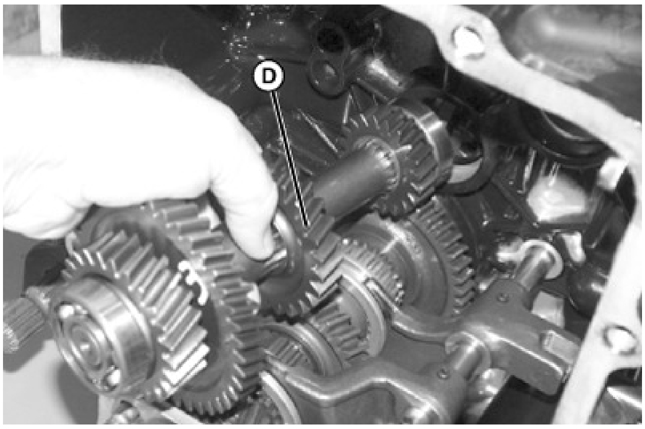
LEGEND:

C	PTO Shaft

PTO Shaft

Remove PTO shaft (C).

[4] -



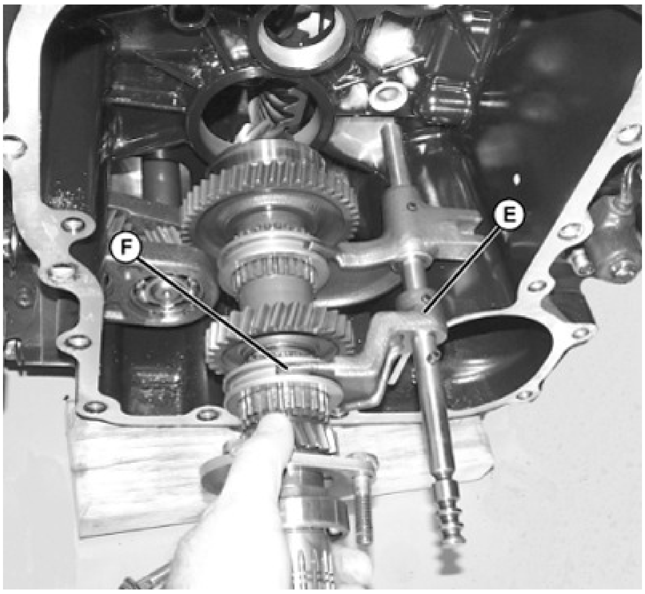
LEGEND:

D	Reduction Shaft

Reduction Shaft

Slide pinion shaft out slightly and then remove reduction shaft (D).

[5] -



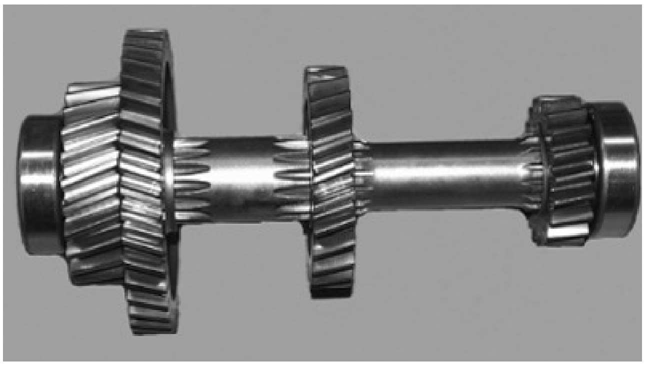
LEGEND:

E	Shift Shaft
F	Pinion Shaft

Pinion and Shift Shaft

Remove pinion shaft (F) and shift shaft (E) together.

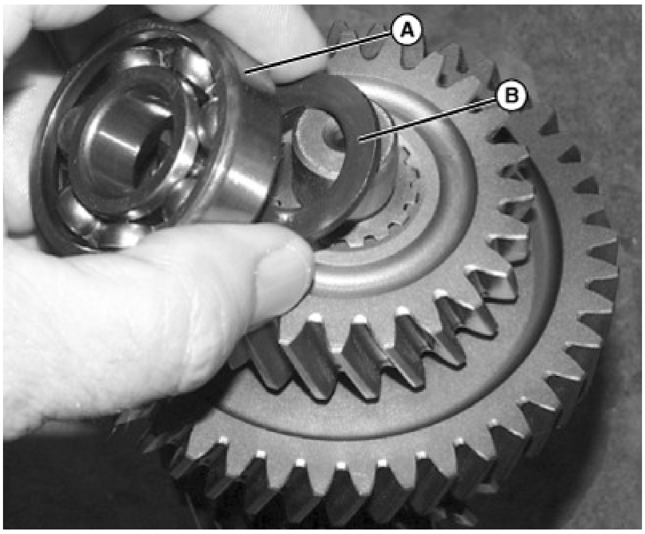
Driven Shaft Disassembly:



Driven Shaft Gears

[1] - Inspect all gears on driven shaft for worn or broken teeth. Check bearings for wear or damage.

[2] -



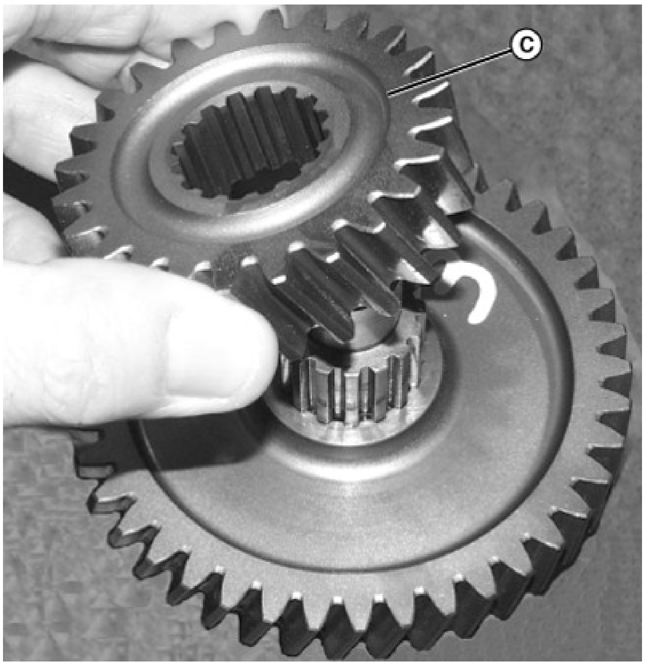
LEGEND:

A	Bearing
B	Washer

Driven Shaft Front Bearing

Remove bearing (A) and washer (B).

[3] -



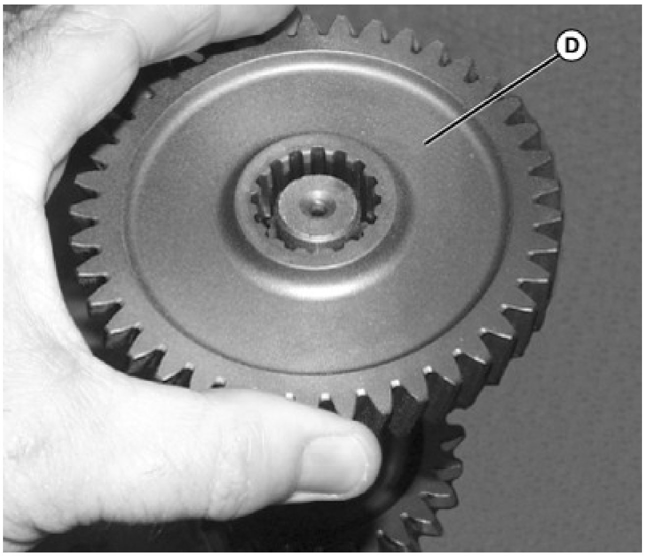
LEGEND:

C	24T Gear

24T Gear

Remove 24T gear (C).

[4] -



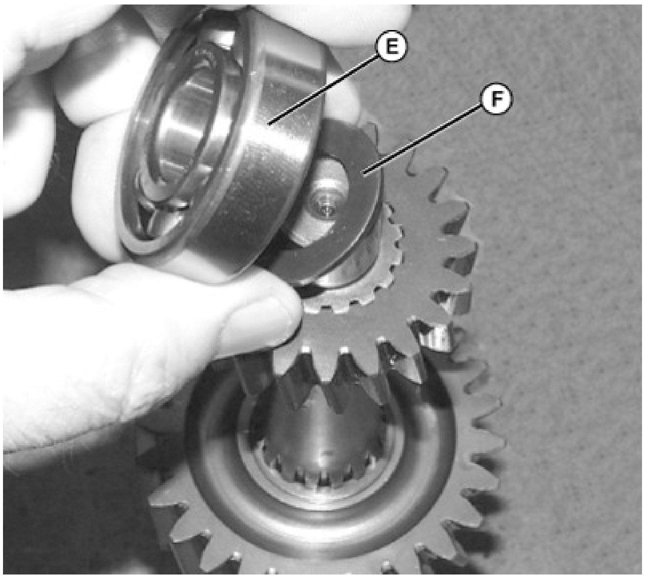
LEGEND:

D	41T Gear

41T Gear

Remove 41T gear (D).

[5] -



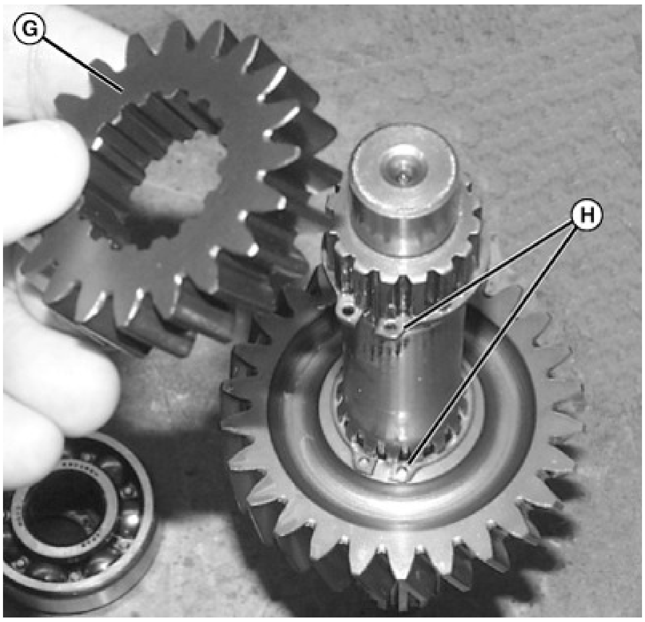
LEGEND:

E	Bearing
F	Washer

Driven Shaft Rear Bearing

Remove bearing (E) and washer (F).

[6] -



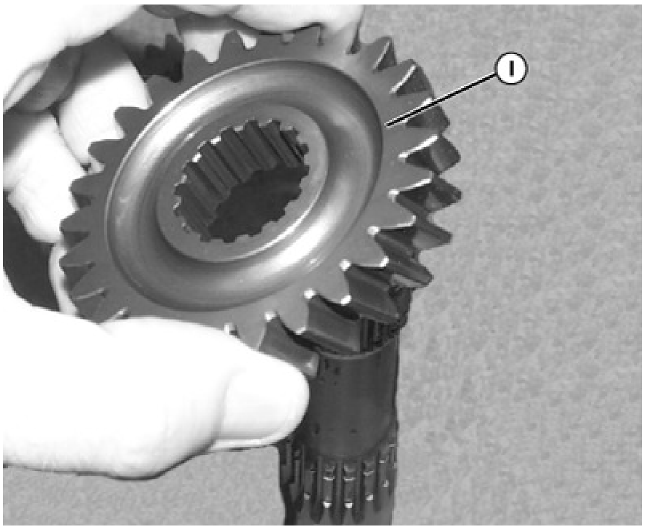
LEGEND:

G	20T Gear
H	Snap Ring (2 used)

20T Gear

Remove 20T gear (G) and two snap rings (H).

[7] -



LEGEND:

I	26T Gear

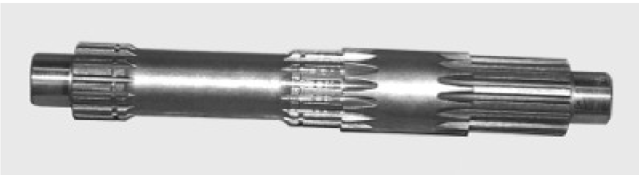
26T Gear

Remove 26T gear (I).

[8] -

IMPORTANT:

Avoid Damage! DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.



Driven Shaft

Clean all parts in solvent. Dry with compressed air.

[9] - Inspect bearings for discolored, burned, balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[10] - Inspect splines and gear teeth on all gears and driven shaft assembly for wear or damage. Replace as required.

Assembly:

- Assemble in the reverse order of disassembly.

Pinion Shaft Disassembly:

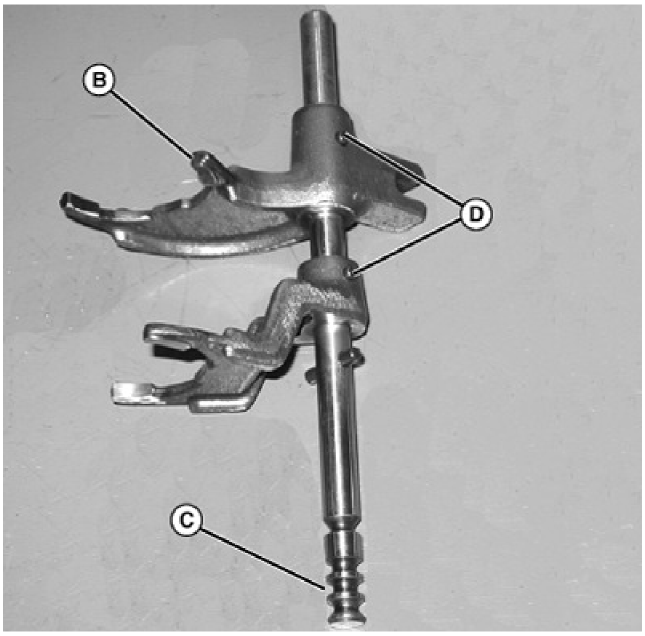
LEGEND:

A	Shift Fork and Shaft Assembly

Pinion Shaft Assembled

[1] - Remove shift fork and shaft assembly (A) from pinion shaft.

[2] -



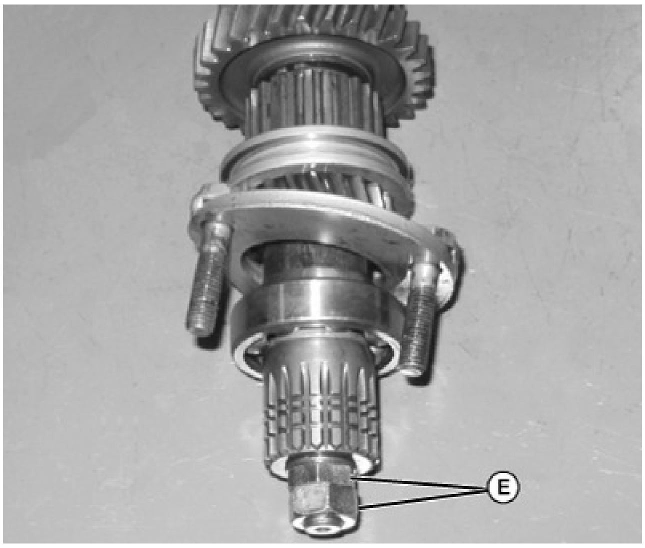
LEGEND:

B	Fork Ends
C	Detent Grooves
D	Roll Pins

Shift Fork Removed

Inspect fork ends (B) for excessive wear or bending. Check detent grooves (C) for wear or damage. If fork removal is necessary, drive out roll pins (D) with a punch and remove/replace forks as needed.

[3] -



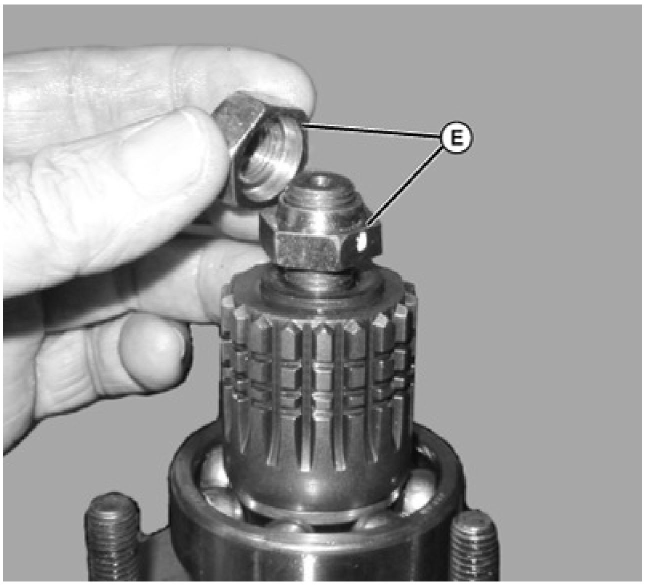
LEGEND:

E	Outer and Inner Locking Nuts

Pinion Shaft Locking Nuts

Using two wrenches, loosen outer and inner locking nuts (E).

[4] -



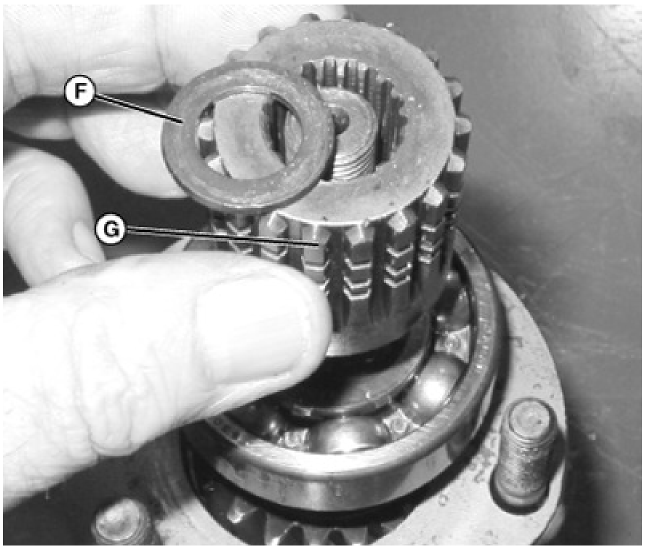
LEGEND:

E	Locking Nuts

Locking Nut Removal

Remove locking nuts (E). Note the difference between inner and outer nut.

[5] -



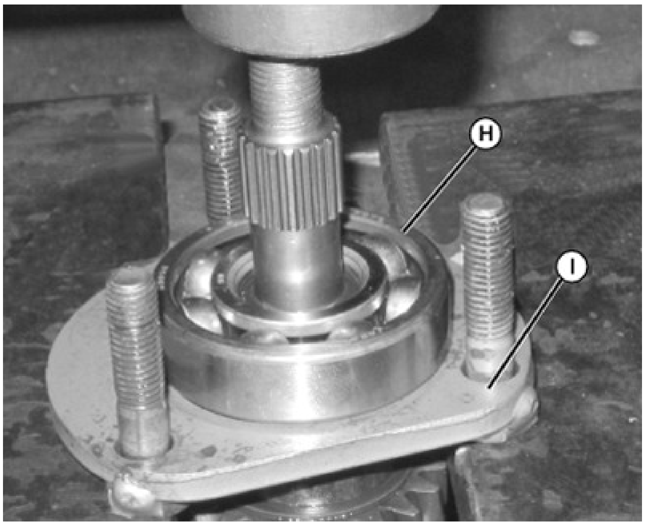
LEGEND:

F	Washer
G	Splined Collar

Pinion Shaft Splined Collar

Remove washer (F) and splined collar (G).

[6] -



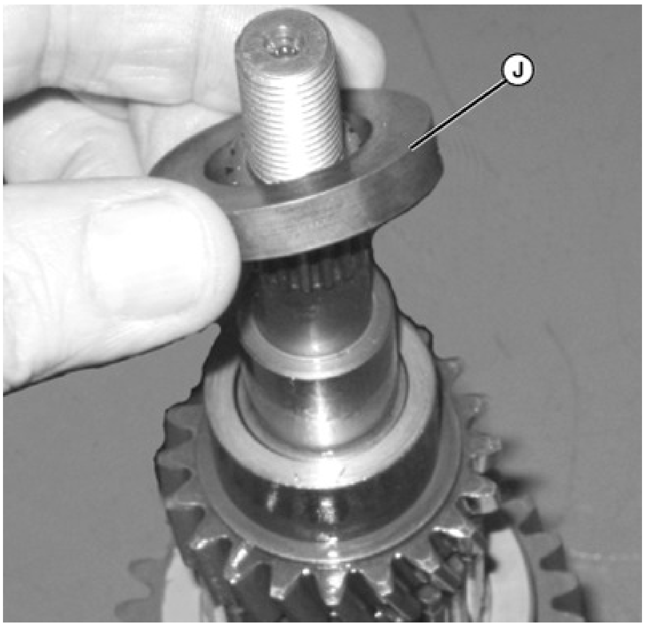
LEGEND:

H	Bearing
I	Retainer

Outer Pinion Shaft Bearing and Retainer

Remove bearing (H) and retainer (I) with a press.

[7] -



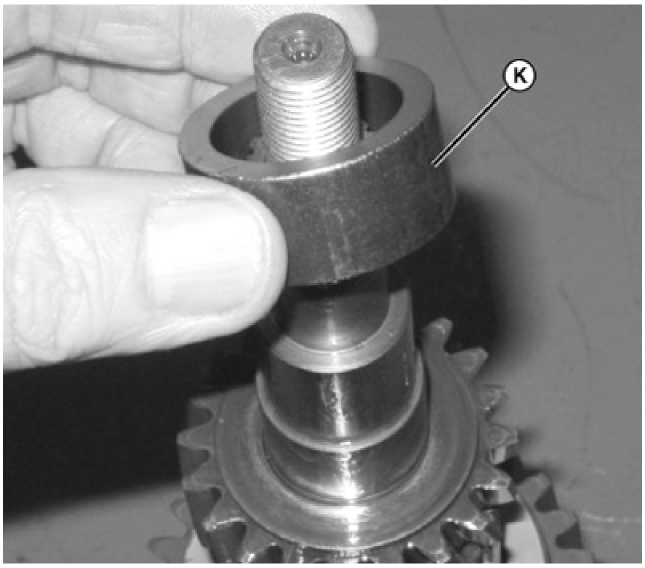
LEGEND:

J	Washer

Thrust Washer

Remove washer (J).

[8] -



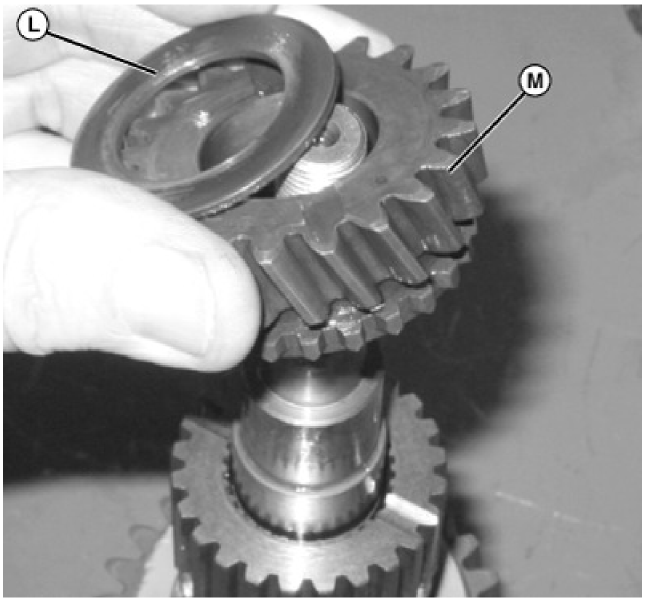
LEGEND:

K	Spacer

Spacer

Remove spacer (K).

[9] -



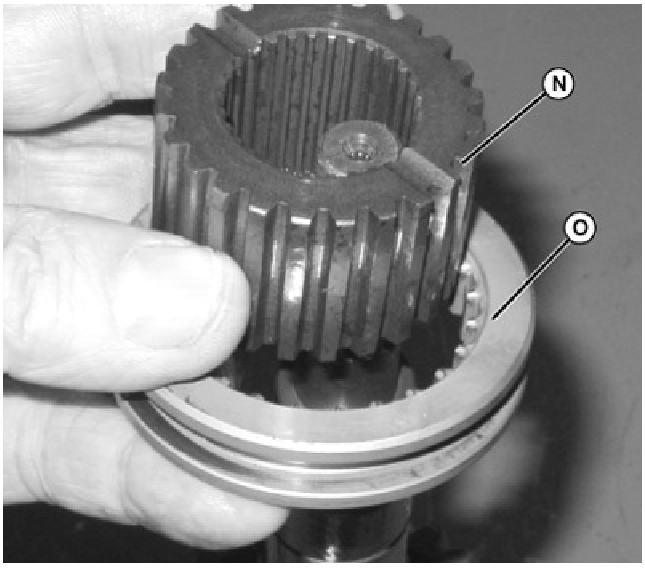
LEGEND:

L	Washer
M	20T Gear

Washer and 20T Gear

Remove washer (L) and 20T gear (M).

[10] -



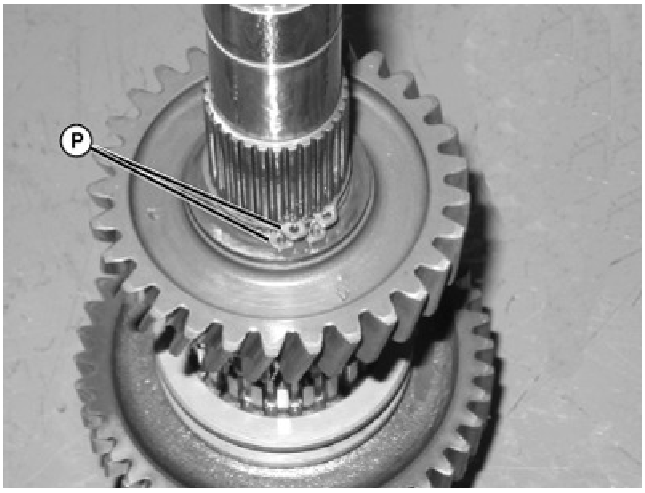
LEGEND:

N	Splined Collar
O	Shift Collar

Splined and Shift Collar

Remove splined collar (N) and shift collar (O).

[11] -



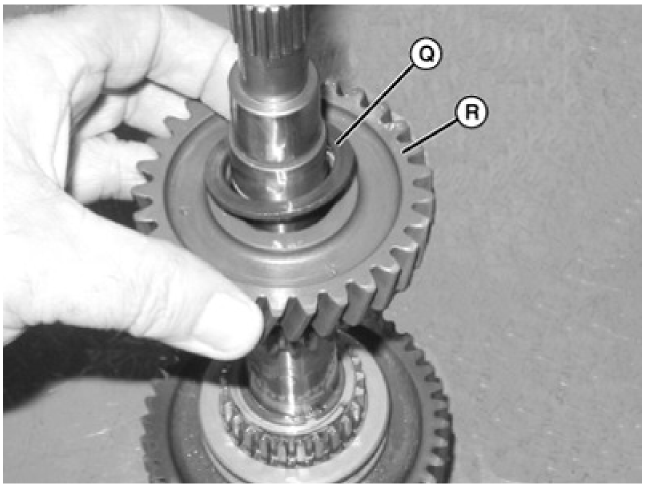
LEGEND:

P	Snap Ring (2 used)

Inner Snap Rings

Remove two snap rings (P).

[12] -



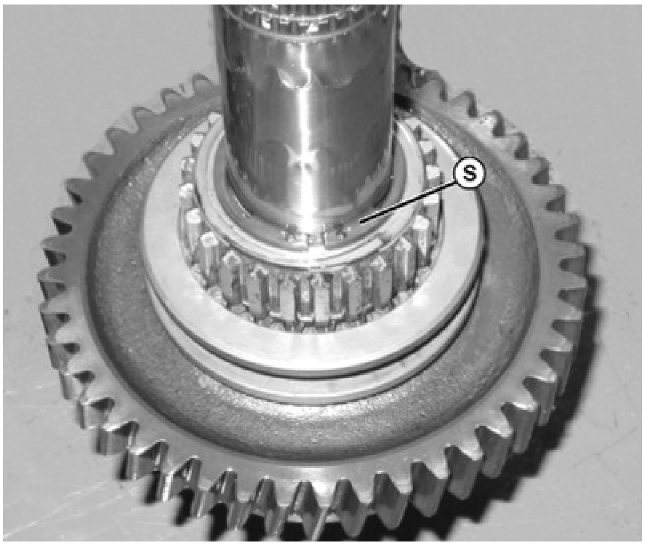
LEGEND:

Q	Washer
R	29T Gear

29T Gear and Washer

Remove washer (Q) and 29T gear (R).

[13] -



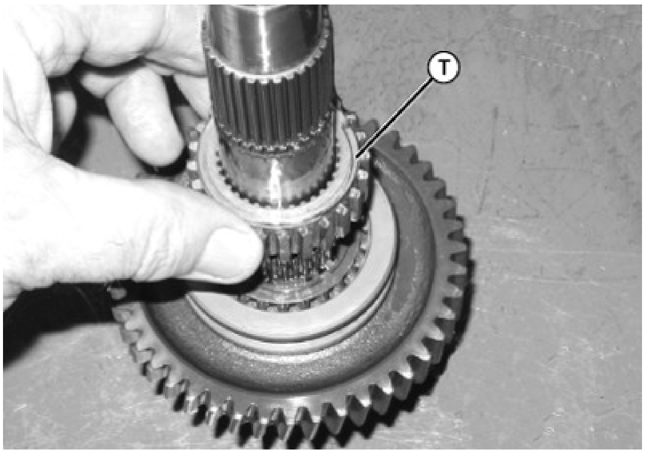
LEGEND:

S	Snap Ring

Splined Collar Snap Ring

Remove snap ring (S).

[14] -



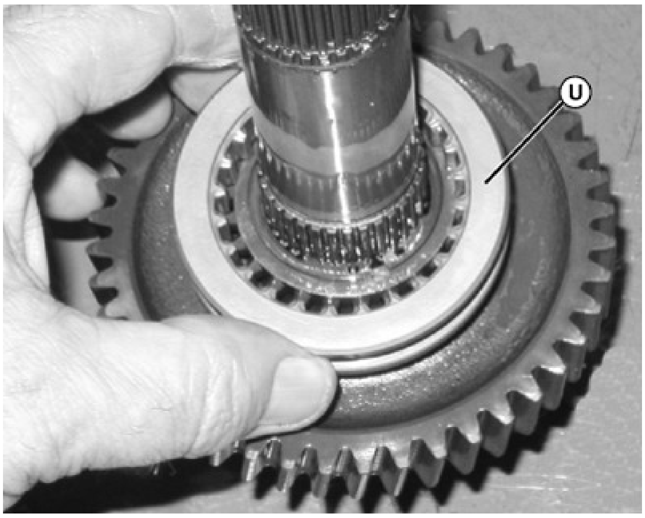
LEGEND:

T Splined Collar

Splined Collar

Remove splined collar (T).

[15] -



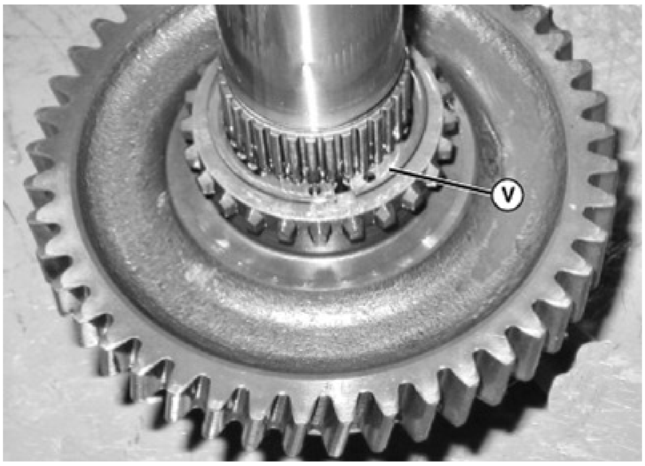
LEGEND:

U Shift Collar

Shift Collar

Remove shift collar (U).

[16] -



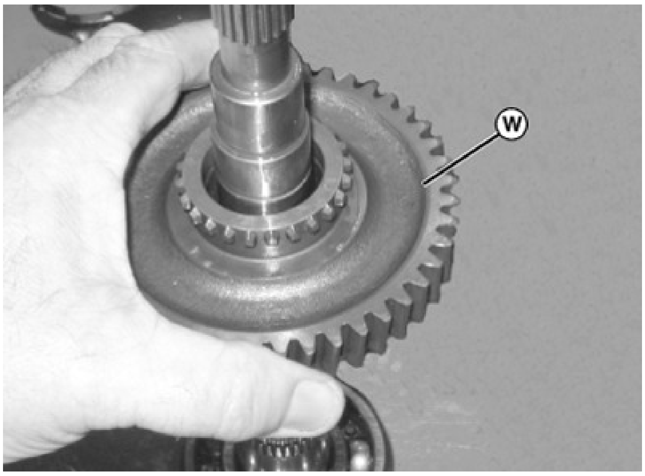
LEGEND:

V Snap Ring

Outer Snap Ring

Remove snap ring (V).

[17] -



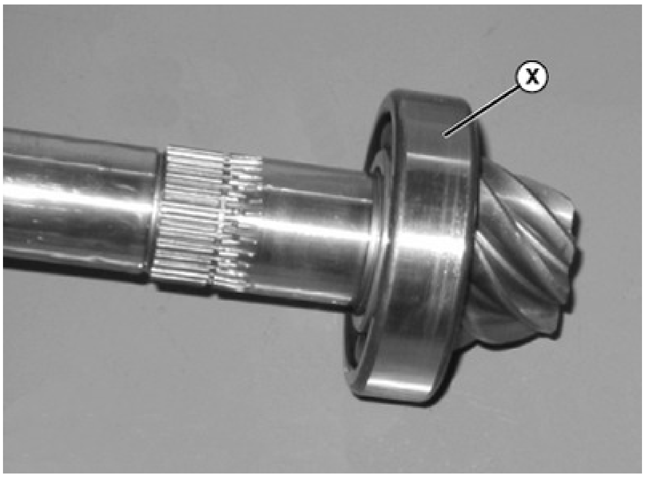
LEGEND:

W	44T Gear

44T Gear

Remove 44T gear (W).

[18] -



LEGEND:

X	Bearing

Pinion Shaft End Bearing

Inspect bearing (X). If bearing needs replacement, remove bearing in a press.

[19] - Clean all parts. Inspect bearings for discolored, burned balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[20] - Inspect all gears for wear or damage. Examine all gear teeth as well as splines on the inside or gear bore if applicable. Replace any worn or damaged parts.

[21] -

→NOTE:

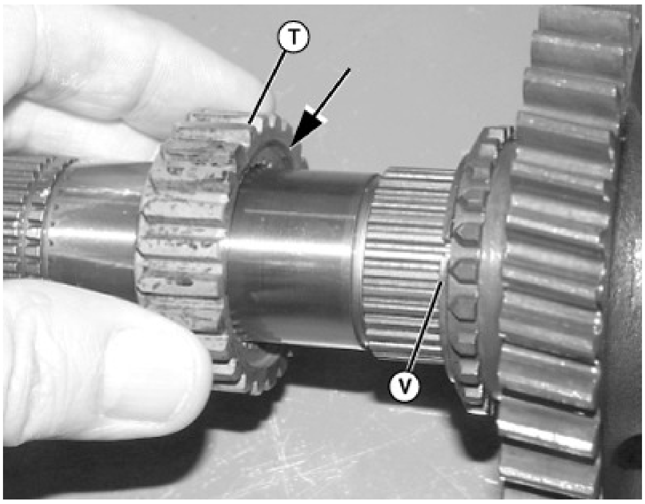
Pinion gear and differential ring gear are sold as a set and cannot be replaced individually.

Inspect pinion shaft for wear or damage. Inspect all splines and gear teeth. Inspect bearing areas of shaft. Replace pinion shaft and differential ring gear as a set if worn or damaged.

Assembly:

- Parts are assembled in the reverse order of disassembly.
- Coat parts with clean J20C oil during assembly.

Number	Name	Use
◦ J20C (us)	Oil	Coat parts for assembling.



LEGEND:

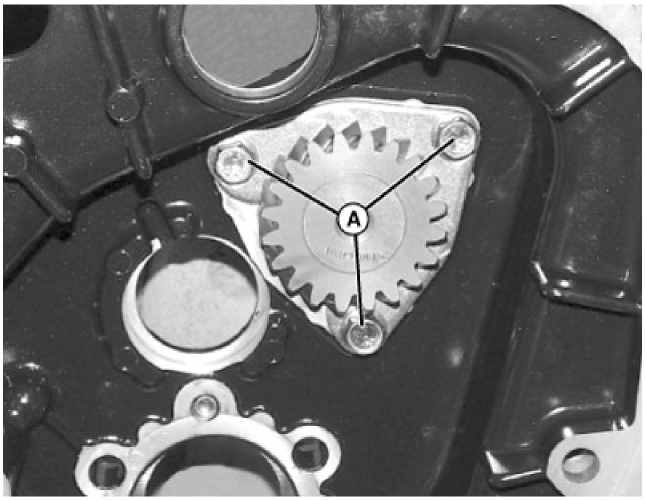
T	Splined Collar
V	Snap Ring

Splined Collar Install

- Install splined collar (T) with cutout area (arrow) toward snap ring (V).
- Assemble the rest of the parts in the reverse order of disassembly.
- Tighten eccentric inner lock nut (thin nut) and outer nut (thick nut) to specification.

Item	Measurement	Specification
Eccentric Lock Nut	Torque	78—97 N·m (58—72 lb.-ft.)

Main Gear Disassembly/Assembly



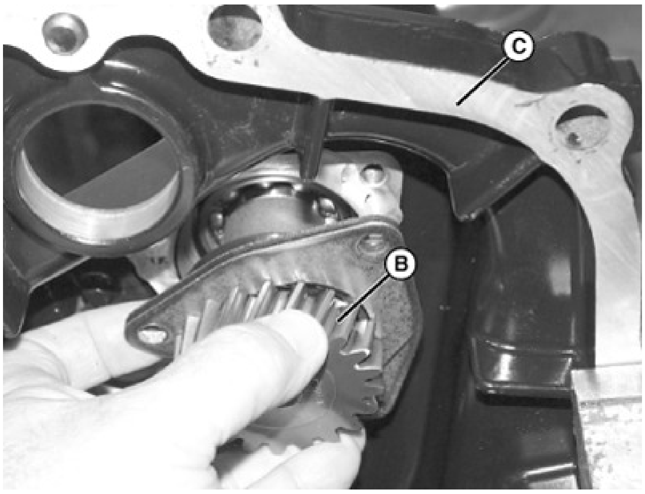
LEGEND:

A	Cap Screw (3 used)

Keeper Plate Cap Screws

[1] - Remove three cap screws (A) from keeper plate.

[2] -



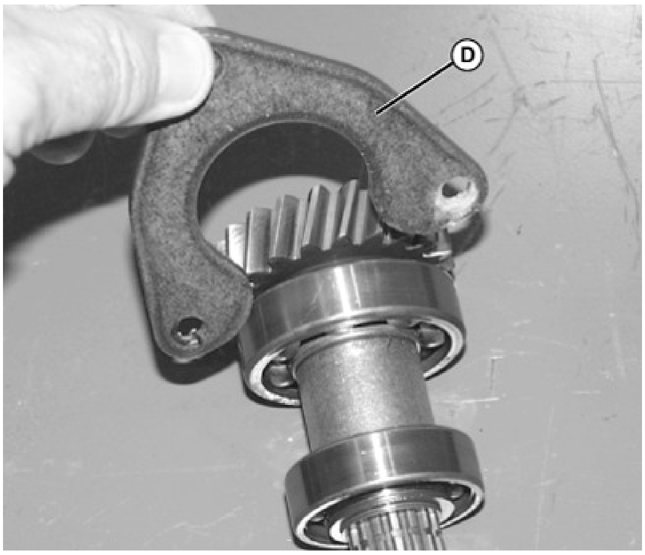
LEGEND:

B	Main Shaft Assembly
C	Center Plate

Main Shaft Assembly Removal

Remove main shaft assembly (B) from center plate (C).

[3] -



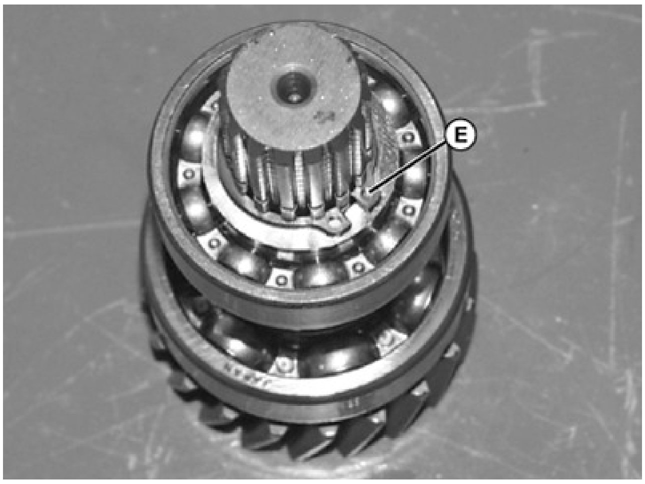
LEGEND:

D	Keeper Plate

Keeper Plate

Remove keeper plate (D).

[4] -



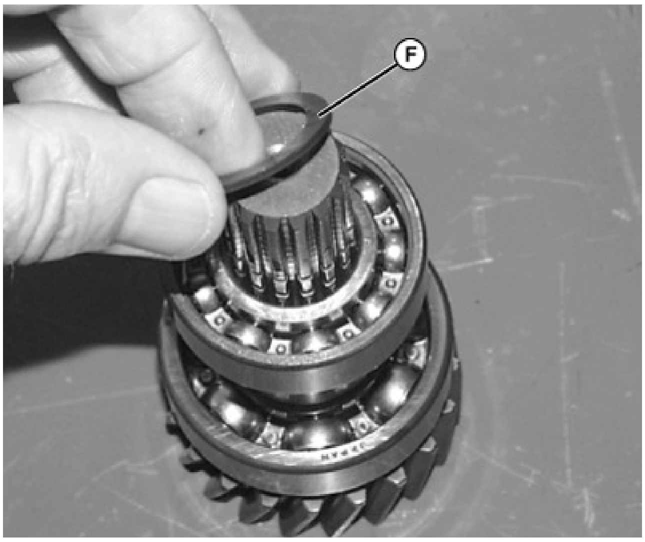
LEGEND:

E	Snap Ring

Main Gear Outer Snap Ring

Remove snap ring (E).

[5] -



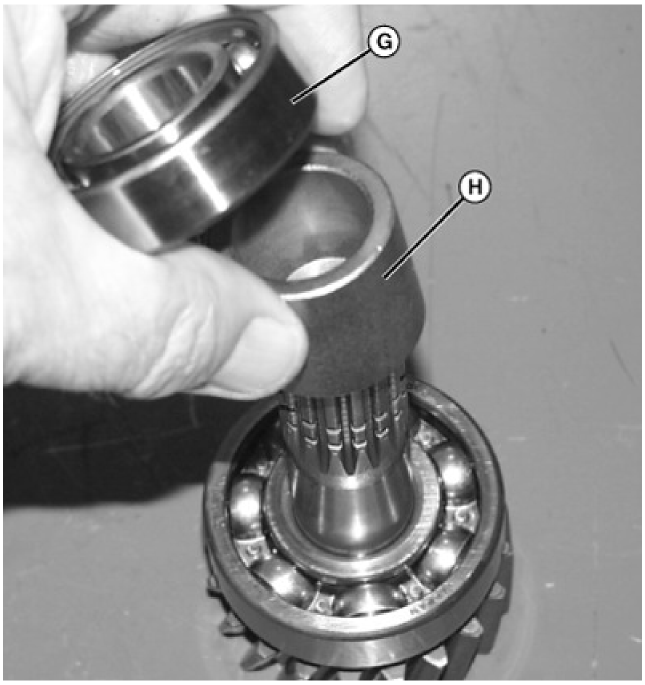
LEGEND:

F	Washer

Main Gear Washer

Remove washer (F).

[6] -



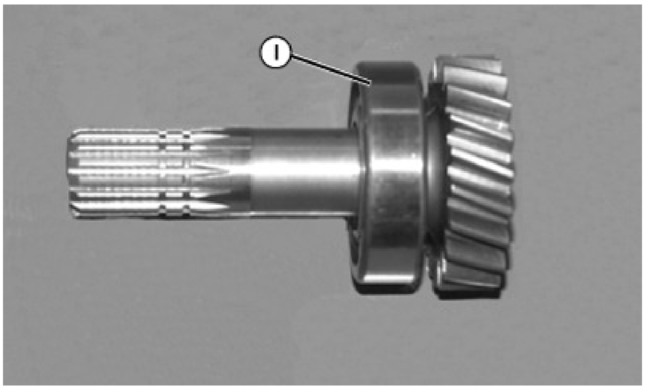
LEGEND:

G	Bearing
H	Spacer

Main Gear Outer Bearing

Remove bearing (G) using a bearing puller or a press. Remove spacer (H).

[7] -



LEGEND:

I	Bearing

Main Gear Inner Bearing

Remove bearing (I) using a knife edge puller and a press.

[8] - Clean all parts. Inspect bearings for discolored, burned balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[9] - Inspect spines and gear teeth on shaft assembly for wear or damage. Replace shaft as required.

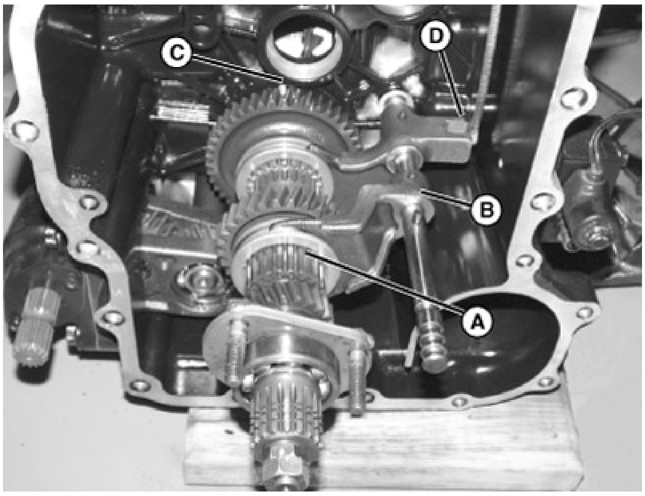
Assembly:

- Assemble main shaft in the reverse order of disassembly.
- Apply Loctite to keeper plate cap screws and tighten to specification.

Item	Measurement	Specification
Keeper Plate Cap Screw	Torque	28 N·m (21 lb.-ft.)

- Oil the bearings after installation.

Assemble Range Transmission—eHydro™



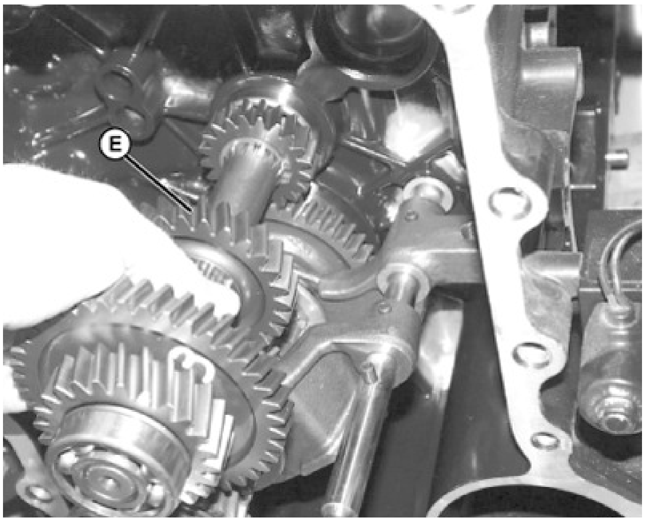
LEGEND:

A	Pinion Shaft
B	Shift Shaft
C	Gear Bearing Boss
D	Slot in Shift Fork

Pinion and Shift Shaft Assembly

[1] - Install new O-ring on shift shaft. Install pinion shaft (A) and shift shaft (B) assembly into transaxle case. Do not seat against transaxle case at this time. Leave a 14 mm (0.5 in.) gap between gear bearing boss and case (C). Align shift arm with slot in shift fork (D).

[2] -



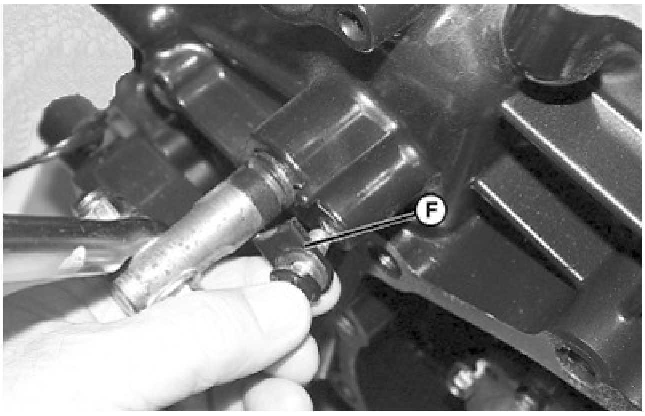
LEGEND:

E	Driven Shaft

Driven Shaft

Install driven shaft (E). Seat all shafts against transaxle case. Check that shift arm is engaged in shift fork.

[3] -



LEGEND:

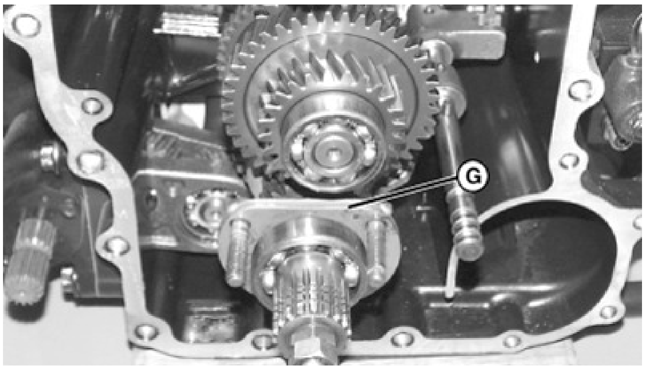
F	Keeper Plate

Keeper Plate

Install keeper plate (F) in shift shaft.

[4] - If not already done, clean all old gasket material from mating surfaces.

[5] -



LEGEND:

G Bearing Plate

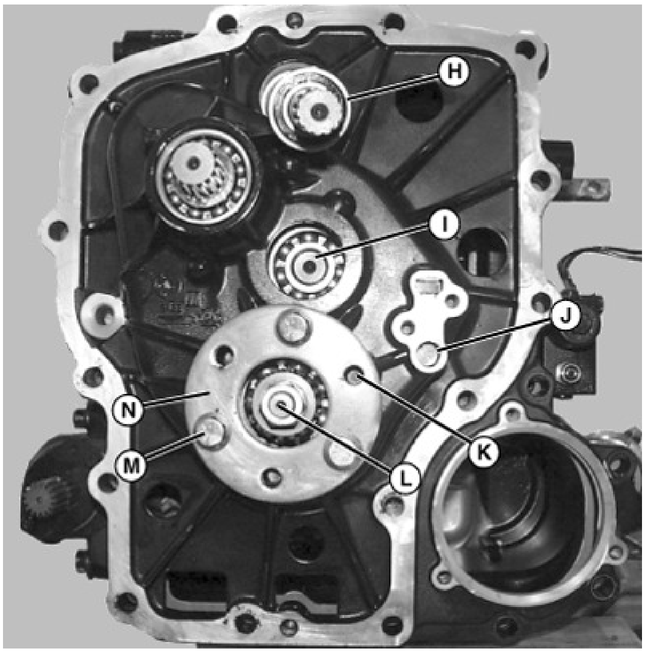
Bearing Plate

Position flat side of bearing plate (G) up.

[6] -

→NOTE:

All fasteners in the transaxle except the two eccentric locking nuts on the end of the pinion shaft are to have thread locking compound applied during assembly. The bearing plate fasteners may have to be removed again for pinion depth adjustment, so you may want to wait until pinion shimming is correct before applying thread locker fasteners.



LEGEND:

H PTO Shaft Front Bearing
I Driven Shaft
J Shift Shaft
K Rear Bearing Plate Studs
L Pinion Shaft
N Front Bearing Plate
M Cap Screws

Case End

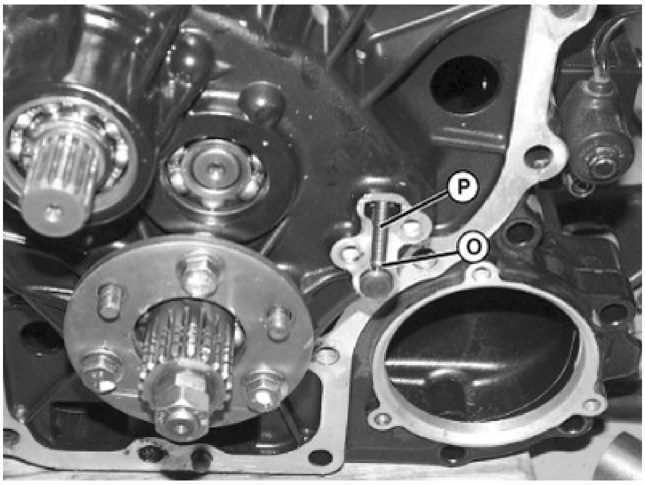
Install PTO shaft front bearing (H) through center plate. Install new gasket and begin installing center plate on alignment dowels.

[7] - Align driven shaft (I), shift shaft (J), the rear bearing plate studs (K), and the pinion shaft (L) with their respective holes in the center plate. Tap center plate into position with a soft hammer.

[8] - Install front bearing plate (N) and cap screws (M) and tighten to specification.

Item	Measurement	Specification
Front Bearing Cap Screw	Torque	56 N·m (41 lb.-ft.)

[9] -



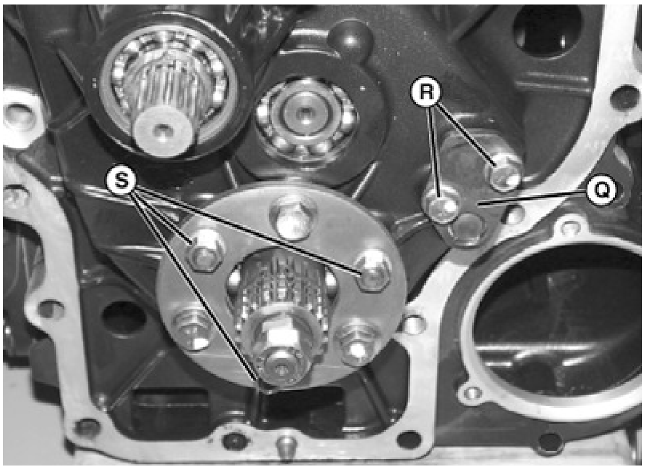
LEGEND:

O	Detent Ball
P	Spring

Detent Ball and Spring

Install detent ball (O) and spring (P).

[10] -



LEGEND:

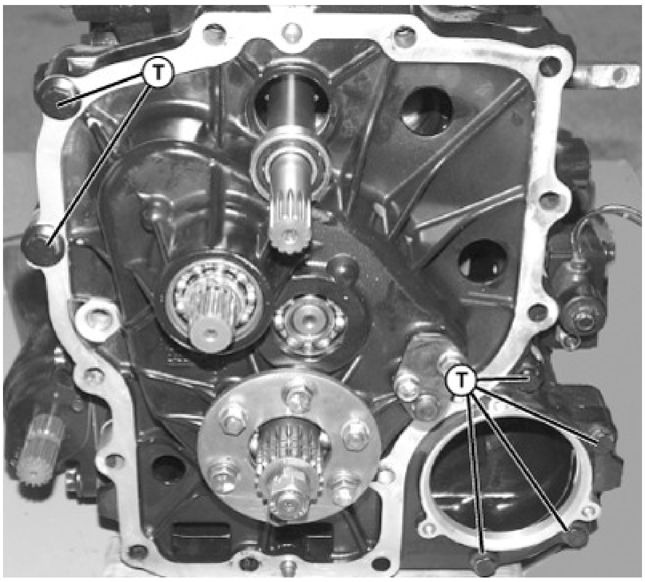
Q	Detent Cover
R	Cap Screws
S	Lock Washers and Nuts

Detent Cover and Lock

Install detent cover (Q) with cap screws (R). Install lock washers and nuts (S) on bearing plate studs and tighten bearing plate cap screws and nuts to specification.

Item	Measurement	Specification
Bearing Plate Cap Screw	Torque	56 N·m (41 lb.-ft.)

[11] -



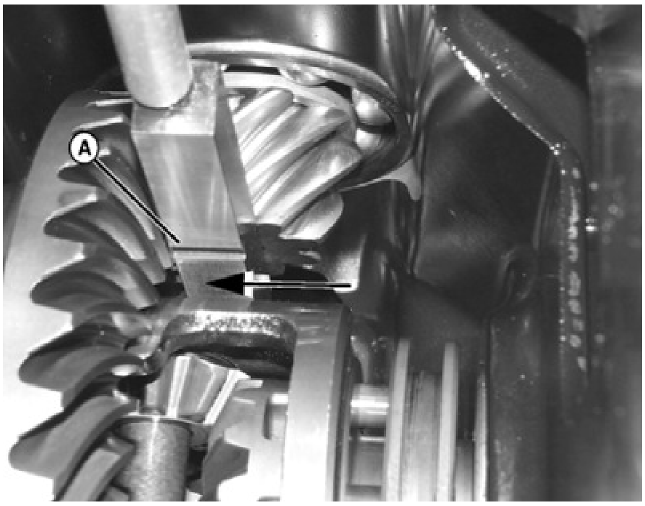
LEGEND:

T	Cap Screws

Center Plate Cap Screws

Install cap screws (T) in center plate and tighten to specification.

[12] -



LEGEND:

A 15.5 mm tool

Pinion Shaft Depth

Check pinion shaft depth with 15.5 mm tool (A). Make sure that tool is against ring gear. If tool is tight or “no go” side of tool fits between differential housing and pinion shaft, adjust pinion shaft depth. (See Differential Pinion Shaft Adjustment in Section 70, Group 35.)

When pinion shaft depth is correct, apply Loctite ™ to bearing plate cap screws and nuts. Tighten cap screws first, and then nuts, to specification.

Item	Measurement	Specification
Bearing Plate Cap Screw and Nut	Torque	56 N·m (41 lb.-ft.)

Final Drive Removal

Left-Hand Final Drive Removal:

→**NOTE:**

Be sure to adequately support final drives before removing cap screws securing final drive to transmission housing.

Make sure that opposite final drive is adequately supported, if applicable, before removing a final drive.

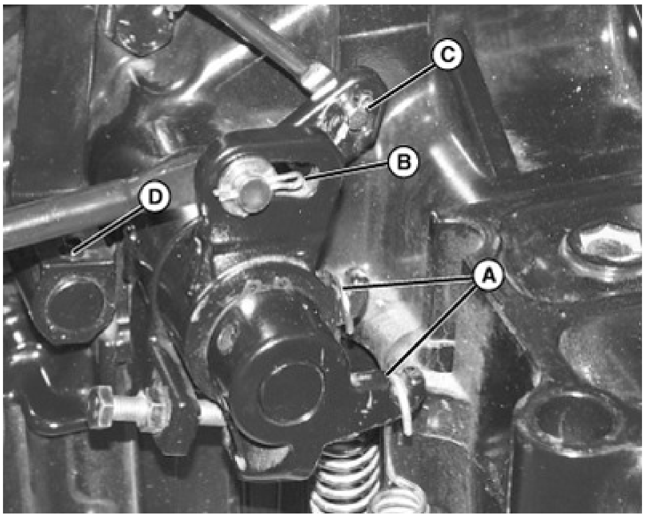
[1] - Remove rear wheels. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] - Drain oil from transaxle.

[3] - Disconnect lower three point lift link.

[4] - Disconnect differential lock pedal linkage.

[5] -



LEGEND:

A	Park Brake Springs
B	Cotter Pin and Washer
C	Cotter Pin
D	Roll Pin

Park Brake Linkage

Disconnect park brake springs (A).

[6] - Remove cotter pin and washer (B) and disconnect left brake rod.

[7] - Remove cotter pin (C) and disconnect park brake linkage.

[8] - Remove roll pin (D) and differential lock lever.

[9] - Remove brake shaft. (See Brake Shaft Removal and Installation in Section 100, Group 30.)

[10] -

→**NOTE:**

Mark the cap screws for reinstallation locations.

Remove cap screws securing final drive to transmission housing. Mark cap screws for reinstallation locations. Separate final drive from transmission housing.

Right-Hand Final Drive Removal:

→NOTE:

Be sure to adequately support final drives before removing cap screws securing final drive to transmission housing.

Make sure that opposite final drive is adequately supported, if applicable, before removing a final drive.

→NOTE:

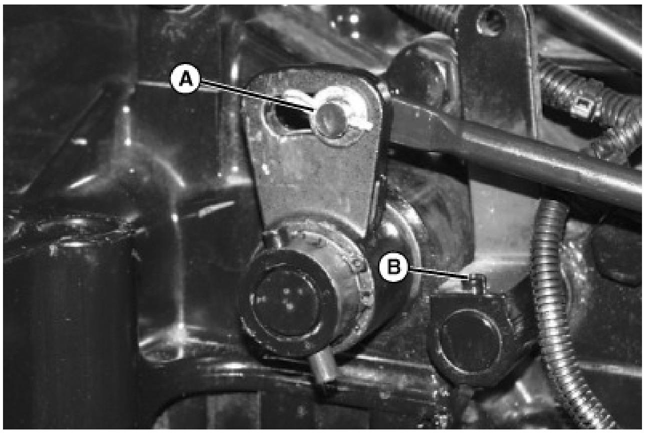
Right-hand final drive is removed the same as the left-hand final drive.

[1] - Remove rear wheels. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] - Drain oil from transaxle.

[3] - Disconnect lower three point lift link.

[4] -



LEGEND:

A	Brake Link Rod
B	Roll Pin

Brake Link Rod

Remove cotter pin and washer from brake link rod (A). Disconnect brake link rod from brake arm.

[5] - Remove roll pin (B) and differential lock lever.

[6] - Remove brake shaft. (See Brake Shaft Removal and Installation in Section 100, Group 30.)

[7] -

→NOTE:

Mark cap screws for reinstallation locations.

Remove cap screws securing final drive to transmission housing. Mark cap screws for reinstallation locations. Separate final drive from transmission housing.

Final Drive Installation

Left-Hand Final Drive Installation:

→NOTE:

Be sure to adequately support final drive while installing.

Installation is reverse of removal.

Tighten final drive cap screws to specification.

Item	Measurement	Specification
Final Drive Cap Screw	Torque	145 N·m (106 lb.-ft.)

Right-Hand Final Drive Installation:

→NOTE:

Be sure to adequately support final drive while installing.

Installation is reverse of removal.

Tighten final drive cap screws to specification.

Item	Measurement	Specification
Final Drive Cap Screw Torque	Torque	145 N·m (106 lb.-ft.)

Final Drive Disassembly, Inspection, and Assembly

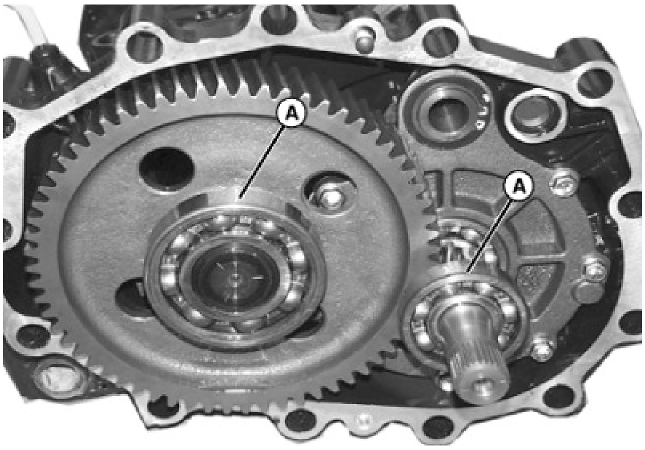
→NOTE:

Left-hand final drive is shown in the following story. Right-hand drive disassembly, inspection, and assembly is basically the same.

Disassemble:

[1] - Remove final drive from the machine. (See Final Drive Removal in Section 70, Group 40.)

[2] -



LEGEND:

A	Bearings

Final Drive Housing

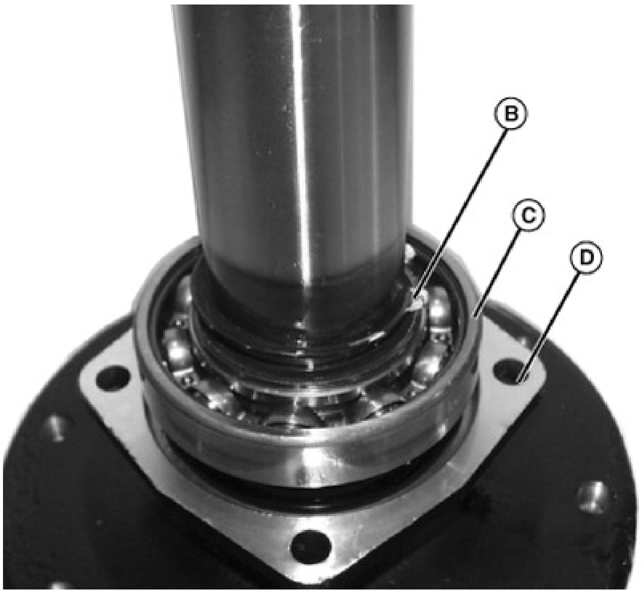
Remove bearings (A).

[3] - Remove final drive gear and spacer.

[4] - Remove four cap screws from oil seal housing at the end of the final drive.

[5] - Drive axle shaft out from final drive housing.

[6] -



LEGEND:

B	Snap Ring and Washer
C	Bearing
D	Oil Seal Housing

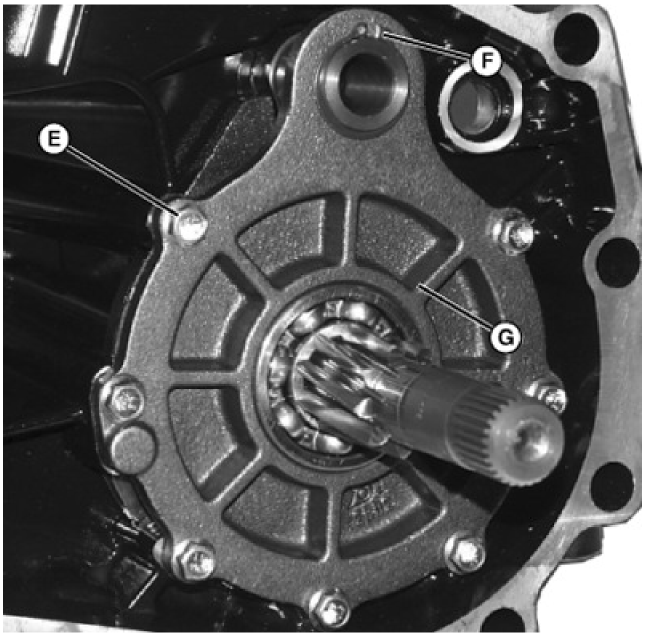
Axle Shaft

Remove snap ring (B) and washer.

[7] - Remove bearing (C) and oil seal housing (D).

[8] - Replace oil seal in oil seal housing.

[9] -



LEGEND:

E	Cap Screw (7 used)
F	Snap Ring
G	Brake Assembly

Brake Assembly

Remove seven caps screws (E).

[10] - Remove snap ring (F). Remove brake assembly (G).

[11] -

LEGEND:

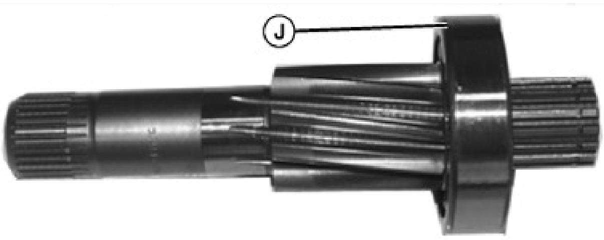
H	Snap Ring
I	Pinion Shaft

Friction Discs and Plates

Remove snap ring (H), friction disks and plates.

[12] - Drive out pinion shaft (I) from brake assembly cover.

[13] -



LEGEND:

J	Bearing

Pinion Shaft

Remove bearing (J) from pinion shaft.

[14] -

> ***IMPORTANT:***
>
> ***Avoid Damage! DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.***

Clean all bearings in a suitable solvent. Dry with compressed air.

[15] - Inspect all bearings for discolored, burned, balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

[16] - Inspect rear axle splines for damage. Inspect bearing areas of axle. If worn or damaged, replace axle.

[17] - Inspect bearing areas in rear axle housing. Bearings should be a snug fit. If bearings are loose in housing, replace rear axle housing.

[18] - Inspect pinion shaft splines for damage. Inspect bearing areas of pinion shaft. If worn or damaged, replace pinion shaft.

Assembly:

Assembly of the final drive is the reverse of disassembly.

- Install a new axle oil seal in oil seal housing whenever the axle has been removed.
- Place oil seal housing on axle and press outboard bearing on axle. Install axle in final drive housing.
- Tighten oil seal housing to final drive housing to specification.
- Assembly and install brake assembly. (See Brake Assemble in Section 100, Group 30.)
- Tighten final drive housing to transmission housing to specification.

Item	Measurement	Specification
Oil Seal Housing-to-Final Drive Housing	Torque	28 N·m (21 lb.-ft.)
Brake Assembly-to-Final Drive Housing	Torque	28 N·m (21 lb.-ft.)
Final Drive Housing-to-Transmission Housing	Torque	145 N·m (107 lb.-ft.)

Differential Lock Fork

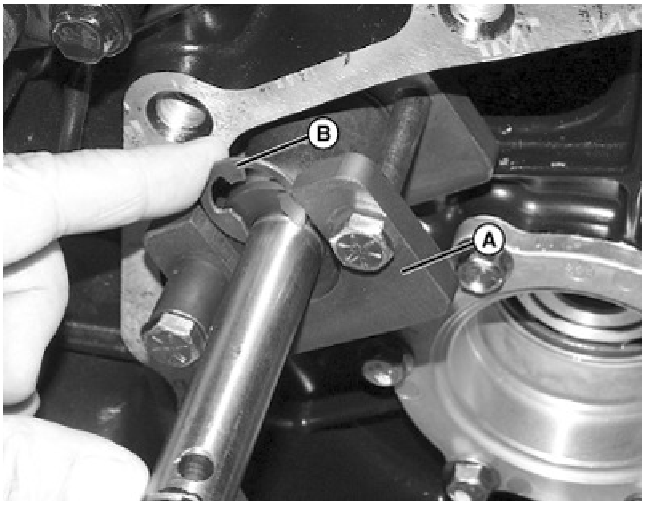
Removal:

[1] - Remove rockshaft assembly.

[2] - Remove left final drive. (See Final Drive Removal in Section 70, Group 40.)

[3] - Remove right side differential lock lever or spacer from differential shaft.

[4] -



LEGEND:

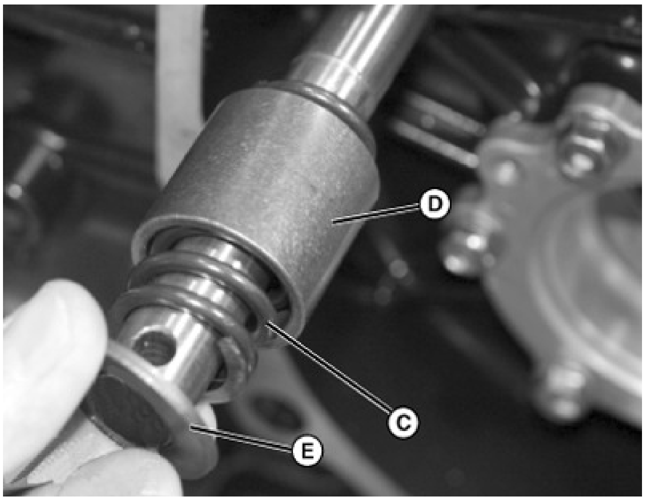
A	Tool
B	E-ring

Differential Lock E Ring

Install tool (A). Compress spring tension and remove E-ring (B).

[5] - Remove tool.

[6] -



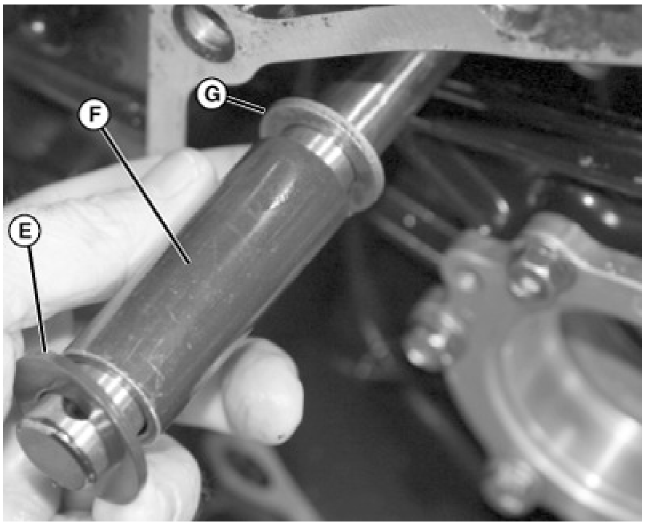
LEGEND:

E	Large Washer
C	Spring
D	Spacer

Differential Shaft Lock Spacer

Remove large washer (E), spring (C) , and spacer (D).

[7] -



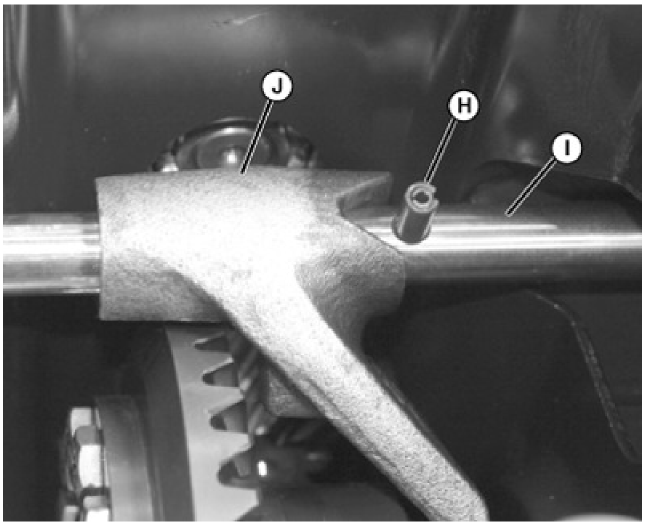
LEGEND:

E	Inside Large Washer
F	Spacer
G	Small Washer

Inside Large Washer

Remove inside large washer (E), spacer (F), and small washer (G).

[8] -



LEGEND:

H	Inner and Outer Roll Pins
I	Differential Lock Shaft
J	Differential Lock Fork

Differential Lock Shaft Roll Pins

Drive inner and outer roll pins (H) out of differential lock shaft (I).

[9] - Pull shaft out of differential lock fork (J) and remove fork.

Installation:

Installation of differential lock fork is the reverse of removal.

Differential Removal and Installation

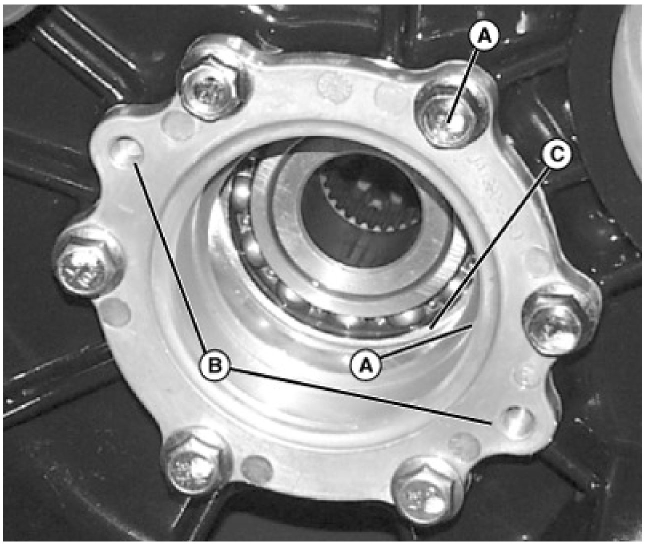
Removal:

[1] - Remove PTO shaft, and clutch and brake assembly. (See PTO Clutch and Brake in Section 70, Group 50.)

[2] - Remove differential lock fork. (See Differential Lock Fork in Section 70, Group 35.)

[3] - If not already off, remove right final drive assembly.

[4] -



LEGEND:

A	Cap Screw (6 used)
B	Threaded Holes
C	Shim

Differential Bearing Carrier

Remove six cap screws (A) securing differential bearing carrier to transmission housing.

[5] - Place two of the cap screws in threaded holes (B) and alternately turn one half to one turn at a time to pull bearing carrier out of case.

[6] - Note location of shim (C) located between differential carrier and differential bearing.

[7] - Remove differential through top of transaxle case.

Disassembly:

LEGEND:

D	Differential Lock Collar

Differential Lock Collar

[1] - Remove bearings from differential.

[2] - Remove differential lock collar (D).

[3] -

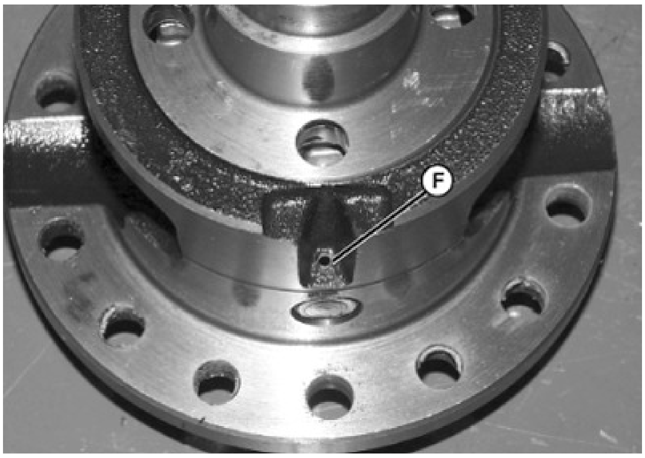
LEGEND:

E	Cap Screw (14 used)

Ring Gear

Remove fourteen cap screws (E) securing ring gear to differential. Remove ring gear.

[4] -



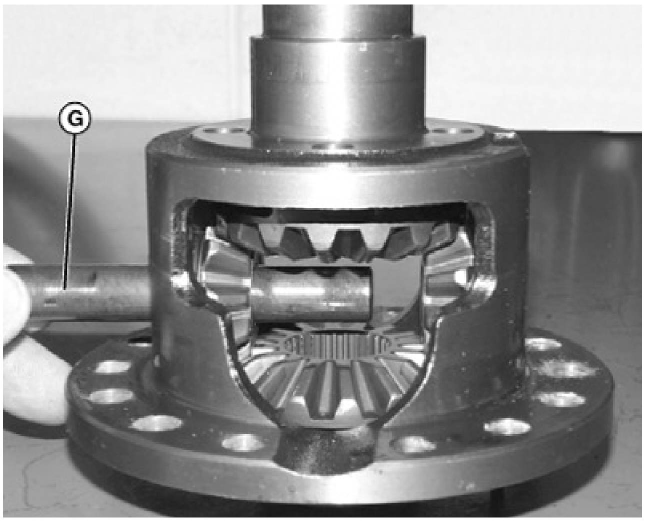
LEGEND:

F	Retaining Spring Pin

Retaining Spring Pin

Drive retaining spring pin (F) into differential housing until it clears pinion shaft.

[5] -



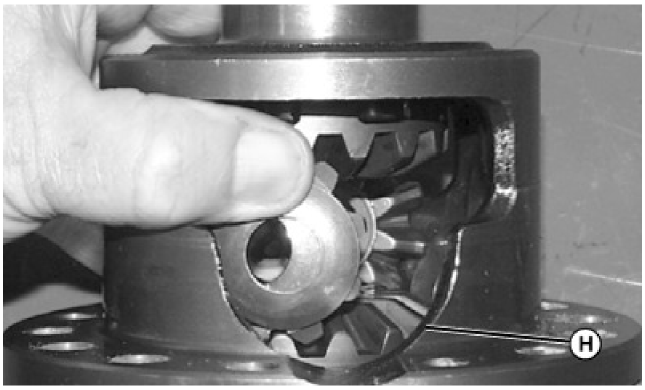
LEGEND:

G	Pinion Shaft

Pinion Shaft

Remove pinion shaft (G).

[6] -



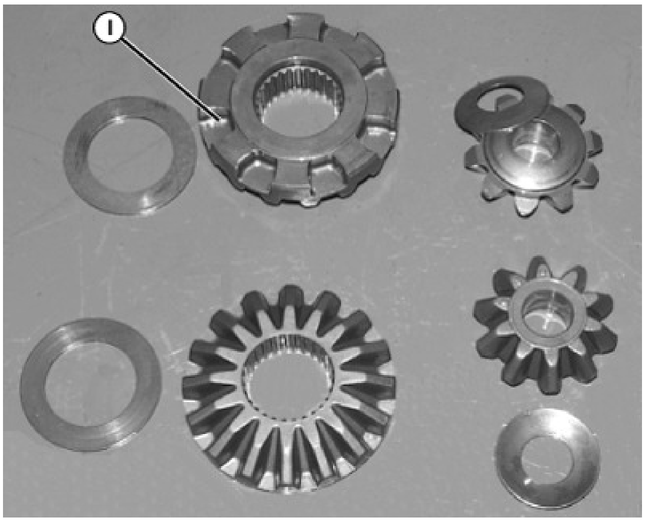
LEGEND:

H Differential Case Opening

Differential Gears

Rotate gears to open spot in differential case (H) and remove all gears and thrust washers from case.

[7] -



LEGEND:

I Differential Lock Notches

Gear Wear

Inspect all gear teeth for wear and damage. Check back side of gears at thrust washer contact area for wear or damage. Check differential lock notches (I) for wear, damage, or rounded off corners. Check thrust washers for wear or damage. Replace any worn or damaged parts.

[8] -

IMPORTANT:

Avoid Damage! DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

Clean bearings in a suitable solvent. Dry with compressed air.

[9] - Inspect bearings for discolored, burned, balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

Assembly:

Assembly of the differential is the reverse of disassembly.

- Clean old Loctite from ring gear threads and differential housing holes.
- Apply grease to thrust washers to hold them in place while assembling.
- Install gears in differential housing. Make sure that differential lock gear is on correct side of housing.
- Apply Loctite to ring gear cap screws when installing.
- Tighten ring gear cap screws to specification in a Chris-cross pattern.

Item	Measurement	Specification
Ring Gear Cap Screw	Torque	78 N·m (58 lb.-ft.)

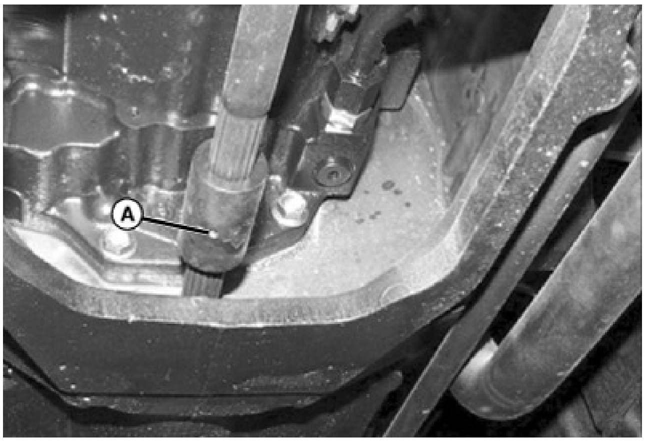
- Install differential into transaxle housing.

- Adjust backlash of differential. (See Differential Backlash Adjustment in Section 70, Group 35.)
- After obtaining correct backlash tighten differential carrier cap screws to specification.

Item	Measurement	Specification
Differential Carrier Cap Screw	Torque	28 N·m (21 lb.-ft.)

MFWD Drive Shaft Removal and Installation

[1] -



LEGEND:

A Spring Pin

Spring Pin

Remove spring pin (A) from drive shaft splined connector on each end of driveshaft.

[2] - Support drive shaft and slide splined connectors toward center of drive shaft, removing drive shaft from machine.

[3] - Installation is the reverse of removal.

[4] - Install new spring pins in connectors.

MFWD Removal and Installation

Removal:

[1] - Remove differential drive shaft.

[2] -

→NOTE:

Steering cylinder fittings will squirt oil if the wheels are turned unless the hydraulic fittings are capped.

Label and remove power steering hoses from front axle steering cylinder. Cap steering cylinder hydraulic fittings.

[3] -

→NOTE:

Machine splitting stands may be used for additional support.

Raise the front of the machine and remove front tires. Support frame to allow MFWD removal.

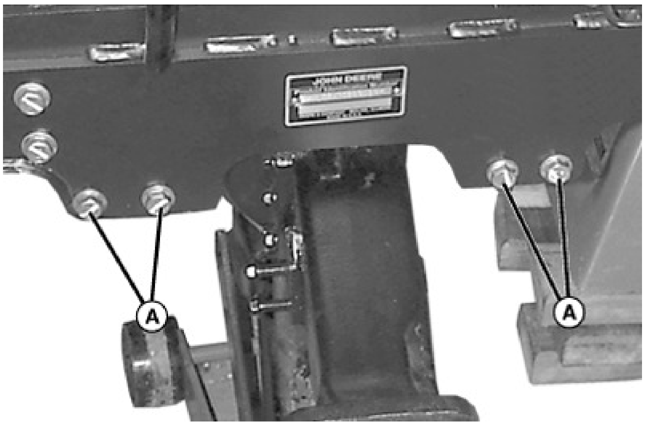
[4] -

CAUTION:

Avoid Injury! Properly support the MFWD axle assembly to prevent rotation on wheel bearings during removal.

Support the front axle with a floor jack.

[5] -



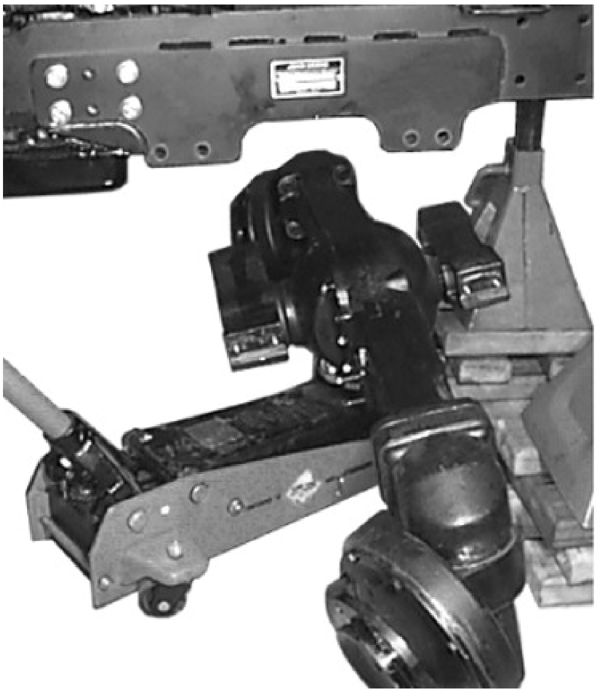
LEGEND:

A	Trunnion Mounting Cap Screws

Trunnion Mounting Cap Screws

Remove axle front trunnion mounting cap screws (A) on both sides of machine.

[6] -



Axle Removal

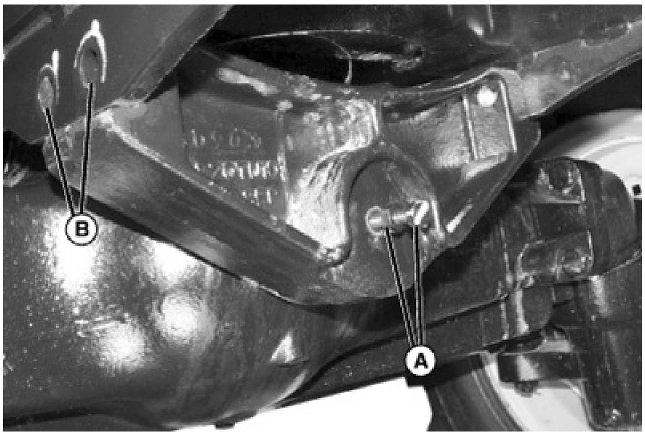
Lower floor jack and remove axle from machine.

[7] - Inspect axle pin bushings in trunnions and replace if necessary.

Installation:

[1] - Install new V-ring seals on axle pins.

[2] -



LEGEND:

A	Bolt and Jam Nut
B	Frame Holes

Axle Trunnion

Install trunnions on axle.

a. Place disk inside front trunnion. It may be necessary to stick disk in place with grease.
b. Loosen jam nut and bolt(A).
c. Raise axle with floor jack and align holes in trunnions with holes in frame (B).
d. Install and tighten eight trunnion mounting bolt.
e. Tighten bolt (A) to specification.

Item	Measurement	Specification
Bolt	Torque	30 N·m (22 lb.-ft.)

→NOTE:

(stop to stop) equals full side to side.

f. Oscillate axle stop to stop 3 times.

g. Re-tighten bolt (A) to specification.

Item	Measurement	Specification
Bolt	Torque	30 N·m (22 lb.-ft.)

h. Hold bolt (A) and tighten jam nut to specification.

Item	Measurement	Specification
Jam Nut	Torque	70 N·m (51 lb.-ft.)

[3] - Connect steering cylinder hydraulic lines.

[4] - Install differential drive shaft.

MFWD Final Drive Cover

Removal and Inspection:

[1] - Drain differential and final drive housing being worked on.

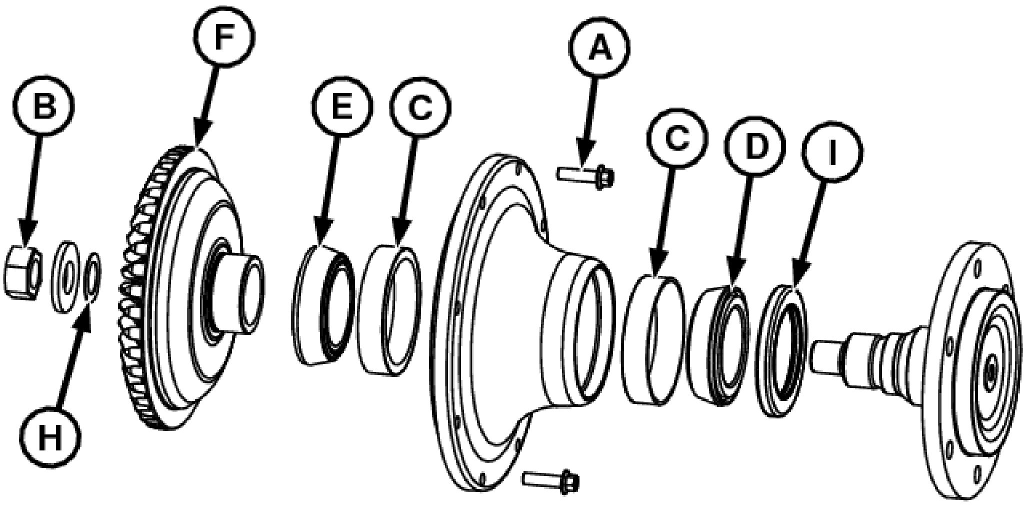
[2] - Raise and support final drive being serviced.

[3] - Remove wheel and tire from final drive.

[4] -

→NOTE:

Shims (H) may not be present.



MFWD Final Drive

LEGEND:

A	Cap Screw (8 used)
B	Retaining Nut
C	Bearing Cups
D	Hub Bearing Cone
E	Second Inside Bearing Cone
F	Bevel Gear
H	Shims (May not be present)
I	Hub Seal

Remove eight cap screws (A). Separate final drive cover and hub shaft from final drive housing.

[5] -

→NOTE:

The final drive cover is sealed to the final drive housing. If necessary, pry the cover from the housing using the two reliefs on the sides of the cover.

Secure wheel end-of-hub shaft and remove retaining nut (B).

[6] -

IMPORTANT:

Avoid Damage! The retaining nut (B) on the hub shaft is a special "torque prevailing" nut. ALWAYS replace this nut—DO NOT reuse.

NEVER tighten a torque prevailing nut with an impact wrench. ALWAYS use a torque wrench to tighten torque prevailing nuts.

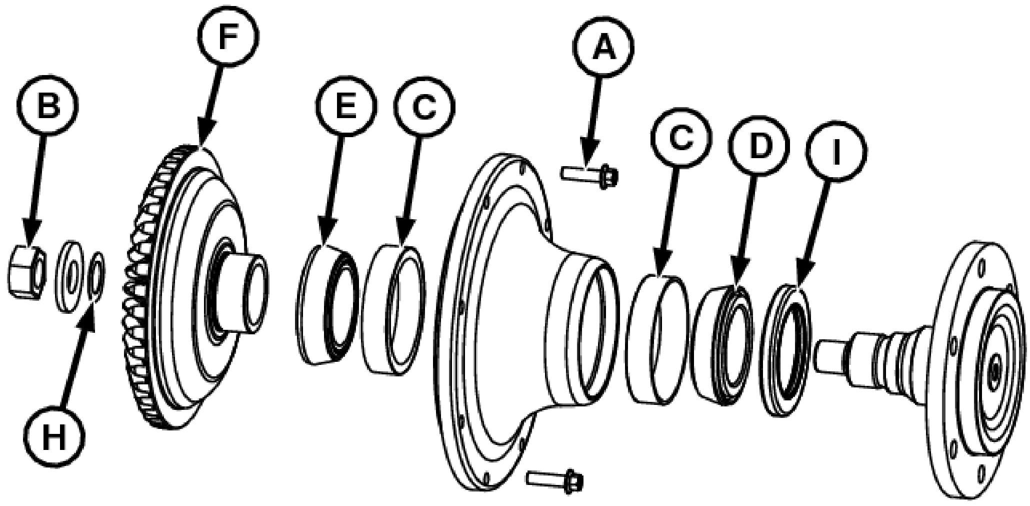
Press hub shaft from final drive cover, bearings, and bevel gear.

[7] - Disassemble remaining components from final drive cover assembly.

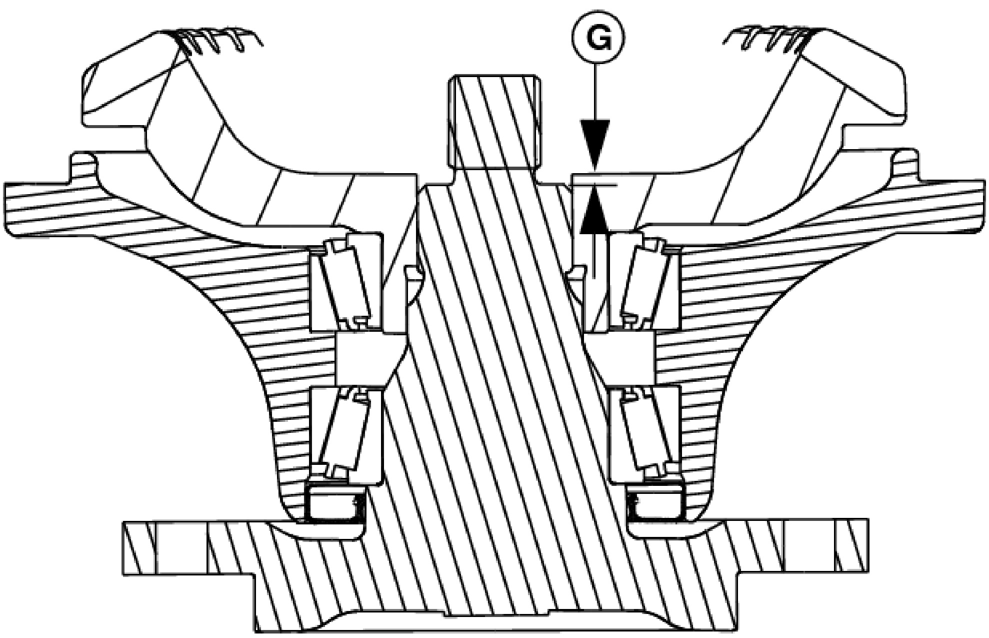
[8] - Clean and inspect all parts. Replace any unserviceable components.

Installation:

[1] -



MFWD Final Drive



Bearing Adjustment Dimension

LEGEND:

A	Cap Screw (8 used)
B	Retaining Nut
C	Bearing Cups
D	Hub Bearing Cone
E	Second Inside Bearing Cone
F	Bevel Gear
G	Bearing Seat Dimension
H	Shims (May not be present)

I Hub Seal

Install bearings cups (C) in final drive cover.

[2] - Install hub bearing cone (D) to outer bearing cup.

[3] - Coat outer surface of a new hub seal with PM38655 Form-in-Place Gasket. Install new hub seal (I).

Number	Name	Use
• PM38655 (us)	Loctite ™ Flexible Form-in-Place Gasket	Coat new hub outer surface.

[4] - Install hub shaft in bearing cone, cups, and final drive cover.

[5] - Install second (inside) bearing cone (E) and bevel gear (F).

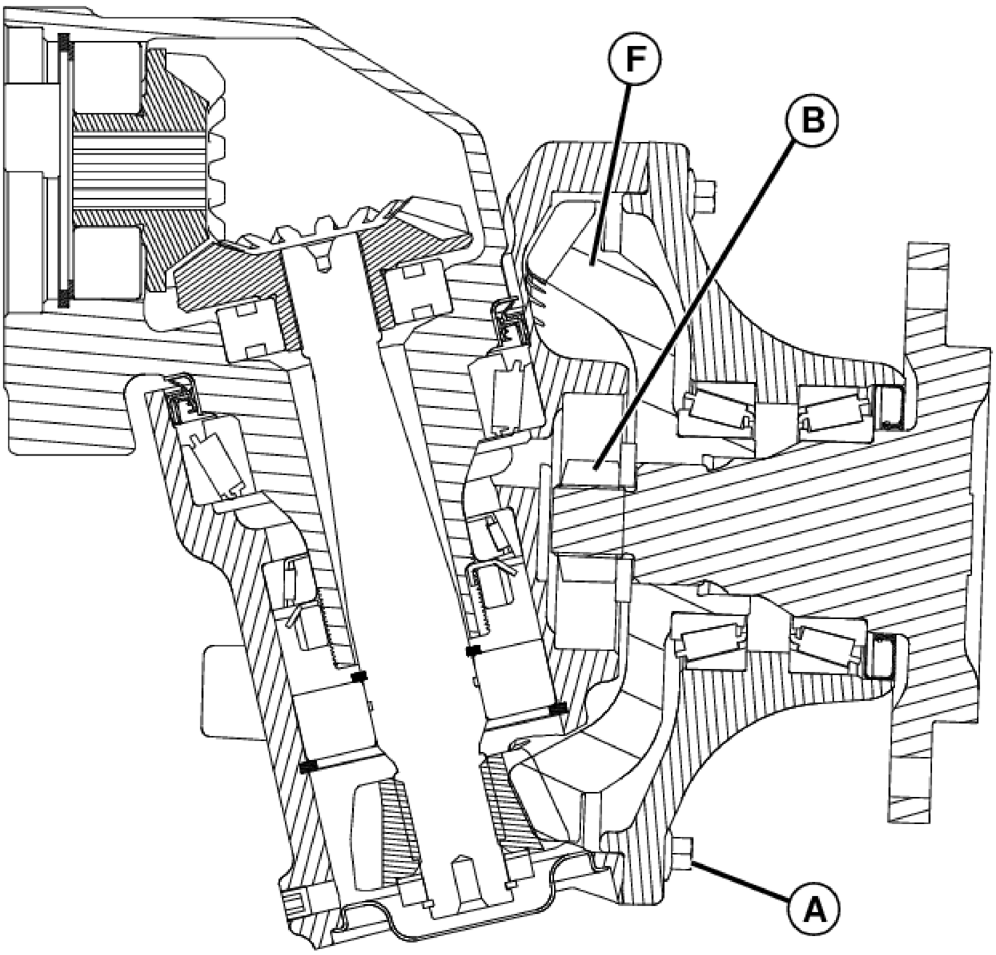
[6] - To adjust bearings:

a. Apply **1200 lbs** axial load on the web of bevel gear 41T, while rolling and oscillating the bearings to insure proper seating of the bearing.
b. With the load applied, measure dimension (G) between the gear face and the end of the non-threaded portion of hub shaft.

→NOTE:
The shim [AM127817] is available in 0.66 mm (0.026 in.) thickness.

Select the same thickness shims as the measured dimension, and install shims (H) to shaft.

→NOTE:
For initial assembly and measurements, assemble final drive with the USED torque prevailing nut. Do not use a NEW torque prevailing nut until final assembly.



Housing Cross Section

LEGEND:

A	Cap Screws
B	Torque Prevailing Nut
F	Bevel Gear

Assemble the washer and USED torque prevailing nut (B) to hub shaft. Tighten the nut to specification.

Item	Measurement	Specification
USED Torque Prevailing Nut	Torque	447—488 N·m (330—360 lb.-ft.)

e. If the rolling torque is not correct, repeat the previous steps. If the rolling torque is correct:

f. Remove the USED torque prevailing nut. Apply John Deere PM38654 High Strength Thread Lock to the threads, and assemble the washer and a NEW torque prevailing nut (B) to hub shaft. Tighten nut to specification.

Item	Measurement	Specification
NEW Torque Prevailing Nut	Torque	447—448 N·m (330—360 lb.-ft.)

Number	Name	Use
◦ PM38654 (us)	Loctite ™ High Strength Thread Lock and Sealant	Apply to torque prevailing nut.

[7] - Apply PM38655 Form-in-Place Gasket to mating surface of final drive cover. Install final drive cover to final drive housing. Tighten cap screws (A) to specification.

Number	Name	Use
• PM38655 (us)	Loctite ™ Flexible Form-in-Place Gasket	Seals the mating surface of final drive cover.

Item	Measurement	Specification
Final Drive Cover Cap Screw	Torque	30—38 N·m (22—28 lb.-ft.)

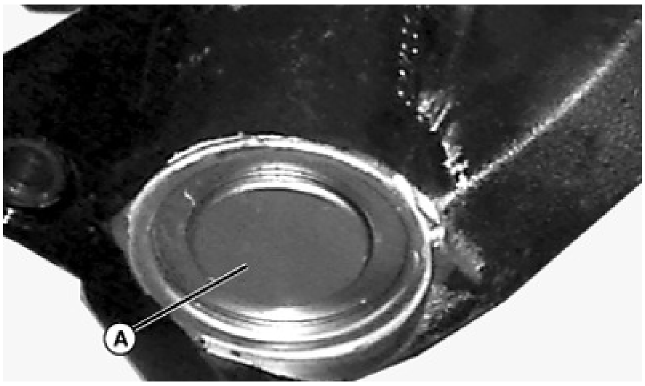
[8] - Fill MFWD with oil.

Number	Name	Use
• J20C (us)	Oil	MFWD Oil

Item	Measurement	Specification
MFWD Oil	Capacity	5.5L (1.45 gal.) J20C

MFWD Spindle Shaft

Removal and Disassembly:

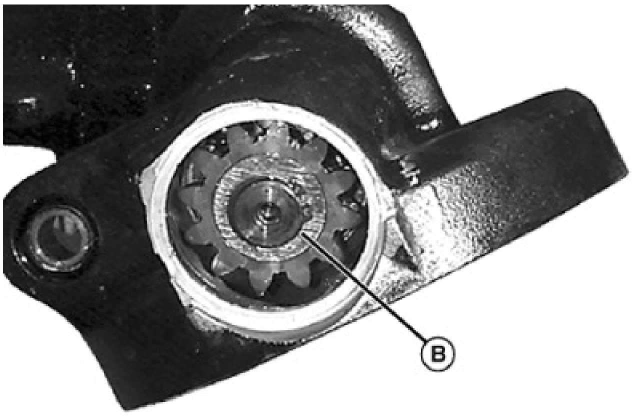


LEGEND:
A Spindle Cap

Spindle Cap

[1] - Carefully remove spindle cap (A) from housing.

[2] -

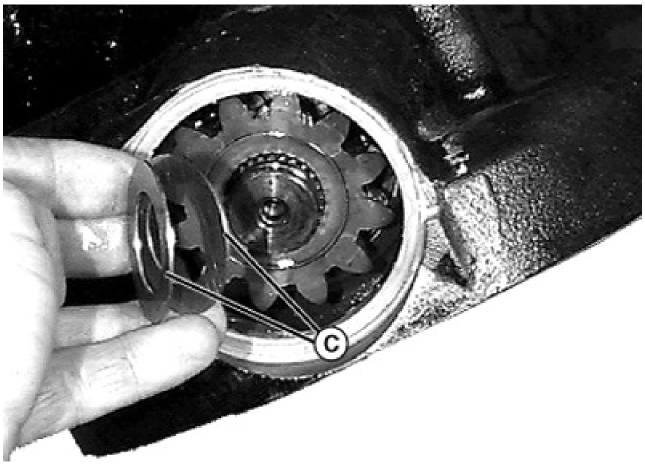


LEGEND:
B Snap Ring

Spindle Shaft Snap Ring

Remove snap ring (B) from spindle shaft.

[3] -

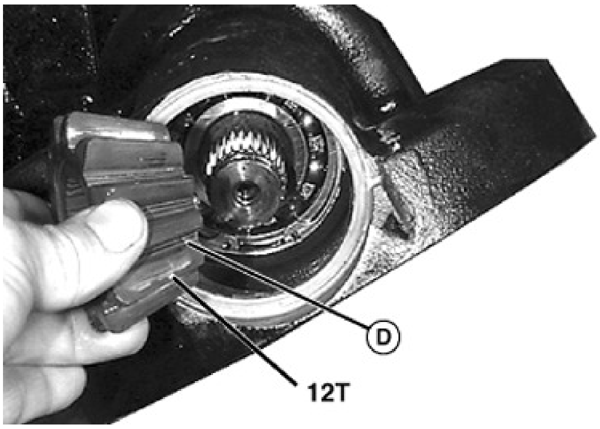


LEGEND:
C Washer and Shims

Spindle Shaft Washer and Shim

Remove washer and shims (C) from spindle shaft. Save any shims from between washer and bevel gear.

[4] -



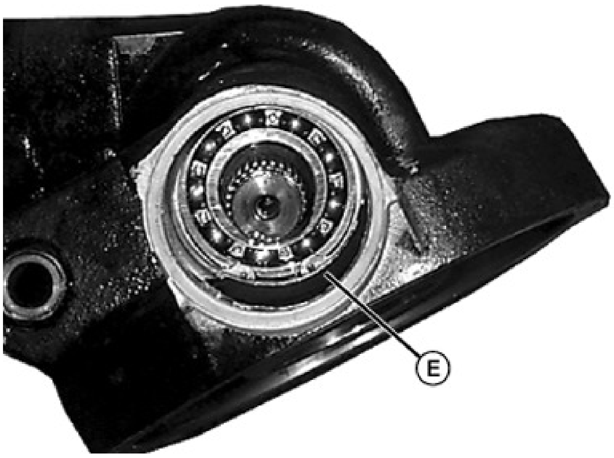
LEGEND:

D Bevel Gear

Spindle Shaft Bevel Gear

Remove bevel gear (D) from spindle shaft.

[5] -



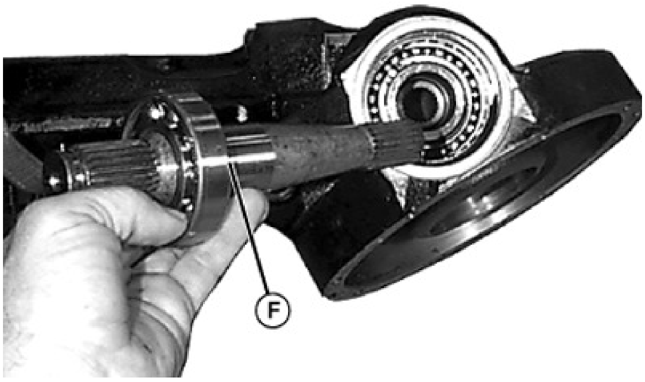
LEGEND:

E Snap Ring

Spindle Housing Snap Ring

Remove snap ring (E) from spindle housing.

[6] -



LEGEND:

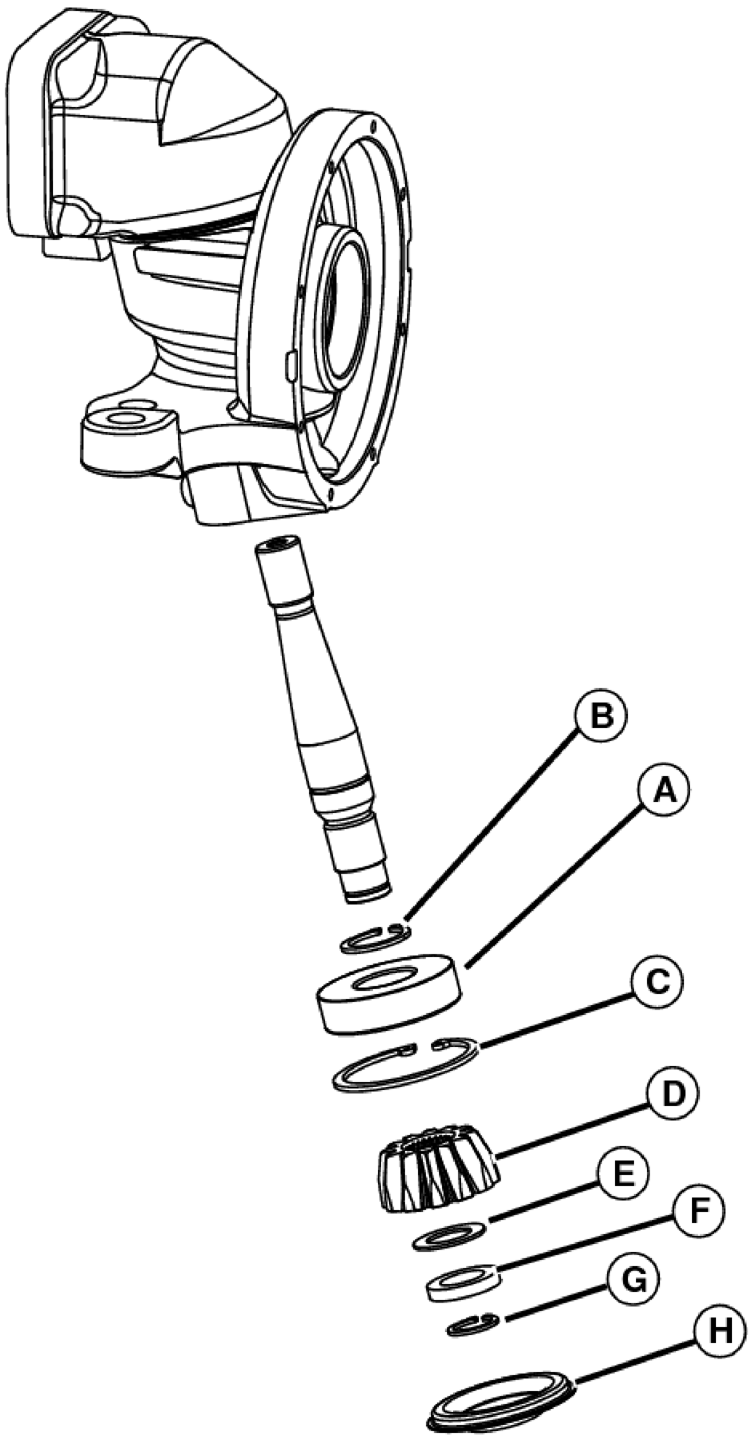
F Spindle Shaft

Spindle Shaft and Bearing

Remove spindle shaft (F) and bearing from spindle housing.

[7] - Remove snap ring and bearing from spindle shaft. Inspect all parts, and replace any unserviceable components.

Assembly and Installation:



Spindle Shaft Exploded View

LEGEND:

A	Bearing
B	Snap Ring
C	Internal Snap Ring
D	12T Bevel Gear
E	Shims
F	Washer
G	Snap Ring
H	Final Drive Housing Cap

[1] - Install bearing (A) and snap ring (B) on spindle shaft.

[2] - Install spindle shaft assembly in final drive housing.

[3] - Install internal snap ring (C) in final drive housing.

[4] - Install bevel gear 12T (D), any shims (E), washer (F), and snap ring (G) on spindle shaft.

[5] - Install final drive cover to final drive housing, if removed.

[6] - To set the backlash of the lower final drive, shim the bevel gear to achieve end play specification.

Item	Measurement	Specification
Lower Final Drive	End Play	0.64—0.76 mm (0.025—0.030 in.)

[7] - The end play sets backlash specification.

Item	Measurement	Specification
Lower Final Drive	Backlash	0.13—0.18 mm (0.005—0.007 in.)

[8] - Apply John Deere PM38652 retaining compound to final drive housing cap (H) and install.

Number	Name	Use
• PM38652 (us)	Retaining Compound	Apply to drive housing cap.

MFWD Final Drive Housing

Tools Required:

- KML 10008 Ring Nut Socket

  Ring Nut Socket

  KML 10008

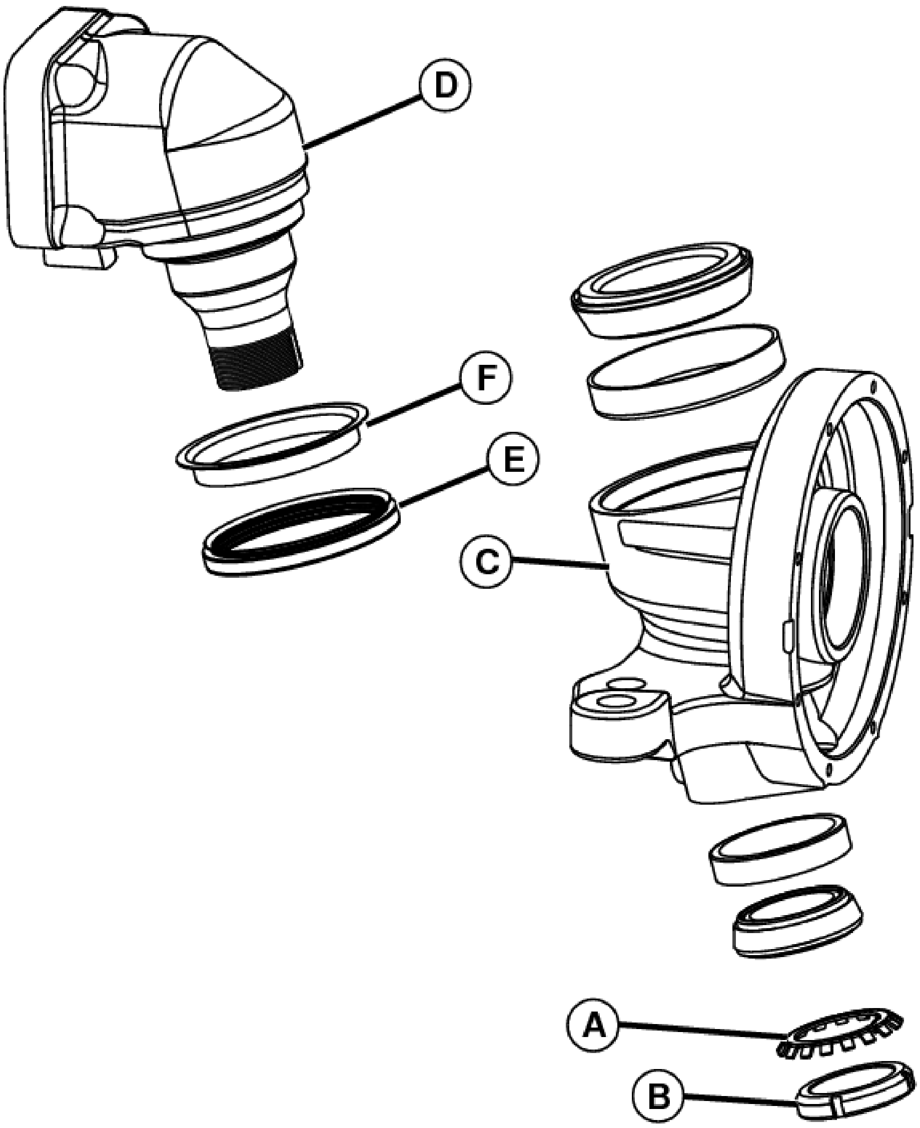
  Remove retaining spanner nut from final drive housing

Disassembly:

[1] - Remove final drive cover. (See MFWD Final Drive Cover in Section 70, Group 40.)

[2] - Remove final drive spindle shaft. (See MFWD Spindle Shaft in Section 70, Group 40.)

[3] -



Final Drive Housing Exploded View

LEGEND:

A	Locking Washer Tabs
B	Retaining Nut
C	Final Drive Housing
D	Spindle Housing
E	Seal
F	Seal Sleeve

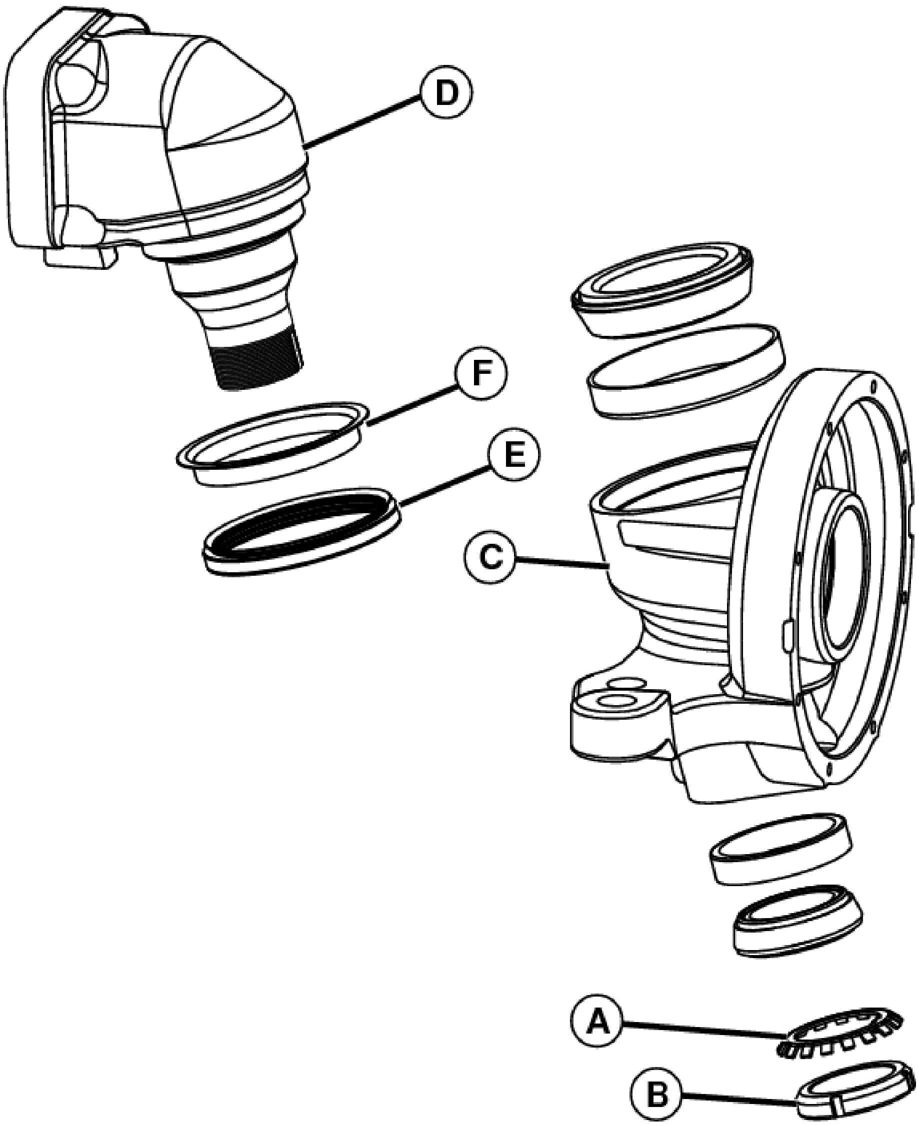
Straighten tabs on locking washer (A) that secure retaining nut (B) in place. Remove retaining nut from final drive housing.

[4] - Remove final drive housing (C) from spindle housing (D), and put final drive housing in a vise.

[5] - Remove bearing cups and bearing cones from final drive housing. Clean and inspect all components. Replace any unserviceable components.

[6] - Remove seal (E) and seal sleeve (F) from spindle housing.

Assembly:



Spindle and Final Drive Housing Exploded View

LEGEND:

A	Locking Washer
B	Bearing Retaining Spanner Nut
C	Bearing Cups and Cones
D	Spindle Housing
E	Final Drive Housing Seal
F	Seal Sleeve

[1] - Clean seal sleeve (F), replace if worn or scratched.

[2] - Replace final drive housing seal (E).

[3] - Install bearing cups and cones in final drive housing (C).

[4] - Install spindle housing to final drive housing.

[5] - Install locking washer (A) to spindle housing (D).

[6] - Install a new bearing retaining spanner nut (B) on final drive housing. To correctly install nut:

a. Tighten the spanner nut to specification. Oscillate the final drive housing on the spindle housing several times to seat the bearing.

Item	Measurement	Specification
Spanner Nut	Torque	40.7 N·m ± 2.7 N·m
		(30 lb.-ft. ± 2 lb.-ft.)

b. Shock the wheel end by hitting end stops with a soft mallet.

c. Retighten the nut to specification.

d. Bend a locking washer tab into slot in nut.

[7] - Install spindle shaft. (See MFWD Spindle Shaft in Section 70, Group 40.)

[8] - Install final drive cover. (See MFWD Final Drive Cover in Section 70, Group 40.)

Spindle Housing

Removal and Disassembly:

[1] - Remove final drive. (See MFWD Final Drive Cover in Section 70, Group 40.)

[2] - Remove four cap screws fastening spindle housing to MFWD housing.

[3] - Remove the internal snap ring from spindle housing. Remove shims.

[4] - Remove bearing and axle gear 21T assembly from spindle housing.

[5] - Remove bearing and spindle gear 15T assembly from spindle housing.

[6] -

→NOTE:

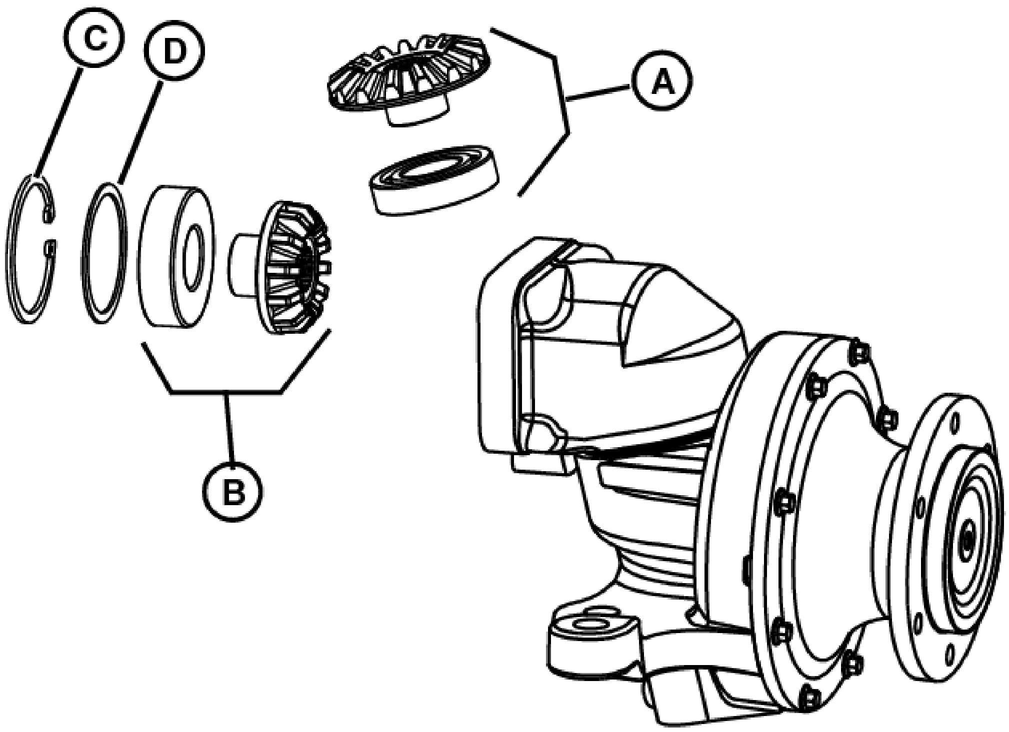
The bearings are pressed onto the gears, and the assemblies are slip fit into the housing.

If necessary, press gears from bearings.

[7] - Clean and inspect all parts. Replace any unserviceable parts.

Assembly and Installation:

[1] -



Spindle Housing

LEGEND:

A	15T Bearing and Spindle Gear Assembly
B	12T Bearing and Axle Gear
C	Internal Snap Ring
D	Shim

Install bearing and spindle gear 15T assembly (A) to spindle housing.

[2] -

→NOTE:

Do not install shim (D) until backlash measurements are taken.

Install bearing and axle gear 12T assembly (B) to spindle housing.

[3] - Install internal snap ring (C) to spindle housing.

[4] - Set backlash of the axle gear. To set backlash:

1. Measure distance between the bearing and the snap ring at several locations.
2. Shim bearing and (axle) gear to end play specification, to achieve proper backlash specification.

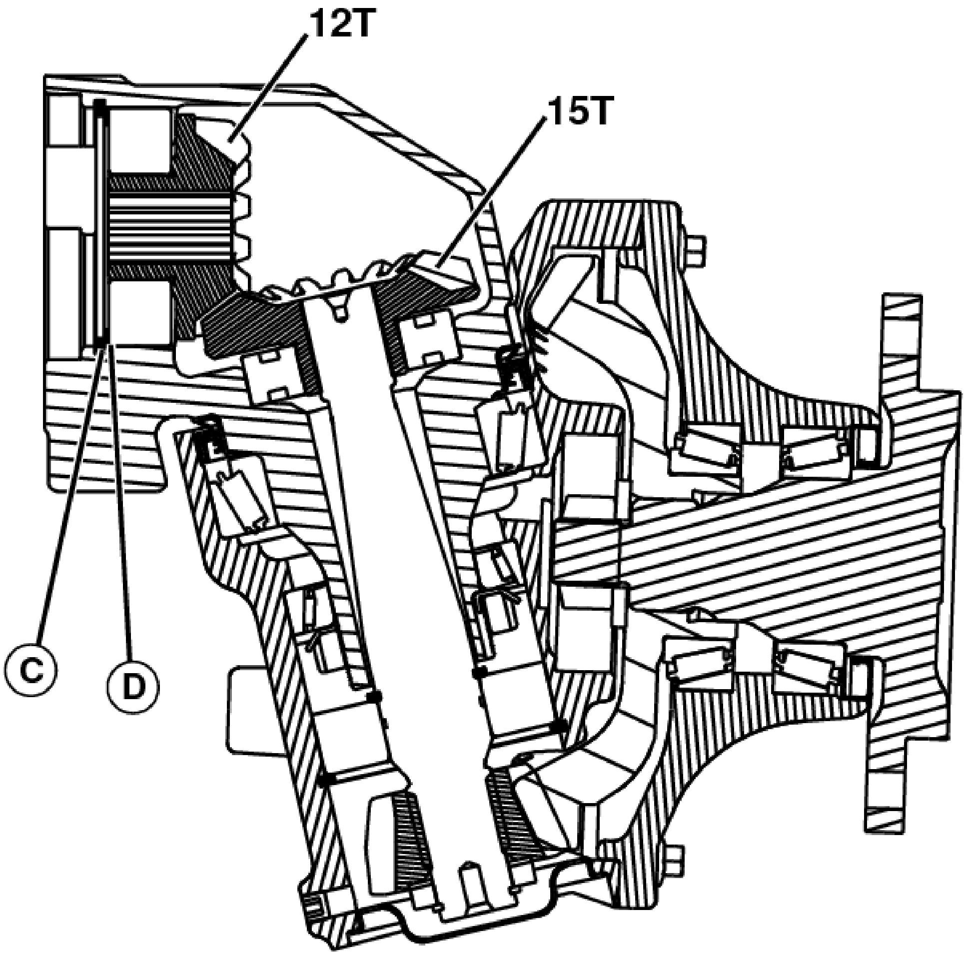
Item	Measurement	Specification
Spindle Gear	End Play	0.15—0.28 mm (0.006—0.011 in.)

Item	Measurement	Specification
Spindle Gear	Backlash	0.10—0.20 mm (0.004—0.008 in.)

[5] - Remove internal snap ring (C). Install shims as needed to set backlash.

[6] - Install internal snap ring (C).

[7] -



Spindle Housing Cross Section

LEGEND:

12T	12T Bearing and Axle Gear
15T	15T Bearing and Spindle Gear Assembly
C	Internal Snap Ring
D	Shim

Apply John Deere PM38655 sealant to mating surfaces of the MFWD housing and spindle housing.

Number	Name	Use
• PM38655 (us)	Loctite ™ Flexible Form-in-Place Gasket	Applied to MFWD housing and spindle housing.

[8] -

→NOTE:

Washers used to fasten spindle housing to axle are special hardened washers.

Install spindle housing to the MFWD housing:

1. Apply PM38654 High Strength Thread Lock to the threads and install cap screws fastening the spindle housing to the MFWD housing.

Number	Name	Use
◦ PM38654 (us)	Loctite ™ High Strength Thread Lock and Sealant	Apply to spindle housing cap screw threads.

2. Tighten the cap screws to specification.

Item	Measurement	Specification
Spindle Housing Cap Screw	Torque	286—316 N·m (211—233 lb.-ft.)

[9] - Install final drive housing. (See MFWD Final Drive Cover in Section 70, Group 40.)

MFWD Differential

Center Section Removal and Disassembly

[1] - Remove the MFWD axle. (See MFWD Removal and Installation .

[2] - Remove spindle housings. (See Spindle Housing .

[3] -

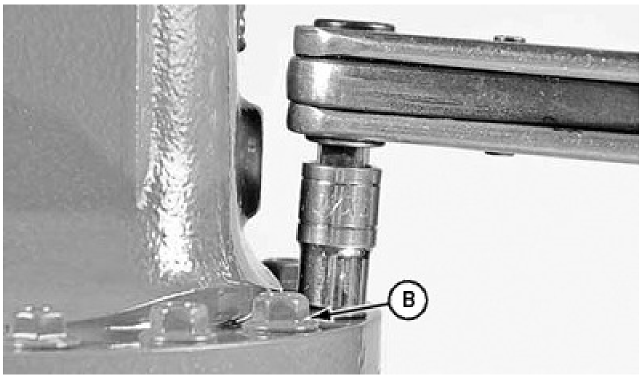
LEGEND:

A	Axle Shafts

Axle Shafts

Remove axle shafts (A).

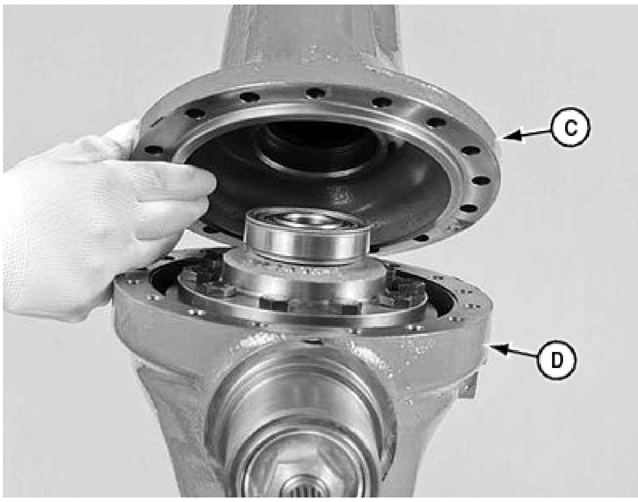
[4] -



LEGEND:

B	Cap Screw
C	Right-Hand Trumpet Arm
D	Left-Hand Trumpet Arm

Left-Hand Trumpet Arm

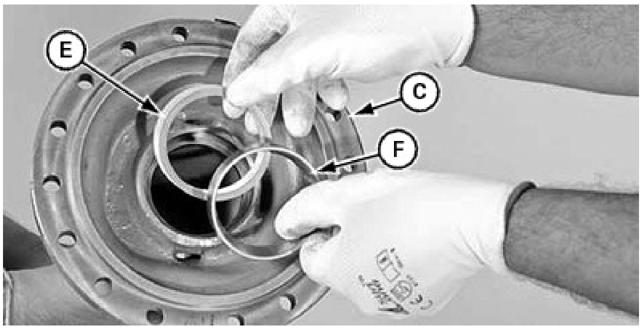


Right-Hand Trumpet Arm

Keep the left-hand trumpet arm (D) properly supported. Remove capscrews (B) from left-hand trumpet arm.

[5] - Remove the right-hand trumpet arm (C) from the center section.

[6] -



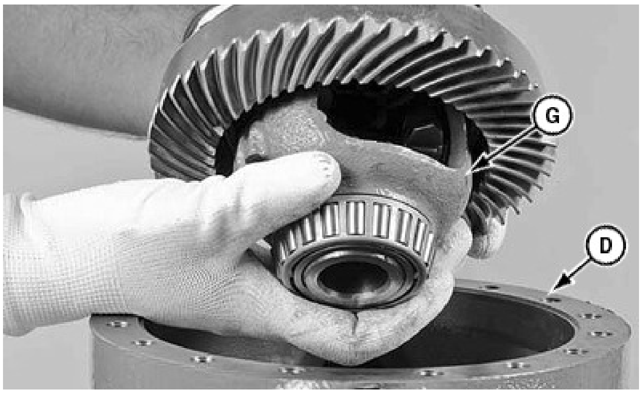
LEGEND:

C	Right-Hand Trumpet Arm
E	Shim
F	Bearing Cup

Shim and Bearing Cup

Remove the shim (E) and bearing cup (F) from the right-hand trumpet arm (C).

[7] -



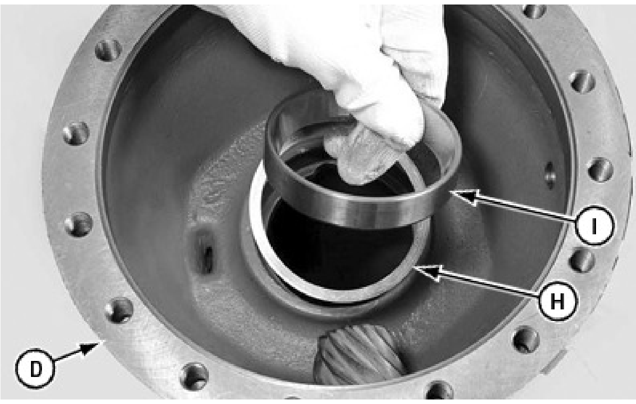
LEGEND:

D	Left-Hand Trumpet Arm
G	Differential Assembly

differential assembly

Remove the differential assembly (G) from left-hand trumpet arm (D).

[8] -



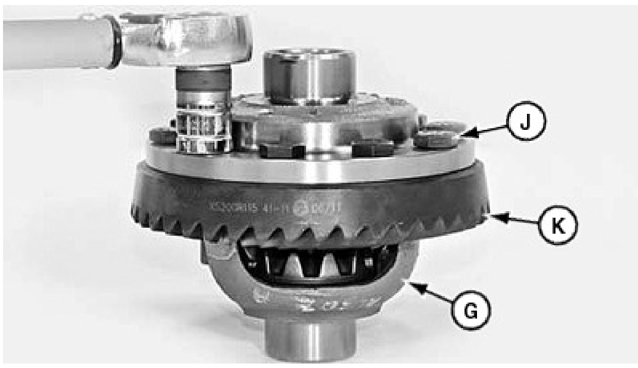
LEGEND:

D	Left-Hand Trumpet Arm
H	Shim
I	Bearing Cup

Shim

Remove the shim (H) and bearing cup (I) from the left-hand trumpet arm (D).

[9] -



LEGEND:

G	Differential Assembly
J	Cap Screws
K	Ring Gear

Ring Gear

Press both bearings off differential assembly if necessary. Remove ring gear cap screws (J) and ring gear (K) from differential assembly (G).

[10] -

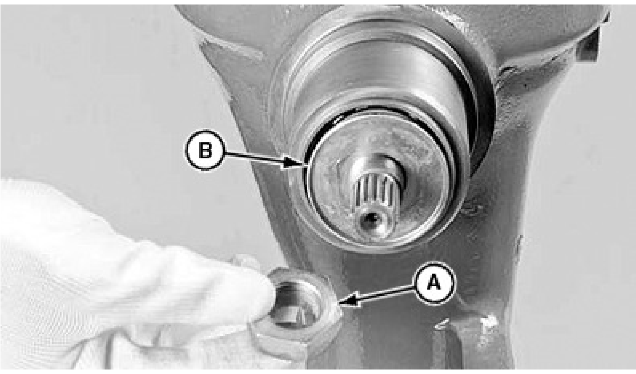
> **→NOTE:**
>
> **The differential case and internal parts come as an assembly. If any damage is apparent, there is no need to disassemble the case, as the whole assembly must be replaced.**

Clean and inspect all parts, replacing any damaged components.

Pinion Disassembly

[1] -

Loosen Pinion Nut



Remove The Pinion Nut

LEGEND:

A	Pinion Nut
B	Slinger

Loosen pinion nut (A).

[2] - Remove the pinion nut (A) and slinger (B). DO NOT discard pinion nut.

[3] -

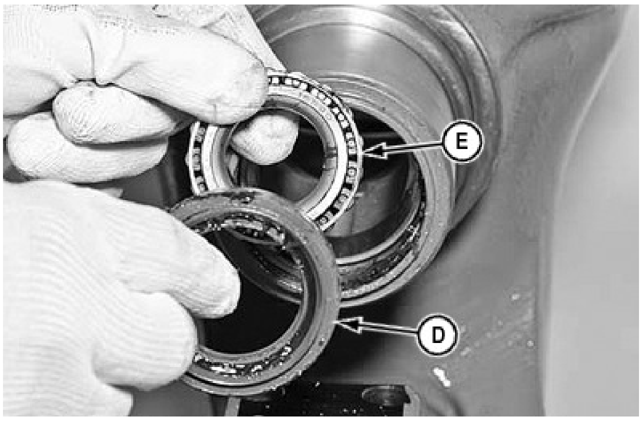
Remove Spacer

LEGEND:

C	Spacer

Remove spacer (C).

[4] -



LEGEND:

D	Oil Seal
E	Bearing Cone

Oil Seal

Remove oil seal (D) and bearing cone (E).

[5] -

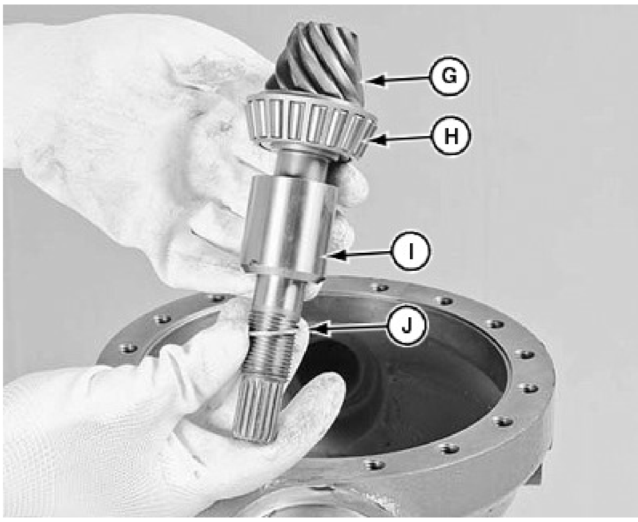
LEGEND:

F	O-Ring

O-Ring

Remove O-ring (F).

[6] -



LEGEND:

G	Pinion
H	Bearing Cone
I	Pinion Bearing Spacer
J	Shim

Pinion

Remove pinion (G), bearing cone (H), pinion bearing spacer (I), and shim (J) from housing.

→NOTE:

The ring gear and pinion gear are a matched set and are serviced as an assembly. If either the ring gear or pinion has wear or damage, both must be replaced.

[7] -

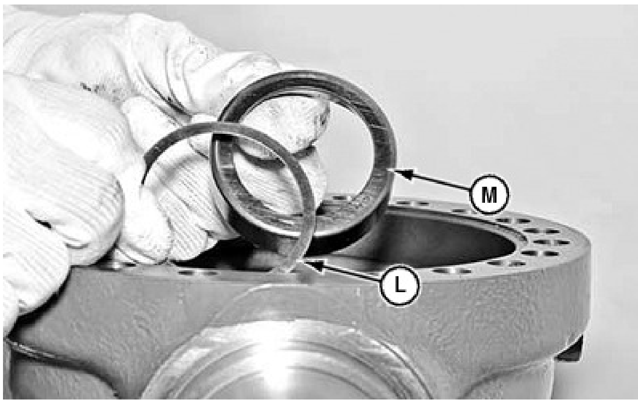
LEGEND:

K	Bearing Cups

Bearing Cups

Remove both bearing cups (K), being careful not to damage housing surface.

[8] -



LEGEND:

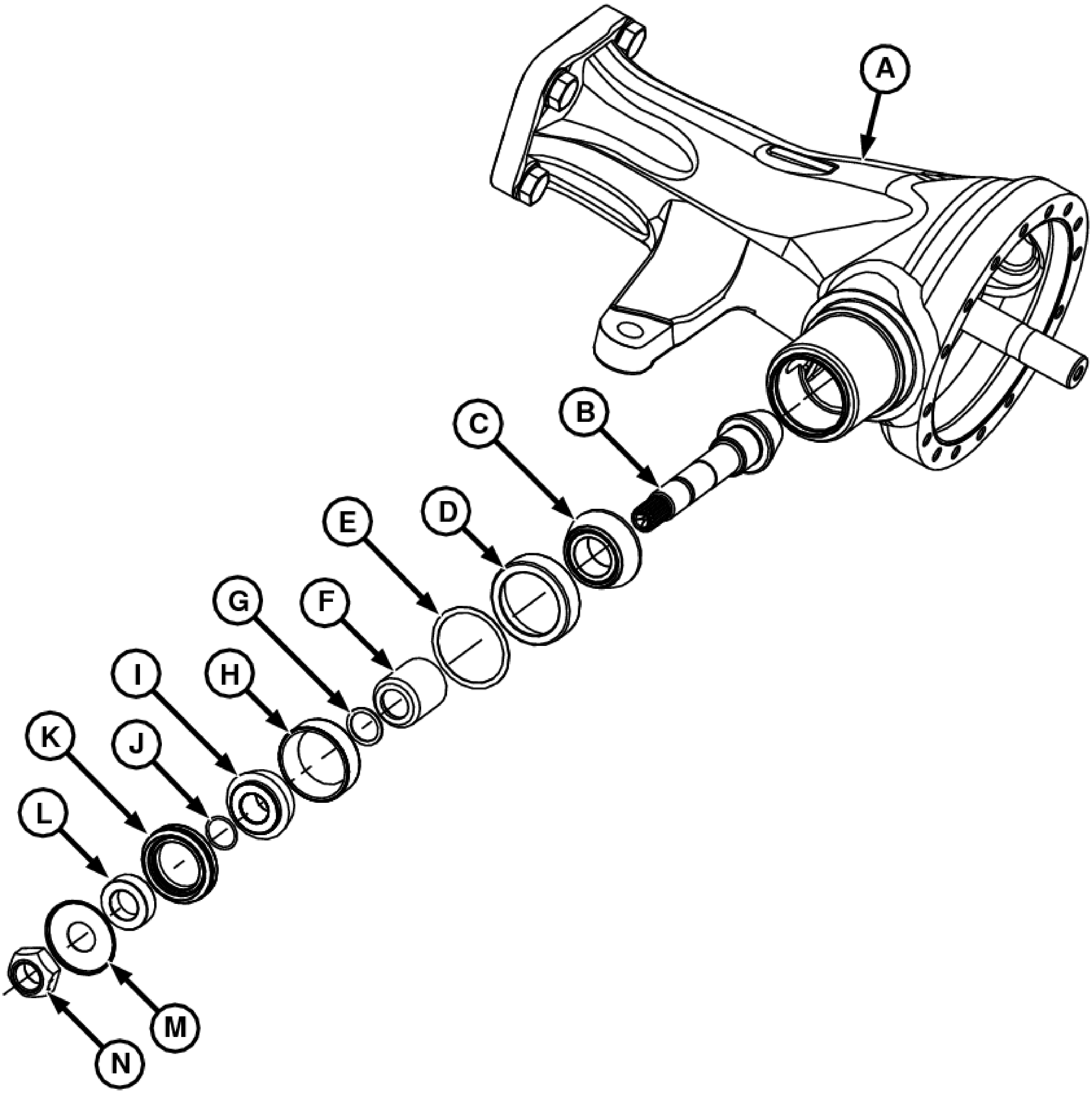
L	Shim
M	Inner Bearing Cup

Inner Bearing Cup

Remove shim (L) with inner bearing cup (M).

Center Section Assembly & Installation

[1] -



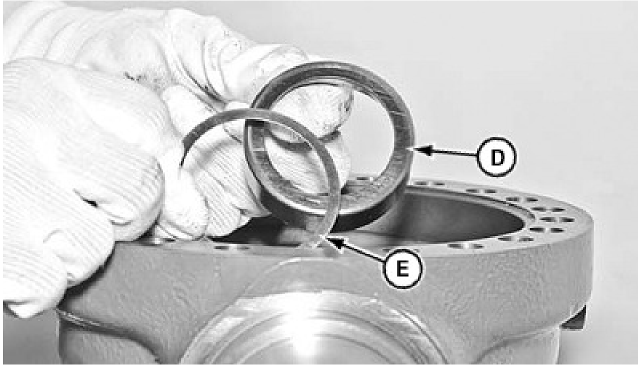
Center Section Assembly

LEGEND:

A	Housing
B	Pinion
C	Bearing Cone
D	Bearing Cup
E	Inner Shim
F	Spacer
G	Shim
H	Bearing Cup
I	Bearing Cone
J	O-Ring
K	Oil Seal
L	Spacer
M	Slinger
N	Pinion Nut

Assemble bearing cone (C) to pinion (B).

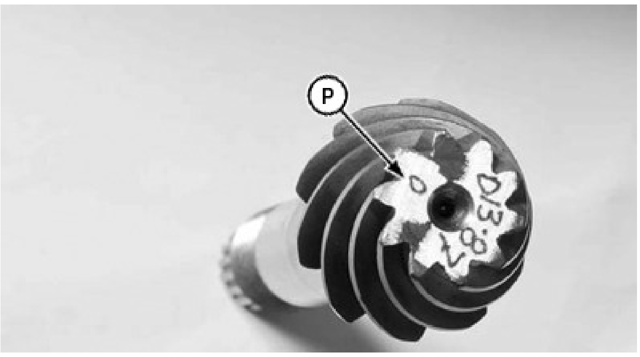
[2] -



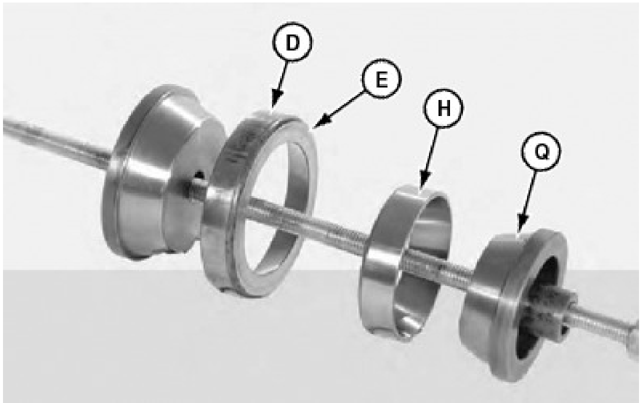
LEGEND:

D	Bearing Cup
E	Inner Shim
H	Bearing Cup
P	Number
Q	Pinion Bearing Cup Tool

Inner Shim



Pinion Stem



Pinion Bearing Cup Tool

Place inner shim (E) under bearing cup (D) to set pinion height.

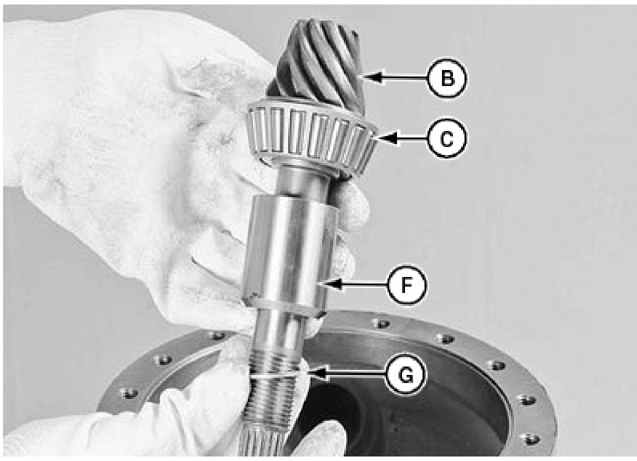
- If the original pinion and bearing are being used, use the original shims or install new shims that are the same thickness as original shims.
- If ring and pinion or bearing are being replaced, notice the positive (+) or negative (-) number (P) on the end of pinion or on pinion stem. The number indicates the best running position of each particular gearset in thousandths of an inch.
- If the number on the new set is not the same as the number on the one being replaced, adjust the height by adding or removing inner shim or shims (E) from original shim pack according to dimension etched on the end of pinion or on pinion stem. Example 1: If the old pinion reads +4 and the new pinion is marked 0, add 0.004 in. shims to the original pack.Example 2: If the old pinion reads +2 and the new pinion is marked -1, add 0.003 in. shims to the original pack.

[3] - Using a pinion bearing cup tool (Q), assemble bearing cups (D and H) and shim (E) in the housing.

→NOTE:

Bearing cup (D) and shim (E) are installed on the inside of the housing. Bearing cup (H) is installed on the outside of the housing.

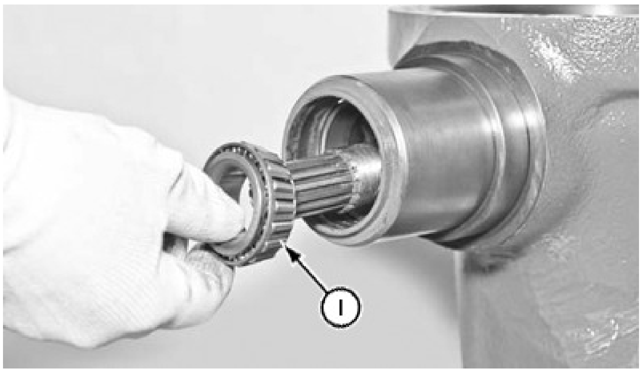
[4] -



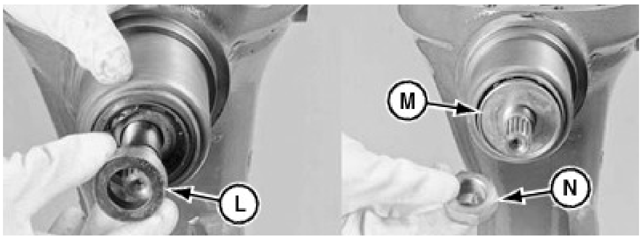
Pinion With Bearing

LEGEND:

B	Pinion
C	Bearing
F	Spacer
G	Shim
I	Bearing Cone
L	Spacer
M	Slinger
N	Old Pinion Nut



Bearing Cone



Spacer

Install the pinion (B), bearing (C), spacer (F), and shim (G).

→NOTE:

Number on pinion and ring gear indicate matched set. Make sure numbers on ring and pinion gears match before assembling.

[5] - Install the bearing cone (I).

[6] - Install the spacer (L), slinger (M), and OLD pinion nut (N).

→NOTE:

Spacer bore chamfer faces toward O-ring.

[7] - Tighten to specification.

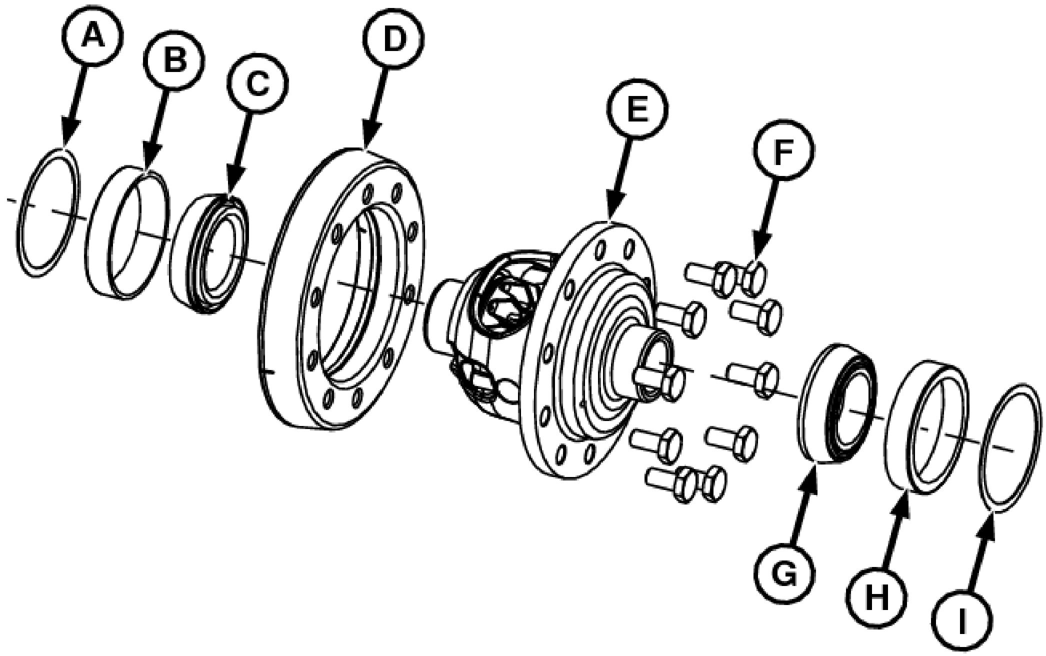
Item	Measurement	Specification
Old Pinion Nut	Torque	135—160 N·m (100—118 lb.-ft.)

[8] - Check the rotation of the pinion and verify that the pinion rotation torque is with in specification.

Item	Measurement	Specification
Pinion Rotation	Torque	1.13—1.69 N·m (10—15 lb.-in.)

- If the pinion does not turn within specification, adjust the shim pack (G). Add shims if rotation torque is too high; remove shims if rotation torque is too low.

Differential Assembly

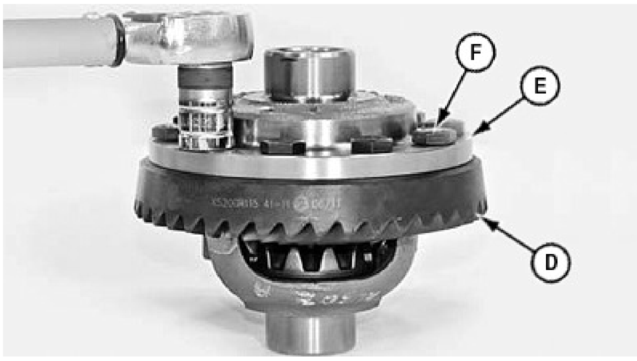


Differential Assembly

LEGEND:

A	Shim
B	Bearing Cup
C	Bearing Cone
D	Ring Gear
E	Differential
F	Ring Gear Cap Screws
G	Bearing Cone
H	Bearing Cup
I	Shim

[1] -



LEGEND:

D	Ring Gear
E	Differential
F	Ring Gear Cap Screws

Ring Gear

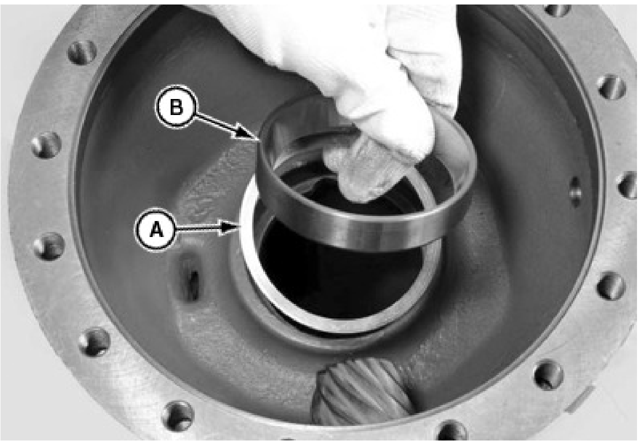
Install the ring gear (D) to the differential (E). Tighten the ring gear cap screws (F) to specification.

Item	Measurement	Specification
Ring Gear Cap Screws	Torque	79—88 N·m (58—65 lb.-ft.)

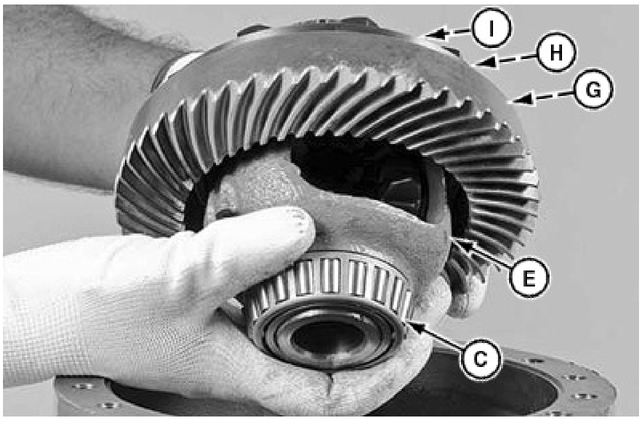
→NOTE:

Cap screws used to fasten differential and ring gear are special cap screws and should be replaced after disassembly.

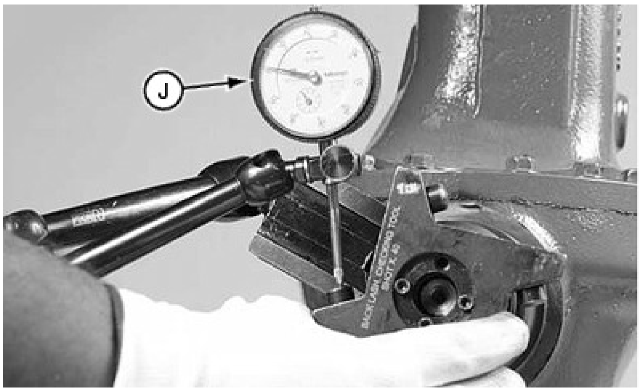
[2] -



Installing Bearing Cup



Differential



Dial Indicator

LEGEND:

A	Shim
B	Bearing Cup
C	Bearing Cone
E	Differential Case Assembly
G	Bearing Cone
H	Bearing Cup
I	Shim
J	Dial Indicator

Install shim (A) and bearing cup (B) onto center section.

→NOTE:

The bearing shim or shims control the ring and pinion backlash and the preload of the differential bearings.

[3] -

IMPORTANT:

There may be several shims on each differential case. Whatever shim thickness is added to one side of the differential case must be removed from the other side, or whatever shims are removed from one side must be added to the other side to keep bearing preload from changing.

a. If bearing cones (C and G) were not removed, place original shims (A and I), or new shims equaling the same thickness, on the same side of the differential assembly from which they were removed.

b. If the bearing cone or gearset is being replaced, set the bearing preload and gear backlash by adding or removing shim or shims between the ring gear side bearing and differential case.

c. Shim the bearings until preload is 2—4 N·m (1.5—3 lb.-ft.).

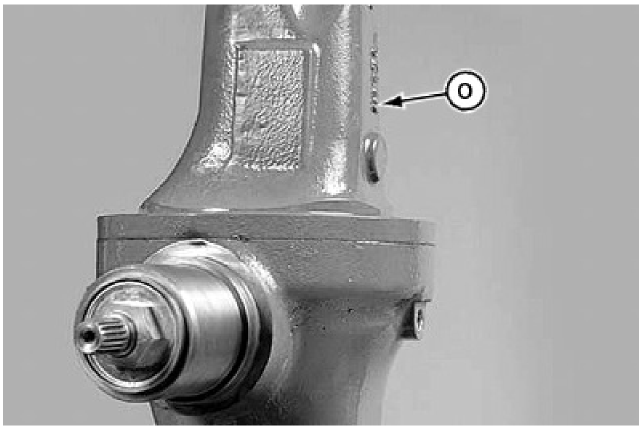
Install the differential case assembly (E) to the carrier housing.

[4] - Check gear backlash with a dial indicator (J) and make sure it is 0.010—0.015 in. (0.25–0.37 mm) at pinion start end.

[5] - Install the bearing cup (H) and shim (I) on bearing cone (G). Temporarily assemble the left-hand trumpet arm with four cap screws and check the backlash and pre-load using the backlash measurement tool.

- If backlash is CORRECT, continue to next step.
- If backlash Is NOT CORRECT, remove the left-hand trumpet arm, then recalculate and select the necessary shims to obtain the correct backlash and preload.

[6] -



LEGEND:

O	Left-Hand Trumpet Arm

Left-Hand Trumpet Arm

Remove the four cap screws used for the temporary assembly and remove the left-hand trumpet arm (O).

[7] -

LEGEND:

P	Left-Hand Trumpet Arm Surface

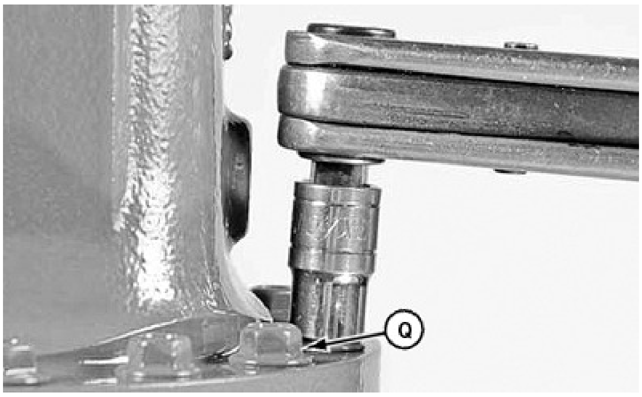
Left-Hand Trumpet Arm Surface

Apply Hylomar M (optional: Loctite 515) evenly to the left-hand trumpet arm surface (P).

[8] -

→NOTE:

Apply Loctite ™ 262 to axle housing cap screws threads.



LEGEND:

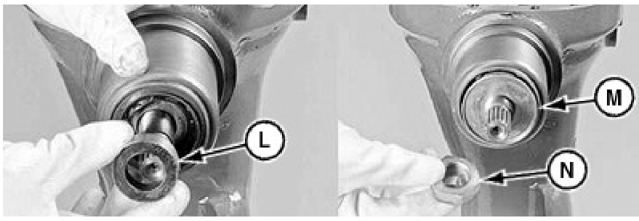
Q	Axle Housing Cap Screw

Axle Housing Cap Screw

Attach the left-hand trumpet arm to the right-hand trumpet arm with axle housing cap screws (Q). Torque to specification.

Item	Measurement	Specification
Axle Housing Cap Screw	Torque	68—75 N·m (50—55 lb.-ft.)

[9] -



LEGEND:

L	Spacer
M	Slinger
N	Old Pinion Nut

Old Pinion Nut

Remove spacer (L), slinger (M), and old pinion nut (N).

[10] -

→NOTE:

Always use new O-ring.

LEGEND:

J	O-Ring

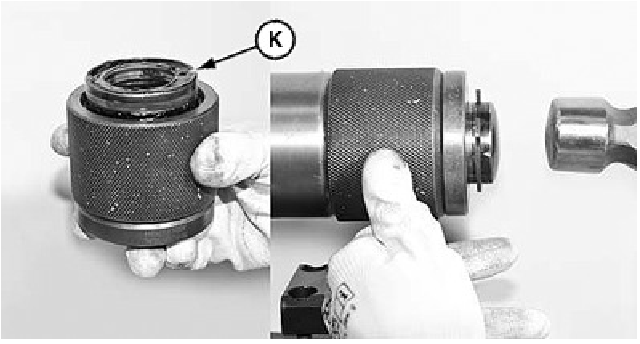
O-ring

Install new O-ring (J).

[11] -

→NOTE:

Always use new oil seal.



LEGEND:

K	New Oil Seal

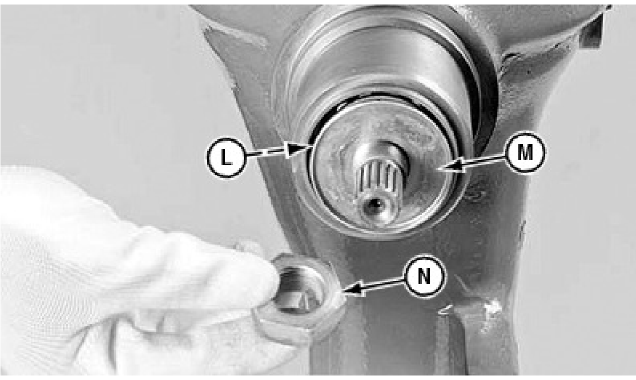
New Oil Seal

Install a new oil seal (K) using the spacer seal tool, ensure that the seal seats correctly.

[12] -

→NOTE:

Apply Loctite ™ 272 to pinion threads.



LEGEND:

L	Spacer
M	Slinger
N	New Pinion Nut

New Pinion Nut

Install spacer (L), slinger (M), and new pinion nut (N). Tighten to specification.

Item	Measurement	Specification
New Pinion Nut	Torque	135—160 N·m (100—118 lb.-ft.)

Pinion Depth Setup and Adjustment

Required only if differential carrier housing is replaced using any gear set that was not installed with that carrier housing at the factory.

Tools Required:

Differential Set-Up Tool Kit

Differential Set-Up Tool Kit

JDG1395A

To set- up differential.

Procedure:

LEGEND:

A	Tool A
B	Tool B

Pinion Depth Tools

[1] - Remove inner pinion bearing cup (if installed) and retain any shims from behind cup for possible reuse. Install tool (A) into pinion bearing bore.

Pinion Depth Tool Set

JDG1395A

Set and adjust depth of differential pinion.

[2] - Install tool (B) across differential bearing saddles.

[3] - While holding the tool (B) down, measure the distance between the two tools with a feeler gauge. This value will generally be between.

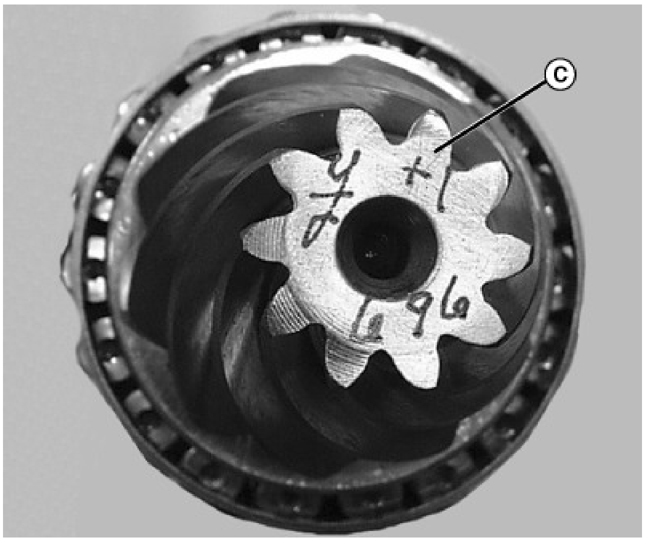
Item	Measurement	Specification
Tool Value	Distance	0.64—0.86 mm (0.026—0.034 in.)

But it is acceptable to have measurements between.

Item	Measurement	Specification
Acceptable Tool Value	Distance	0.45—0.96 mm (0.018—0.038 in.)

Record the measurement.

[4] -



LEGEND:

C	± Number

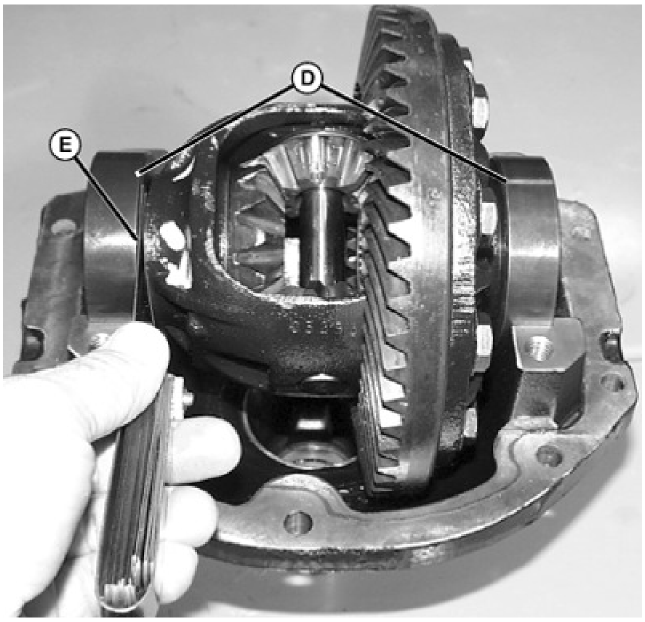
Pinion Gear End

Locate the (+) or (-) number (C) on the end of the pinion gear. This number indicates the best running position of each particular gear set in thousandths of an inch.

[5] - The shim pack thickness to be used under the pinion bearing cup is calculated as follows:

a. Use the feeler gauge thickness dimension measured in step 3.
b. If the number on the pinion is a (+) number SUBTRACT that number in thousandths of an inch from the feeler gauge thickness dimension measured in step 3.
c. If the number on the pinion is a (-) number ADD that number in thousandths of an inch to the feeler gauge thickness dimension measured in step 3.
d. After calculating shim pack thickness, assemble a shim pack measuring the exact amount calculated above and place it under the pinion bearing cup.

Determining Differential Bearing Preload:



LEGEND:

D	Bearing Substitute Tool
E	Gap

Differential Bearing Preload

[1] - Place the bearing substitute tool (D) on each side of the differential case.

[2] - Pry the differential back and forth with a small bar to seat the bearing tools against the outer edges of bearing bores.

[3] - Pry the differential all the way over against one of the bearing tools.

[4] - Using a feeler gauge, measure the gap between the differential carrier and the bearing tool (E). Record the measurement.

[5] - Add **0.03—0.09 mm (0.001—0.004 in.)** to the measurement for bearing preload.

[6] - Assemble a shim pack measuring the exact amount of the calculation above.

Differential Backlash Adjustment:

→NOTE:

Pinion shaft assembly must be installed.

[1] -

Ring Gear Measurement

Install pinion shaft per assembly/installation instructions.

[2] - Divide the shim pack assembled in the previous step into two stacks with the thickness of the two stacks being as equal as possible.

[3] - Install one shim pack and a bearing substitute tool on each side of the differential case.

[4] - Install dial indicator to measure ring gear movement.

[5] - Hold the pinion gear shaft to keep it from moving. Rotate the ring gear back and forth, and observe readout on dial indicator.

Item	Measurement	Specification
Ring Gear Measurement	Backlash	0.10—0.20 mm
		(0.004—0.008 in.)

Results:

IMPORTANT:

Avoid Damage! Whatever shim thickness is added to one side of the differential case must be removed from the other side. Or whatever shims are removed from one side must be added to the other to keep bearing preload from changing.

- If necessary, adjust backlash. Gear backlash is adjusted by changing the shim pack thickness on the ring gear side bearing. Removing shims increases backlash, adding shims decreases backlash.
- When backlash is correct, remove bearing substitute tools and install bearings.
- Install the bearing caps. Tighten the cap screws for the bearing caps to specification and recheck backlash.

Item	Measurement	Specification
Bearing Cap Screw	Torque	54—68 N·m

Item	Measurement	Specification
		(40—50 lb.-ft.)

Group 45 - PTO Theory of Operation

PTO Clutch and Brake Theory of Operation

Function:

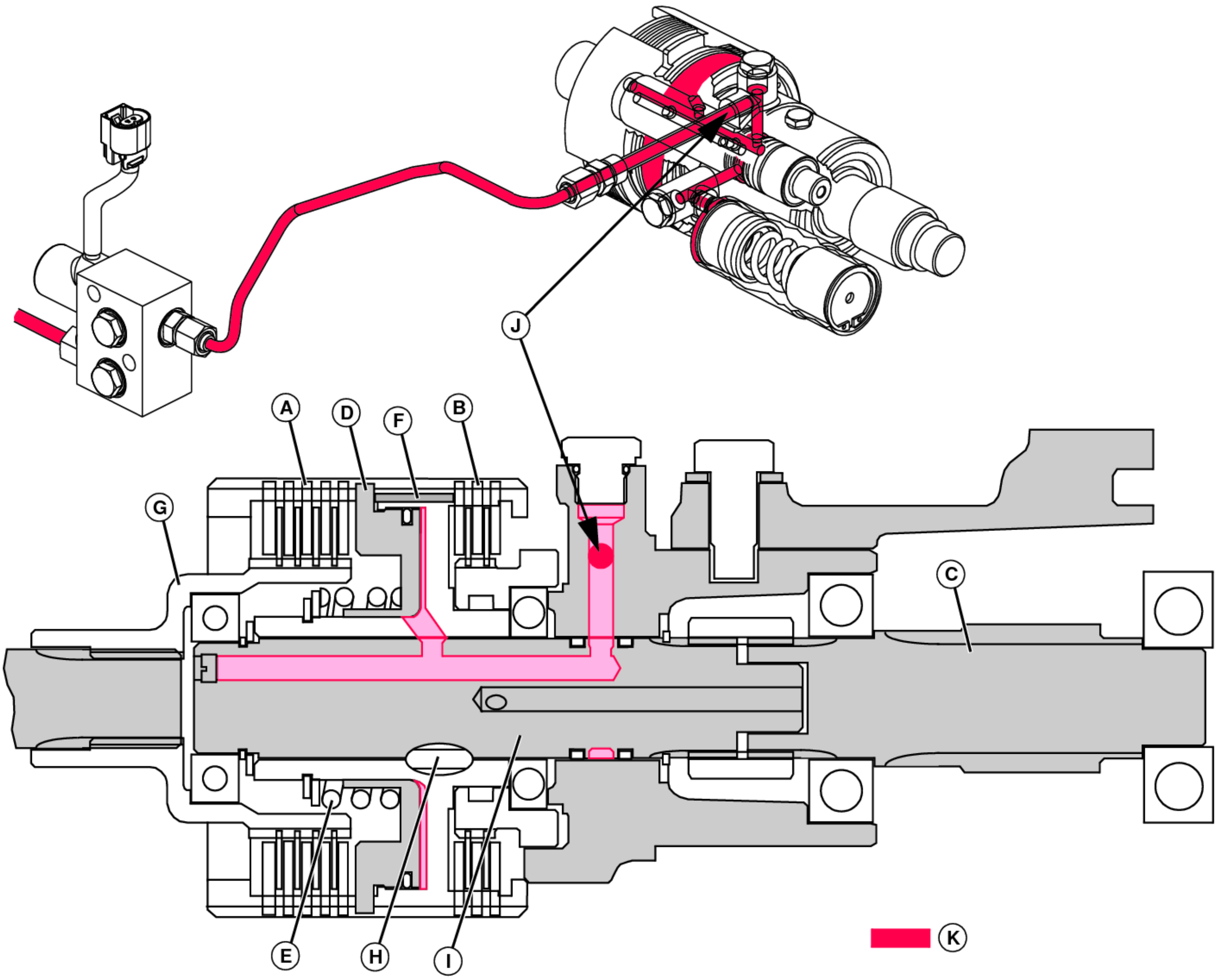
The PTO clutch provides a means for engaging and disengaging the PTO output shaft from the engine. The PTO brake is provided to positively stop the rotation of the PTO system when the PTO clutch is disengaged. The PTO clutch and PTO brake work simultaneously; if one is engaged, the other is disengaged. Both mid and rear PTO output shafts are affected by the operation of the PTO clutch and PTO brake.

Theory:

The PTO clutch (A) and PTO brake (B) are engaged or disengaged by the operator with the PTO switch. This switch operates the PTO solenoid valve mounted on the left side of the rear case.

The PTO brake contained inside the housing of the PTO clutch/brake unit is a spring loaded multi-plate wet brake and is normally engaged, preventing the PTO pinion shaft (C) from rotating. The PTO clutch is a multi-plate wet clutch and is normally disengaged.

When the PTO solenoid is energized, pressure oil flows behind the piston (D) in the PTO clutch housing. Piston action compresses the PTO clutch spring (E) and applies pressure to the clutch pack; at the same time releasing pressure on the interlock pins (F) and disengaging the PTO brake (B). Pressure applied to the clutch pack locks the disks (splined to the PTO hub (G)), to the friction plates (locked to the clutch housing). The clutch housing is keyed (H) to the clutch drive shaft (I). Power is transferred from the input shaft to the PTO hub, through the clutch plates and disks, to the clutch housing, and finally to the PTO drive shaft.



PTO Clutch and Brake

LEGEND:

A	PTO Clutch
B	PTO Brake
C	PTO Pinion Shaft
D	Piston
E	PTO Clutch Spring
F	Interlock Pins
G	PTO Hub
H	Clutch Housing
I	Clutch Drive Shaft
J	Pressure Oil Inlet (from PTO Valve)
K	PTO Clutch Pressure Oil

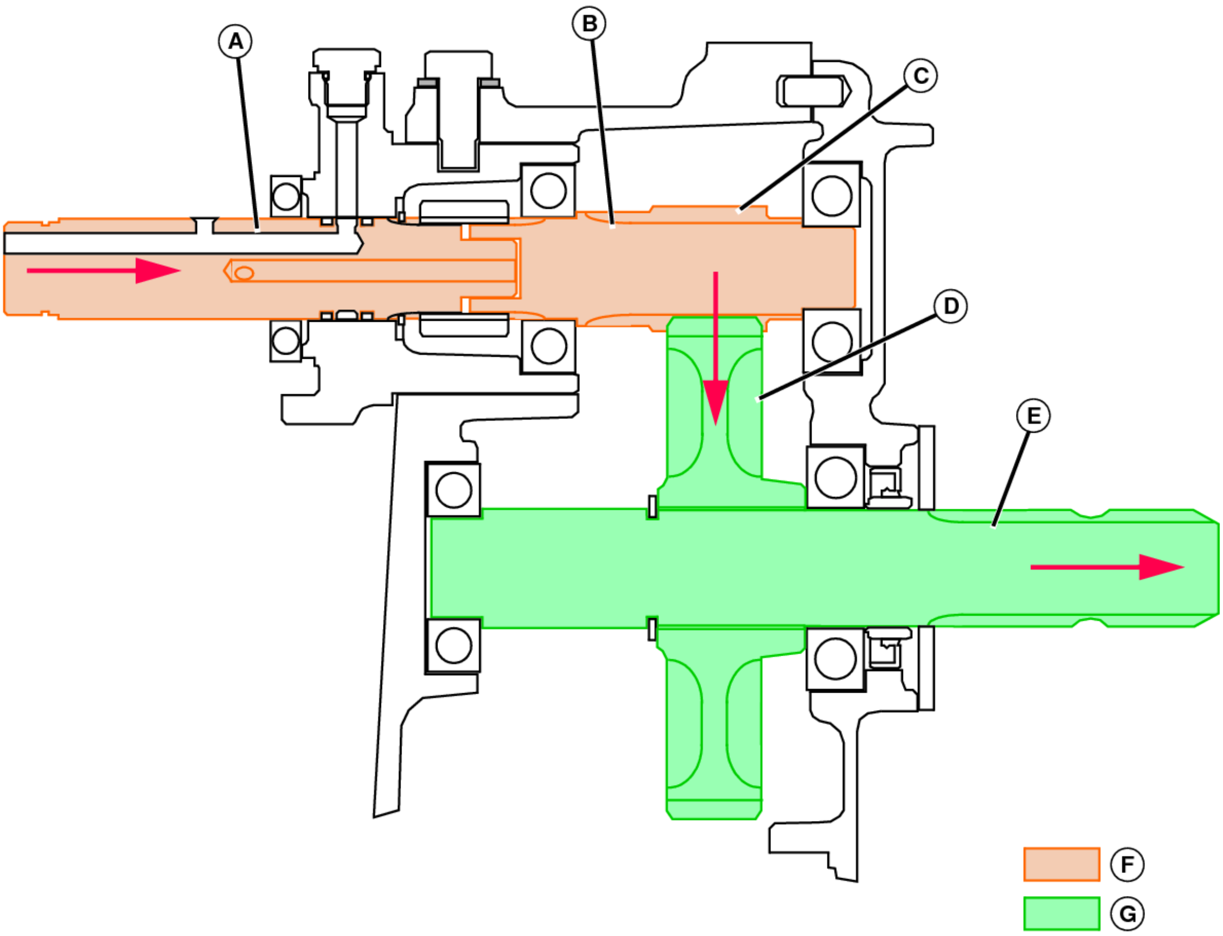
Power Transmission—Rear PTO

Function:

The rear PTO provides a means for transferring engine power to rear mounted attachments.

Theory:

Power is provided to the PTO gear power train through PTO clutch and PTO drive shaft (A). Power is not transferred until the operator engages the PTO solenoid. The PTO drive shaft turns in a counterclockwise direction and is coupled directly to the PTO pinion shaft (B). The PTO pinion shaft is a shaft and gear (C) machined as a single part. This gear is in constant mesh with the gear (D) which is splined to the PTO stub shaft (E), and rotates in a clockwise direction. The rear PTO always turns clockwise when looking at the end of the PTO shaft from the rear of the machine. The rear PTO runs independently of the machine forward or rearward motion, or rate of travel. Speed of the PTO is dependent on engine RPM. The rear PTO is limited to 585 rpm at maximum engine speed.



Rear PTO

LEGEND:

A	PTO Drive Shaft
B	PTO Pinion Shaft
C	Shaft and Gear
D	Gear
E	PTO Stub Shaft
F	Input Power
G	Rear PTO Power

Power Transmission—Mid PTO

Function:

The mid PTO provides a means for transferring engine power to mid mount attachments such as a mower deck. It also provides a means for engaging and disengaging engine power to the mid PTO stub shaft.

Theory:

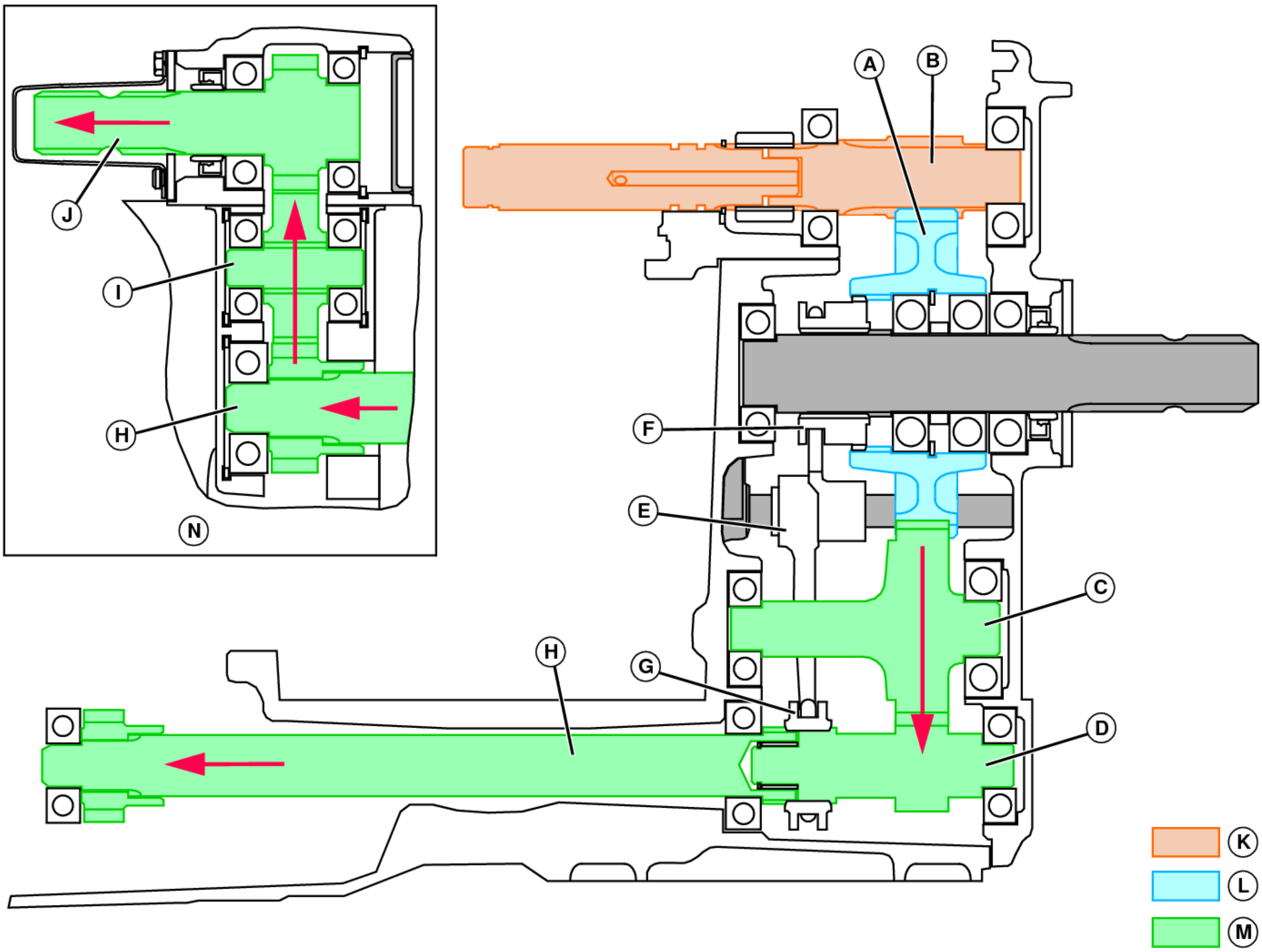
Power is not available to the rear PTO or mid PTO until the operator engages the PTO switch; which energizes the PTO solenoid. Power is provided to the rear and mid PTO through the 62 tooth gear (A) which rotates freely clockwise on bearings on the rear PTO stub shaft. The 62 tooth gear (A) is in constant mesh with the PTO pinion shaft (B) and the 32 tooth mid PTO idler gear shaft (C). The idler gear shaft (C) is also in constant mesh with the 15 tooth lower mid PTO gear shaft (D). Any time the PTO pinion shaft (B) is rotating, so is the lower mid PTO gear shaft (D).

A double shift fork assembly (E) is used to engage the rear PTO, mid PTO or both. The double shift fork slides the rear PTO shift collar (F) and the mid PTO shift collar (G) at the same time. The graphic below shows the rear PTO and the mid PTO both engaged. Shift collar (F) is splined to the rear PTO stub shaft. Shift collar (G) slides on the splines of the lower mid PTO gear shaft (D) and the mid PTO drive shaft (H).

When the operator selects the rear PTO only, shift collar (F) moves to the rear and keeps the gear (A) coupled to the rear PTO stub shaft. The shift collar (G) also moves to the rear and uncouples the lower mid PTO gear shaft (D) from the mid PTO drive shaft (H).

When the operator selects the mid PTO only, the rear PTO shift collar (F) disengages from gear (A). The mid PTO shift collar (G) locks the lower mid PTO gear shaft (D) to the mid PTO drive shaft (H).

The mid PTO drive shaft (H) drives an idler gear shaft (I) in the mid PTO case. See the inset graphic below. The idler gear shaft (I) is in constant mesh with the mid PTO drive shaft and the mid PTO stub shaft (J).



Mid PTO

LEGEND:

A	62T Gear
B	PTO Pinion Shaft
C	Idler Gear Shaft
D	15T Lower Mid PTO Gear Shaft
E	Double Shift Fork Assembly
F	PTO Shift Collar
G	Mid PTO Shift Collar
H	Mid PTO Drive Shaft
I	Idler Gear Shaft
J	PTO Stub Shaft
K	Input Power
L	Power Transfer
M	Mid PTO Power
N	Mid PTO Case Shown From Top

Group 50 - PTO Repair

PTO Drive Shaft and Gears

Removal:

[1] - Park machine on a level surface, shut off engine, and set park brake.

[2] - If necessary, remove center lift link, draft arms, and adjustable draft links.

[3] -

→NOTE:

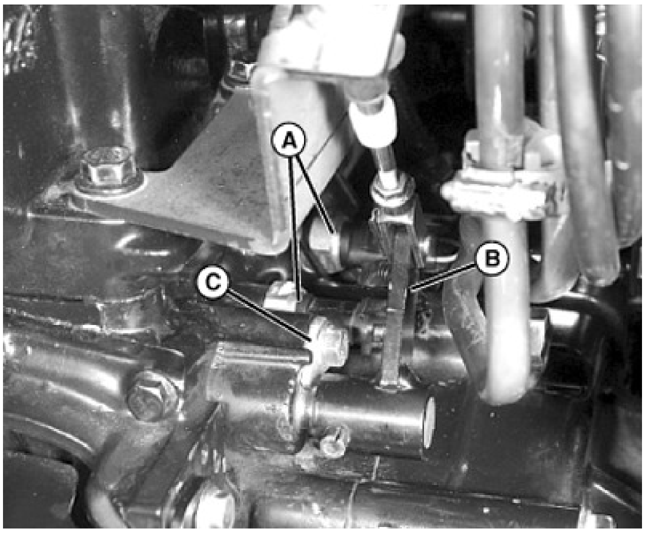
Capacity of the hydraulic system is approximately 25.7 l (6.8 gal.) for eHydro ™ machines.

Drain hydraulic oil from reservoir.

[4] - Remove rear PTO shield assembly.

[5] - For Machines with MID PTO:

[6] -



LEGEND:

A	Wiring Harness
B	PTO Shift Arm
C	Cap Screw and Retainer Plate

PTO Shift Arm

Disconnect wiring harness from PTO switches (A).

[7] - Disconnect PTO shift cable linkage from PTO shift arm (B).

[8] - Remove cap screw and retainer plate (C) from PTO shift arm (B).

[9] -

IMPORTANT:

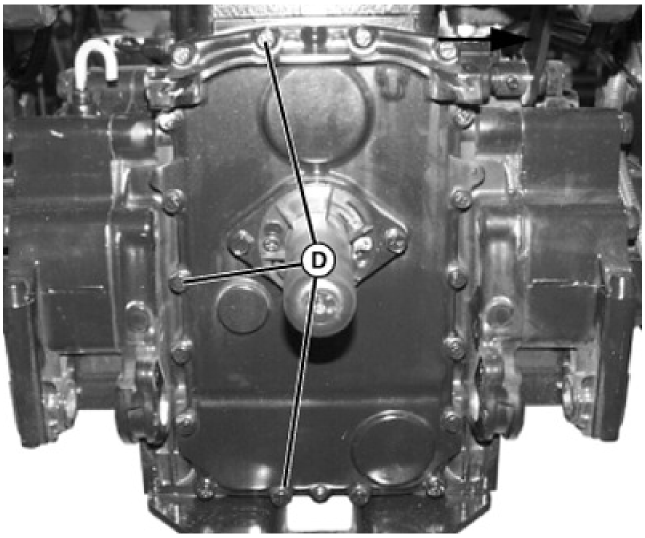
Avoid Damage! Remove PTO switches (C) before moving PTO shift arm.

Slide PTO shift arm as far out of transmission case as possible.

[10] -

→NOTE:

Gear assembly may or may not come out of transmission case as a unit.



LEGEND:

D	Cap Screws

PTO Cover

Remove all cap screws (D) securing PTO cover to transmission case. Gently pry around edges of cover. Wobble shaft and pull at the same time to remove rear cover, PTO stub shaft and gear.

[11] - Remove all cap screws (D) securing PTO cover to transmission case. Gently pry around edges of cover. Wobble shaft and pull at the same time to remove rear cover, PTO stub shaft and gear.

Installation—Machines Without Mid PTO:

Installation is performed in the reverse order of removal.

- Thoroughly clean mating surfaces of rear cover and differential housing to remove all traces of old gasket.
- Install a new gasket on rear cover.
- Tighten cap screws, retaining rear cover, to specification.

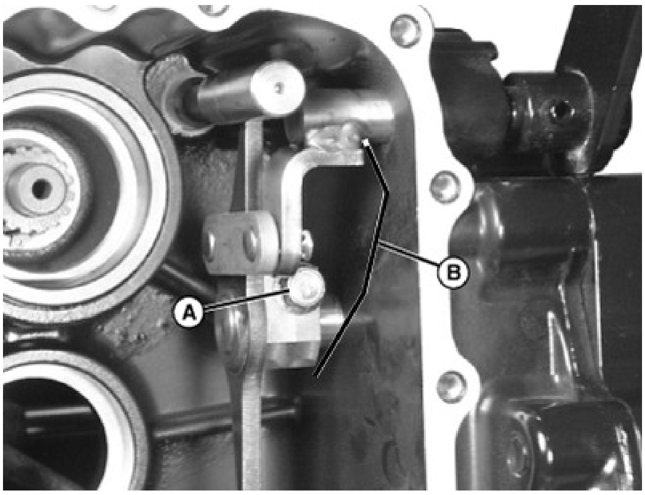
Item	Measurement	Specification
Rear Cover Cap Screws	Torque	28 N·m (20 lb.-ft.)

Installation—Machines With Mid PTO:

[1] -

IMPORTANT:

Avoid Damage! Replace all O-rings, gaskets, and seals. Used or damaged O-rings, gaskets, and seals will leak.



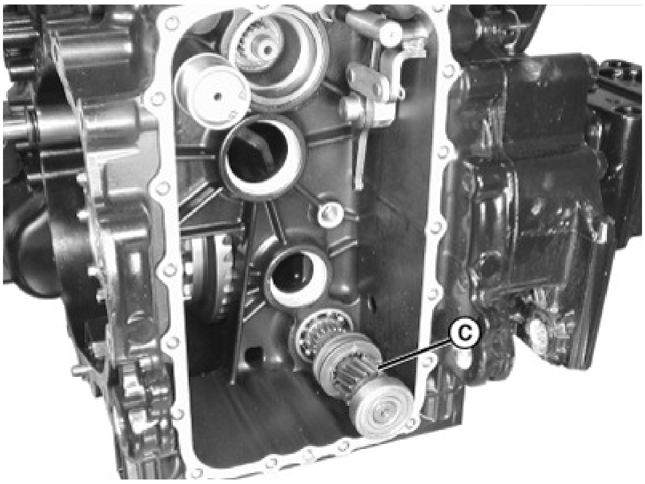
LEGEND:

A	Cap Screw
B	Shift Assembly

Shift Arm Assembly

Remove cap screw (A) from shift arm. Slide shift assembly (B) to the outside of transmission case as far as possible.

[2] -



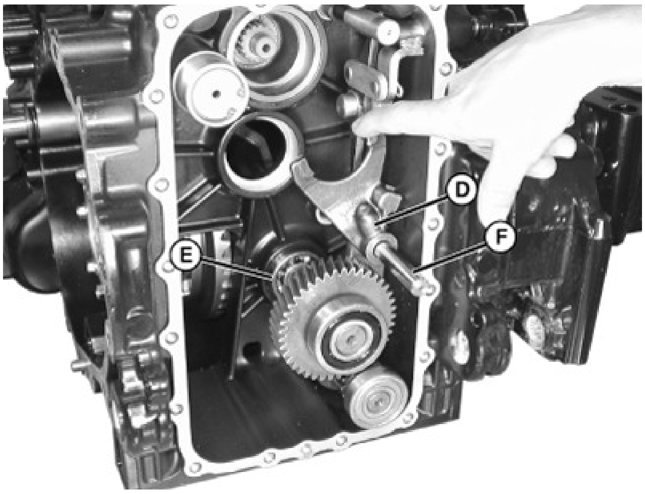
LEGEND:

C Mid PTO Gear Shaft Assembly

Mid Gear Shaft Assembly

Loosely install mid PTO gear shaft assembly (C) bearing into case.

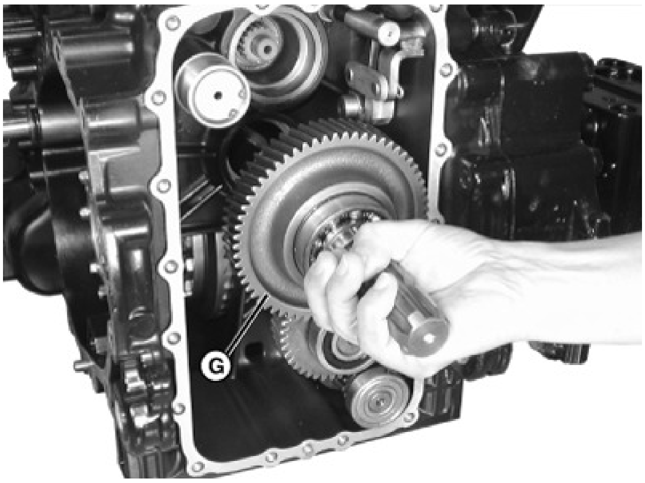
[3] -



LEGEND:

D Shift Fork Assembly
E Idler Gear Shaft Assembly Bearing
F Shift Fork Shaft
G PTO Stub Shaft Assembly

Shift Fork to Case



Stub Shaft to Case

Place shift fork assembly (D) longer shift fork over mid PTO gear shaft collar, raise shorter shift fork up and loosely install idler gear shaft assembly bearing (E) into case. Do not seat shift fork shaft (F) into case.

[4] -

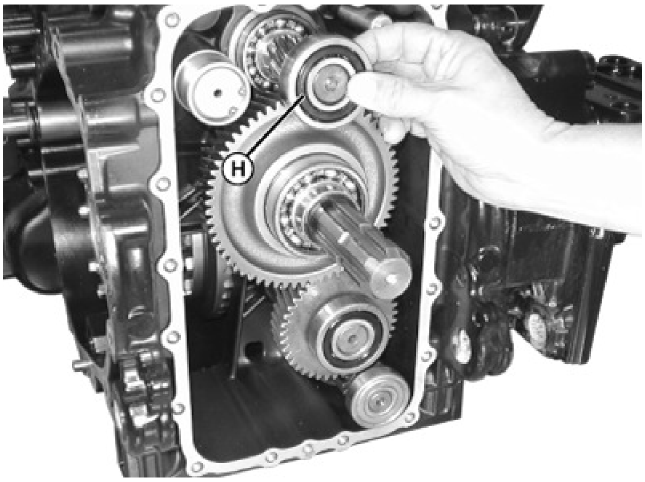
→NOTE:

When installing PTO stub shaft and gear assembly, slide shift collar forward to ease installation.

Install PTO stub shaft assembly (G) into place ensuring that the shorter shift fork is seated into stub shaft assembly shift collar.

[5] - Seat stub shaft assembly bearing, and shift fork shaft (D) into transmission case bearing holes.

[6] -



LEGEND:

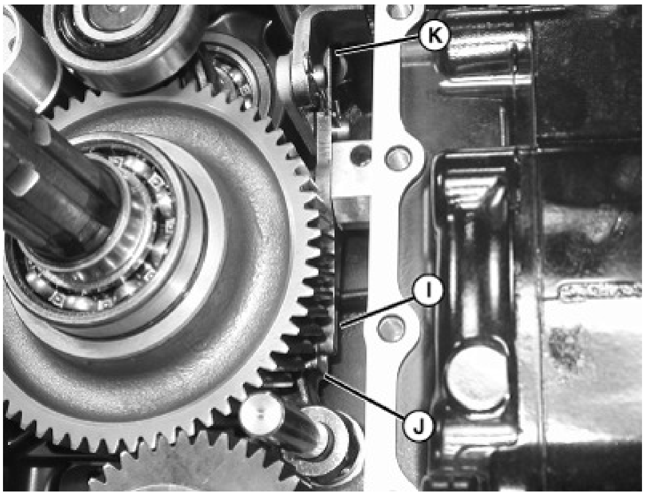
H	PTO Pinion Shaft Assembly

PTO Pinion Shaft

Install PTO pinion shaft assembly (H).

[7] - Carefully seat all shaft assemblies fully into case.

[8] -



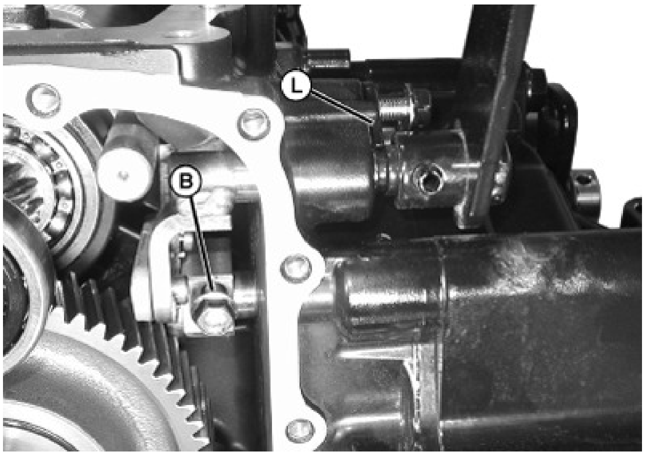
LEGEND:

I	Shift Lever
J	Fork Notch
K	Switch Shaft Notch

Shift Assembly

Rotate shift lever until shift lever (I) aligns with fork notch (J) and switch shaft notch (K). Slide shift assembly into transmission case to seat shift lever into notches.

[9] -



LEGEND:

B	Cap Screw
L	Keeper Plate

Keeper Plate

Apply thread lock compound to, and install cap screw (B).

[10] - Install keeper plate (L) and secure with cap screw.

[11] - Thoroughly clean mating surfaces of rear cover and differential housing to remove all traces of old gasket.

[12] - Replace PTO seal in rear cover.

[13] - Install a new gasket on rear cover.

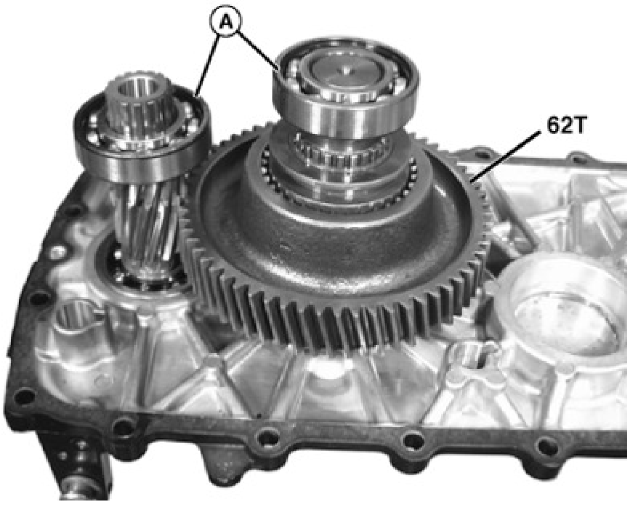
[14] - Coat PTO rear plate bearing surfaces with clean oil. Carefully install plate ensuring that shafts and bearings are aligned with rear plate bearing surfaces.

[15] - Tighten cap screws, retaining rear cover, to specification.

Item	Measurement	Specification
Rear Cover Cap Screws	Torque	28 N·m (28 lb.-ft.)

Disassembly:

[1] -



LEGEND:

A	Bearings
B	Shift Collar

PTO stub shaft with shift collar (shown) for mid-PTO machines only.

Remove rear PTO drive shaft and gears as an assembly.

[2] - If not already done, remove coupler from PTO pinion shaft.

[3] - Using a suitable puller, remove bearings (A) from PTO pinion shaft and PTO stub shaft.

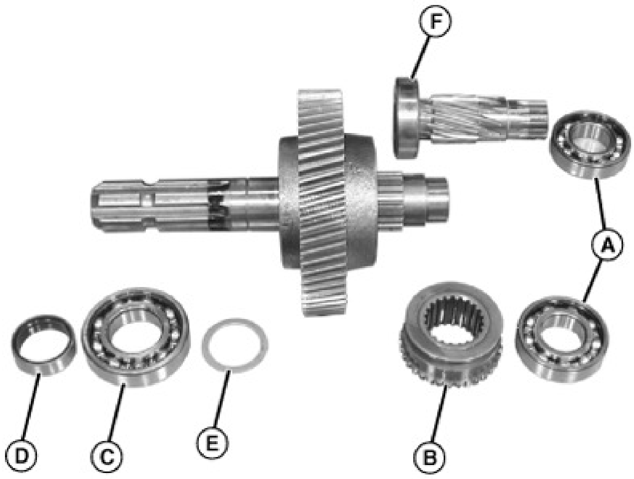
[4] - Inspect bearings for smooth operation, wear, or damage. Replace as necessary.

[5] - Machines without mid PTO: Remove snap ring and 62T gear.

[6] - Machines with mid PTO: Remove shift collar (B) from stub shaft.

[7] - Remove drive PTO stub shaft, rear bearing, and seal sleeve (toward inside of cover).

[8] -



LEGEND:

C	Bearing
D	Seal Sleeve
E	Thrust Bearing
F	Bearing

PTO Shaft

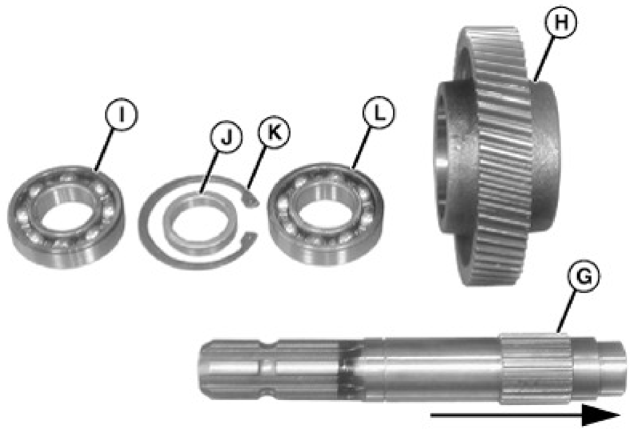
Using a press or suitable driver, remove bearing (C) and seal sleeve (D) from PTO shaft. Remove thrust bearing (E).

[9] - Remove bearing (F) from pinion shaft.

[10] - Inspect all bearings for smooth operation, wear, or damage. Replace as necessary.

[11] - Replace seal sleeve.

[12] -



LEGEND:

G	PTO Stub Shaft
H	62T Gear
I	Bearing
J	Spacer
K	Snap Ring
L	Bearing

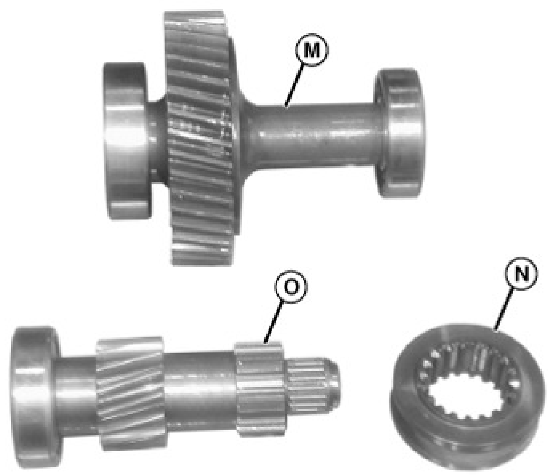
Stub Shaft

Press PTO stub shaft (G) out of 62T gear (H) and bearing assembly.

[13] - Remove bearing (I), spacer (J), snap ring (K) and remaining bearing (L) from 62T gear.

[14] - Inspect bearings for smooth operation, wear, or damage. Replace as necessary.

[15] -



LEGEND:

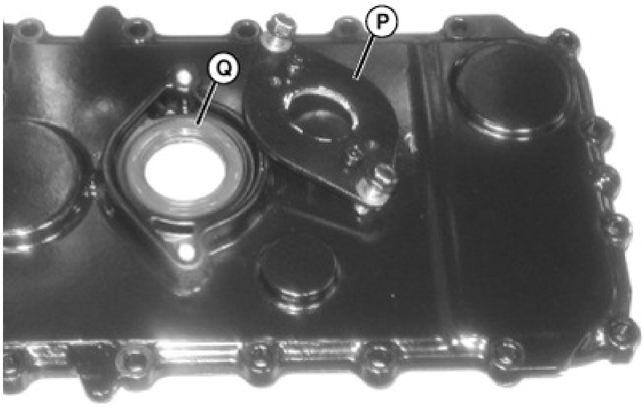
M	Idler Shaft Bearing
N	Shift Collar
O	Lower Mid PTO Gear Shaft

Idler Shaft

Inspect bearings on idler shaft (M) for smooth operation, wear, or damage. Replace as necessary.

[16] - Remove shift collar (N) from lower mid PTO gear shaft (O). Inspect needle bearing and roller bearing on shaft for smooth operation, wear, or damage. Replace as necessary.

[17] -



LEGEND:

P	Oil Seal Plate
Q	PTO Shaft Seal

Rear PTO Cover

Remove two cap screws and oil seal plate (P).

[18] - Using a seal puller or suitable driver, remove seal (Q) from rear PTO cover.

Assembly:

IMPORTANT:

Avoid Damage! DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

IMPORTANT:

Avoid Damage! Use liberal amounts of transmission oil to lubricate components as they are assembled. DO NOT use grease or other heavy lubricants unless they are specifically called for in the assembly story.

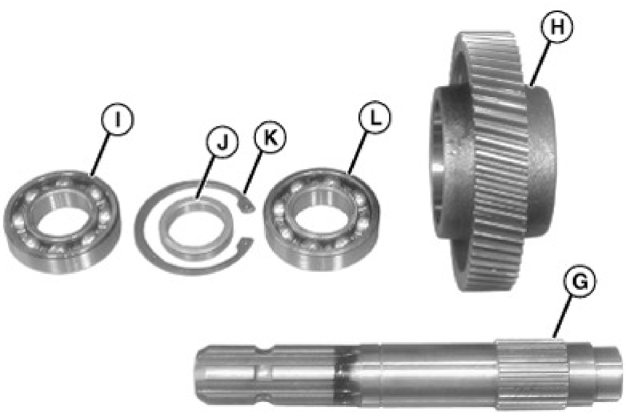
→NOTE:

Before beginning assembly, be sure that all components are clean, and in good condition.

[1] - Clean mating surface of rear cover to remove old gasket material.

[2] - Using a suitable driver, install new PTO shaft seal (Q) in PTO cover. Install oil seal plate (P).

[3] - Assemble gear shaft assemblies.



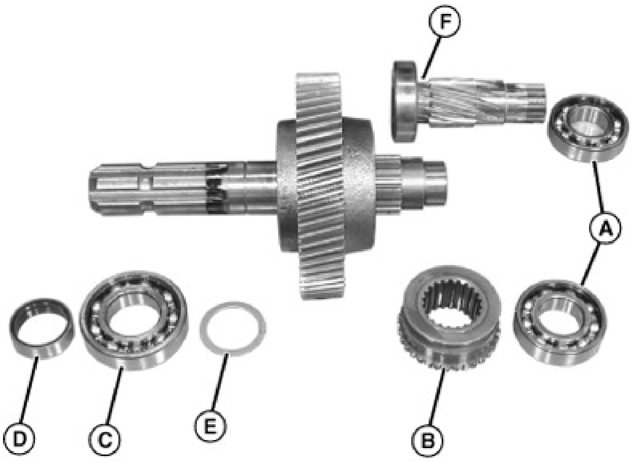
LEGEND:

G	PTO Stub Shaft
H	62T Gear
I	Bearing
J	Spacer
K	Snap Ring
L	Bearing

a. ***Stub Shaft***

   Install bearing (L), snap ring (K), spacer (J), and remaining bearing (I) on to 62T gear.

b. Press PTO stub shaft (G) into 62T gear (H) and bearing assembly.



LEGEND:

A	Bearing
B	Shift Collar
C	Bearing
D	Seal Sleeve
E	Thrust Washer
F	PTO Pinion shaft

c. ***PTO Shaft***

Install thrust bearing (E). Using a press or suitable driver, install bearing (C) and new seal sleeve (D) onto PTO shaft.

d. Install shift collar (B) onto shaft. Press bearing (A) onto shaft.

e. Press bearing onto PTO pinion shaft (F).

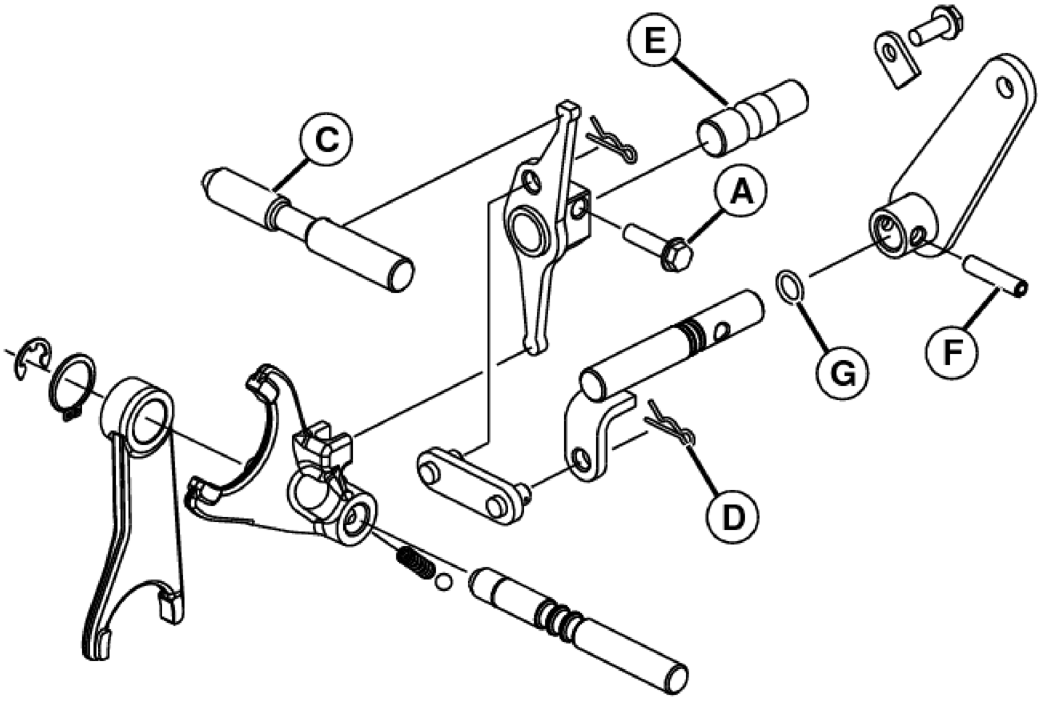
[4] -

→NOTE:

Check shafts to ensure that they are properly installed in transmission case; if bearings are not fully seated in case, PTO cover may break when installed onto transmission housing and attaching cap screws are tightened.

Install shaft and bearing assemblies into transmission case. (See PTO Drive Shaft and Gears in Section 70, Group 50.)

Rear and Mid PTO Shifter

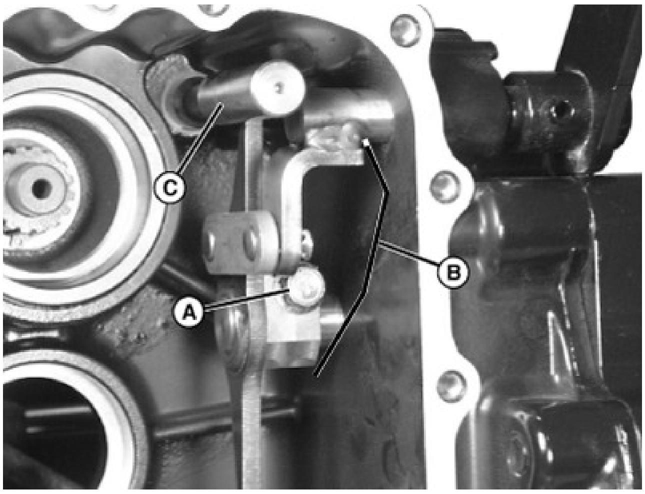


Rear and Mid- PTO Shifter

LEGEND:

C	Switch Shaft
D	Spring Pin
E	Shaft
F	Roll Pin
G	O-ring

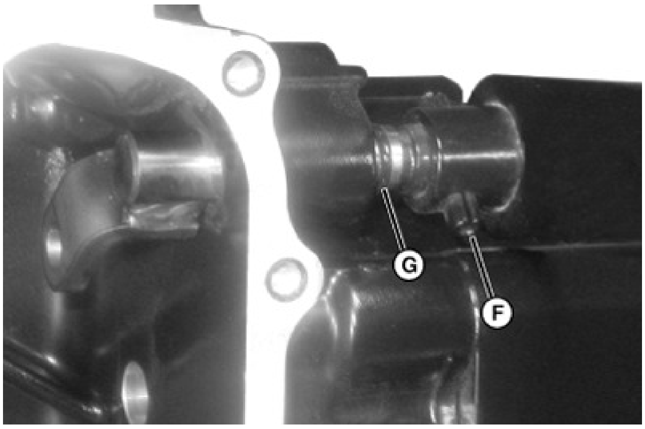
[1] -



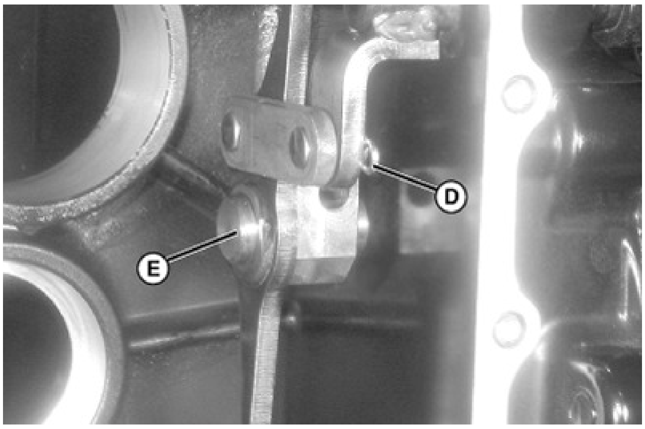
LEGEND:

A	Shift Arm Cap Screw
B	Shift Assembly
C	Switch Shaft
D	Spring Pin
E	Shaft
F	Roll Pin
G	O-ring

Shift Arm Assembly



Shift Shaft



Spring Pin and Shaft Assembly

Remove cap screw (A) from shift arm. Slide shift assembly (B) to the outside of transmission case as far as possible.

[2] - Remove switch shaft (C).

[3] - Remove spring pin (D).

[4] - Remove shaft (E) from transmission case.

[5] - Remove roll pin (F).

[6] - Slide shift shaft out of transmission case.

Installation is performed in the reverse order of removal.

- Replace O-ring (G).
- Apply thread lock to cap screw (A) before installation.
- Install shift shaft retainer plate.

PTO Clutch and Brake

Removal:

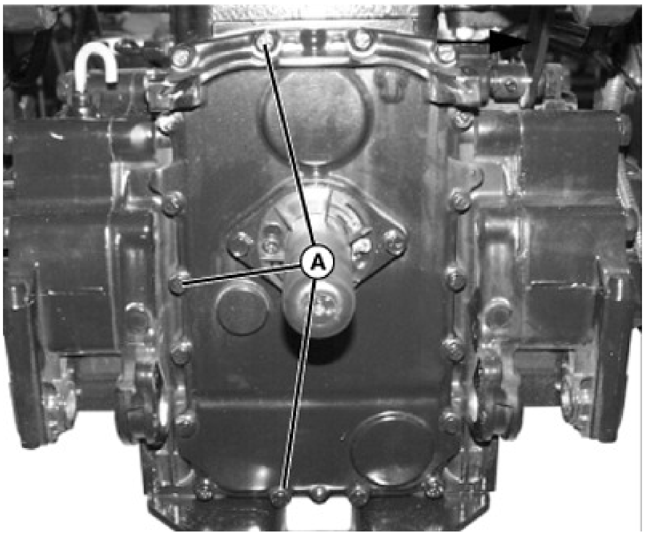
[1] - Split machine at rear of tunnel to access PTO clutch shaft.

[2] - Remove rockshaft.

[3] -

→NOTE:

Gear assembly may or may not come out of transmission case as a unit.



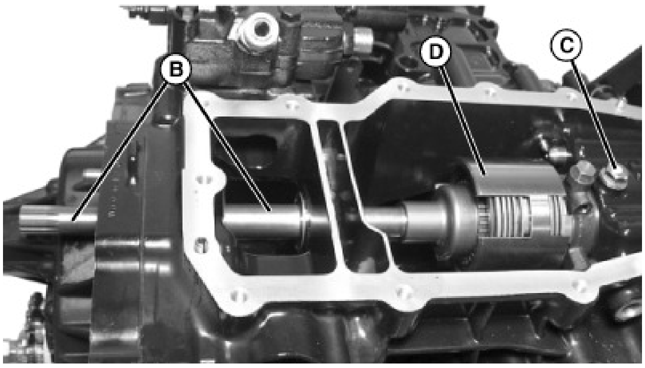
LEGEND:

A	Cap Screws

PTO Cover

Remove all cap screws (A) securing PTO cover to transmission case. Gently pry around edges of cover. Wobble shaft and pull at the same time to remove rear cover, PTO stub shaft, and gear.

[4] -



LEGEND:

B	Drive Shaft
C	Retainer Cap Screw
D	Clutch Assembly

PTO Clutch Assembly

Remove snap ring securing front of PTO drive shaft (B).

[5] - Slide PTO clutch drive shaft assembly (B) forward.

[6] -

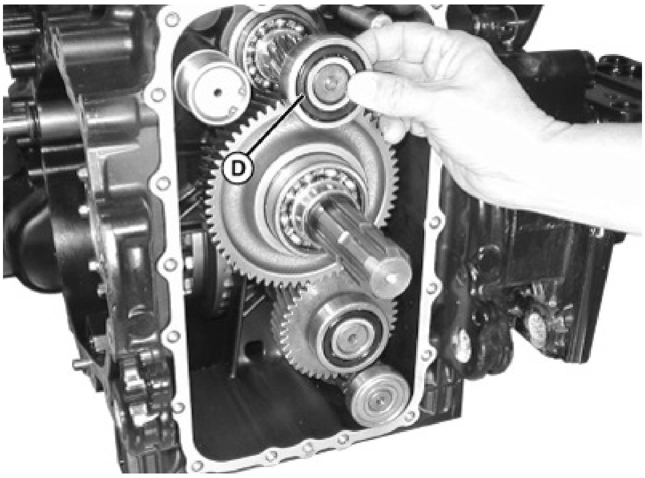
→NOTE:

Retainer cap screw is installed with thread lock applied.

Remove retainer cap screw (C).

[7] - Slide PTO clutch assembly (D) forward and remove from transmission case.

[8] -



LEGEND:

D	Pinion Shaft Assembly

PTO and Mid PTO gears shown.

Installation is the reverse of removal using the following special instructions:

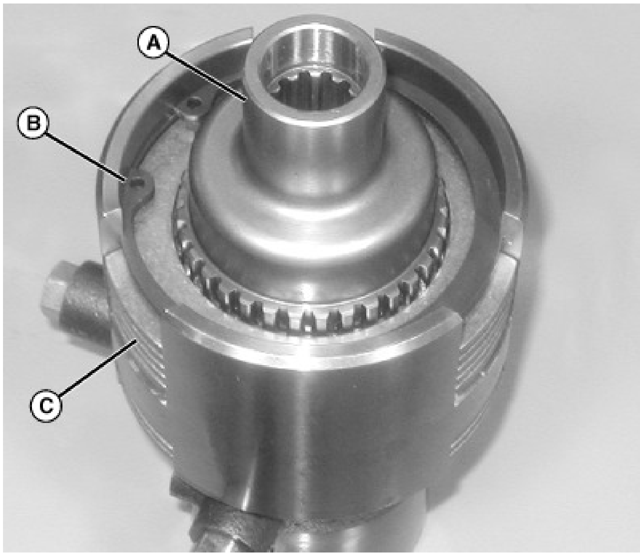
- Coat PTO clutch retainer cap screw threads with thread lock. Tighten to specification.

Item	Measurement	Specification
PTO Clutch Retainer Cap Screw	Torque	45—58 N·m (33—43 lb.-ft.)

- Install PTO pinion shaft assembly (D) after PTO clutch is installed.
- Replace PTO seal in rear cover.
- Install a new gasket on rear cover.
- Coat PTO rear plate bearing surfaces with clean oil. Carefully install plate ensuring that shafts and bearings are aligned with rear plate bearing surfaces.
- Tighten cap screws, retaining PTO rear cover, to specification.

Item	Measurement	Specification
PTO Rear Cover Cap Screws	Torque	28 N·m (20 lb.-ft.)

PTO Clutch Disassembly:



LEGEND:

A	Clutch Hub
B	Large Internal Snap Ring
C	Clutch Plates and Disks

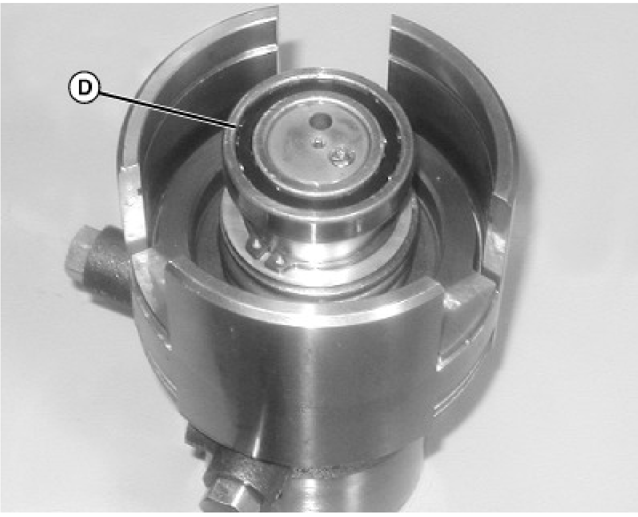
PTO Clutch

[1] - Remove clutch hub (A) from clutch cylinder.

[2] - Remove large internal snap ring (B) from PTO clutch housing.

[3] - Remove clutch plates and disks (C) from clutch cylinder.

[4] -



LEGEND:

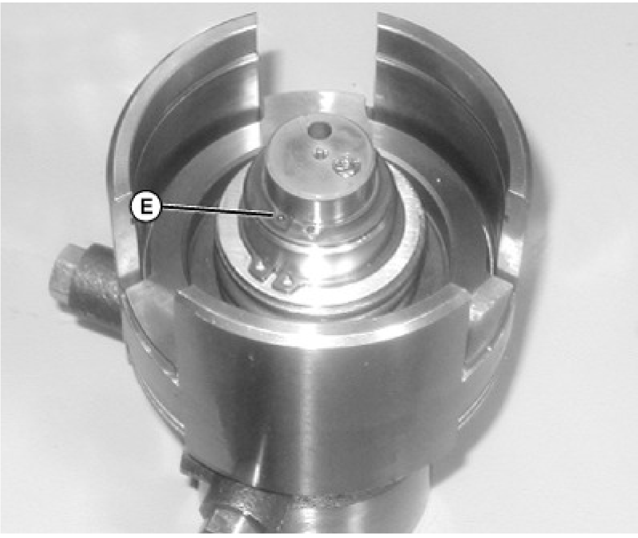
D	Bearing

PTO Shaft Bearing

Remove bearing (D) from PTO shaft.

[5] - Inspect bearing for smooth operation, wear, or damage. Replace as necessary.

[6] -



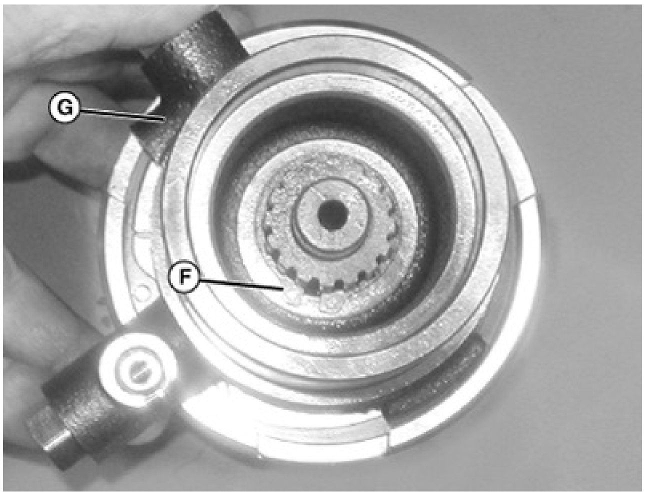
LEGEND:

E	Snap Ring

Snap Ring and Thrust Washer

Remove snap ring (E) and thrust washer from PTO shaft.

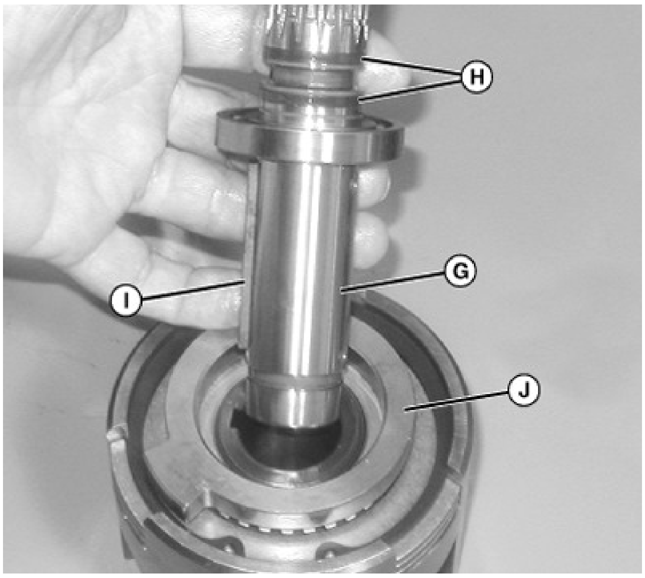
[7] -



LEGEND:

F	Snap Ring
G	PTO Shaft
H	PTO Shaft Seals
I	Key
J	Brake Clutch Hub

Snap Ring



Shaft and Bearing Assembly

Remove snap ring (F) from PTO shaft.

[8] - Remove PTO adapter housing from PTO assembly.

[9] - Remove PTO shaft (G) and bearing assembly from clutch cylinder.

[10] -

→NOTE:

Apply grease to seals when installing.

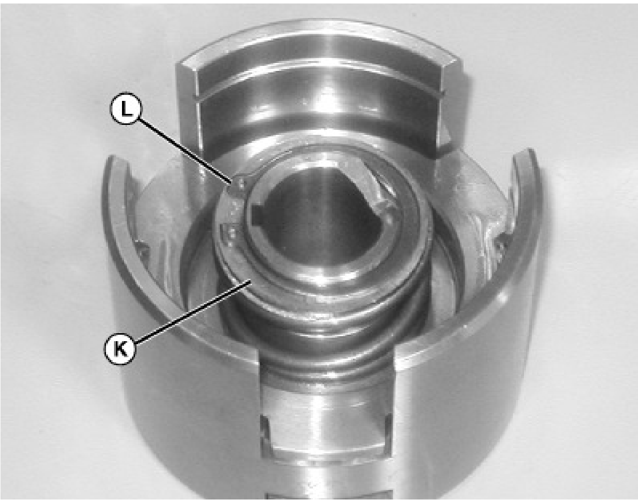
Remove and replace PTO shaft seals (H).

[11] - Remove key (I) from groove in shaft. Inspect key for shearing. Replace as necessary.

[12] - Inspect bearing for smooth operation, wear, or damage. Replace as necessary.

[13] - Remove brake clutch hub (J).

[14] -



LEGEND:

K	Clutch Spring Washer
L	External Snap Ring

Clutch Case

Place JDG1169 Clutch Spring Compressor over washer (K) in clutch.

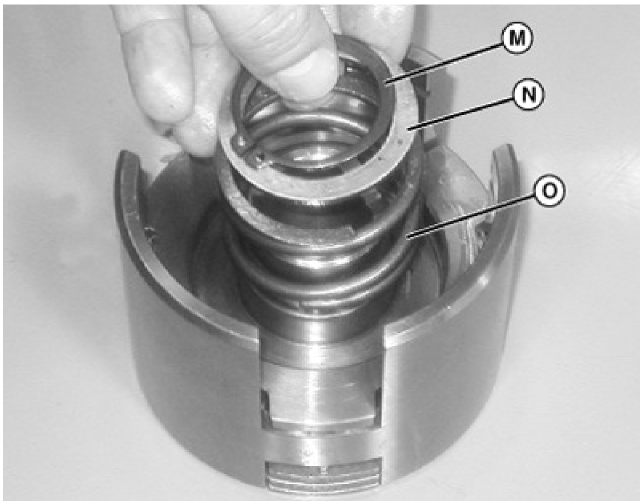
Clutch Spring Compressor

JDG1169

Compresses clutch spring for disassembly and assembly.

[15] - Using a press, compress spring and remove external snap ring (L) from groove. Slowly release spring compression.

[16] -



LEGEND:

M	External Snap Ring
N	Washer
O	Spring

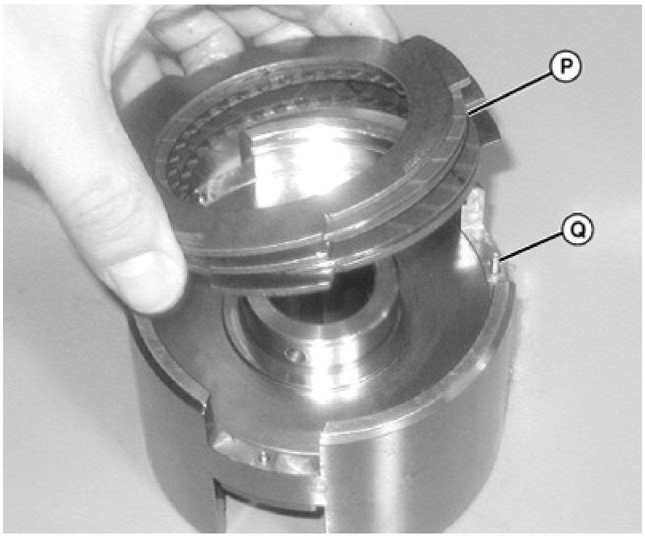
Clutch Spring

Remove external snap ring (M), washer (N) and spring (O).

[17] -

→NOTE:

When piston is removed, interlock pins (Q) will fall out of clutch housing. Use care to avoid losing pins.



LEGEND:

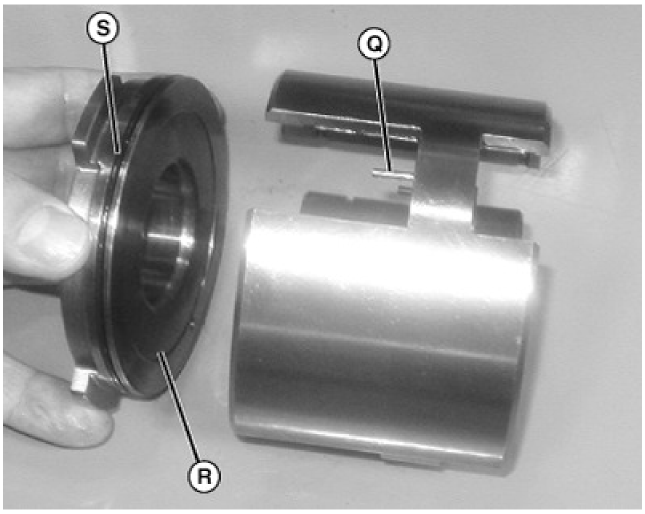
P	Brake Plates
Q	Interlock Pin (3 used)

Brake Plate

Remove snap ring and brake plates (P) from clutch housing. Be careful to not drop or lose three interlock pins (Q).

[18] - Inspect end plate, separator plates and friction plates for wear, discoloration, scoring or warping. Measure plate thickness. If plates do not meet minimum plate thickness specification, replace clutch plate pack as a unit.

[19] -



LEGEND:

R	Piston
Q	Interlock Pin (3 used)
S	O-ring

Clutch Piston

Remove piston (R).

[20] - Remove three interlock pins (Q).

[21] -

> **→NOTE:**
>
> **Apply grease to O-ring when installing.**

Replace O-ring (S) in outer groove of piston.

[22] - Measure interlock pins. If pins do not meet length specification, replace pins as a set.

Item	Measurement	Specification
Pin Length (Minimum)	Distance	19.5 mm (0.768 in.)
End Plate (Minimum)	Distance	3.05 mm (0.120 in.)
Friction Plates (Minimum)	Distance	2.15 mm (0.084 in.)
Disks (Minimum)	Distance	1.9 mm (0.075 in.)

PTO Clutch Assembly:

> ***IMPORTANT:***
>
> ***Avoid Damage! Soak clutch and brake disks in hydraulic oil for one (1) hour before assembling clutch or brake packs. Failure to complete this step will result in premature clutch failure.***

Assembly is performed in the reverse order of disassembly.

- Apply grease to packings and seal lips when installing.
- Replace piston O-ring.
- Replace PTO shaft seals.
- Install PTO clutch assembly.

Mid PTO

Removal:

[1] - Split machine at rear of tunnel to access PTO clutch shaft.

[2] - Park machine on a level surface, shut off engine, and set park brake.

[3] - If necessary, remove center lift link, draft arms, and adjustable draft links.

[4] -

→NOTE:

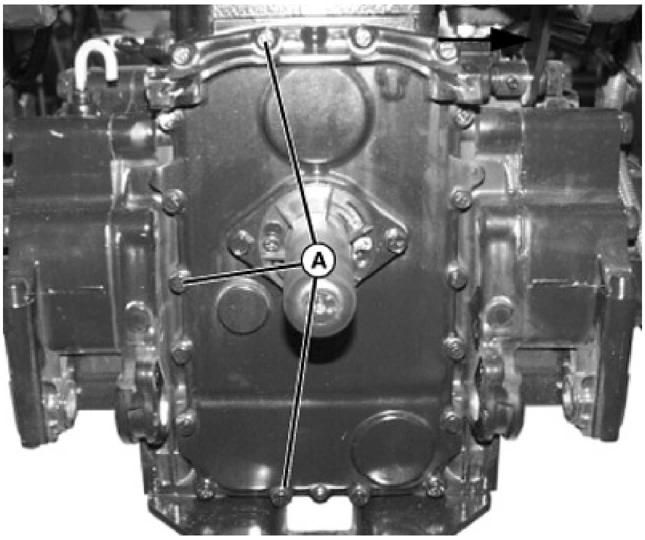
Capacity of the hydraulic system is approximately 25.7 L (6.8 gal.) for eHydro ™ machines.

Drain hydraulic oil from reservoir.

Item	Measurement	Specification
Hydraulic System	Capacity	25.7 L (6.8 gal.)

[5] - Remove rear PTO shield assembly.

[6] -



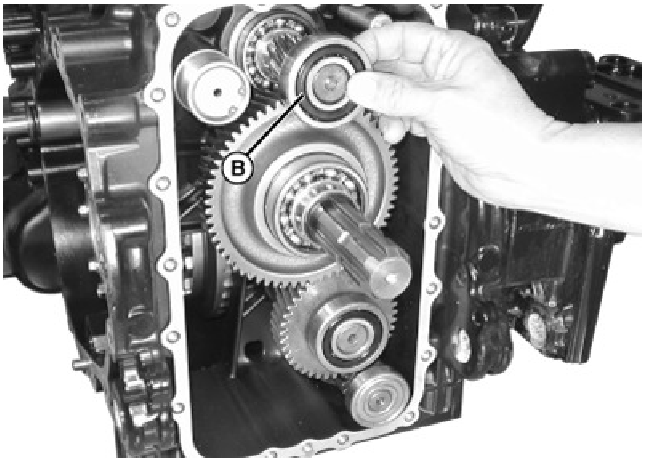
LEGEND:

A	Cap Screws

PTO Cover

Remove all cap screws (A) securing PTO cover to transmission case. Gently pry around edges of cover. Wobble shaft and pull at the same time to remove rear cover, PTO stub shaft, and gear.

[7] -



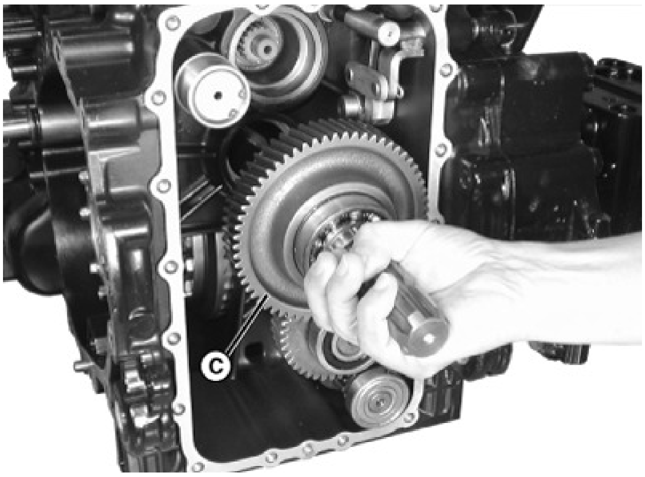
LEGEND:

B	Pinion Shaft Assembly

PTO Pinion Shaft Assembly

Remove PTO pinion shaft assembly (B).

[8] -



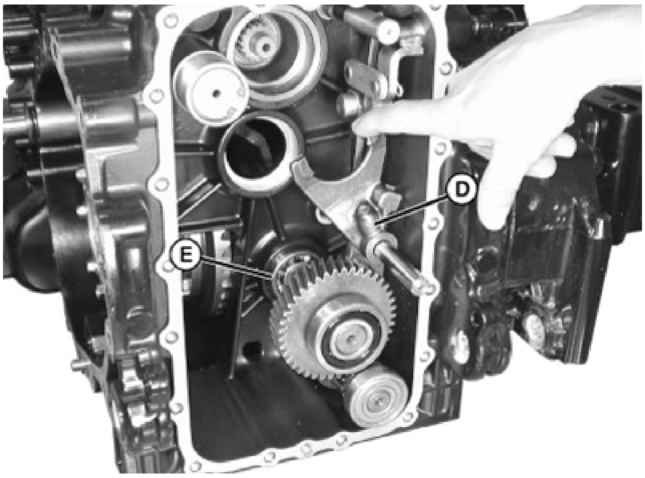
LEGEND:

C Stub Shaft Assembly

Stub Shaft to Case

Remove PTO stub shaft assembly (C).

[9] -



LEGEND:

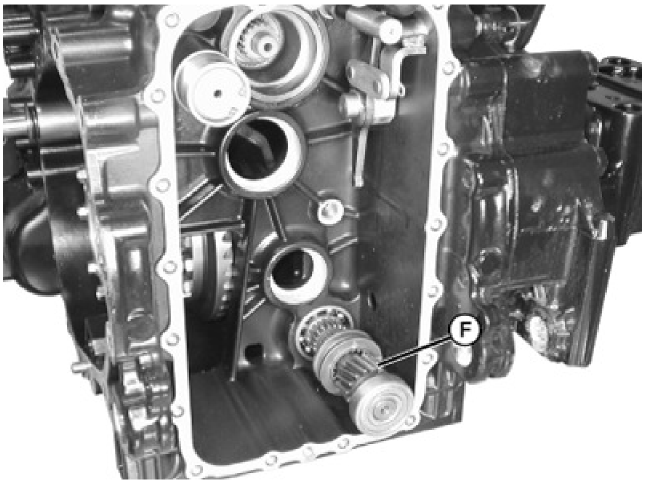
D Shift Fork Assembly

E Idler Gear Shaft Assembly Bearing

Idler Shaft Assembly

Hold up shift fork assembly (D) and remove idler gear shaft assembly bearing (E).

[10] -



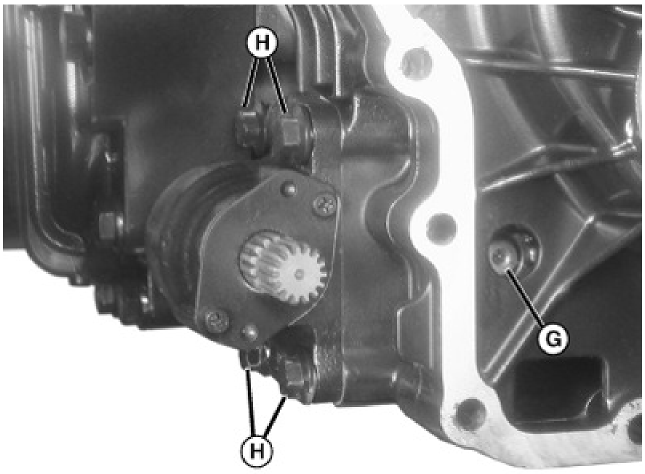
LEGEND:

F Mid Gear Shaft Assembly

Mid Gear Shaft Assembly

Remove mid PTO gear shaft assembly (F).

[11] -



LEGEND:

G	Mid PTO Shaft
H	Cap Screw (4 used)

Mid PTO Shaft

Carefully drive mid PTO shaft (G) rearward of transmission until it is clear of mid PTO bearing. Remove shaft from transmission housing.

[12] - Inspect mid PTO shaft bearings for wear or damage. Replace if necessary.

[13] - Remove four cap screws (H) and mid PTO housing from transmission housing.

Installation:

Installation is the reverse of removal. (See PTO Drive Shaft and Gears in Section 70, Group 50.)

- Apply grease to packings and seal lips when installing.
- Tighten cap screws securing mid PTO cover to transmission housing to specification.

Item	Measurement	Specification
Mid PTO Cover-to-Transmission Cap Screws	Torque	45—50 N·m (33—37 lb.-ft.)

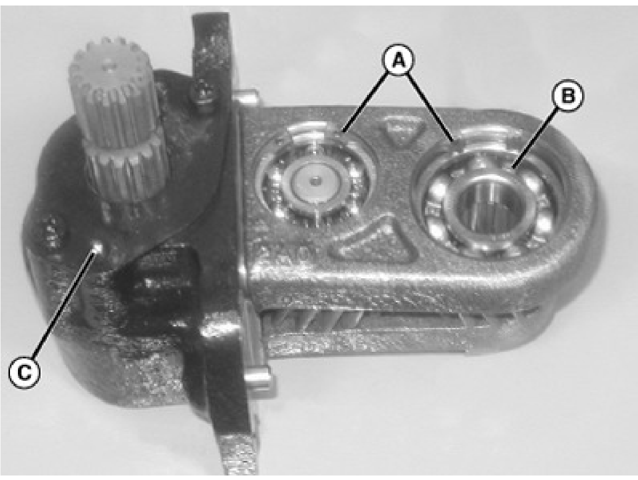
- Replace mid PTO cover to transmission housing gasket.
- Tighten four mounting mid PTO cap screws to specification.

Item	Measurement	Specification
Mid PTO Mounting Cap Screws	Torque	80 N·m (59 lb.-ft.)

→NOTE:

Replace O-rings. Old O-rings will leak.

Disassembly and Assembly



LEGEND:

A	Snap Rings
B	Bearing and Gear
C	Two Screws and Seal Plate

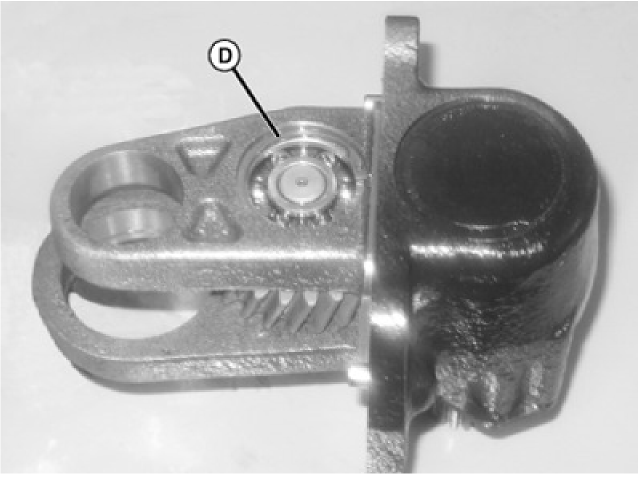
Snap Ring and Gear

[1] - Remove snap rings (A).

[2] - Remove bearing and gear (B).

[3] - Remove two screws and seal plate (C).

[4] -



LEGEND:

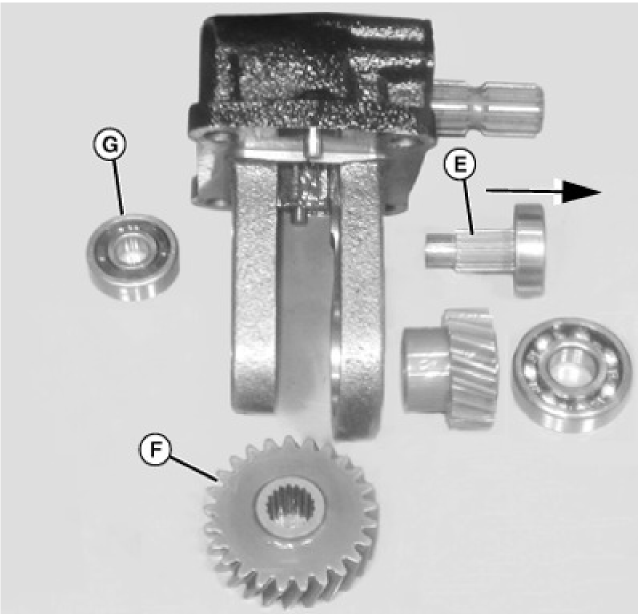
D	Snap Ring

Bearings

Remove snap ring (D).

[5] - Inspect bearing for wear or damage. Replace if necessary.

[6] -



LEGEND:

E	Shaft and Bearing
F	Gear
G	Bearing

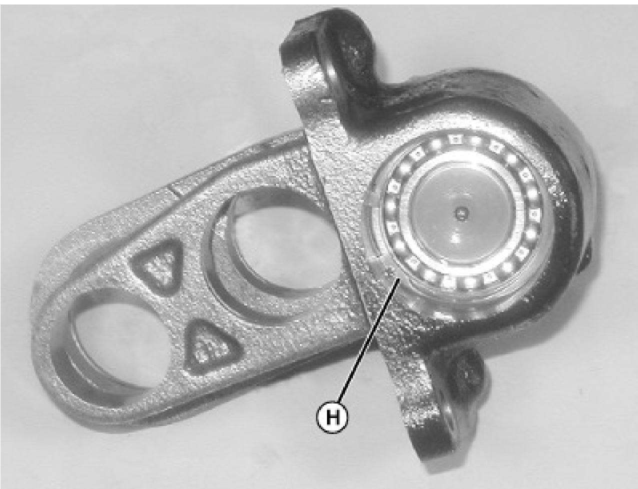
Stub Shaft and Gears

Remove shaft and bearing (E) and gear (F).

[7] - Remove remaining bearing (G).

[8] - Inspect bearings for wear or damage. Replace if necessary.

[9] -



LEGEND:

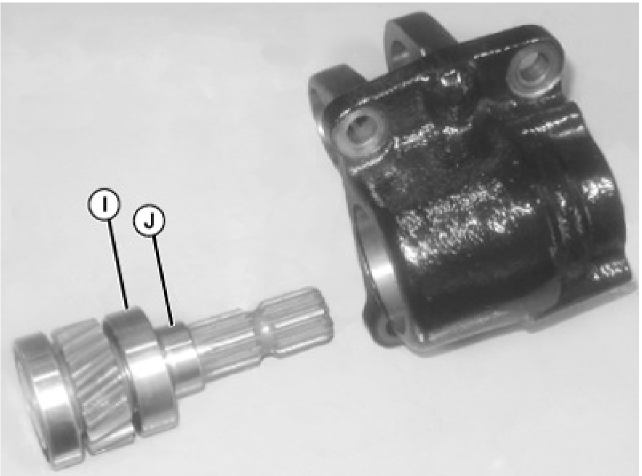
H	Snap Ring

Cover Seal

Remove cover seal to expose mid PTO stub shaft. Remove snap ring (H).

[10] - Remove stub shaft and bearing assembly from case.

[11] -



LEGEND:

I	Bearing
J	Seal Sleeve

Stub Shaft Bearing and Seal

Using an edge puller, remove bearing (I) and seal sleeve (J) from stub shaft. Replace seal sleeve before assembly.

[12] - Inspect bearings for wear or damage. Replace if necessary.

[13] -

LEGEND:

K	Shaft Seal

Stub Shaft Seal

Remove and replace shaft seal (K).

Assembly:

→NOTE:

Liberally lubricate all press fit parts with hydraulic oil to aid assembly.

Assembly is performed in the reverse order of disassembly.

- Apply grease to packings and seal lips when installing.
- Replace shaft seal.
- Replace cover seal.
- Tighten four mid PTO mounting cap screws to specification.

Item	Measurement	Specification
Mid PTO Mounting Cap Screws	Torque	80 N·m (59 lb.-ft.)

- Apply thread lock to two seal plate screws. Tighten screws to specification.

Item	Measurement	Specification
Seal Plate Screws	Torque	3 N·m (27 lb.-in.)

Section 80 - HYDRAULICS

Table of contents

Group 05 - Specifications

Hydraulic Specifications

Item	Measurement	Specification
Hydraulic Oil:		
Type		John Deere J20D
Hydraulic Oil	Capacity	25.7 L (6.8 gal.)
At Rated Engine rpm:		
Rated Engine Speed	Speed	2600 rpm
System Pressure	Pressure	17 240 kPa (172.4 bar) (2500 psi)
Steering Relief Pressure	Pressure	10 340 kPa (103.4 bar) (1500 psi)
Steering Pump	Capacity	20 L/min. (5.3 gpm)
Steering Pump	Displacement	9 cm^3/rev (0.549 cu. in../rev)
Implement Pump	Capacity	32.5 L/min. (8.6 gpm)
Implement Pump Displacement	Displacement	14.6 cm^3/rev (0.891 cu. in../rev)
Total Pump Flow	Volume	46.5 L/min. (13.9 gpm)
Pump	Type	Gear
System Regulated Pressure	Pressure	1800 kPa (18 bar) (261 psi)
Pump Size	Displacement	51 cm^3/rev (3.1 cu. in../rev)
Motor Size	Displacement	43.5 cm^3/rev (2.65 cu. in../rev)
Loop Pressure	Pressure	38 470 kPa (384.7 bar) (5580 psi)
Charge Pressure		1800 kPa (18 bar) (261 psi)
Charge Pressure variable with oil temperature (cold or hot)	Pressure	1515 / 2000 kPa (15.15 / 20.0 bar) (220 / 290 psi)
eHydro ™ Pump Type		PV Axial Piston
eHydro ™ Motor Type		MF Axial Piston
Rockshaft and Lift Arms:		
Lift Cycle Time	Time	2.5—3 seconds
Drop Cycle Time	Time	2.5—3 seconds
Lift Arm Drop in 5 minutes with Rate of Drop/Stop Valve Closed (maximum)	Distance	51 mm (2 in.)
Lift Arm Raise Angle	Angle	50°
Lift Arm Lower Angle	Angle	20°
Total Lift Arm Range	Angle	70°

Item	Measurement	Specification
Variance Between Lift Arms	Angle	5° Maximum
PTO Clutch:		
Clutch Hydraulic Pressure at Full Throttle	Pressure	860—1380 kPa (8.6—13.8 bar) (125—200 psi)
Clutch Hydraulic Pressure at Full Throttle (maximum)	Pressure	2000 kPa (20 bar) (290 psi)

Repair Specifications

Item	Measurement	Specification
Rockshaft Specifications:		
Splined Sleeve—Minimum	OD	46.5 mm (1.832 in.)
Bushing—Maximum	ID	44.2 mm (1.738 in.)

Item	Measurement	Specification
Gear Pump		
Shaft Bushing—Maximum	ID	19.15 mm (0.754 in.)
Shaft Bearing Surface—Minimum	OD	18.95 mm (0.746 in.)
Bushing—Steering (Front)—Minimum	Thickness	13.57 mm (0.534 in.)
Bushing—Implement (Rear)—Minimum	Thickness	19.02 mm (0.749 in.)
Drive/Idler Gear—Front Pump (Steering)—Minimum	Thickness	9.43 mm (0.371 in.)
Rear Pump (Implement)	Thickness	17.63 mm (0.694 in.)

Torque Specifications

Item	Measurement	Specification
Torque Specifications (alphabetical)		
Adapter Fitting to Pump (Front Pump)	Torque	21 N·m (180 lb.-in.)
Adapter Fitting to Pump (Rear Gear Pump)	Torque	28 N·m (21 lb.-ft.)
J-Tube Nuts (SCV or Manifold Block to Rockshaft)	Torque	81—89 N·m (60—67 lb.-ft.)
Manifold Block, or SCV Valve to Tunnel Cap Screws	Torque	63 N·m (47 lb.-ft.)
Pump Cover Cap Screws—M8	Torque	28 N·m (21 lb.-ft.)
Pump Cover Cap Screws—M10	Torque	55 N·m (40 lb.-ft.)
Pump to Mounting Plate Cap Screws (Front or Rear Gear Pump)	Torque	22 N·m (192 lb.-in.)
Pump to SCU Tube Nut (Front Gear Pump)	Torque	50 N·m (37 lb.-ft.)
Pump to SCV Tube Nuts (Rear Gear Pump)	Torque	69 N·m (51 lb.-ft.)
Rockshaft Cap Screws (8.8)	Torque	55 N·m (40 lb.-ft.)
Rockshaft Cap Screws (10.9)	Torque	80 N·m (60 lb.-ft.)
Rockshaft Control Valve-to-Rockshaft Housing Cap Screws	Torque	39 N·m (29 lb.-ft.)
Rockshaft Cylinder Head Cap Screws	Torque	80 N·m (60 lb.-ft.)
Rockshaft Filter Tube Nut	Torque	28 N·m (21 lb.-ft.)
Rockshaft Lift Arm to Splined Shaft Cap Screws	Torque	68 N·m (50 lb.-ft.)
SCV Tube to Quick Disconnect Coupler	Torque	51—57 N·m (38—42 lb.-ft.)
SCV Work Port Tubes to Adaptor Fittings	Torque	51—57 N·m (38—42 lb.-ft.)
Suction Tube Elbow Cap Screws (Front Gear Pump)	Torque	9 N·m (84 lb.-in.)

Item	Measurement	Specification
SCV Torque Specifications:		
Cover Socket Head Cap Screws	Torque	19 N·m (168 lb.-in.)
Lever Assembly Cap Screws	Torque	40 N·m (30 lb.-ft.)
Load Check Valves	Torque	24 N·m (212 lb.-in.)
Relief Valve	Torque	50 N·m (37 lb.-ft.)
Valve Spring Retainer Plugs	Torque	15 N·m (133 lb.-in.)

Essential or Recommended Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Adapter Fitting, 1-1/16-12 M 37° X 1-14 F ORFS

JT05689

Used to test hydraulic system pressure/flow.

Adapter Fitting, 3/4 F NPT X 1-1/16-12 F 37° Sw

JT03012

Used to test hydraulic system pressure/flow.

In-Line Flow Meter With Pressure Gauge

JT05984

Used to test hydraulic system pressure/flow.

Hose, 3/4 M NPT X 3/4 M NPT X 10 ft.

JT03377

Used to test hydraulic system pressure/flow.

Adapter Fitting, 7/16-20 M 37° X 9/16-18 M ORFS

JT03375

Used to test steering pressure.

Pressure Gauge, 0—14 000 kPa (0—140 bar) (0—2000 psi)

JT03117

Used to test steering pressure.

Hose with Quick Disconnect Fitting

JT03017

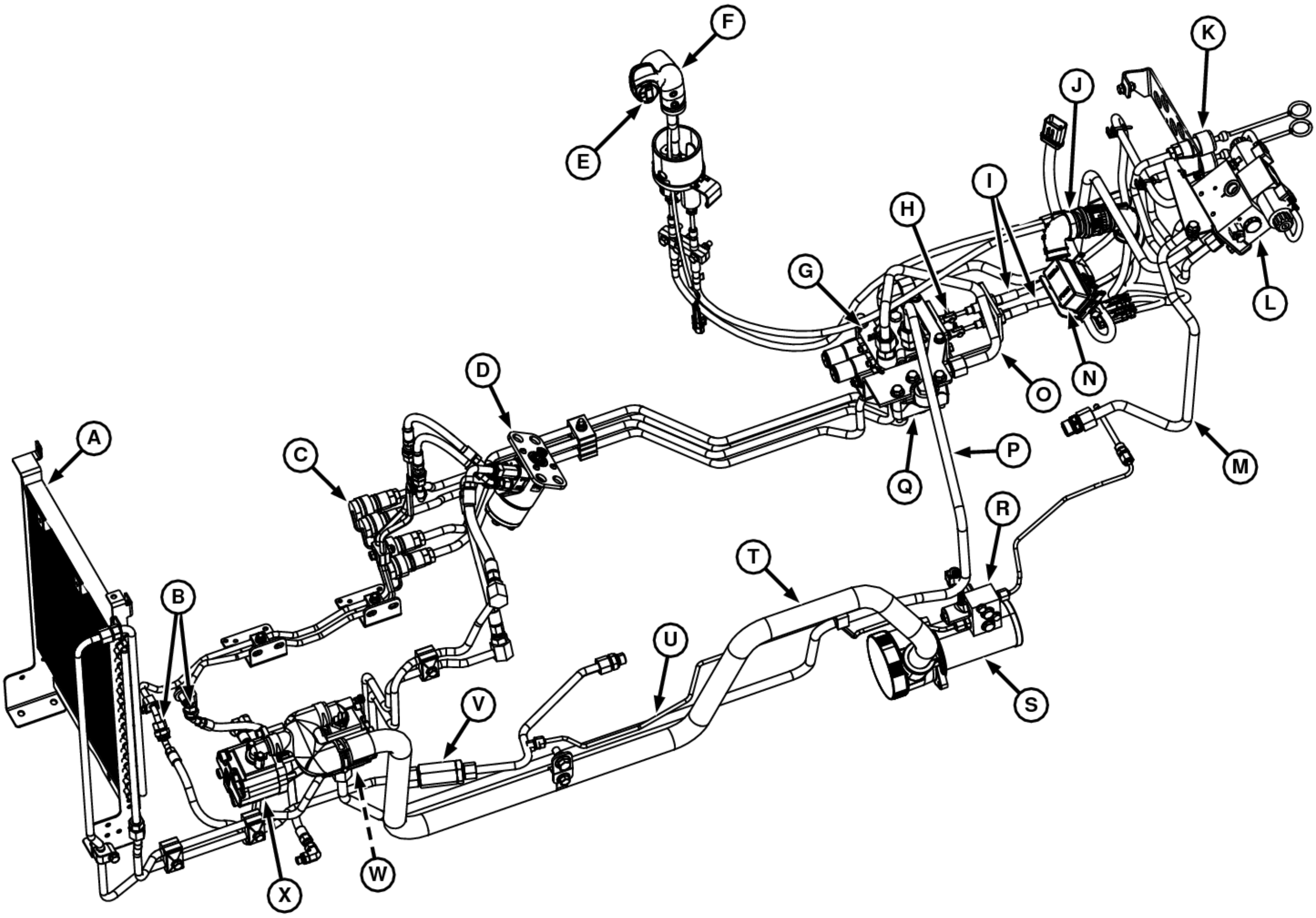
Used to test steering pressure.

Pressure Gauge — 0—2000 kPa (20 bar); or, 0—300 psi

Used to test PTO clutch pressure.

Group 10 - Component Location

Hydraulic System (Cab)—eHydro Transmission



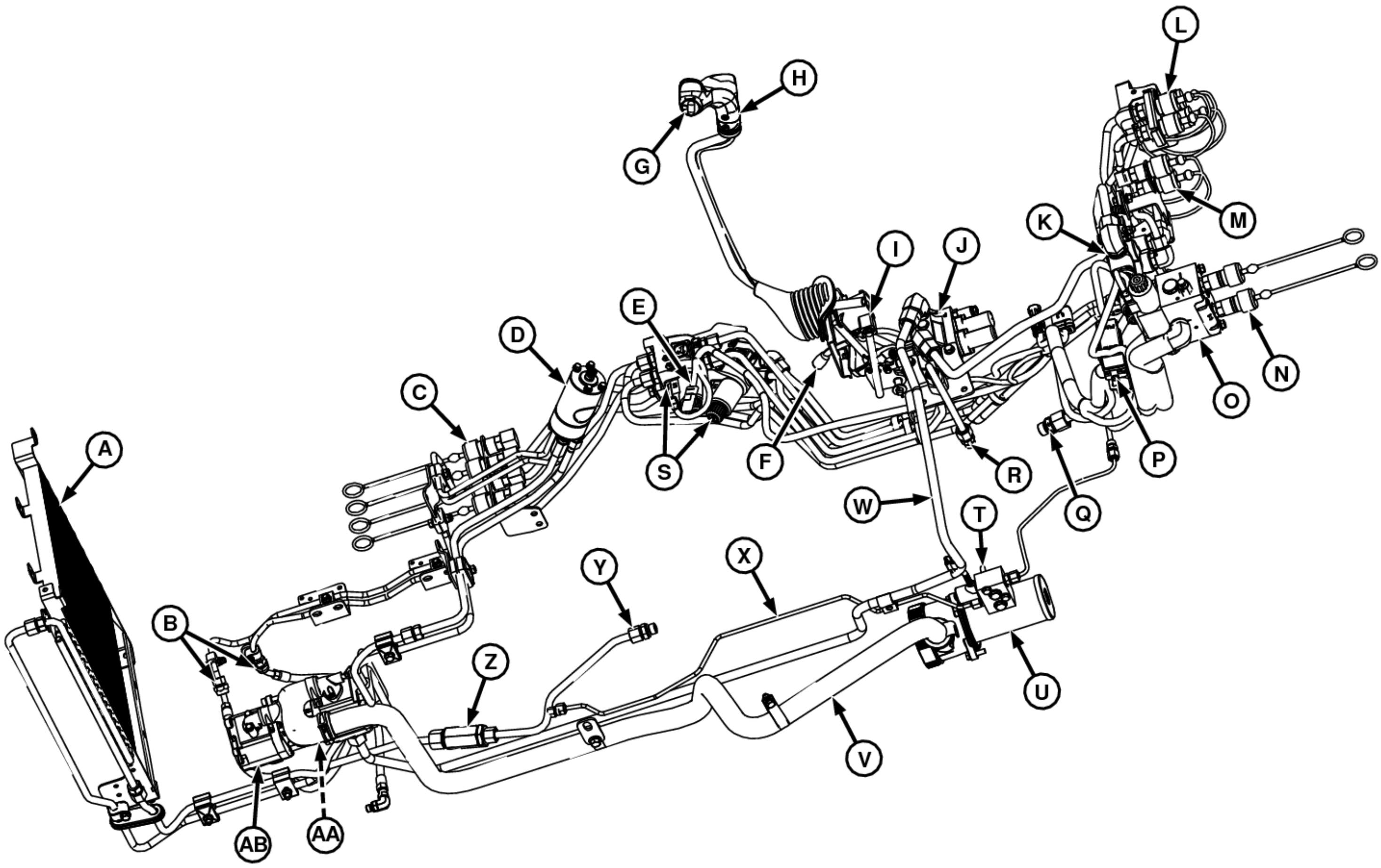
Hydraulic System Cab Component Location

LEGEND:

A	Oil Cooler
B	Steering Hose Connections

C	Front Hydraulic Quick Disconnects
D	Steering Control Unit (SCU)
E	3rd SCV EH Switch
F	SCV Control
G	Selective Control Valve (SCV) Body
H	3rd SCV Spool
I	SCV Control Cables
J	Electrical Connector
K	Rear Hydraulic Quick Disconnects
L	EH Valve
M	EH Tank Port to Rockshaft
N	Load Center
O	Selective Control Valve (SCV) Body to Manifold Line
P	Implement Pressure Line
Q	Manifold
R	Transmission PTO Clutch Solenoid Valve
S	Suction Filter
T	Suction Line (Sump to Pumps)
U	Pressure Line Tap for PTO Clutch
V	In-Line Filter
W	Rear Pump (SCV)
X	Front Pump (Steering)

Hydraulic System (Open Station)—eHydro Transmission (—OCT 2014)

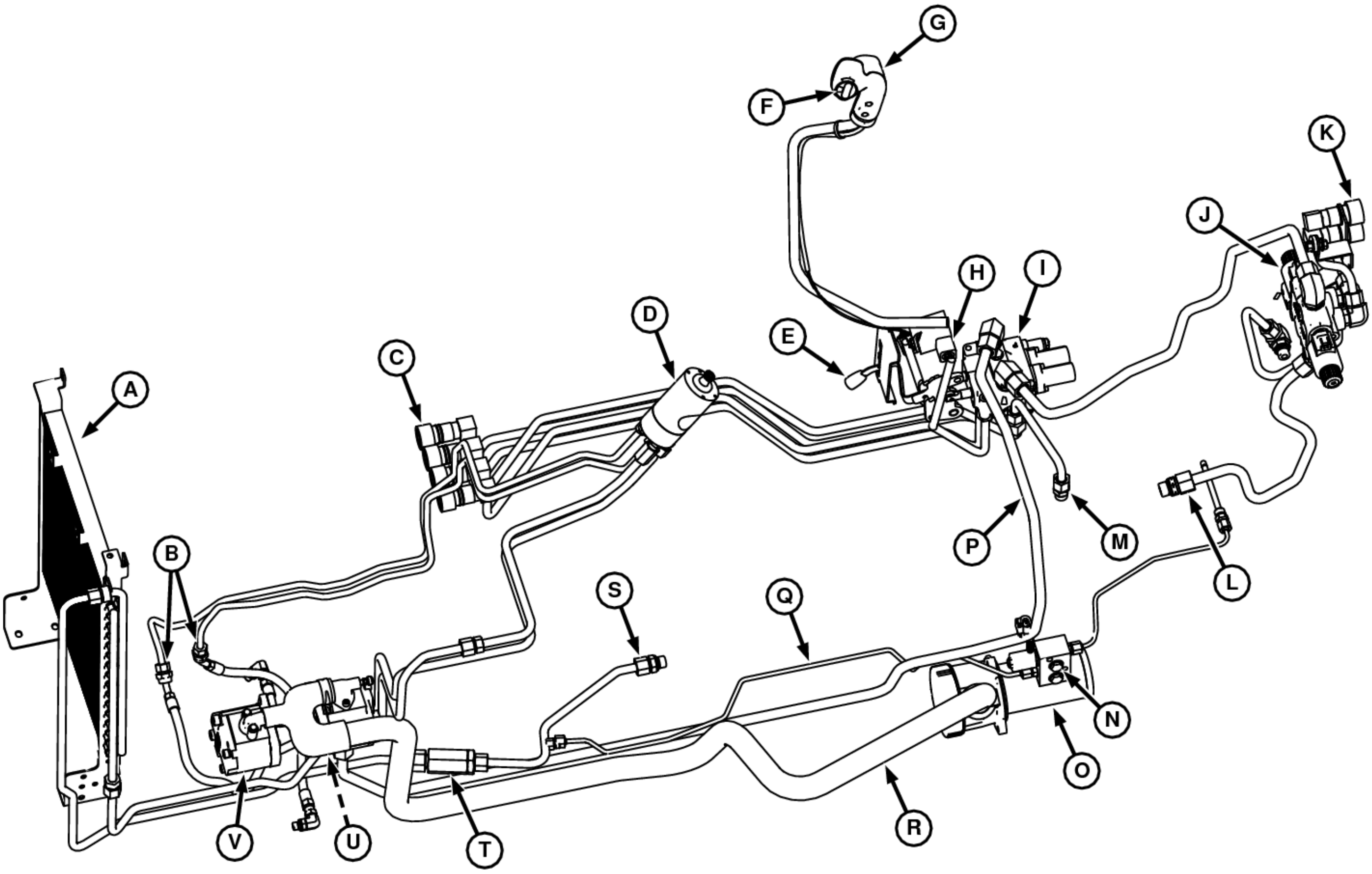


Hydraulic System Component Location Open Station (October —2013)

LEGEND:

A	Oil Cooler
B	Steering Hose Connections
C	Front Hydraulic Quick Disconnects
D	Steering Control Unit (SCU)
E	Diverter Harness
F	SCV Lever
G	3rd SCV EH Switch
H	SCV Control
I	3rd EH Harness
J	Dual Spool Selective Control Valve (SCV) Body
K	Single Spool EH Valve
L	Diverter Hydraulic Quick Disconnects
M	Single Spool EH Hydraulic Quick Disconnects
N	3rd Spool EH Valve Hydraulic Quick Disconnects
O	3rd Spool EH Valve
P	Load Center
Q	3rd Spool EH Valve to Rockshaft
R	Dual Spool Selective Control Valve (SCV) Body to Tank
S	6 Way Diverter Valve
T	Transmission PTO Clutch Solenoid Valve
U	Suction Filter
V	Suction Line (Sump to Pumps)
W	Implement Pressure Line
X	Pressure Line Tap for PTO Clutch
Y	Hydraulic Filter to HST
Z	In-Line Filter
AA	Rear Pump (SCV)
AB	Front Pump (Steering)

Hydraulic System (Open Station)—eHydro Transmission (OCT 2014—)



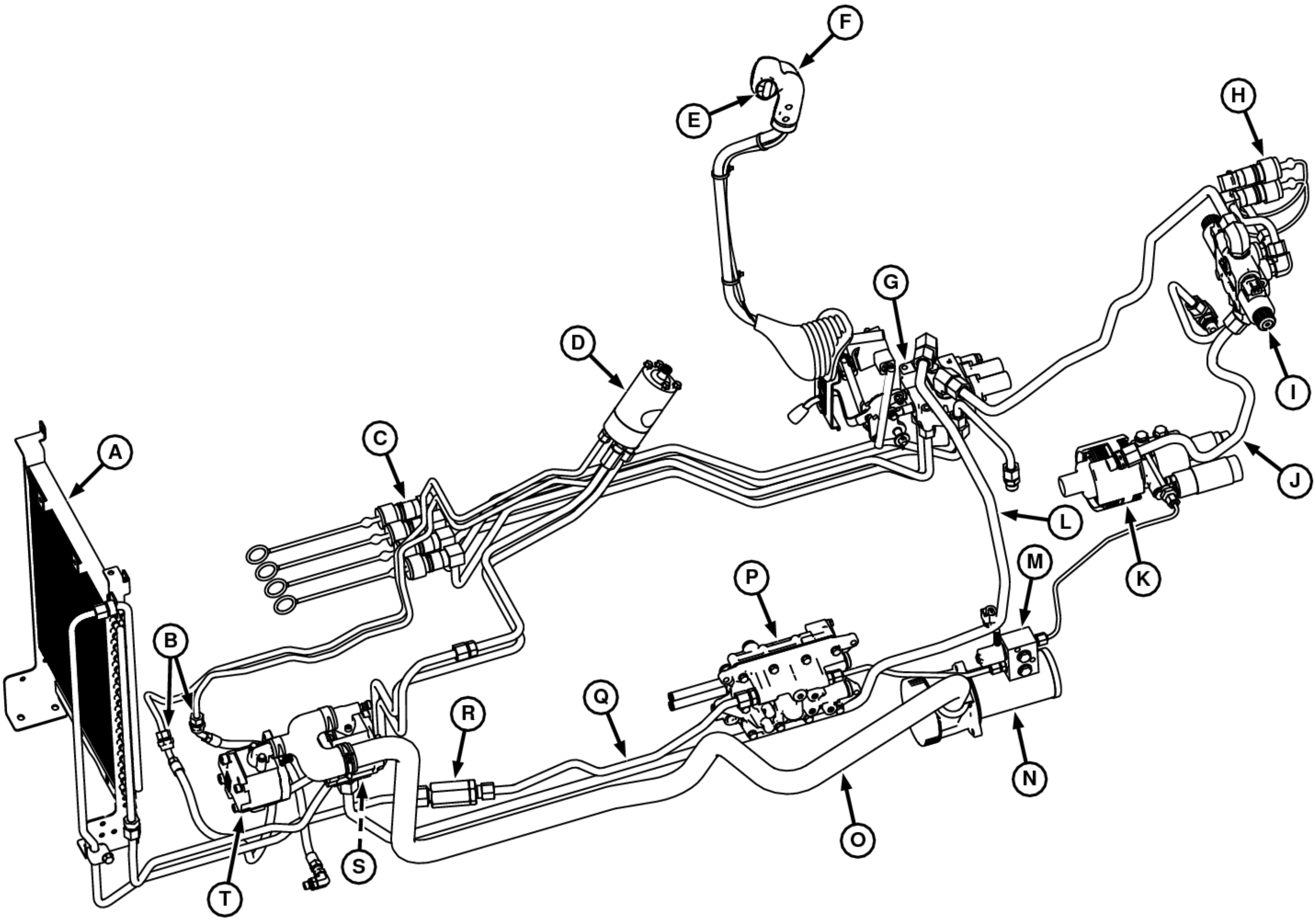
Hydraulic System components (October 2014—)

LEGEND:

A	Oil Cooler
B	Steering Hose Connections
C	Front Hydraulic quick Disconnect
D	Steering Unit Control (SCU)
E	SCV Lever
F	3rd SCV EH Switch
G	SCV Control
H	3rd EH Harness
I	Dual Spool Selective Control Valve (SCV) Body
J	Single Spool EH Valve
K	Single Spool EH Hydraulic Quick Disconnect
L	3rd Spool EH Valve to Rockshaft
M	Dual Spool Body to Tank
N	Transmission PTO Clutch Solenoid Valve

O	Suction Filter
P	Implement Pressure Line
Q	Pressure Line Tap for PTO Clutch
R	Suction Line (Sump to Pumps)
S	Hydraulic Filter to HST
T	In Line Filter
U	Rear Pump (SCV)
V	Front Pump (Steering)

Hydraulic System—PowrReverser Transmission



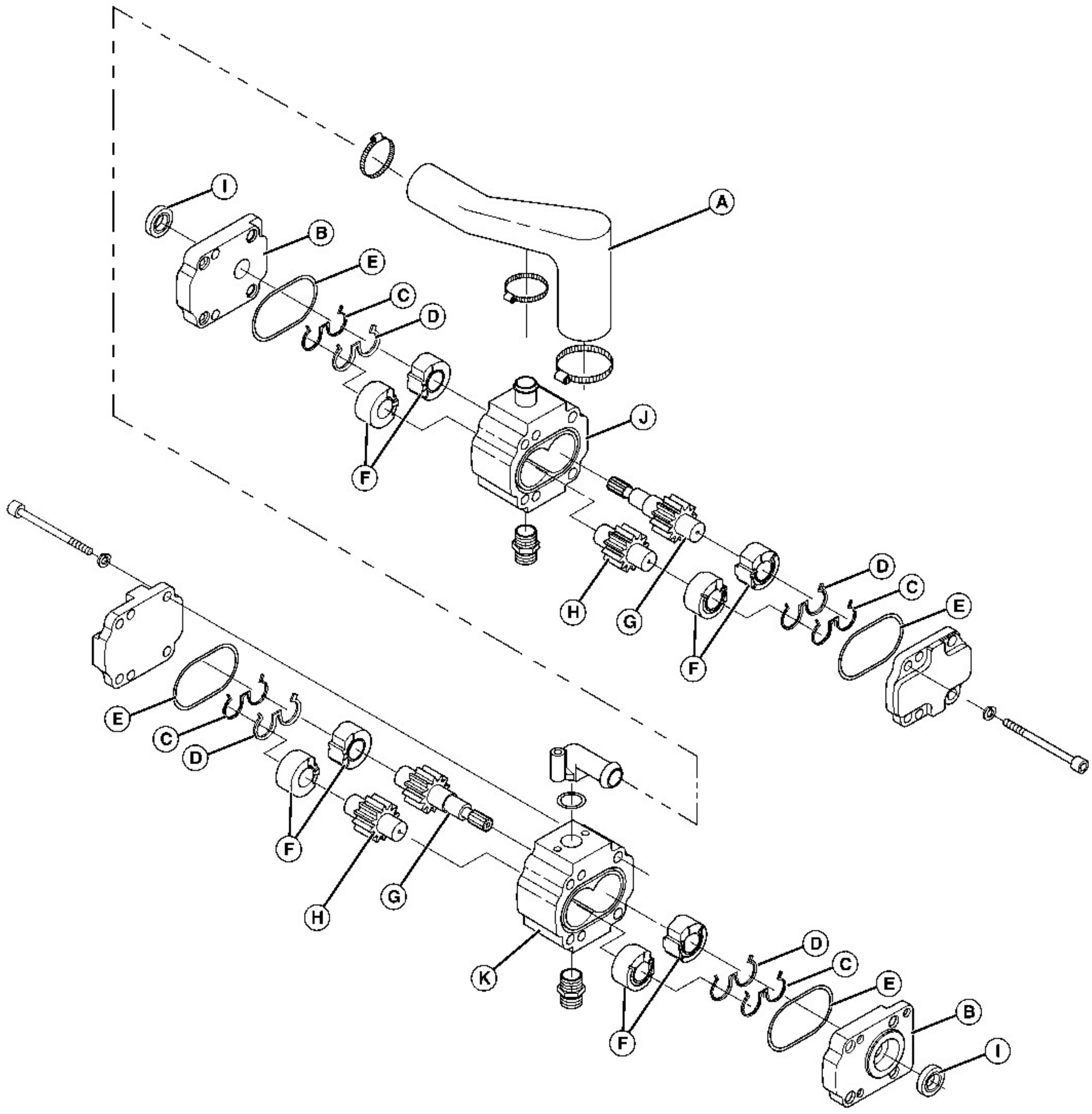
Hydraulic System Component Location—PRT

LEGEND:

A	Oil Cooler
B	Steering Hose Connections
C	Front Hydraulic Quick Disconnects
D	Steering Control Unit (SCU)

E	3rd SCV EH Switch
F	SCV Control
G	Selective Control Valve (SCV) Body
H	Rear Hydraulic Quick Disconnects
I	EH Valve
J	EH Tank Port to Rockshaft
K	PRT Clutch
L	Implement Pressure Line
M	Transmission PTO Clutch Solenoid Valve
N	Suction Filter
O	Suction Line (Sump to Pumps)
P	PRT Valve
Q	Pressure Line Tap for PTO Clutch
R	In-Line Filter
S	Rear Pump (SCV)
T	Front Pump (Steering)

Hydraulic Gear Pump

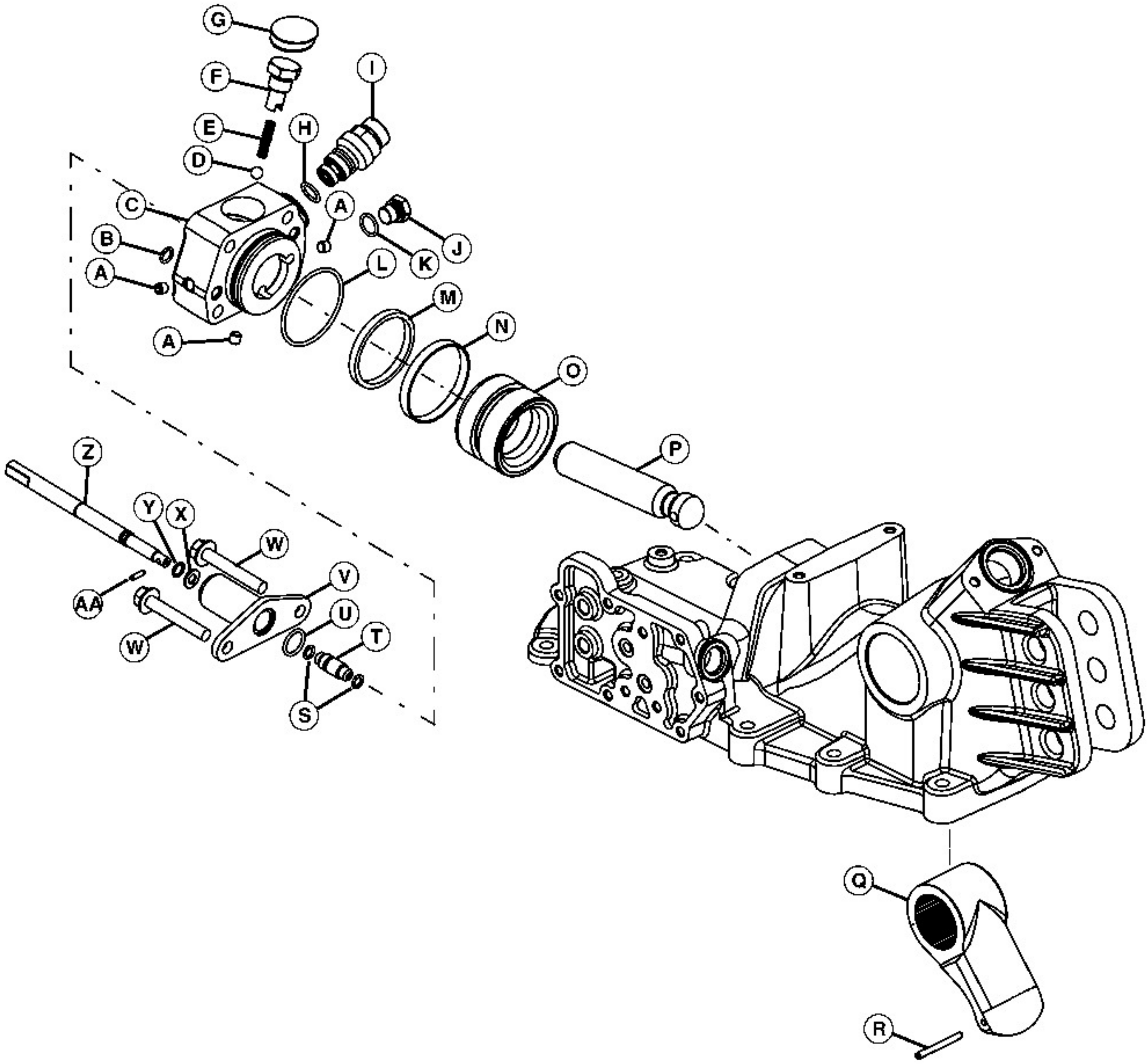


Hydraulic Gear Pump Component Location

LEGEND:

A	Suction Manifold
B	Front Cover
C	Seal
D	Backing Ring
E	Body Seal
F	Bushings
G	Drive Gear
H	Driven Gear
I	Drive Gear Shaft Seal
J	Rear Pump (Rockshaft)
K	Front Pump (Steering)

Rockshaft Piston, Rod, and Rate of Drop Valve



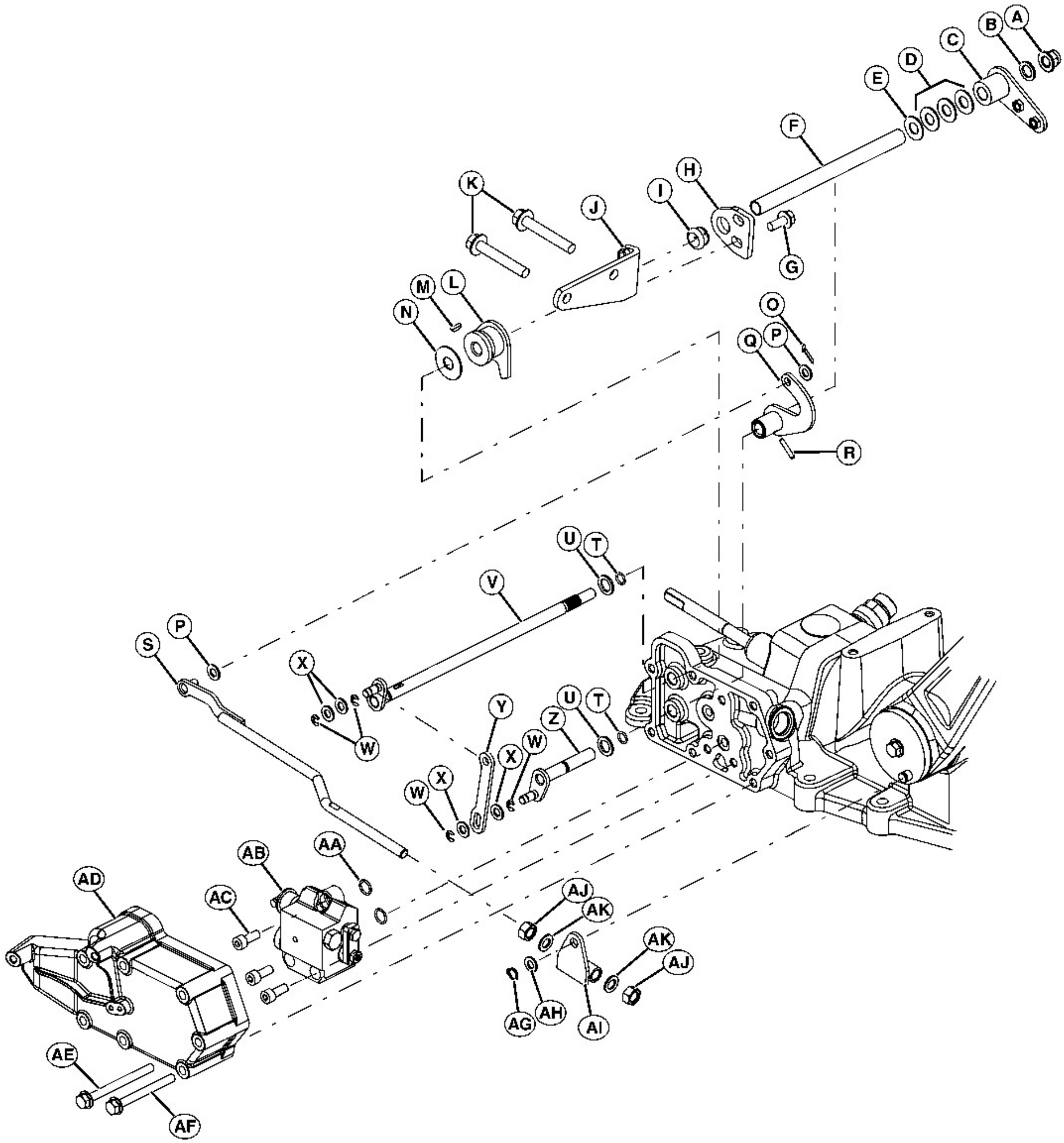
Rockshaft Piston, Rod, and Rate of Drop Valve Component Location

LEGEND:

A	Plug (3 used)
B	O-ring
C	Cover, Cylinder head
D	Ball
E	Spring
F	Plug
G	Cap
H	O-ring
I	Valve, Relief
J	Plug
K	O-ring
L	O-ring
M	Slip Ring
N	Seal
O	Piston
P	Rod
Q	Arm, Crank
R	Pin
S	O-ring
T	Valve Spool
U	O-ring

V	Stem Housing
W	Flange Screw (2 used)
X	Washer
Y	O-ring
Z	Stem, Valve
AA	Pin

Rockshaft Control Valve, Plunger Assembly and Controls



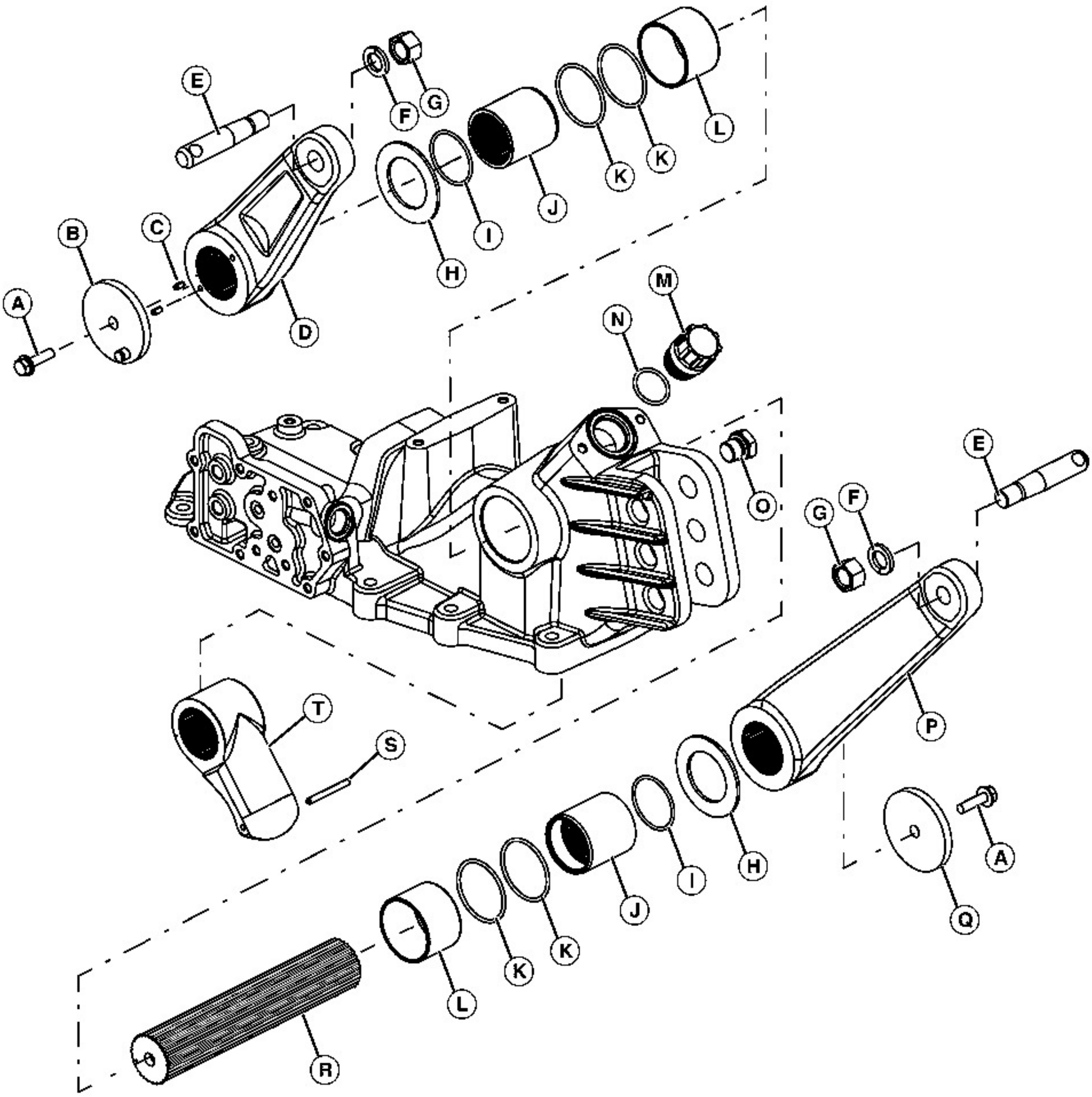
Rockshaft Control Valve, Plunger Assembly and Controls Component Location

LEGEND:

A	Nut
B	Washer
C	Arm, Lift Control
D	Washer, Friction (AR)
E	Washer
F	Tube
G	Flange Screw (2 used)
H	Bracket
I	Bushing

J	Bracket Weldment
K	Flange Screw (2 used)
L	Cam
M	Key
N	Washer
O	Cotter Pin
P	O-ring
Q	Cam
R	Pin
S	Feedback Arm
T	O-ring (2 used)
U	Washer (2 used)
V	Cam Shaft
W	C-Clip (4 used)
X	C-Clip (4 used)
Y	Link Bracket
Z	Cam Shaft
AA	O-ring (2 used)
AB	Valve, Rockshaft Control
AC	Socket Head Cap Screw (3 used)
AD	Control Valve Cover
AE	Bolt (2 used)
AF	Bolt (5 used)
AG	Snap Ring
AH	Washer
AI	Washer (2 used)
AJ	Nut (2 used)
AK	Feedback Bracket

Rockshaft and Lift Arms (Exploded View)



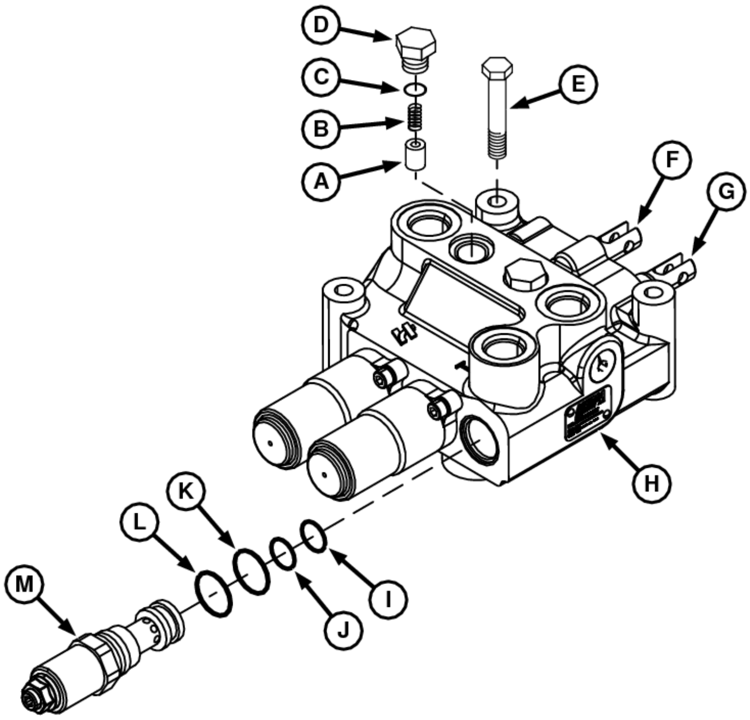
Rockshaft and Lift Arms (Exploded View)

LEGEND:

A	Bolt (2 used)
B	Plate, Cam
C	Pin, Split (2 used)
D	Arm, Lift
E	Pin (2 used)
F	Lock Washer (2 used)
G	Nut (2 used)
H	Washer (2 used)
I	O-ring (2 used)
J	Splined Sleeve (2 used)
K	O-ring (4 used)
L	Bushing (2 used)
M	Cap
N	O-ring
O	Plug
P	Arm, Lift
Q	Plate
R	Shaft, Splined

S	Pin
T	Arm, Crank

SCV Components

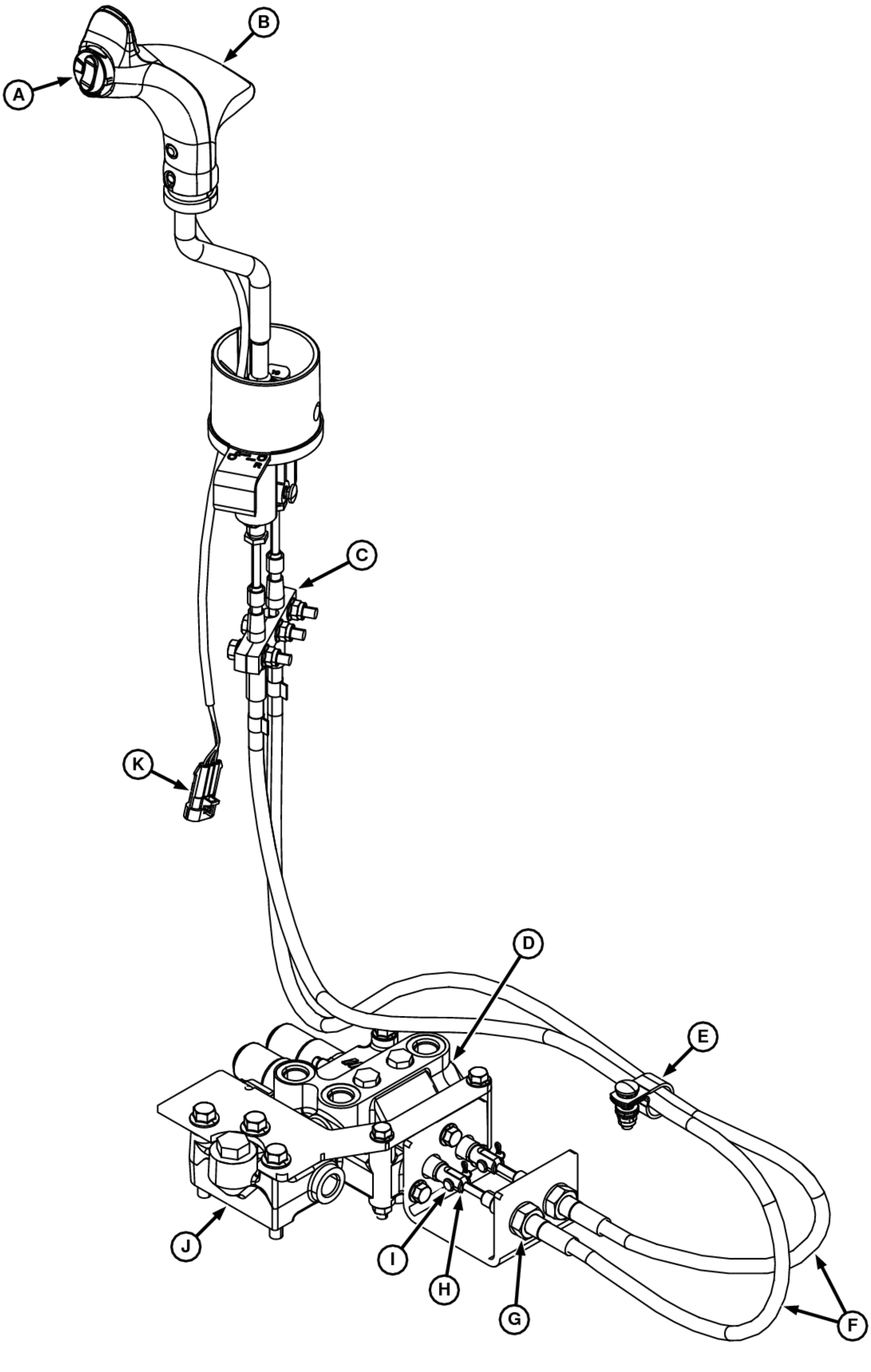


SCV Components

LEGEND:

A	Poppet (3 used)
B	Spring (3 used)
C	O-ring (3 used)
D	Cap (3 used)
E	Cap Screw
F	Spool
G	Spool
H	Valve Body
I	Backing Washer
J	Backing Washer
K	O-ring
L	O-ring
M	Charge Pressure Relief Valve

SCV Cable Control Components



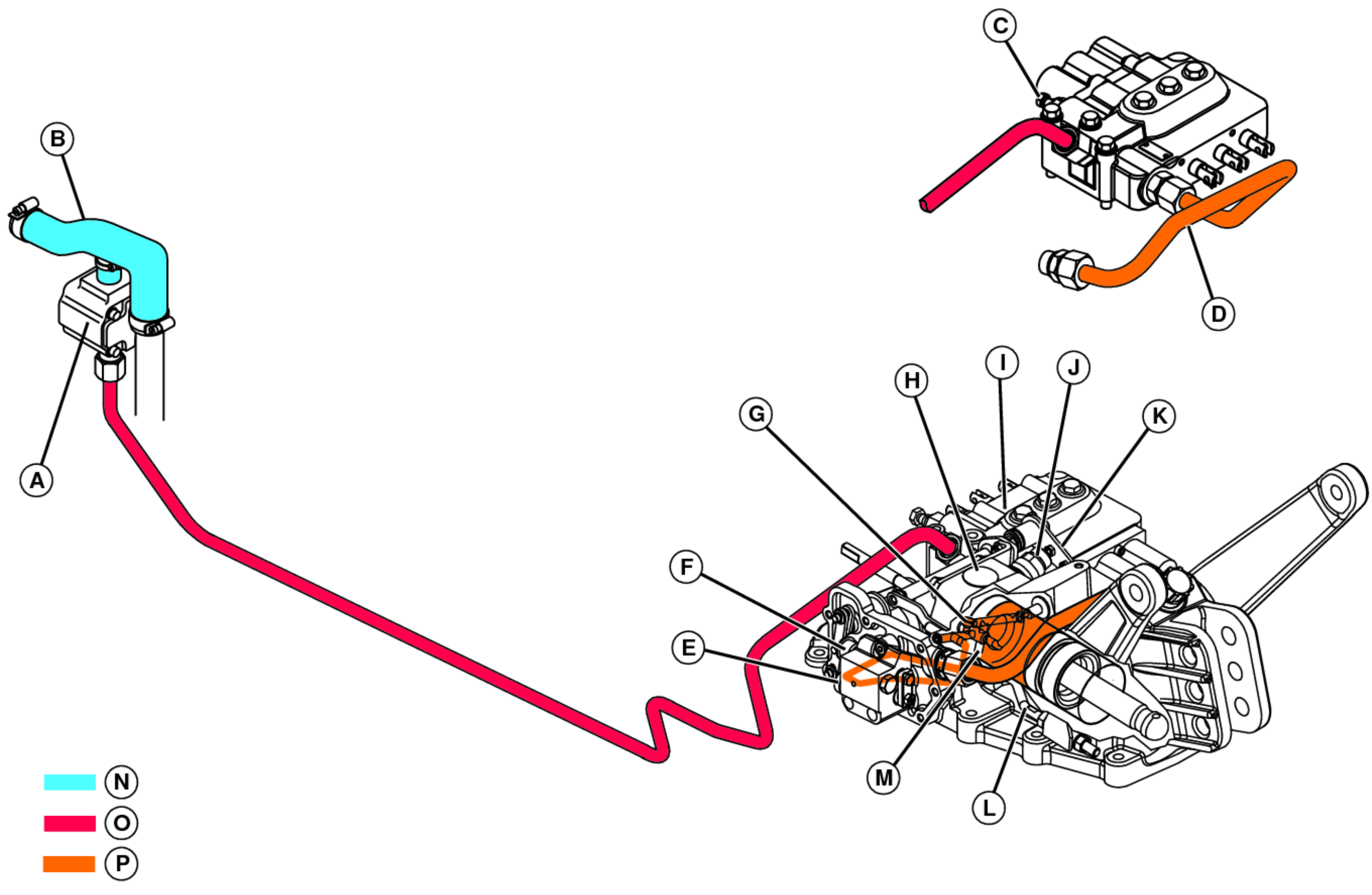
SCV Cable Control Components

LEGEND:

A	3rd EH Control Switch
B	3rd SCV Control Lever
C	Clamp with 3 M8x40 Bolts and Nut (3 used)
D	Dual SCV Valve Body

E	Clamp with Hardware
F	SCV Control Cable (2 used)
G	Adjusting Nut (2 used on each cable)
H	Spring Locking Pin (2 used)
I	Drilled Pin (2 used)
J	Manifold
K	3rd EH Harness Connector

SCV and Rockshaft System Components

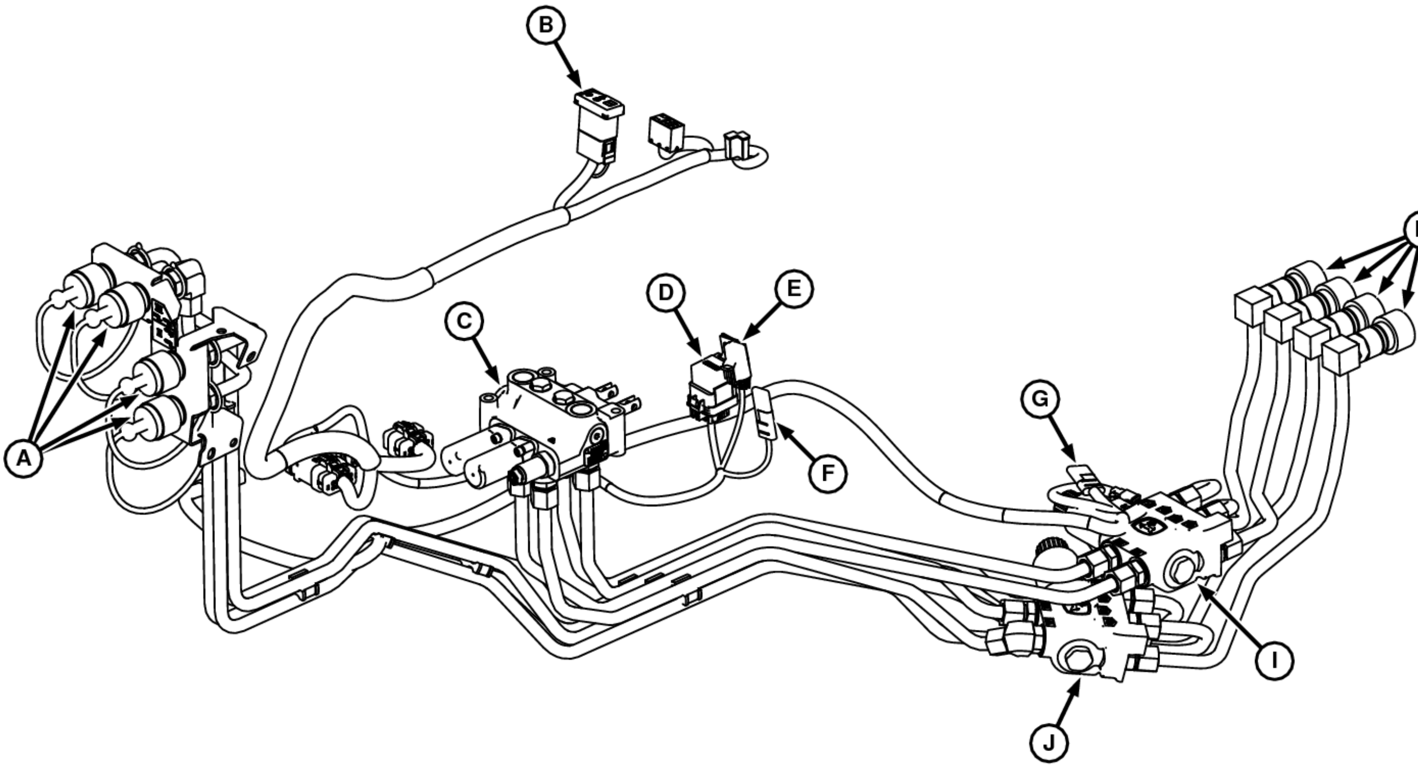


SCV and Rockshaft System Components

LEGEND:

A	Gear Pump, Rear (Implement)
B	Hydraulic Oil Suction Manifold
C	SCV System Pressure Relief Valve
D	Rockshaft System Pressure Supply Line
E	Lowering Valve
F	Rate Of Drop/Stop Valve
G	Main Spool Valve
H	Piston Cover
I	SCV
J	Rockshaft Relief Valve
K	Rockshaft Control Arm
L	Position Feedback Linkage
M	Cylinder
N	Sump Oil
O	High Pressure Oil
P	Rockshaft Pressure Oil

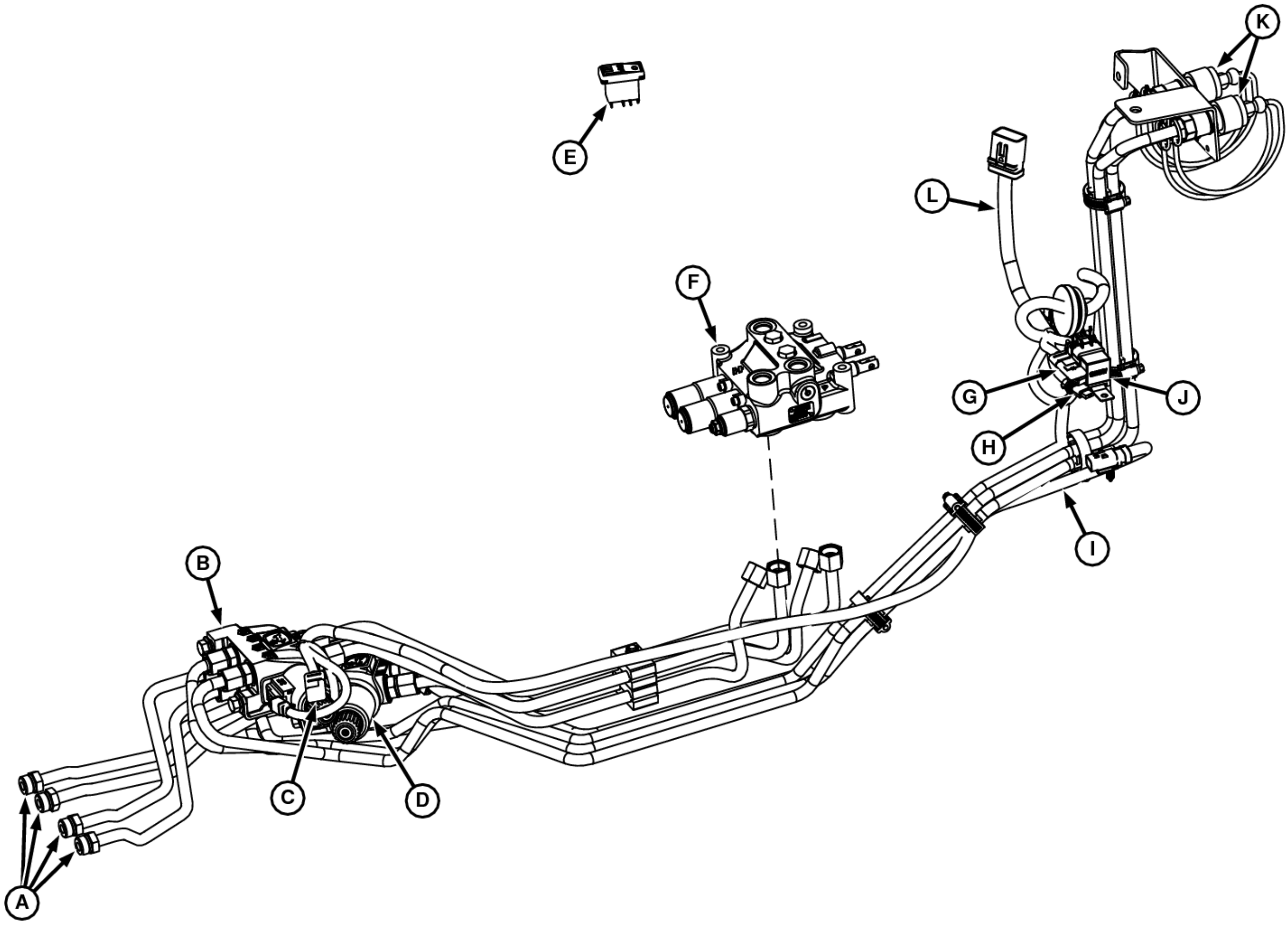
Diverter Valve Components



Diverter Valve

LEGEND:	
A	Rear Hydraulic Quick Disconnects
B	Diverter Valve Control Switch
C	SCV - 2 Spool
D	Diverter Valve Solenoid Relay
E	Fuse
F	Diode
G	Diode
H	Front Hydraulic Connectors
I	Diverter Valve
J	Diverter Valve

Diverter Valve Components (OCT 2014—)



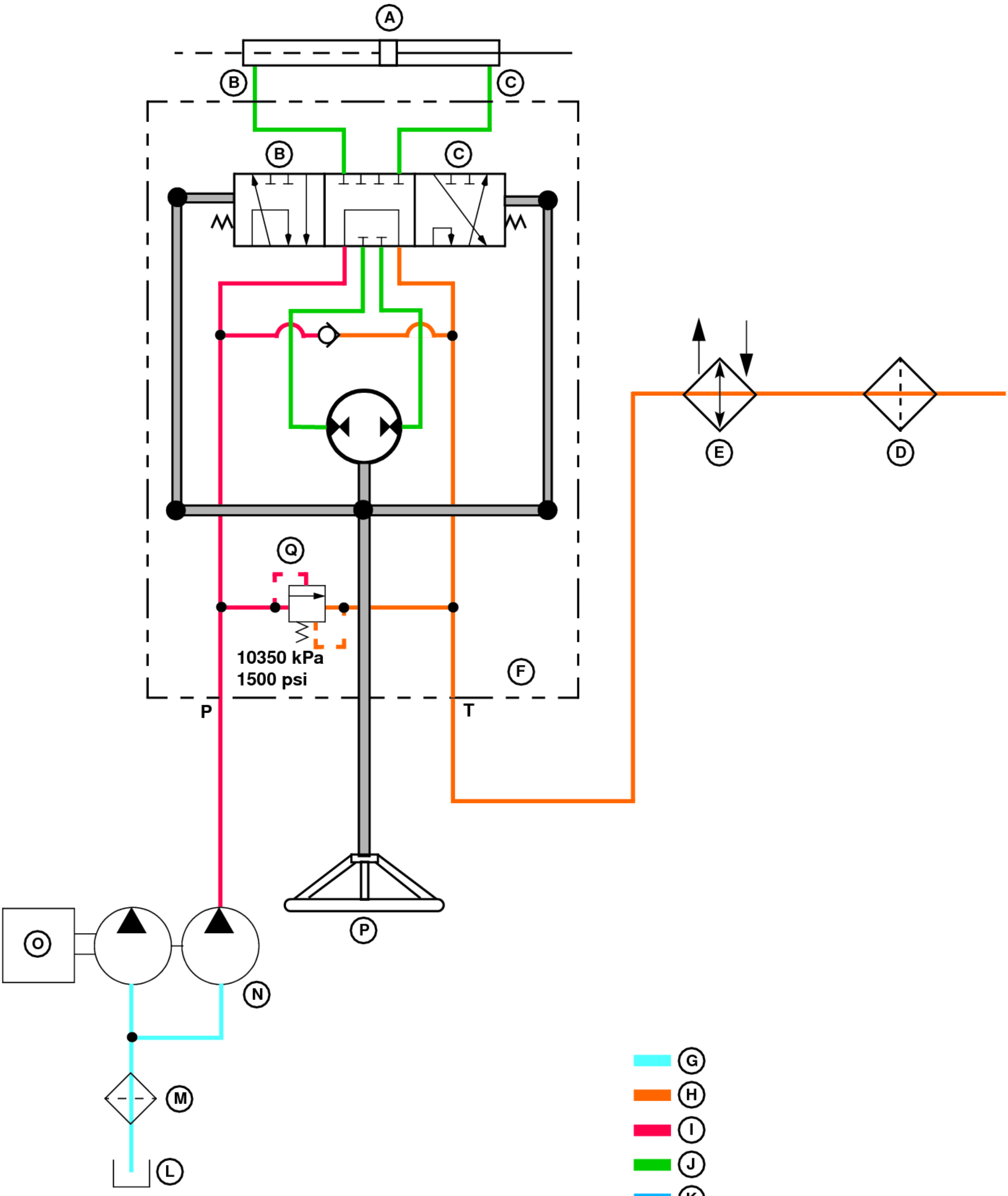
Diverter Valve Components (October 2014—)

LEGEND:

A	Front Hydraulic Connectors
B	Diverter Valve
C	Diode
D	Diverter Valve
E	Diverter Valve Control Switch
F	SCV - 2 Spool
G	Diode
H	Fuse
I	Diverter Jumper Wiring Harness
J	Diverter Valve Solenoid Relay
K	Rear Hydraulic Quick Disconnects
L	Rear Wire Harness Connectors

Group 15 - Schematics

Steering System Schematics



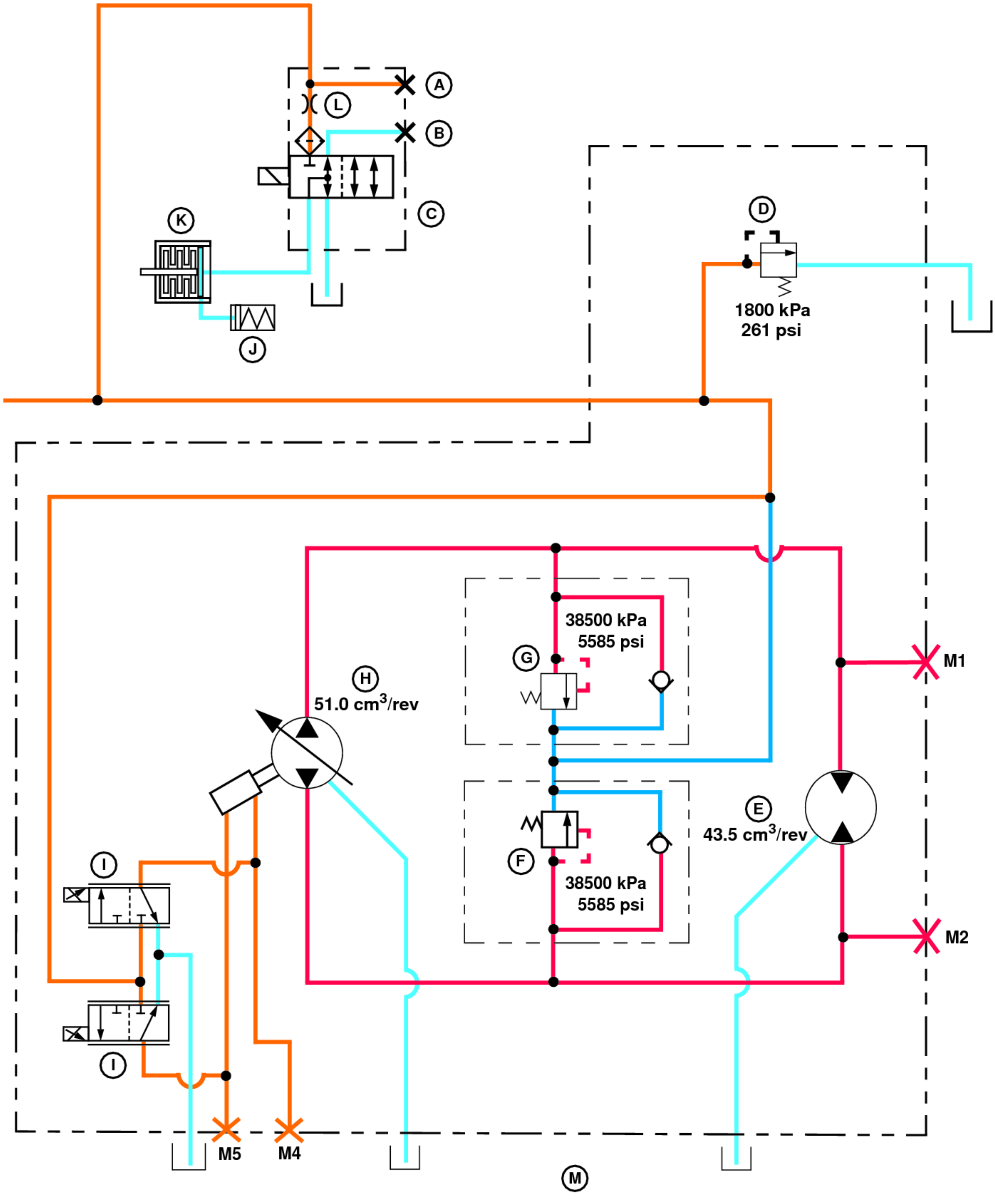
Steering Schematics — Page 1 of 2

LEGEND:

A	Steering Cylinder
B	Left

C	Right
D	In-Line Filter
E	Oil Cooler
F	Power Steering Valve
G	Sump Oil
H	Charge Pressure/Tunnel Lubrication Oil
I	High Pressure Oil
J	Steering Oil
K	Make Up/Closed Loop Oil
L	Sump
M	Suction Filter
N	9 cm^3 / rev Gear Pump (Front)
O	Engine
P	Steering Wheel
Q	Relief Valve

Steering System Schematics (continued)



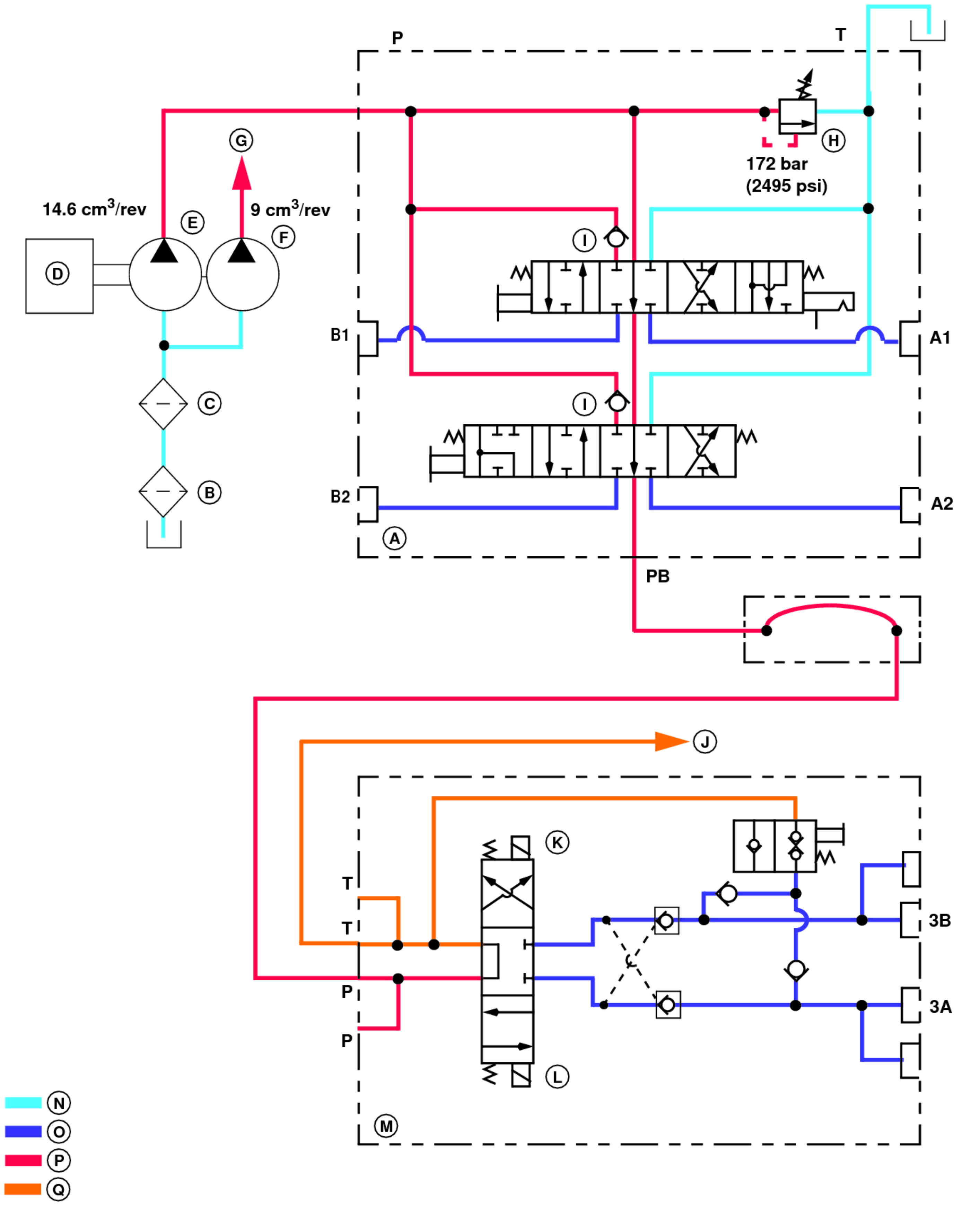
Steering Schematics — Page 2 of 2

LEGEND:

A	Diverter Valve Port Out
B	Diverter Valve Port Return
C	PTO Clutch Solenoid Valve
D	Charge Pressure Relief Valve
E	Hydraulic Motor 43.5 cm^3/rev
F	System Relief Valve

G	System Relief Valve
H	eHydro Hydraulic Pump 51.0 cm^3/rev
I	Proportional Solenoid Valve (2 used)
J	Accumulator
K	PTO Clutch
L	Orifice
M	Hydrostatic Transmission

3rd EH Valve Schematics (OCT —2014)



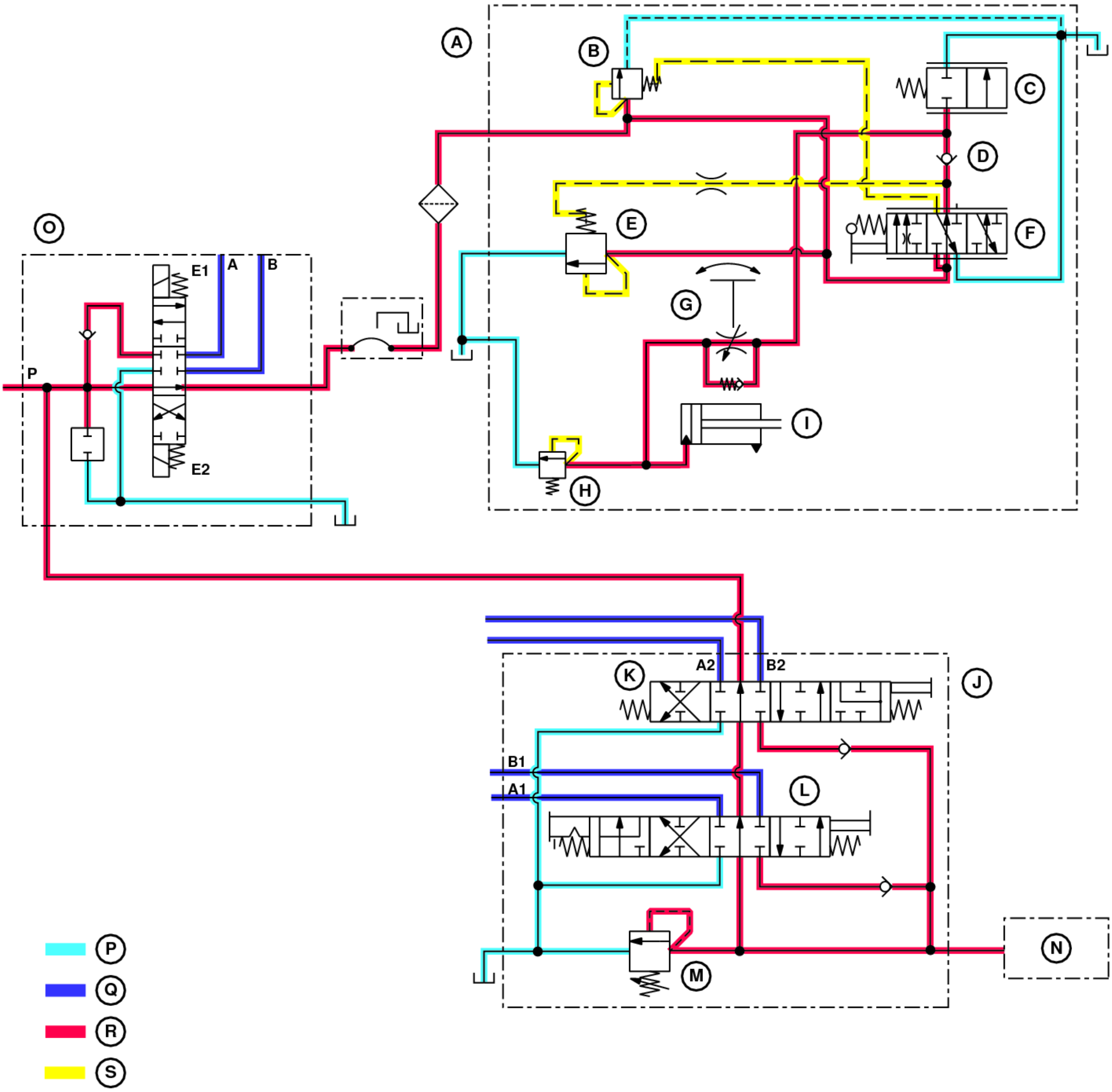
3rd EH Valve Schematics

LEGEND:

A	Dual Selective Control Valve (SCV)
B	Intake Filter (150 mesh)
C	Suction Filter
D	Engine

E	Implement Gear Pump
F	Gear Pump
G	To Steering
H	System Pressure Relief Valve
I	Load Check Valve
J	To Rockshaft
K	Y09 Third Function “A” Solenoid
L	Y10 Third Function “B” Solenoid
M	Electro-Hydraulic 3rd SCV
N	Sump Oil
O	SCV Work Port Oil
P	High-Pressure Oil
Q	Rockshaft Pressure Oil

3rd EH Valve Schematics (Cab)(OCT 2014—)



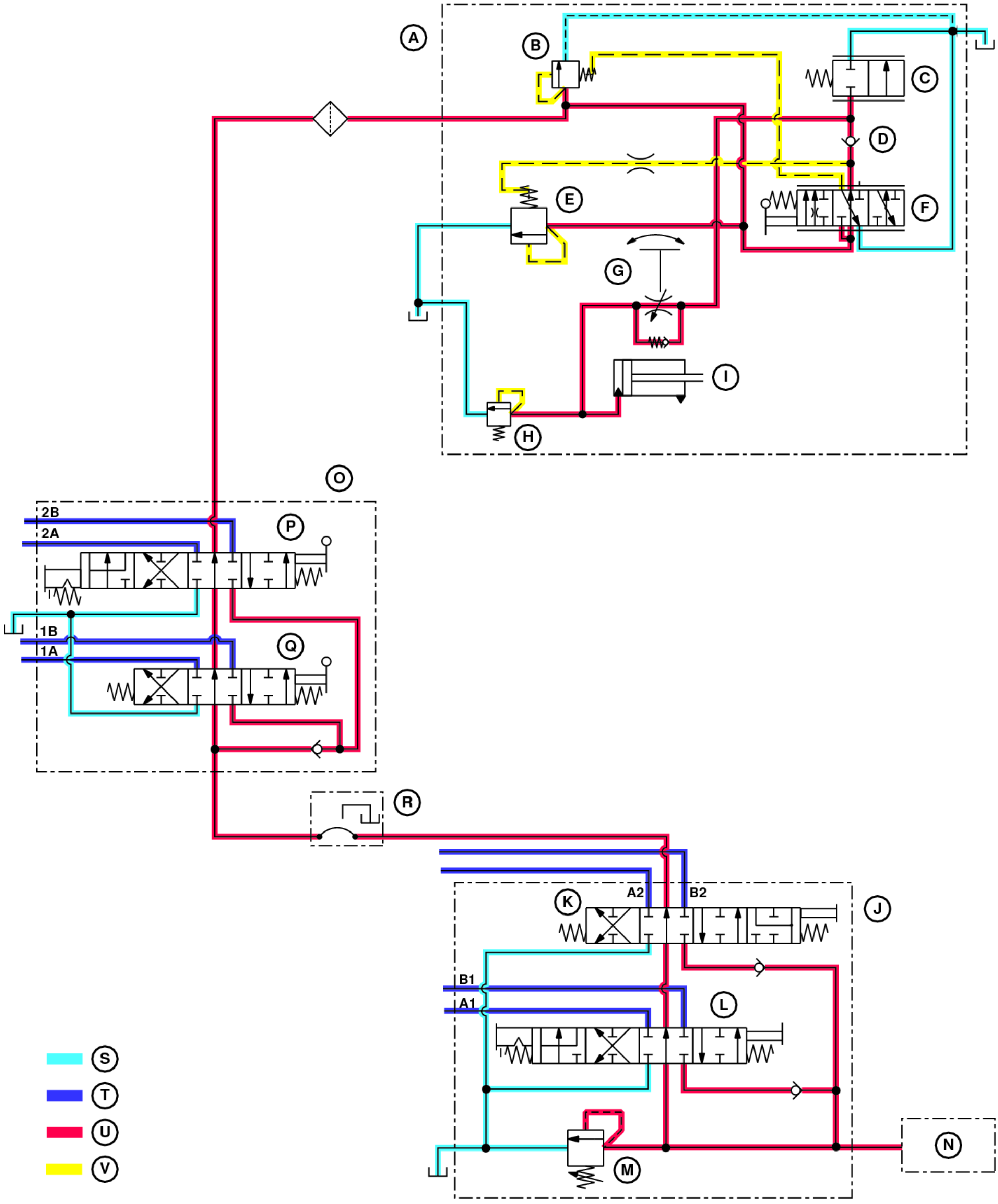
3rd EH Valve (October 2014—)

LEGEND:

A	Rockshaft Control Valve
B	Unload Valve—.48 bar (7 psi)
C	Lowering Valve
D	Load Check Valve
E	Flow Control Valve
F	Main Spool Valve
G	Rate Of Drop Or Stop Valve
H	Rockshaft Relief Valve—206 bar (3000 psi)
I	Cylinder
J	Dual SCV Valve
K	Spool 2
L	Spool 1
M	Flow Control Valve
N	Implement Pump

O	3rd EH Valve
P	Sump Oil
Q	SCV Work Port Oil
R	High-Pressure Oil
S	Pilot Oil

4th, and 5th SCV Schematics (Open Station)



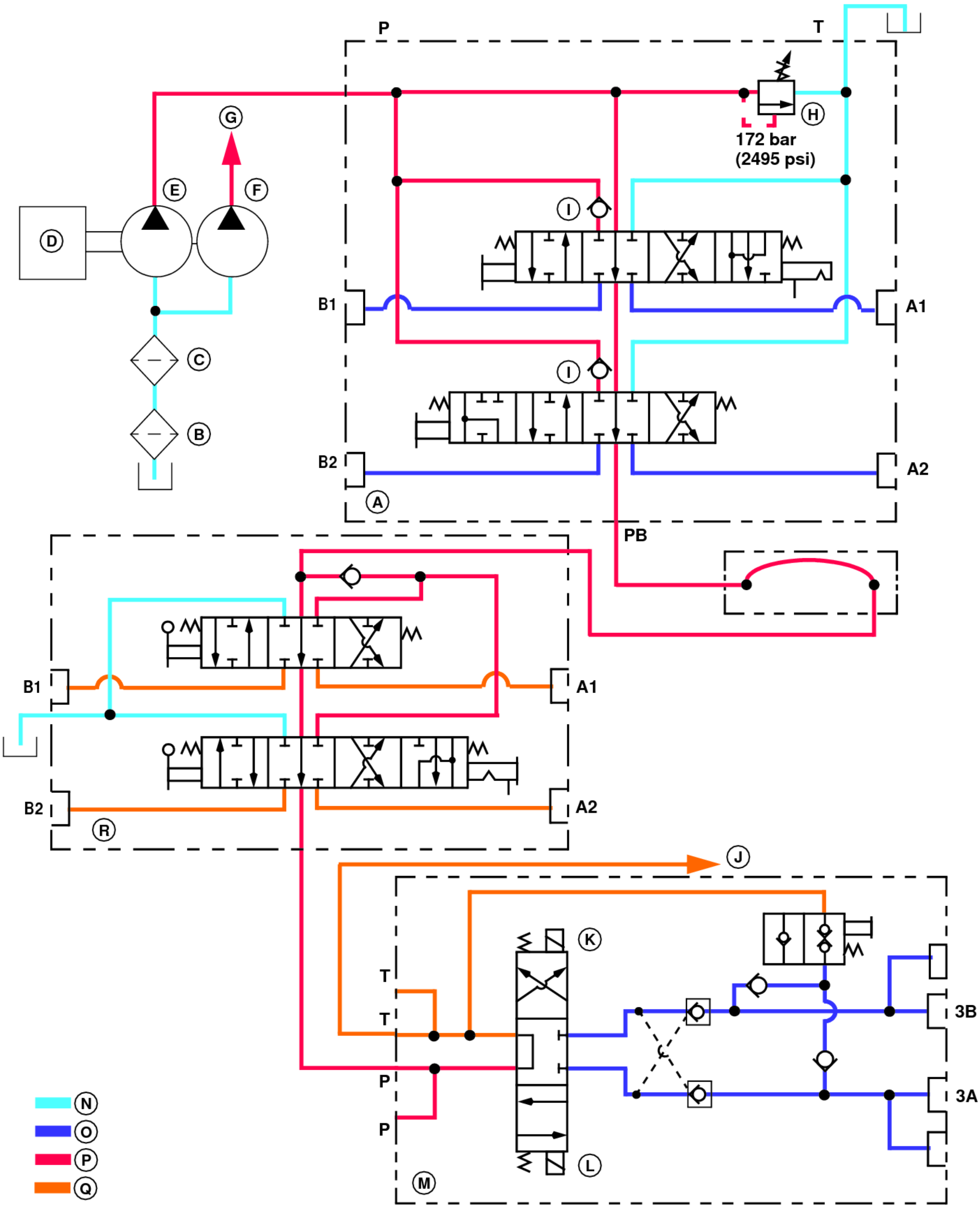
4th, and 5th SCV Schematics

LEGEND:

A	Rockshaft Control Valve
B	Unload Valve—.48 bar (7 psi)
C	Lowering Valve
D	Load Check Valve

E	Flow Control Valve
F	Main Spool Valve
G	Rate Of Drop Or Stop Valve
H	Rockshaft Relief Valve—206 bar (3000 psi)
I	Cylinder
J	Dual SCV Valve
K	Spool 2
L	Spool 1
M	Flow Control Valve
N	Implement Gear Pump
O	4th & 5th Valve
P	Spool 2
Q	Spool 1
R	Jumper Hose (Use When Power Beyond is Provided)
S	Sump Oil
T	SCV Work Port Oil
U	High-Pressure Oil
V	Pilot Oil

3rd, 4th, and 5th SCV Schematics (OCT —2014)



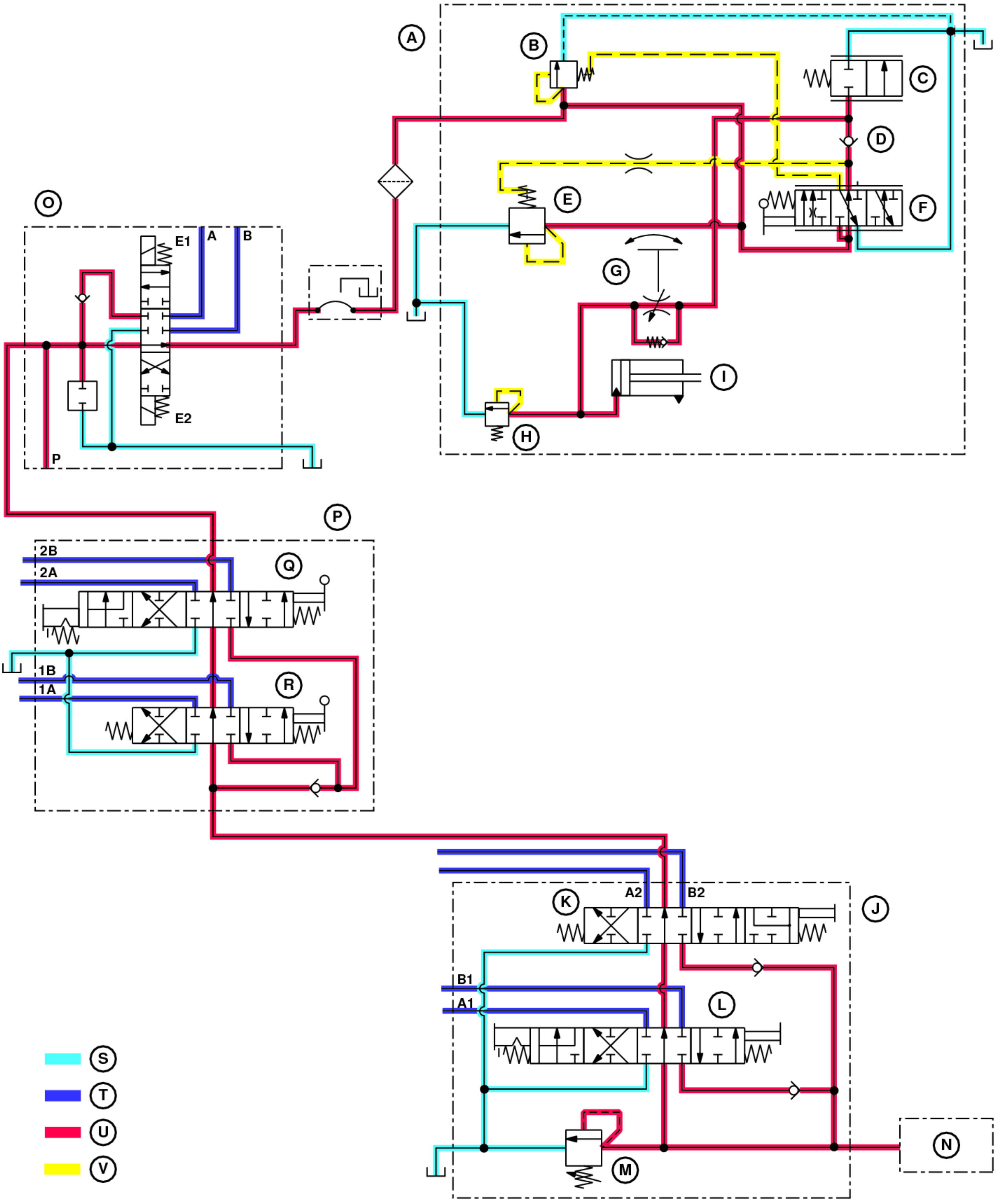
3rd, 4th, and 5th SCV Schematics

LEGEND:

A	2-Spool Selective Control Valve (SCV)
B	Intake Filter (150 mesh)
C	Suction Filter
D	Engine

E	Implement Gear Pump
F	Steering Gear Pump
G	To Steering
H	System Pressure Relief Valve
I	Load Check Valve
J	To Rockshaft
K	Y09 Third Function “A” Solenoid
L	Y10 Third Function “B” Solenoid
M	Electro-Hydraulic 3rd SCV
N	Sump Oil
O	SCV Work Port Oil
P	High-Pressure Oil
Q	Rockshaft Pressure Oil
R	4th and 5th SCV

3rd, 4th, and 5th SCV Schematics (Open Station) (OCT 2014—)



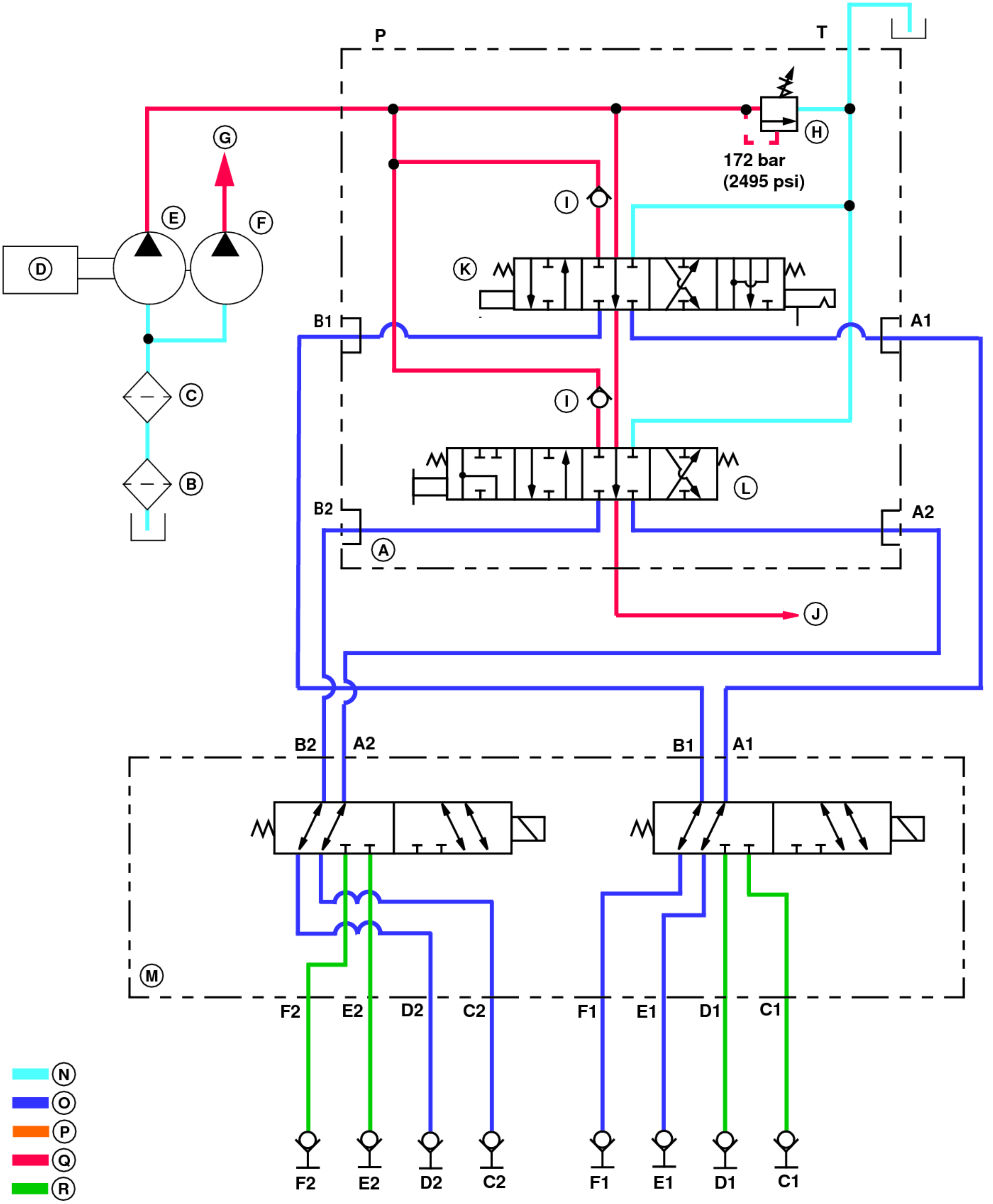
3rd, 4th, and 5th SCV Schematics (October 2014—)

LEGEND:

A	Rockshaft Control Valve
B	Unload Valve—.48 bar (7 psi)
C	Lowering Valve
D	Load Check Valve

E	Flow Control Valve
F	Main Spool Valve
G	Rate Of Drop Or Stop Valve
H	Rockshaft Relief Valve—206 bar (3000 psi)
I	Cylinder
J	Dual SCV Valve
K	Spool 2
L	Spool 1
M	Flow Control Valve
N	Implement Pump
O	3rd EH Valve
P	4th & 5th Valve
Q	Spool 2
R	Spool 1
S	Sump Oil
T	SCV Work Port Oil
U	High-Pressure Oil
V	Pilot Oil

Diverter Valve Schematic



Diverter Valve Schematic

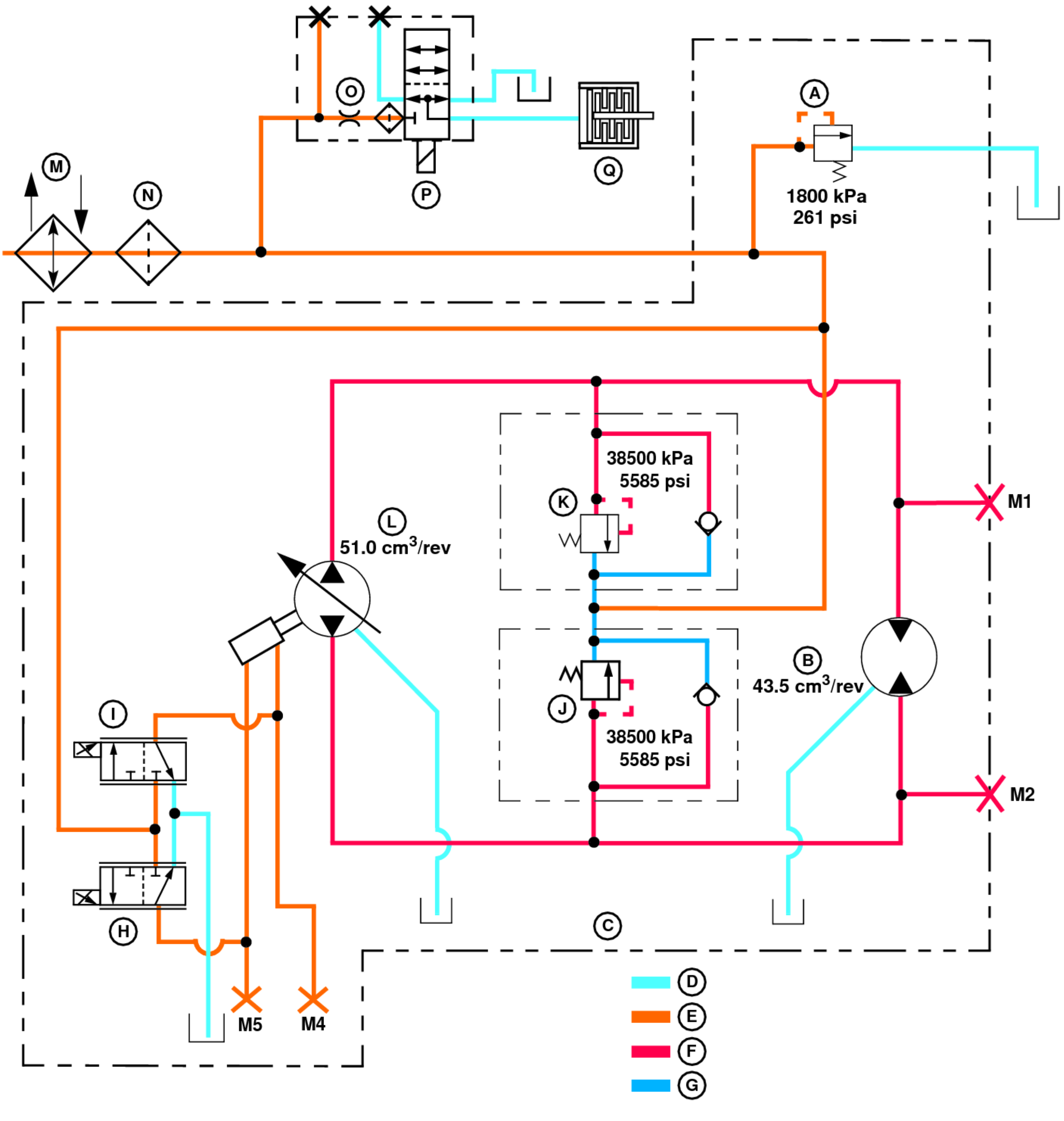
LEGEND:

A	2-Spool Selective Control Valve (SCV)
B	Intake Filter (150 mesh)
C	Suction Filter
D	Engine

E	Implement Gear Pump
F	Steering Gear Pump
G	To Steering
H	System Pressure Relief Valve
I	Load Check Valve
J	To Rockshaft
K	Spool 1
L	Spool 2
M	Diverter Valve
N	Sump Oil
O	SCV Work Port Oil
P	Charge Pressure Oil
Q	High-Pressure Oil
R	Trapped Oil

Group 20 - Theory of Operation

eHydro™ Hydraulic Operation



eHydro Hydraulic Schematic

LEGEND:

A	Charge Pressure Relief Valve
B	Hydraulic Motor 48.5 cm ^{3} /rev
C	Hydrostatic Transmission
D	Sump Oil
E	Charge Pressure/Tunnel Lubrication Oil
F	High Pressure Oil
G	Make Up/Closed Loop Relief Oil
H	Proportional Solenoid Valve
I	Proportional Solenoid Valve
J	System Relief Valve

K	System Relief Valve
L	eHydro™ Hydraulic Pump 51.0 cm^3 /rev
M	Oil Cooler
N	In-Line Filter

Theory

The eHydro ™ hydraulic system receives its supply from the power steering return line. This oil is pumped through an oil cooling radiator in front of the main radiator.

The charge pressure oil then passes through an in-line filter. The filtered oil goes to the PTO clutch solenoid and the hydrostatic transmission.

The charge pressure oil is regulated to **1800 kPa (18 bar) (261 psi)** and travels to the transmission proportional solenoid valves and the hydraulic pump and motor make-up oil line.

The proportional valves, one for forward and one for reverse, control the oil going to the servo control of the hydraulic pump. The proportional valves are controlled by the electronic logic controller. See controller theory in the Electrical section.

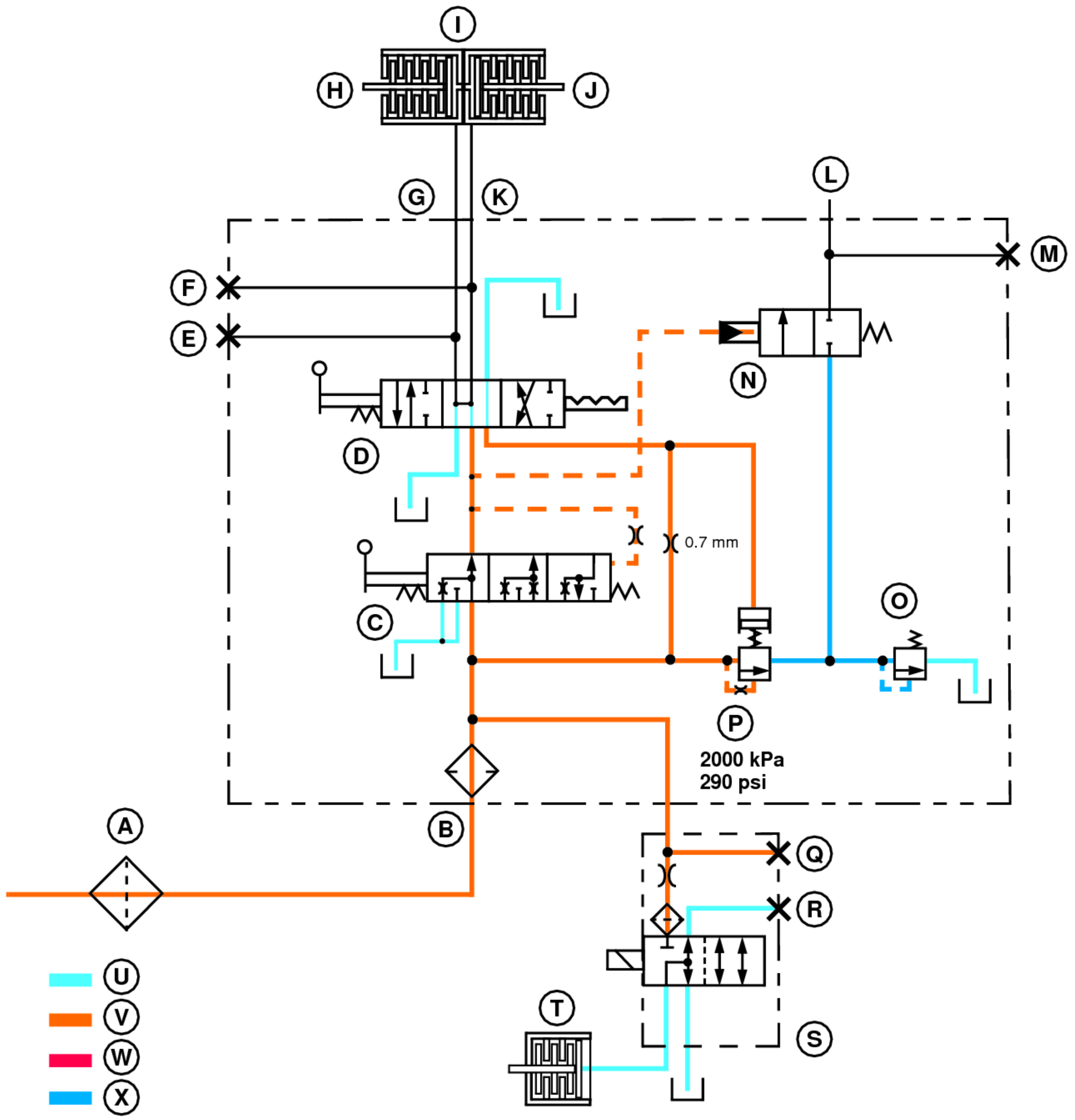
The hydraulic pump is connected directly to the engine and is rotating any time the engine is running. The swash plate of the hydraulic pump is servo controlled and remains flat unless one of the proportional valves opens and the servo rotates the plate. When the swash plate rotates, oil is pumped through the transmission to rotate the hydraulic motor. Oil is pumped either direction through the transmission depending on which direction the hydraulic pump swash plate is rotated. The direction of the oil flow controls the direction of motor rotation.

Only the side of the pump and motor circuit loop that the pump is sending oil into has high pressure. The other side of the circuit loop provides a return route for the hydraulic motor oil and supply oil for the hydraulic pump. If the low pressure side falls below **1800 kPa (18 bar) (261 psi)** the check valve opens and charge pressure oil enters the circuit to make-up any lost oil.

The system relief valves open if the hydraulic pump pressure exceeds **38 500 kPa (385 bar) (5585 psi)** on the motor drive side of the circuit.

The M1 and M2 pressure ports provide locations that may be used for checking the charge pressure of **1800 kPa (18 bar) (261 psi)** and the motor drive pressure of **38 500 kPa (385 bar) (5585 psi)** . The higher drive pressure and lower charge pressure will be at the opposite ports when the machine is in reverse as compared to the pressures when the machine is in forward.

PowrReverser™ Hydraulic Operation



PowrReverser™ Hydraulic Operation

LEGEND:

A	In-Line Filter
B	Pressure In Port
C	Clutch Pedal Valve (Up)
D	Forward/Reverse Valve (Neutral)
E	Forward Test Port
F	Reverse Test Port
G	Forward Port
H	Forward Port
I	Clutch
J	Reverse
K	Reverse Port
L	Lubrication Oil Port
M	Lubrication Test Port
N	Lubrication Cut-Off Valve

O	Lubrication Relief Valve
P	Modulation Valve
Q	Diverter Valve Port Out
R	Diverter Valve Port Return
S	PTO Clutch Solenoid Valve
T	PTO Clutch
U	Sump Oil
V	Charge Pressure/Tunnel Lubrication Oil
W	High Pressure Oil
X	Lubrication Oil (Trapped)

Theory

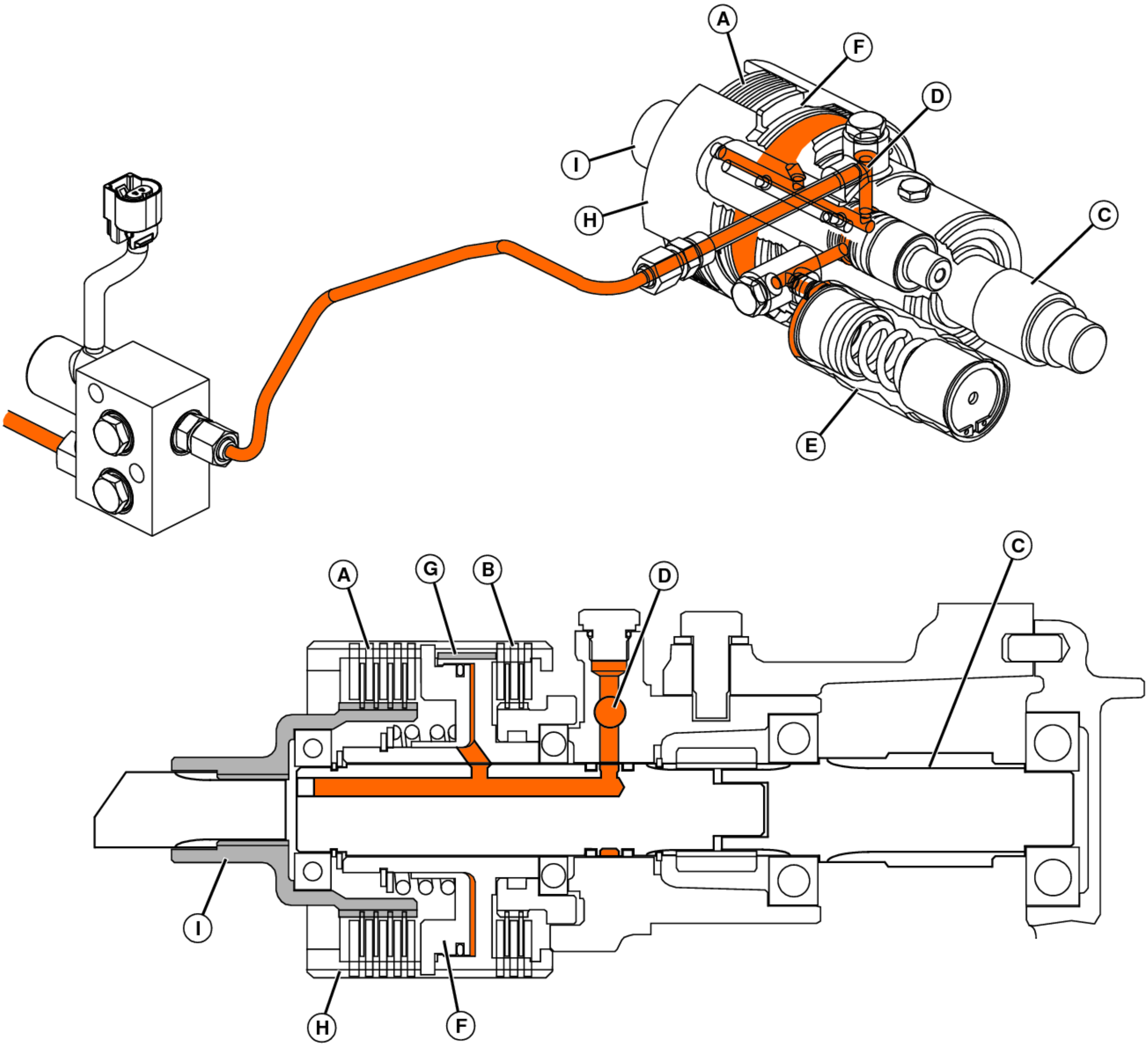
The PowrReverser ™ ™ hydraulic system receives its supply from the power steering return line. The oil is run through an in-line filter.

The filtered oil then is regulated to a pressure of **2000 kPa (290 psi)** for the traction clutches and hydraulic system. The flow that goes through the modulation valve then is used for lubrication. The lube circuit also has a relief valve. If the lube pressure rises too high the valve opens and allows the pressure to be relieved.

The oil that is regulated to **2000 kPa (290 psi)** travels through the clutch pedal valve to the forward/reverse valve to the traction clutches. The forward/reverse valve spool controls the oil going to the traction clutches. When the direction is selected, the pressure oil is supplied to one side of the clutch and the oil in the other side of the clutch is released to the sump.

PTO Clutch Operation

PTO Clutch



PTO Clutch

LEGEND:

A	PTO Clutch
B	PTO Brake
C	PTO Clutch Shaft
D	Side Port
E	Spring Loaded Accumulator
F	Piston
G	Pins
H	Clutch Basket
I	Clutch Hub

Function:

The PTO clutch provides a means for disengaging the PTO output shaft from the engine. The PTO brake is provided to positively stop the rotation of the PTO system when the PTO clutch is disengaged. The PTO clutch and PTO brake work simultaneously. Both the mid and rear PTO are affected by the operation of the PTO clutch and PTO brake.

The rear PTO shaft is engaged directly from the clutch. The mid PTO gears are driven by gears engaged to the rear PTO. The mid PTO gears are only engaged when they are shifted into gear.

Theory:

The PTO clutch (A) is engaged or disengaged by the operator through an electrical switch which controls the solenoid of the PTO valve (See “PTO Valve Operation” below). The PTO brake (B) is automatically spring applied when the PTO clutch is disengaged. The PTO brake is a spring loaded multi-plate wet brake and is normally engaged, preventing the PTO clutch shaft (C) from rotating. The PTO clutch is a multi-plate wet clutch and is normally disengaged.

When the operator pulls the PTO switch to the on position, a hydraulic control valve is activated and supplies pressurized hydraulic oil to activate the PTO clutch through a side port (D). The pressurized oil is kept from engaging the clutch too abruptly when a PTO attachment is being used, by a spring loaded accumulator (E) to the side of the clutch.

The PTO clutch piston is moved forward by the hydraulic pressure. As the piston (F) moves forward, the spring pressure applied to the brake by the piston, through the three pins (G), is removed and disengages the brake. At the same time, the piston is applying pressure to the PTO clutch pack and engaging the PTO clutch. The pressure applied to the clutch pack locks the plates (splined to the clutch basket (H)), to the friction plates (locked to the clutch hub (I)). Power is transferred from the input shaft to the clutch hub, through the friction plates and separator plates to the clutch basket, and finally to the PTO drive shaft.

A locking tab on the outside of the brake housing allows the PTO drive shaft to rotate slightly to aid in aligning the splines of an attachment drive shaft during hook-up.

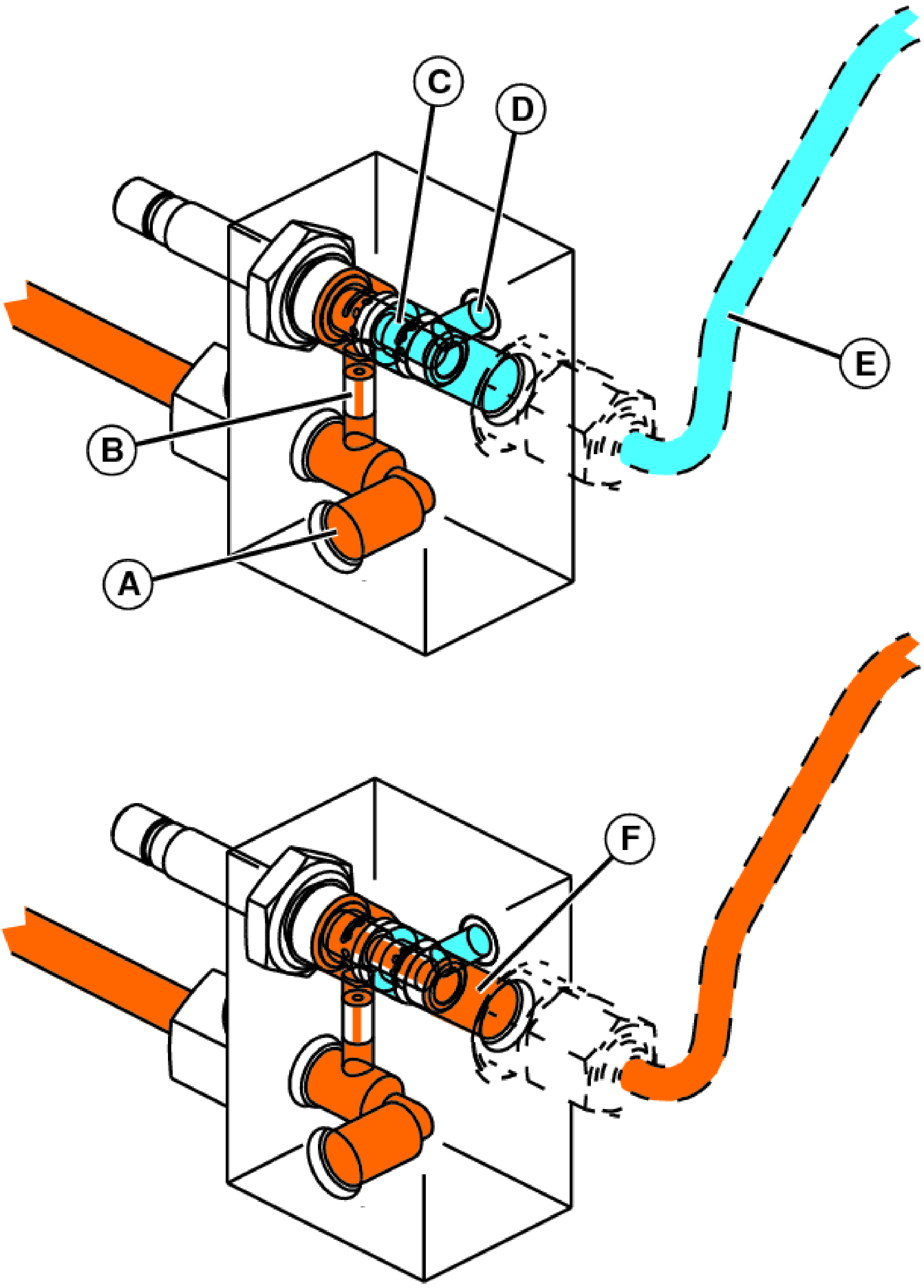
PTO Valve Operation

Function:

The PTO control valve is an electrically operated single spool hydraulic valve. The valve controls the PTO clutch by supplying pressurized oil to the clutch when the solenoid is activated.

The PTO control valve is also the connection point for hydraulic control oil to the diverter valve kit option.

Theory:



PTO Valve

LEGEND:

A	Solenoid Valve Body Lower Chamber
B	Orifice
C	Solenoid Valve Stem Core
D	Port

E	PTO Clutch
F	Valve Stem

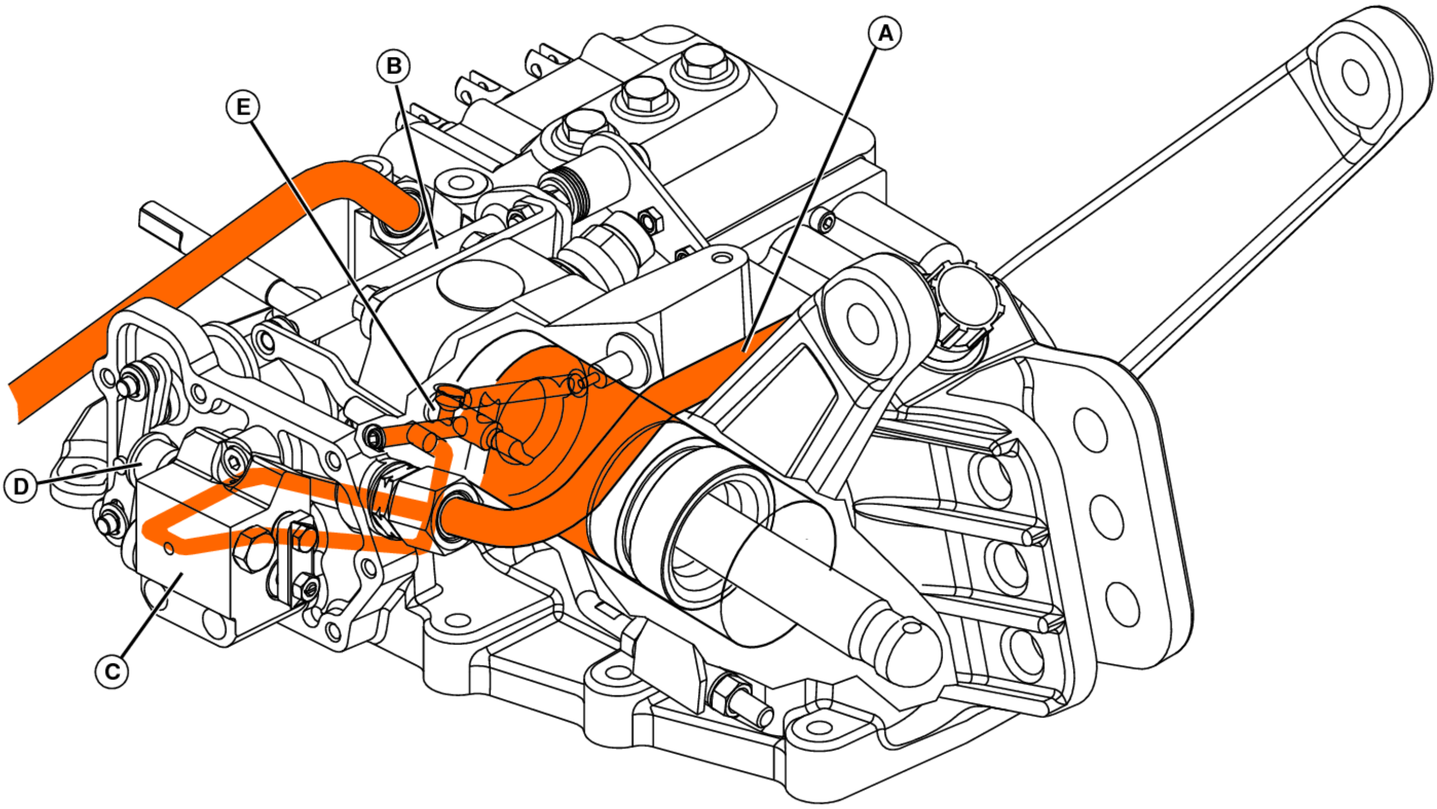
In the normally off state, pressurized oil is provided to the solenoid valve body lower chamber (A). An orifice (B) provides a narrow route for the pressurized oil to the solenoid valve stem where it is trapped unless the valve coil is energized.

A port (D) is the valve block is vented directly to the transmission sump. Holes in the stem core align with slots in the valve stem and oil from the PTO clutch (E) flows through the valve stem to the sump which keeps the PTO clutch disengaged.

When the PTO valve solenoid is energized, the solenoid valve stem core (C) is pulled toward the solenoid coil. The holes in the valve stem core, which had been aligned with the slots in the valve stem, are blocked and the PTO clutch is no longer vented to the transmission sump. A second set of holes in the stem core align with slots in the valve stem and the pressurized oil flows though the valve stem (F) core to the PTO clutch.

Rockshaft Operation

Rockshaft Operation



Rockshaft

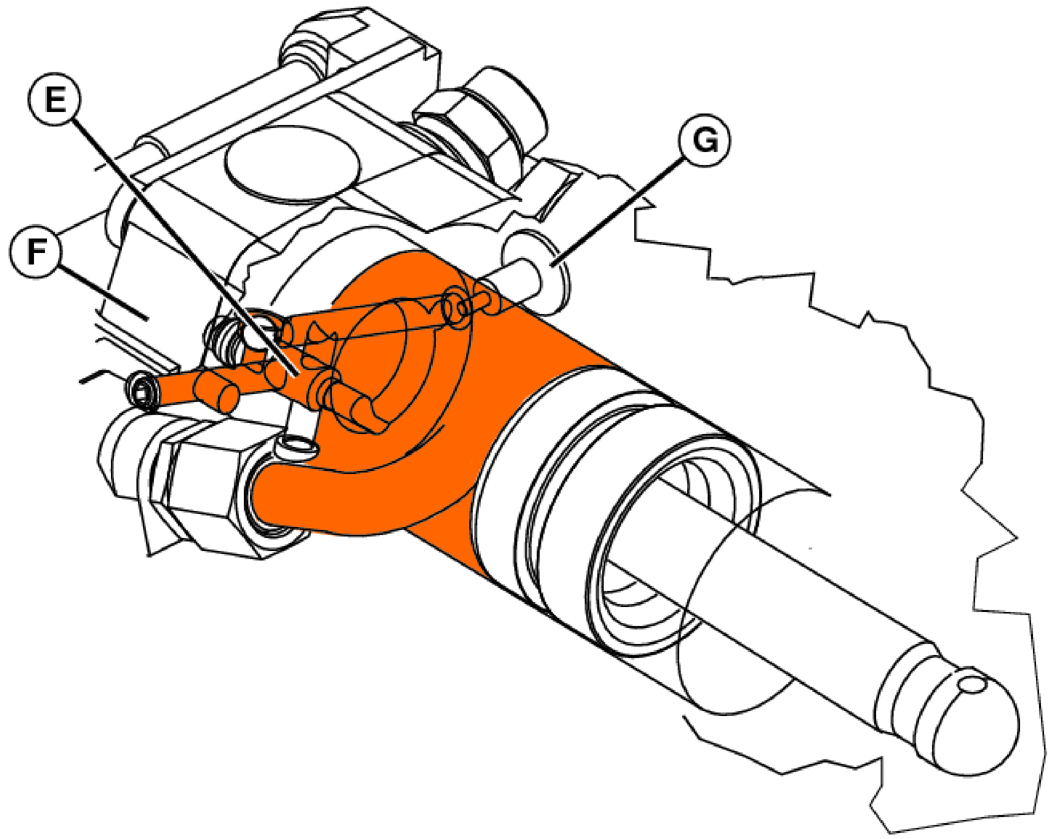
LEGEND:

A	SCV Valve Block
B	Cross-shaft
C	Rockshaft Control Valve
D	Main Spool
E	Drop/Stop Valve

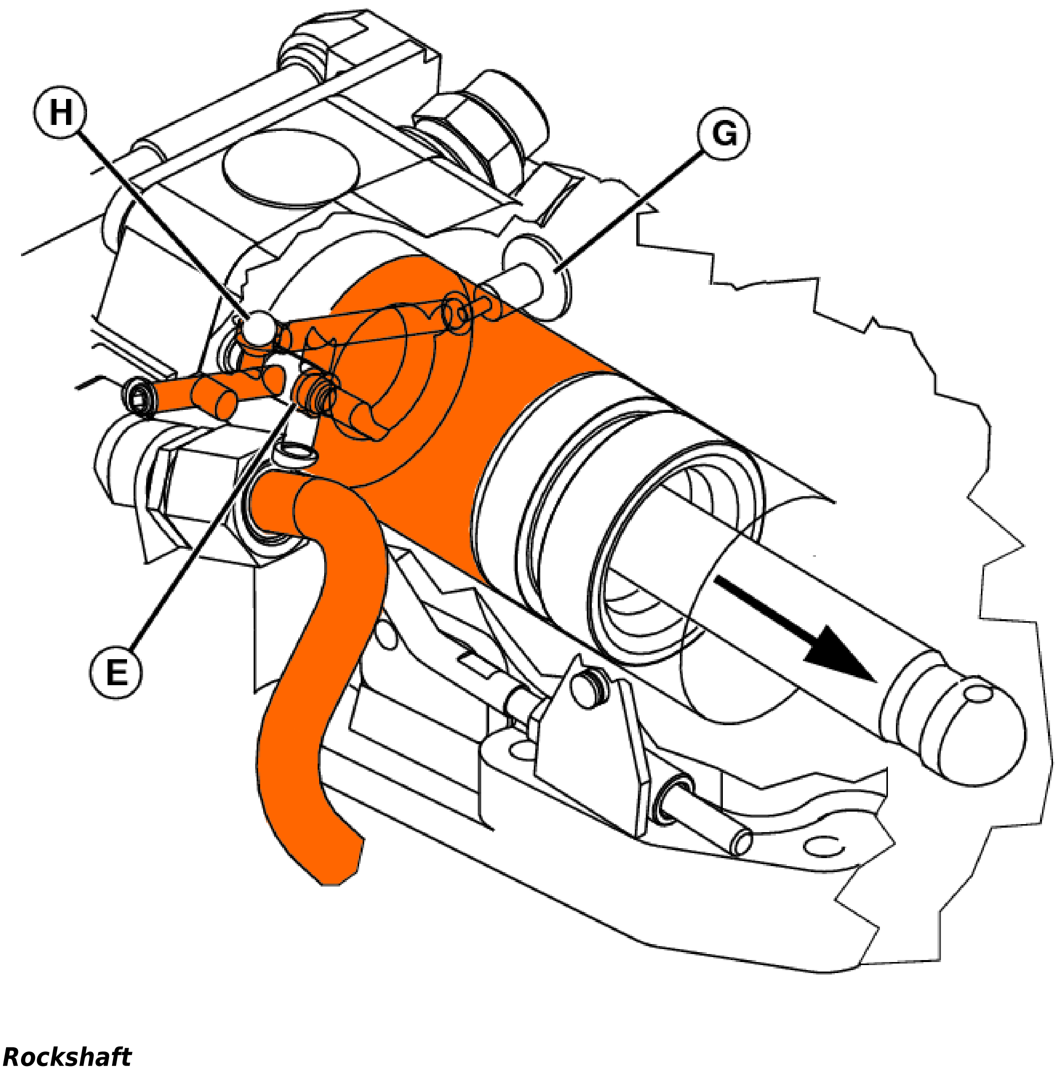
Charge pressure oil is provided to the rockshaft control valve from the SCV valve block (A).

The rockshaft is operated by moving the lift control lever. The lever rotates a cross-shaft (B) that is linked to the rockshaft control valve (C).

The control valve contains two spools, the main spool (D) for raising and lowering the rockshaft and one for rockshaft position sensing. When the cross-shaft is rotated, the control linkage pushes in the main spool or allows the main spool spring to back the spool out of the control valve. When the spool is pushed in, charge oil is allowed to enter the piston cylinder and the rockshaft arms raise.



Rockshaft



Rockshaft

LEGEND:

E	Drop/Stop Valve
F	Piston Cover
G	Port
H	Check Ball

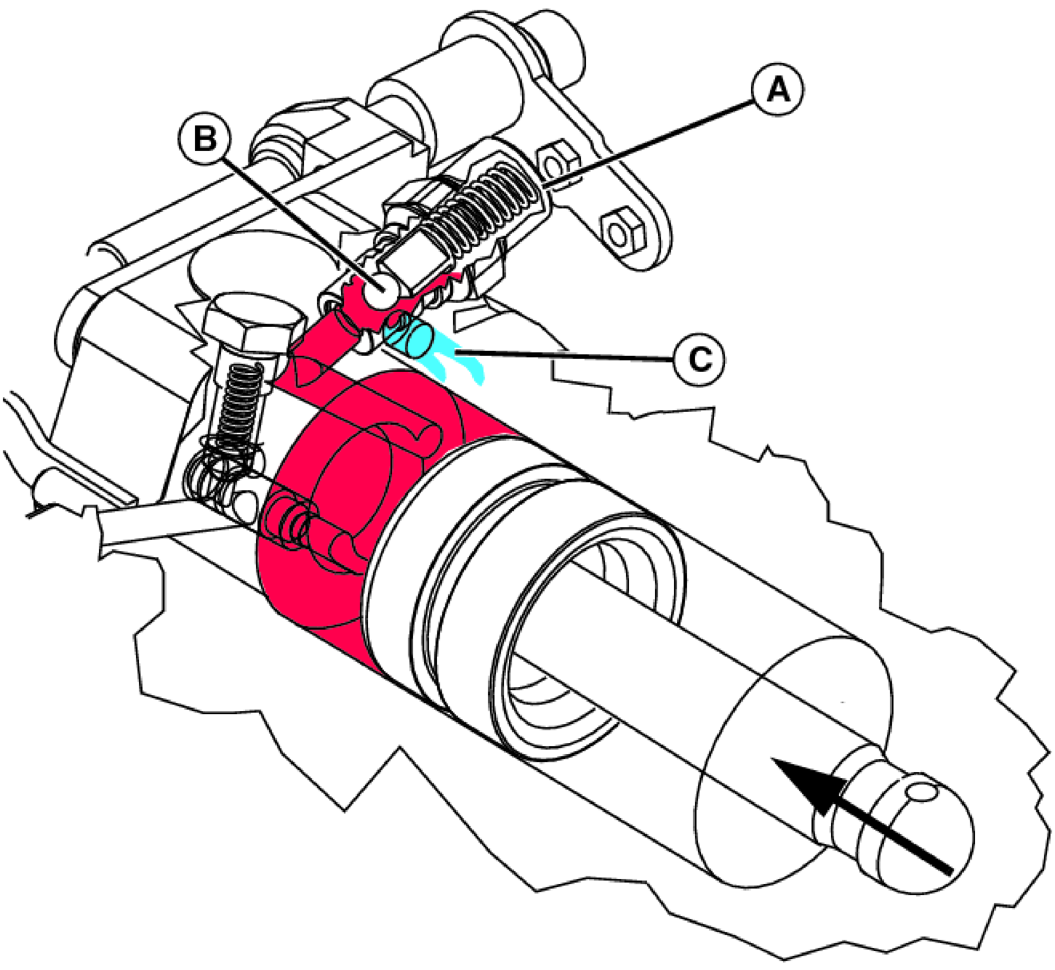
The rate of drop/stop valve (E) controls the rate at which oil enters and leaves the cylinder. Turning the control knob under the front of the operators seat changes the rate of drop/stop valve setting from fully open to fully closed.

With the rate of drop/stop valve (E) fully open, Charge oil, controlled by the control valve, passes through a passage into the piston cover (F), past the rate of drop/stop valve and into the cylinder.

Cylinder pressure can be measured at port (G).

As the rate of drop/stop valve is closed, charge oil entering the cylinder has to go around the valve. Check ball (H) is raised and oil is channeled around the valve. This action allows oil to enter the cylinder while the check ball prevents oil from leaving the cylinder. This allows the rockshaft to be raised and locked into position.

Pressure Relief Valve Operation:



Pressure Relief Valve

LEGEND:

A	Pressure Relief Valve
B	Check Ball
C	Oil

The pressure relief valve (A) is a spring loaded valve that opens when the rockshaft cylinder pressure becomes greater than **20 680 kPa (206.8 bar) (3000 psi)** .

If too great of a load is placed on the rockshaft arms the check ball (B) moves against spring pressure, opens the valve and dumps oil (C) to the rockshaft sump housing.

Diverter Valve (Option)

This machine model series can be equipped with an optional diverter valve and rear hydraulic outlets to operate hydraulically driven implements.

Function:

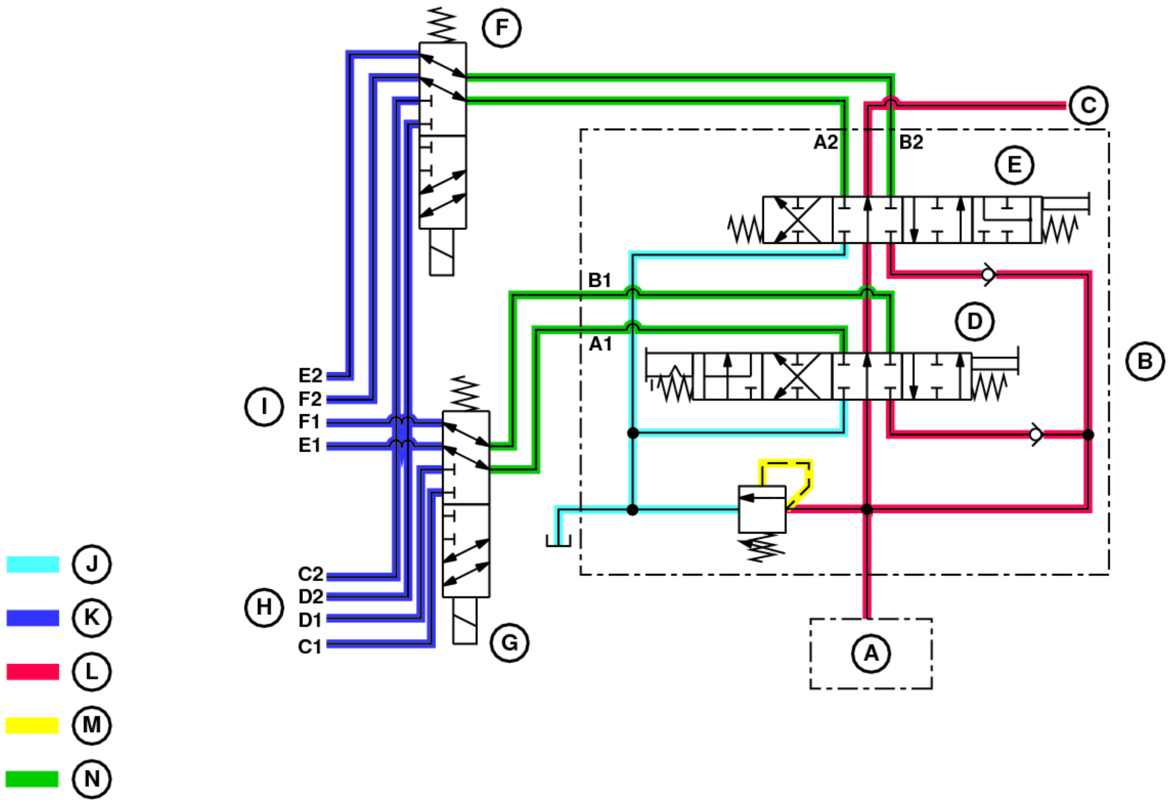
The diverter valve option provides a means to shift hydraulic pressure (provided from 2-spool SCV) to either front quick couplers or rear quick couplers. The diverter valve is controlled by an electrical switch and solenoid valves.

→NOTE:

If the key switch is moved to the off position, the dual SCV lever defaults to operating the front quick couplers. The key switch must be moved to the run position and the diverter system reactivated to operate the rear couplers.

Theory:

The pressurized hydraulic oil is provided from the implement gear pump (A) to the 2-spool SCV (B). Pressurized hydraulic oil flows through the 2-spool SCV to the rockshaft valve (C) until the dual SCV lever is moved. Then either spool 1 (D) or spool 2 (E) or both allows pressurized hydraulic oil to flow out to the diverter valves (F and G). The pressurized hydraulic oil then passes through the diverter valve to the front hydraulic quick couplers (H). The return quick couplers receive return oil while the attachment is functioning. If using the rear hydraulic quick couplers (I), activate the diverter switch (O). To activate, press the top (P) of the diverter switch. Current is then sent to the diverter solenoids which allows hydraulic oil to flow to the rear hydraulic quick couplers. Pressing the bottom (Q) of the diverter switch deactivates the rear hydraulic quick couplers and hydraulic pressure returns to the default, front hydraulic quick couplers. When no movement of the dual SCV lever is detected the hydraulic oil is routed through the 2-spool SCV to the rockshaft valve.

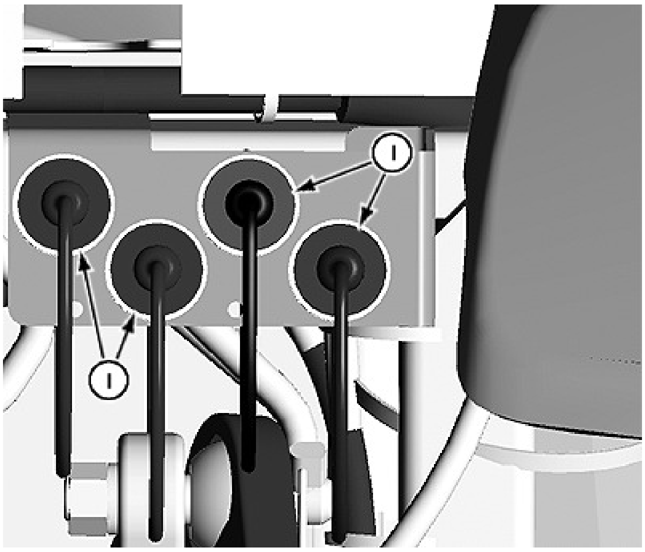


Shown With Diverter Switch Activated

LEGEND:

A	Implement Gear Pump
B	2-Spool (SCV)
C	To The Rockshaft Valve
D	Spool 1
E	Spool 2
F	Diverter 1
G	Diverter 2

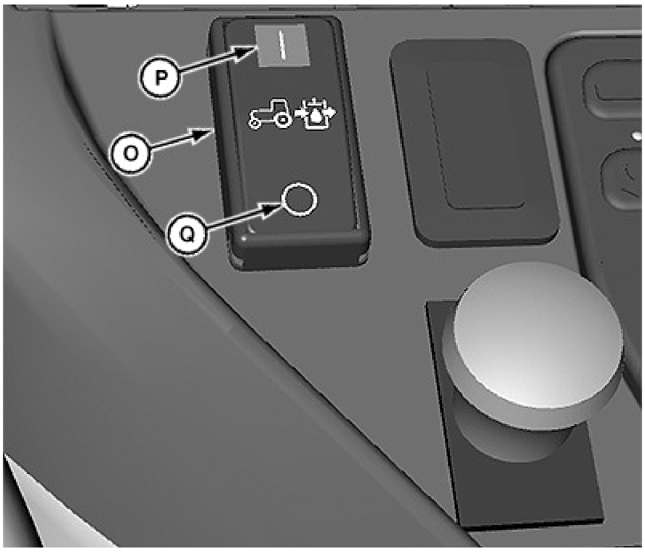
H	Front Quick Couplers
I	Rear Quick Couplers
J	Sump Oil
K	SCV Work Port Oil
L	High-Pressure Oil
M	Pilot Oil
N	Trapped Oil



LEGEND:

I	Rear Couplers
O	Diverter Switch
P	Top
Q	Bottom

Diverter Switch



Rear Hydraulic Quick Couplers

Group 25 - Troubleshooting

Hydrostatic (eHydro) Troubleshooting

Symptom	Problem	Solution
Poor Transmission Performance	Poor Transmission Performance.	Loss of charge pressure.
		Low hydraulic fluid level.
		Plugged filter.
		Improper current to solenoid valve.
		Solenoid valve malfunction.
		Plugged screens at solenoid valve.
		Worn rotating kit components.
		Parking brake is on.
		Ballasted too heavily.
		Wrong valve installed.
	Complete Loss of Transmission Power.	Loss of charge pressure.
		Low hydraulic fluid level.
		No current to solenoid valves.
		Failure of high-pressure components in pump or motor.
		Mechanical failure at 3-speed gearbox or drive line.
	Machine Creeps In Neutral.	Solenoid valve is getting current input.
		Threshold set-point incorrect (software setting).
		Improper neutral adjustment made in field.
		Worn servo piston components.
	Machine Moves When Started.	Solenoid valve is getting current input.
		Solenoid valve is stuck on.
	Excessive Pedal Movement To Begin Travel.	Threshold set-point incorrect (software setting).
		Sticky solenoid valve.
		Low charge pressure.
		Improper neutral adjustment made in field.
		Worn servo piston components.
	Loss of Charge Pressure.	Engine speed too low to develop required charge flow.
		Inefficient charge pump not providing required flow.
		Charge flow diverted to hydro (steering, MFWD).
		Extreme temperature increases demand but reduces flow.
		Reduction in hydro efficiency increases charge flow demand.
		Cut or worn seal ring on servo piston.
		Leakage past the charge pressure relief valve.

Rockshaft Hydraulics

Test Conditions:

Machine sitting on level ground outdoors in an area clear of obstructions.

Hydraulic oil in reservoir at proper level.

Speed range selector in “NEUTRAL.”

Park brake engaged.

Engine running at high idle.

Sufficient weight on lift arms to allow self-lowering.

Rockshaft rate of drop/stop valve fully open.

Symptom	Problem	Solution

Performance Checks Fail	With the rockshaft lift control in the full raise (rearward) position and then in the lower position, the lift arms do not raise to the full lift height and then fully lower	Perform Rockshaft Position Feedback Adjustment. (See Rockshaft Position Feedback Linkage Adjustment in Section 80, Group 30.)
		Does the rockshaft pass the lift cycle and leakage tests? (See Rockshaft Lift Cycle Test , and Rockshaft Leakage Test in Section 80, Group 30.)

Group 30 - Tests and Adjustments

Multi-Function Lever Cable Adjustment

Reason:

To ensure that proper SCV operation and multi-function lever can be locked properly.

Tools:

24 mm open-end wrenches (2)

Procedure:

[1] -

CAUTION:

Do not perform SCV cable adjustments with any SCV operated attachments installed on the machine. Attachments could be lowered during adjustment and cause injury!

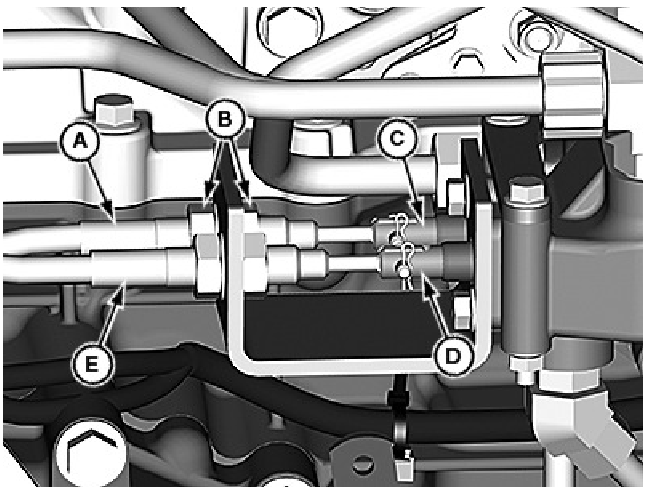
LEGEND:

A	Multi-Function Lever Lock

Multi-Function Lever Lock

Operate multi-function lever lock (A) and check lock operation. If lock engages and disengages easily, no adjustment is needed. If multi-function lever has to be moved out of the neutral position to get the lock engaged, the cables need adjustment.

[2] -



LEGEND:

A	Cable
B	Nut (4 used)
C	Spool
D	Spool
E	Cable

Right rear wheel removed for photo.

Lock the multi-function lever. Cables (A and E) should not be putting any force on spools (C and D) in either direction.

[3] - To adjust, loosen nuts (B) on both cables and back them away from the bracket. The spools are spring loaded to stay in the neutral position. Move each cable to a position where it is not applying any force on the spool. Hold cable in place and turn nuts up against bracket. Use a wrench on both nuts and tighten equally against bracket.

[4] - Recheck multi-function lever lock operation and readjust if necessary.

Hydraulic System Bleed Procedure

Reason:

To remove air trapped in the hydraulic system which will prevent proper operation.

Procedure:

[1] -

→NOTE:

Fill the new hydraulic oil filter with new oil before installing.

Install a new hydraulic oil filter.

[2] - Fill the transaxle with specified JDM J20D (preferred) or J20C oil to the proper level on dipstick.

[3] - Turn the key to START and hold for 10 seconds. Turn the key to OFF.

[4] - Raise machine front end and support on suitable stands.

[5] - Start the engine and run at low idle.

[6] - Slowly turn the steering wheel left and right until wheels turn smoothly indicating that any trapped air has been bled back to the reservoir.

[7] - Operate rockshaft several times until it operates smoothly.

[8] - Stop the engine and check the hydraulic reservoir oil level. Fill as needed. Check all line connections for leaks; tighten if necessary.

[9] - Lower the machine to the ground.

[10] - Drive machine in forward and reverse several times until transmission operates smoothly.

Rate of Drop/Stop Valve Adjustment

Reason:

To ensure that lift arms lower rear attachment completely and lower it at a safe rate of speed.

Equipment:

- BW13586 Ballast Box

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission to “neutral”.

[3] - Install BW13586 ballast box, or approximately 227 kg (500 lb.), on the three point hitch.

Ballast Box

BW13586

Used to adjust drop/stop valve.

[4] - Start engine and run at fast idle.

[5] - Put lift control lever in full UP position.

[6] - Raise weight as high as it will go.

[7] - Close rate of drop/stop valve.

[8] - Put lift control lever in full DOWN position.

[9] - Open rate of drop stop valve 1-1/2 to 2 turns.

[10] - Time duration of drop cycle from full up to full down.

Item	Measurement	Specification
Rockshaft Drop Time	Time	2.5—3 seconds

Results:

If the weight lowers slower than specified time, open rockshaft rate of drop/stop valve until specification is met. If weight drop time will not meet specification, the rate of drop/stop valve may be clogged or faulty, or the rockshaft control valve may be faulty. (See Rockshaft Disassembly and Assembly in Section 80, Group 35.)

Lift Arms Adjustment

Reason:

To ensure that lift arms are operating through the correct range of motion.

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] - Start engine and use hydraulics to rotate rockshaft to full UP position.

[4] - Using angle gage, check lift arms against specifications. If not correct, remove lift arm and reset. (See Rockshaft Lift Arms Removal and Installation in Section 80, Group 35.)

Item	Measurement	Specification
Lift Arm Angle		
Lift Arm Raise Angle	Angle	50°
Lift Arm Lower Angle	Angle	20°
Total Lift Arm Range	Angle	70°
Maximum Variance Between Arms	Angle	5°

[5] - Compare angle of second lift arm with first, they should be within 5° of each other. If not, reset lift arms on splines and/or replace rockshaft.

System Pressure/Flow Test

Reason:

To ensure that hydraulic pump pressure and flow are maintained at sufficient levels for rockshaft and SCV attachment operation, and to determine if hydraulic pump is worn.

Equipment:

- JT05689—Adapter Fitting (1-1/16-12 M 37° X 1-14 F ORFS) (2 Required)
  Adapter Fitting, 1-1/16-12 M 37° X 1-14 F ORFS
  JT05689
  Used to test hydraulic system pressure/flow.
- JT03012—Adapter Fitting (3/4 F NPT X 1-1/16-12 F 37° Sw) (2 Required)
  Adapter Fitting, 3/4 F NPT X 1-1/16-12 F 37° Sw
  JT03012
  Used to test hydraulic system pressure/flow.
- JT05984—In-Line Flow Meter With Pressure Gauge
  In-Line Flow Meter With Pressure Gauge
  JT05984
  Used to test hydraulic system pressure/flow.
- JT03377—Hose (3/4 M NPT X 3/4 M NPT X 10’) (2 Required)
  Hose, 3/4 M NPT X 3/4 M NPT X 10 ft.
  JT03377
  Used to test hydraulic system pressure/flow.

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] -

CAUTION:

Avoid Injury! Make sure to relieve system pressure before loosening any system lines or hoses.

Cycle all controls to relieve any pressure that may be in the hydraulic system.

[4] - Remove hydraulic tube between rear pump and SCV valve.

[5] - Connect test equipment between rear pump and SCV valve. Open valve on flowmeter fully.

[6] - Start engine and run at high idle.

[7] -

CAUTION:

Avoid Injury! Do not close valve on flowmeter fully. Pump pressure may exceed working pressure of hose.

Slowly close valve on flowmeter until working pressure is reached. Record flow reading on gauge.

Item	Measurement	Specification
Relief Pressure	Pressure	17 240 kPa

Item	Measurement	Specification
		(172.4 bar)
		(2500 psi)
Hydraulic System Flow	Volume	32.5 L/min.
		(8.6 gpm)

Results:

- Pressure too Low: If system pressure reading cannot be reached, mesh filter may be restricted. Suction line may be restricted or leaking air. Pump may be worn. (See Hydraulic Gear Pump Removal and Installation in Section 80, Group 35.)
- Flow too low: Mesh filter may be restricted. Suction line may be restricted or leaking air. Pump may be worn. (See Hydraulic Gear Pump Removal and Installation in Section 80, Group 35.)

System Pressure Adjustment

→NOTE:

On machines equipped with a manifold block in place of an SCV, system pressure is set at the factory, and should not require adjustment.

Reason:

To adjust hydraulic pressure so that system pressure is maintained at correct levels to perform work without causing damage to the hydraulic system.

Equipment:

- JT05689—Adapter Fitting (1-1/16-12 M 37° X 1-14 F ORFS) (2 Required)
  Adapter Fitting, 1-1/16-12 M 37° X 1-14 F ORFS
  JT05689
  Used to adjust hydraulic system pressure.
- JT03012—Adapter Fitting (3/4 F NPT X 1-1/16-12 F 37° Sw) (2 Required)
  Adapter Fitting, 3/4 F NPT X 1-1/16-12 F 37° Sw
  JT03012
  Used to adjust hydraulic system pressure.
- JT05984—In-Line Flow Meter With Pressure Gauge
  In-Line Flow Meter With Pressure Gauge
  JT05984
  Used to adjust hydraulic system pressure.
- JT03377—Hose (3/4 M NPT X 3/4 M NPT X 10’) (2 Required)
  Hose, 3/4 M NPT X 3/4 M NPT X 10 ft.
  JT03377
  Used to adjust hydraulic system pressure.

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] -

CAUTION:

Avoid Injury! Make sure to relieve system pressure before loosening any system lines or hoses.

Cycle all controls to relieve any pressure that may be in the hydraulic system.

[4] - Remove hydraulic tube between rear pump and SCV valve.

[5] - Connect test equipment between rear pump and SCV valve. Open valve on flowmeter fully.

[6] - Start engine and run at high idle.

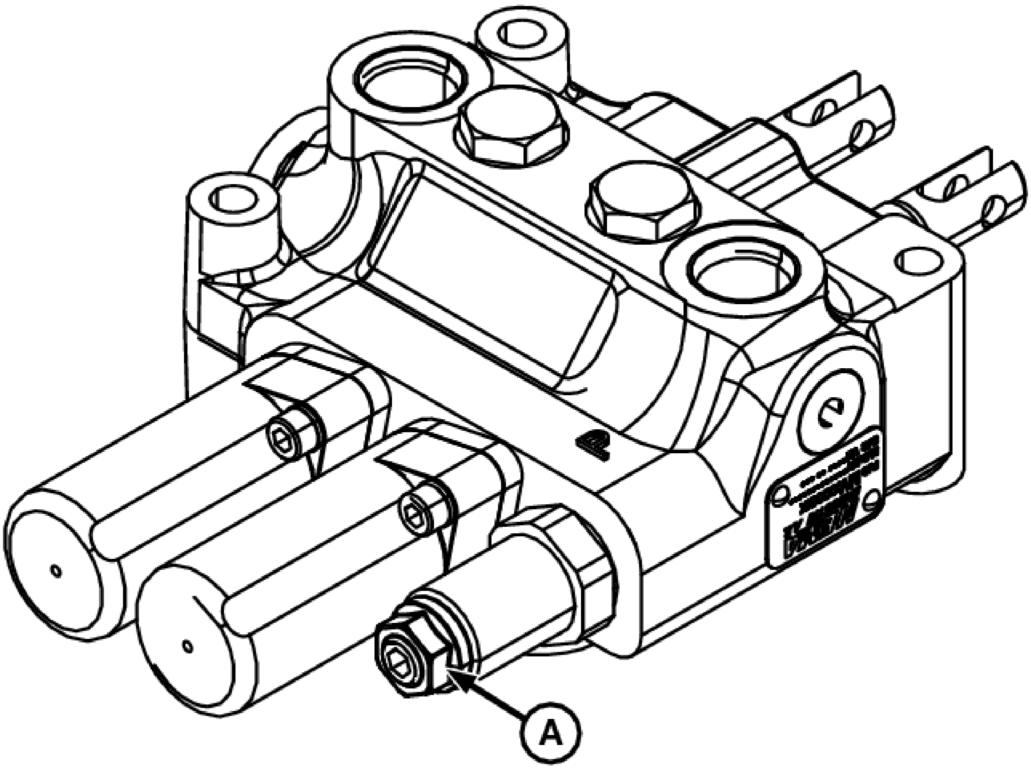
[7] - Move SCV control lever to open SCV valve to a closed work port (dead head).

[8] - Check pressure reading on gauge.

Item	Measurement	Specification
Relief Pressure	Pressure	17 240 kPa (172.4 bar)

Item	Measurement	Specification
		(2500 psi)

Results:



System Pressure Relief Valve

LEGEND:

A	Pressure Relief Valve

- Pressure too low: Turn system pressure relief valve (A) clockwise until pressure reading is within specification.

→NOTE:

If system pressure will not meet specification, pump may be worn. Perform system pressure/flow test (See System Pressure/Flow Test in Section 80, Group 30.)

- Pressure too high: Turn system pressure relief valve counterclockwise until pressure reading is within specification.

Steering Pressure Test

Reason:

To ensure that steering pump pressure is maintained at correct level for steering without causing damage to the system, and to determine if hydraulic pump is worn.

Equipment:

- JT03375—Adapter Fitting (7/16-20 M 37° X 9/16-18 M ORFS)
  Adapter Fitting, 7/16-20 M 37° X 9/16-18 M ORFS
  JT03375
  Used to test steering pressure.
- JT03117—Pressure Gauge, 0—14 000 kPa (0—140 bar) (0—2000 psi)
  Pressure Gauge, 0—14 000 kPa (0—140 bar) (0—2000 psi)
  JT03117
  Used to test steering pressure.
- JT03017—Hose with Quick Disconnect Fitting
  Hose with Quick Disconnect Fitting
  JT03017
  Used to test steering pressure.

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] -

CAUTION:

Avoid Injury! Make sure to relieve system pressure before loosening any system lines or hoses.

Remove hydraulic hose on left side of steering cylinder.

[4] - Attach gauge to left steering hose.

[5] -

→NOTE:

Turning steering wheel to the right will cause hydraulic oil to leak out of disconnected cylinder port. Turn wheel only to left when performing test.

Start engine and run at high idle.

[6] - Turn steering wheel to the left. While turning wheel, check pressure reading on gauge.

Item	Measurement	Specification
Steering Pressure ± (10%)	Pressure	10 340 kPa (103.4 bar) (1500 psi)

Results:

- No pressure: Steering hoses may be incorrectly connected to the SCU. Check hose connections.
- Pressure too low: Relief valve in SCU may be stuck open or defective; perform steering system test, or gear pump may be worn; disassemble and inspect pump. (See Hydraulic Gear Pump Removal and Installation in Section 80, Group 35.)
- Pressure too high: Relief valve in SCU may be clogged or defective.

PTO Clutch Pressure Test

Reason:

To test hydraulic pressure to the main PTO. If correct pressure is supplied to the clutch, clutch malfunctions can be isolated to the clutch assembly. If low or no pressure is supplied to the clutch, clutch malfunctions can be isolated to the hydraulic system.

Equipment:

- Pressure Gauge — 0—2000 kPa (20 bar); or, 0—300 psi.

  Pressure Gauge — 0—2000 kPa (20 bar); or, 0—300 psi.

  Used to test PTO clutch pressure.

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmissions to NEUTRAL.

[3] - Place PTO switch in OFF position.

[4] -

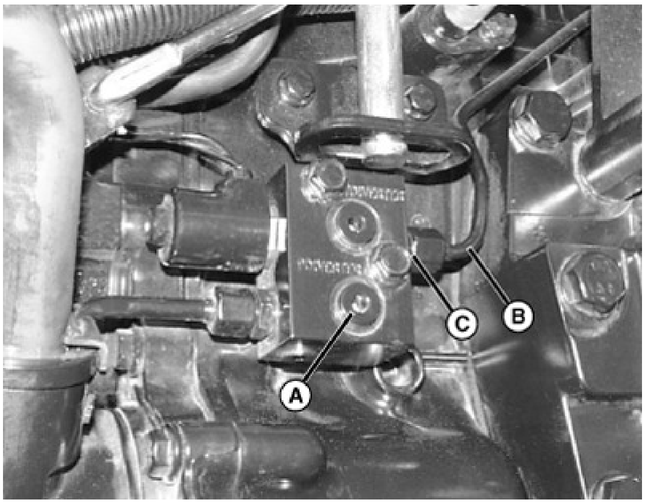
CAUTION:

Avoid Injury! Make sure to relieve system pressure before loosening any system lines or hoses.

Cycle all controls to relieve any pressure that may be in the hydraulic system.

[5] - Locate the PTO clutch solenoid valve on left side of the machine above hydraulic suction filter.

[6] -



LEGEND:

A	Pressure Port
B	PTO Clutch Supply Line
C	PTO Clutch Supply Oil Port

PTO Clutch Solenoid

Remove plug from PTO clutch solenoid valve pressure port (A).

[7] - Install quick connect fitting or equivalent. Install hose and pressure gauge to fitting.

[8] - Start machine.

[9] - Check pressure gauge for charge pressure.

[10] - Stop machine.

[11] - Cycle all controls to relieve any pressure that may be in the hydraulic system.

[12] - Remove test gauge and fittings.

[13] - Install plug in port (A).

Results:

- Pressure is within specification: Check PTO clutch solenoid valve for proper operation.
- Disconnect PTO clutch supply line (B) from valve body.
- Use appropriate fittings to connect pressure gauge to PTO clutch supply oil port (C).
- Start machine, engage PTO and check for pressure reading.

Item	Measurement	Specification
PTO Clutch Charge Pressure	Pressure	1725—2000 kPa (17.25—20 bar) (250—290 psi)

- If charge pressure is not present or is low, repair or replace PTO clutch solenoid valve. If charge pressure is present, go to PTO clutch for repair.
- No pressure or pressure is low: Check charge pressure.

Rockshaft Cable Adjustment

Reason:

Improperly adjusted cable could adversely affect rockshaft arm travel. Procedure must be performed after cable replacement.

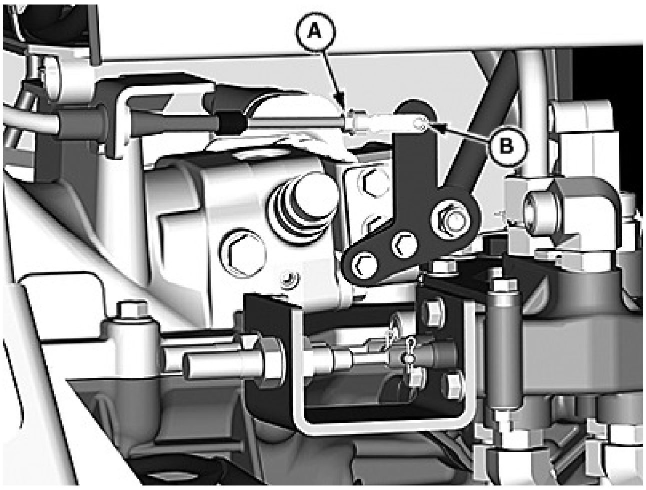
Tools:

- 10 mm open-end wrench

Procedure:

[1] - Park machine safely with park brake locked. See Park Machine Safely in Section 10, Group 05.)

[2] -



LEGEND:

A	Jam Nut
B	Pin

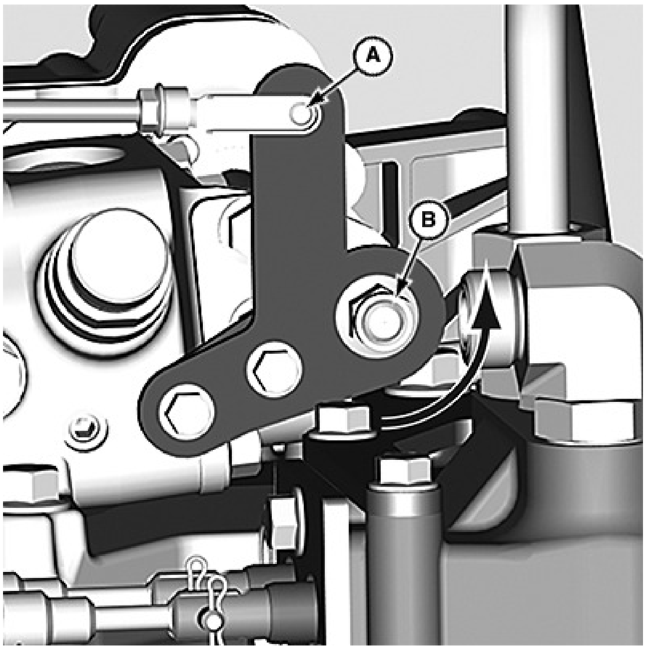
Right rear wheel removed for photo.

Loosen jam nut (A).

[3] - Remove pin (B).

[4] - Place lift lever in cab all the way back in the raised position.

[5] -



LEGEND:

A	Rockshaft Control
B	Nut

Rockshaft Control

Turn the rockshaft control assembly all the way counterclockwise to the raised position.

[6] - Turn the yoke on the cable as needed to align hole in yoke with hole in rockshaft control (A).

[7] - Install pin and tighten jam nut.

[8] - Operate rockshaft lever.

a. The rockshaft lever should require a 6 to 8 pound force to operate the lever. This can be adjusted by tightening or loosening nut (B).
b. The lever in the cab should not touch either side of the plastic after final adjustment.

Rockshaft Lift Cycle Test

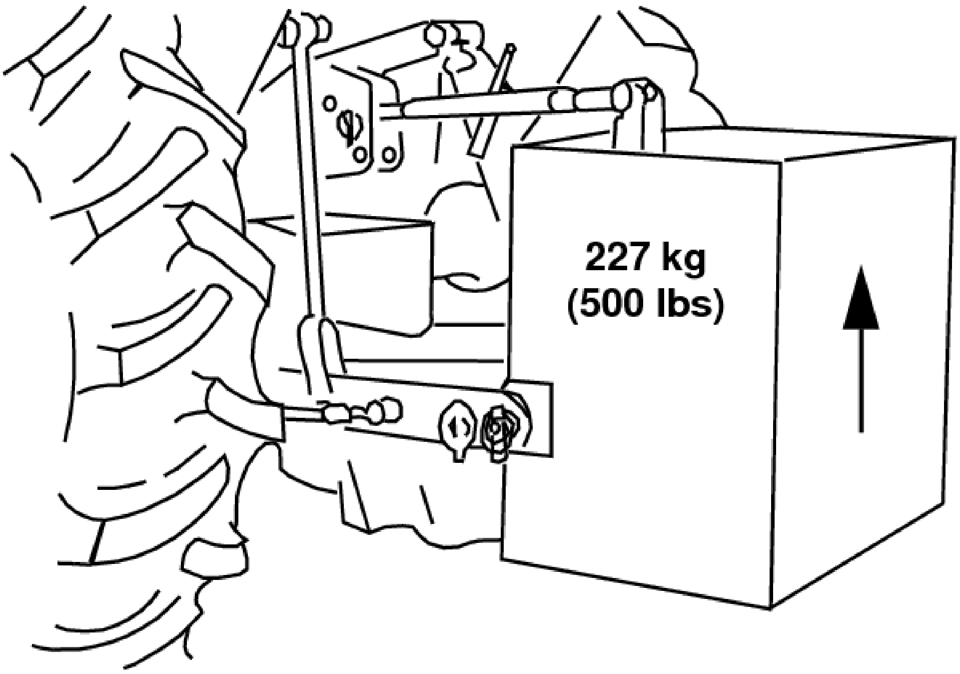
Reason:

To ensure that hydraulic system is functioning correctly and capable of lifting rated load.

Equipment:

- BW13586 Ballast Box

Procedure:



Ballast Box

[1] - Park machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] - Install BW13586 ballast box, or approximately **227 kg (500 lb.)** , on the three point hitch.

Ballast Box

BW13586

Used to test rockshaft lift cycle.

[4] - Open rate of drop/stop valve completely.

[5] - Start engine and run at fast idle.

[6] - Move lift control lever to full UP position.

[7] - Time duration of lift cycle from full down to full up.

Item	Measurement	Specification
Rockshaft Lift Time	Time	2.5—3 seconds

Results:

If the weight raises slower than specified there may be internal leakage in the lift cylinder or rockshaft control valve.

Rockshaft Leakage Test

Reason:

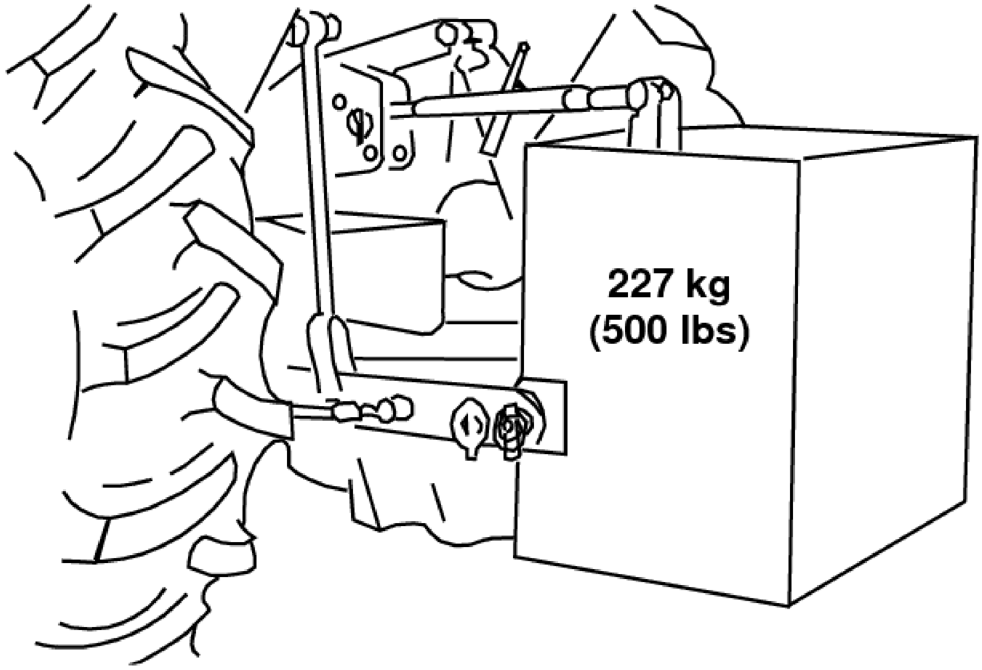
To ensure that hydraulic system is functioning correctly and capable of lifting rated load.

Equipment:

- BW13586 Ballast Box

Procedure:

[1] -



Ballast Box

Park machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] - Install BW13586 ballast box, or approximately **227 kg (500 lb.)** , on the three point hitch.

Ballast Box

BW13586

Used to test rockshaft leakage.

[4] - Start engine and run at fast idle **(2500—2700 rpm)** .

[5] - Put lift control lever in full UP position.

[6] - Raise weight as high as it will go.

[7] - Close rate of drop/stop valve.

[8] - Shut off engine.

[9] - Measure distance weight drops in five minutes.

[10] - Restart engine, open rate of drop/stop valve fully and raise weight to full UP position.

[11] - Shut off engine.

[12] - Measure distance weight drops in five minutes.

Item	Measurement	Specification
Rockshaft Drop in 5 Minutes (Maximum)	Distance	51 mm (2 in.)

Results:

If the weight drops farther than specified distance with the stop/drop valve closed (first test) there may be leakage in the cylinder, relief valve or drop/stop valve.

If the weight drops farther with the drop/stop valve open (second test) than it did in the first test, there may be leakage in the rockshaft control valve.

Rockshaft Position Feedback Linkage Adjustment

Reason:

To ensure that draft arms raise to maximum lift height without engaging relief valve.

Procedure:

[1] - Position machine on a level surface and set park brake.

[2] - Shift transmission to NEUTRAL.

[3] - Position lift control lever in the full forward (down) position and provide enough weight on lift arms to allow self lowering.

[4] - Start engine.

[5] - Move lift control lever to full raise position (back).

[6] - Lift arm should raise fully without engaging the relief valve. Check that there is **25.4 mm (1 in.)** of slack above the vertical height.

Item	Measurement	Specification
Lift Arm (Fully Raised)-to-Relief Valve	Distance	25.4 mm (1 in.)

Results:

If specification is not met, lengthen the lift arm position feedback rod to increase, or shorten to reduce the maximum height until within specification. The relief valve should not engage.

Group 35 - Repair

Diverter Valve Removal and Installation

[1] -

CAUTION:

Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

Relieve pressure from the hydraulic system by lowering the rockshaft and moving the SCV lever through all positions.

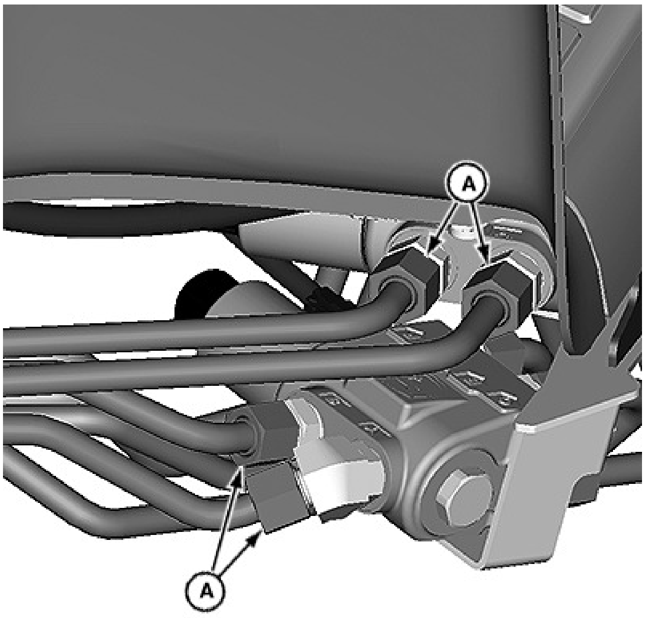
[2] -

CAUTION:

Avoid crushing injury. Use a safe lifting device and support machine securely on jack stands. Block front and rear of wheel not raised to prevent machine movement. Wheel can be heavy or difficult to handle when removing.

Remove rear wheel on right side of machine.

[3] -



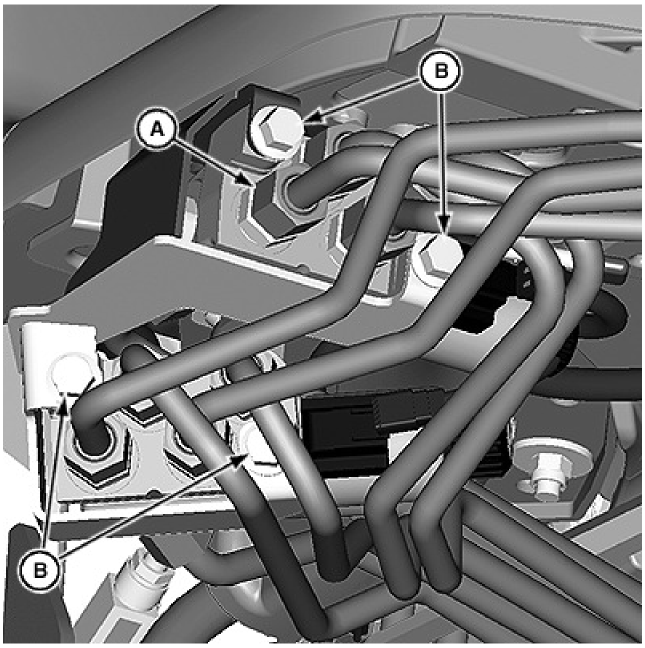
LEGEND:

A	Hydraulic Line (4 used)

Rear Diverter Line

Disconnect hydraulic lines (A) from rear of diverter valve. Install caps and plugs to prevent system contamination.

[4] -



LEGEND:

A	Hydraulic Line (4 used)
B	Cap Screw (4 used)

Front Diverter Line

Disconnect 8 hydraulic lines (A) from front of diverter valve. Install caps and plugs to prevent system contamination.

[5] - Disconnect wire harness from diverter valves.

[6] - Remove cap screws (B) and diverter valve.

Installation is done in reverse order of removal.

- Transfer over fittings and install new O-rings.
- Bleed hydraulic system. See Hydraulic System Bleed Procedure.
- Tighten hydraulic lines to specification.

Item	Measurement	Specification
Hydraulic Line	Torque	50 N·m (37 lb.-ft.)

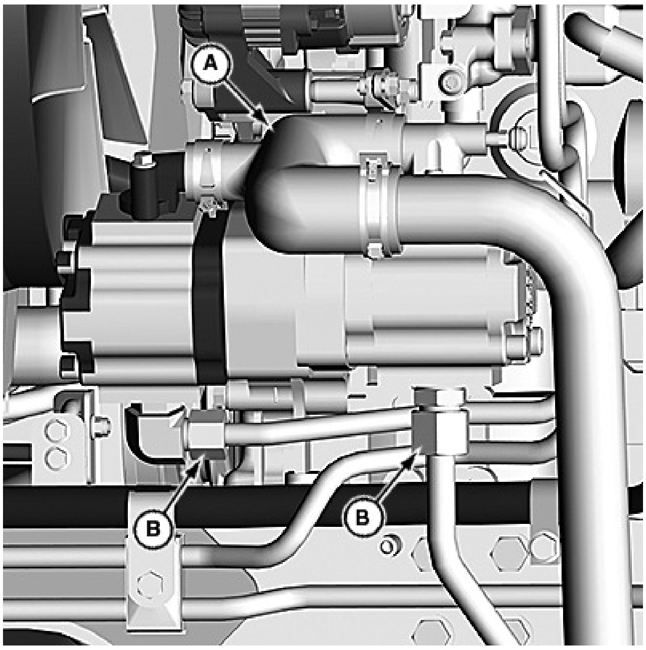
Hydraulic Gear Pump Removal and Installation

Removal:

[1] - Remove left side engine side panel.

[2] - Put a drain pan under the pumps to catch residual oil.

[3] -



LEGEND:

A	Suction Manifold
B	Pressure Tube (2 used)

Gear Pump R & I

Disconnect suction manifold (A) and pressure tubes (B) from pumps to be removed.

[4] -

IMPORTANT:

Depending on the engine exhaust configuration, the removal of certain exhaust components may be required to remove the front pump.

→NOTE:

Each pump has four socket head cap screws securing it to the engine drive housing.

Remove the appropriate pump.

Installation:

[1] - Install new body seals on the suction fittings and pressure tubes. Secure to the pump with cap screws. Tighten to specification.

Item	Measurement	Specification
Suction Fitting and Pressure Tube Cap Screw	Torque	9 N·m (84 lb.-in.)

[2] - Install new gaskets on the pump mounting flanges.

[3] - Align the splines on the pump input shaft with splines on the engine drive. Insert the pump into the engine housing.

[4] - Secure each pump with socket head cap screws. Tighten cap screws to specification.

Item	Measurement	Specification
Pump Cap Screw	Torque	22 N·m (192 lb.-in.)

[5] - Inspect the suction manifold for damage or cracking. Replace if necessary.

Gear Pump Disassembly and Inspection:

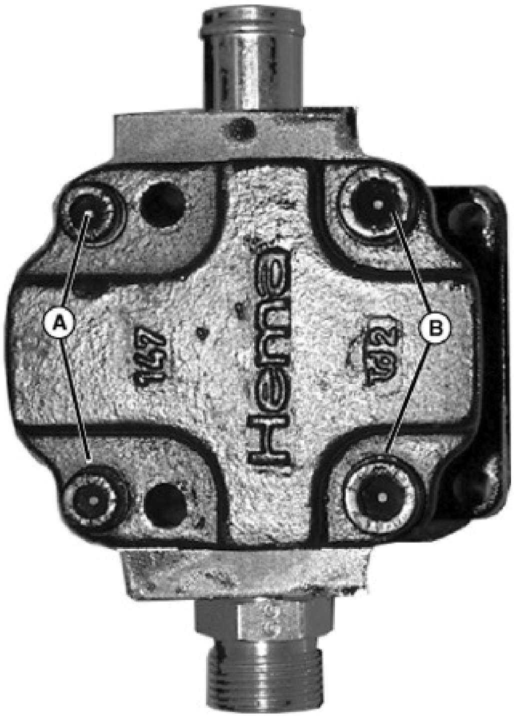
[1] -

IMPORTANT:

Avoid Damage! Replace all body seals, gaskets, and seals any time the pump is opened. Used or damaged body seals, gaskets, and seals will leak.

→NOTE:

Available pump components are serviced only in the seal kit for the pump. Verify the availability of pump components before disassembling the pump.



LEGEND:

A	M8 Socket Head Cap Screw (2 used)
B	M10 Socket Head Cap Screw (2 used)

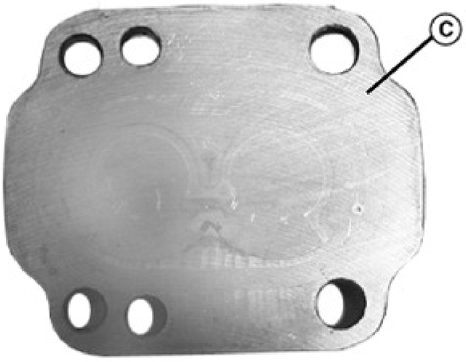
Pump Removed

Remove the pump from the engine.

[2] - Remove two M8 socket head cap screws (A) and two M10 socket head cap screws (B) securing the rear pump cover to the pump body and front cover.

[3] - Remove the rear pump cover.

[4] -



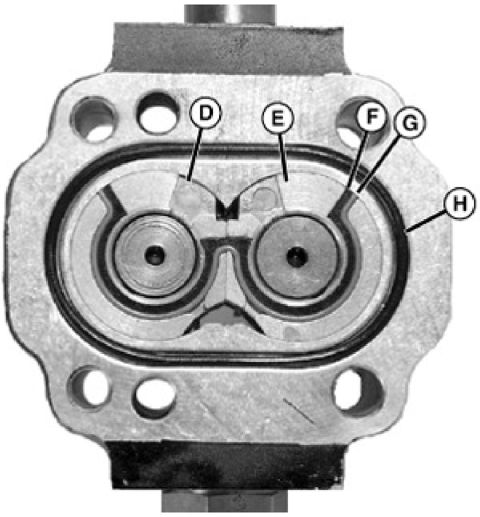
LEGEND:

C	Inside Pump Cover

Inside Pump Cover

Inspect the inside of the pump cover (C) for wear or damage.

[5] -



LEGEND:

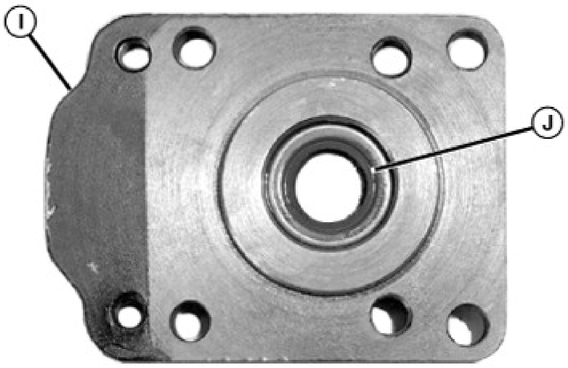
D	Rear Pump Bushings
E	Rear Pump Bushings
F	Seal
G	Backing Ring
H	Body Seal

Rear Pump Bushing

Remove the seal (F) and backing ring (G) from the rear pump bushings (D, E).

[6] - Replace the body seal (H).

[7] -



LEGEND:

I	Front Cover
J	Shaft Seal

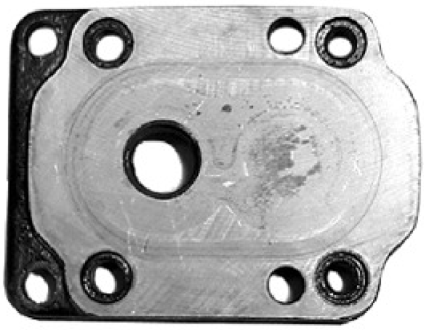
Front Cover

Remove the front cover (I).

[8] - Inspect the outside of the front cover for wear or damage.

[9] - Inspect the shaft seal (J) for cracks, wear, or damage. If necessary replace the shaft seal.

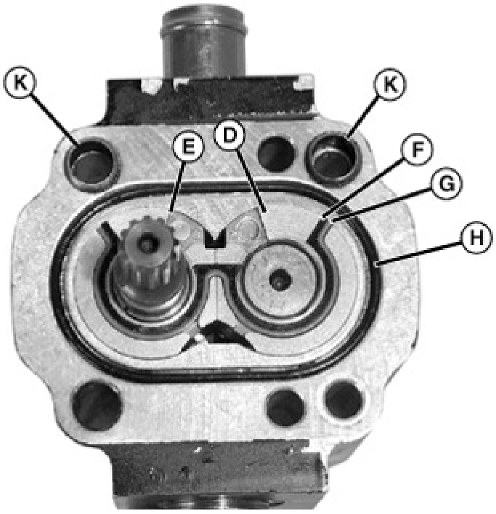
[10] -



Inside Front Cover

Inspect the inside of the front cover for scoring, wear, or damage.

[11] -



LEGEND:

D	Front Pump Bushing
E	Front Pump Bushing
F	Seal
G	Backing Ring
H	Body Seal
K	Alignment Dowel (2 used)

Front Pump Bushing

Remove the seal (F) and backing ring (G) from the front pump bushings (D, E).

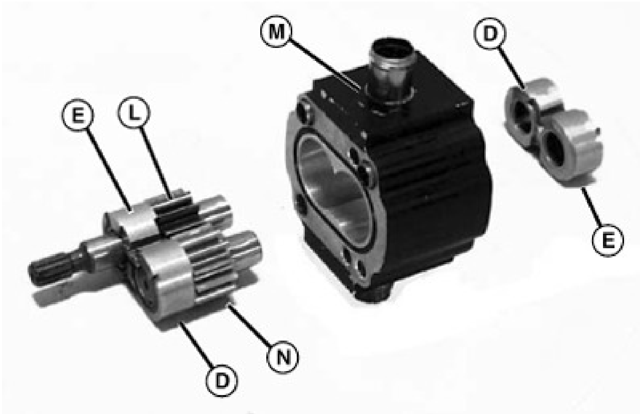
[12] - Inspect two alignment dowels (K) for damage. Replace if necessary.

[13] - Replace the body seal (H).

[14] -

→NOTE:

The dowels may remain in either the pump cover or body when the cover is removed.



LEGEND:

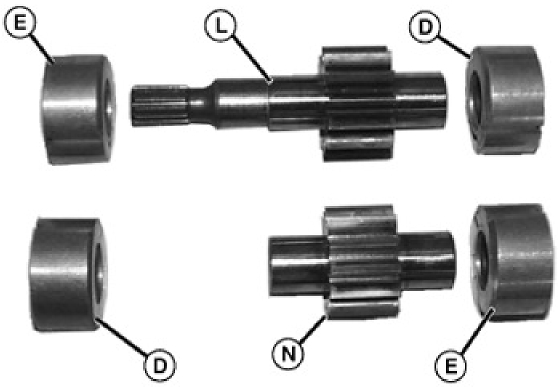
D	Front and Rear Bushings
E	Front and Rear Bushings
L	Drive Gear
M	Pump Housing
N	Driven Gear

Pump Housing

Note the location and markings on the front and rear bushings (D, E) to assure correct orientation at assembly.

[15] - Remove the front bushings, drive gear (L), and driven gear (N) from the pump housing (M).

[16] -



LEGEND:

D	Bushings
E	Bushings
L	Drive Gear
N	Gear

Gears

Remove the bushings (D and E) from the gears (L and N).

[17] - Inspect the gear and bushing faces for scoring, scratches, or damage.

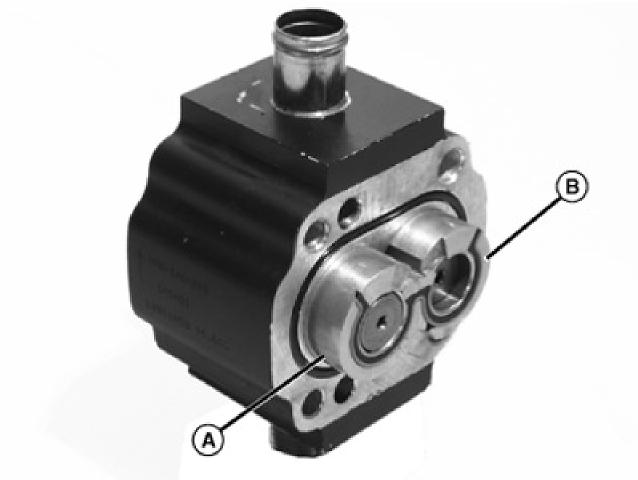
[18] - Inspect the drive gear (L) shaft splines and bearing surfaces for wear or damage.

[19] - Inspect the gear shaft bearing surfaces for wear or damage.

[20] - Inspect inside of bushings for scoring or excessive scratching.

[21] - Inspect pump housing internal surfaces for scoring or scratching. Replace pump if damaged.

Assembly:



LEGEND:

A	Rear Bushing
B	Rear Bushing

Pump Assembly

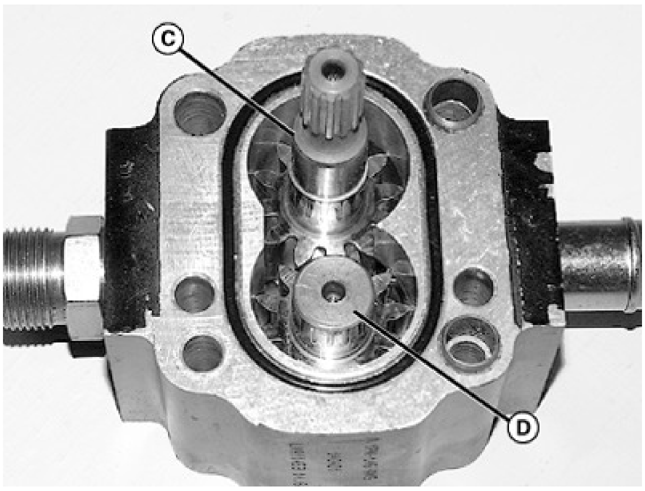
[1] - Lubricate all parts with hydraulic oil before assembly.

[2] - Install the rear bushings (A and B) into the pump housing bore as shown. Push the bushings in by hand until they are flush with the back of the pump housing.

[3] -

→NOTE:

The bushings should be oriented so that the opening formed by the seal faces the top of the pump.



LEGEND:

C	Drive Gear
D	Driven Gear

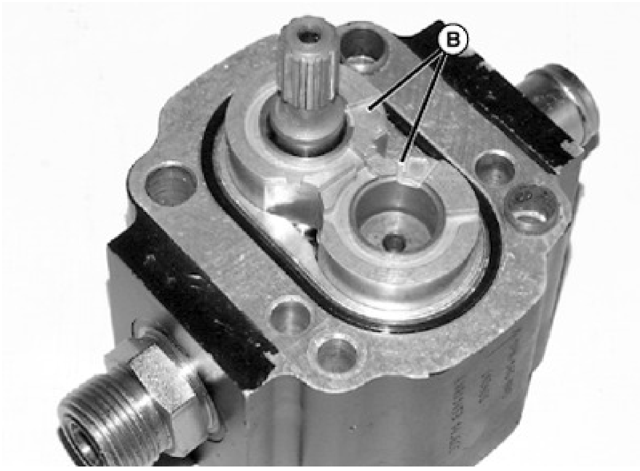
Back Pump Body

Lay the back of the pump body on a clean, flat surface. Install the drive gear (C) and driven gear (D) into the pump body and rear bushings.

[4] -

→**NOTE:**

The driven gear is symmetrical and can be placed in the pump body either end first.



LEGEND:

B Front Bushings

Front Bushings

Install the front bushings (B) into the pump housing, and onto the drive gear and idler gear shafts.

[5] -

→**NOTE:**

The bushings should be oriented so that the opening formed by the seal faces the top of the pump.

Replace the seal backing ring and seal in the front and rear bushings.

[6] -

→**NOTE:**

The seal and the backing ring MUST be installed in the correct orientation. The flat side of the seal must face the bushings. The flat side of the backing ring must face the pump cover.

Replace the front and rear body seals.

[7] - Install front cover over the drive gear shaft and onto pump body.

[8] - Install rear cover and secure the covers with two M8 and two M10 socket head cap screws. Tighten M8 and M10 cap screws to specification.

Item	Measurement	Specification
Socket Head Cap Screw—M8-to-Gear Pump Cover	Torque	22 N·m (195 lb.-in.)
Socket Head Cap Screw—M10-to-Gear Pump Cover	Torque	43 N·m (32 lb.-ft.)

[9] - Install the pump to the engine.

Rockshaft Removal and Installation (Open Station)

Removal

[1] - Disconnect and remove lift and drag links.

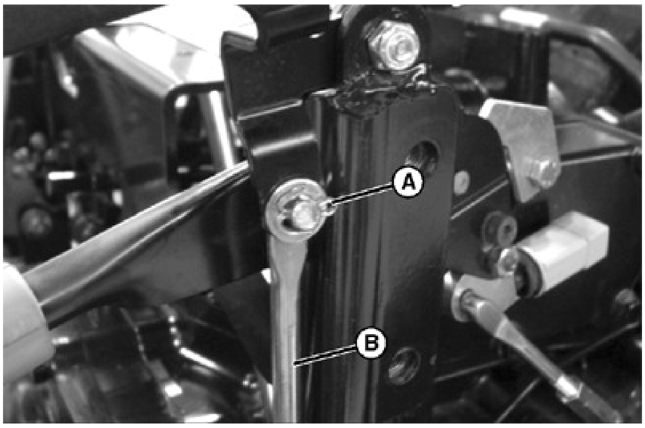
[2] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station).

[3] - Remove seat closeout panel. See Seat Closeout Removal and Installation (Open Station)—eHydro Transmission or Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission.

[4] - Remove rear fenders. See Rear Fenders Removal and Installation (Open Station).

[5] - Disconnect and lay aside any electrical wires running over rockshaft. To avoid confusion during assembly, label all connectors.

[6] -



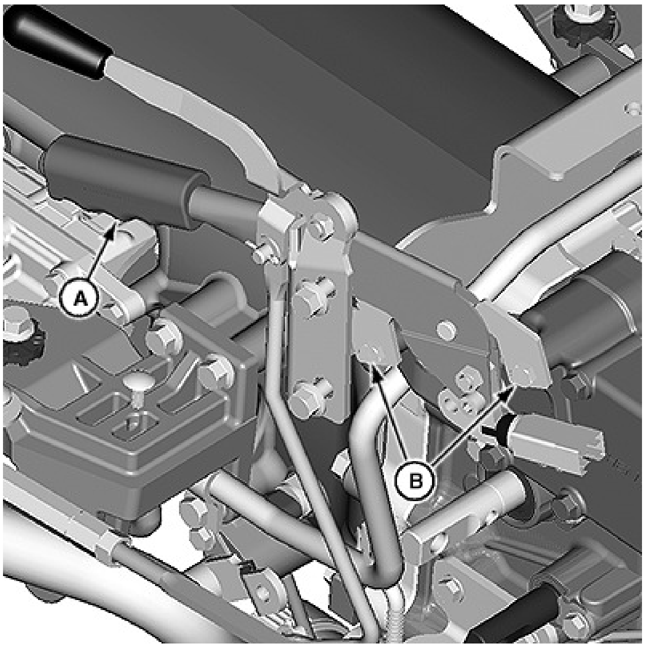
LEGEND:

A	Cotter Pin
B	MFWD Linkage

MFWD Linkage

Remove cotter pin (A) and washer. Disconnect MFWD linkage (B).

[7] -



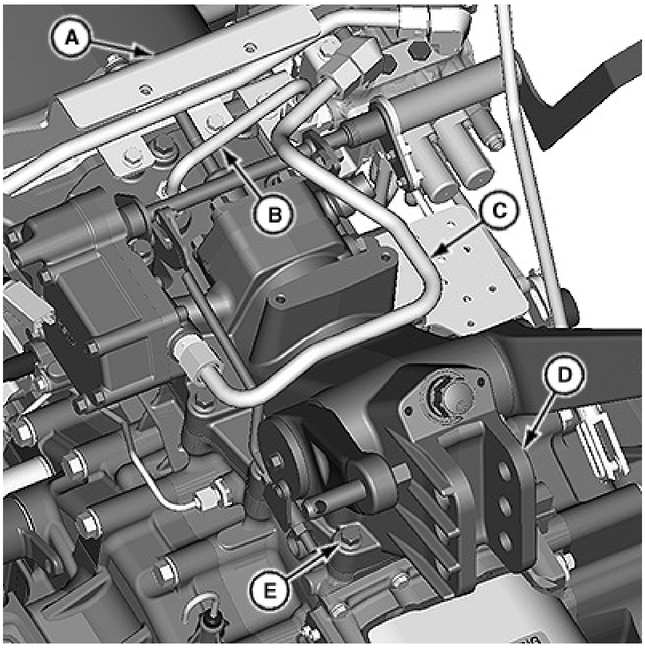
LEGEND:

A	Brake Handle Assembly
B	Cap Screw (2 used)

Brake Handle

Remove two cap screws (B) and brake handle assembly (A).

[8] -



LEGEND:

A	Seat Support Bracket
B	Supply Line
C	Rockshaft Line
D	Rockshaft
E	Cap Screw (12 used)

Rockshaft

Remove seat support bracket (A).

[9] - Disconnect and remove supply line (B) and rockshaft line (C).

[10] -

→NOTE:

The cap screws being removed come in various lengths.

Remove 12 cap screws (E) securing rockshaft (D) to differential housing.

[11] -

→NOTE:

Rockshaft is heavy! Use a hoist or have an assistant help remove rockshaft.

Remove rockshaft.

Installation

Installation is done in the reverse order of removal.

- Clean mating surfaces of rockshaft and final drive housing. Install a new gasket on transaxle rockshaft mounting surface.
- If lift arms have been removed they must be reset. See Lift Arms Adjustment .
- Tighten cap screws to specification.

Rockshaft Removal and Installation (Cab)

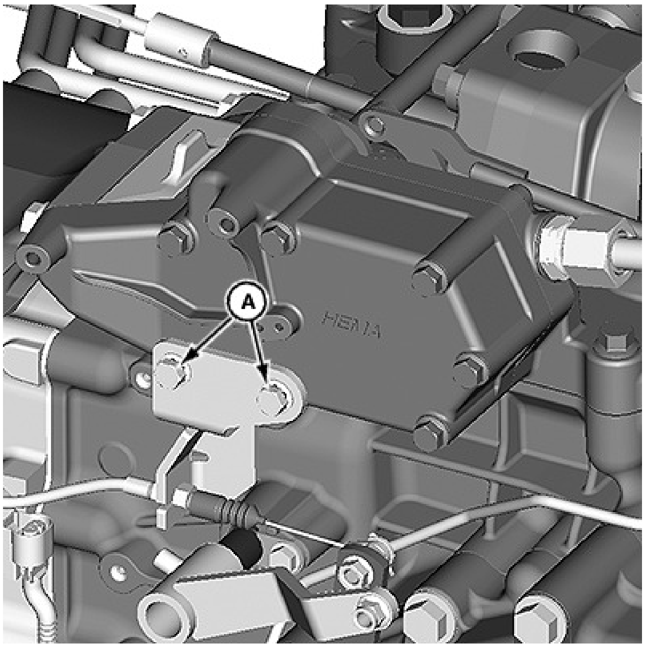
Removal

[1] - Disconnect and remove lift and drag links.

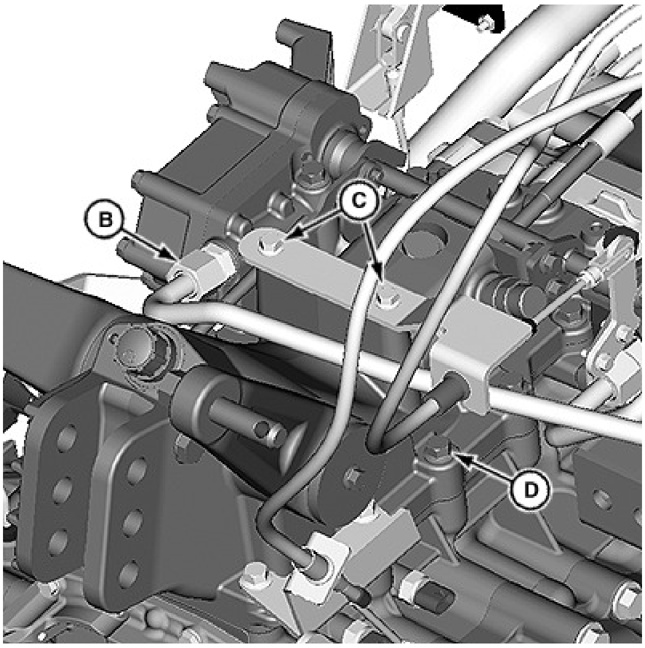
[2] - Remove cab. See Cab Removal and Installation .

[3] - Disconnect and lay aside any electrical wires running over rockshaft. To avoid confusion during assembly, label all connectors.

[4] -



Rockshaft



Rockshaft

LEGEND:

A Cap Screw (2 used)
B Supply Line
C Cap Screw (2 used)
E Cap Screw (12 used)

Remove cap screws (A) and bracket.

[5] - Remove cap screws (C) and bracket.

[6] - Disconnect and remove supply line (B).

[7] -

→NOTE:

The cap screws being removed come in various lengths.

Remove 12 cap screws (E) securing rockshaft (D) to differential housing.

[8] -

→NOTE:

Rockshaft is heavy! Use a hoist or have an assistant help remove rockshaft.

Remove rockshaft.

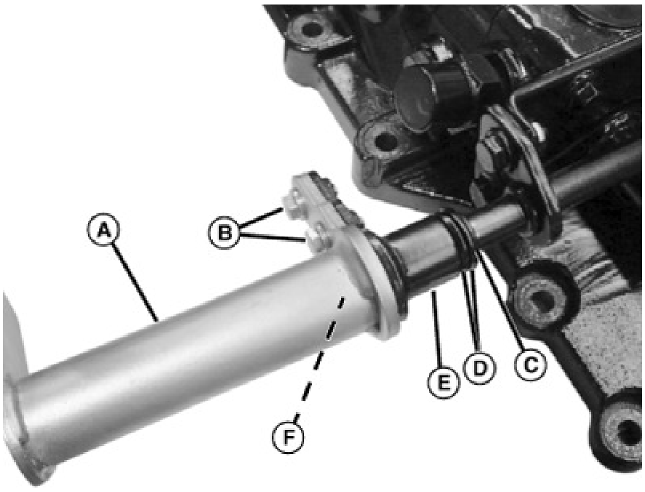
Installation

Installation is done in the reverse order of removal.

- Clean mating surfaces of rockshaft and final drive housing. Install a new gasket on transaxle rockshaft mounting surface.
- If lift arms have been removed they must be reset. See Lift Arms Adjustment .
- Tighten cap screws to specification.

Rockshaft Disassembly and Assembly

Disassemble:



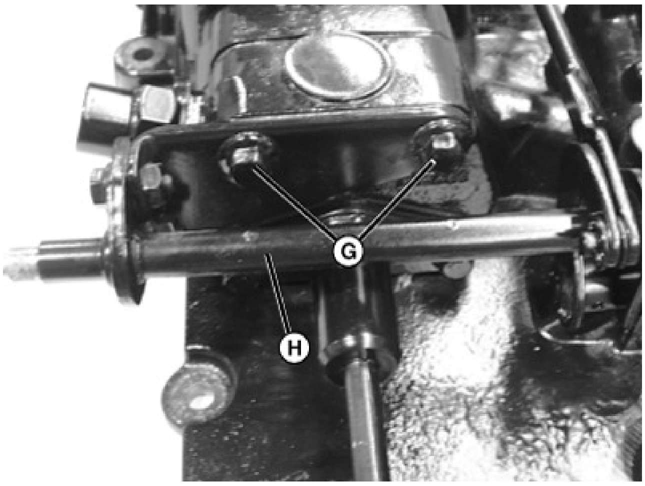
LEGEND:
A Control Lever
B Cap Screw (2 used)
C Flat Washer
D Belleville Washer (2 used)
E Lever Arm
F Lock Nut

Rockshaft Control Lever and Arm

[1] - Remove two cap screws (B) that retain control lever (A) to lever arm (E). Remove control lever.

[2] - Remove lock nut (F), lever arm (E), two belleville washers (D), and one flat washer (C).

[3] -



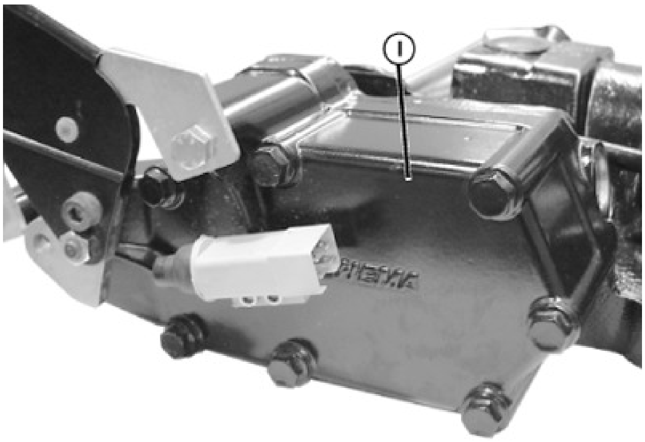
LEGEND:
G Cap Screw (2 used)
H Shaft Support Tube

Shaft Support Tube

Remove two cap screws (G).

[4] - Remove shaft support tube (H) and bracket assembly.

[5] -

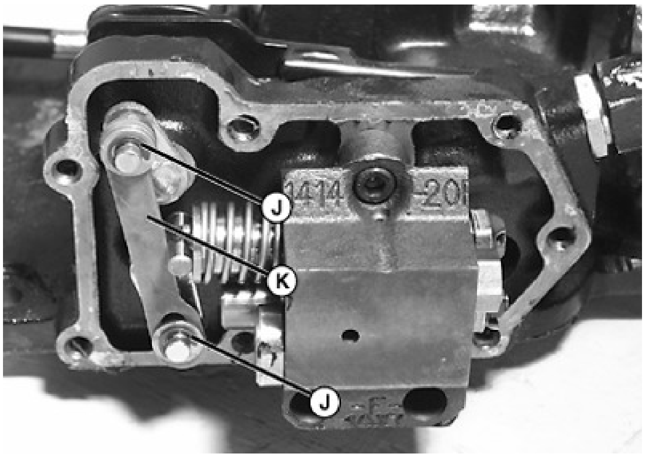


LEGEND:
I Rockshaft Valve Cover

Rockshaft Valve Cover

Remove six cap screws and rockshaft valve cover (I).

[6] -



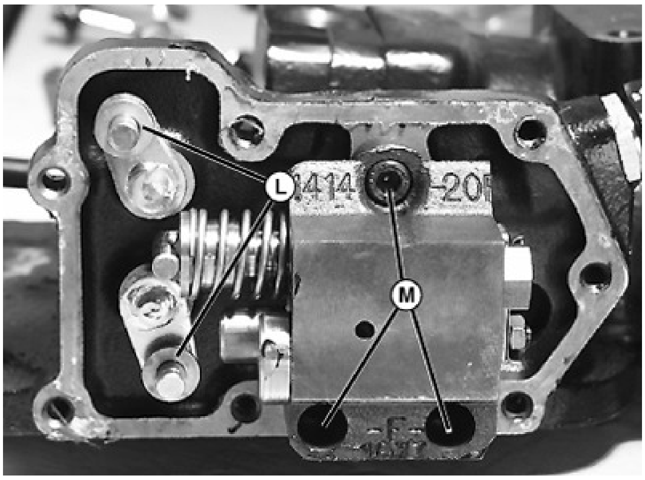
LEGEND:

J	Snap Ring (2 used)
K	Link

Link Removal

Remove two snap rings (J), two flat washers, and link (K).

[7] -



LEGEND:

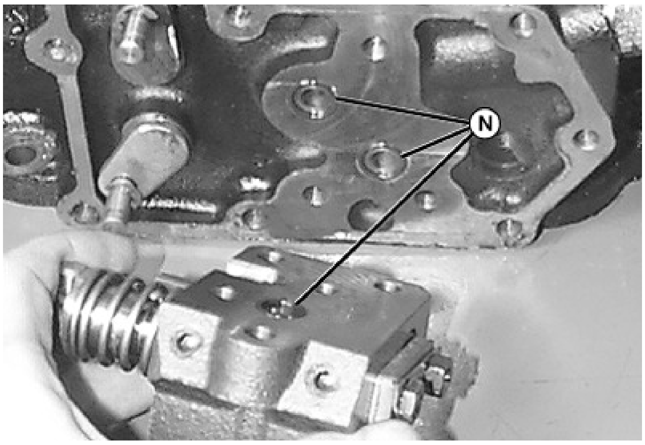
L	Washer (2 used)
M	Socket Head Cap Screw (3 used)

Rockshaft Control Valve

Remove two washers (L).

[8] - Remove three socket head cap screws (M) and rockshaft control valve.

[9] -



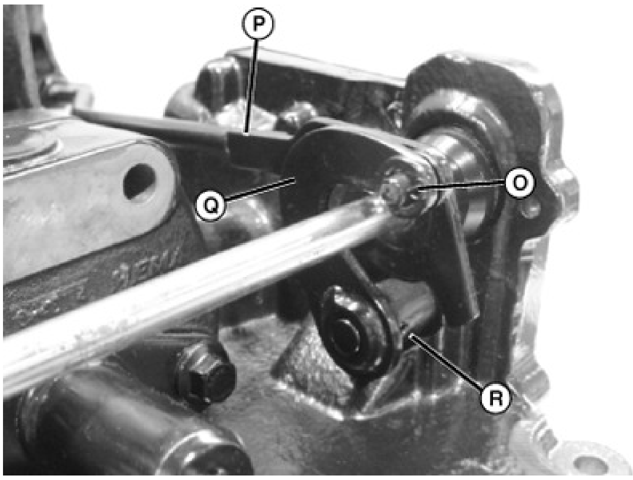
LEGEND:

N	O-rings (3 used)

O-rings

Replace three O-rings (N).

[10] -



LEGEND:

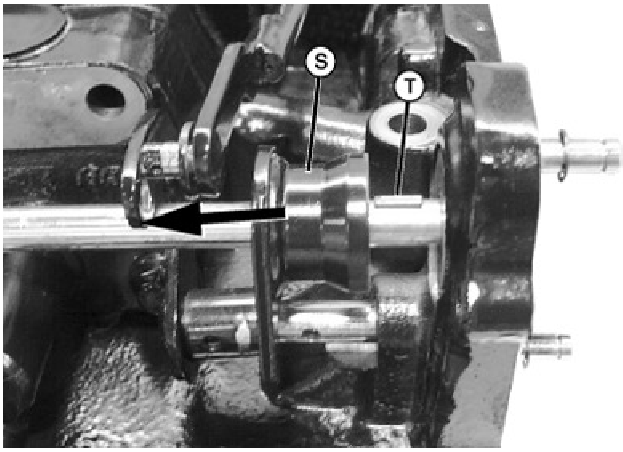
O	Cotter Pin
P	Position Feedback Rod
Q	Feedback Lever
R	Spring Pin

Position Feedback Rod

Remove cotter pin (O) and washer, and disconnect position feedback rod (P) from feedback lever (Q).

[11] - Remove spring pin (R), and feedback lever.

[12] -



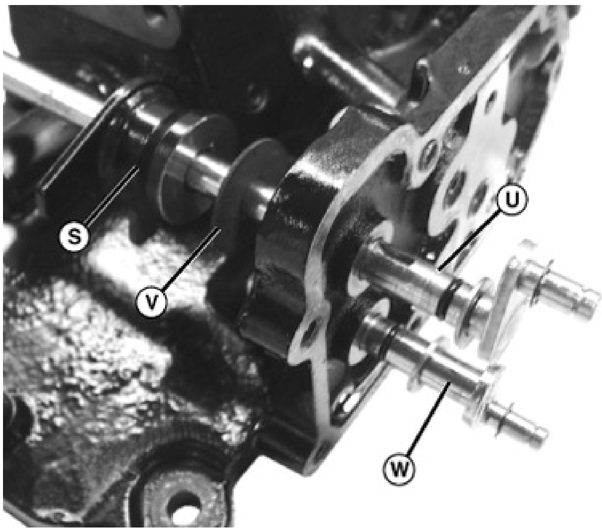
LEGEND:

S	Limiter
T	Woodruff Key

Limiter

Slide limiter (S) away from rockshaft housing. Remove woodruff key (T).

[13] -



LEGEND:

S	Limiter
U	Lift Control Shaft
V	Rubber Washer
W	Position Feedback Shaft

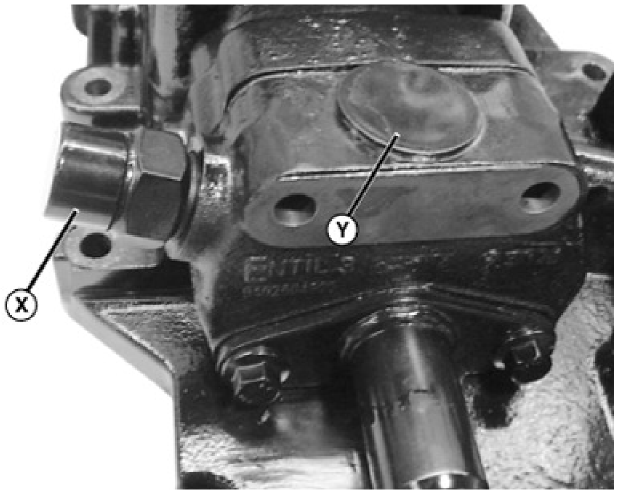
Lift Control and Feedback Shaft

Remove lift control shaft (U) from rockshaft housing. Remove limiter (S) and rubber washer (V).

[14] - Remove position feedback shaft (W) from housing.

[15] - Replace O-rings on lift control and position feedback shafts.

[16] -



LEGEND:

X	Relief Valve
Y	Plastic Cap

Cylinder Head

Remove relief valve (X).

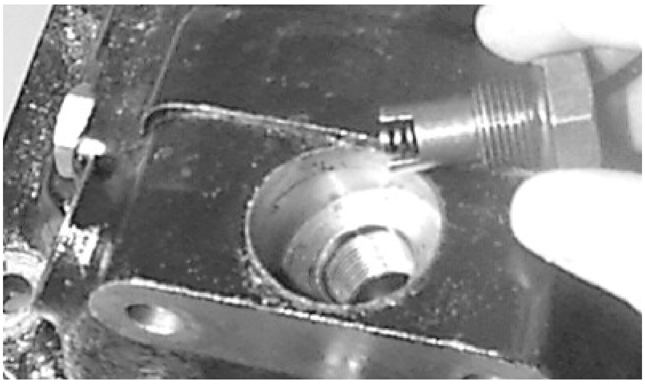
[17] - Remove plastic cap (Y) on top of cylinder head.

[18] -

Relief Valve

Replace two O-rings in relief valve.

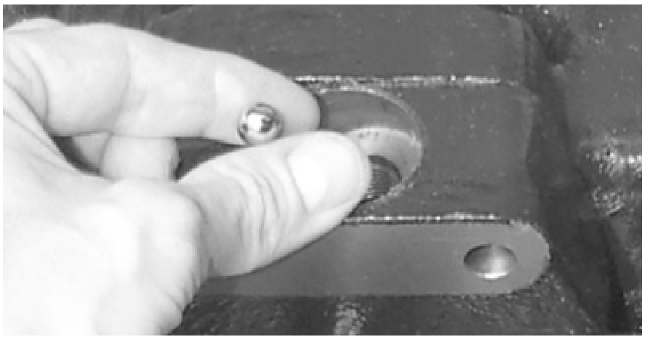
[19] -



Plug and Spring

Remove plug and spring.

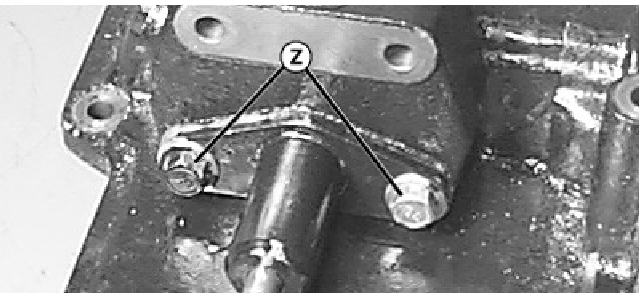
[20] -



Remove Ball

Remove ball.

[21] -



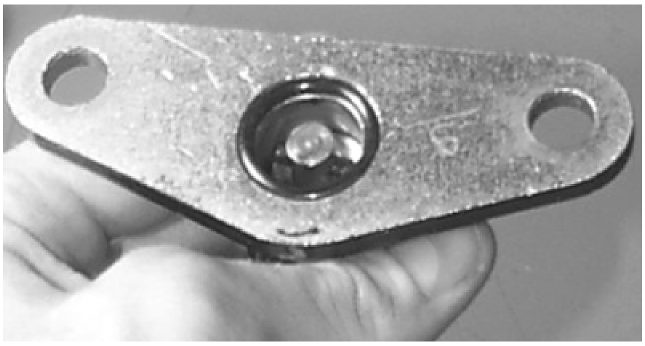
LEGEND:

Z	Cap Screw (2 used)

Rate of Drop Valve Stem

Remove two cap screws (Z) and rate of drop/stop valve stem.

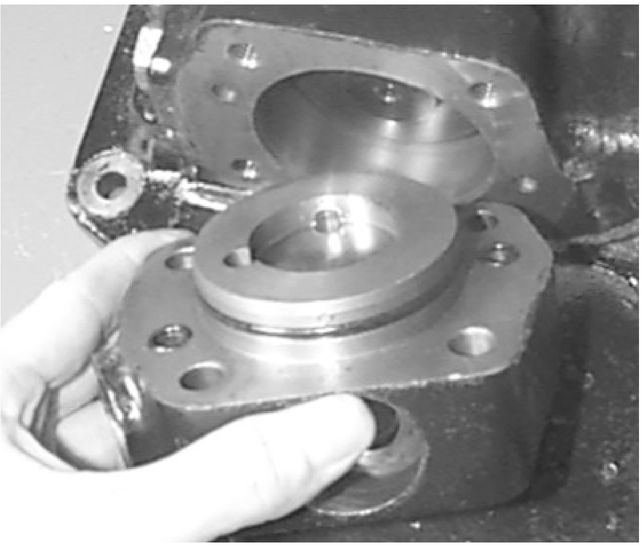
[22] -



Valve Stem End

Replace O-ring in end of valve stem.

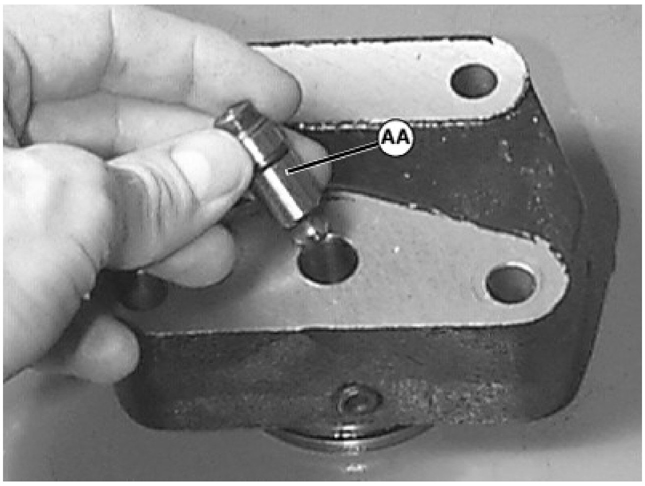
[23] -



Cylinder Head O-ring

Remove cylinder head. Replace O-rings in cylinder head.

[24] -



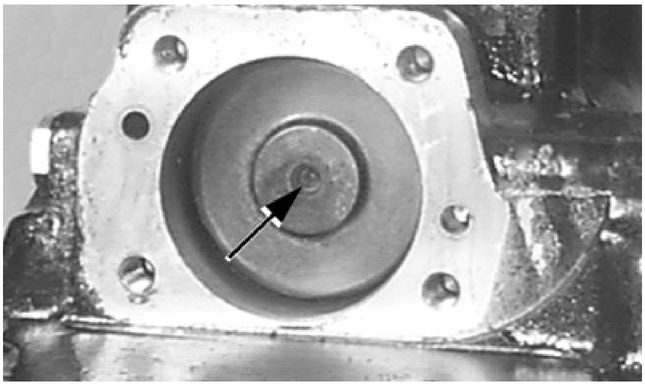
LEGEND:

AA	Rate of Drop/Stop Valve Spool

Rate of Drop/Stop Valve Spool

Remove rate of drop/stop valve spool (AA). Replace O-ring on spool.

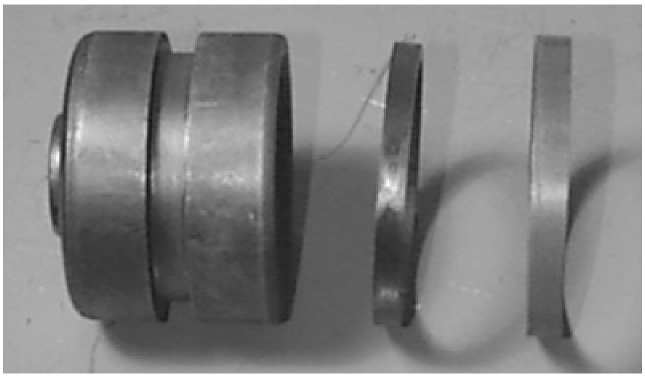
[25] -



Piston

Place a suitable cap screw in threaded hole in end of piston. Remove piston.

[26] -



Inner and Outer Piston Rings

Replace inner and outer piston rings.

Assemble:

IMPORTANT:

Avoid Damage! Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

→NOTE:

When assembling, DO NOT lubricate Belleville washers or lift control lever friction surfaces.

[1] - Install a new inner and outer piston rings.

[2] -

IMPORTANT:

Avoid Damage! Use care when installing piston into cylinder bore to prevent damage to piston rings. Be sure that piston rings are centered in cylinder bore and properly seated in piston ring groove during installation.

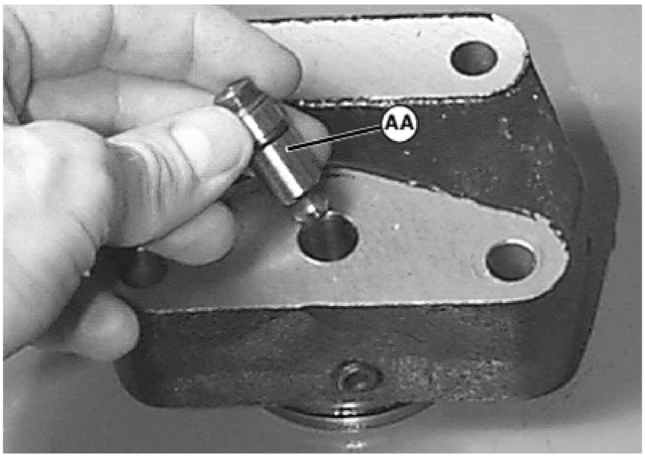
Lubricate piston and rings liberally with hydraulic oil. Using a plastic mallet, install piston into cylinder bore.

[3] - Install new O-rings into cylinder head.

[4] - Install cylinder head into cylinder bore. Retain with two lower cap screws and tighten to specification.

Item	Measurement	Specification
Rockshaft Cylinder Head Cap Screw	Torque	80 N·m (60 lb.-ft.)

[5] -



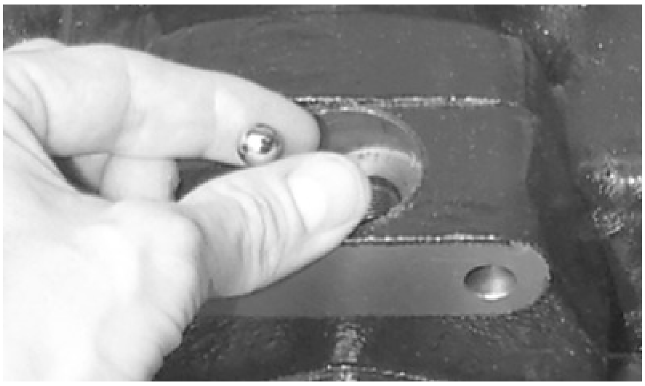
LEGEND:
AA Rate of Drop/Stop Valve Spool

Cylinder Head Bore

Install a new O-ring onto rate of drop/stop valve spool (AA). Install rate of drop/stop valve spool into bore in cylinder head.

[6] - Install a new O-ring into end of rate of drop/stop valve stem. Install rate of drop/stop valve stem onto cylinder head and retain with two cap screws.

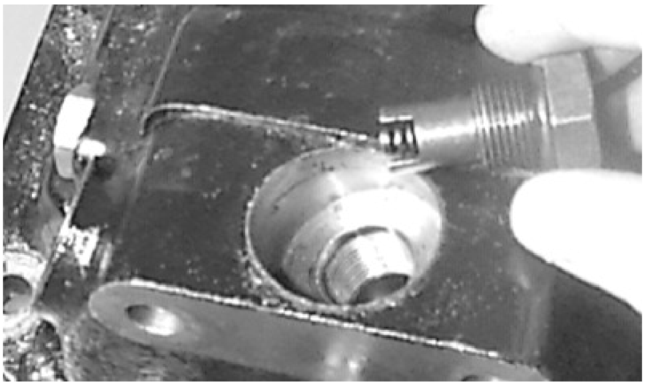
[7] -



Ball Install

Install ball.

[8] -



Plug and Spring Install

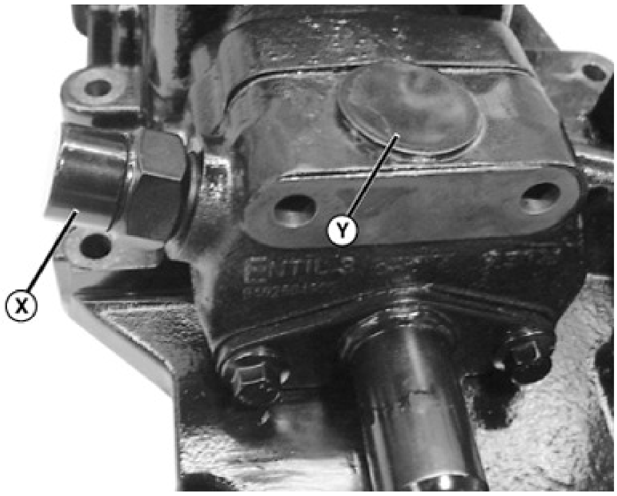
Install plug and spring.

[9] -

Relief Valve O-rings

Install two new O-rings in relief valve.

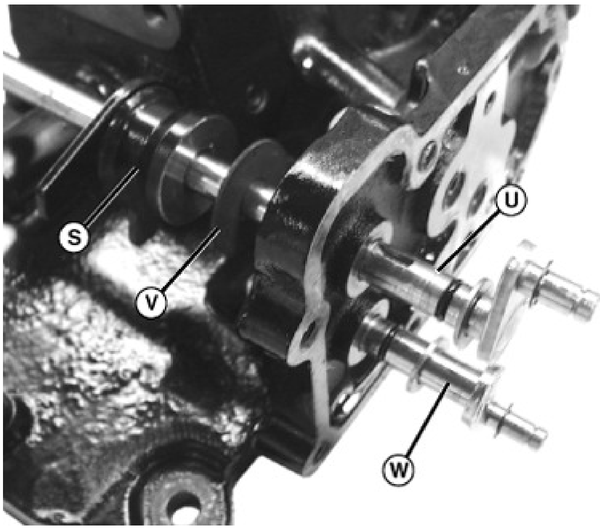
[10] -



LEGEND:

S	Limiter
U	Lift Control
V	Rubber Washer
W	Feedback Shafts
X	Relief Valve
Y	Plastic Cap

Cylinder Head



Lift Control and Feedback Shaft

Install plastic cap (Y) on top of cylinder head.

[11] - Install relief valve (X). Tighten to specification .

Item	Measurement	Specification
SCV Relief Valve	Torque	50 N·m (37 lb.-ft.)

[12] - If removed, install washers onto lift control (U) and position feedback (W) shafts.

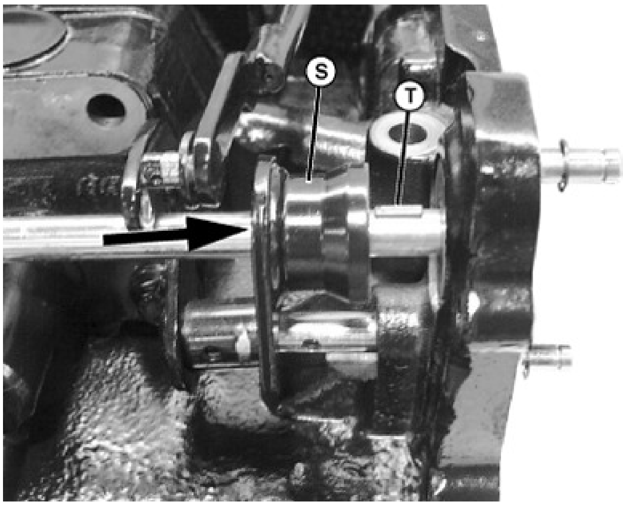
[13] - If removed, install snap rings onto lift control and position feedback shafts.

[14] - Install new O-rings onto lift control and position feedback shafts.

[15] - Install lift control shaft into rockshaft housing. Install rubber washer (V) and limiter (S) onto shaft.

[16] - Install position feedback shaft into housing.

[17] -



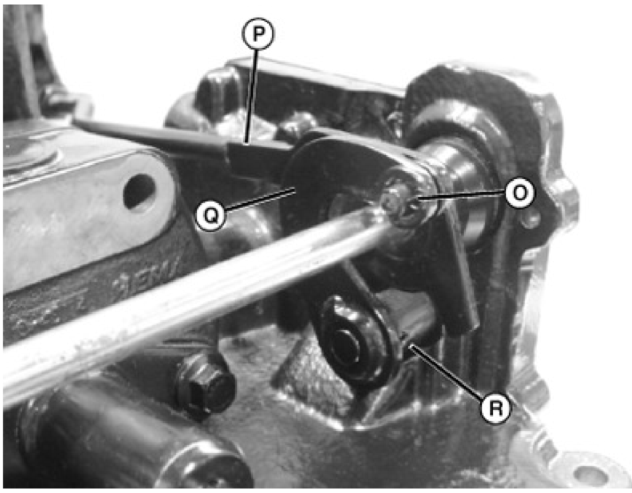
LEGEND:

S	Limiter
T	Woodruff Key

Limiter

Install woodruff key (T) into shaft. Slide limiter (S) over woodruff key and against rockshaft housing.

[18] -



LEGEND:

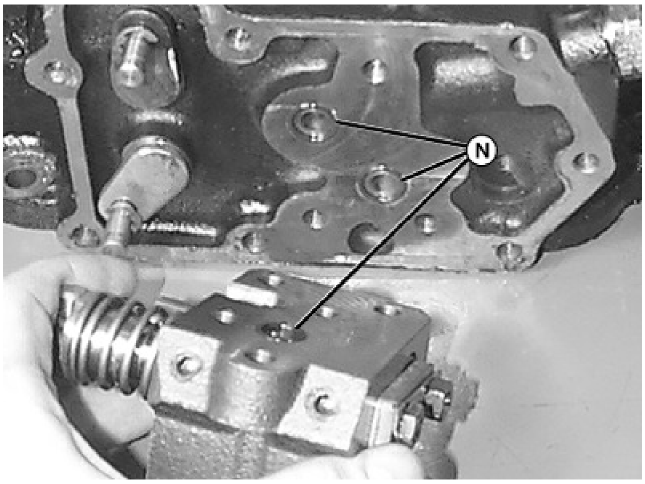
O	Washer and Cotter Pin
P	Position Feedback Rod
Q	Feedback Lever
R	Spring Pin

Position Feedback Rod

Install feedback lever (Q) onto feedback shaft. Retain with spring pin (R).

[19] - Connect position feedback rod (P) to position feedback lever. Retain with washer and cotter pin (O).

[20] -



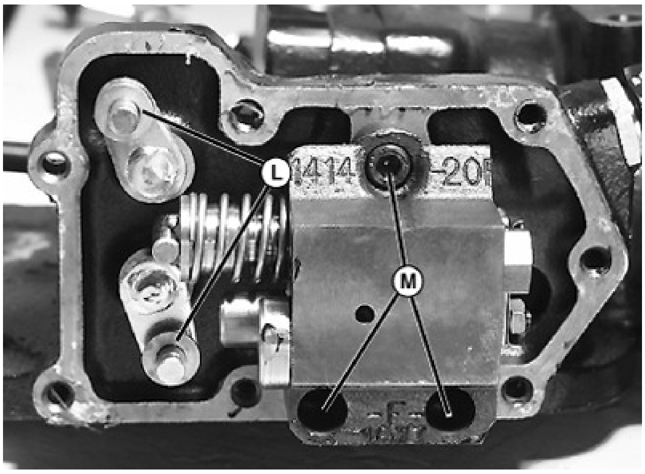
LEGEND:

N	O-rings

O-rings

Install new O-rings (N) into rockshaft control valve and rockshaft housing at rockshaft valve mounting surface.

[21] -



LEGEND:

L	Washer (2 used)
M	Socket Head Cap Screw (3 used)

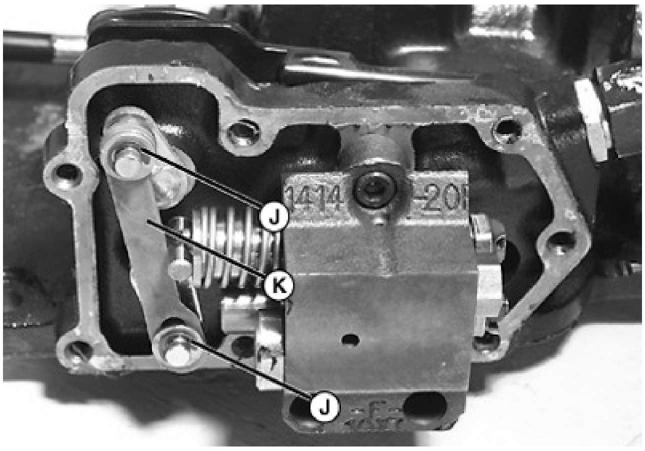
Rockshaft Control Valve

Install rockshaft control valve and retain with three socket head cap screws (M). Tighten cap screws to specification.

Item	Measurement	Specification
Socket Head Cap Screw-to-Rockshaft Control Valve	Torque	39 N·m (29 lb.-ft.)

[22] - Install two washers (L).

[23] -

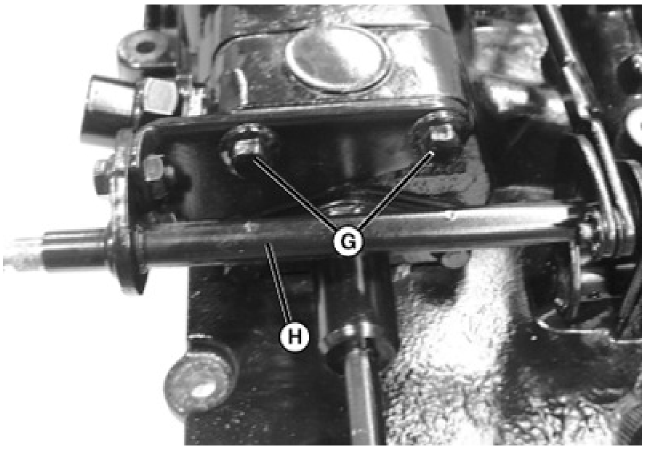


LEGEND:
J Flat Washer (2 used) and Snap Ring (2 used)
K Link

Link Install

Install link (K). Retain with two flat washers, and two snap rings (J).

[24] -



LEGEND:
G Cap Screw (2 used)
H Shaft Support Tube

Shaft Support Tube

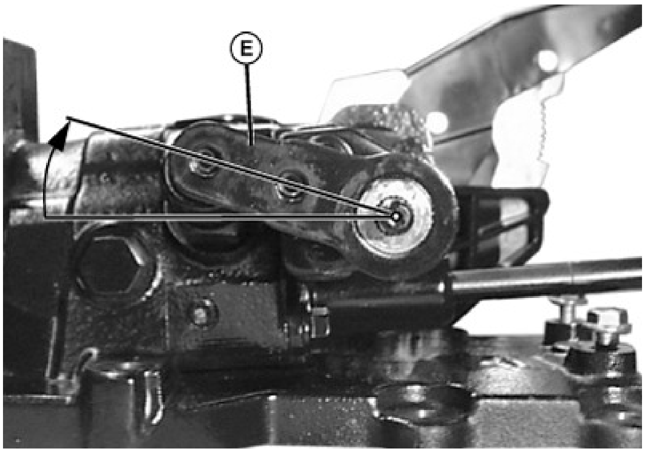
Install shaft support tube (H) assembly onto lift control shaft and retain with two cap screws (G). Tighten cap screws to specification.

Item	Measurement	Specification
Cap Screw-to-Shaft Support Tube	Torque	80 N·m (60 lb.-ft.)

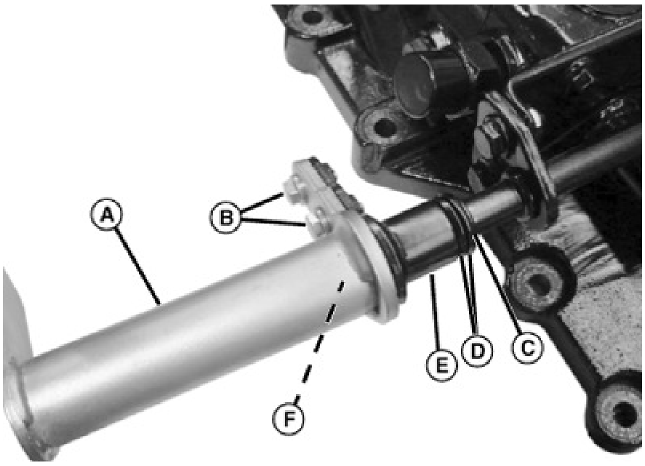
[25] -

IMPORTANT:

Avoid Damage! Make sure that Belleville washers are correctly installed with cupped sides of each pair of washers facing each other.



Lever Arm



Rockshaft Control Lever and Arm

LEGEND:

A	Control Lever
B	Cap Screw (2 used)
C	Washer
D	Belleville Washer (2 used)
E	Lever Arm

Install washer (C), two belleville washers (D), and lever arm (E) to shaft.

[26] -

→NOTE:

Lever arm should be installed so that when the lever arm (E) is fully rotated up, the lever arm is one spline above parallel to the ground.

Retain with lever arm (E) lock nut.

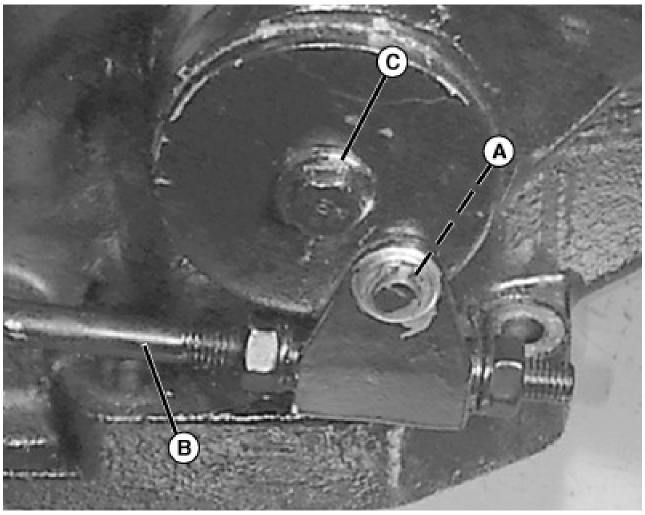
[27] - Install control lever (A) to lever arm (E). Retain with two cap screws (B).

Rockshaft Lift Arms Removal and Installation

Removing:

→NOTE:

Lift arms may be removed with rockshaft assembly installed in machine. DO NOT remove splined cross shaft unless rockshaft is first removed from machine. Internal components will fall into transmission if splined cross shaft is removed while rockshaft is attached to transmission.



LEGEND:

A	Snap Ring
B	Position Feedback Rod
C	Cap Screw

Cam Plate Pin

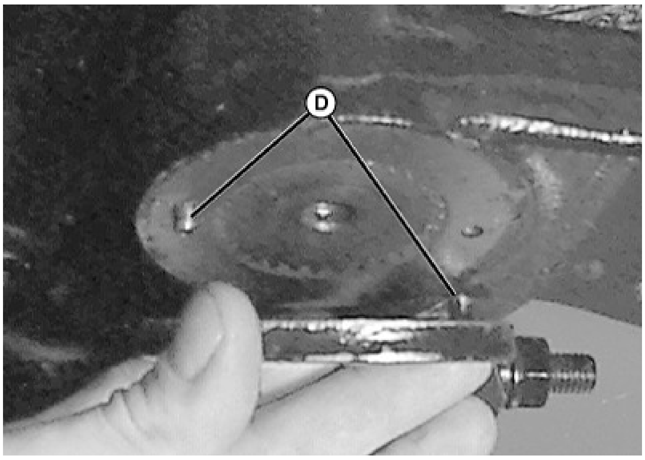
[1] - Remove snap ring (A) and washer from end of cam plate pin. Disconnect position feedback rod (B).

[2] - Remove cap screw (C) from end of rockshaft.

[3] -

→NOTE:

Two spring pins (D) retain cam plate to rockshaft.



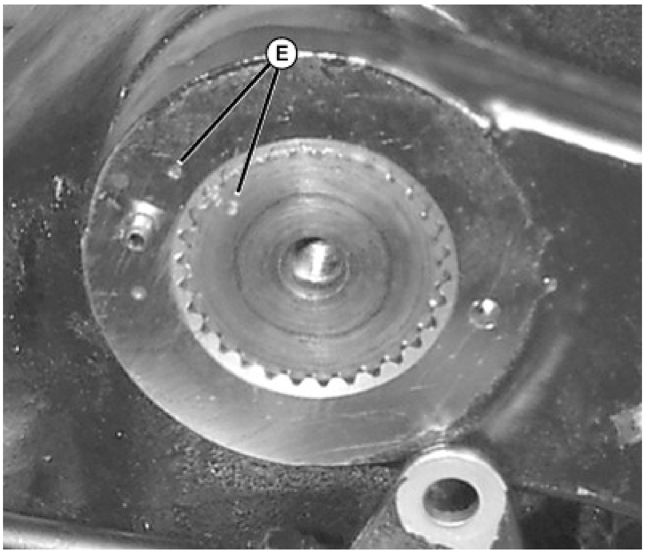
LEGEND:

D	Spring Pins

Cam Plate

Remove cam plate.

[4] -



LEGEND:

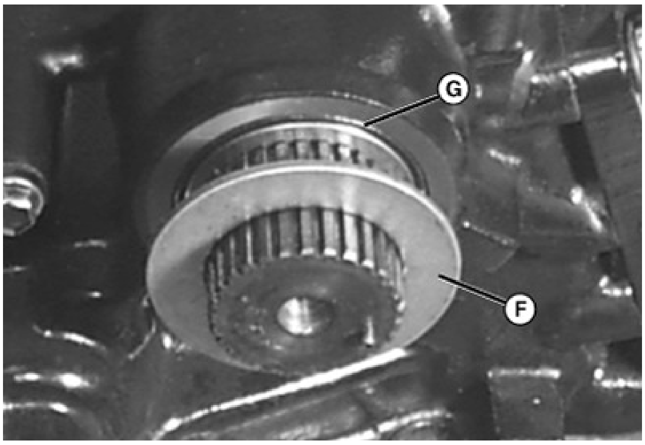
E	Mark Splined Cross Shaft and Lift Arm

Splined Cross Shaft

If not already done, use center punch to mark (E) splined cross shaft and lift arm.

[5] - Remove lift arm from splined cross shaft.

[6] -



LEGEND:

F	Washer
G	Outer O-ring

Splined Cross Shaft Washer

Remove washer (F) from splined cross shaft.

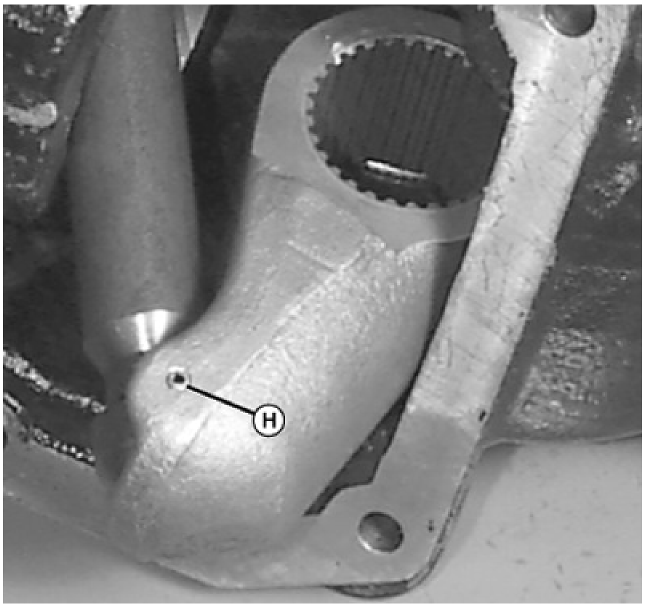
[7] - Remove outer O-ring (G) from groove in housing.

[8] -

> **→NOTE:**
>
> **DO NOT remove splined cross shaft unless rockshaft is first removed from vehicle. Internal components will fall into transmission if splined cross shaft is removed while rockshaft is on transmission. If rockshaft assembly is still installed on transmission, remove right lift arm only.**

Remove right side lift arm and splined cross shaft from housing as a unit.

[9] -



LEGEND:

H	Spring Pin

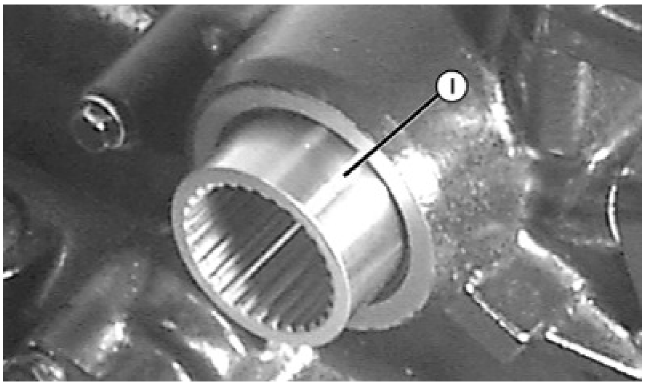
Rockshaft Lever Arm and Piston Rod

If necessary, remove spring pin (H) and separate rockshaft lever arm and piston rod. Remove lever arm and piston rod from rockshaft housing.

[10] -

→NOTE:

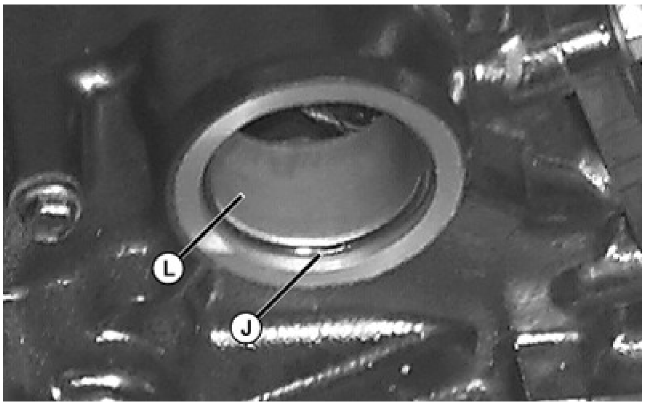
Inner O-ring may come out of bore with splined sleeve when removed.



LEGEND:

I	Splined Sleeve (2 used)
J	Inner O-ring
L	Bore of Rockshaft Housing

Splined Sleeves



Rockshaft Housing Bore

Remove two splined sleeves (I) from housing.

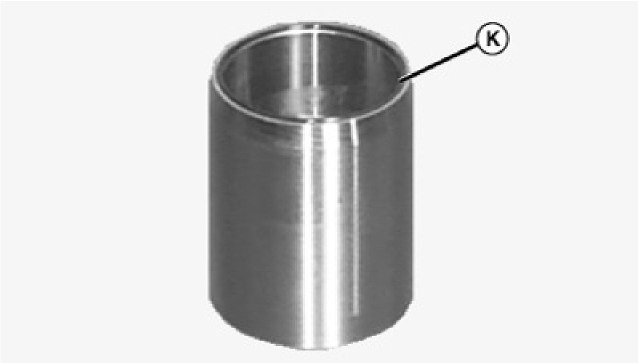
[11] -

→**NOTE:**

Beveled ends of the splined sleeves should face inward. There is an O-ring in ID of beveled end of splined sleeve.

Remove inner O-ring (J) from bore of rockshaft housing.

[12] -



LEGEND:

K	O-Rings
L	Bushing ID

Splined Sleeve

Remove O-rings (K) from bevelled end of splined sleeves.

[13] - Inspect splines on ID of splined sleeves for damage. Inspect OD for grooves or excessive wear. Replace as required.

[14] - Measure OD of splined sleeves. If not in specification, replace.

Item	Measurement	Specification
Splined Sleeve—Minimum	OD	46.5 mm (1.832 in.)

[15] - Measure ID of bushing (L) in housing. If not in specification, replace.

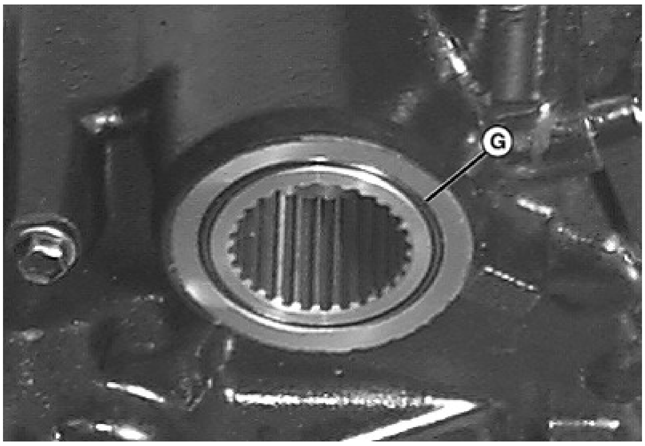
Item	Measurement	Specification
Rockshaft Lift Arm Bushing—Maximum	ID	44.2 mm (1.738 in.)

Installing:

[1] -

IMPORTANT:

Avoid Damage! Replace all O-rings and seals. Used or damaged O-rings and seals will leak.



LEGEND:

G	Outer O-ring

Splined Sleeve Rockshaft Housing

If necessary, use a piloted bushing driver to install new bushings into rockshaft housing.

[2] - Install two new inner O-rings into rockshaft housing against bushings.

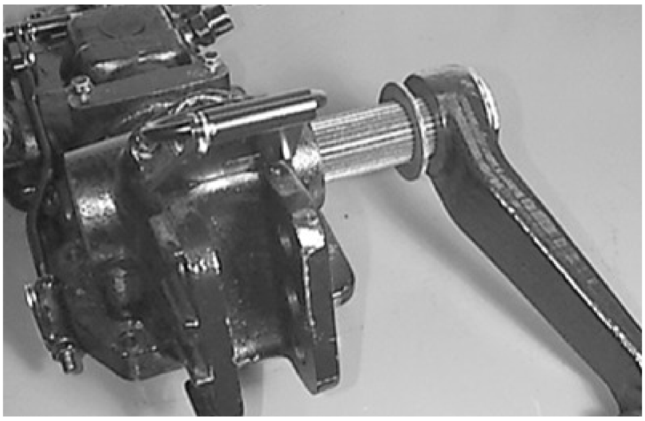
[3] - Install new O-rings into bevelled end of two splined sleeves.

[4] - Install right side splined sleeve into rockshaft housing with bevel to the inside.

[5] - Install new outer O-ring (G) into groove between splined sleeve and rockshaft housing.

[6] - Align punch marks and assemble right side lift arm to splined cross shaft. Secure with large washer, and cap screw.

[7] -



Right Side Lift Arm

Install washer onto rockshaft against right side lift arm.

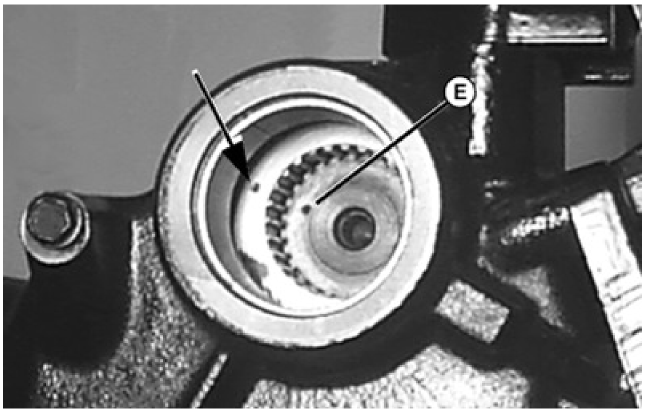
[8] -

→NOTE:

Install shaft carefully to prevent splined cross shaft from knocking O-ring out of groove in bevelled end of splined sleeve.

Install right side lift arm and rockshaft into right splined sleeve in rockshaft housing.

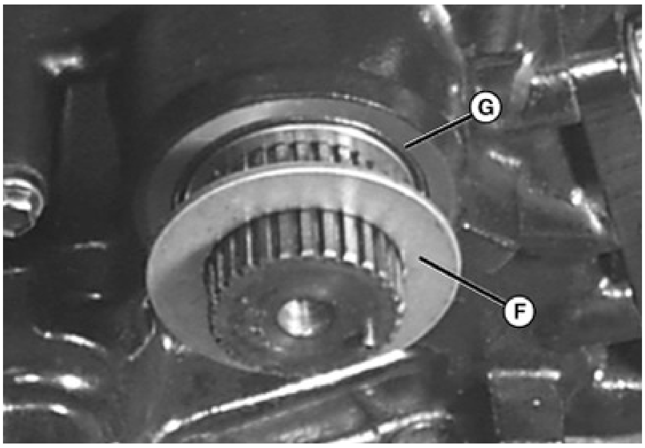
[9] -



LEGEND:

E	Punch Marks
F	Washer
G	Outer O-ring

Splined Cross Shaft and Rockshaft Arm



Splined Cross Shaft Washer

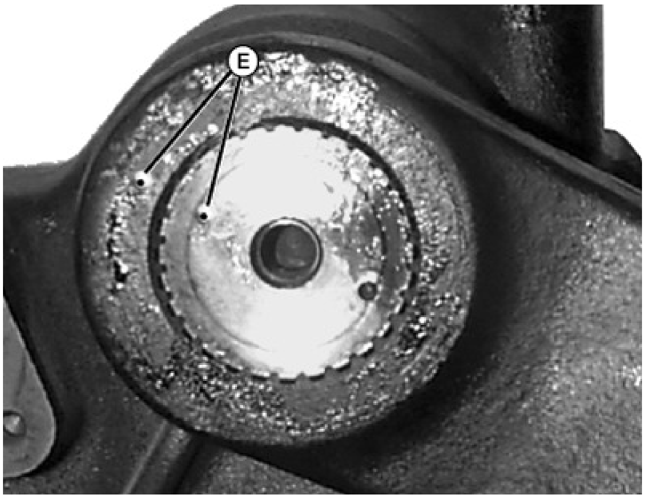
Align punch marks (E) on splined cross shaft and rockshaft lever arm and install cross shaft through lever arm and into housing.

[10] - Install left side splined bushing into rockshaft housing and onto splined cross shaft.

[11] - Install outer O-ring (G) into groove between splined sleeve and rockshaft housing.

[12] - Install washer (F) onto splined cross shaft.

[13] -



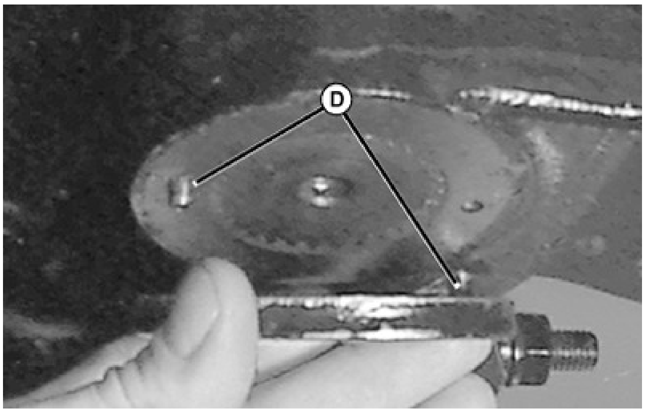
LEGEND:

E	Punch Marks

Lift Arm and Splined Cross Shaft

Align punch marks (E) on lift arm and splined cross shaft, and install left side lift arm onto shaft.

[14] -



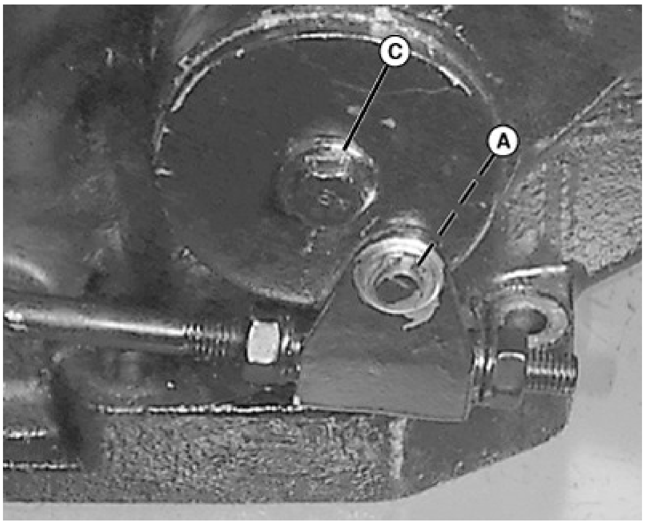
LEGEND:

D	Spring Pins

Cam Plate

Replace spring pins (D) in lift arm or cam plate if damaged.

[15] -



LEGEND:

A	Washer and Snap Ring
C	Cap Screw

Cam Plate Pin

Install cam plate. Apply thread lock and retain with cap screw (C).

[16] -

→NOTE:

Whenever the rockshaft feedback mechanism has been disturbed, be sure to adjust Rockshaft Position Feedback Linkage. (See Rockshaft Position Feedback Linkage Adjustment in Section 80, Group 30.

Attach position feedback rod and retain with washer and snap ring (A).

Item	Measurement	Specification
Lift Arm Raise (Above Horizontal)	Angle	50°
Lift Arm Lower (Below Horizontal)	Angle	20°
Total Lift Arm Range	Angle	70°
Maximum Variance Between Lift Arms	Angle	5°

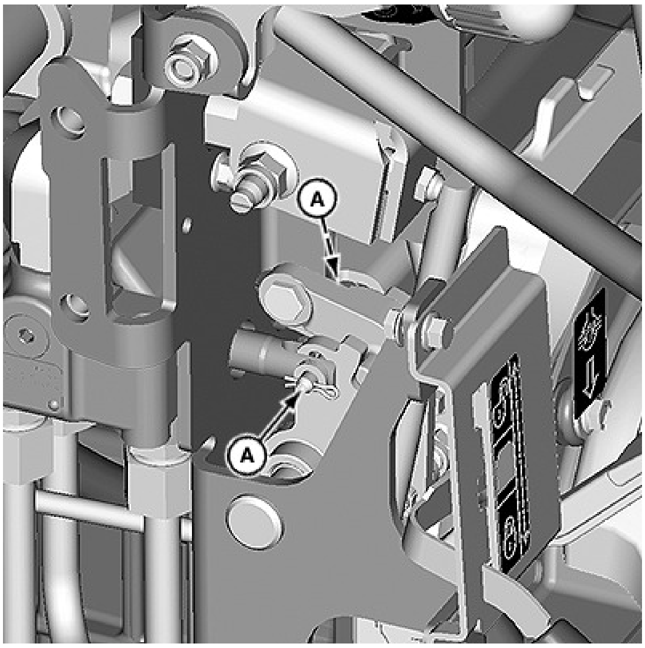
Selective Control Valve (SCV) Removal and Installation (Open Station)

[1] - Remove right rear fender. See Rear Fenders Removal and Installation (Open Station) .

[2] - Remove seat and support assembly. See Seat and Support Removal and Installation (Open Station) .

[3] - Remove seat closeout. See Seat Closeout Removal and Installation (Open Station)—eHydro Transmission or Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[4] -



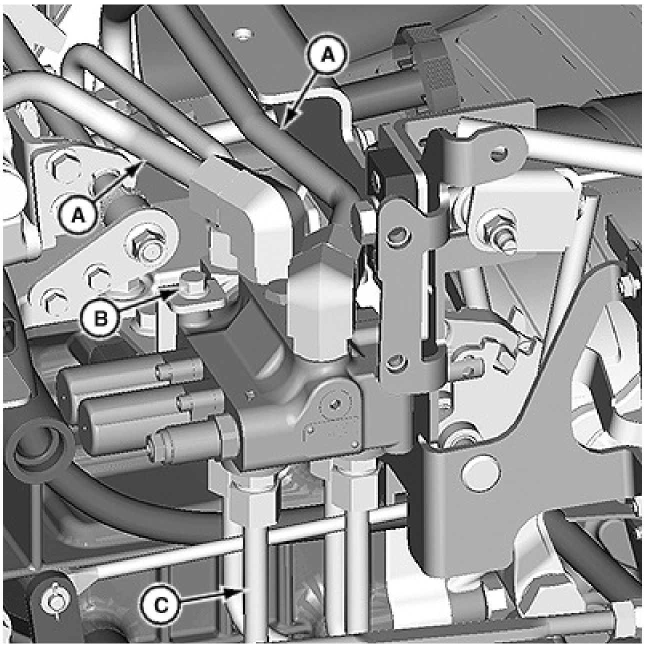
LEGEND:

A Cotter Pin, Washer, and Clevis Pin (2 used)

Cotter and Clevis Pins

Remove cotter pin, washer, and clevis pin (A) (one for each SCV spool).

[5] -



LEGEND:
A Oil Line (2 used)
B Flange Screw and Nut (2 used)
C Oil Line (4 used)

SCV Removal

Disconnect top two oil lines (A).

[6] - Disconnect bottom four oil lines (C).

[7] - Remove two flange screws and nuts. (B)

[8] - Remove SCV.

[9] - Repair or replace as needed.

Installation is done in reverse order of removal.

- Replace O-rings.

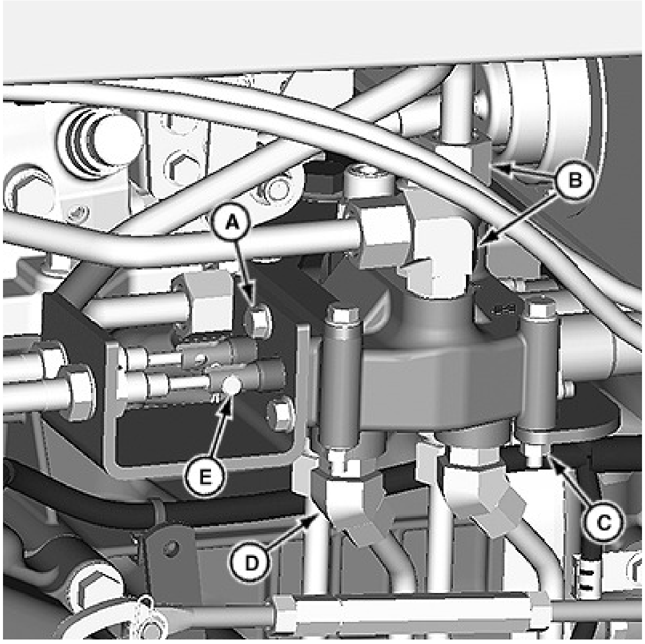
IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

- Transfer over elbows fittings.
- Tighten SCV fitting and lines to specification.

Selective Control Valve (SCV) Removal and Installation (Cab)

[1] - Remove right rear wheel. See Rear Wheel Removal and Installation .

[2] -



LEGEND:

A Cap Screw (2 used)
B Oil Line (2 used)
C Flange Screw and Nut (2 used)
D Oil Line (4 used)
E Cotter Pin, Washer, and Clevis Pin (2 used)

CAB SCV R & I

Remove cotter pin, washer, and clevis pin (E) (one for each SCV spool).

[3] - Remove cap screws (A) and bracket.

[4] - Disconnect top two oil lines (B).

[5] - Disconnect bottom four oil lines (D).

[6] - Remove 3 flange screws and nuts. (C)

[7] - Remove SCV.

[8] - Repair or replace as needed.

Installation is done in reverse order of removal.

- Replace O-rings.

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

- Transfer over elbows fittings.
- Tighten SCV fitting and lines to specification.

3rd EH Selective Control Valve (SCV) Removal and Installation (Cab) (OCT 2014—)

CAUTION:

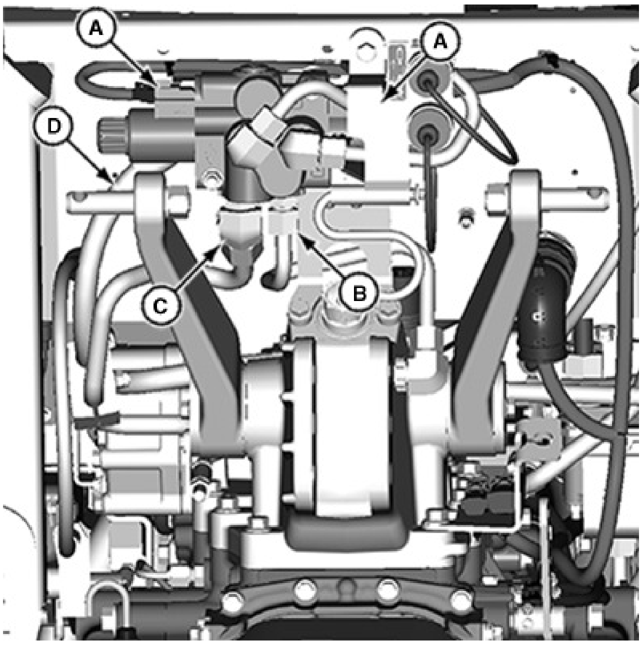
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

Removal

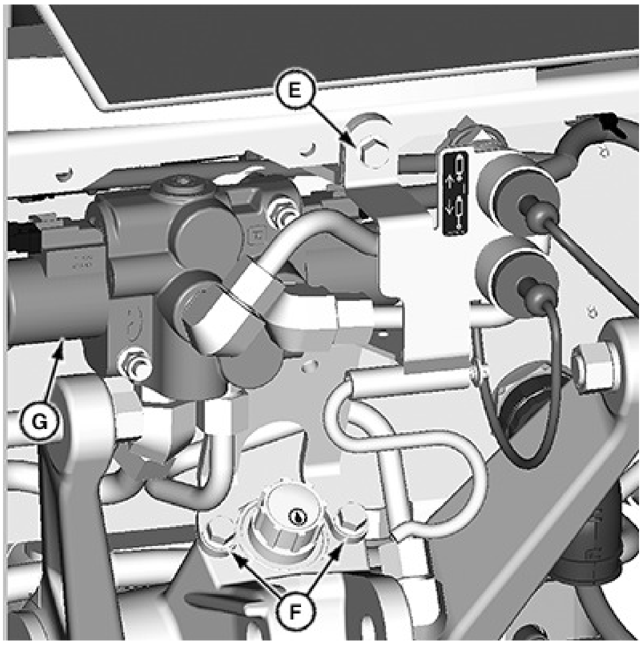
[1] - Relieve pressure from the hydraulic system by lowering the rockshaft and moving the multi-function lever through all positions.

[2] -

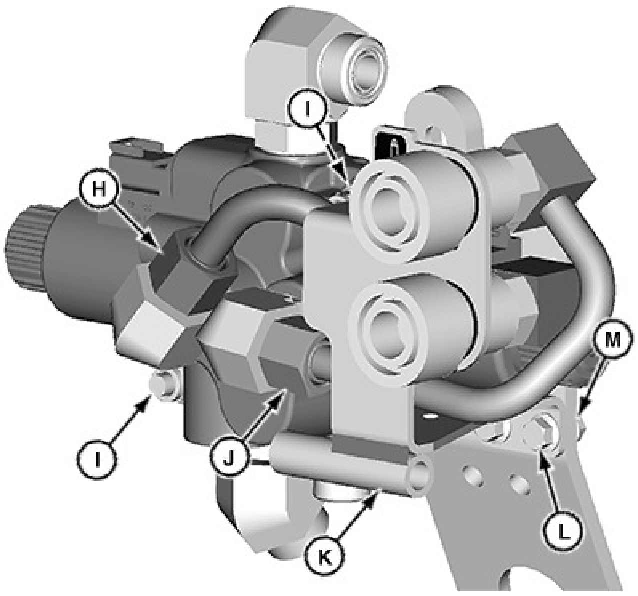


LEGEND:
- A Wiring Harness
- B Hydraulic Line (SCV to Tank)
- C Hydraulic Line (SCV to Rockshaft)
- D Hydraulic Hose (SCV to Dual Spool SCV)
- E Cap Screw and Nut
- F Cap Screw (2 used)
- G EH Solenoid Valve
- H Port B
- I Round Head Square Neck Cap Screw and Nut (2 used)
- J Port A
- K Quick Coupler Bracket
- L Cap Screw (2 used)
- M Nut (2 used)

Disconnect Harness



Disconnect Bracket



Disconnect Hydraulic Lines

Disconnect wiring harness (A).

[3] - Disconnect hydraulic lines (B and C)

[4] - Remove cap screw and nut (E).

[5] - Remove cap screws (F) and pull EH solenoid valve (G) assembly away from machine to disconnect hydraulic hose (D) from rear elbow fitting. Remove EH solenoid valve assembly.

[6] - Disconnect hydraulic lines at port A (J) and port B (H).

[7] - Remove cap screws (L), nuts (M), and quick coupler bracket (K).

[8] - Remove EH solenoid valve (G) from mounting bracket by removing two round head square neck cap screws and nuts (I).

[9] - Remove and replace components as needed.

Prepare Valve Assembly

→NOTE:

Assemble and torque oil lines and hydraulic fittings as per JDV 14.1. Make sure that adapter O-rings and face seals are properly installed. Inspect the fitting sealing surfaces and O-ring. They must be free of dirt or defects. Lubricate O-rings and install into groove using petroleum jelly to hold in place.

[1] - Transfer all elbow fittings if a new valve is being installed.

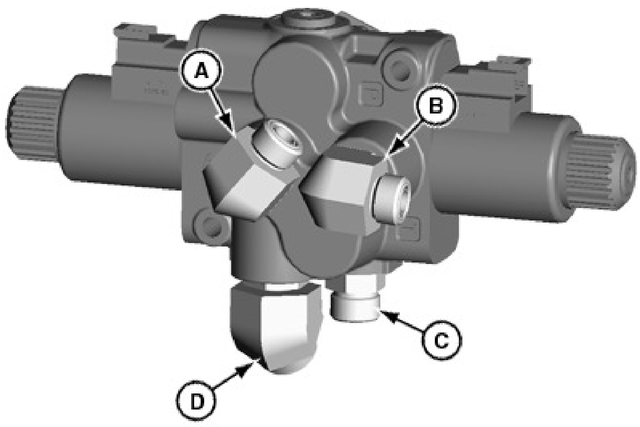
[2] -

→NOTE:

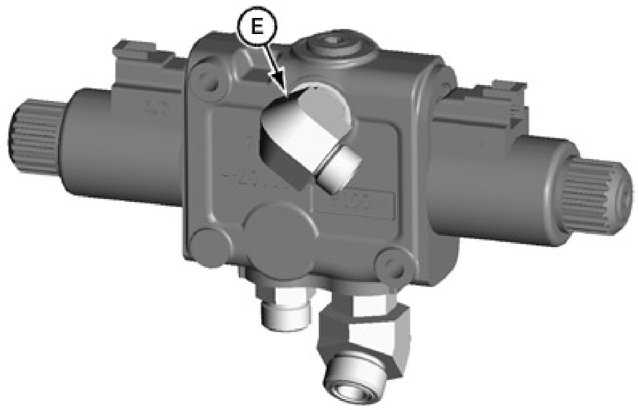
The 3 o'clock position on the EH valve is the zero degree reference mark.

LEGEND:

A	90° Elbow Fitting
B	90° Elbow Fitting
C	Straight Adapter Fitting
D	45° Elbow Fitting
E	90° Elbow Fitting



Front EH Fittings



Rear EH Fitting

Install 90° elbow fitting (A) facing up at 50°.

[3] - Install 90° elbow fitting (B) facing down at 5°.

[4] - Install straight adapter fitting (C).

[5] - Install 45° elbow fitting (D) with EH port facing front.

[6] - Install 90° elbow fitting (E) facing down at 35°.

Installation

Installation is done in reverse order of removal.

- Bleed hydraulic system.
- Tighten hydraulic lines to specification.
- Tighten EH solenoid valve to mounting bracket round head square neck cap screws and nuts to specification.

Item	Measurement	Specification
M8 Nut	Torque	20 ± 4 N·m (15 ± 3 lb.-ft.)

3rd EH Selective Control Valve (SCV) Removal and Installation (Open Station) (OCT 2014—)

CAUTION:

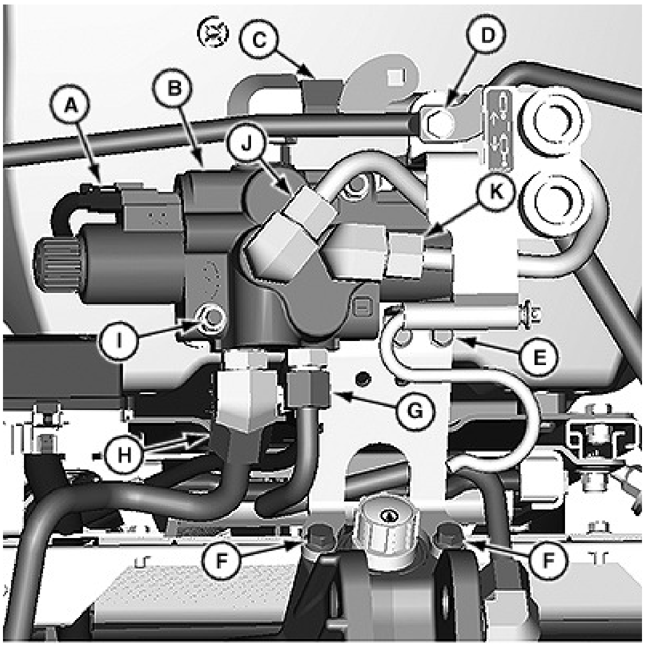
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

Removal

[1] - Relieve pressure from the hydraulic system by lowering the rockshaft and moving the multi-function lever through all positions.

[2] -



LEGEND:
A Wiring Harness
B EH Solenoid Valve
C Hydraulic Line (SCV to Dual Spool SCV)
D Cap Screw and Nut
E Cap Screw and Nut (2 used)
F M8 Cap Screw (2 used)
G Hydraulic Line (SCV to Tank)
H Hydraulic Line (SCV to Rockshaft)
I Round Head Square Neck Cap Screw and Nut (2 used)
J Port B
K Port A

Remove 3rd EH SCV

Disconnect wiring harness (A) from both ends of the EH solenoid valve (B).

[3] -

IMPORTANT:

To avoid hydraulic system contamination, install caps and plugs where needed.

Disconnect hydraulic line (C).

[4] - Disconnect hydraulic lines (G and H).

[5] - Remove cap screw and nut (D).

[6] - Disconnect hydraulic lines at port A (K) and port B (J).

[7] - Remove cap screws and nuts (D and E) and quick coupler bracket.

[8] - Remove cap screws (F) and EH solenoid valve assembly from machine.

[9] - Remove EH solenoid valve (B) from mounting bracket by removing two round head square neck cap screws and nuts (I).

Prepare Valve Assembly

→NOTE:

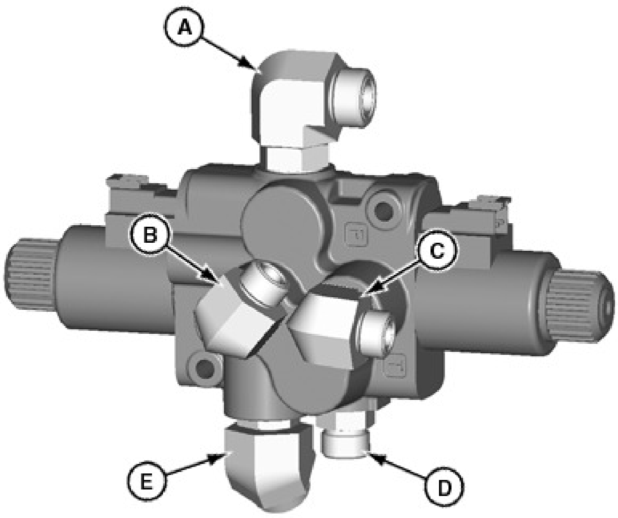
Assemble and torque oil lines and hydraulic fittings as per JDV 14.1. Make sure that adapter O-rings and face seals are properly installed. Inspect the fitting sealing surfaces and O-ring. They must be free of dirt or defects. Lubricate O-rings and install into groove using petroleum jelly to hold in place.

[1] - Transfer all elbow fittings if a new valve is being installed.

[2] -

→NOTE:

The 3 o'clock position on the EH valve is the zero degree reference mark.



LEGEND:

A	90° Elbow Fitting
B	90° Elbow Fitting
C	90° Elbow Fitting
D	Straight Adapter Fitting
E	45° Elbow Fitting

Install Fittings

Install 90° elbow fitting (A) with EH port facing right.

[3] - Install 90° elbow fitting (B) facing up at 50°.

[4] - Install 90° elbow fitting (C) facing down at 5°.

[5] - Install straight adapter fitting (D).

[6] - Install 45° elbow fitting (E) with EH port facing front.

Installation

Installation is done in reverse order of removal.

- Bleed hydraulic system.
- Tighten hydraulic lines to specification.
- Tighten EH solenoid valve to mounting bracket round head square neck cap screws and nuts to specification.

Item	Measurement	Specification
M8 Nut	Torque	20 ± 4 N·m (15 ± 3 lb.-ft.)

Section 90 - STEERING

Table of contents

Group 05 - Specifications

Steering

Item	Measurement	Specification
Specifications:		
Steering Wheel Outer Diameter	Diameter	356 mm (14.0 in.)
Front Steering Angle: Maximum Inside	Angle	62°
Front Steering Angle: Maximum Outside	Angle	54°
Maximum Rotation of Steering Wheel—Steering at Maximum Right or Left and Constant Torque Applied to Steering Wheel	Rotation	5
Toe-In	Distance	0—3 mm (0—0.125 in.)
Steering Cylinder Retracted Length (Tie Rod End to Tie Rod End)	Length	522 mm (20.55 in.)
Steering System Pressure	Pressure	10 342 kPa ± 10% (103.42 bar ± 10%) (1500 psi ± 10%)

Item	Measurement	Specification
Lubrication Intervals:		
Tie Rod Ends, Front Axle Pivot Pin (Normal Conditions)		Every 50 hours
Tie Rod Ends, Front Axle Pivot Pin (Dusty Conditions)		Every 10 hours

Torque Specifications

Item	Measurement	Specification
Specifications:		
Steering Wheel Nut	Torque	39—49 N·m (29—36 lb.-ft.)
Wheel Mounting Bolts	Torque	140 N·m (103 lb.-ft.)
Tilt Steering Column Cap screws	Torque	40 N·m (30 lb.-ft.)
Hose-to-Tube Fitting at Cylinder	Torque	37—45 N·m (27—33 lb.-ft.)
Steering Cylinder Hose Ends	Torque	26—37 N·m (19—27 lb.-ft.)
SCU Hose Ends: Cylinder Tube-to-Hose at SCU	Torque	22—26 N·m (16—20 lb.-ft.)
Pressure or Return Tube-to-Hose at SCU	Torque	45—55 N·m (33—41 lb.-ft.)
Steering Cylinder Hose-to-Adaptor Fitting on SCU	Torque	19—27 N·m (168—240 lb.-in.)
Pressure or Return Hose-to-Adaptor Fitting on SCU	Torque	40—57 N·m (30—42 lb.-ft.)
SCU-to-Machine Cap Screws	Torque	30—38 N·m (22—28 lb.-ft.)
Adaptor Fittings-to-SCU Ports	Torque	14—16 N·m (115—150 lb.-in.)
Tie Rod-to-Spindle Arm Castle Nut (MFWD)	Torque	115—129 N·m (85—95 lb.-ft.)
Tie Rod-to-Steering Cylinder Rod	Torque	115—129 N·m (85—95 lb.-ft.)
Steering Cylinder Bracket-to-Front Axle Cap Screws	Torque	115—122 N·m (85—90 lb.-ft.)

Essential or Recommended Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Adapter Fitting, 7/16-20 M 37° X 9/16-18 M ORFS

JT03375—Adapter

Used to check steering pump pressure.

Pressure Gauge 0—14 000 kPa (0—140 bar) (0—2000 psi)

JT03117

Used to check steering pump pressure.

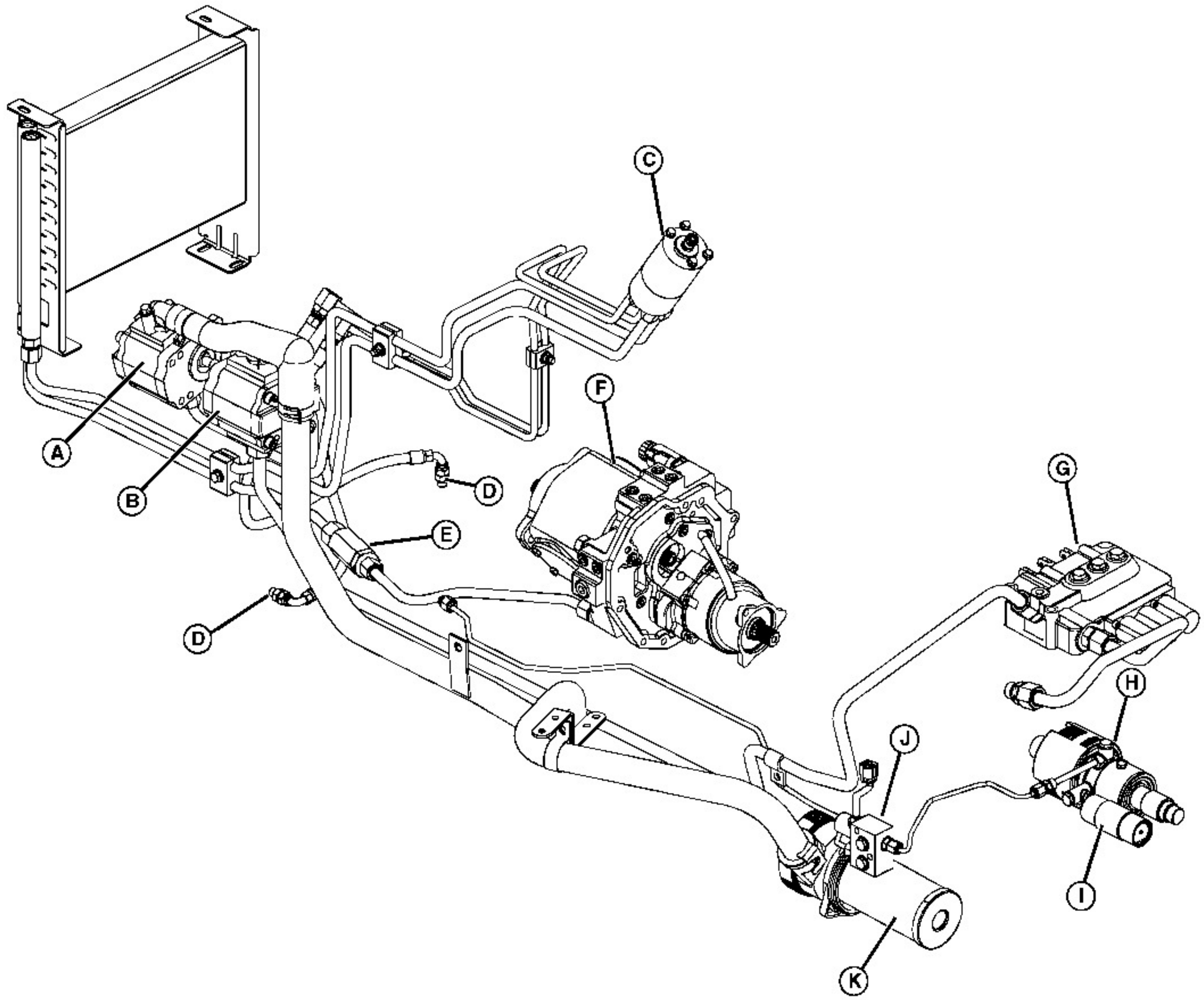
Hose with Quick Disconnect Fitting

JT03017

Used to check steering pump pressure.

Group 10 - Component Location

Steering System Components, eHydro™

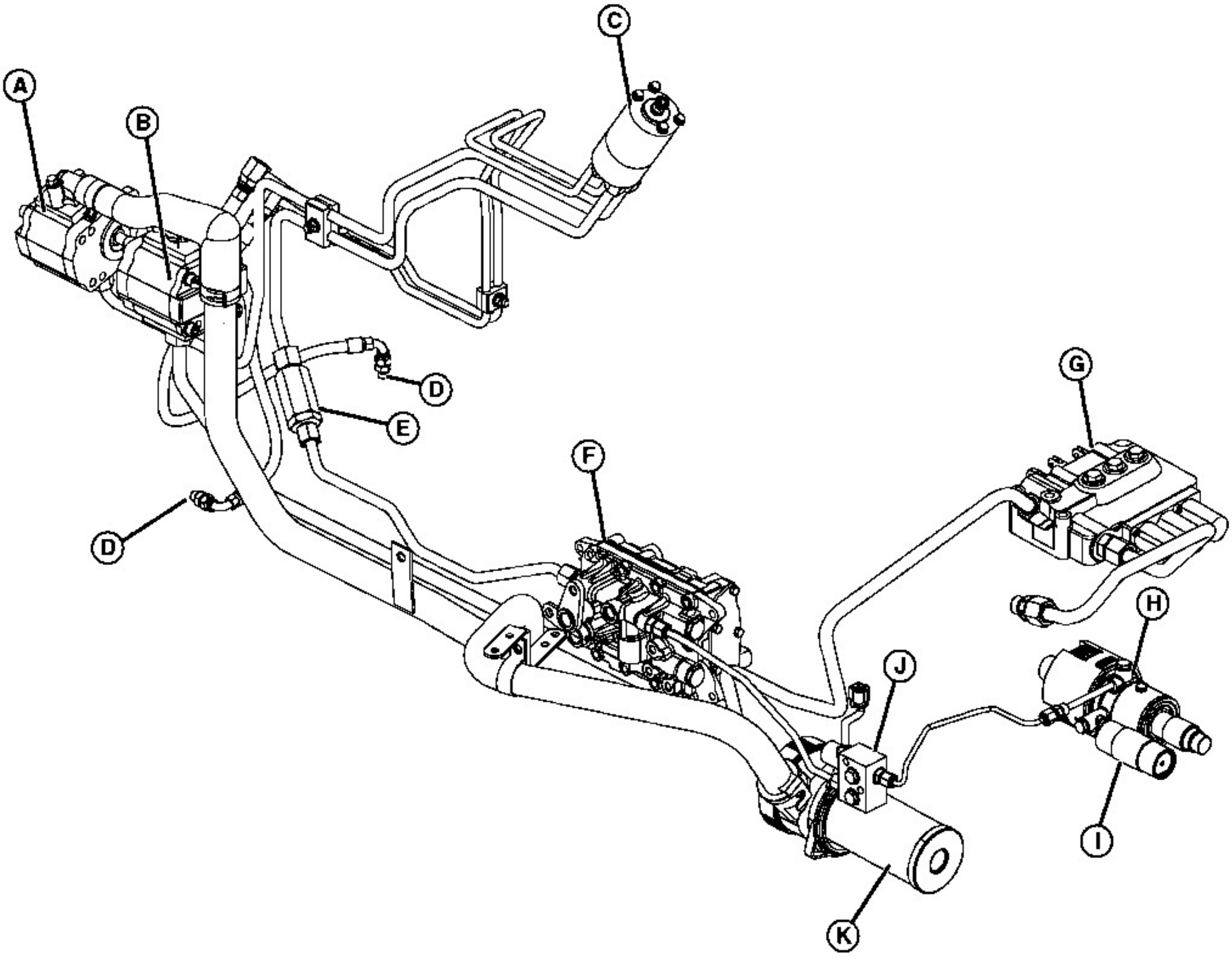


Steering System Components—eHydro™

LEGEND:

A	Gear Pump, Steering (Front)
B	Gear Pump, Implement (Rear)
C	Power Steering Valve
D	Connectors to Steering Cylinder
E	Charge Pressure In-Line Filter
F	Hydrostatic Transmission
G	SCV (3-spool shown)
H	PTO Clutch
I	Accumulator
J	PTO Solenoid Valve
K	Suction Filter

Steering System Components, PowrReverser™

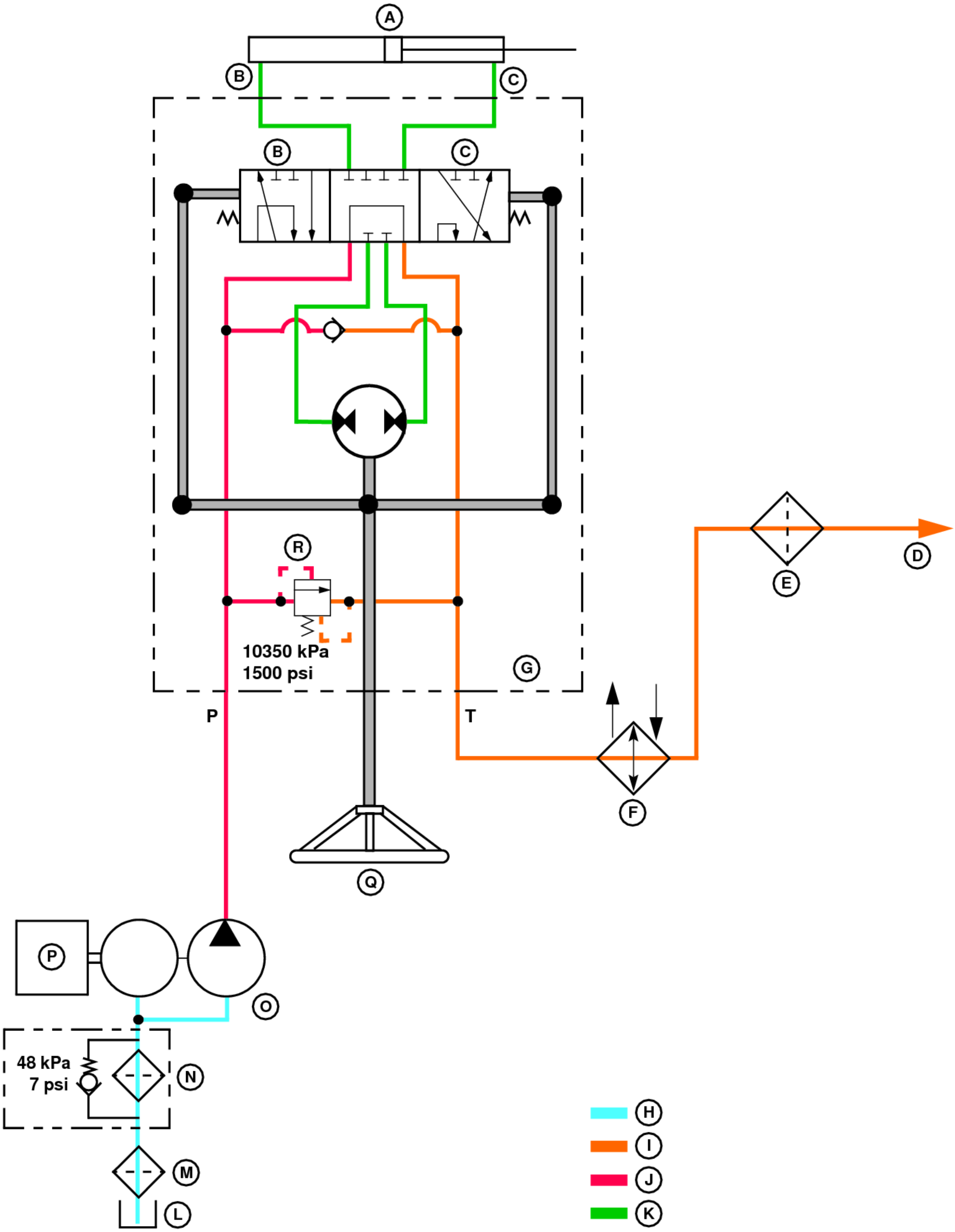


Steering System Components—PowrReverser™

LEGEND:

A	Gear Pump, Steering (Front)
B	Gear Pump, Implement (Rear)
C	Power Steering Valve
D	Connectors to Steering Cylinder
E	Charge Pressure In-Line Filter
F	PRT Control Valve Assembly
G	SCV (3-spool shown)
H	PTO Clutch
I	Accumulator
J	PTO Solenoid Valve
K	Suction Filter

Steering System Schematic—eHydro



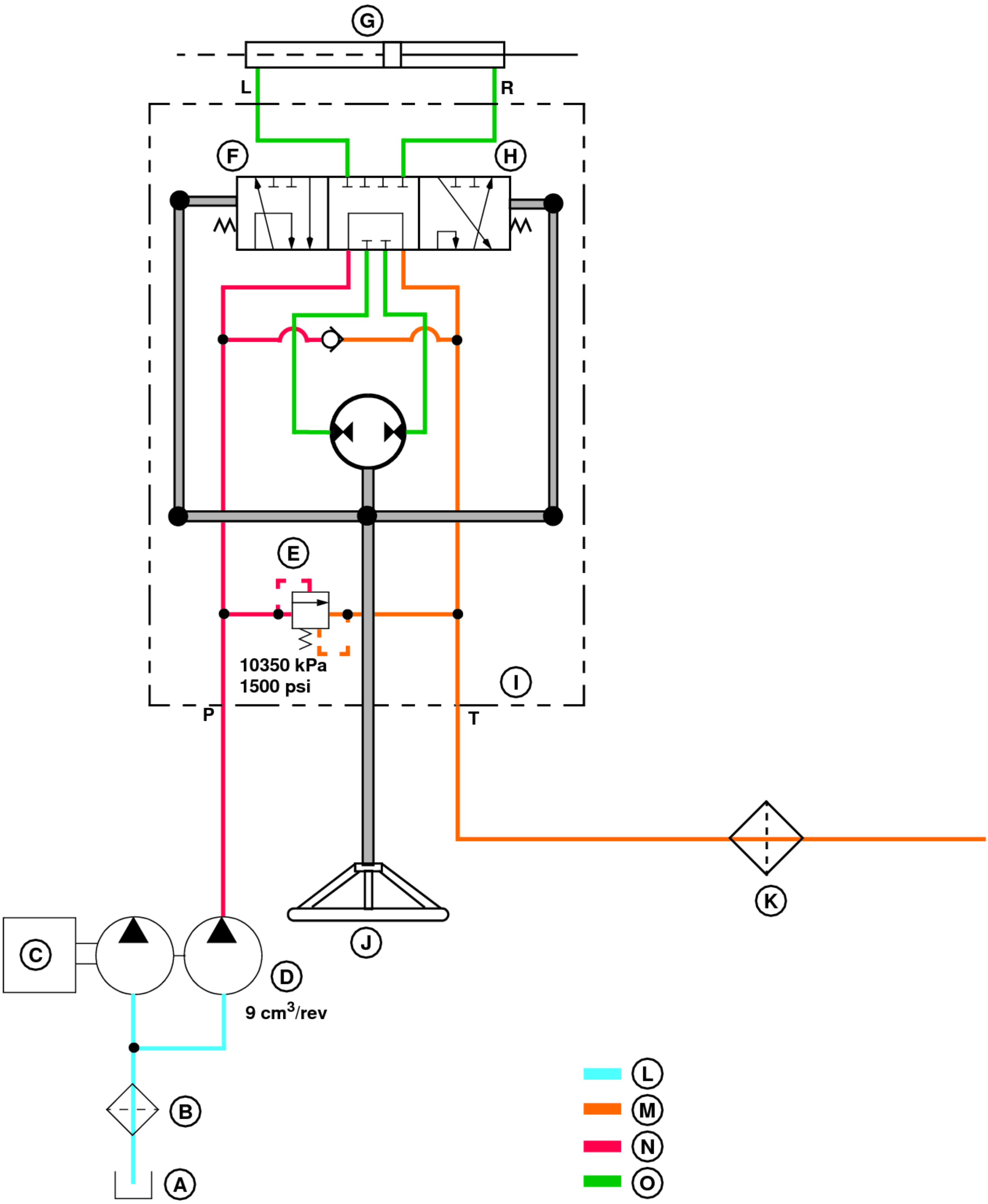
Steering System Schematic

LEGEND:

A	Steering Cylinder
B	Left
C	Right
D	To Transmission

E	Mesh Filter
F	Oil Cooler
G	Steering Control Unit
H	Sump Oil
I	Charge Pressure/Tunnel Lubrication Oil
J	High Pressure Oil
K	Steering Oil
L	Sump
M	150 Mesh Intake Filter
N	Suction Filter
O	Steering Pump (Rear)
P	Engine
Q	Steering Wheel
R	Relief Valve

Steering System Schematics, PowrReverser™



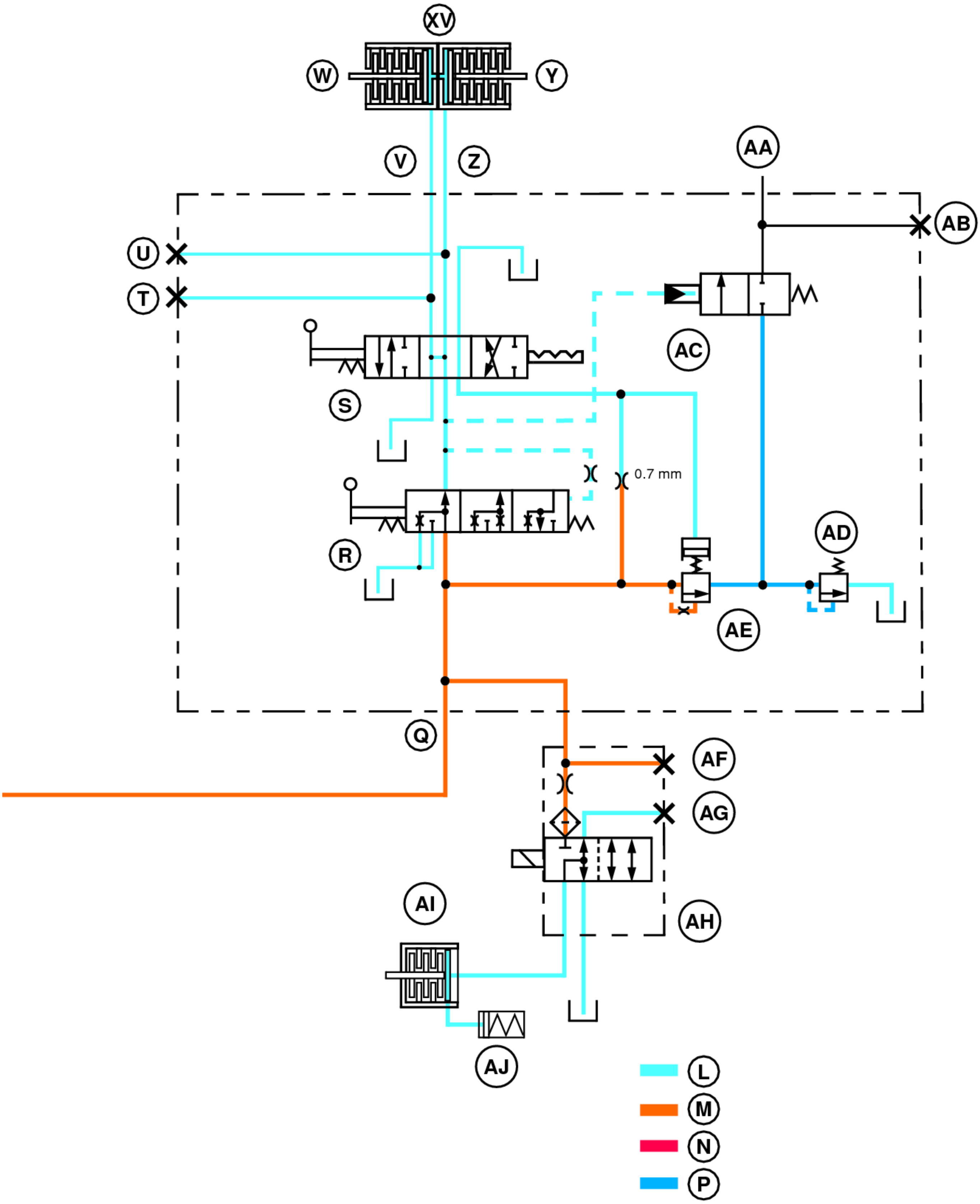
Steering System Schematics—PowrReverser™

LEGEND:

A	Sump
B	Suction Filter
C	Engine
D	Steering Pump (Rear)

E	Relief Valve
F	Left
G	Steering Cylinder
H	Right
I	Power Steering Valve
J	Steering Wheel
K	In-Line Filter
L	Sump Oil
M	Charge Pressure/Tunnel Lubrication Oil
N	High Pressure Oil
O	Steering Oil

Steering System Schematics, PowrReverser ™ (continued)



Steering System Schematics—PowrReverser™ (continued)

LEGEND:

L	Sump Oil
M	Charge Pressure/Tunnel Lubrication Oil
N	High Pressure Oil
P	Lubrication Oil (Trapped)
Q	Pressure in Port
R	Clutch Pedal Valve (Up)
S	Forward/Reverse Valve (Neutral)

T	Forward Test Port
U	Reverse Test Port
V	Forward Port
W	Forward
X	Clutch
Y	Reverse
Z	Reverse Port
AA	Lubrication Oil Port
AB	Lubrication Test Port
AC	Lubrication Cut-Off Valve
AD	Lubrication Relief Valve
AE	Modulation Valve
AF	Diverter Valve Port Out
AG	Diverter Valve Port Return
AH	PTO Clutch Solenoid Valve
AI	PTO Clutch
AJ	Accumulator

Group 15 - Theory of Operation

eHydro Model

The front hydraulic pump supplies hydraulic pressure to the steering control unit (SCU). The SCU utilizes an open center control valve to operate the steering cylinder. When the steering wheel is turned, the SCU directs hydraulic pressure to the appropriate steering cylinder hose, pushing the steering cylinder ram, which pivots the front spindles and wheels. The SCU has no relief valve. The SCU and steering cylinder are not serviceable, and must be replaced as complete units.

Excess oil from the SCU is sent to the oil cooler, mounted in the front of the machine. After the oil is cooled, it passes through the in-line filter and goes to the hydrostatic unit. The hydrostatic unit is a combination motor and pump, and operates as a closed loop. Most of the hydraulic oil delivered to this unit passes through the charge pressure relief valve, and returns to the reservoir. A small amount of oil flows through the hydrostatic unit, providing makeup oil, and internal lubrication, then returns to the reservoir.

PowrReverser™ Model

Excess oil from the SCU passes through the cooler (if equipped), through the in-line filter and goes to the PRT clutch control valves.

Group 20 - Diagnostics

Steering System Check

Symptom	Problem	Solution
Steering Operation Problems	Wheel bolts loose.	Tighten bolts to specification.
	Tires improperly inflated.	Inflate to proper pressure.
	Tire or rim runout.	Remount tires. Replace tires or rims as necessary
	Wheels do not rotate freely or have rough spots.	Replace bearings.
	Tie rod not straight or castle nuts loose.	Straighten or replace tie rod. Tighten castle nuts to specification. (See Tie Rod Removal and Installation MFWD in Section 90, Group 30.)
	Toe-in incorrect.	(See Toe-in Adjustment MFWD in Section 90, Group 25.)
	Steering cylinder not fastened securely or does not operates from stop-to-stop smoothly.	Tighten steering rod fasteners and hose fittings. Replace steering cylinder if it leaks. (See Steering Cylinder Removal and Installation MFWD in Section 90, Group 30.)
	Steering wheel installed improperly or the nut not tightened to specification.	(See Steering Wheel Removal and Installation in Section 90, Group 30.)

Steering Operation

Symptom	Problem	Solution
Steering Function Problems	Steering pulls in one direction.	Tire size incorrect, out-of-round, or air pressure incorrect.
		Tie rod ends loose or worn.
		Toe-in incorrect.
		Spindles and/or bearings worn or not lubricated sufficiently.
		Steering cylinder rod (tie rod) bent or damaged.
		Wheel bearing retaining nut loose.
		Wheel bearings worn or lost lubricating properties.
		Front steering suspension weak or unstable.
	Steers hard left, right, or both.	Spindles and/or bearings worn or not lubricated sufficiently.
		Tie rod ends loose or worn.
		Toe-in incorrect.
		Steering cylinder rod (tie rod) bent or damaged.
		Tire size incorrect, out-of-round, or air pressure incorrect.
		Steering wheel and/or shaft splines worn or stripped.
		SCU leaking internally.
		Steering cylinder leaking internally.
	Steering locks in hard left or right turns.	Tie rod ends loose or worn.
		Steering cylinder rod (tie rod) bent or damaged.
		Spindles and/or bearings worn or not lubricated sufficiently.
	Steering wheel pulls upward.	Steering wheel nut loose, stripped, or fallen off.
		Steering control unit mounting loose.
	Steering wanders.	Tie rod ends loose or worn.
		Spindles and/or bearings worn or not lubricated sufficiently.
		Steering control unit mounting loose.
		Wheel bearings worn or lost lubricating properties.
		Tire size incorrect, out-of-round, or air pressure incorrect.
		Steering wheel and/or shaft splines worn or stripped.
		Front steering suspension weak or unstable.
		SCU leaking internally.
		Steering cylinder leaking internally
	Steering shimmies or vibrates.	Tie rod ends loose or worn.
		Wheel bearing retaining nut loose.
		Spindles and/or bearings worn or not lubricated sufficiently.
		Wheel bearings worn or lost lubricating properties.
		Tire size incorrect, out-of-round, or air pressure incorrect.
		Front steering suspension weak or unstable.
	Front wheels “plow” loose soil to sides.	Toe-in incorrect.
	Steering wheel spins freely.	Steering wheel and/or shaft splines worn or stripped.
		Steering wheel nut loose, stripped, or fallen off.
		Steering control unit mounting loose.
	Steering wheel turns, but wheels do not.	Steering cylinder rod (tie rod) bent or damaged.
		SCU leaking internally.
		Steering cylinder leaking internally.
	Steering wheel tilt does not lock	Tilt steering locking mechanism worn or damaged.

Symptom	Problem	Solution
Steering Noise	Noise during turns or over rough terrain.	Tie rod ends loose or worn.

		Spindles and/or bearings worn or not lubricated sufficiently.
		Steering control unit mounting loose.
		Front steering suspension weak or unstable.
		Wheel bearings worn or lost lubricating properties.
	Wheel bearing noise.	Spindles and/or bearings worn or not lubricated sufficiently.
		Wheel bearing retaining nut loose.
		Wheel bearings worn or lost lubricating properties.

Group 25 - Tests and Adjustments

Steering Pressure Check

Reason:

To ensure that steering pump pressure is maintained at correct level for steering without causing damage to the system, and to determine if hydraulic pump is worn.

Equipment:

- JT03375—Adapter Fitting (7/16-20 M 37° X 9/16-18 M ORFS)
  Adapter Fitting, 7/16-20 M 37° X 9/16-18 M ORFS
  JT03375—Adapter
  Used to check steering pump pressure.
- JT03117—Pressure Gauge 0—14000 kPa (0—140 bar) (0—2000 psi)
  Pressure Gauge 0—14 000 kPa (0—140 bar) (0—2000 psi)
  JT03117
  Used to check steering pump pressure.
- JT03017—Hose with Quick Disconnect Fitting
  Hose with Quick Disconnect Fitting
  JT03017
  Used to check steering pump pressure.

Procedure:

[1] - Park machine on a level surface and set park brake.

[2] -

CAUTION:

Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

Shift transmission to NEUTRAL.

[3] - Cycle all controls to relieve any pressure that may be in the hydraulic system.

[4] - Remove hydraulic hose on left side of steering cylinder.

[5] - Attach gauge to left steering hose.

[6] -

→NOTE:

Turning steering wheel to the right will cause hydraulic oil to leak out of disconnected cylinder port. Turn wheel only to left when performing test.

Start engine and run at high idle.

[7] - Turn steering wheel to the left. While turning wheel, check pressure reading on gauge.

Item	Measurement	Specification
Steering System Pressure	Pressure	12 410—13 789kPa (1800—2000 psi)

Results:

- **No pressure:** Steering hoses may be incorrectly connected to the SCU. Check hose connections.
- **Pressure too low:** Relief valve in SCU may be stuck open or defective; perform steering system test. See Steering System Test or gear pump may be worn; disassemble and inspect pump.
- **Pressure too high:** Relief valve in SCU may be clogged or defective.

Steering System Test

Reason:

To check steering control unit and steering cylinder operation and check for internal leakage.

Tools:

- Torque wrench
- Caps for hydraulic lines

Procedure:

[1] - Run the machine until the hydraulic fluid is at operating temperature.

[2] - Turn the steering wheel to the full right position. Apply **6.8 N·m (60 lb.-in.)** constant torque to the steering wheel retaining nut, and count the steering wheel rotations in one minute.

[3] - Repeat the procedure turning the steering wheel to the full left position.

[4] - Stop engine.

Results:

- If the rotation in left or right-hand direction exceeds 5 rotations in one minute, the steering system has internal leakage. To determine whether it’s the SCU or cylinder that is leaking, proceed as follows:

Procedure:

[1] - Label and remove both left and right hydraulic hoses at the steering cylinder.

[2] - Cap the ends of both hoses.

[3] - Repeat the SCU test.

Results:

- If the rotation speed is now below 5 rotations in one minute, replace the steering cylinder.
- If the rotation speed remains above 5 rotations in one minute, replace the SCU.

Toe-in Adjustment MFWD

Reason:

To ensure proper wheel tracking when turning, and to prevent tire scrub and premature tire wear.

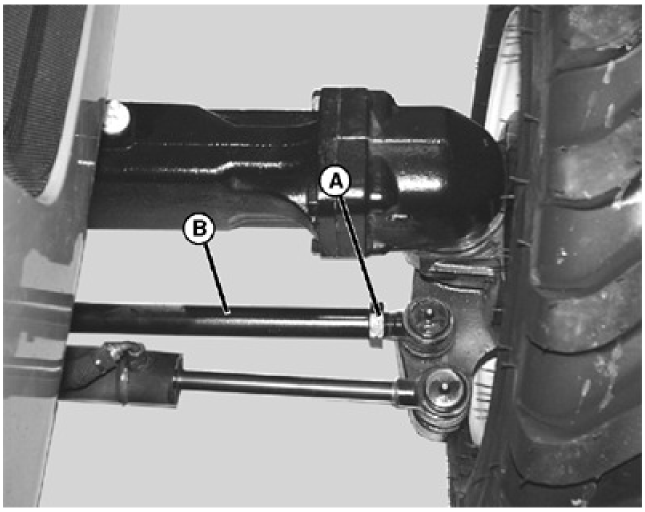
Tools:

- Wrenches
- Tape Measure
- Tire scribing tool

Procedure:

→NOTE:

If both tie rod ends were removed, screw-in the rod end until the distance from the lock nut to the end of the threads is approximately 22 mm (0.875 in.). Tighten the lock nuts.



LEGEND:

A	Jam Nut
B	Tie Rod

Tie Rod

[1] - Jack up front axle so tires are off floor.

[2] - Rotate tire by hand and scribe a line near the center of each of the front tires.

[3] - Measure and record the distance between the lines at the front and the rear of the tire at about axle height. The front measurement should be 0—3 mm (0—0.125 in.) less than the rear measurement.

Item	Measurement	Specification
Toe-In	Distance	0—3 mm
		(0—0.125 in.)

[4] -

→NOTE:

One of the tie rod ends and jam nut has left-hand threads.

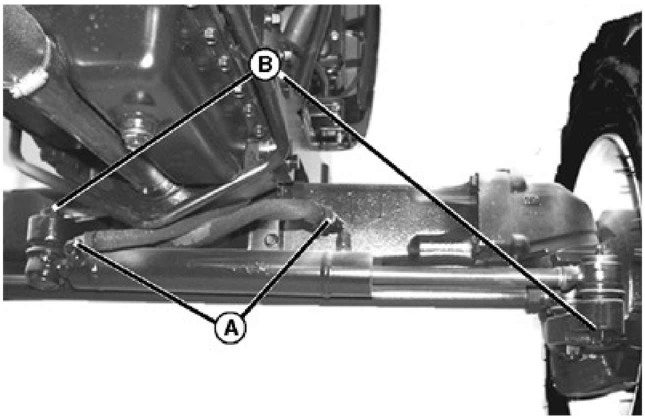
If measurement is not correct, loosen jam nuts (A) on both ends of tie rod and turn the tie rod (B) using a wrench to increase or decrease the amount of toe until the measured dimension is within specification.

[5] - Tighten the jam nuts.

Group 30 - Repair

Steering Cylinder Removal and Installation MFWD

Removal:



LEGEND:

A	Hoses
B	Cotter Pins and Castle Nuts

Steering Cylinder Removal

→NOTE:

Cylinder ball end studs are tapered. Use a tie rod end removal tool to avoid damaging threads if cylinder is to be re used.

[1] - Mark hoses (A) and disconnect from cylinder.

[2] - Remove cotter pins and castle nuts (B).

[3] - Remove cylinder.

Installation:

[1] - Inspect rubber boots on ends of cylinder. Replace boots if necessary.

[2] - Install cylinder and tighten castle nuts to specification. If slots in castle nut do not line up with cotter pin hole, continue tightening nut until next slot lines up.

Item	Measurement	Specification
Castle Nuts	Torque	115—129 N·m
		(85—95 lb.-ft.)

[3] - Connect hoses to cylinder.

Item	Measurement	Specification
Hose Ends	Torque	26—37 N·m
		(19—27 lb.-ft.)

Steering Wheel Removal and Installation

Removal:

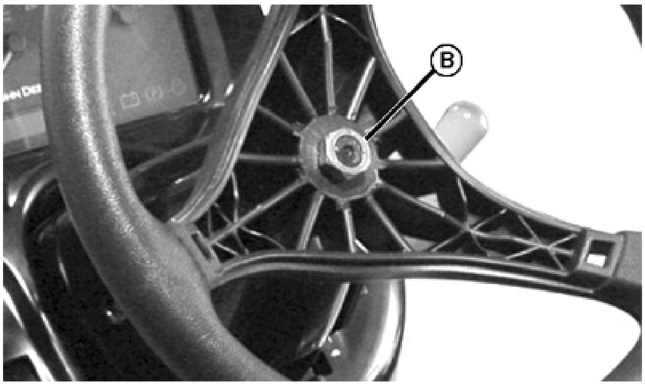
LEGEND:

A	Locking Tabs (3 used)

Steering Wheel Locking Tabs

[1] - Disengage three locking tabs (A) at underside of steering wheel and remove steering wheel center cover.

[2] -



LEGEND:

B	Lock Nut

Steering Wheel Lock Nut

Remove lock nut (B).

[3] - Remove steering wheel. If necessary, use a suitable puller.

Installation:

→NOTE:

Lubricate the steering shaft splines with general-purpose grease before installing steering wheel to allow easy removal.

[1] - Install steering wheel and retain with nut. Tighten steering wheel nut to specification.

Item	Measurement	Specification
Steering Wheel Nut	Torque	39—49 N·m
		(29—36 lb.-ft.)

[2] - Install center cover to steering wheel.

Tilt Steering Mechanism Removal and Installation

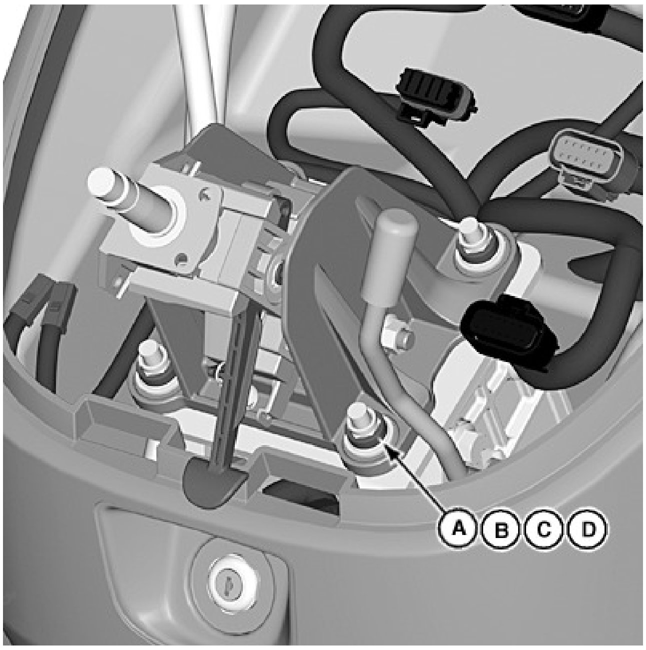
→NOTE:

The tilt steering mechanism contains no serviceable parts and must be replaced as a complete unit.

Removal:

[1] - Remove control panel. (See Control Panel Removal and Installation (Open Station)—eHydro Transmission or Control Panel Removal and Installation (Open Station)—PowrReverser Transmission or Control Panel Removal and Installation (Cab) .

[2] -



LEGEND:

A	Nut (4 used)
B	Washer (4 used)
C	Rubber Isolator (4 used)
D	Carriage Bolt (4 used)

Open Station Machine Shown. Cab Is Similar.

Remove four nuts (A), washers (B), rubber isolators (C), and carriage bolts (D) securing tilt steering column to center support. Lift column to remove assembly.

Installation:

[1] - Install tilt steering column onto center support, aligning steering column shaft with shaft on SCU valve. Secure with hardware that was previously removed. Tighten to specification.

[2] - Remainder of installation is done in the reverse order of removal.

Item	Measurement	Specification
Tilt Steering Column Nut	Torque	25 N·m ± 20%
		(18.5 lb.-ft. ± 20%)

Steering Control Unit (SCU) Removal and Installation (Cab)

The SCU has no serviceable components. If the SCU does not meet specifications, the unit must be replaced.

Removal:

[1] - Remove hood assembly. (See Hood Removal and Installation (Cab and Open Station) in Section 120, Group 10.)

[2] - Remove control panel. (See Control Panel Removal and Installation (Cab) in Section 120, Group 10.)

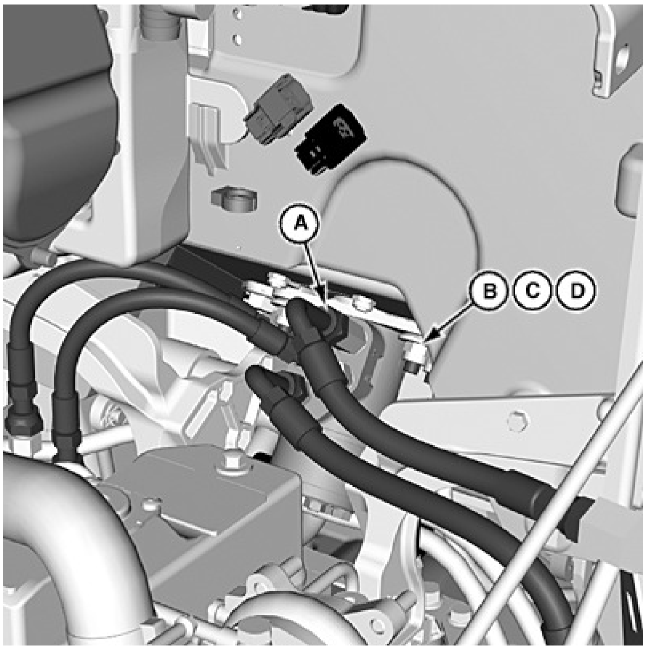
[3] - Remove cowl panel. (See Cowl Panel Removal and Installation (Cab) in Section 120, Group 10.)

[4] - If equipped, remove after treatment device (ATD) and rear mounting bracket. See relevant component technical manual (CTM).

[5] -

→NOTE:

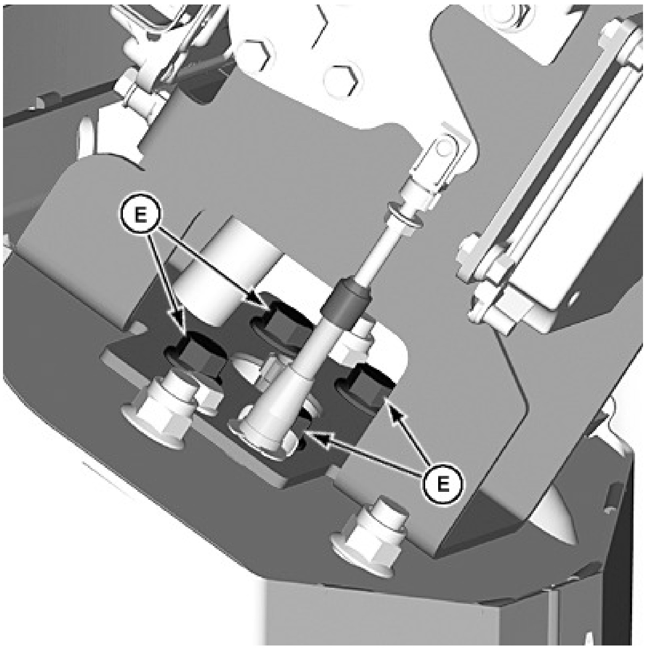
Place shop rags under the SCU hydraulic lines to absorb fluid when the lines are disconnected.



LEGEND:

A	Hydraulic Hose (4 used)
B	Nut (4 used)
C	Washer (4 used)
D	Rubber Isolator (4 used)
E	Cap Screw (4 used)

Disconnect SCU Hoses



Remove Cap Screws

Label and disconnect the four hydraulic hoses (A).

[6] -

→NOTE:

Two people will be required to perform this step.

Remove four cap screws (E), rubber isolators (D), washers (C), and nuts (B). Remove the SCU from the machine.

[7] - Label and remove SCU adapter fittings.

Installation:

[1] -

→NOTE:

New O-rings should be installed at this time.

Check that O-rings are installed on port fittings.

[2] - Install SCU adapter fittings and tighten to specification.

Item	Measurement	Specification
SCU Adapter Fitting	Torque	35 N·m (26 lb.-ft.)

[3] -

→NOTE:

Uneven or improper tightening of cap screws attaching SCU to machine can result in distortion of the valve body and premature failure of the SCU.

Install the SCU to the machine. Secure with hardware that was removed earlier and tighten to specification.

Item	Measurement	Specification
Steering Control Unit Hardware	Torque	25 N·m ± 20% (18.5 lb.-ft. ± 20%)

[4] - Install the hydraulic lines to the adapter fittings and tighten to specification.

Item	Measurement	Specification
11/16 Hydraulic Line Tube Nut	Torque	24 N·m (18 lb.-ft.)
M14 Hydraulic Line Tube Nut	Torque	35 N·m (26 lb.-ft.)

[5] - Remainder of installation is done in the reverse order of removal.

[6] - Fill the hydraulic system to the proper level; bleed the system if necessary.

Steering Control Unit (SCU) Removal and Installation (Open Station)

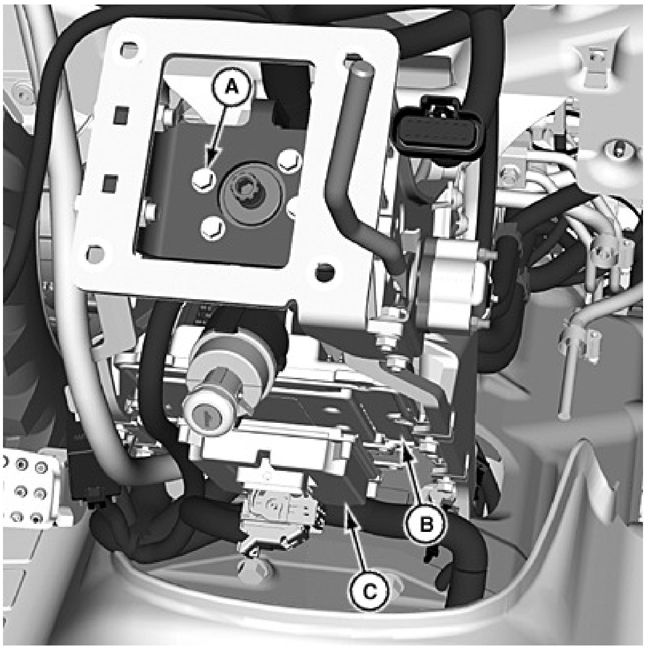
The steering control unit (SCU) has no serviceable components. If the SCU does not meet specifications, the unit must be replaced.

Removal:

[1] - Remove fuel tank. (See Fuel Tank Removal and Installation (Open Station) in Section 120, Group 10.)

[2] - Remove tilt steering mechanism. (See Tilt Steering Mechanism Removal and Installation in Section 90, Group 30.)

[3] -



LEGEND:

A	Cap Screw (4 used)
B	Engine Controller (If equipped)
C	Transmission Controller

Disconnect SCU

Disconnect harness connector and remove transmission controller (C).

[4] - Disconnect harness connector and remove engine controller (B).

[5] -

→NOTE:

Place shop rags under SCU hydraulic lines to absorb fluid when the lines are disconnected.

Label and disconnect the four hydraulic lines.

[6] - Remove four cap screws (A). Remove SCU from steering column support.

Installation:

[1] -

→NOTE:

New O-rings should be installed at this time.

Check that O-rings are installed on port fittings.

[2] -

→NOTE:

Uneven or improper tightening of cap screws attaching SCU to machine can result in distortion of the valve body and premature failure of the SCU.

Install the SCU into steering column support. Secure with four cap screws that were removed earlier and tighten to specification.

Item	Measurement	Specification
SCU Mounting Cap Screw	Torque	32 N·m (23.5 lb.-ft.)

[3] - Connect hydraulic lines to SCU adapter fittings and tighten to specification.

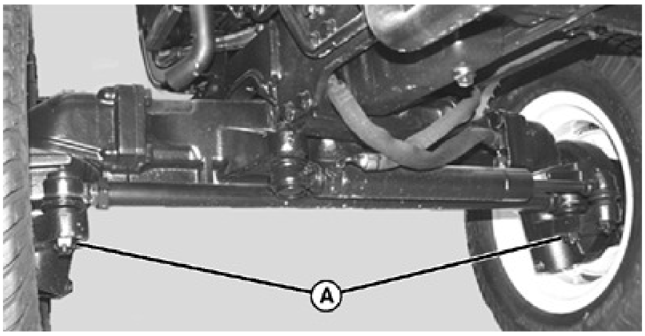
Item	Measurement	Specification
9/16 Hydraulic Line Tube Nut	Torque	16 N·m (12 lb.-ft.)
11/16 Hydraulic Line Tube Nut	Torque	24 N·m (18 lb.-ft.)

[4] - Remainder of installation is done in the reverse order of removal.

[5] - Fill the hydraulic system to the proper level; bleed the system if necessary.

Tie Rod Removal and Installation MFWD

Removal:



LEGEND:
A Castle Nuts

Tie Rod Graphics

[1] - Remove cotter pins from castle nuts (A) and remove castle nuts.

[2] -

→NOTE:

If removing tie rod ends, one of the tie rod ends and jam nut has left-hand threads.

Using a tie rod end separator, remove tie rod ends from spindles.

Installation:

[1] - Inspect tie rod end boots. If necessary, replace boots.

[2] - Insert tie rod ends into holes in spindle arms.

[3] - Install two castle nuts to rod ends.

[4] - Tighten castle nuts (A) to specification.

Item	Measurement	Specification
Castle Nuts	Torque	75—108 N·m (55—80 lb.-ft.)

[5] - Install the cotter pins. If slots in castle nuts do not align with holes after torquing, tighten nuts until next slot aligns.

[6] -

→NOTE:

Only grease tie rods if grease fitting is present.

Lubricate tie rod ends using general-purpose grease. Follow lubrication procedure outlined in the maintenance section of the operator’s manual.

[7] - Adjust toe-in. (See Toe-in Adjustment MFWD in Section 90, Group 25.

Section 100 - BRAKES

Table of contents

Group 05 - Specifications

Brakes

Item	Measurement	Specification
Specifications:		
Brake	Type	Wet Multiple Disc
Brake Pedal Travel	Distance	60 mm (2-3/8 in.)
Pedal Differential	Distance	2 mm (0.08 in.) or Less

Transaxle Oil

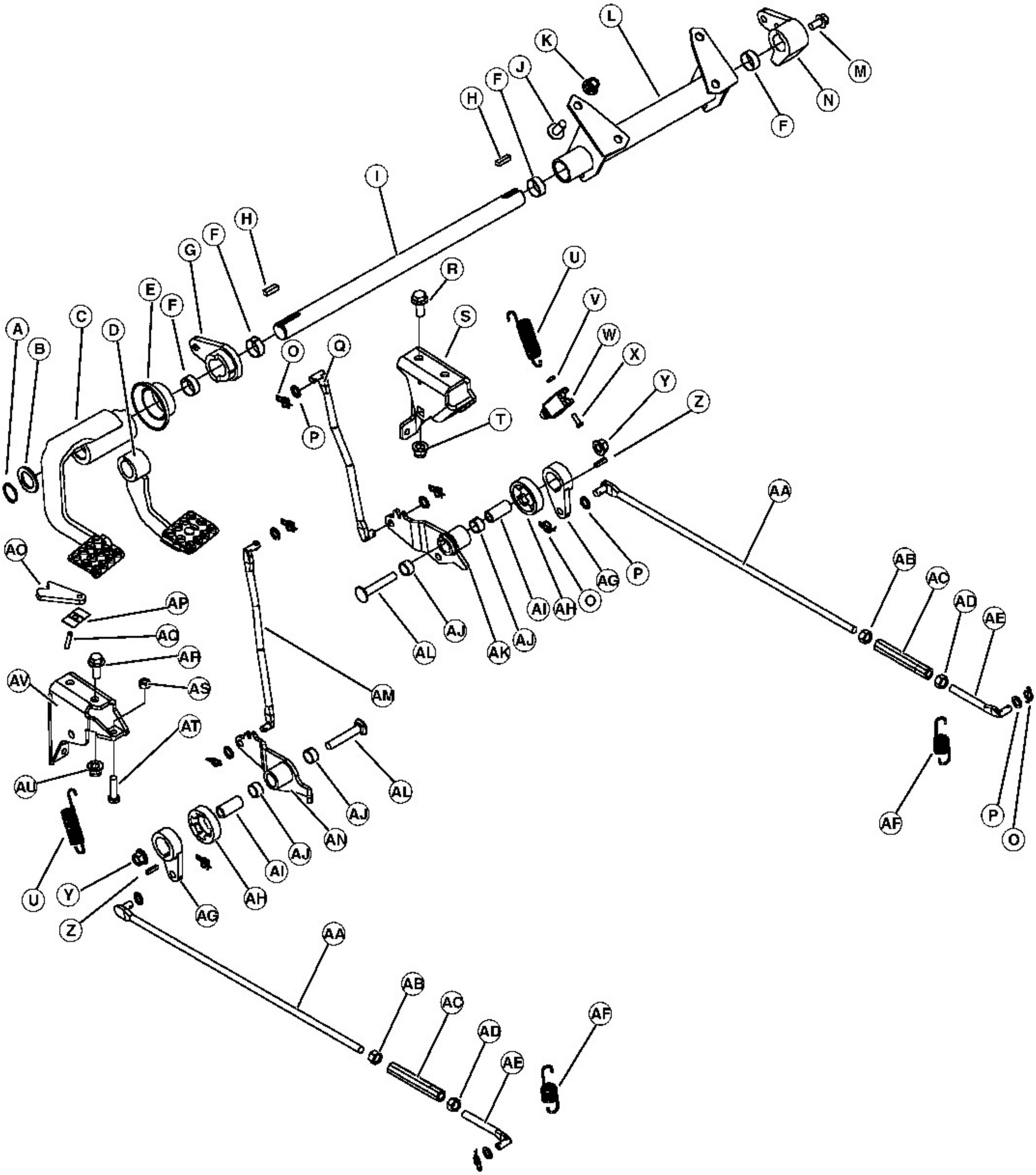
Item	Measurement	Specification
Specifications:		
Type		John Deere J20D
Capacity eHydro ™ Machines)		25.7 L (6.8 gal.)

Torque Specifications

Item	Measurement	Specification
Specifications:		
Rear Wheel Bolts	Torque	140 N·m (103 lb.-ft.)
Brake Assembly Cap Screw	Torque	28 N·m (21 lb.-ft.)
Park Brake Lever Cap Screw	Torque	55—80 N·m (41—60 lb.-ft.)

Group 10 - Component Location

Brake Pedals and Linkage (Cab)—eHydro Transmission



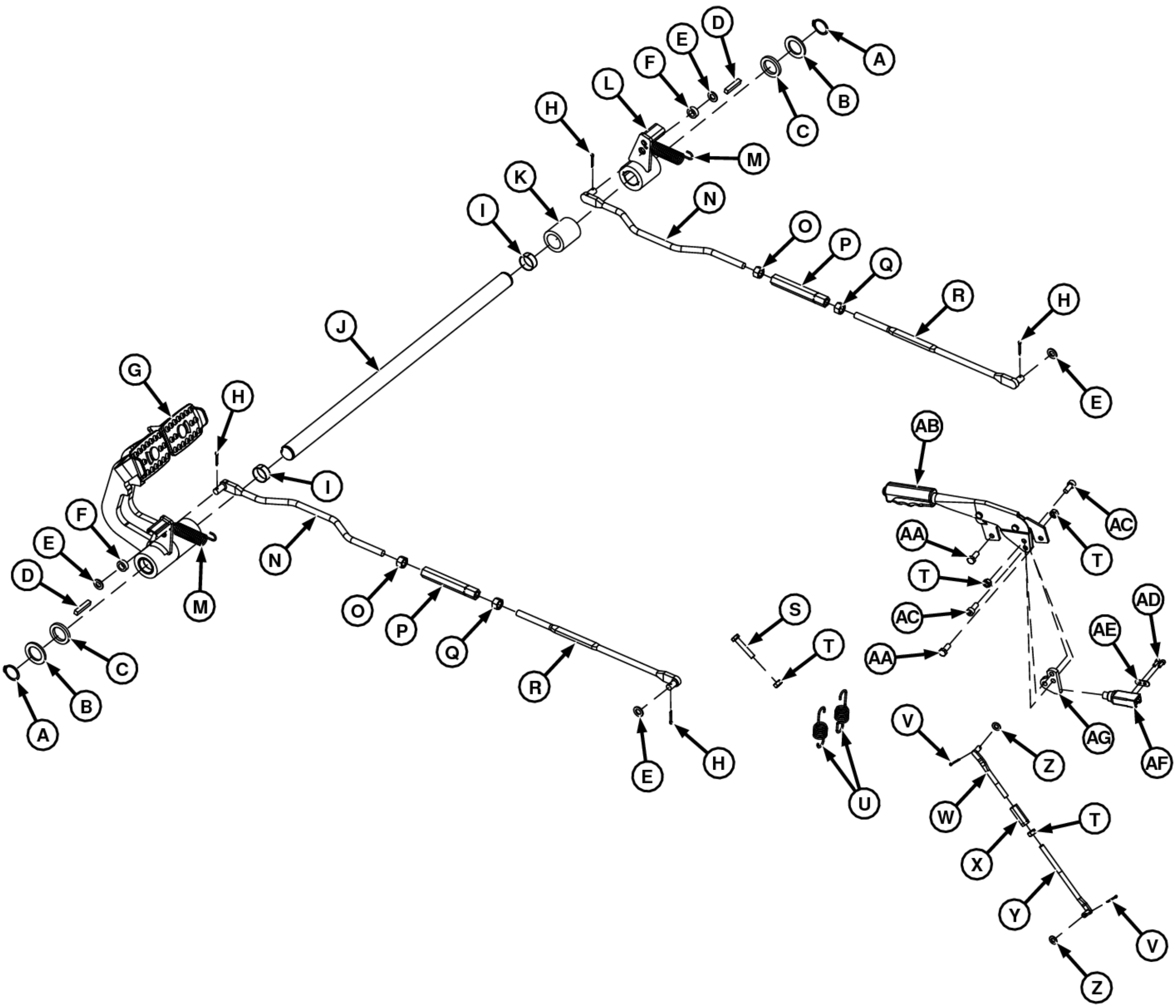
Cab

LEGEND:

A	Snap Ring
B	Washer

C	Left Brake Pedal
D	Right Brake Pedal
E	Seal
F	Bushing
G	Bellcrank
H	Key
I	Shaft
J	Screw
K	Lock Nut
L	Pedal Support
M	Bolt
N	Bellcrank
O	Spring Locking Pin
P	Washer
Q	Link
R	Bolt
S	Bracket
T	Lock Nut
U	Spring
V	Nut
W	Switch
X	Cap Screw
Y	Lock Nut
Z	Key
AA	Brake Rod
AB	Nut
AC	Turnbuckle
AD	Nut LH
AE	Brake Rod-Rear
AF	Spring
AG	Bellcrank
AH	Spacer
AI	Spacer
AJ	Bushing
AK	Bellcrank
AL	Bolt
AM	Rod
AN	Bellcrank
AO	Crossbar
AP	Leaf Spring
AQ	Spring Pin
AR	Bolt
AS	Nut
AT	Bolt
AU	Nut
AV	Bracket

Brake Pedals and Linkage (Open Station)—eHydro Transmission



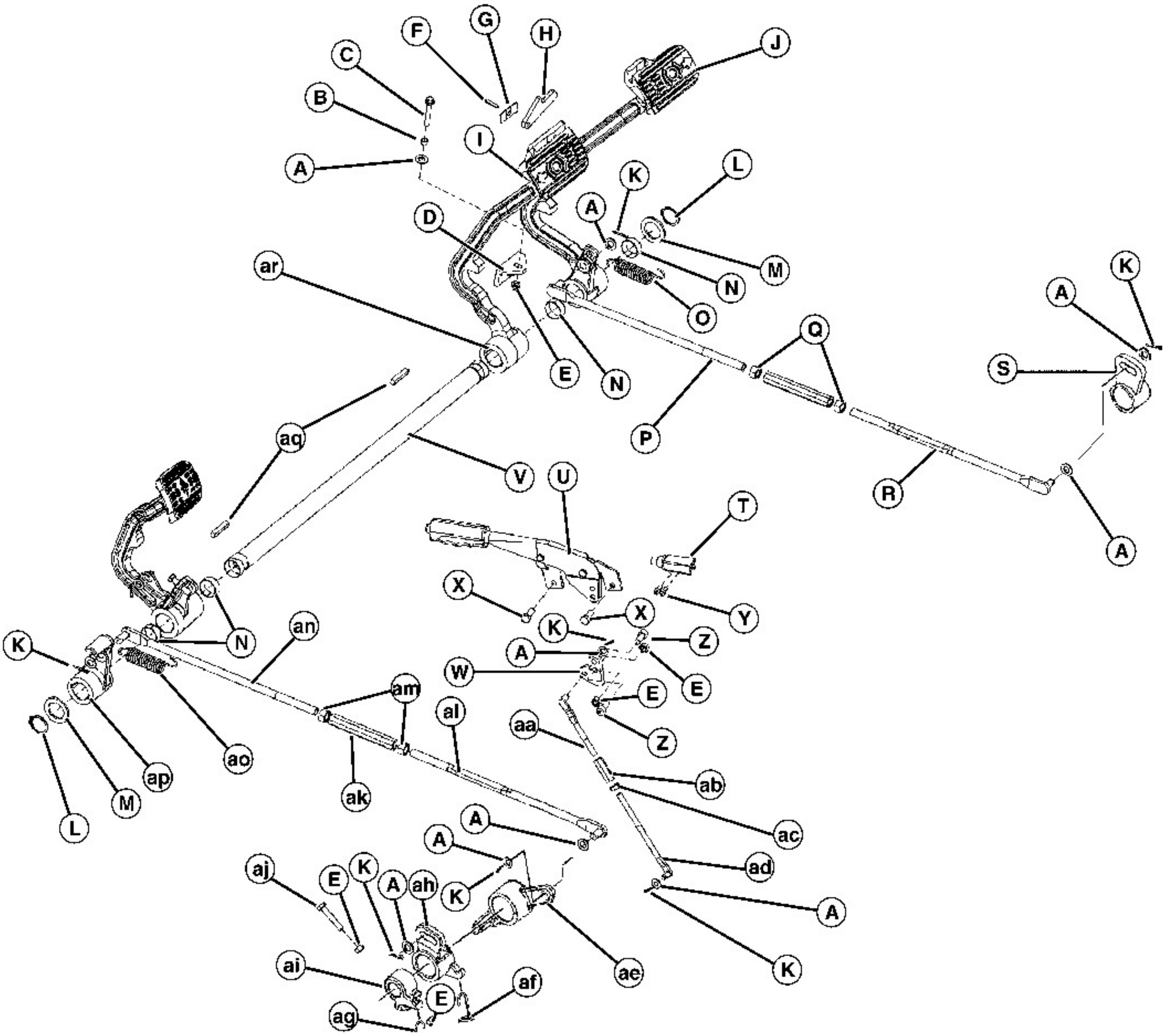
Open Station

LEGEND:

A	Snap Ring
B	Washer
C	Washer
D	Shaft Key
E	Washer
F	Bushing
G	Brake Pedal Kit
H	Cotter Pin
I	Bushing
J	Pedal Shaft
K	Spacer
L	Bell Crank
M	Return Spring
N	Upper Brake Rod

O	Nut
P	Turnbuckle
Q	Nut, Left Hand Thread
R	Lower Brake Rod
S	Cap Screw
T	Nut
U	Park Brake Return Spring
V	Cotter Pin
W	Lower Brake Rod
X	Turnbuckle
Y	Lower Brake Rod
Z	Washer
AA	Cap Screw
AB	Hand Brake Lever
AC	Socket Head Screw
AD	Screw
AE	Plate Support
AF	Brake Switch
AG	Limit Switch Actuator

Brake Pedals and Linkage—PRT



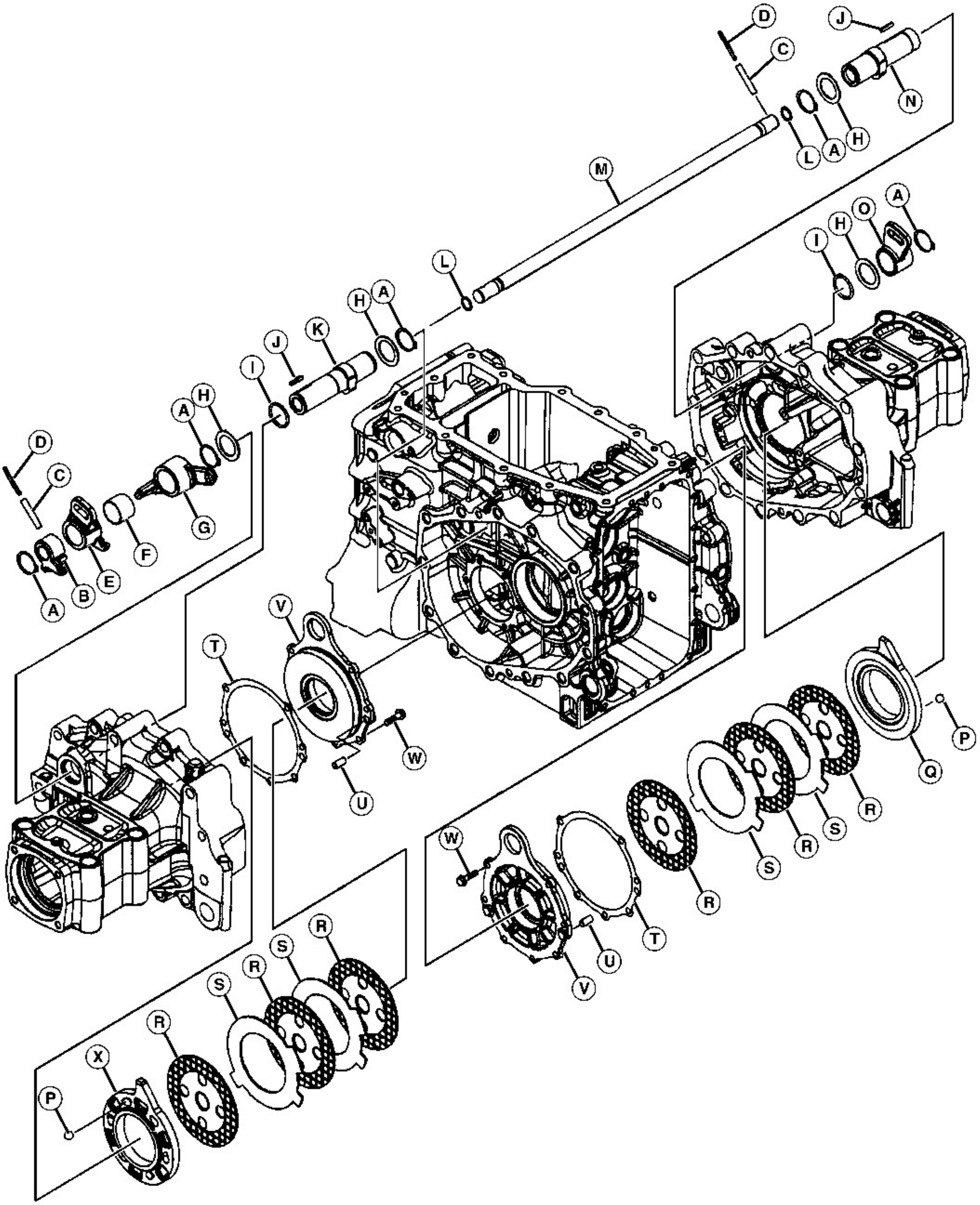
Brake Pedals and Linkage—PRT

LEGEND:

A	Washer
B	Spacer
C	Screw
D	Pad
E	Nut
F	Spring Pin
G	Spring
H	Pedal Locking Arm
I	Left Brake Pedal
J	Right Brake Pedal
K	Cotter Pin
L	Snap Ring
M	Washer
N	Bushing
O	RH Brake Return Spring
P	RH Upper Brake Rod
Q	Jam Nuts
R	RH Lower Brake Rod
S	RH Brake Bellcrank

T	Park Brake Switch
U	Park Brake Handle
V	Pedal Shaft
W	Actuator
X	Cap Screw
Y	Hex Head Screw
Z	Screw
AA	Upper Park Brake Rod
AB	LH Brake Turnbuckle
AC	Jam Nut
AD	Lower Park Brake Rod
AE	Bellcrank
AF	Brake Return Spring
AG	Park Brake Return Spring
AH	Park Brake Bellcrank
AI	Brake Return Spring Turnbuckle
AJ	Park Brake Adjustment Cap Screw
AK	Turnbuckle
AL	LH Lower Brake Rod
AM	Jam Nut
AN	LH Upper Brake Rod
AO	LH Brake Return Spring
AP	LH Brake Bellcrank

Brake Assembly



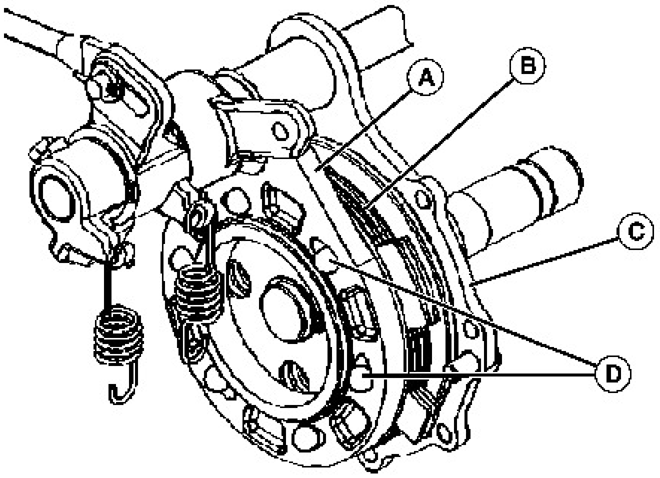
Brake Assembly

LEGEND:

A	Snap Ring (5 used)
B	Park Brake Arm
C	Spring Pin 8x50 (2 used)
D	Spring Pin 5x50 (2 used)

E	Brake Arm (Left)
F	Bushing
G	Park Brake Arm (Left)
H	Washer 35x50x2 (4 used)
I	O-ring (2 used)
J	Key (2 used)
K	Brake Cam (Left)
L	O-ring (2 used)
M	Shaft, Brake Pedal
N	Brake Cam (Right)
O	Brake Arm (Right)
P	Ball 1/2 (6 used each side)
Q	Brake Actuator Plate (Right)
R	Disc, Friction (3 used each side)
S	Plate, Friction (2 used each side)
T	Gasket, Brake Cover
U	Dowel Pin (2 used)
V	Brake Cover (2 used)
W	Bolt (7 used each side)
X	Brake Actuator Plate (Left)

Brake Housing

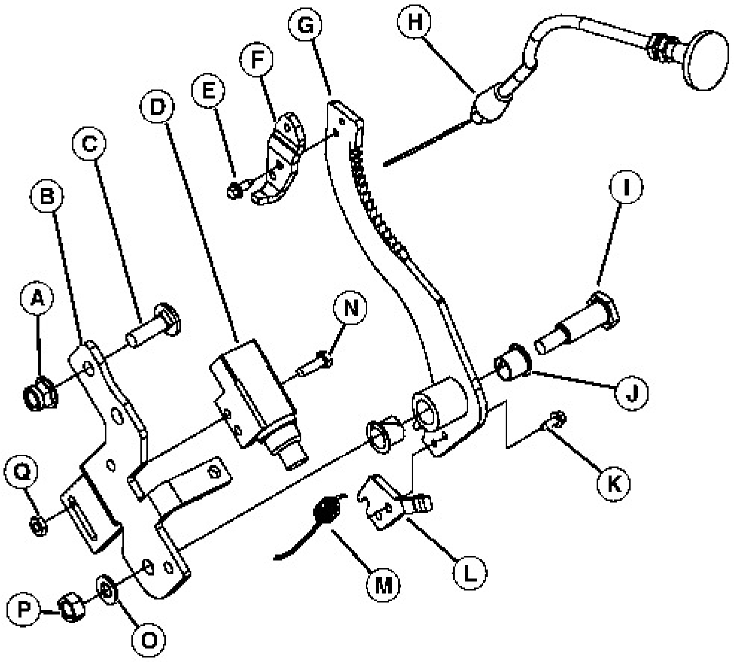


Brake Housing

LEGEND:

A	Brake Arm and Actuator Plate
B	Friction Discs and Plates
C	Brake Cover
D	Steel Balls (6 Used)

Park Brake Linkage—North America

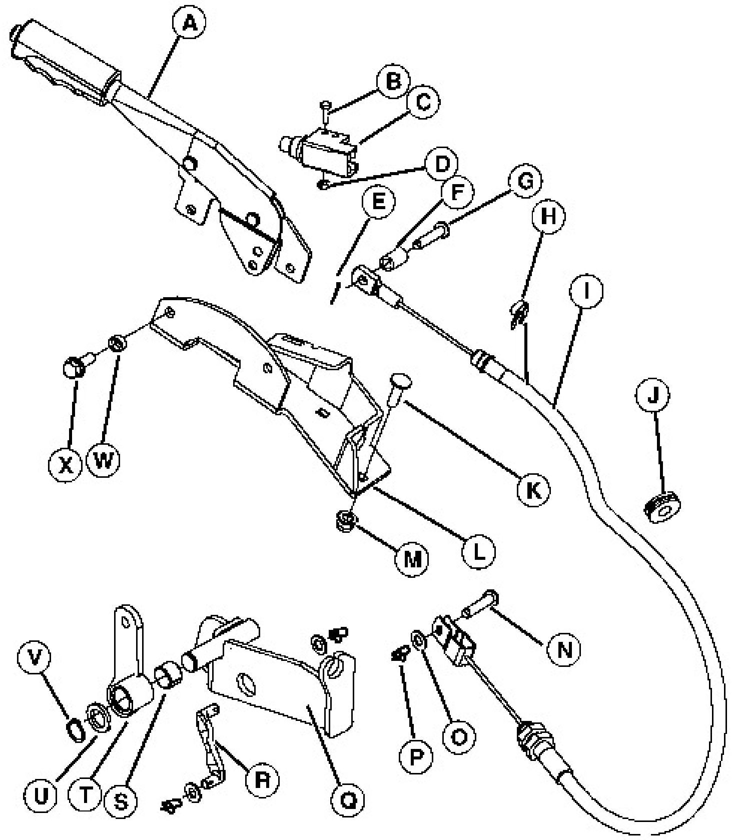


Park Brake Linkage—North America

LEGEND:

A	Locknut
B	Bracket
C	Carriage Bolt
D	Park Brake Switch
E	Shoulder Bolt
F	Pawl
G	Park Lock
H	Cable
I	Shoulder Bolt
J	Bushing
K	Screw
L	Bracket
M	Extension Spring
N	Screw
O	Washer
P	Nut
Q	Nut

Park Brake Linkage—Export



LEGEND:

A	Park Brake Lever
B	Screw
C	Switch
D	Nut
E	Cotter Pin
F	Bushing
G	Pin
H	Clip
I	Cable
J	Grommet
K	Bolt
L	Bracket
M	Nut
N	Pin
O	Washer (3)
P	Clip (3)
Q	Bracket
R	Link
S	Bushing
T	Bellcrank
U	Washer
V	Snap Ring
W	Spacer
X	Bolt

Park Brake Linkage—Export

Group 15 - Theory of Operation

Brakes

The brakes are mechanical wet disk brakes.

The brake assembly is bolted in the final drive housing and operates off the pinion shaft (A). There are three friction disks (B) and two friction plates (C) that are alternated between the actuator (D) and the brake cover (E). The brake cover and the actuator act like friction plates. The only components that rotate with the axle are the brake disks, which are splined to the pinion driveshaft.

When the brake pedal is pushed, the brake rod pulls the brake lever (F) forward. The brake lever is keyed to the brake shaft. This rotates the cam lever (G) which rotates the actuator (D). There are balls set in sockets in the final drive housing that the actuator rests on. The sockets in the actuator are ramped. As the actuator rotates, the balls force it toward the brake cover. This compresses the disks between the friction plates and stops rotation of the pinion shaft.

When the brake pedal is released, the return springs on the pedals pull the pedals back to the original position. When that occurs the cam lever rotates back allowing the actuator plate to go back to its original position, releasing the brakes.

Parking Brake—North America

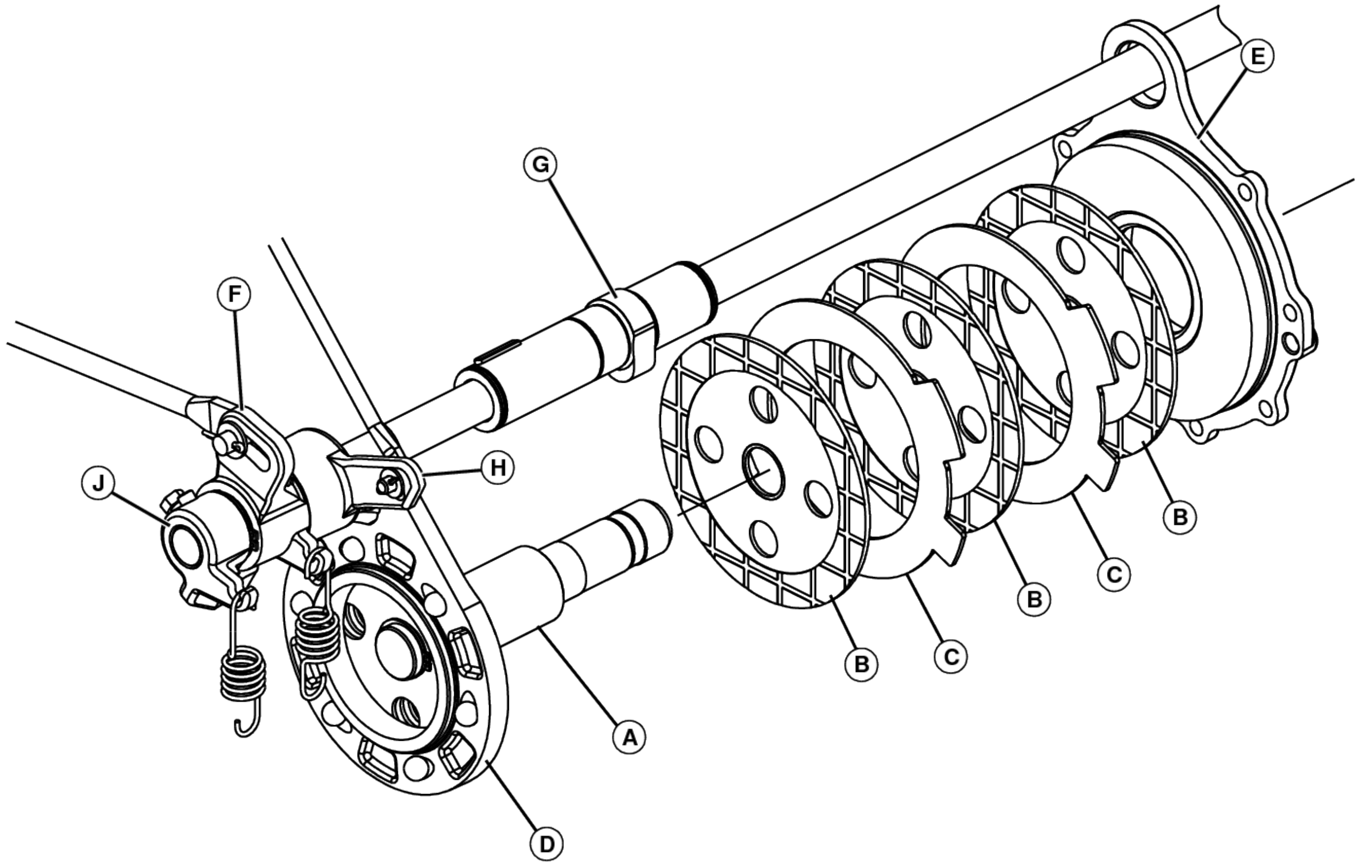
The parking brake operates by locking the brake pedals in the engaged position.

The parking brake is operated by pressing down on and holding the brake pedals and then pulling out on the park brake knob. When the knob is pulled out, the parking brake pawl rotates forward. The pawl engages the teeth on the lock lever holding the brakes in the locked on position.

The brake pedal return springs and the trapped energy on the brakes maintain force which holds the parking brake lock lever in position. The parking brake is released by pushing down on the brake pedals which allows the pawl to disengage from the teeth on the lock lever.

Parking Brake—Export

The parking brake uses a lever, and a cable that rotate the park brake shaft and bell crank that are on the brake shaft. When the lever is pulled up, the cable rotates the park brake shaft. This rotates the parking brake shaft assembly and engages the brakes. The park brake is locked in position by a ratchet on the park brake lever. The brakes are held in position until the park brake release button is pushed, and the park brake lever is pushed down.



Left Side Shown

LEGEND:

A	Pinion Shaft
B	Friction Disc (3 used)
C	Friction Plate (2 used)
D	Actuator
E	Brake Cover
F	Brake Lever
G	Cam Lever

Group 20 - Diagnostics

Brake Pedals and Linkage Checks

Symptom	Problem	Solution
Brake Pedals Do Not Operate Smoothly	Brake linkage damaged/binding.	Inspect for worn bushings or damage. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Brake pedal free play not set to about 30 mm (1.2 in.).	Adjust pedals to specification. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission .
	Total brake pedal travel not set to about 60 mm (2.4 in.)	Adjust brake pedals to specification. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission
	Brake pedal heights not within 2 mm (0.8 in.) of each other.	Adjust brake pedals to specification. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission
	Brake linkage bent or binding.	Adjust linkage to specification or repair or replace damaged parts. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Park brake lever does not operate smoothly or is improperly adjusted.	Adjust to specification or replace damaged parts.

Brake Operation Problems

Symptom	Problem	Solution
Steering or Machine Pulls In One Direction When Braking	Brake pedal interlock lever not engaged.	Lock pedals together.
	Brake pedals improperly adjusted	Adjust brakes. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission .
	Brake linkage damaged or binding.	Repair or replace components as necessary. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Brakes worn or no longer serviceable.	Repair or replace as necessary. See Brake Disassembly and Inspection .

Symptom	Problem	Solution
Brakes Drag or Slow To Release	Brake pedals improperly adjusted.	Adjust brakes. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission .
	Brake linkage damaged or binding.	Repair or replace components as necessary. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Brake return springs weak, damaged, or missing.	Repair or replace as necessary. See Brake Disassembly and Inspection .

Symptom	Problem	Solution
Brakes Not Effective	Brake pedals improperly adjusted.	Adjust brakes. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission .
	Brake linkage damaged or binding.	Repair or replace components as necessary. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Brake friction/stationary plates worn or damaged.	Repair or replace as necessary. See Brake Disassembly and Inspection .
	Brake actuator cam and/or actuator worn or damaged.	Repair or replace as necessary. See Brake Shaft Removal and Installation .
	Actuator balls or sockets worn, pitted, or scored.	Repair or replace as necessary. See Brake Disassembly and Inspection .

Symptom	Problem	Solution
Excessive Pedal Travel	Brake pedals improperly adjusted.	Adjust brakes. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission .
	Brake linkage damaged or binding.	Repair or replace components as necessary. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Brake friction/stationary plates worn or damaged.	Repair or replace as necessary. See Brake Disassembly and Inspection .
	Brake actuator cam and/or actuator worn or damaged.	Repair or replace as necessary. See Brake Shaft Removal and Installation .
	Actuator balls or sockets worn, pitted, or scored.	Repair or replace as necessary. See Brake Disassembly and Inspection .

Symptom	Problem	Solution
Noise During Braking	Brake linkage damaged or binding.	Repair or replace components as necessary. See Brake Pedal and Linkage Removal and Installation (Cab) or Brake Pedal and Linkage Removal and Installation (Open Station) .
	Brake friction/stationary plates worn or damaged.	Repair or replace as necessary. See Brake Disassembly and Inspection .
	Brake actuator cam and/or actuator worn or damaged.	Repair or replace as necessary. See Brake Shaft Removal and Installation .
	Actuator balls or sockets worn, pitted, or scored.	Repair or replace as necessary. See Brake Disassembly and Inspection .

Symptom	Problem	Solution
Oil Leaking From Final Drive Casing	Oil leaking from final drive casing at brake arms.	Replace brake shaft O-rings. See Brake Shaft Removal and Installation .

Internal Components

Symptom	Problem	Solution
Improper Brake Function	Brake friction materials excessively worn.	Replace friction plates and disks. (See Brake Disassembly and Inspection in Section 100, Group 30.)
	Brake actuators do not have smooth operation.	Replace any worn parts. (See Brake Disassembly and Inspection in Section 100, Group 30.)
	Steel balls or sockets pitted or scored.	Replace steel balls or actuator. (See Brake Disassembly and Inspection in Section 100, Group 30.)

Group 25 - Tests and Adjustments

Brake Pedal Adjustment—eHydro Transmission

Reason:

To set the brake linkage free play to allow proper pedal movement, and full application of the brake disks. The brakes are adjusted using turnbuckles to lengthen or shorten the brake rods.

Tools:

- 18 mm open-end wrenches
- Ruler

Procedure:

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Place wheel chocks in front and behind both rear wheels and release park brake.

[3] - Unlock the brake pedals.

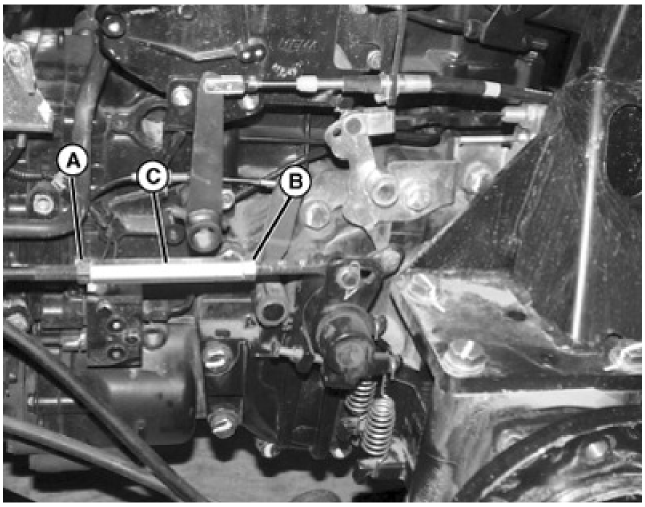
[4] -

IMPORTANT:

Avoid Damage! The jam nuts (B) on the rear of the turnbuckle are left-hand thread.

→NOTE:

The brake rod turnbuckles are located on the left and right side of the transmission.



LEGEND:
A Front
B Rear
C Left- and Right-Hand Side Brake Rod Turnbuckles

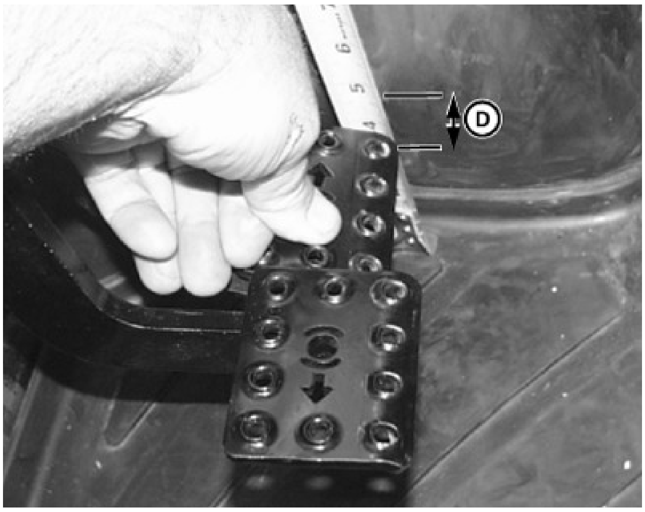
Brake Rod Turnbuckle

Loosen the jam nuts on the front (A) and rear (B) of the left and right side brake rod turnbuckles (C).

[5] -

IMPORTANT:

Avoid Damage! Adjust the right pedal free play and then the left pedal.



LEGEND:

D	Pedal Free Play Measurement

Right-Hand Foot Pedal

Measure the free travel of the right pedal.

[6] - Adjust the right turnbuckle until the pedal free play measurement (D) is within specification.

Item	Measurement	Specification
Brake Pedals Free Play	Distance	30—36 mm (1.2—1.4 in.)

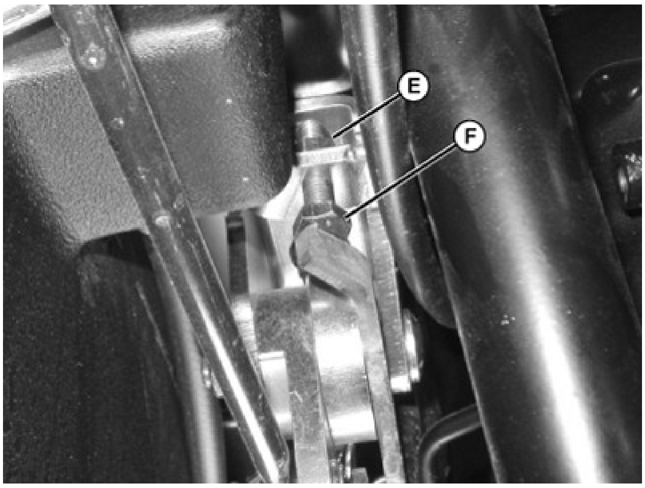
Item	Measurement	Specification
Brake Pedals Free Play	Force	49 N (11 lb.)

[7] - Tighten the nuts to the turnbuckles and verify that the pedal free play remains within specification.

[8] - Measure the differential between the right and left brake pedals. The difference between left and right side pedal free play (pedal differential) should be within specification.

Item	Measurement	Specification
Specification:		
Pedal Free Play—Pedal Differential	Distance	2 mm (0.08 in.)

[9] - If needed, adjust the left pedal to bring the pedals within specification as follows:

a. 

LEGEND:

E	Jam Nut
F	Stop Bolt

Stop Bolt

Loosen the jam nut (E) and turn the stop bolt (F), in or out, until the pedal differential is within specification.

b. Hold the stop bolt in position and tighten the jam nut.

[10] - Measure the free travel of the left pedal.

Item	Measurement	Specification
Brake Pedals Free Play	Distance	30—36 mm (1.2—1.4 in.)

Item	Measurement	Specification
Brake Pedals Free Play Force	Force	49 N (11 lb.)

[11] - Adjust the left turnbuckle until the pedal free play measurement is within specification using force.

[12] - Tighten the nuts to the turnbuckles and verify that the pedal free play remains within specification.

[13] - Check brake switch specification and adjust if needed. (See Brake Switch Adjustment in Section 100, Group 25.)

Results:

If the brakes are adjusted correctly:

- The wheel brakes will engage when the pedals are depressed 30—36 mm (1.2—1.4 in.), using 49 N (11 lb.) of force.

Brake Pedal Adjustment—PowrReverser Transmission

Reason:

To set the brake linkage free play to allow full pedal movement and full application of the brake disks on the rear axle shafts. The brakes are adjusted using adjustable turnbuckles to lengthen or shorten the brake rods.

→NOTE:

Perform brake pedal adjustment before performing parking brake adjustments.

Tools:

- Ruler
- Open End Wrenches

Procedure:

[1] - Park machine safely and block front wheels to prevent movement.

[2] - Lift both rear wheels off the ground.

[3] - Place a horizontal line on the wheels to observe wheel rotation.

[4] - Unlock brake pedals.

[5] - Measure travel of each pedal.

[6] -

LEGEND:

A Pedal Travel

Measure Pedal Travel

Adjust each turnbuckle on brake rod until the pedal travel (A) is within specification. Both pedals must travel the same distance.

Item	Measurement	Specification
Pedal Travel	Distance	60 mm (2-3/8 in.)

[7] - Lock the pedals together.

[8] -

→NOTE:

An assistant may be needed to perform the remaining steps.

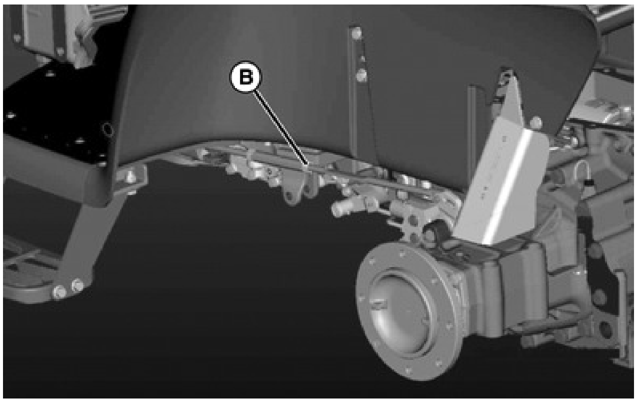
Start the machine, place the transmission in Range B and set engine throttle speed to specification.

Item	Measurement	Specification
Engine Throttle	Speed	2000 rpm

[9] - Depress forward control pedal.

[10] - Depress brake pedals.

[11] -



LEGEND:
B Turnbuckle (2 used)

Wheel removed for clarity

Both hubs should slow down at the same rate of speed. If not, adjust the turnbuckles (B) until they slow down at the same rate of speed.

[12] - Hold the turnbuckle and tighten the jam nuts.

[13] - Lower the tractor to the ground.

Results:

If the brakes are adjusted correctly:

- The brakes will begin engagement when the pedals are depressed. (See specification.)

Item	Measurement	Specification
Brake Engagement	Position	60 mm (2-3/8 in.)

Brake Switch Adjustment

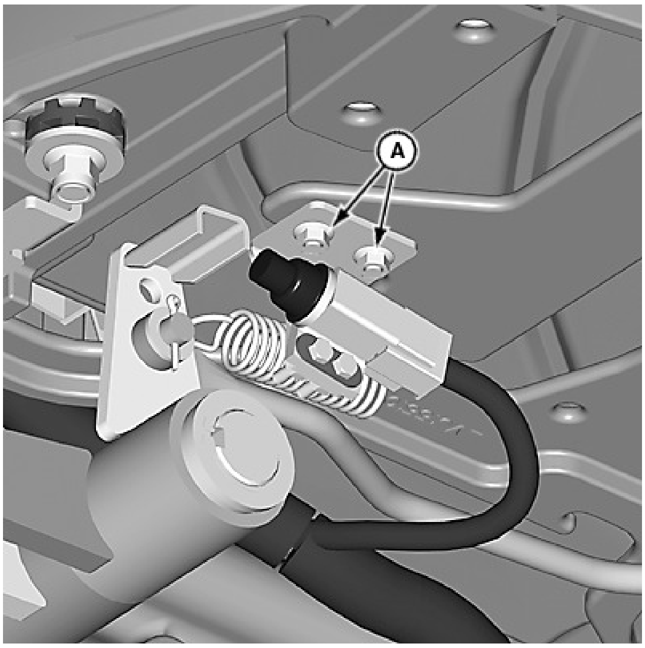
[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05.)

[2] - Lock the brake pedals.

[3] - Press brake pedal. The brake lights should go within specification.

Item	Measurement	Specification
Switch Contact	Distance	1— 4 mm (.040—.150 in.)

[4] -



LEGEND:
A Nut (2 used)

Adjust Brake Switch

Loosen nuts (A) and adjust brake switch fore or aft to specification.

Parking Brake Adjustment

[1] - Make sure that the machine is in 2WD.

[2] - Park machine safely and block front wheels.

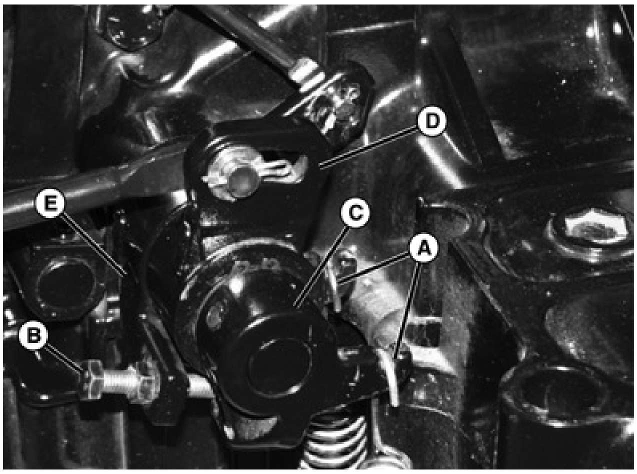
[3] - Remove the rear wheels.

[4] - Mark a horizontal line on both wheel hubs to observe wheel RPM.

[5] -

CAUTION:

Avoid Injury! Brake return springs under high tension. Wear safety glasses and gloves when removing or installing springs from pedal.



LEGEND:

A	Brake Spring (2 used)
B	Cap Screw
C	Park Brake Bell Crank
D	Brake Bell Crank
E	Park Brake Bell Crank

Brake Adjustment

Remove the brake springs (A).

[6] - Loosen jam nut and back out cap screw (B) until gap between the cap screw and the park brake bell crank (C) is at specification.

Item	Measurement	Specification
Cap Screw and The Park Brake Bell Crank	Gap	10 mm (0.4 in.)

[7] - Rotate brake bell crank (D) counter clockwise until it stops.

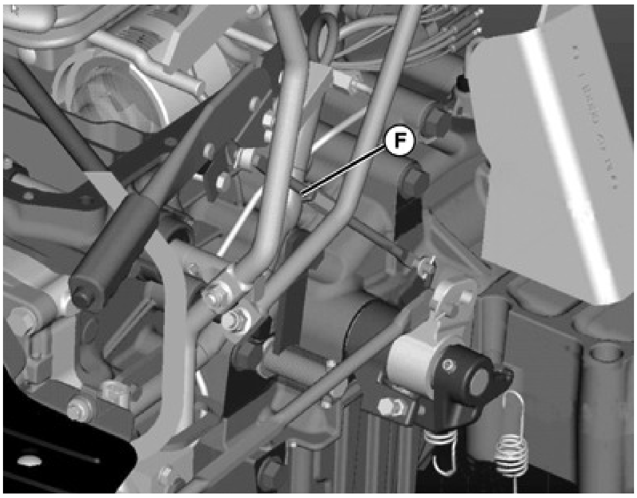
[8] - Hold brake bell crank (D) stationary, rotate park brake bell crank (E) counter clockwise until it contacts brake bell crank (D).

[9] - Hold brake bell crank (D) and park brake bell crank (E) stationary, rotate park brake bell crank (C) counter clockwise until it stops.

[10] - Adjust cap screw (B) until it just contacts park brake bell crank (C). Tighten jam nut.

[11] - Engage the park brake lever two clicks from the bottom.

[12] -



LEGEND:

F	Jam Nut

Brake Adjustment

Loosen jam nut (F) and adjust park brake rod until the play between the rod and park brake bell crank (E) is eliminated. Repeat on other side if necessary.

[13] - Tighten jam nut.

[14] - Replace the brake springs.

[15] - Start the machine, place the transmission in Range B and set engine throttle speed to specification.

Item	Measurement	Specification
Engine Throttle	Speed	1500 rpm

[16] - Depress forward control pedal.

[17] - Engage park brake to a minimum of five clicks.

[18] - Both wheels should slow down at the same rate of speed. See “Results” below.

[19] - Replace rear wheels and lower to the ground.

Results:

If both wheels slow down at the same rate, the park brake is correctly adjusted.

If the wheels slow down at different rates, or if only one slows down:

- Stop the engine.
- Loosen the jam nut and adjust cap screw (B)
- Adjust the cap screw clockwise for the left wheel or counter clockwise for the right wheel.
- Tighten the jam nut.
- Start engine and repeat test to check that the wheels slow down at the same rate. Repeat procedure as necessary.

Group 30 - Repair

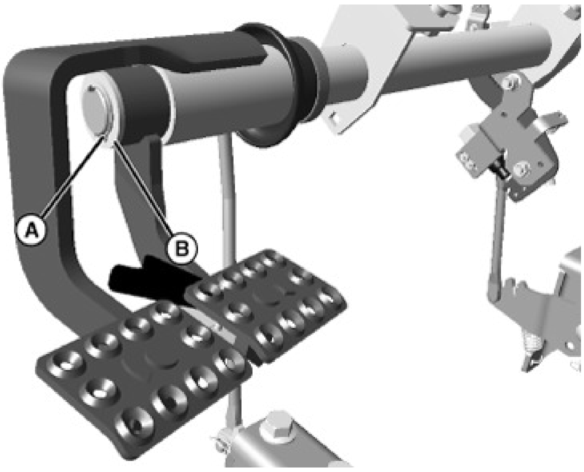
Brake Pedal and Linkage Removal and Installation (Cab)

[1] - Park machine safely. (See Park Machine Safely in Section 10, Group 05).

[2] - Place wheel chocks in front and behind both rear wheels and release park brake.

[3] - Unlock the brake pedals.

[4] -



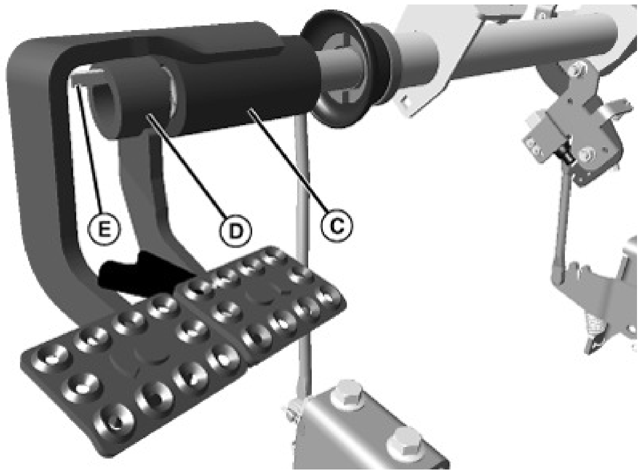
LEGEND:

A	Retaining Ring
B	Washer

Retaining Ring

Remove the retaining ring (A) and washer (B).

[5] -



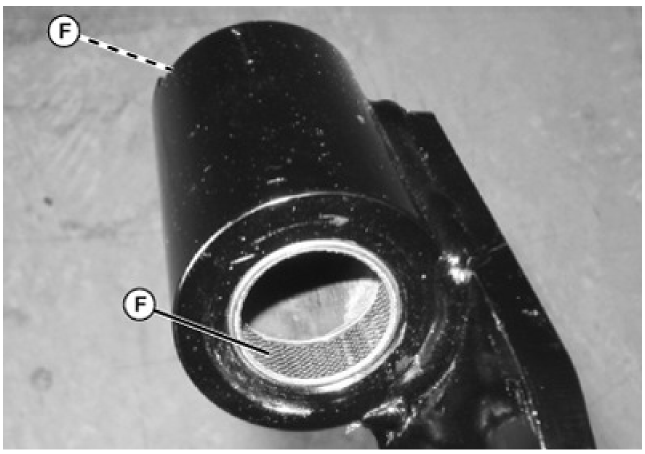
LEGEND:

C	Left Pedal
D	Right Pedal
E	Key

Brake Pedals

Remove the left pedal (C), right pedal (D), and key (E) off the brake shaft as a set.

[6] -



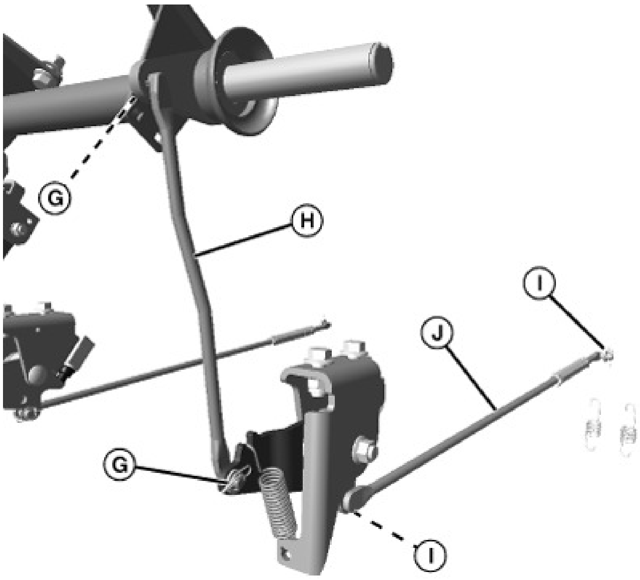
LEGEND:

F	Bushings

Pivot Tube Bushings

Inspect the bushings (F) inside the left pedal pivot tube.

[7] -



LEGEND:

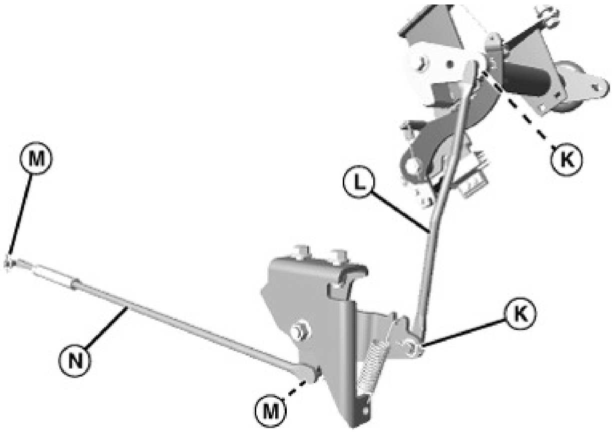
G	Spring Pins and Washers
H	Left Upper Link
I	Soring Pins and Washers
J	Left Adjusting Link

Left Upper Link

Remove the spring pins and washers (G) then remove the left upper link (H).

[8] - Remove the spring pins and washers (I) then remove the left adjusting link (J).

[9] -



LEGEND:

K	Spring Pins and Washers
L	Right Upper Link
M	Spring Pins and Washers
N	Right Adjusting Link

Right Upper Link

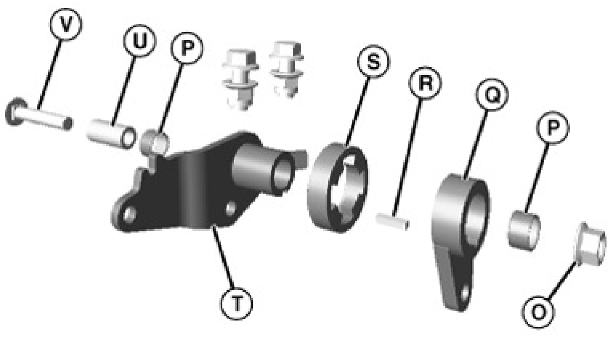
Remove the spring pins and washers (K) then remove the right upper link (L).

[10] - Remove the spring pins and washers (M) then remove the right adjusting link (N).

[11] -

→NOTE:

Left-hand side shown, right-hand side similar.



LEGEND:

O	Nut
P	Bushing
Q	Bellcrank
R	Key
S	Spacer
T	Bellcrank
U	Spacer
V	Carriage Bolt

Bellcrank Assembly

Remove the nut (O) and carriage bolt (V) from the bellcrank pivot bracket (not shown). Lower the bellcrank assembly (P—U) out of the bellcrank pivot bracket.

[12] - Disassemble the components and inspect for wear or damage. Replace as needed.

[13] - Install parts in reverse order.

Brake Pedal and Linkage Removal and Installation (Open Station)

→NOTE:

Hydrostatic brake pedals are shown; PowrReverser is similar and on the right side of the tractor.

[1] - Park machine safely. See Park Machine Safely.

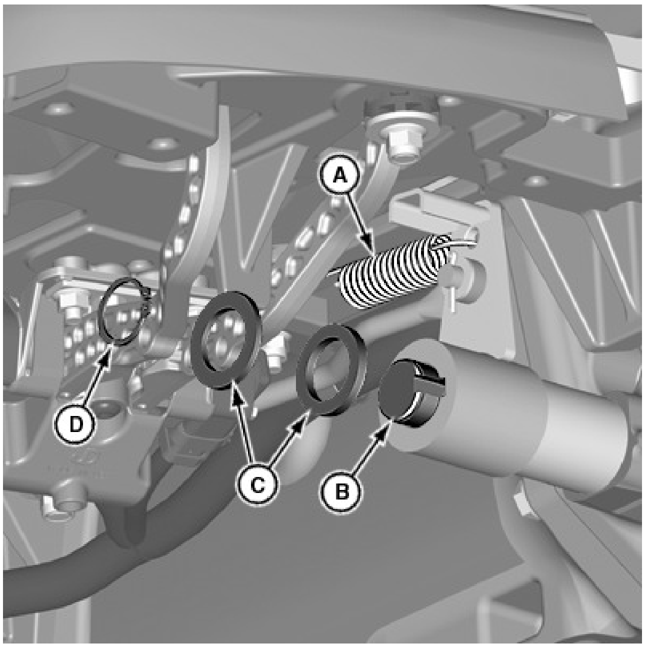
[2] - Place wheel chocks in front and behind both rear wheels and release park brake.

[3] - Unlock the brake pedals.

[4] -

→NOTE:

Label the two washers (C) when removing them from the brake pedal shaft. There are two different sizes of washers (C) used in this assembly. On a model equipped with a PowrReverser transmission, there is only one washer (C).



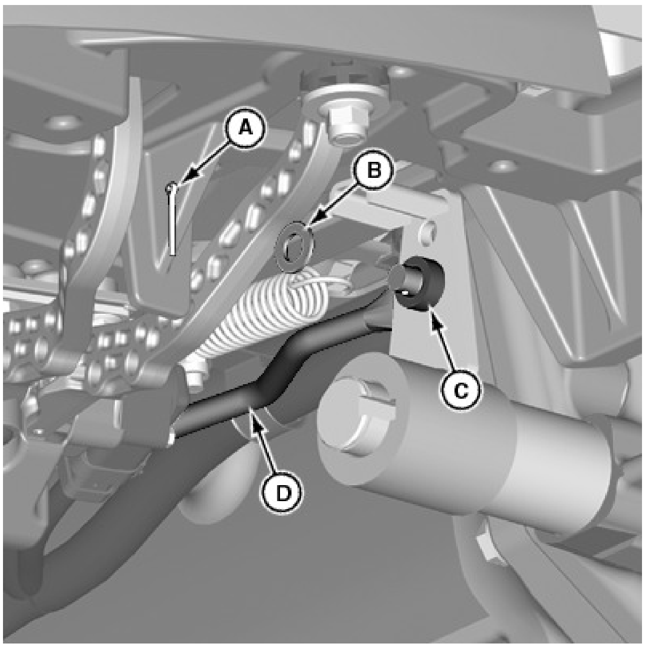
LEGEND:

A	Spring
B	Brake Pedal Shaft
C	Washer (2 used—Hydrostatic) (1 used—PowrReverser)
D	Snap Ring

Snap Ring & Washers

Disconnect spring (A) and remove snap ring (D) and washers (C) on both sides of the brake pedal shaft (B).

[5] -



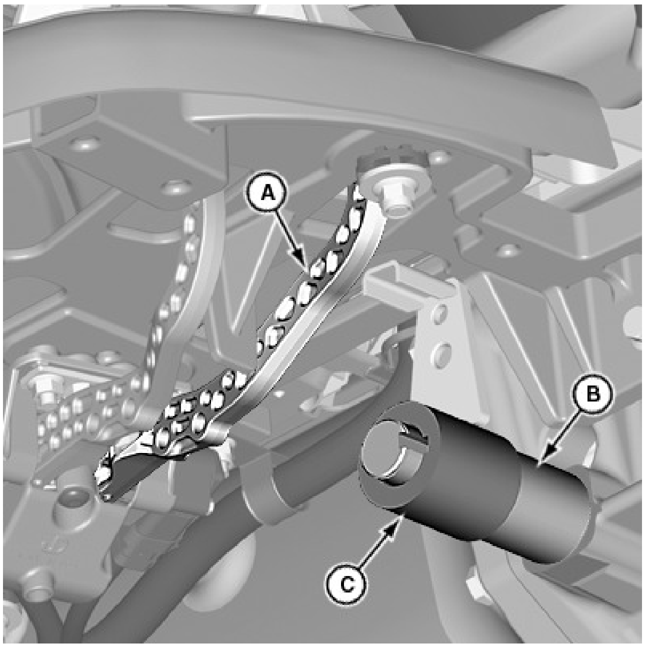
LEGEND:

A	Cotter Pin
B	Washer
C	Bushing
D	Brake Rod

Cotter Pin and Washer

Remove cotter pin (A), washer (B), and bushing (C) and disconnect upper brake rod (D) on both sides.

[6] -



LEGEND:

A	Pedal Arm
B	Spacer
C	Pedal Hub

Pedal Arm

Pull down on the forward pedal arm (A) to slide the brake pedal hub (C) on the shaft to gain access to the key.

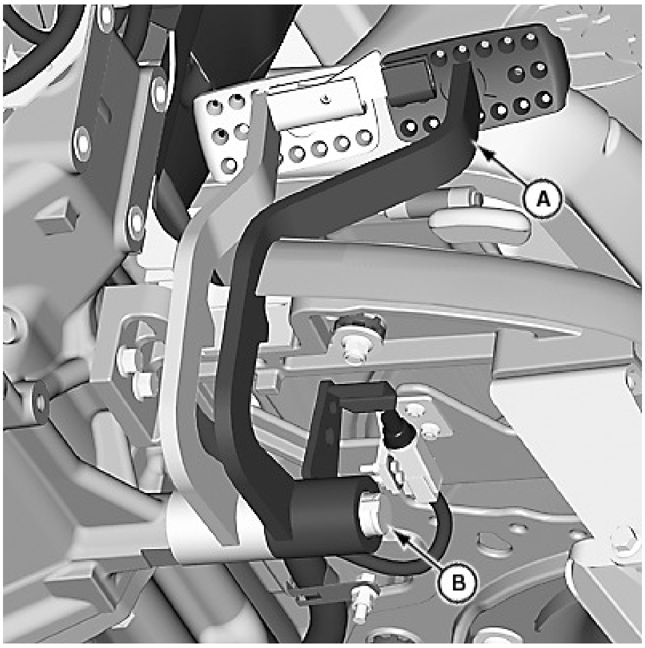
[7] - Remove key then slide brake pedal hub back on the shaft and then rotate forward and remove from shaft.

[8] - Remove spacer (B) from shaft.

[9] -

→NOTE:

Use a brass punch and hammer to assist in sliding the brake pedal shaft.



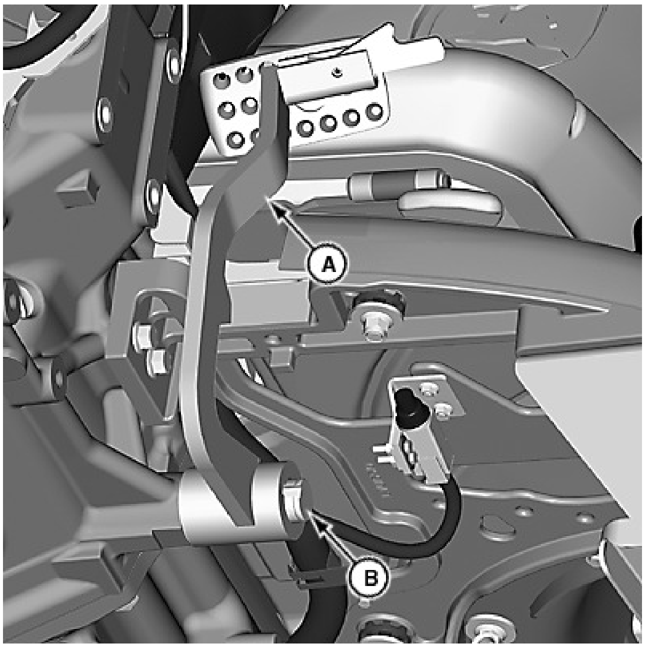
LEGEND:

A	Left Brake Pedal
B	Brake Pedal Shaft

Remove Left Brake Redal

Push on brake pedal shaft (B) until the left brake pedal (A) can be removed.

[10] -



LEGEND:

A	Right Brake Pedal
B	Brake Pedal Shaft

Remove Right Brake Pedal

Rotate brake pedal shaft (B) forward and remove right brake pedal (A) and key.

[11] -

LEGEND:

A	Bushing (2 used)

Brake Pedal Bushings

Inspect the bushings (A) inside the left pedal pivot tube.

[12] - Disassemble the components and inspect for wear or damage. Replace as needed.

[13] - Install parts in reverse order.

Brake Shaft Removal and Installation

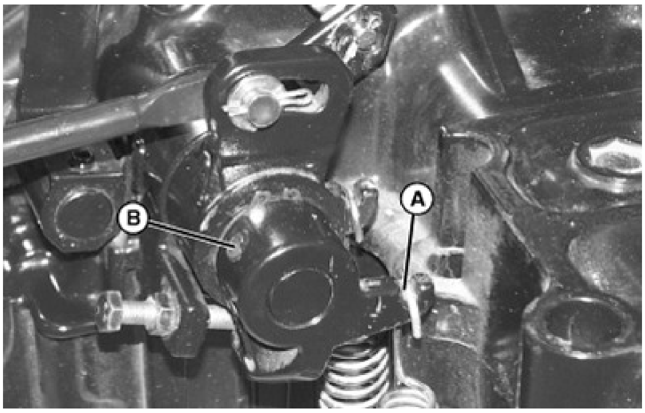
Removal:

[1] - Block front wheels and release park brake.

[2] - Remove left rear wheel. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[3] - Remove left fender.

[4] -



LEGEND:

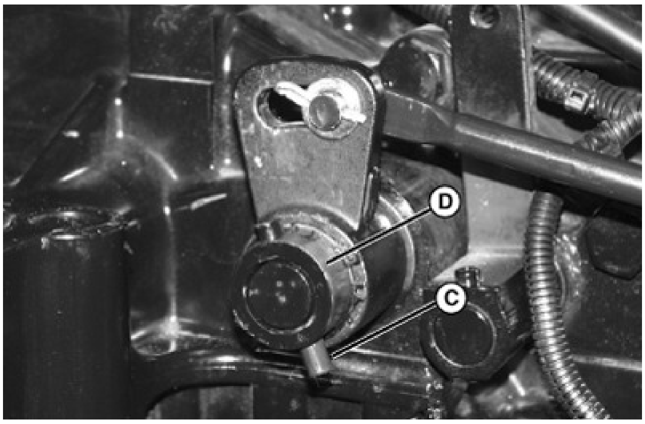
A	Brake Spring
B	Roll Pin

Brake Spring

Disconnect brake spring (A).

[5] - Remove roll pin (B) and park brake bell crank.

[6] -



LEGEND:

C	Roll Pin
D	Collar

Collar

Remove roll pin (C) and collar (D).

[7] - Remove brake shaft from differential case.

[8] - Inspect all parts for wear or damage. Replace any worn or damaged parts.

[9] -

LEGEND:

E	O-rings

Brake Shaft O-rings

Replace O-rings (E) on shaft.

Installation:

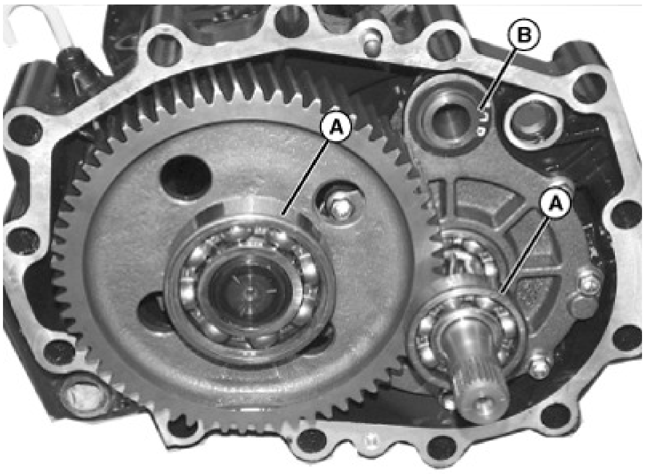
Install parts in reverse order using the following special instructions:

- Grease brake shaft
- Adjust park brake.
- Tighten wheel bolts to specification.

Item	Measurement	Specification
Wheel Bolts	Torque	140 N·m (103 lb.-ft.)

Brake Disassembly and Inspection

[1] -



LEGEND:

A	Bearings
B	Snap Ring

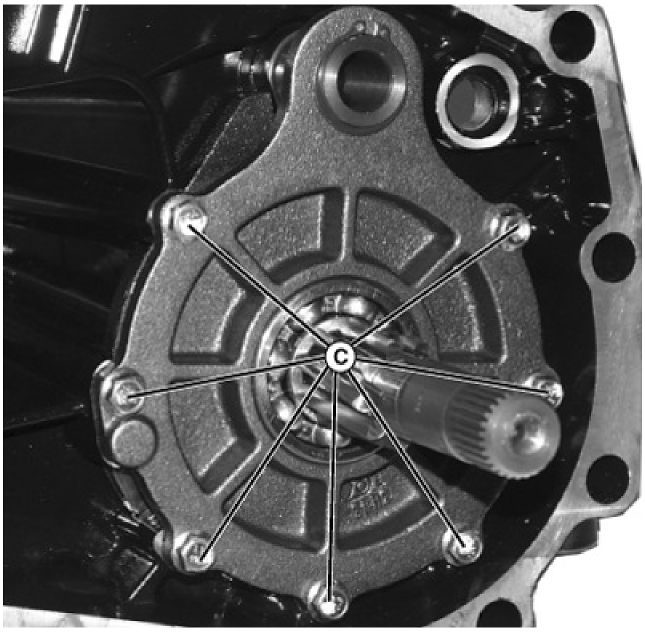
Final Drive Gear

Remove final drive. (See Final Drive Removal in Section 70, Group 40.)

[2] - Remove bearings (A) and final drive gear.

[3] - Remove snap ring (B).

[4] -



LEGEND:

C	Cap Screw (7 used)

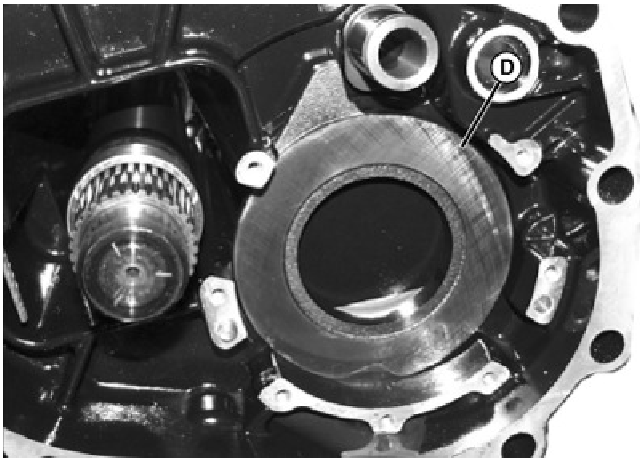
Brake Assembly

Remove seven cap screws (C) and remove brake assembly.

[5] -

→NOTE:

If final drive housing is lying on its side, steel balls may fall out when park brake actuator plate is removed.



LEGEND:

D	Brake Actuator Plate

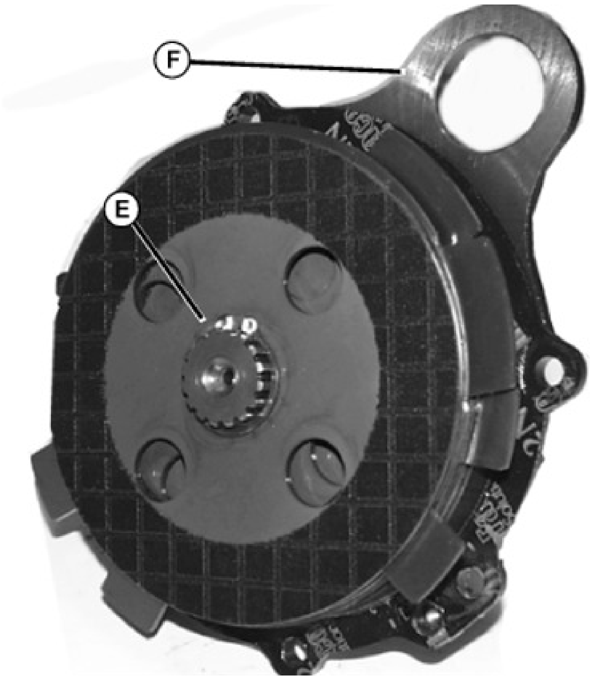
Brake Actuator Plate

Remove brake actuator plate (D). Be careful not to lose any steel balls that may fall out when plate is removed.

[6] - Remove six steel balls from the final drive housing.

[7] - Inspect the steel balls and actuator plate for wear, galling, scratches, or cracking. Replace any worn or damaged parts.

[8] -



LEGEND:

E	Snap Ring
F	Brake Cover

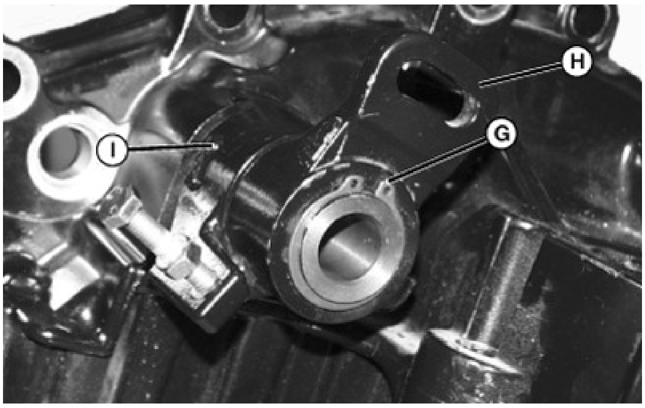
Brake Assembly

Remove snap ring (E). Disassemble brake assembly.

[9] - Remove old gasket from the mounting surfaces of the brake cover (F).

[10] - Inspect all parts for wear or damage. Replace any worn or damaged parts.

[11] -



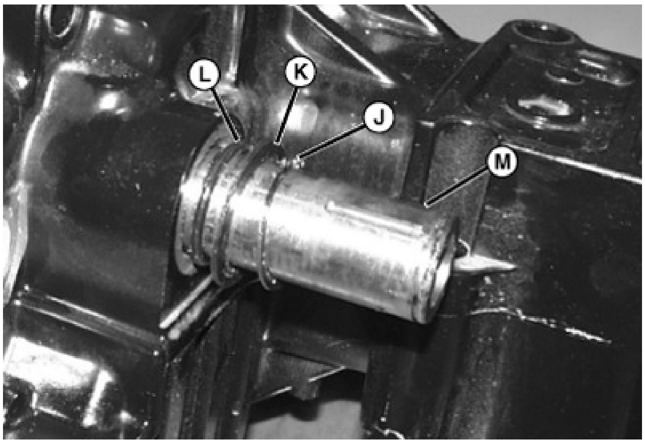
LEGEND:

G	Snap Ring
H	Brake Bell Crank
I	Park Brake Bell Crank

Bell Crank

Remove snap ring (G), brake bell crank (H), park brake bell crank (I), and shaft key.

[12] -



LEGEND:

J	Snap Ring
K	Washer
L	O-Ring
M	Park Brake Actuator Cam

Park Brake Actuator Cam

Remove snap ring (J), washer (K), and O-ring (L).

[13] - Remove the park brake actuator cam (M).

[14] - Inspect the brake actuator cam and final drive housing for wear or damage. Replace any worn or damaged parts.

Brake Assemble

[1] - Install brake actuator cam into final drive housing. Replace O-ring and retain with washer and snap ring.

[2] - Install park brake bell crank, shaft key, and brake bell crank on brake actuator cam.

[3] - Dip the six steel balls in transmission oil. Install the balls into the final drive housing.

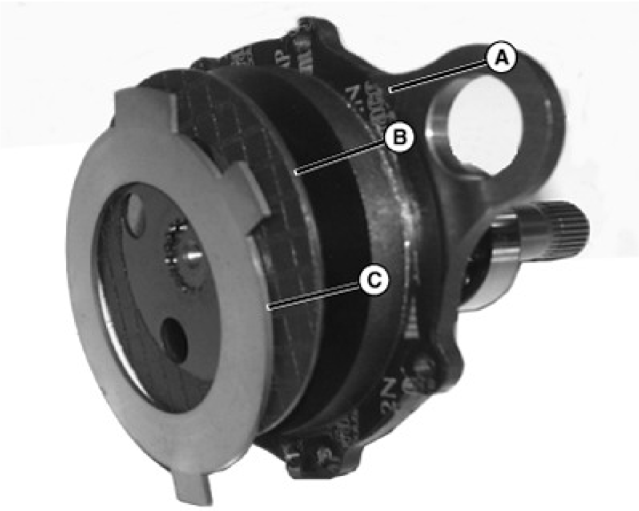
[4] -

→NOTE:

Be certain the steel balls locate into the ramps of the actuator.

Dip the brake actuator plate in transmission oil. Install the plate into the final drive housing. Be certain that steel balls locate into the ramps of the plate.

[5] -



LEGEND:

A	Gasket
B	Friction Disc (3 used)
C	Friction Plate (2 used)

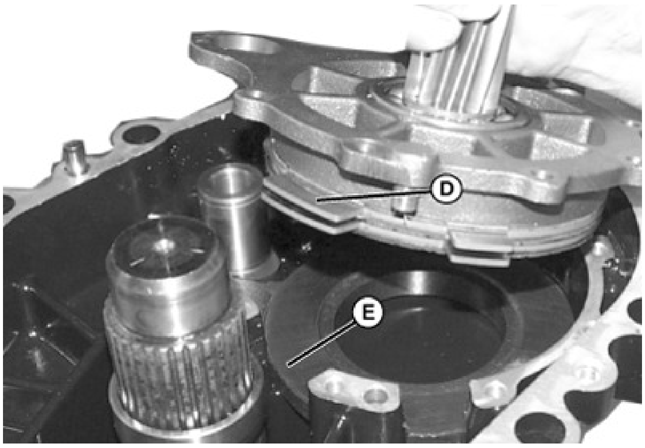
Friction Disc and Friction Plate

Install new gasket (A) on to the brake cover.

[6] - Dip the friction plates and the friction disks in transmission oil. Install friction disk (B) first, then install friction plate (C). Alternate disks and plates, ending with a disk.

[7] - Secure disks and plates with snap ring.

[8] -



LEGEND:

D	Aligning Tab
E	Slot

Brake Assembly

Install brake assembly into final drive housing by aligning tab (D) with slot (E).

[9] - Secure using cap screws.

[10] - Tighten cap screws to specification.

Item	Measurement	Specification
Brake Assembly Cap Screw Torque	Torque	28 N·m (21 lb.-ft.)

[11] - Install washer and snap ring on brake actuator cam.

[12] - Install final drive gear.

[13] - Install bearings on axle shaft and pinion shaft.

[14] - Install final drive to transmission case.

[15] - Adjust brake pedals. See Brake Pedal Adjustment—eHydro Transmission or Brake Pedal Adjustment—PowrReverser Transmission .

Section 110 - HVAC

Table of contents

Group 05 - Specifications

Air Conditioner Specifications

Item	Measurement	Specification
Refrigerant:		
Type		R-134a
Capacity of System (approximate)		1.27 kg (2.8 lb.) (2 lb. 12 oz.)
Torque:		
Hub-to-Pulley Clearance	Clearance	0.35—0.65 mm (0.014—0.026 in.)
Clutch Hub Retaining Cap Screw	Torque	14 N·m (124 lb.-in.)
Condenser Outlet Line	Torque	14—20 N·m (124—177 lb.-in.)
Condenser Inlet Line	Torque	33—39 N·m (24—29 lb.-ft.)
Compressor Discharge Line	Torque	33—39 N·m (24—29 lb.-ft.)
Compressor Suction Line	Torque	35—42 N·m (25—31 lb.-ft.)
Compressor Relief Valve	Torque	12—16 N·m (106—142 lb.-in.)
Manifold Cap Screw	Torque	26 N·m (19 lb.-ft.)
Air Conditioning Receiver/Dryer Cap Screw	Torque	14—20 N·m (124—177 lb.-in.)
Receiver/Dryer Lines	Torque	14—20 N·m (124—177 lb.-in.)

Group 10 - Tools and Materials

Service Equipment and Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Adaptor, 7/8-18 M O-ring Tube x 7/16-20 M45

JT02099

Used to check for refrigerant oil leaks.

Cap, 7/16-20 F 45

JT03194

Used to restrict discharge of refrigerant oil.

Adaptor, 3/4-18 M O-ring Tube x 7/16-20 M45

JT02100

Used to check for refrigerant oil leaks.

Electronic Leak Detector

JT02081

Used to detect refrigerant oil leaks.

Air Conditioning R-12/R-134a Fitting Kit

JT02098

Used to test evaporator/heater core for leaks.

Test Block

JT02106

Used to test evaporator/heater core for leaks.

Plate

JT02123

Used to test evaporator/heater core for leaks.

Plate

JT02124

Used to test evaporator/heater core for leaks.

Screw

JT02125

Used to test evaporator/heater core for leaks.

Screw

JT02126

Used to test evaporator/heater core for leaks.

Adapter

JT02103

Used to test evaporator/heater core for leaks.

Adapter

JT02105

Used to test evaporator/heater core for leaks.

Cap

JT03194

Used to test evaporator/heater core for leaks.

R-134a Refrigerant Recovery and Recycling Station

JT02050

Used to recover/recycle air conditioning refrigerant.

HFC134a Refrigerant Charging Station

JT02046

Used to recover/recycle air conditioning refrigerant.

R-134a Refrigerant Recovery, Recycling, and Charging Station

JT02047

Used to recover/recycle air conditioning refrigerant.

Enviro-Charge Plus

JT02168

Used to recover/recycle air conditioning refrigerant.

Other Material

Number	Name	Use
• (us)	GENESOLV 2004™ Solvent	Used to flush air conditioning system.
• JT02077 (U.S.) (us)	ART338 A/C Flushing Solvent	Used to flush air conditioning system.
• (us)	Naphtha 673 Parts Solvent	Used to flush air conditioning system.
• TY15949 (12 oz) (U.S.), TY15951 (30 lb) (U.S.) (us)	Refrigerant R-134a	Used to charge the air conditioning.
• TY22025 (us)	Low Viscosity (ISO 40) R134A PAG Oil	Used to lubricate O-rings, gaskets, and lip seal during assembly of compressor.

Service Parts Kits

The following kits are available through your parts catalog:

- Compressor Shaft Seal Kit
- Compressor Clutch Hub and Pulley Kit
- Compressor Clutch Coil Kit
- Compressor Hardware Kit

Group 15 - General Information

System Information

Flushing

Flushing the system or a component is a cleaning process using a liquid solvent to wash out oil and debris. Purging is always necessary after flushing to remove solvent from the system or component.

Purging

Purging the system or a component is a cleaning process using a gas to force liquid from the system. Purging alone will not force refrigerant oil out of the system.

Evacuating

Evacuating the system is a process to draw air and moisture from the system with a vacuum.

When to Flush an Air Conditioning System

- The compressor has an internal failure.
- No oil remains in used compressor.
- Oil drained from compressor appears or smells overheated.
- System was contaminated with a mixture of refrigerant oils.
- System was left open to the atmosphere long enough for dirt, moisture, or debris to enter the tubing or components.
- System has an internal blockage.

When to Purge an Air Conditioning System

- After flushing system with solvent, to prevent oil dilution.
- System was contaminated with nitrogen or two refrigerants.
- System was left open to the atmosphere and flushing could not be performed.
- A repair required installation of new lines, condenser, or evaporator.

Solvents

The following three solvents are recommended for flushing air conditioning systems. Each adequately dissolves oil and sludge but at a different rate. Use only solvents with an equivalent MSDS.

- GENESOLV 2004 ™ Solvent

Number	Name	Use
◦ (us)	GENESOLV 2004™ Solvent	Used to flush air conditioning system.

- ART338 A/C Flushing Solvent

Number	Name	Use
◦ JT02077 (U.S.) (us)	ART338 A/C Flushing Solvent	Used to flush air conditioning system.

- Naphtha 673 Parts Solvent

Number	Name	Use
◦ (us)	Naphtha 673 Parts Solvent	Used to flush air conditioning system.

Refrigerant Oil Information

CAUTION:

Avoid Injury! New compressors are charged with a mixture of nitrogen, R-134a Refrigerant, and TY22025 (R-134a) Refrigerant Oil. Wear safety goggles and discharge compressor slowly to avoid possible injury.

New compressors contain 60 mL (2 fl oz) of new oil.

The normal operating oil level of a compressor is 174 mL (6 fl oz).

Item	Measurement	Specification
Compressor Oil	Capacity	174 mL (6 fl oz)

Determine Correct Refrigerant Oil Charge

Procedure

IMPORTANT:

Avoid Damage! Use care in checking and adding oil. Too much oil will reduce cooling capacity. Too little oil will result in poor lubrication of the compressor, leading to early failure.

→NOTE:

Determine amount of oil charge for system prior to installation of compressor.

[1] - Compressors are divided into three categories when determining correct oil charge:

a. New compressor.
b. Used compressor, not flushed.
c. Used compressor, flushed.

[2] - If complete system, lines, and components were flushed, add correct amount of oil:

IMPORTANT:
During initial startup allow compressor to idel for at least 3 minutes to insure proper break in.

New compressor contains 60 mL (2 fl oz). Add 112 mL (4 oz.) to new compressor.

b. Used compressor (drained)- Not flushed, add 210 mL (7.1 fl oz) of new oil.- Flushed, add 230 +15/-0 mL (7.7—8.2 fl oz) of new oil.

[3] - If complete system was not flushed, add correct amount of oil for compressor, plus amount of oil for each component serviced:

a. New compressor contains 230 +15/-0 mL (7.7—8.2 fl oz) of new oil. Connect battery to clutch coil and rotate drive shaft to remove all oil. Return 25 mL (0.85 fl oz) of oil to compressor.
b. Used compressor (drained)- Not flushed, add 40 mL (1.4 fl oz) of new oil.- Flushed, add 60 mL (2.0 fl oz) of new oil.

Remove compressor to determine correct oil charge if any components have been removed, drained, and flushed.

→NOTE:

If the complete system was purged with all components in place, the amount of oil lost is negligible.

Use the following chart as a guide for adding oil:

→NOTE:

Hoses = 2 mL per 30 cm (0.06 fl oz per ft). Approximate total length equals 600 cm (20 ft).

Refrigerant Oil Charge Volume Chart

Component	Oil Charge
Evaporator	60 mL (2.0 fl oz)
Condenser	60 mL (2.0 fl oz)
Receiver/Dryer	15 mL (0.5 fl oz)
Compressor	60 mL (2.0 fl oz)
Hoses	50 mL (1.7 fl oz)

IMPORTANT:

Avoid Damage! DO NOT leave the system or R-134a compressor oil containers open. Oil easily absorbs moisture. DO NOT spill R-134a compressor oil on acrylic or ABS plastic. Oil will deteriorate these materials rapidly. Identify R-134a oil containers and measures to eliminate accidental mixing of different oils.

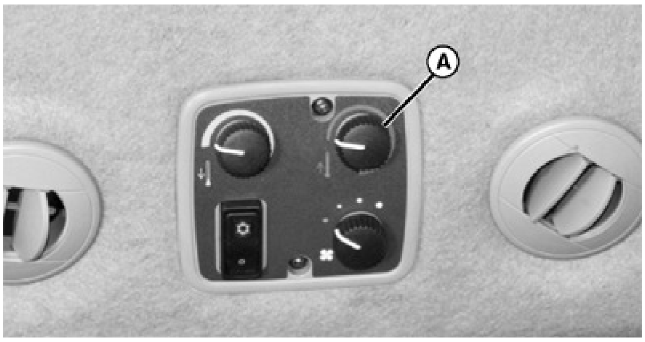
If any section of hose is removed and flushed or replaced, measure length of hose and use the formula to determine correct amount of oil to be added.

Group 20 - Tests and Adjustments

Heater Temperature Control Cable Adjustment

Procedure

[1] -



LEGEND:
A Heater Temperature Control Knob

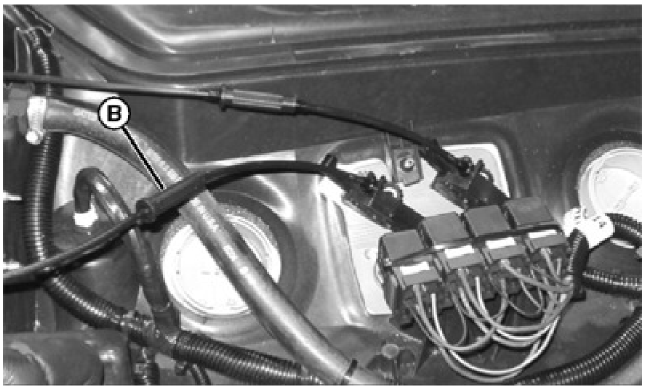
Climate Control Panel

Turn the heater temperature control knob (A) (CW) to full heat position.

[2] -

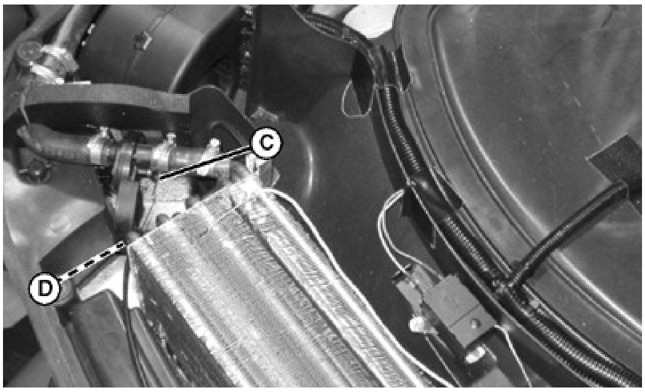
→NOTE:

Heater cable adjuster is located under the cab outer roof on the right side of machine. Remove outer roof for adjustment.



LEGEND:
B Cable Adjuster
C Full Open Position
D Retainer Clip

Cable Adjuster



Heater Valve Arm

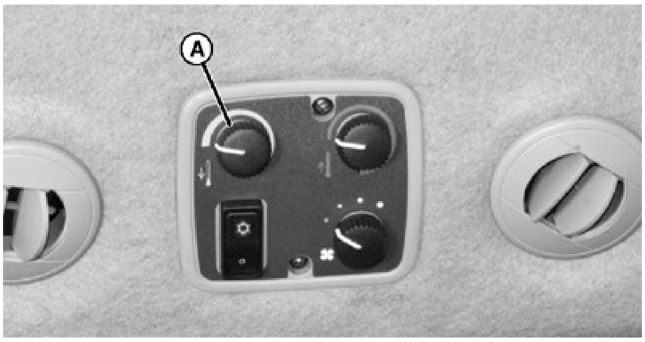
Adjust cable adjuster (B) until the heater valve arm is in the full open position (C).

[3] - Turn the heater temperature control knob to OFF (CCW). Heater valve arm should be in the full closed position. Adjust cable position with retainer clip (D), as required, and readjust cable with adjuster (B).

Air Conditioner Temperature Control Switch Cable Adjustment

Procedure

[1] -



LEGEND:
A Air Conditioner Temperature Control Knob

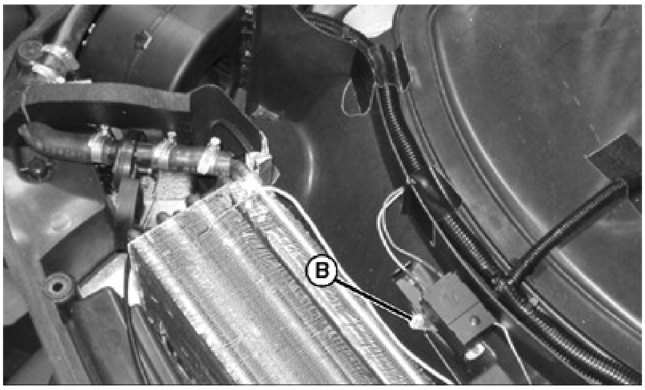
Temperature Control Knob

Turn the air conditioner temperature control knob (A) (CCW) to full cool position.

[2] -

→NOTE:

The air conditioner temperature control switch cable adjuster is located under the cab outer roof on the right side of machine. Remove outer roof for adjustment.



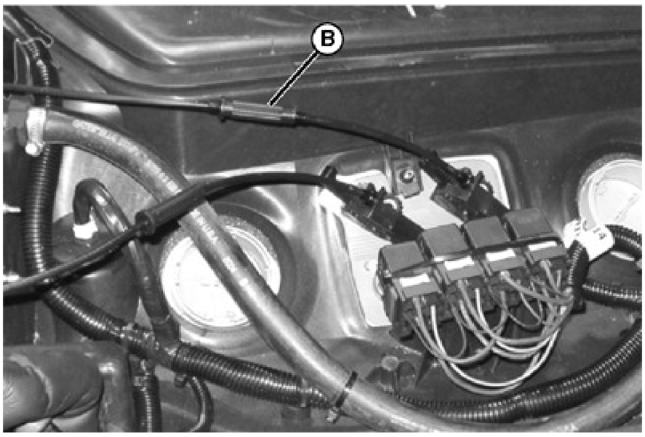
LEGEND:
B Set Screw

Temperature Control Switch Arm

Loosen set screw (B) and move the air conditioner temperature control switch arm to the full open position (shown). Tighten set screw.

[3] - Turn the air conditioner temperature control knob to OFF (CW). Air conditioner temperature control switch arm should be in the full closed position. Adjust arm as required.

[4] -



LEGEND:
B Cable Adjuster

Cable Adjuster

Adjust cable adjuster (B) until the heater valve arm is in the full open position.

Compressor Shaft Seal Leakage Test

Procedure

[1] - Remove front plate from compressor pulley.

[2] -

IMPORTANT:

Avoid Damage! Do not lose inner clutch hub shims.

Remove clutch hub and screw.

[3] - Install JT02099 Adapter in suction port and JT02100 Adapter in discharge port. Cap discharge port adapter using JT03194.

Adaptor, 7/8-18 M O-ring Tube x 7/16-20 M45

JT02099

Used to check for refrigerant oil leaks.

Adaptor, 3/4-18 M O-ring Tube x 7/16-20 M45

JT02100

Used to check for refrigerant oil leaks.

Cap, 7/16-20 F 45

JT03194.

Used to restrict discharge of refrigerant oil.

[4] - Connect gauge set and/or container of R-134a Refrigerant to suction port of compressor as shown in photo.

Number	Name	Use
• TY15949 (12 oz) (U.S.), TY15951 (30 lb) (U.S.) (us)	Refrigerant R-134a	Used to charge the air conditioning.

[5] - Open valves to pressurize compressor.

[6] -

IMPORTANT:

Avoid Damage! Do not exceed range of low pressure gauge.

Check the following for leaks using JT02081 Electronic Leak Detector or 50-50 mix of soap and water:

Electronic Leak Detector

JT02081

Used to detect refrigerant oil leaks.

a. Shaft seal
b. Manifold seal
c. Housing seals at front, rear, and midsection of compressor body
d. Relief valve
e. Suction coupler Schrader ™ valve

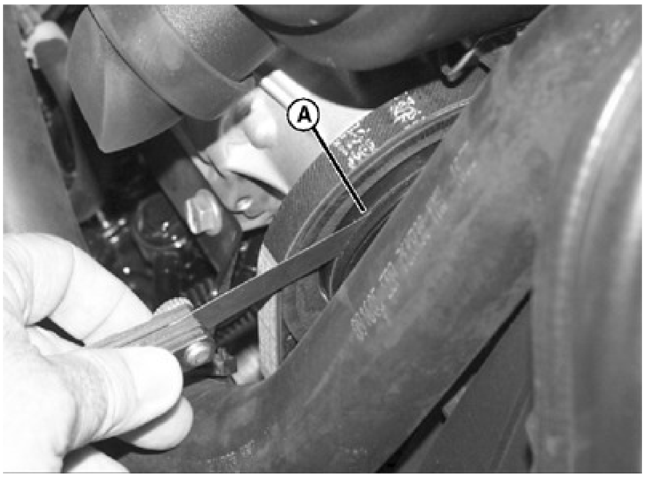
[7] - Leakage should not exist. Repair compressor, if necessary, and repeat test.

[8] - Assemble compressor and add required oil. (See Determine Correct Refrigerant Oil Charge in Section 110, Group 15.)

Compressor Clutch Hub Clearance Check

Procedure

[1] -



LEGEND:
A Clutch Hub

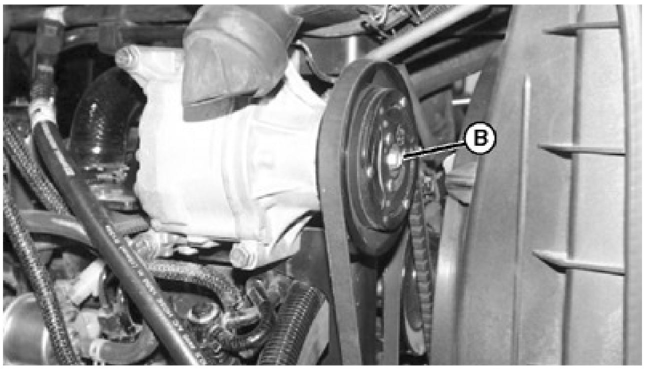
Compressor Clutch Hub

Measure the clearance between pulley and clutch hub (A) using a feeler gauge.

[2] - Rotate the clutch and check the clearance in three equally spaced locations around the clutch hub.

Item	Measurement	Specification
Hub-to-Pulley	Clearance	0.35—0.65 mm (0.014—0.026 in.)

[3] -



LEGEND:
B Cap Screw

Clutch

Compare measurements with specification. If clearance is not correct, remove bolt (B) and slide clutch off compressor shaft. There are shims between the clutch hub and the compressor shaft. Add shims to increase clearance, remove shims to decrease clearance.

[4] - When clearance is correct, install clutch hub retaining cap screw and tighten to specification.

Item	Measurement	Specification
Clutch Hub Retaining Cap Screw	Torque	14 N·m (124 lb.-in.)

Evaporator/Heater Core Leak Test

Equipment

- JT02098 Air Conditioning R12/R134a Fitting Kit
- JT02106 Test Block
- JT02124 Plate
- JT02123 Plate
- JT02126 Screws
- JT02125 Screws
- JT02105 Adapter
- JT02103 Adapter
- JT03194 Cap

Procedure

[1] - Using JT02098 Air Conditioning R12/R134a Fitting Kit, install JT02106 Test Block using JT02124 and JT02123 Plates, JT02126 and JT02125 Screws, and JT02105 and JT02103 Adapters. Cap one adapter with JT03194. Connect shop air to other adapter.

Air Conditioning R12/R134a Fitting Kit

JT02098

Used to test evaporator/heater core for leaks.

Test Block

JT02106

Used to test evaporator/heater core for leaks.

Plate

JT02123

Used to test evaporator/heater core for leaks.

Plate

JT02124

Used to test evaporator/heater core for leaks.

Screw

JT02125

Used to test evaporator/heater core for leaks.

Screw

JT02126

Used to test evaporator/heater core for leaks.

Adapter

JT02103

Used to test evaporator/heater core for leaks.

Adapter

JT02105

Used to test evaporator/heater core for leaks.JT03194.

Cap

JT03194

Used to test evaporator/heater core for leaks.

[2] - Apply shop air pressure and spray surface using 50-50 mixture of liquid soap and water to check for leaks.

[3] -

→NOTE:

Minor leaks may be repaired, but evaporator heater core should be replaced if there is a major leak or restriction.

Repair or replace evaporator/heater core as required.

Compressor Oil Charge Check

Procedure

[1] - Remove compressor.

[2] - Remove manifold caps and drain oil. Record amount.

[3] -

→NOTE:

Save oil if compressor is new.

If MORE than 6 mL (0.2 fl. oz.) of oil was drained and appears normal, or if any other components were replaced or flushed see Determine Correct Refrigerant Oil Charge in Section 110, Group 15.

[4] - If LESS than 6 mL (0.2 fl. oz.) of oil was drained or appears black:

a. Perform a volumetric efficiency test on compressor to determine serviceable condition. Flush with solvent to internally wash out oil if compressor is serviceable.
b. Remove, clean, and bench test expansion valve, but do not disassemble valve.
c. Remove and discard receiver/dryer.
d. Install a new receiver/dryer.
e. Flush complete system.
f. Install required oil. (See Determine Correct Refrigerant Oil Charge in Section 110, Group 15.)
g. Connect all components.

Item	Measurement	Specification
Condenser Outlet Line	Torque	14—20 N·m (124—177 lb.-in.)
Condenser Inlet Line	Torque	33—39 N·m (24—29 lb.-ft.)
Compressor Discharge Line	Torque	33—39 N·m (24—29 lb.-ft.)
Compressor Suction Line	Torque	35—42 N·m (25—31 lb.-ft.)
Compressor Relief Valve	Torque	12—16 N·m (106—142 lb.-in.)
Manifold Cap Screw	Torque	26 N·m (19 lb.-ft.)

h. Purge, evacuate, and charge system.

Add Refrigerant Oil to System

Procedure

IMPORTANT:

Avoid Damage! Use only TY22025 (R-134a) refrigerant oil.

→NOTE:

Some oil may have to be added through compressor line and fitting.

[1] - Add approximately 170 mL (5.6 fl. oz.) of R-134a refrigerant oil through compressor suction port and 85 mL (2.9 fl. oz.) into discharge port when system has been completely flushed. (See Determine Correct Refrigerant Oil Charge in Section 110, Group 15.)

Number	Name	Use
• TY22025 (us)	Low Viscosity (ISO 40) R134A PAG Oil	Used to lubricate O-rings, gaskets, and lip seal during assembly of compressor.

[2] - Install manifold to compressor, if removed. Tighten cap screws to specification.

Item	Measurement	Specification
Manifold Cap Screw	Torque	26 N·m (19 lb.-ft.)

Recover/Recycle Refrigerant

Operate the air conditioning system for 10 minutes with engine at high idle if the compressor is operable. Set temperature control for maximum cooling and set blower switch at high. This allows the refrigerant oil to be circulated throughout the system and indicates the quantity of oil in the compressor.

Stop the engine and use the following procedure to recover and recycle the refrigerant.

IMPORTANT:

Avoid Damage! Use only R-314a refrigerant, recycling, and charging machines. Do not mix R-134a equipment, refrigerant, and refrigerant oils with R-12 systems to prevent compressor damage.

[1] -

→NOTE:

JT02047 R-134a refrigerant recovery, recycling, and charging station can be substituted for the JT02046 and JT02050. JT02168 Enviro-Charge Plus can be substituted for all recover, recycling, and recharging stations.

Connect JT02050 R-134a refrigerant recovery and recycling equipment to a JT02046 HFC134a refrigerant charging station.

R-134a Refrigerant Recovery and Recycling Station

JT02050

Used to recover/recycle air conditioning refrigerant.

HFC134a Refrigerant Charging Station

JT02046

Used to recover/recycle air conditioning refrigerant.

R-134a Refrigerant Recovery, Recycling, and Charging Station

JT02047

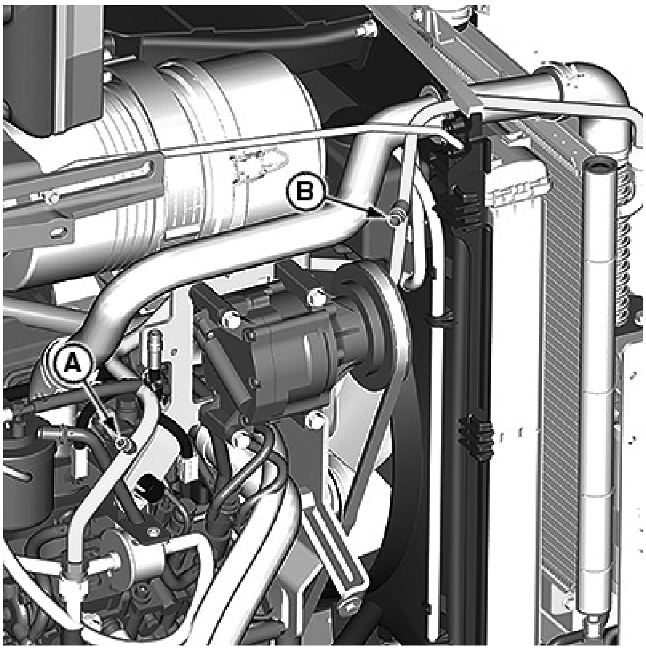
Used to recover/recycle air conditioning refrigerant.

Enviro-Charge Plus

JT02168

Used to recover/recycle air conditioning refrigerant.

[2] -



LEGEND:

A	Suction Line Fitting
B	Discharge Fitting

Air Conditioning Refrigerant Lines

Connect low-side hose (blue) from the charging station to suction line fitting (A). Connect high-side hose (red) to the discharge fitting (B) on the discharge line.

[3] - Follow the manufacturer's instructions and discharge the system. Cap the fittings to prevent contamination from entering the system.

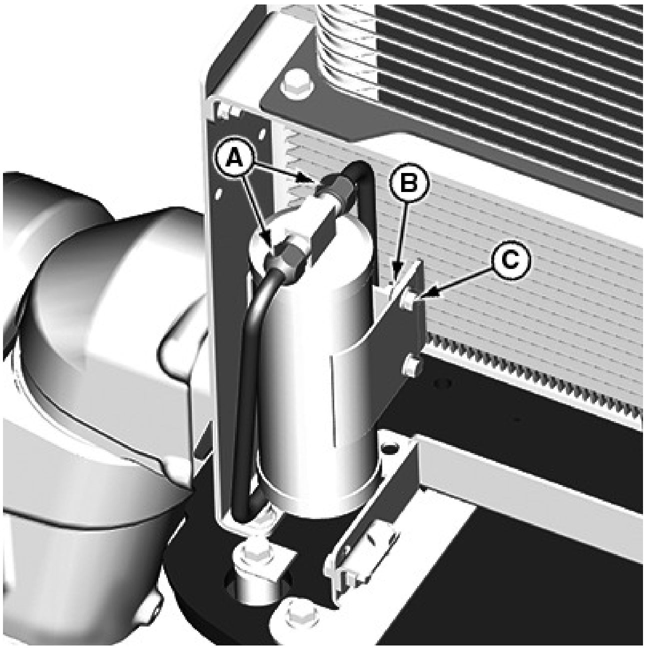
Air Conditioner Receiver/Dryer

The receiver/dryer is not serviceable. If the air conditioning system is discharged for servicing and the receiver/dryer is two years old or older, it should be replaced. If the receiver/dryer is less than two years old it should be replaced if the system was contaminated.

[1] - Recover/recycle air conditioning refrigerant. (See Recover/Recycle Refrigerant in Section 110, Group 20.)

[2] - Disconnect and remove battery. (See Battery Removal and Installation in Section 110, Group 20.)

[3] -



LEGEND:

A	Line
B	Flange Nut (2 used)
C	Cap Screw (2 used)

Receiver/Dryer

Disconnect lines (A) from receiver/dryer.

[4] - Remove cap screws (C), flange nuts (B), and receiver/dryer.

[5] -

IMPORTANT:

Avoid Damage! Receiver/dryer flow direction must be correct for installation. Note flow direction arrow.

→NOTE:

When a new receiver/dryer is installed and there were no leaks found in the system, add 15 ml (0.5 oz.) of R-134a refrigerant oil. If leaks are found in the system, follow procedure for checking and adding refrigerant oil. (See Determine Correct Refrigerant Oil Charge in Section 110, Group 15.)

Install new receiver-dryer and tighten cap screws to specification.

Item	Measurement	Specification
Air Conditioning Receiver/Dryer Cap Screw	Torque	14—20 N·m (124—177 lb.-in.)

[6] - Connect lines to receiver/dryer and tighten to specification.

Item	Measurement	Specification
Receiver/Dryer Line	Torque	14—20 N·m (124—177 lb.-in.)

Section 120 - MISCELLANEOUS

Table of contents

Group 05 - Specifications

Cab Specifications

Item	Measurement	Specification
Specifications		
Cab Door Hinge Mounting Flange Nut	Torque	28 N·m (20 lb.-ft.)
Inner Cab Roof Mounting Cap Screw	Torque	12 N·m (106 lb.-in.)
Cab A/C Line	Torque	45 N·m (33 lb.-ft.)
Cable Sleeve	Torque	6—19 N·m (144—168 lb.-in.)
Cable Nut	Torque	16—19 N·m (144—168 lb.-in.)
Steering Wheel Nut	Torque	39—49 N·m (29—36 lb.-ft.)
Center Link Spring Holder	Torque	50 N·m (37 lb.-ft.)
Front Wheel Lug Bolt	Torque	140 N·m (103 lb.-ft.)
Rear Wheel Lug Bolt	Torque	140 N·m (103 lb.-ft.)
Seat Support Bolt	Torque	20 N·m (177 lb.-in.)
Cab Mounting Screw—M12	Torque	140 N·m (105 lb.-ft.)
Cab Mounting Screw—M16	Torque	310 N·m (229 lb.-ft.)
Center Link Bracket Cap Screw	Torque	90 N·m (66 lb.-ft.)

Essential or Recommended Tools

→NOTE:

Order tools from the SERVICEGARD ™ Catalog.

ESSENTIAL TOOLS listed are required to perform the job correctly and are obtainable only from the SERVICEGARD ™ Catalog.

RECOMMENDED TOOLS, as noted, are suggested to perform the job correctly. Some tools may be available from local suppliers or may be fabricated.

Cab Lift Bar

JDG1580

Used to remove and install cab.

Cab Lifting Bracket Set

JDG2069

Used to remove and install cab.

Other Material

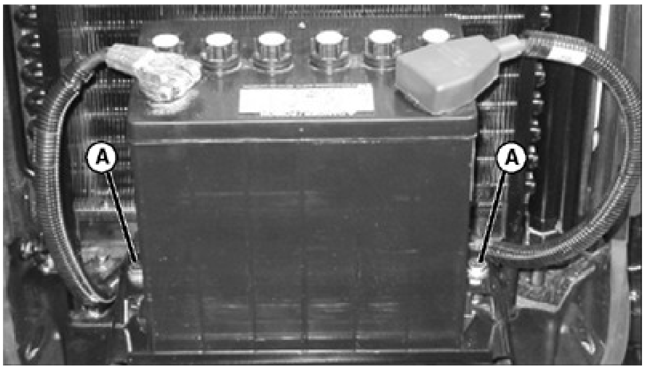
Number	Name	Use
• PM38654 (U.S.) (us)	Thread Lock and Sealer (High Strength)	Apply to threads of SCV cable before adjusting.

Group 10 - Repair

Battery Removal and Installation

Removal:

[1] -



LEGEND:

A	Bolts

Battery

Raise hood.

[2] - Disconnect negative (-) battery cable.

[3] - Disconnect positive (+) battery cable.

[4] - Loosen bolts (A). Remove battery hold down clamps.

[5] - Remove battery.

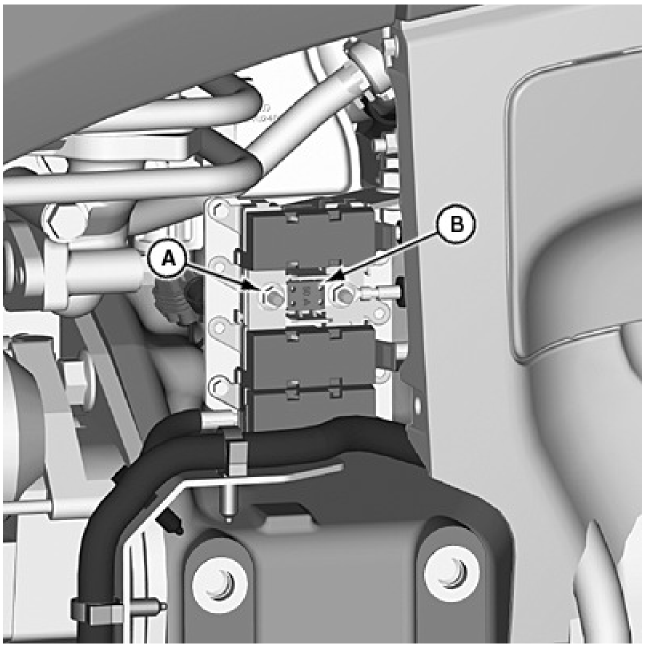
[6] - Install parts in reverse order.

Bus Bar Fuse

[1] - Raise hood and disconnect negative (–) battery cable.

[2] - Remove fuse cover.

[3] -



LEGEND:

A	Flange Nut (2 used)
B	MIDI Fuse

Bus Bar Fuse

Remove two hex flange nuts (A).

[4] -

→NOTE:

See the machine's operator manual for confirming fuse location and size. The fuses are 40A (Glow Plug Relay), 50A (Load Center), and 80A (Alternator).

Remove and replace MIDI fuse (B).

[5] - Install parts in reverse order.

Cab Removal and Installation

Removal:

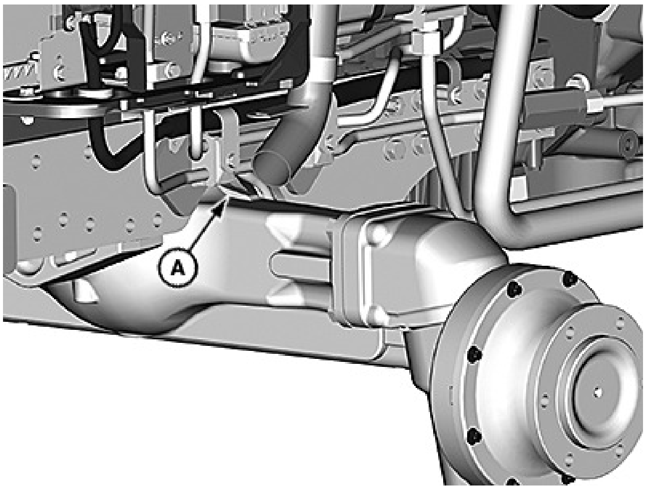
→NOTE:

Close all openings using caps and plugs to prevent contamination. Tag or label all cooling, hydraulic, and HVAC system hoses and lines to aid during installation.

[1] -

CAUTION:

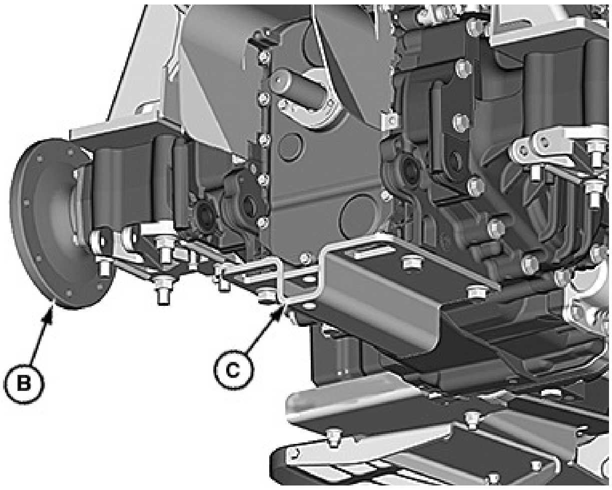
Avoid Injury! Block between the front axle and frame to prevent machine movement when jacking from the rear drawbar.



LEGEND:

A	Block Axle
B	Axle End
C	Drawbar

Block Front Axle



Jack Rear of Machine

Park machine safely. Block front wheels and axle (A).

[2] - Recover/recycle air conditioning refrigerant. (See Recover/Recycle Refrigerant in Section 110, Group 20.)

[3] - Disconnect battery cables, negative (—) cable first.

[4] - Jack rear of machine at drawbar (C) and remove rear wheels.

[5] -

→NOTE:

Do not rest rear axle on ROPS support plates. These will be removed later in the instruction.

Lower machine and rest axle ends (B) on jackstands.

[6] -

CAUTION:

Avoid Injury! Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

→NOTE:

Coolant capacity (full) is approximately 7 L (1.9 gal.). Use suitable container(s). Drain coolant from system after engine has cooled down.

Item	Measurement	Specification
Cooling System	Capacity	7 L (1.9 gal)

Drain coolant from radiator and cooling system.

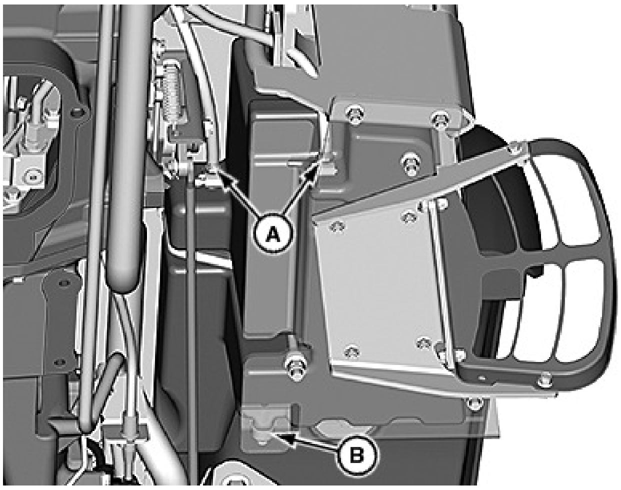
[7] - Locate heater hoses coming from cab and disconnect at engine.

[8] -

→NOTE:

Fuel tank capacity (full) is approximately 44 L (11.8 gal.). Use suitable container(s).

Item	Measurement	Specification
Fuel Tank	Capacity	44 L (11.8 gal)



LEGEND:

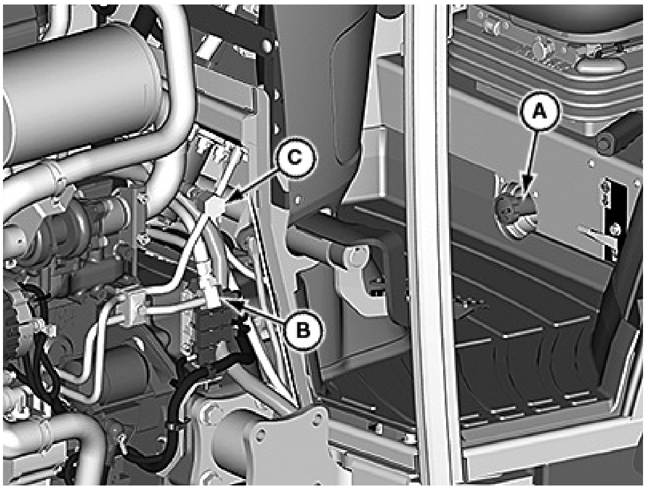
A	Fuel Hose (2 used)
B	Drain Plug

Fuel Tank Shown from Below.

Locate drain plug (B) on bottom rear of fuel tank. Drain tank and disconnect fuel hoses (A).

[9] - Remove cab doors. (See Cab Door Removal and Installation in Section 120, Group 10.)

[10] -



LEGEND:
A Knob
B Steering Pump-to-Steering Control Unit (SCU) Line
C SCU-to-Oil Cooler Line

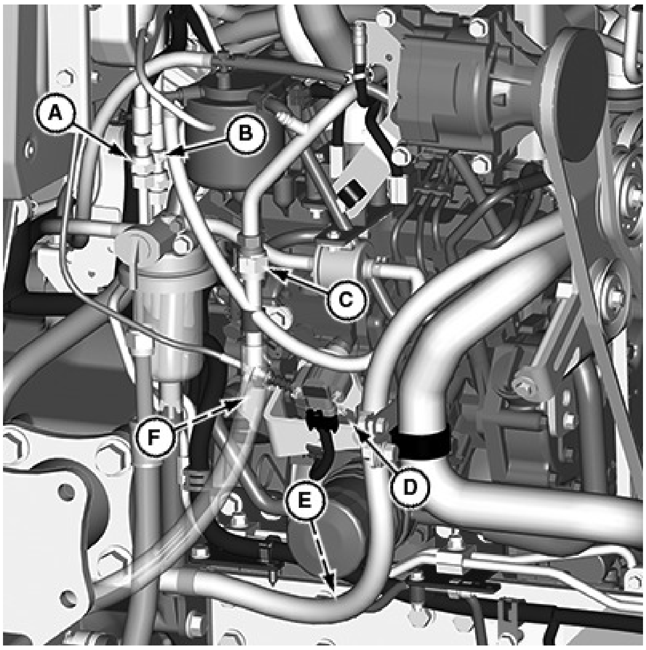
Rate-of-Drop Knob

Loosen set screw and remove rockshaft rate-of-drop knob (A).

[11] - Disconnect steering pump-to-steering control unit (SCU) line (B).

[12] - Disconnect SCU-to-oil cooler line (C).

[13] -



LEGEND:
A SCU-to-Steering Cylinder (Left)
B SCU-to-Steering Cylinder (Right)
C Air Conditioner Evaporator Line
D Throttle Cable
E Air Conditioner Dryer Line
F Bracket

Disconnect Throttle Cable

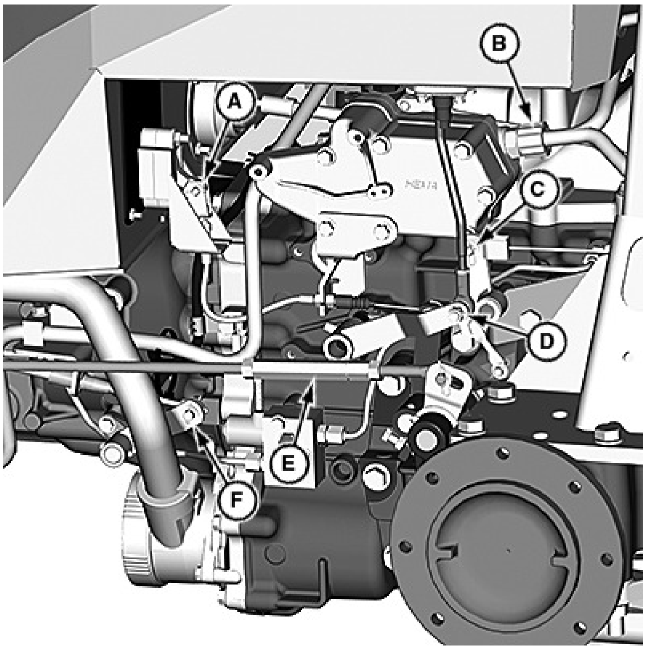
Disconnect SCU-to-steering cylinder lines (A and B).

[14] - Disconnect air conditioner evaporator line (C).

[15] - If machine is equipped with mechanical linkage, disconnect throttle cable (D) from injector pump lever and bracket (F).

[16] - Disconnect air conditioner dryer line (E).

[17] -



LEGEND:

A	Differential Lock Cable
B	Rockshaft Valve Hydraulic Line
C	Park Brake Cable
D	Range Control Lever
E	Left Brake Rod
F	MFWD Shift Cable

Left Hand Linkages

Disconnect differential lock cable (A) from lever and support bracket.

[18] - Disconnect rockshaft valve hydraulic line (B).

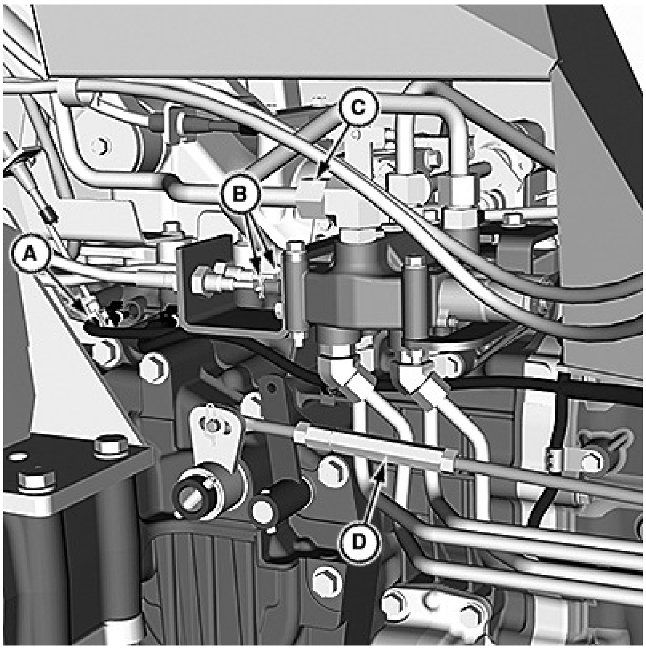
[19] - Disconnect park brake cable (C) from lever and bracket.

[20] - Disconnect range control lever (D).

[21] - Disconnect left brake rod (E) at both ends and remove.

[22] - Disconnect MFWD shift cable (F) from lever and bracket.

[23] -



LEGEND:

A	PTO Selector Cable
B	Spool Control Valve Cable (2 used)
C	Spool Control Valve Hydraulic Line
D	Right Brake Rod

Right Hand Linkages

Disconnect PTO selector cable (A) from lever and bracket.

[24] - Disconnect two spool control valve cables (B) from bracket and SCV.

[25] - Disconnect spool control valve hydraulic line (C).

[26] - Disconnect right brake rod (D) at both ends and remove.

[27] -

Lift Bar

Install JDG1580 lift bar and JDG2069 arms attached to a suitable hoist to cab roof.

Cab Lift Bar

JDG1580

Used to remove and install cab.

Cab Lifting Bracket Set

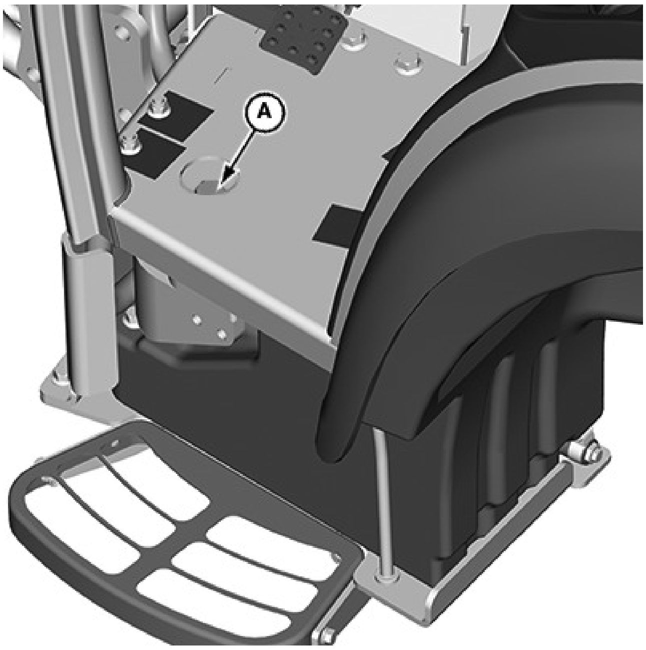
JDG2069

Used to remove and install cab.

[28] -

→NOTE:

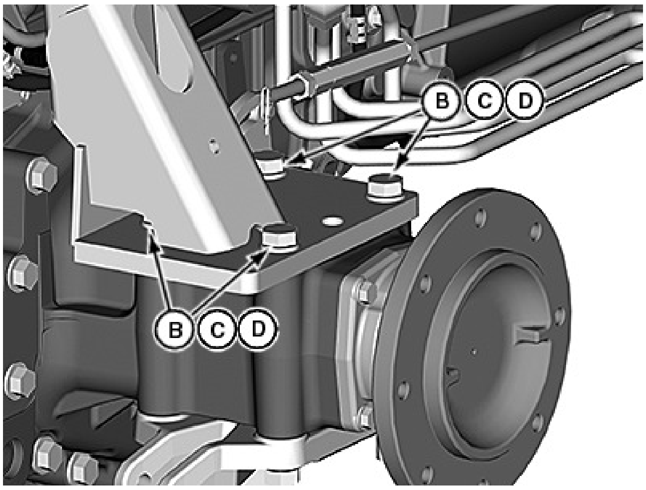
Disconnect sway bar stabilizer from ROPS support plate.



LEGEND:

A	Cap Screw and Nut (2 used)
B	Cap Screw (8 used)
C	Washer (8 used)
D	Nut (8 used)

Front Cab Mounting Hardware



Rear Cab Mounting Hardware

Remove floor mat and front cab mount cap screws and nuts (A).

[29] - Remove four cap screws (B), washers (C), and nuts (D) securing the rear cab structure from each side of the machine.

[30] - Carefully hoist cab. Disconnect any remaining connections from cab to frame.

Check for the following items located near the steering control unit:

a. Cab electrical harness connector.
b. Ground strap(s).
c. Windshield washer supply tube.

Installation:

Installation is done in the reverse order of removal using the following special instructions:

- Tighten mounting cap screws to specification.

Item	Measurement	Specification
Cab Mounting Screw—M16	Torque	310 N·m (229 lb.-ft.)

- Tighten hose fittings to specification. (See Service Recommendations for O-Ring Boss Fittings and Service Recommendations for Flat Face O-Ring Seal Fittings in Section 20, Group 05.)
- Charge A/C system with refrigerant. (See Recover/Recycle Refrigerant in Section 110, Group 20.)
- Apply PM38654 high-strength thread lock and sealer to threads of SCV cable, and install cable.

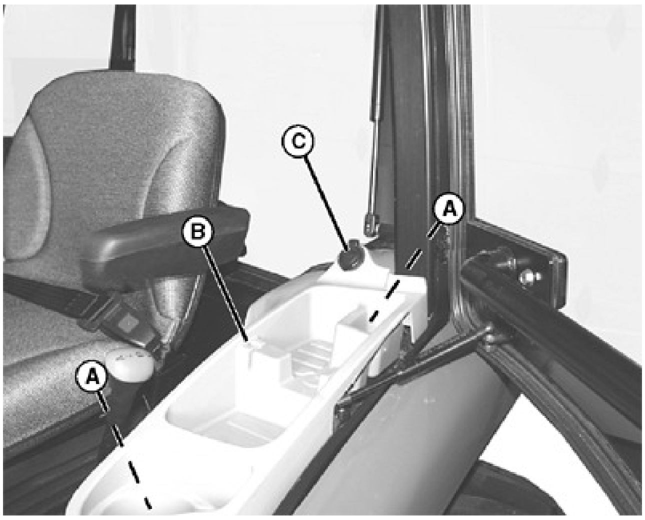
Number	Name	Use
◦ PM38654 (U.S.) (us)	Thread Lock and Sealer (High Strength)	Apply to threads of SCV cable before

- Check and adjust SCV, differential lock, range shift, and MFWD cables as necessary.

Cab Door Removal and Installation

Removal:

[1] -



LEGEND:

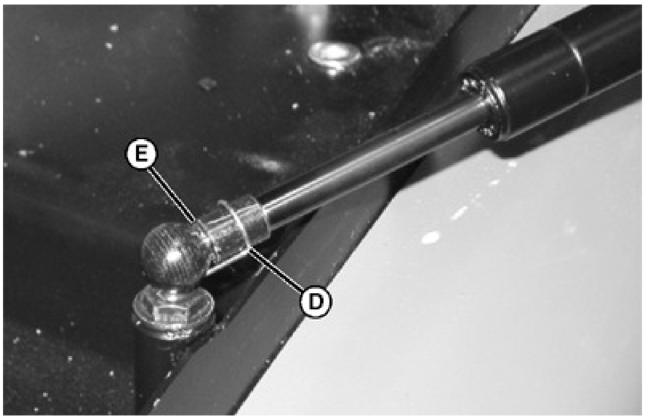
A	Screw (2 used)
B	Control Console
C	Accessory Outlet

Control Console

Remove two screws (A) and control console (B).

[2] - Disconnect wiring harness connector from accessory outlet (C).

[3] -



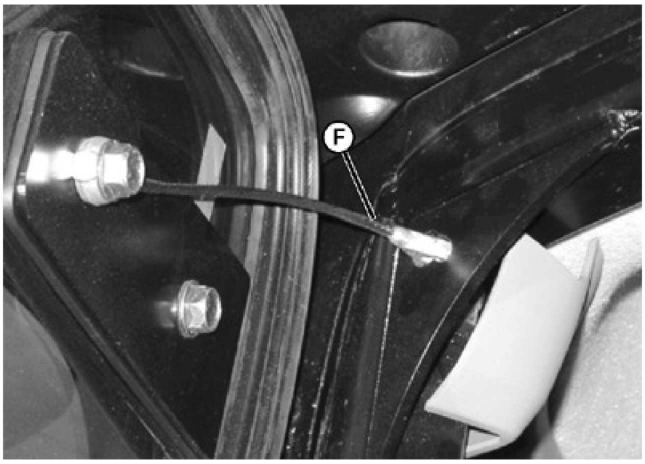
LEGEND:

D	Retaining Pin
E	Lock Groove

Left Door. Retaining pin shown slid out of rod end.

Left side door: Unlock the retaining pin (D) from the lock groove (E) and slide out of rod end.

[4] -



LEGEND:

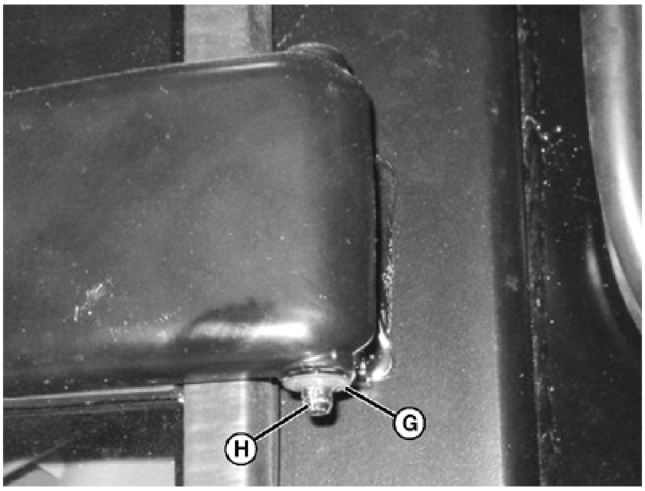
F	Cable

Right Door Travel limit cable shown partial removed.

Right side door: Twist the cable (F) 90° and remove the cable from the door frame.

[5] - Close and latch the door.

[6] -



LEGEND:

G	Push Lock Washer
H	Hinge Pin

Hinge Pin

Remove the push lock washer (G) from each hinge pin and remove the hinge pins (H).

[7] - Unlatch the door and carefully lift the door off the machine.

[8] - Make repairs as necessary.

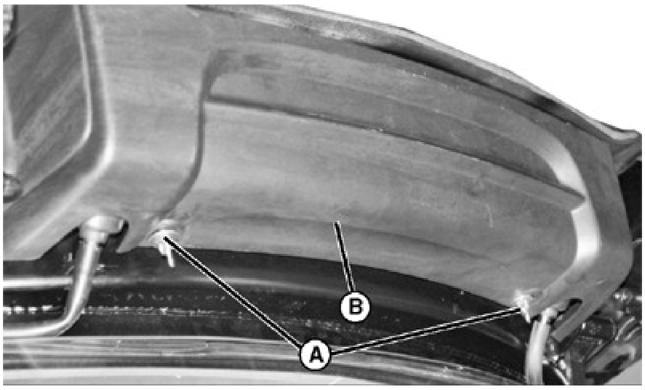
Installation:

Installation is the reverse of removal.

Cab Outer Roof Removal and Installation

Removal:

[1] -



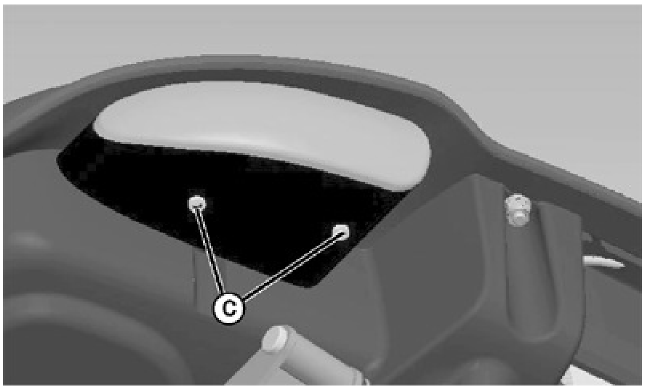
LEGEND:

A	Wing Nut (2 used)
B	Rear Filter Housing

Cab Outer Roof

Remove two wing nuts (A), washers, and rear filter housing (B).

[2] -



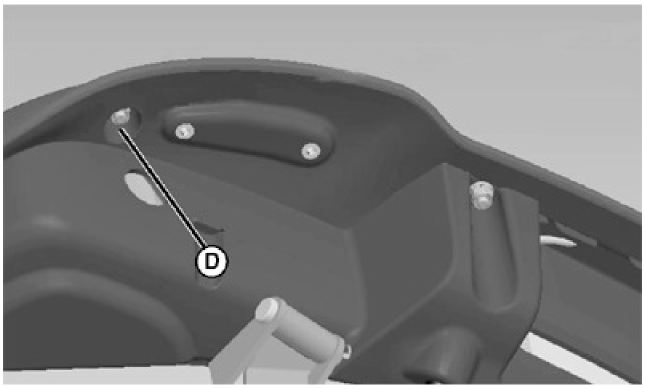
LEGEND:

C	Screw (2 used)

Cab Outer Roof

Remove two screws (C) and remove rear amber lights, rear covers and/or rear work lights on each side.

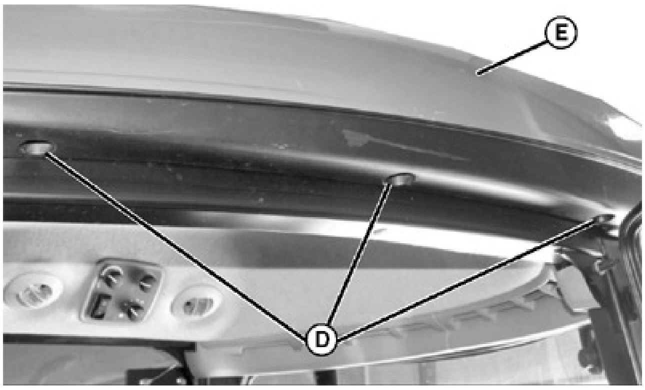
[3] -



LEGEND:

D	Nut (13 used)
E	Top Outer Cab Roof

Cab Outer Roof



Cab Outer Roof

Remove thirteen nuts (D) around outside of cab and lift off top outer cab roof (E).

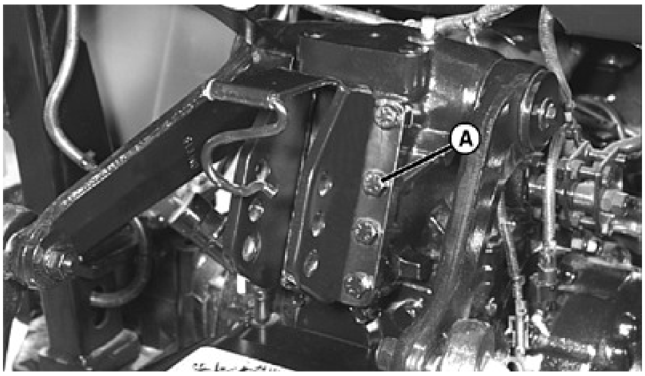
[4] - Repair or replace outer roof as necessary.

Installation:

Installation is the reverse of removal.

Center Link Bracket Removal and Installation

[1] -



LEGEND:

A	Cap Screw (8 used)

Center Link Bracket

Remove eight cap screws (A) and center link bracket.

[2] - Install parts in reverse order using the following special instructions:

- Be sure that dowel pins are properly aligned before tightening cap screws.
- Tighten cap screws on center link bracket to specification.

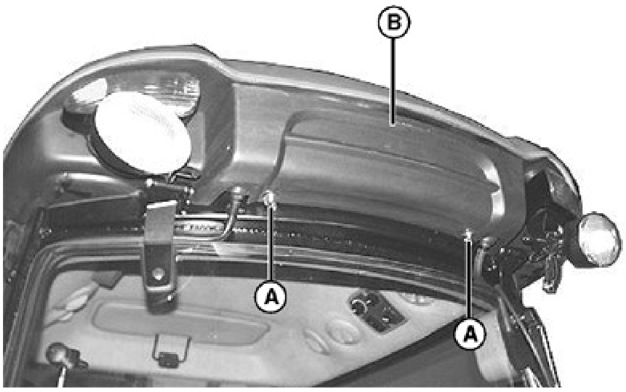
Item	Measurement	Specification
Cap Screw-to-Center Link Bracket	Torque	90 N·m (66 lb.-ft.)

Cleaning Cab Air Filter

[1] -

CAUTION:

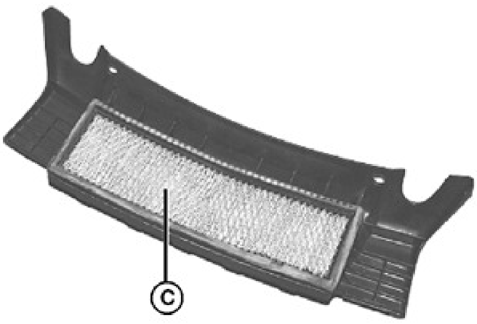
Avoid Injury! Remove any rear implement before servicing cab air filter. Do not stand on 3-point hitch, drawbar hitch or PTO shield.



LEGEND:

A	Wing Bolt (2 used)
B	Filter Base
C	Filter

Filter Base



Filter

Remove two wing bolts (A), washers, and filter base (B).

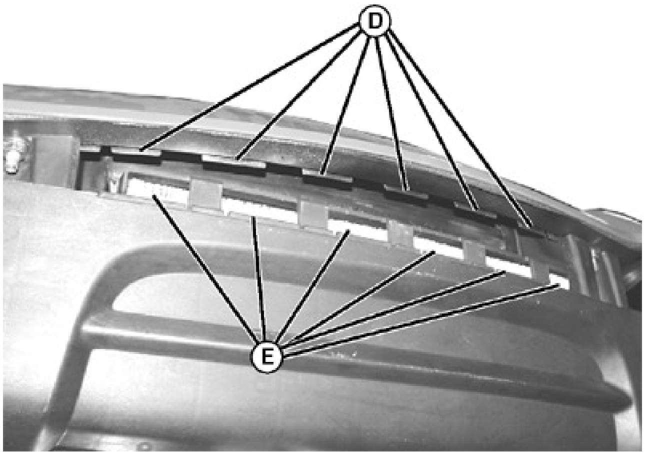
[2] - Remove filter (C) from filter base, and clean with compressed air. Inspect filter for damage. Replace if necessary.

[3] - Install filter back into filter base.

[4] -

IMPORTANT:

Avoid Damage! Be sure the six tabs (D) on the roof panel fit into the slots (E) on filter base.



LEGEND:

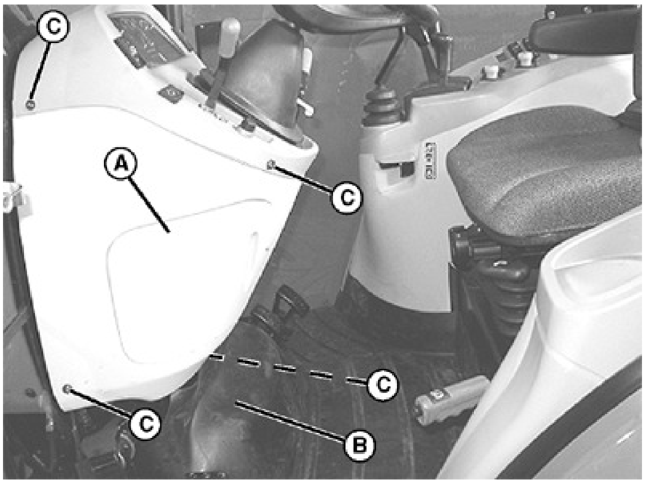
D	Tabs
E	Slots

Rook Panel Slots

Install filter base, making sure six tabs (D) on roof panel are installed into slots (E) in filter base. Secure base assembly back into roof panel with two washers and wing bolts.

Cowl Panel Removal and Installation (Cab)

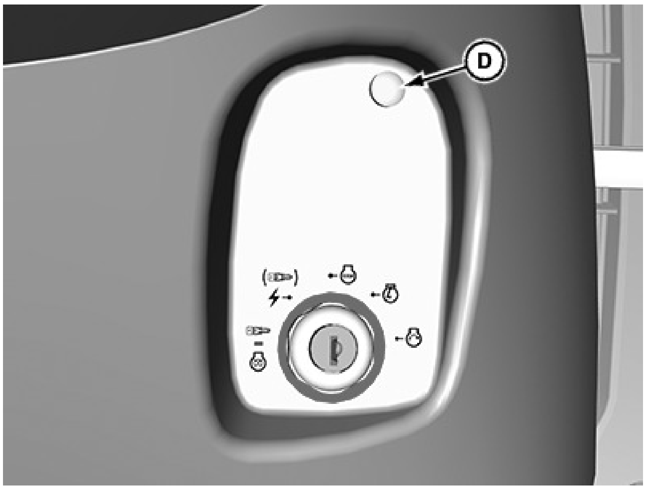
[1] -



LEGEND:

A	Access Cover
B	Floor Mat
C	Hex Head Screw (8 used)
D	Screw

Cowl Panel



Cowl Panel Screw

Pull forward and out to remove access cover (A).

[2] - Move floor mat (B) to gain access to lower hex head screws, and remove four hex head screws (C) on each side of cowl panel.

[3] - Remove hex head screw (D).

[4] - Remove cowl panel and make repairs as necessary.

[5] - Install parts in reverse order of removal.

Cowl Panel Removal and Installation (Open Station)—eHydro Transmission

The control panel and two cowl panels are interlocked when assembled, so all three pieces are involved during removal or installation of an individual component. The key switch is mounted in the left side cowl panel.

Removal:

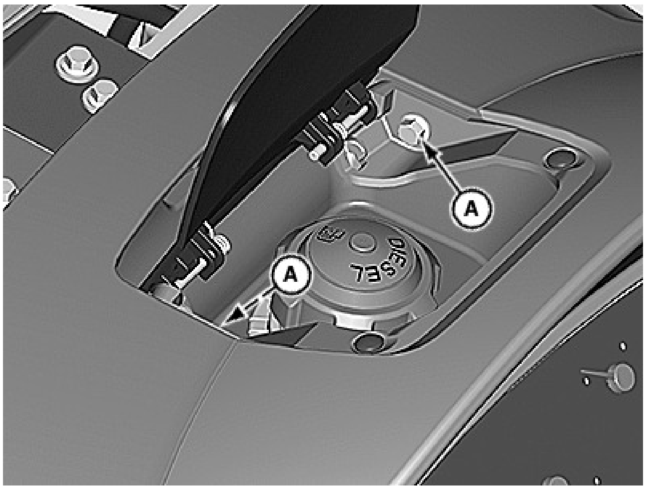
[1] - Disconnect negative (—) battery cable.

[2] - Remove hood and side panel assembly. See Hood Removal and Installation (Cab and Open Station) .

[3] - Pull the engine throttle lever fully rearward to the low idle position.

[4] - Open fuel filler door.

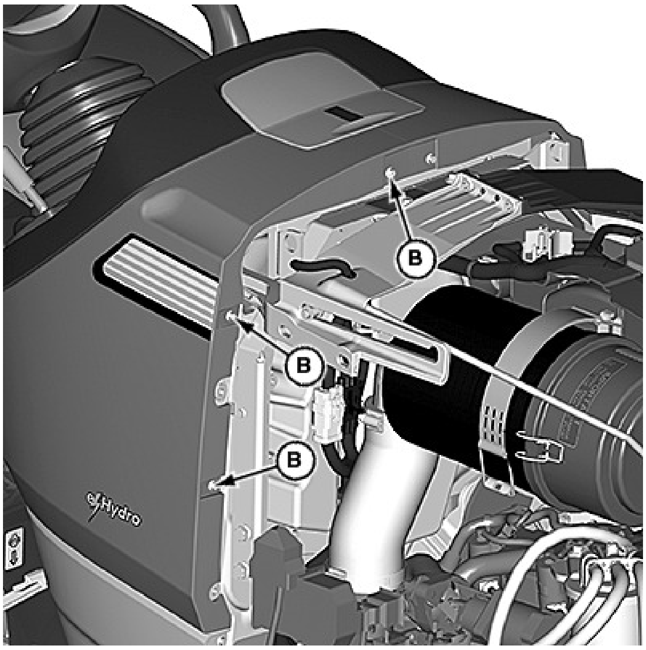
[5] -



LEGEND:

A	Cap Screw (2 used)
B	Cap Screw (6 used)

Fuel Filler Door



Front Cap Screws

Remove two cap screws (A). Do not lose lock nuts located in slots of the fuel bowl support.

[6] - Remove three cap screws (B) on each side of the cowl panel.

[7] -

LEGEND:

A	Steering Wheel
B	Rubber Boot
C	Throttle Knob

Steering Wheel Removal

Remove steering wheel (A), rubber boot (B), and throttle knob (C). See Steering Wheel Removal and Installation.

[8] -

→NOTE:

There are two locking tabs at the inside rear of the control panel. One tab interlocks with each cowl panel, linking the three pieces together. The two cowl panels also have tabs that interlock to each other, and not to the control panel, to aid in assembly and fit.

LEGEND:

A	Control Panel
B	Nut
C	Screw (2 used)

Remove Hardware and Control Panel

Lift control panel (A) and disconnect harness connectors. Remove control panel by pivoting the control panel rearward to disengage the tabs that connect to each side cowl.

[9] - Remove ignition switch nut (B) and screws (C).

[10] -

IMPORTANT:

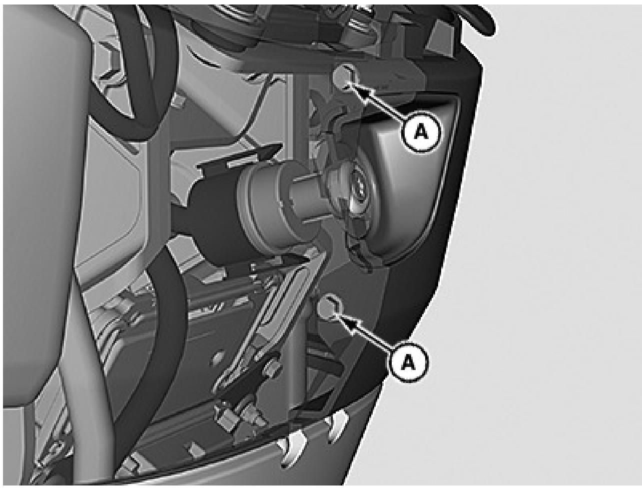
Avoid Damage! Gently flex the cowl and control panels while removing and installing. Do not over flex or the panels will break.

→NOTE:

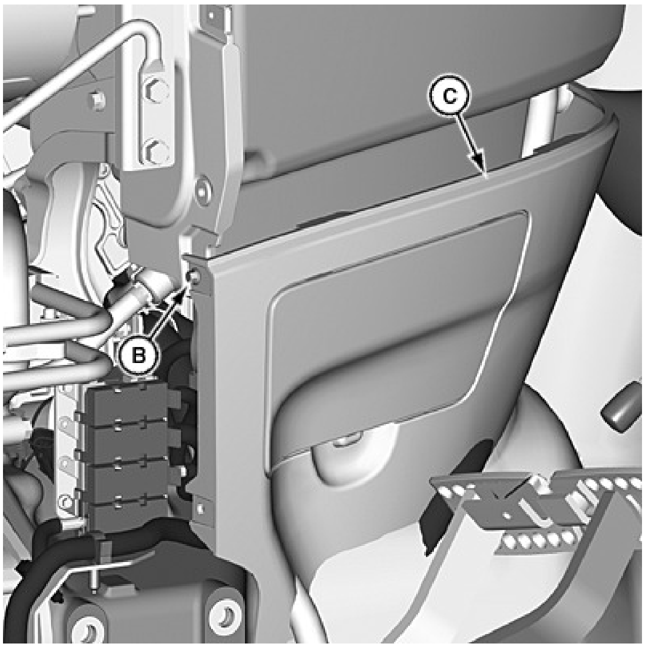
Tilt the steering forward for extra clearance.

Pull the front of the side cowls outward to clear the fuel tank and remove cowl.

[11] -



Cap Screws Under Cowl Panel Shown.



Remove Lower Skirt

LEGEND:

A	Cap Screw (2 used)
B	Cap Screw (2 used)
C	Lower Skirt

Remove cap screws (A) to separate the cowl panels.

[12] - Remove cap screw (B) from each side of lower skirt.

[13] - Remove lower skirt (C).

Installation:

→NOTE:

Align ignition switch with key way in cowl prior to final mounting position.

Installation is done in the reverse order of removal.

Cowl Panel Removal and Installation (Open Station)—PowrReverser Transmission

The control panel and two cowl panels are interlocked when assembled, so all three pieces are involved during removal or installation of an individual component. The key switch is mounted in the left side cowl panel.

Removal:

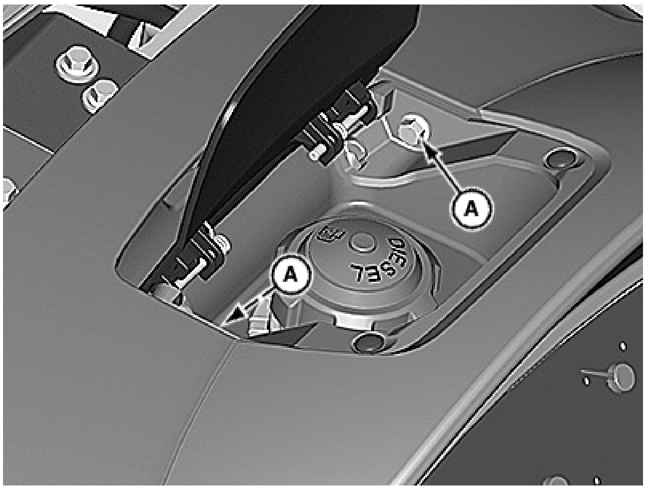
[1] - Disconnect negative (—) battery cable.

[2] - Remove hood and side panel assembly. See Hood Removal and Installation (Cab and Open Station) .

[3] - Pull the engine throttle lever fully rearward to the slow idle position.

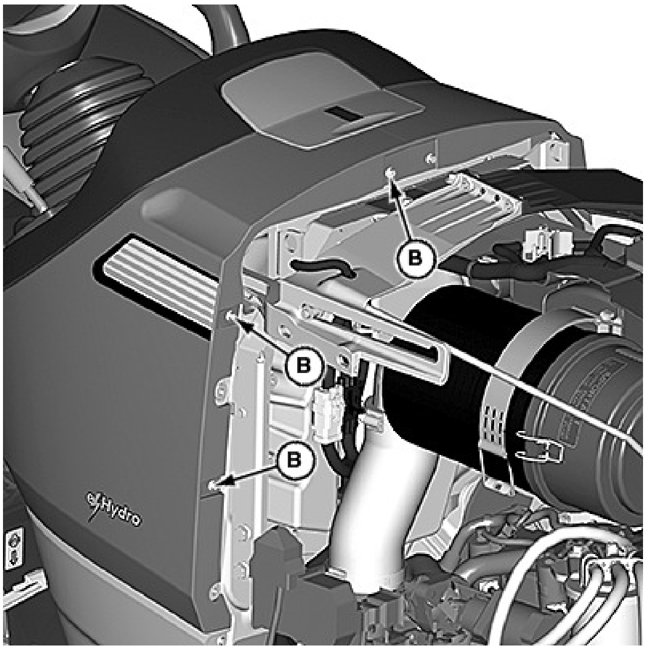
[4] - Open fuel filler door.

[5] -



Fuel Filler Door

LEGEND:
A Cap Screw (2 used)
B Cap Screw (6 used)

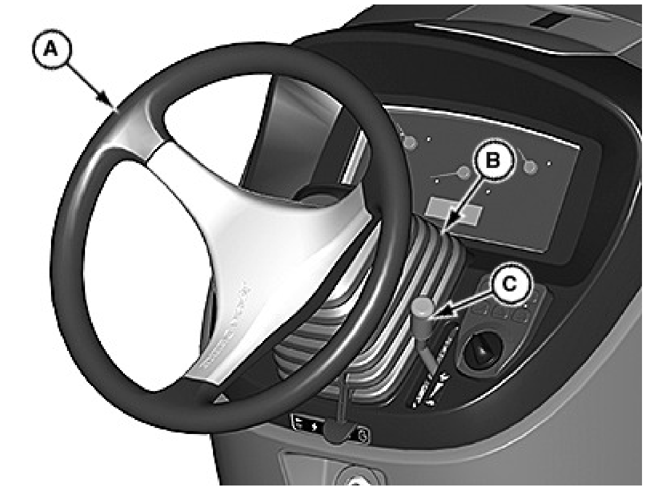


Front Cap Screws

Remove two cap screws (A). Do not lose lock nuts located in slots of the fuel bowl support.

[6] - Remove three cap screws (B) on each side of the cowl panel.

[7] -



LEGEND:

A	Steering Wheel
B	Rubber Boot
C	Throttle Knob

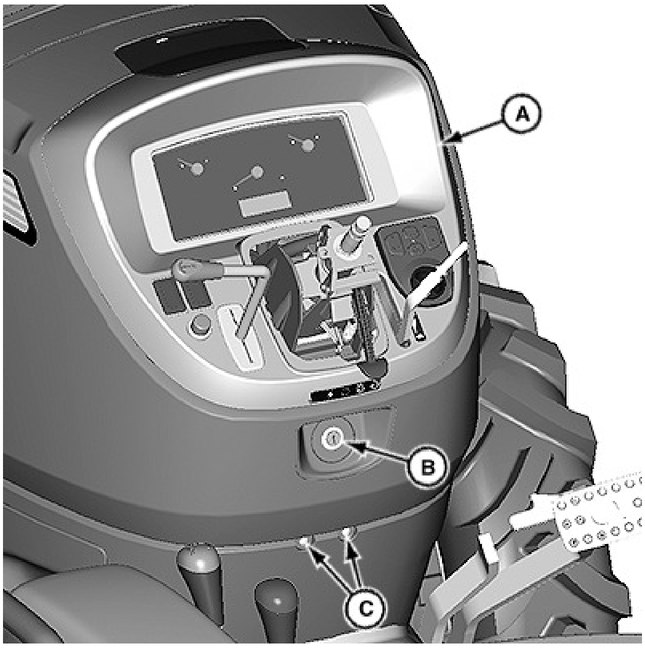
Throttle lever will vary between PRT models.

Remove steering wheel (A), rubber boot (B), and throttle knob (C). See Steering Wheel Removal and Installation.

[8] -

→NOTE:

There are two locking tabs at the inside rear of the control panel. One tab interlocks with each cowl panel, linking the three pieces together. The two cowl panels also have tabs that interlock to each other, and not to the control panel, to aid in assembly and fit.



LEGEND:

A	Control Panel
B	Nut
C	Screw (2 used)

Remove Hardware and Control Panel

Lift control panel (A) and disconnect harness connectors. Disconnect control panel by pivoting the control panel rearward and then sliding forward to disengage the tabs that connect to each side cowl.

[9] - Remove ignition switch nut (B) and screws (C).

[10] -

IMPORTANT:

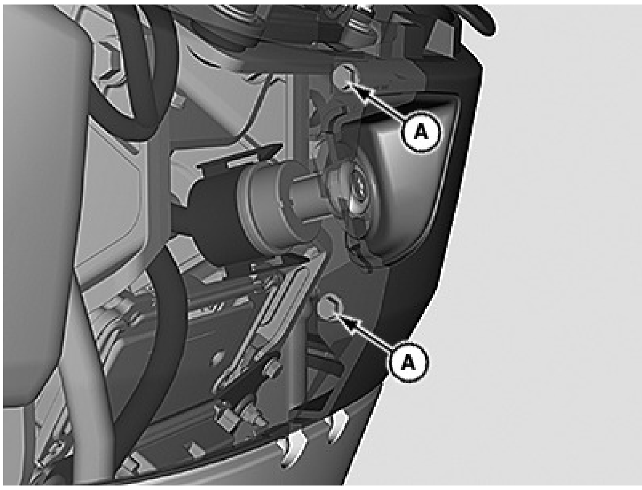
Avoid Damage! Gently flex the cowl and control panels while removing and installing. Do not over flex or the panels will break.

→NOTE:

Tilt the steering forward for extra clearance.

Pull the front of the side cowls outward to clear the fuel tank and remove cowl.

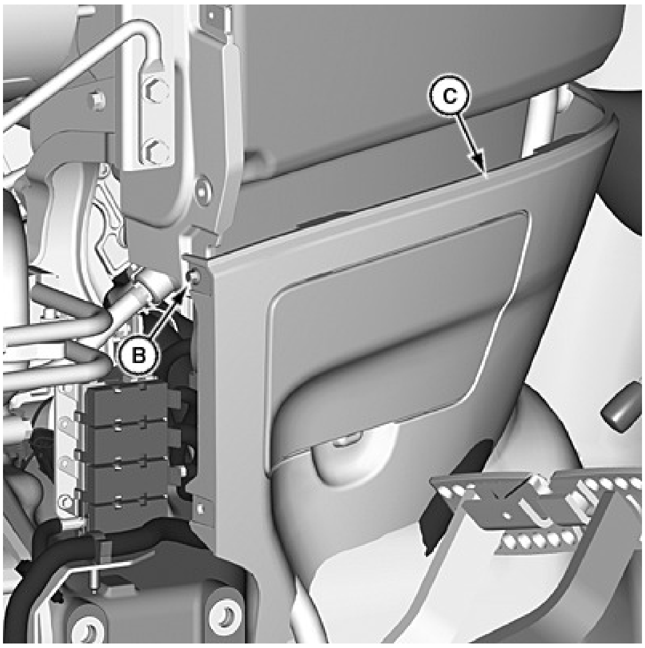
[11] -



LEGEND:

A	Cap Screw (2 used)
B	Cap Screw (2 used)
C	Lower Skirt

Cap Screws Under Cowl Panel Shown.



Remove Lower Skirt

Remove cap screws (A) to separate the cowl panels.

[12] - Remove cap screw (B) from each side of lower skirt.

[13] - Remove lower skirt (C).

Installation:

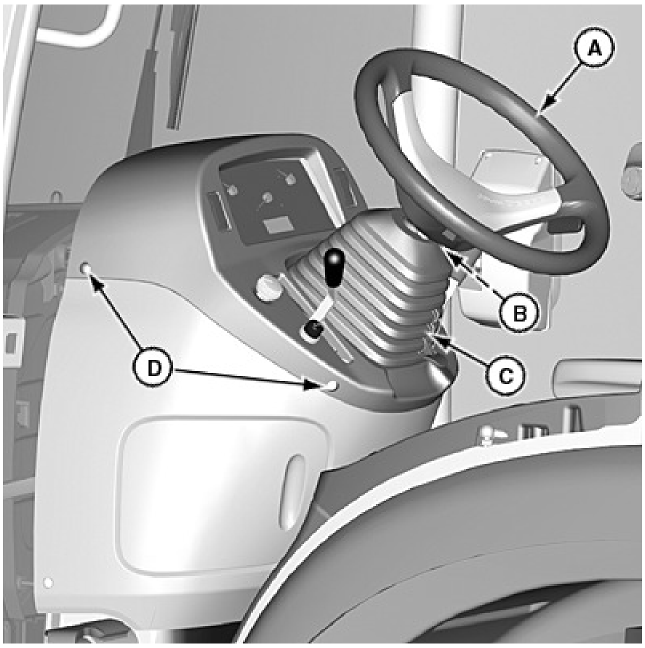
→NOTE:

Align ignition switch with key way in cowl prior to final mounting position.

Installation is done in the reverse order of removal.

Control Panel Removal and Installation (Cab)

[1] -



LEGEND:

A	Steering Wheel
B	Shaft Bushing
C	Boot
D	Hex Head Screw (4 used)

Control Panel R & I

Remove steering wheel (A), boot (C), and shaft bushing (B). (See Steering Wheel Removal and Installation in Section 90, Group 30.)

[2] - Remove knob from throttle lever and MFWD lever.

[3] - Remove two hex head screws (D) from each side of cowl panel.

[4] - Tilt the steering column fully downward.

[5] - Raise control panel enough to disconnect wiring harness connectors from control panel.

[6] - Lift control panel and tilt as necessary to clear the steering shaft, hand throttle lever, and MFWD lever, while removing control panel.

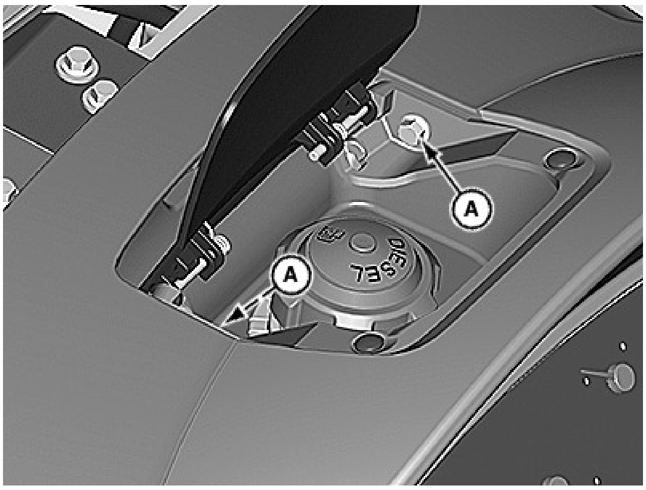
[7] - Install parts in reverse order of removal.

Control Panel Removal and Installation (Open Station)—eHydro Transmission

[1] - Open fuel filler door.

[2] - Tilt the steering column fully downwards.

[3] -



LEGEND:

A	Cap Screw (2 used)
B	Steering Wheel
C	Boot
D	Throttle Knob

Control Panel R & I 01

Control Panel R & I 02

Remove two cap screws (A). Do not to lose lock nuts located in slots in the fuel bowl support.

[4] - Remove steering wheel (B), boot (C), and throttle knob (D). See Steering Wheel Removal and Installation .

[5] -

→NOTE:

Lift control panel and tilt as necessary to clear the steering shaft and hand throttle lever while removing control panel.

Lift control panel and disconnect harness connectors. Remove control panel by pivoting the control panel rearward to disengage the tabs that connect to each side cowl.

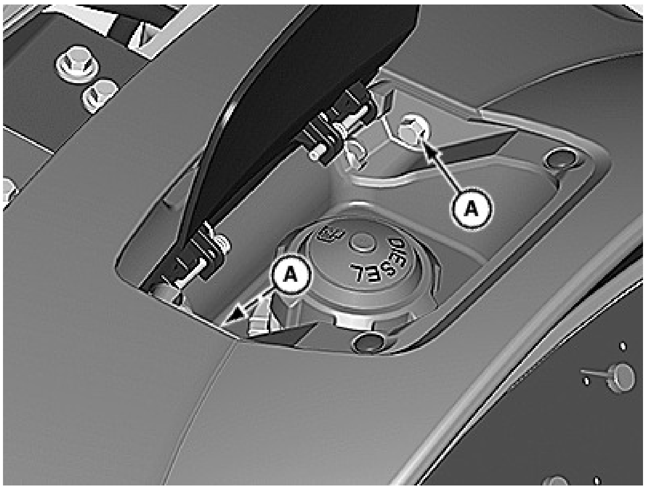
[6] - Install parts in reverse order of removal.

Control Panel Removal and Installation (Open Station)—PowrReverser Transmission

[1] - Open fuel filler door.

[2] - Tilt the steering column fully downwards.

[3] -



LEGEND:

A	Cap Screw (2 used)
B	Steering Wheel
C	Boot
D	Throttle Knob

Control Panel R & I 01

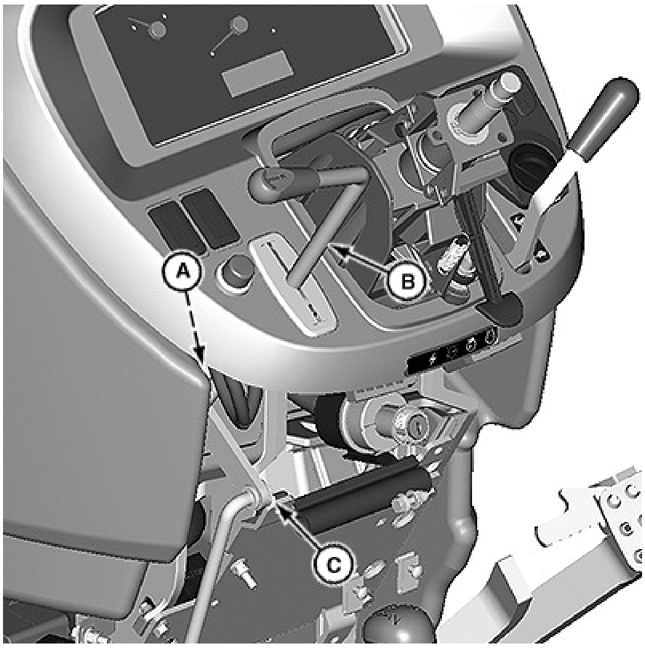
Control Panel R & I 02

Remove two cap screws (A). Do not to lose lock nuts located in slots in the fuel bowl support.

[4] - Remove steering wheel (B), boot (C), and throttle knob (D). See Steering Wheel Removal and Installation .

[5] - Remove cowl panel. See Cowl Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[6] -



LEGEND:

A	Shoulder Bolt
B	PRT Lever
C	Shift Rod

PRT Lever

Remove cotter pin and washer () and disconnect shift rod ().

[7] - Remove shoulder bolt () and PRT lever () as one assembly.

[8] -

> **→NOTE:**
>
> **Lift control panel and tilt as necessary to clear the steering shaft and engine speed control lever while removing control panel.**

Lift control panel and disconnect harness connectors. Remove control panel by pivoting the control panel rearward to disengage the tabs that connect to each side cowl.

[9] - Install parts in reverse order of removal.

Fuel Tank Removal and Installation (Cab)

Removal:

[1] -

CAUTION:

Avoid Injury! Diesel fuel is flammable! Extinguish all open flames before working on fuel system. Do not smoke.

Park machine on level surface, shut engine off, and engage park brake.

[2] - Disconnect battery negative (—) cable.

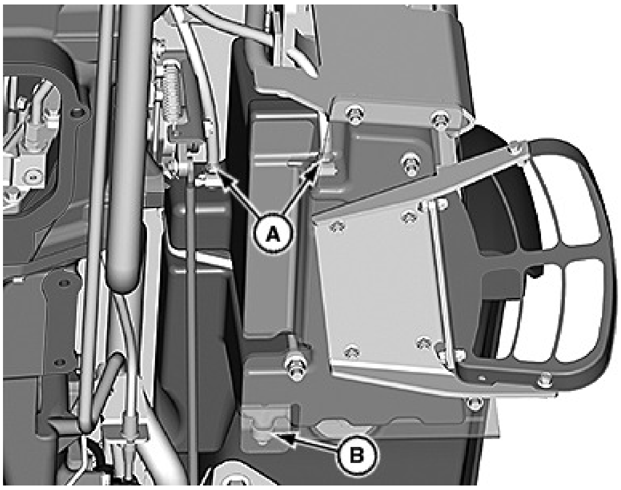
[3] - Remove left rear wheel. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[4] -

→NOTE:

Fuel tank capacity (full) is approximately 44 L (11.8 gal). Use suitable container(s).

Item	Measurement	Specification
Fuel Tank (Cab)	Capacity	44 L (11.8 gal)



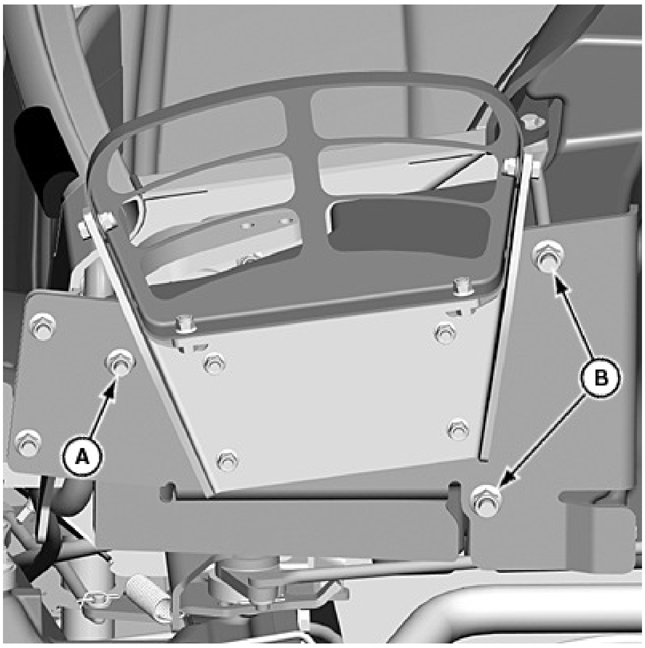
LEGEND:
A Fuel Hose (2 used)
B Drain Plug

Fuel Tank Shown from Below.

Locate drain plug (B) on bottom rear of fuel tank. Drain tank and disconnect fuel hoses (A). Label hoses accordingly.

[5] - Remove left-side control console. (See Left-Side Control Console Removal and Installation (Cab) in Section 120, Group 10.)

[6] -



LEGEND:

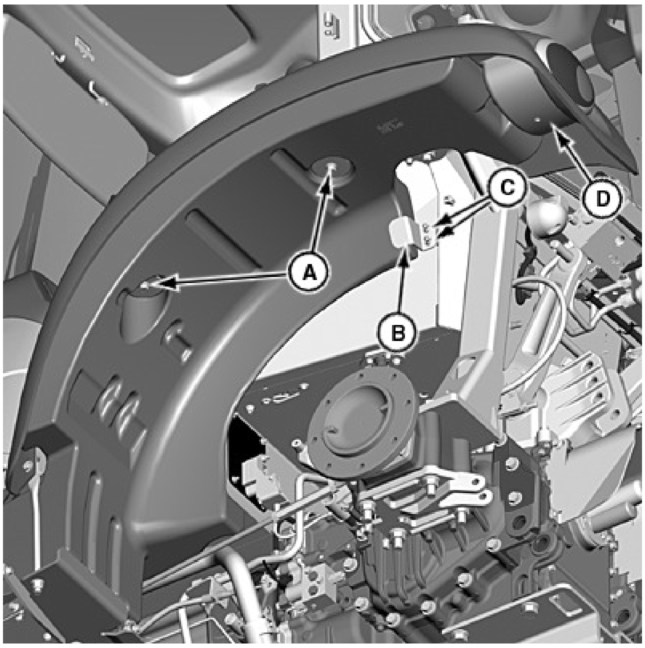
A	Nut
B	Nut (2 used)

Fuel Tank Step

Remove nut (A). Do nut remove cap screw at this time.

[7] - Remove rear nuts (B).

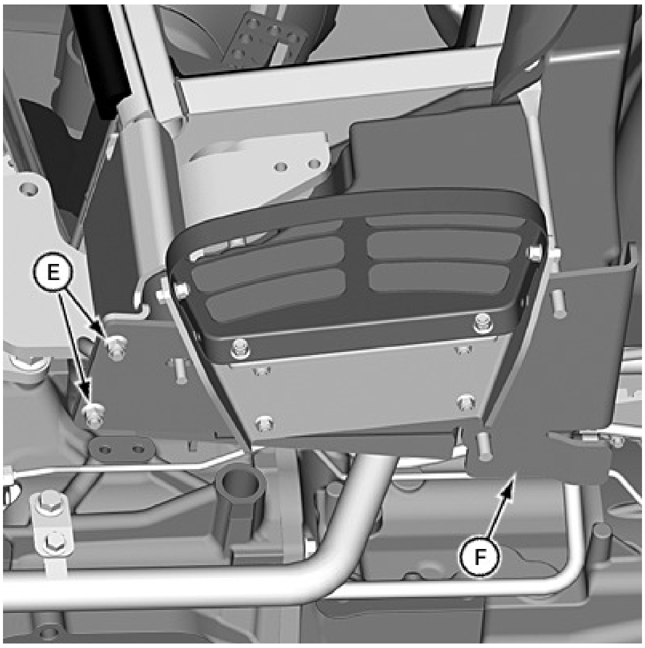
[8] -



LEGEND:

A	Cap Screw, Washer, and Nut (2 used)
B	Mounting Bracket
C	Nut (2 used)
D	Tail Light Cover
E	Cap Screw and Nut (2 used)
F	Step Plate

Remove and Disconnect Hardware



Remove Cap Screws and Nuts

Remove tail light cover (D) and disconnect the fuel lever sender harness.

[9] - Remove cap screws, washers, and nuts (A).

[10] -

> **→NOTE:**
>
> **An assistant should be on the opposite side to assist in removing or installing tank.**

Lower the tank carefully from the fender:

a. Remove nuts (C) and mounting bracket (B).
b. Remove cap screws and nuts (E) along with the step plate (F).

Installation:

Installation is done in the reverse order of removal.

Fuel Tank Removal and Installation (Open Station)

Removal:

[1] -

CAUTION:

Avoid Injury! Diesel fuel is flammable! Extinguish all open flames before working on fuel system. Do not smoke.

IMPORTANT:

Plug or cap all fuel openings to avoid system contamination.

Park machine on level surface, shut engine off, and engage park brake.

[2] - Disconnect battery negative (—) cable.

[3] - Remove hood. See Hood Removal and Installation (Cab and Open Station) .

[4] - Remove control panel. See Control Panel Removal and Installation (Open Station)—eHydro Transmission or Control Panel Removal and Installation (Open Station)—PowrReverser Transmission .

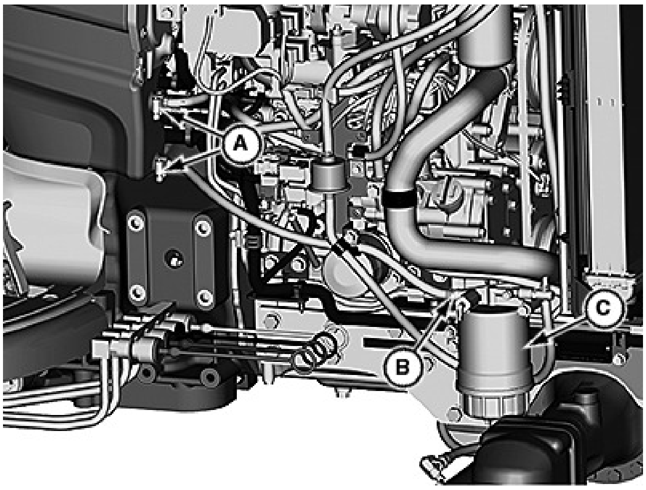
[5] - Remove cowl panel. See Cowl Panel Removal and Installation (Open Station)—eHydro Transmission or Cowl Panel Removal and Installation (Open Station)—PowrReverser Transmission .

[6] -

→NOTE:

Fuel tank capacity (full) is approximately 51 L (13.5 gal.). Use suitable container (s).

Item	Measurement	Specification
Fuel Tank (Open Station)	Capacity	51 L (13.5 gal.)



LEGEND:

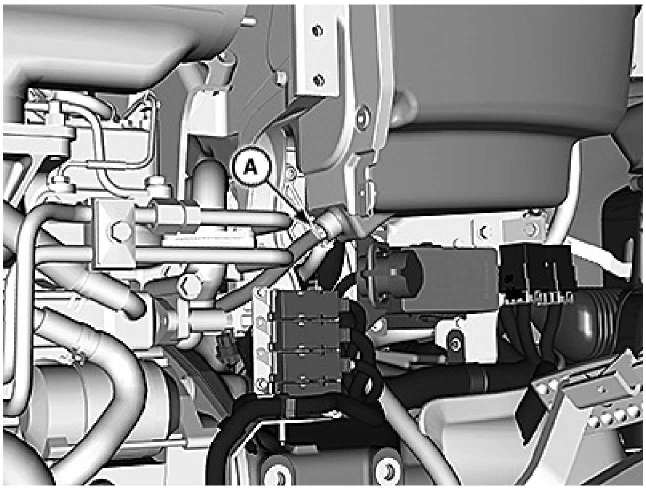
A	Fuel Hoses
B	Fuel Hose
C	Water Separator

Right Side Fuel Hoses

Disconnect fuel hose (B) at water separator (C) and drain fuel. Remove fuel cap to relieve negative pressure and dispense fuel quicker.

[7] - Disconnect fuel hoses (A) at the fuel tank. Label hoses accordingly.

[8] -



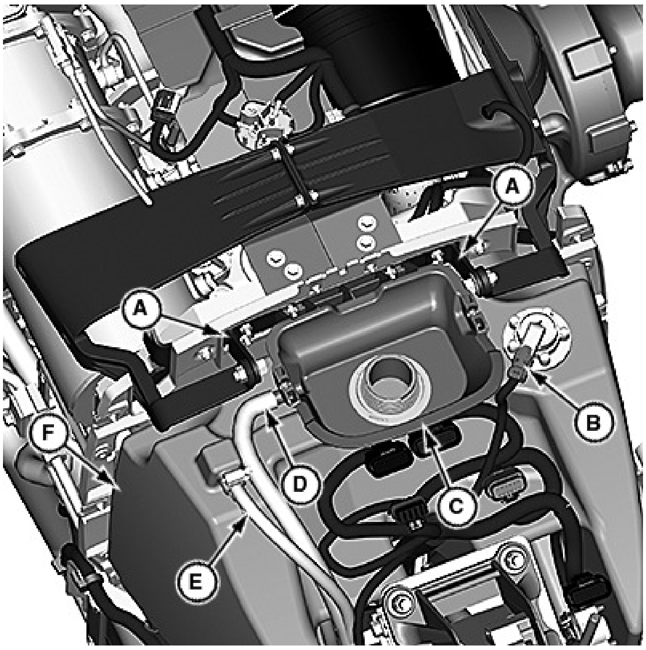
LEGEND:

A	Fuel Hose

Left Side Fuel Hose

Disconnect fuel hose (A).

[9] -



LEGEND:

A	Pivot Assembly
B	Harness
C	Fuel Bowl
D	Drain Hose
E	Return Hose
F	Fuel Tank

Hood Pivot Assembly

Disconnect harness (B) from fuel lever sender.

[10] - Remove hood pivot assembly (A).

[11] - Disconnect drain hose (D) and remove fuel bowl (C).

[12] -

→NOTE:

An assistant should be on the opposite side of the machine to assist in removing or installing tank.

Disconnect fuel return hose (E) and remove fuel tank (F).

Installation:

→NOTE:

Inspect and replace fuel hoses as needed at this time.

Installation is done in the reverse order of removal.

Fuse Panel Cover Removal and Installation

[1] - Pull forward and out on the access cover recessed handle to remove the cover from front clips.

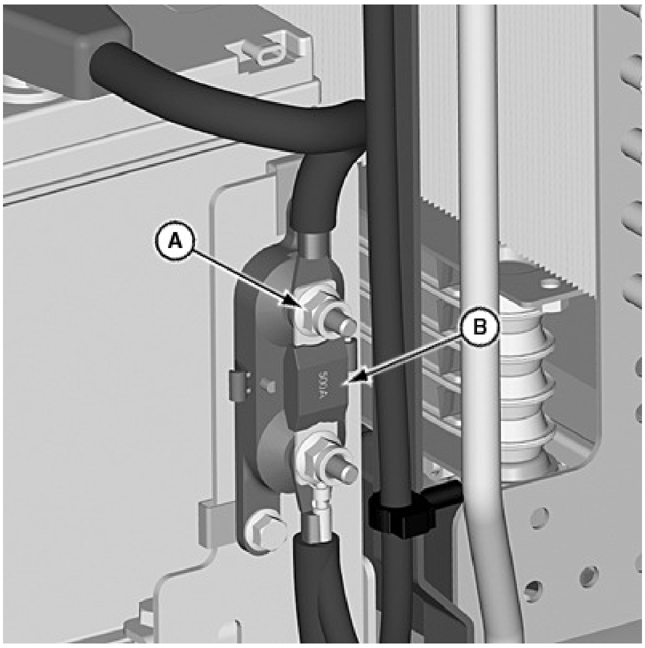
[2] - Install access cover onto front clips, and push inward to secure cover into latch.

Battery Fusible Link

[1] - Lift hood and disconnect negative (–) battery cable.

[2] - Remove cover.

[3] -



LEGEND:

A	Flange Nuts
B	MIDI Fuse

Fusible Link

Remove two hex flange nuts (A).

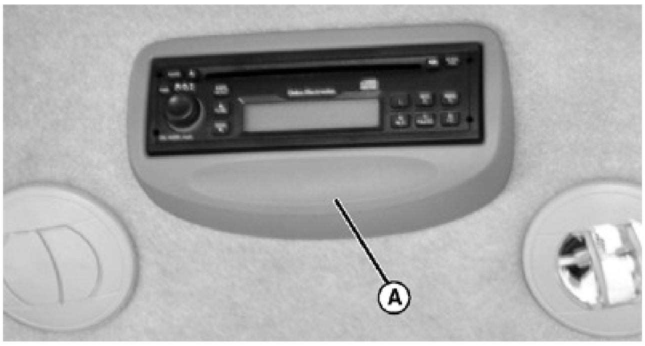
[4] - Remove and replace MIDI fuse (B).

[5] - Install parts in reverse order.

Headliner Removal and Installation

Removal:

[1] -



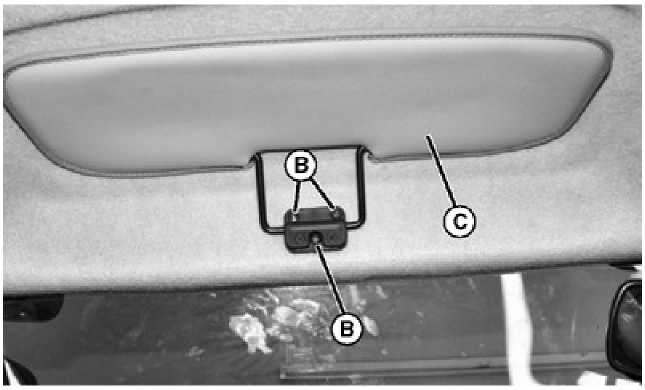
LEGEND:

A	Radio Housing Cover

Radio Housing Cover

Remove radio housing cover (A) and radio from tractor, if equipped.

[2] -



LEGEND:

B	Screw (3 used)
C	Sun Visor Assembly

Sun Visor

Remove three screws (B) and sun visor assembly (C).

[3] -

→NOTE:

There is a slot in front of dome light lens that a flat screwdriver will fit into to ease lens removal.

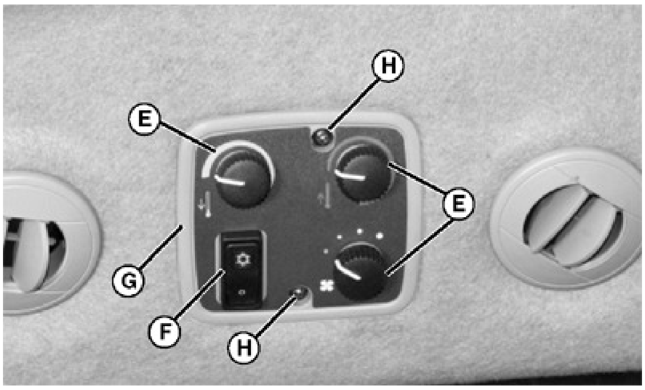
LEGEND:

D	Dome Light Lens

Dome Light

Remove dome light lens (D) and two screws underneath. Disconnect dome light wiring connector.

[4] -



LEGEND:

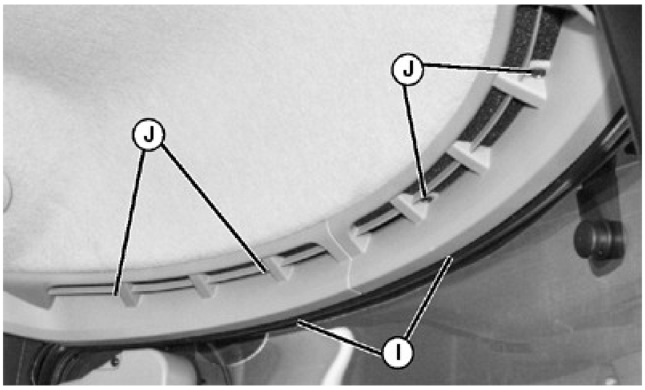
E	Knobs
F	Air Conditioner Switch
G	Cover
H	Screw (2 used)

Climate Control Panel

Pull off three knobs (E) and air conditioner switch (F).

[5] - Remove air conditioner controls cover (G) by removing two screws (H).

[6] -



LEGEND:

I	Recirculation Filter Covers
J	Screw (4 used)

Recirculation Filter Covers

Remove the recirculation filter covers (I) at the rear of cab by removing four screws (J).

[7] - Remove head liner by pulling in outer edges at four corners. Head liner is secured by hanging on copper weld studs of cab frame in four places.

[8] - Repair or replace headliner as necessary.

Installation:

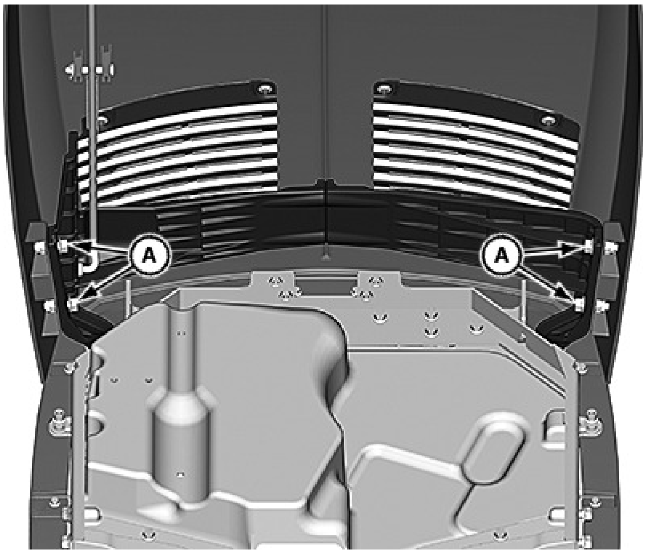
Installation is the reverse of removal.

Hood Removal and Installation (Cab and Open Station)

[1] -

IMPORTANT:

Use an assistant to help hold hood during removal.



LEGEND:

A	Cap Screw and Nut (4 used)

Hood Shown from Below

Open hood and support on hood prop latch.

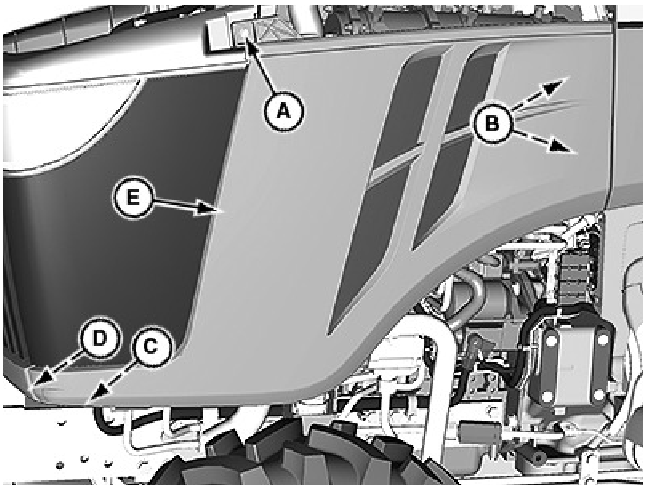
[2] - Remove cap screws and nuts (A). Lift and remove hood.

[3] - Install hood in reverse order of removal.

[4] - If more access to the engine bay is required, follow the steps below.

Removing Side Panels

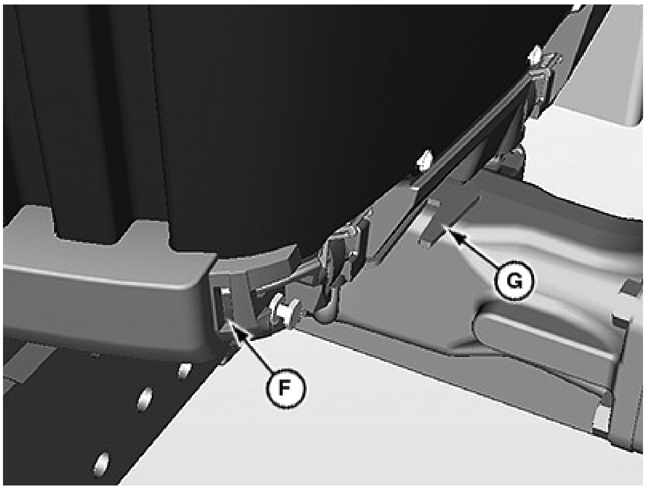
[1] -



LEGEND:

A	Cap Screw (2 used)
B	Mounting Nut (4 used)
C	Mounting Tab
D	Front Mounting Tab
E	Side Panel
F	Front Mounting Slot
G	Mounting Hook

Left Side Shown; Right Side Is Similar.



Side Panel Mount Location

Remove bolt (A) and nut.

[2] - Remove nuts (B) to release side panel.

[3] - Tilt side panel (E) away from machine and slide forward so mounting tab (C) clears mounting hook (G) and front mounting slot (F). Remove side panel.

Installing Side Panels

[1] - Align the side panel mounting hook and tab with front mounting slot (F) and mounting hook (G) on machine.

[2] - Slide side panel, then tilt into place.

[3] - Secure rear of panel mounting bracket with mounting nuts (B).

[4] - Install cap screw (A) and nut to secure side panel (E).

[5] - Lower the hood.

Operator Platform Removal and Installation—eHydro Transmission

Removal:

[1] - Park machine safely on a level surface with wheels blocked to prevent machine movement.

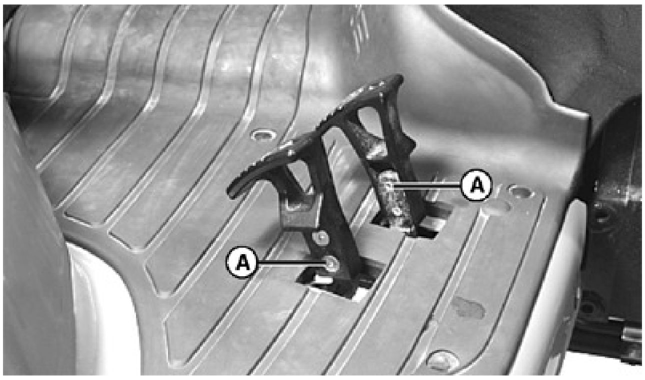
[2] - Remove rear fenders, if desired, to ease operator platform removal. See Rear Fenders Removal and Installation (Open Station) .

[3] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[4] - Remove seat closeout panel. See Seat Closeout Removal and Installation (Open Station)—eHydro Transmission .

[5] - Remove fuse panel cover. See Fuse Panel Cover Removal and Installation .

[6] -



LEGEND:
A Socket Head Screw (4 used)

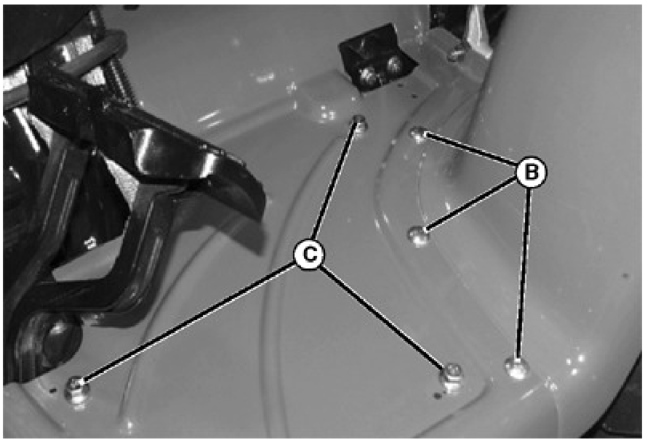
eHydro™ Model Shown

Remove socket head screws (A) and forward and reverse pedals at right side of platform.

[7] - Remove plastic rivets holding floor mat to operators platform.

[8] - Remove floor mat.

[9] -



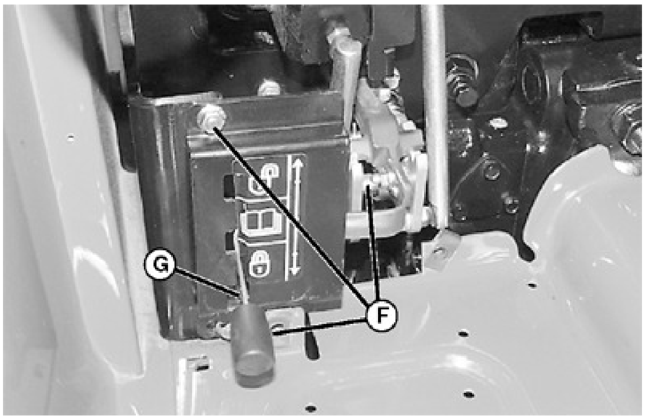
LEGEND:
B Carriage Bolt (3 used)
C Cap Screw (3 used)

Operator Platform

Remove nuts and carriage bolts (B) securing operator platform to fenders, If not already removed. Repeat on other side.

[10] - Remove cap screws (C), lock nuts, and washers from rubber isolators attaching platform to frame. Repeat on other side.

[11] -



LEGEND:

F	Cap Screws (3 used)
G	SCV Lock Lever

SCV Lock Lever and Plate

Remove nuts and cap screws (F) securing SCV lock lever (G) and plate. Remove lever and plate.

[12] - Disconnect differential lock linkage. Move differential lock pedal out of the way.

[13] - Remove operator platform. Inspect rubber isolators for cracks and deterioration. Replace as necessary.

Installation:

Installation is the reverse of removal.

Operator Platform Removal and Installation—PowrReverser Transmission

Removal:

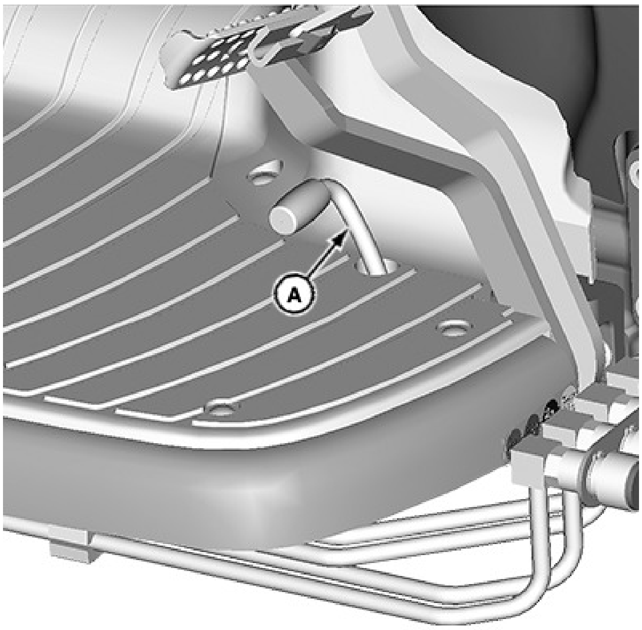
[1] - Park machine safely on a level surface with wheels blocked to prevent machine movement.

[2] - Remove rear fenders, if desired, to ease operator platform removal. See Rear Fenders Removal and Installation (Open Station) .

[3] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[4] - Remove seat closeout panel. See Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission .

[5] -



LEGEND:

A	Foot Throttle Pedal

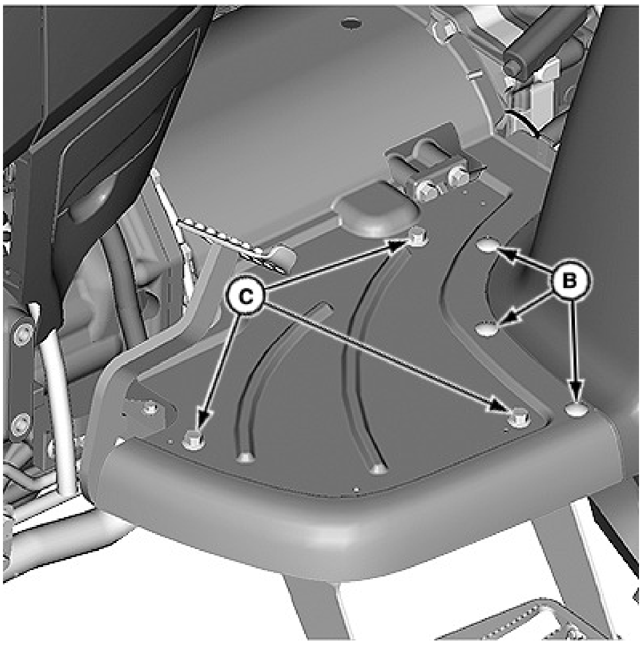
Foot Throttle Pedal

Remove foot throttle pedal.

[6] - Remove plastic rivets holding floor mat to operators platform.

[7] - Remove floor mat.

[8] -



LEGEND:
B Nut and Carriage Bolt (3 used)
C Cap Screw, Lock Nut, and Washer (3 used)

Remove Hardware

Remove nuts and carriage bolts (B) securing operator platform to fenders. Repeat on other side.

[9] - Remove cap screws , lock nuts, and washers (C) from rubber isolators attaching platform to frame. Repeat on other side.

[10] - Disconnect differential lock linkage. Move differential lock pedal out of the way.

[11] - Remove operator platform. Inspect rubber isolators for cracks and deterioration. Replace as necessary.

Installation:

Installation is done in the reverse order of removal.

PRT Lever Removal and Installation

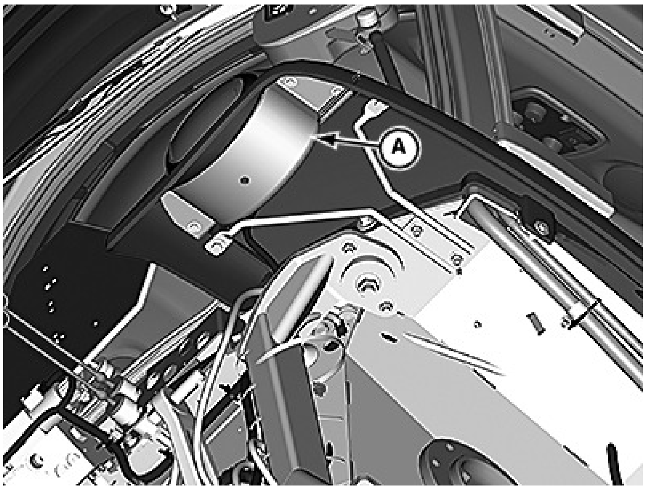
See Control Panel Removal and Installation (Open Station)—PowrReverser Transmission .

Rear Fenders Removal and Installation (Cab)

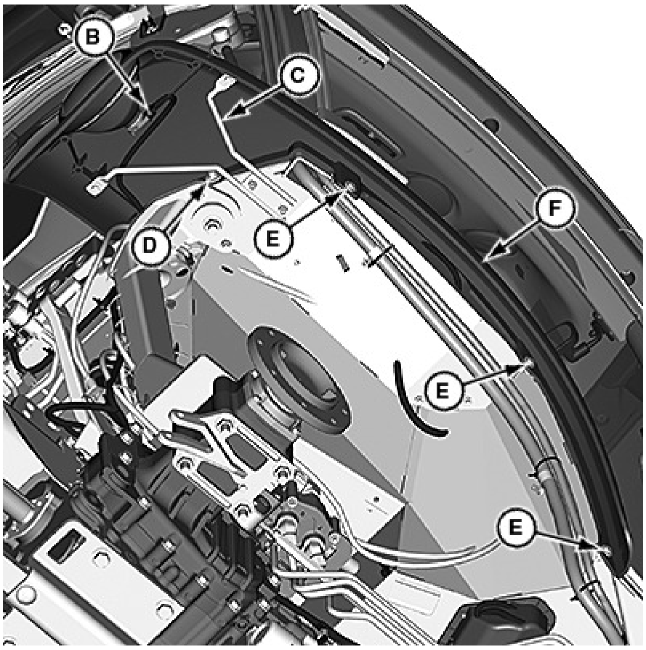
Right Fender

[1] - Remove rear wheels, if desired, to ease fender removal. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] -



Remove Tail Light Cover



Fender Shown from Below

LEGEND:
A Tail Light Cover
B Harness
C Fender Bracket Assembly
D Nut and Washer
E Cap Screw, Washer, and Nut (3 used)
F Fender

Remove tail light cover (A).

[3] - Disconnect tail light harness (B).

[4] - Remove fender bracket assembly (C).

[5] - Remove nut and washer (D).

[6] - Remove cap screws, washers, and nuts (E).

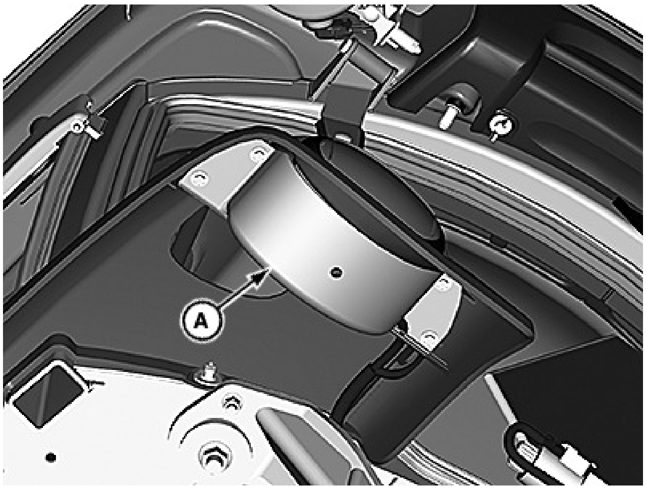
[7] - Remove fender (F). Inspect, repair or replace as needed. If replacing, transfer tail light assembly onto new fender.

Left Fender

[1] - Remove rear wheels, if desired, to ease fender removal. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] - Remove fuel tank. (See Fuel Tank Removal and Installation (Cab) in Section 120, Group 10.)

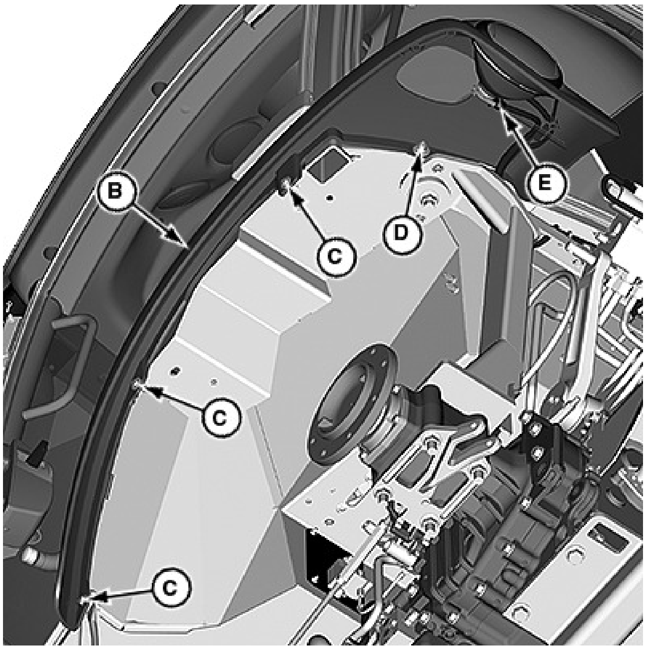
[3] -



LEGEND:

A	Tail Light Cover
B	Fender
C	Cap Screw, Washer, and Nut (3 used)
D	Nut and Washer
E	Harness

Remove Tail Light Cover



Fender Shown from Below

Remove tail light cover (A).

[4] - Disconnect tail light harness (E).

[5] - Remove nut and washer (D).

[6] - Remove cap screws, washers, and nuts (C).

[7] - Remove fender (B). Inspect, repair or replace as needed. If replacing, transfer tail light assembly onto new fender.

Installation:

Installation is done in the reverse order of removal.

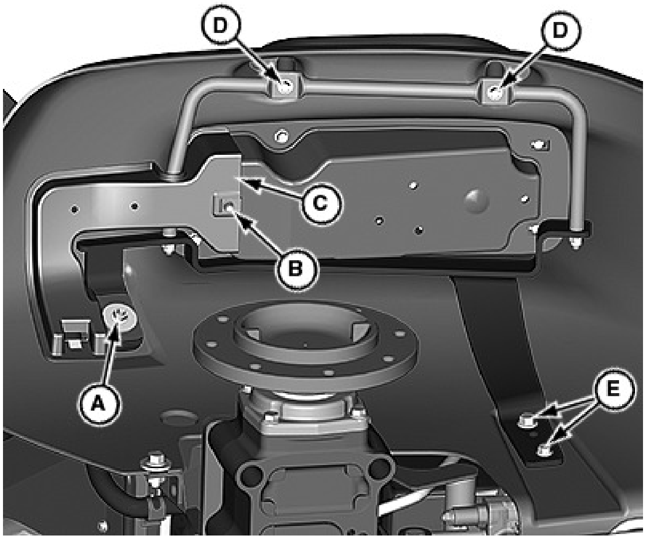
Rear Fenders Removal and Installation (Open Station)

Right Fender

[1] - Remove rear wheels, if desired, to ease fender removal. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] - Remove right-side control console. (See Right-Side Control Console Removal and Installation (Open Station) in Section 120, Group 10.)

[3] -



LEGEND:

A	Cap Screw, Washer, and Nut
B	Screw
C	Harness Cover
D	Cap Screw and Spacer (2 used)
E	Cap Screw (2 used)

Fender Shown from Below

Remove screw (B) and harness cover (C).

[4] - Remove cap screw, washer, and nut (A).

[5] - Remove grab bar cap screws and spacers (D).

[6] -

→NOTE:

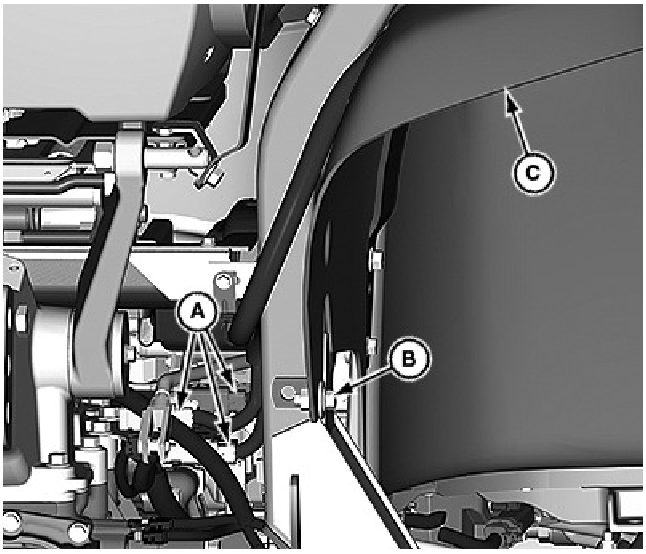
The cap screws are two different sizes.

Remove two cap screws (E) and fender support assembly.

[7] -

→NOTE:

Your machine may be equipped with more electrical items than shown. Disconnect any additional electrical components.



LEGEND:
A Harness Connector (3 used)
B Cap Screw and Washer
C Fender

Disconnect Harness

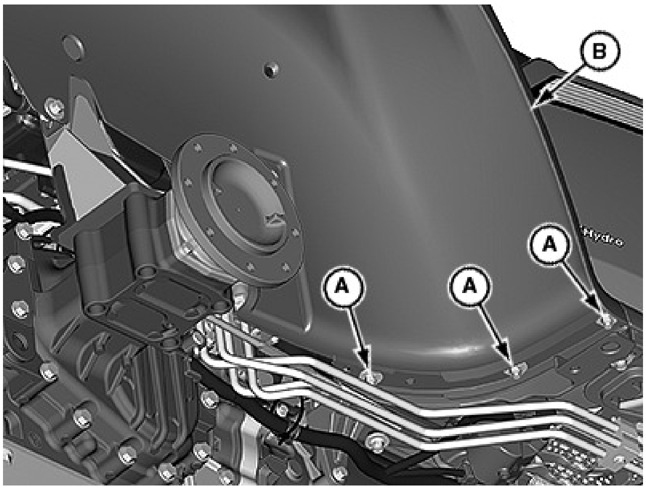
Disconnect harness connectors (A) and route the harness through the fender (C).

[8] - Remove cap screw and washer (B).

[9] -

IMPORTANT:

Avoid Damage! Have an assistant support the fender while the cap screws are removed.



LEGEND:
A Lock Nut and Washer (3 used)
B Fender

Right-Side Operator Platform Shown from Below

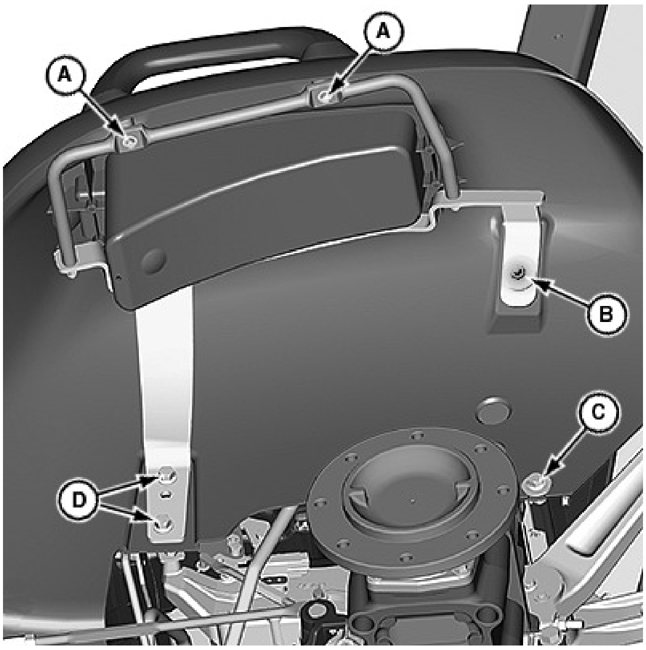
Remove lock nuts and washers (A) from carriage bolts securing front of fender (B) to operator platform.

[10] - Installation is the reverse order of removal.

Left Fender

[1] - Remove rear wheels, if desired, to ease fender removal. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] -



LEGEND:

A	Cap Screw and Spacer (2 used)
B	Cap Screw, Washer, and Nut
C	Cap Screw and Washer
D	Cap Screw (2 used)

Remove Fender Support

Remove grab bar cap screws and spacers (A).

[3] - Remove cap screw, washer, and nut (B).

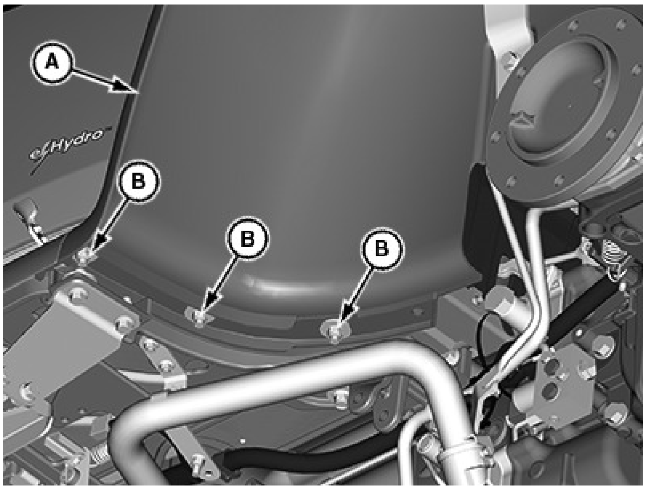
[4] -

> **→NOTE:**
>
> **The cap screws are two different sizes.**

Remove two cap screws (D) and fender support assembly.

[5] - Remove cap screw and washer (C).

[6] -



LEGEND:

A	Fender
B	Lock Nut and Washer (3 used)

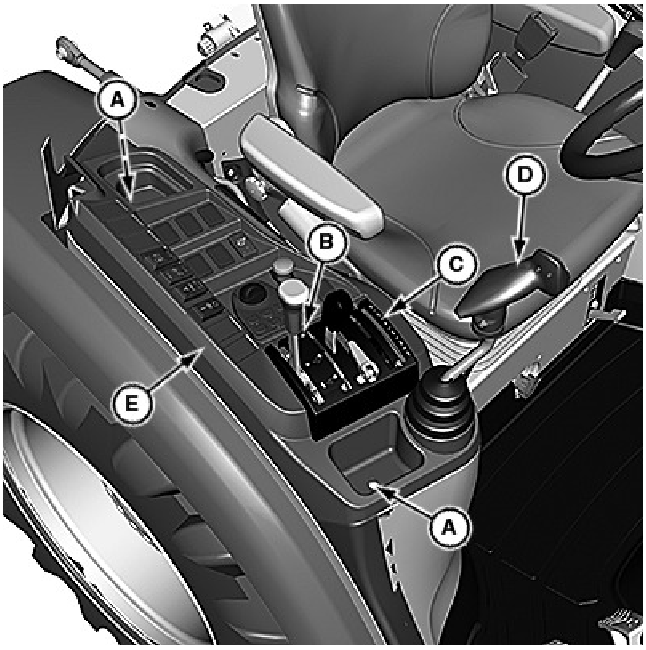
Remove Fender

Remove lock nuts and washers (B) from carriage bolts securing front of fender (A) to operator platform.

[7] - Installation is done in the reverse order of removal.

Right-Side Control Console Removal and Installation (Cab)

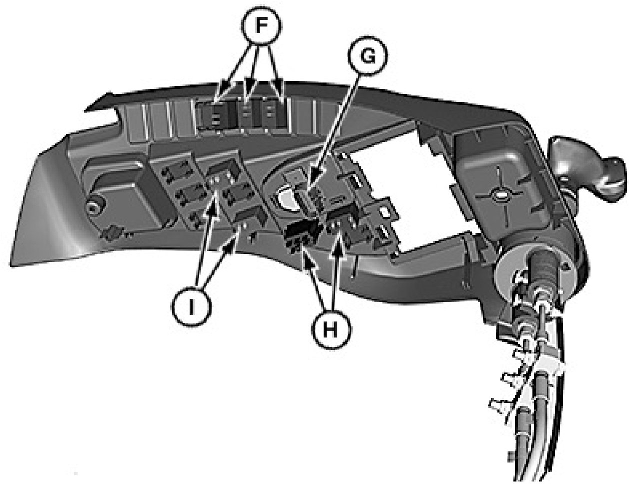
[1] -



LEGEND:

A	Cap Screw (2 used)
B	Cap Screw
C	Black Lever Cover
D	Knob
E	Console
F	Connector
G	Connector
H	Connector
I	Connector

Remove Cover and Hardware



Disconnect Connectors

Remove the cap screw (B) retaining black lever cover (C) to right side console (E). Tilt front of lever cover up to remove. Cover is held in place with tabs at the front and rear. If third SCV is installed, control lever may have to be pulled to the rear to aid removal of lever cover.

[2] - Remove two cap screws (A) securing right-side console, and lift and tilt the console toward the operator seat.

[3] -

→NOTE:

Tag or label wires before disconnecting to aid during installation.

Disconnect wire connectors (F—I), if equipped.

[4] -

→NOTE:

Add a light coat of oil onto shaft surface to ease removal of boot.

Remove dual selective control valve lever knob (D) with boot.

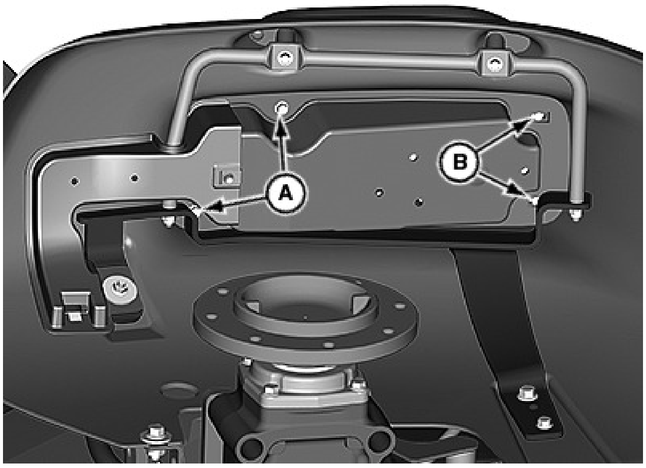
[5] - Lift console (E) over levers.

[6] - Make repairs as necessary.

[7] - Install parts in reverse order of removal.

Right-Side Control Console Removal and Installation (Open Station)

[1] -



LEGEND:

A	Cap Screw (2 used)
B	Screw (2 used)

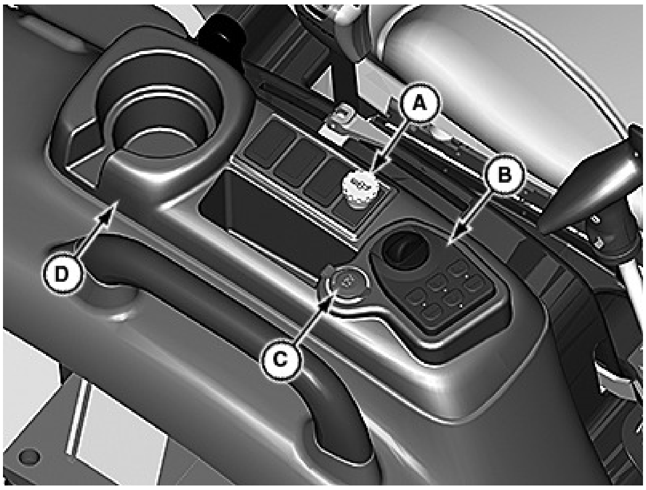
Remove Hardware

Remove cap screws (A) and screws (B).

[2] -

→NOTE:

Tag or label connectors to aid during installation. Machine may have other electrical components that are not shown.



LEGEND:

A	PTO Switch
B	Cruise Control
C	12-Volt Accessory Outlet
D	Console

Remove Console

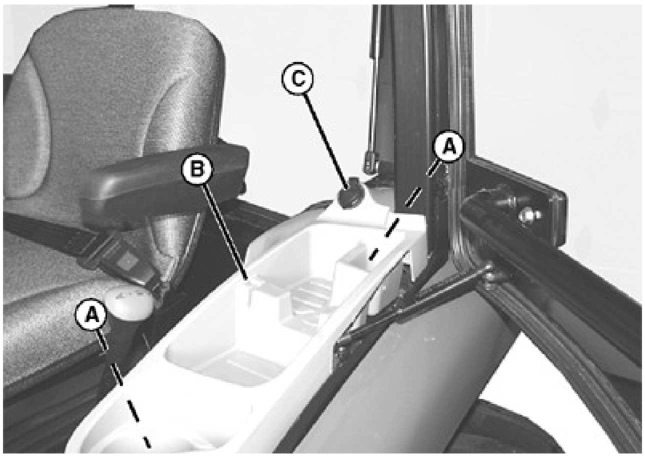
Lift console (D) and disconnect wire connectors (A—C), if equipped.

[3] - Make repairs as necessary.

[4] - Install parts in reverse order or removal.

Left-Side Control Console Removal and Installation (Cab)

[1] -



LEGEND:

A	Screw (2 used)
B	Control Console
C	Accessory Outlet

Left-Hand Console

Remove two screws (A) and control console (B).

[2] - Disconnect wiring harness connector from accessory outlet (C).

[3] - Make repairs as necessary.

[4] - Connect wiring harness connector to accessory outlet.

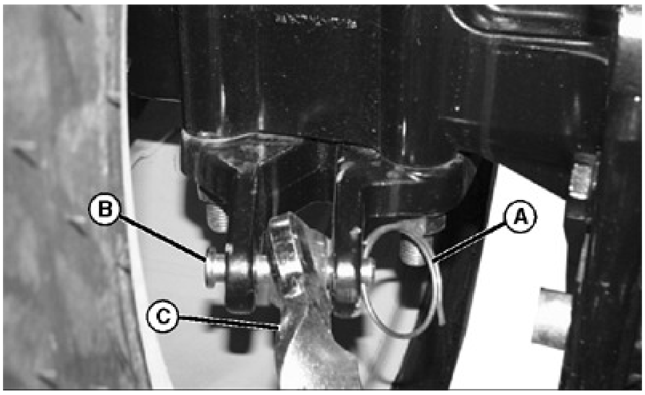
[5] - Install control console and secure with two screws.

Roll Over Protection System (ROPS)

Removal:

[1] - Remove rear wheels and tires. (See Rear Wheel Removal and Installation in Section 120, Group 10.)

[2] -



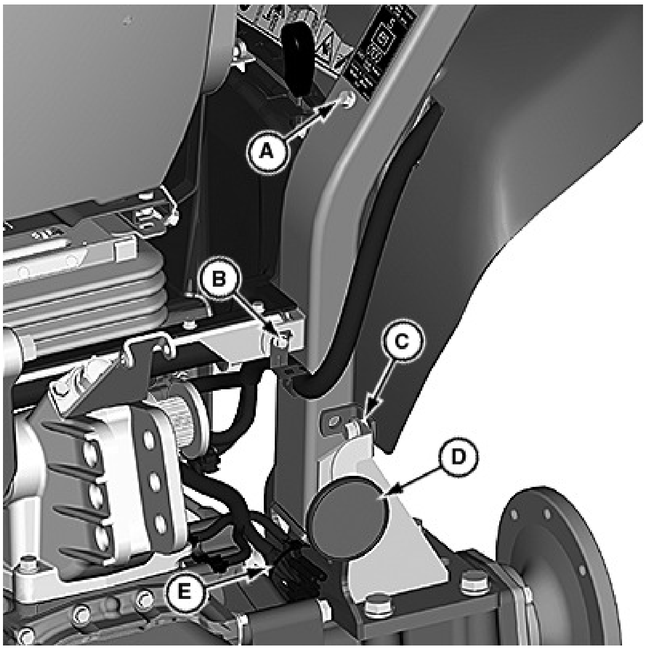
LEGEND:

A	Quick-Lock Ring
B	Pin
C	Sway Bar

Quick Lock Ring and Pin

Remove quick-lock ring (A) and pin (B). Disconnect sway bar (C) from lower left side of ROPS bracket. Repeat for right side.

[3] -



LEGEND:

A	Cap Screw, Washer, and Nut (2 used)
B	Cap Screw (2 used)
C	Hardware
D	Reflector (Machine with License Plate Bracket Only)
E	Warning Light Lead (4 used)

Remove Hardware - Disconnect Electrical

Cut tie strap and disconnect all warning light leads (E) at base of right side of ROPS. Repeat for left side.

[4] - Remove cap screws, washers, and nuts (A). Repeat for left side.

[5] -

→NOTE:

Disconnect fender harness connectors to ease ROPS removal.

Remove cap screws (B) from each side.

[6] -

→NOTE:

Depending on model specifications, hardware (C) will vary in this location.

Remove hardware (C) from ROPS bracket. The reflector (D) is shown on an export model.

[7] -

CAUTION:

Avoid Injury! Machine component is heavy. Use a safe lifting device or get an assistant to help lift and hold component in place for installation.

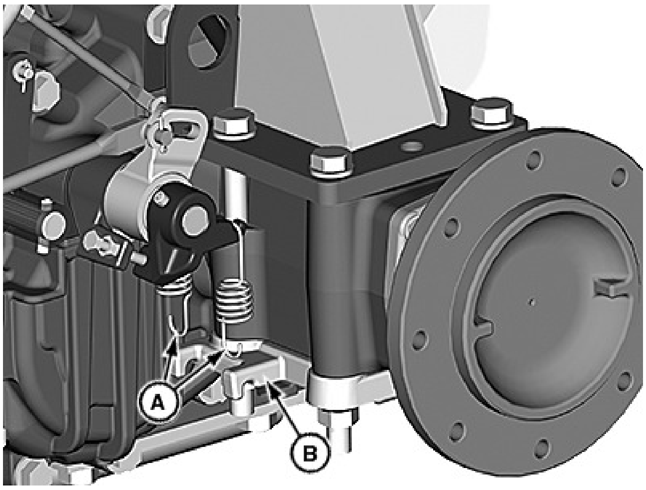
Support ROPS with a suitable lifting device.

[8] -

CAUTION:

Avoid Injury! Springs are installed under tension. Use caution when connecting or disconnecting springs. Wear eye protection.

Remove brake springs (A) from lower left ROPS bracket (B).

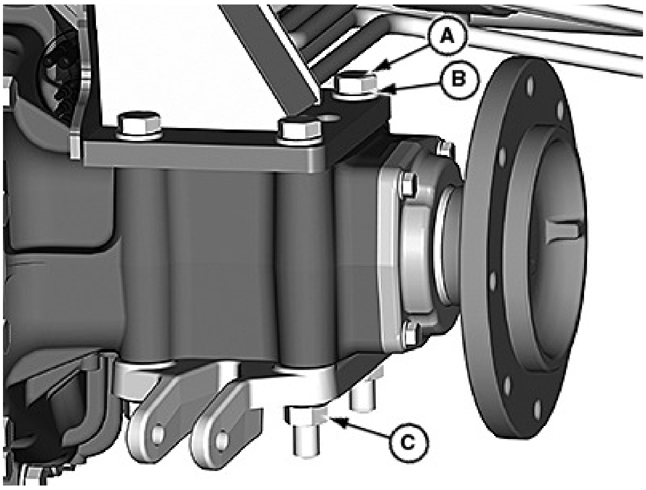


LEGEND:

A	Brake Spring (2 used)
B	ROPS Bracket

Brake Springs

[9] -



LEGEND:

A	Cap Screw (4 used)
B	Washer (4 used)
C	Nut (4 used)

Remove Hardware

Remove nuts (C), washers (B), and cap screws (A) and discard hardware. Repeat for the left side.

[10] - Lift and remove ROPS from machine.

Installation:

Installation is done in the reverse order of removal.

CAUTION:

Avoid Injury! Replace the discarded hardware whenever the ROPS is removed. Always use new, non-flanged grade 10.9 cap screws.

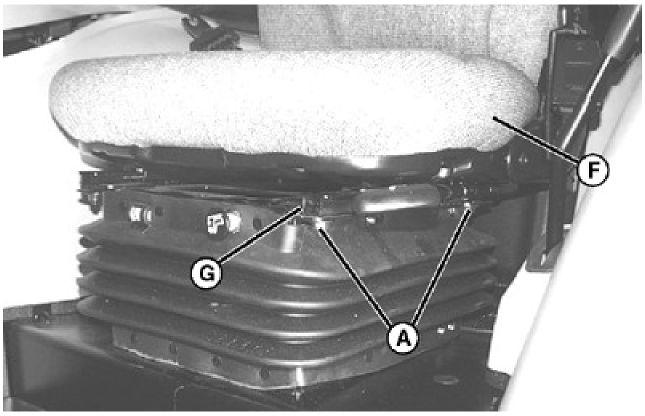
Replace discarded hardware with new and evenly tighten cap screws to specification.

Item	Measurement	Specification
ROPS Hardware	Torque	230 N·m (170 lb.-ft.)

Seat and Support Removal and Installation—Deluxe (Cab)

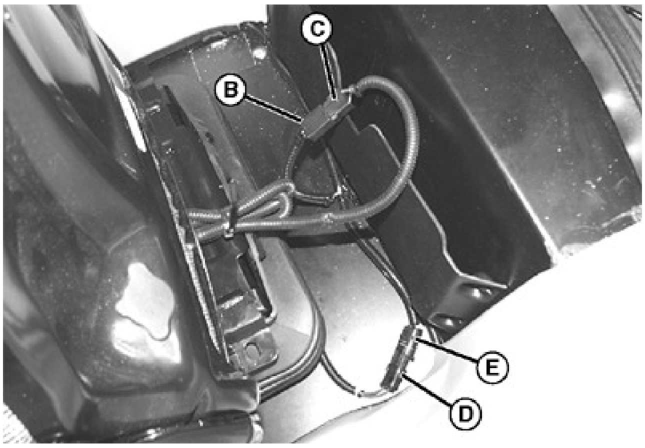
Removal:

[1] -



LEGEND:
A Lock Nut (2 used)
B Wiring Harness Connector
C Seat Wiring Connector
D Seat Pump Wiring Connector
E Main Wiring Connector
F Seat
G Seat Suspension Plate

Air Ride Seat



Air Ride Seat Wiring Harnesses

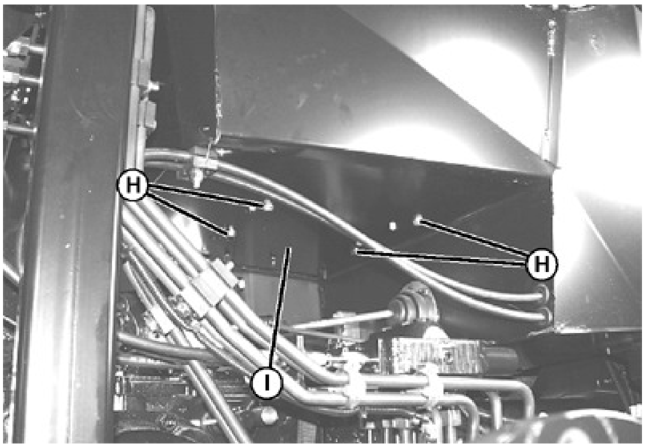
Remove two lock nuts (A) and washers from seat slide assembly on each side.

[2] - Disconnect main wiring harness connector (B) from seat wiring connector (C).

[3] - Disconnect seat pump wiring connector (D) from main wiring connector (E).

[4] - Remove seat (F) from seat suspension plate (G). Remove and keep four spacer washers on top of seat suspension plate.

[5] -



LEGEND:
H Bolt (4 used)
I Seat Closeout Panel

Right Rear Wheel Shown Removed for Clarity.

From below cab, remove four bolts (H) mounting the seat suspension to the seat closeout panel (I).

[6] - Remove seat suspension. Repair or replace parts as necessary.

Installation:

[1] - Place seat suspension onto top of seat closeout panel, making sure that wiring harness is not under seat suspension,

[2] - Install four bolts mounting the seat suspension to the closeout panel. Tighten cap screws specification.

Item	Measurement	Specification
Seat Support Cap Screw	Torque	20 N·m (177 lb.-in.)

[3] - Install four spacer washers and seat assembly onto seat suspension plate. Secure with two washers and lock nuts, removed earlier, on each side.

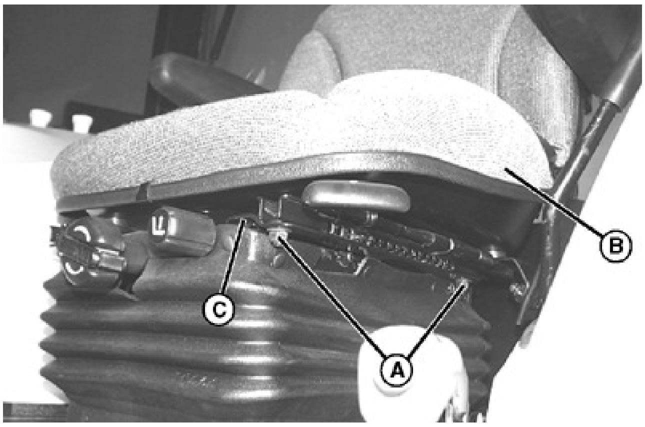
[4] - Connect main wiring harness connector to seat wiring connector.

[5] - Connect seat pump wiring connector to main wiring connector.

Seat and Support Removal and Installation—Standard (Cab)

Removal:

[1] -



LEGEND:

A	Lock Nut (2 used)
B	Seat
C	Seat Suspension Plate

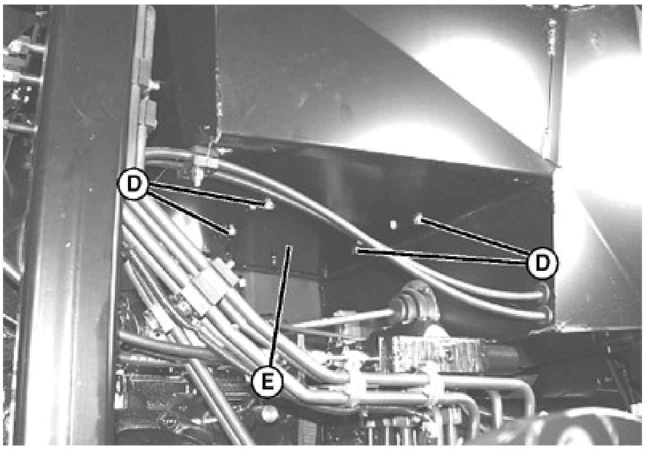
Seat and Support

Remove two lock nuts (A) and washers from seat slide assembly on each side.

[2] - Disconnect main harness connector from seat wiring harness connector.

[3] - Remove seat (B) from seat suspension plate (C). Remove and keep four spacer washers on top of seat suspension plate.

[4] -



LEGEND:

D	Bolt (4 used)
E	Seat Closeout Panel

Right Rear Wheel Shown Removed for Clarity

From below cab, remove four bolts (D) mounting the seat suspension to the seat closeout panel (E).

[5] - Remove seat suspension. Repair or replace parts as necessary.

Installation:

[1] - Place seat suspension onto top of seat closeout panel, making sure that wiring harness is not under seat suspension, .

[2] - Install four bolts mounting the seat suspension to the closeout panel. Tighten cap screws to specification.

Item	Measurement	Specification
Seat Support Cap Screws	Torque	20 N·m (177 lb.-in.)

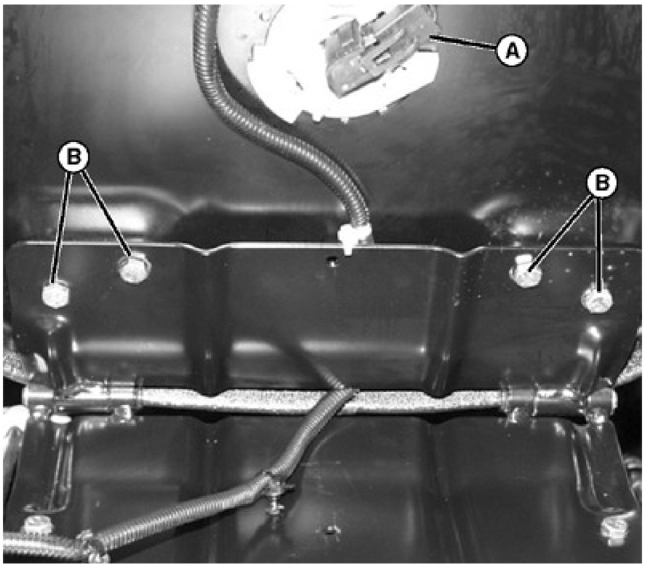
[3] - Install four spacer washers and seat assembly onto seat suspension plate, and secure with two washers and lock nuts, removed earlier, on each side.

[4] - Connect harness connector.

Seat and Support Removal and Installation (Open Station)

Removal:

[1] -



LEGEND:

A	Electrical Connector
B	Cap Screw (4 used)

Seat Pivot Plate Fasteners

Disconnect seat switch electrical connector (A) beneath seat.

[2] - Remove four cap screws (B) attaching seat pivot plate to seat. Remove seat.

[3] - Gently pry seat switch wiring harness retainers to remove from seat support. Move wiring harness out of the way.

[4] - Remove two cap screws and washers at the rear of seat support attaching seat support to rockshaft housing.

[5] - Remove two cap screws and washers at the front of seat support attaching seat support to operator platform.

[6] - Remove seat support.

Installation:

Installation is done in the reverse order of removal.

Seat Closeout Removal and Installation (Open Station)—eHydro Transmission

Removal:

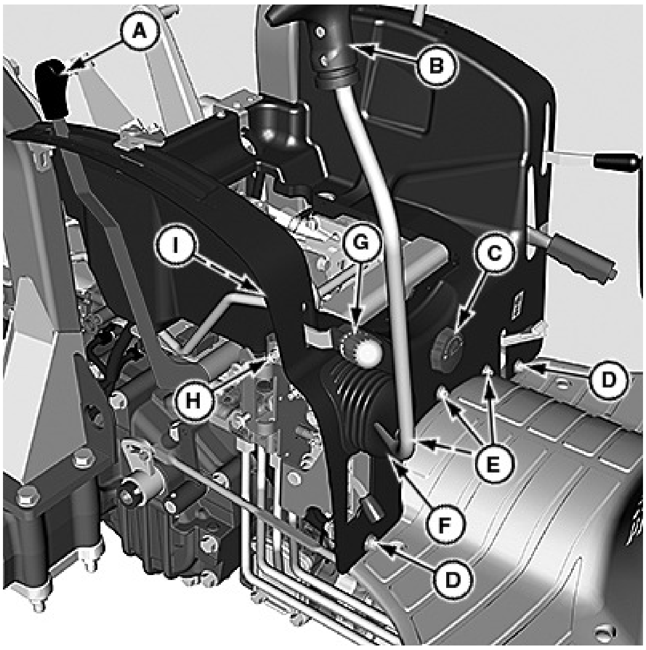
[1] - Park machine on a level surface with wheels blocked to prevent machine movement.

[2] - Remove rear wheels. See Rear Wheel Removal and Installation .

[3] - Remove rear fenders. See Rear Fenders Removal and Installation (Open Station) .

[4] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[5] -



LEGEND:

A	Rockshaft Control Lever
B	SCV Shift Grip
C	Rockshaft Rate-of-Drop Knob
D	Cap Screw (2 used)
E	Nut (3 used)
F	Boot
G	PTO Selection Control Lever Knob
H	Shoulder Bolt
I	PTO Two-Speed Shift Link

Seat Closeout

Remove knobs on the rockshaft control lever (A).

[6] - Remove SCV shift grip (B) and rubber boot (F) from SCV shift lever.

[7] - Remove rockshaft rate-of-drop knob (C) from control shaft at front edge of seat.

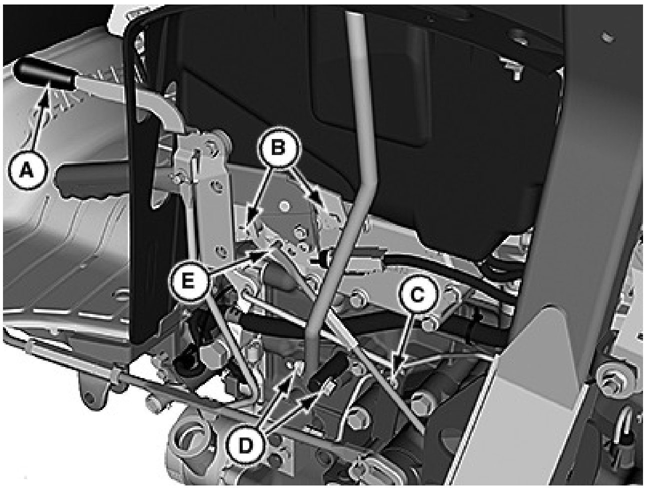
[8] - If equipped with a two-speed PTO:

a. Remove PTO selection control lever (G) knob.
b. Remove the cotter pin, washer, and two-speed PTO shift link (I) from the selection lever.
c. Remove the shoulder bolt (H) and the PTO selection control lever.

[9] - Remove three nuts (E) and washers.

[10] - Remove cap screws (D) and washers.

[11] -



LEGEND:

A	MFWD Selection Control Lever Knob
B	Cap Screw (2 used)
C	Cotter Pin and Washer
D	Cap Screw and Nut
E	Cotter Pin and Washer

Seat Closeout

Remove the cap screw and nut (D) securing the range shift lever to the shift shaft and remove shift lever.

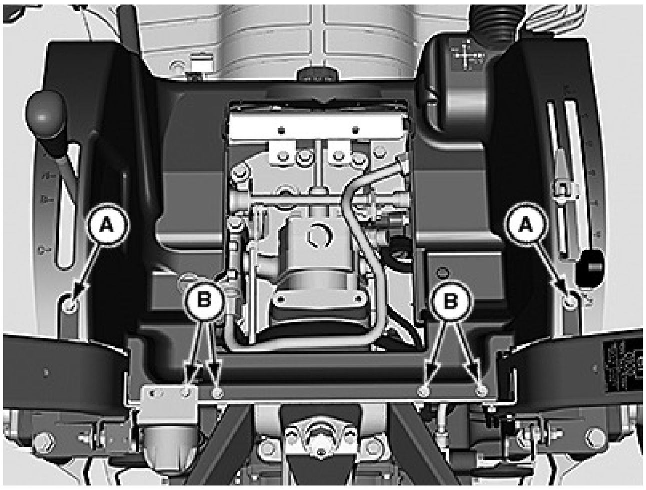
[12] - Remove MFWD selection control lever knob (A).

[13] - Remove the cotter pin and washer (C) and disconnect the differential lock link from the lock lever.

[14] - Remove the cotter pin and washer (E) and disconnect the brake link from park brake lever.

[15] - Remove the two cap screws (B) securing the park brake lever to the rockshaft.

[16] -



LEGEND:

A	Cap Screw (2 used)
B	Cap Screw (4 used)

Seat Closeout

Remove four cap screws (B) securing closeout to crossbar.

[17] - Remove cap screw (A) on each side.

[18] - Remove any other accessories and hardware that may secure the closeout to machine.

[19] -

IMPORTANT:

Avoid Damage! Gently flex the closeout panel while removing and installing. Do not over flex or the closeout panel will break.

Carefully remove closeout from machine.

Installation:

Installation is done in the reverse order of removal.

Seat Closeout Removal and Installation (Open Station)—PowrReverser Transmission

Removal:

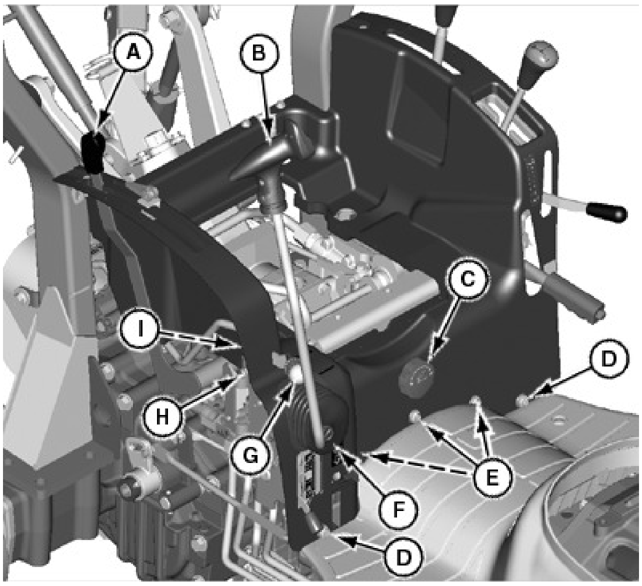
[1] - Park machine on a level surface with wheels blocked to prevent machine movement.

[2] - Remove rear wheels. See Rear Wheel Removal and Installation .

[3] - Remove rear fenders. See Rear Fenders Removal and Installation (Open Station) .

[4] - Remove seat and seat support. See Seat and Support Removal and Installation (Open Station) .

[5] -



LEGEND:
A Rockshaft Control Lever
B SCV Shift Grip
C Rockshaft Rate-of-Drop Knob
D Cap Screw (2 used)
E Nut (3 used)
F Boot
G PTO Selection Control Lever Knob
H Shoulder Bolt
I PTO Two-Speed Shift Link

PRT Seat Closeout

Remove knobs on the rockshaft control lever (A).

[6] - Remove SCV shift grip (B) and rubber boot (F) from SCV shift lever.

[7] - Remove rockshaft rate-of-drop knob (C) from control shaft at front edge of seat.

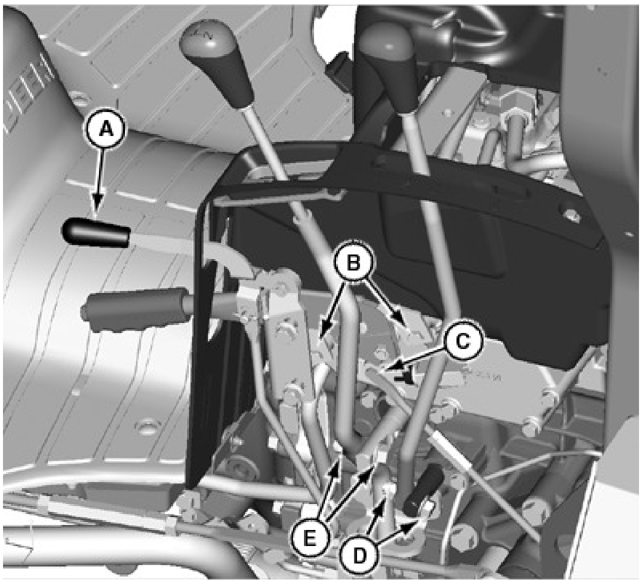
[8] - If equipped with a two-speed PTO:

a. Remove PTO selection control lever (G) knob.
b. Remove the cotter pin, washer, and two-speed PTO shift link (I) from the selection lever.
c. Remove the shoulder bolt (H) and the PTO selection control lever.

[9] - Remove three nuts (E) and washers.

[10] - Remove cap screws (D) and washers.

[11] -



LEGEND:

A MFWD Selection Control Lever Knob
B Cap Screw (2 used)
C Cotter Pin and Washer
D Cap Screw and Nut
E Cap Screw and Nut

PRT Seat Closeout

Remove the cap screw and nut (D) securing the range shift lever to the shift shaft and remove shift lever.

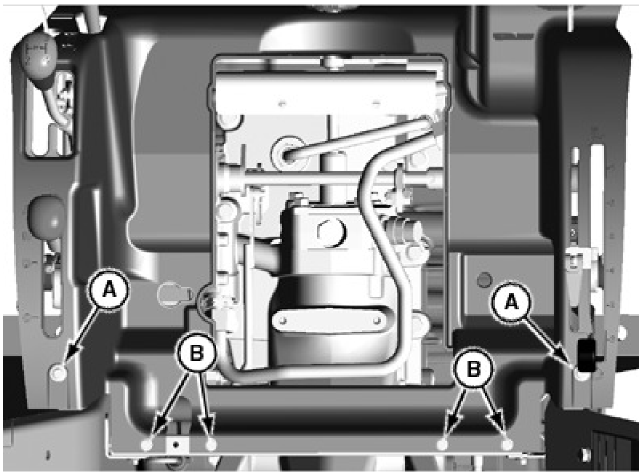
[12] - Remove the cap screw and nut (E) securing the gear shift lever to the shift rod.

[13] - Remove MFWD selection control lever knob (A).

[14] - Remove the cotter pin and washer (C) and disconnect the brake link from park brake lever.

[15] - Remove the two cap screws (B) securing the park brake lever to the rockshaft.

[16] -



LEGEND:

A Cap Screw (2 used)
B Cap Screw (4 used)

PRT Seat Closeout

Remove four cap screws (B) securing closeout to crossbar.

[17] - Remove cap screw (A) on each side.

[18] - Remove any other accessories and hardware that may secure the closeout to machine.

[19] -

> ***IMPORTANT:***
>
> ***Avoid Damage! Gently flex the closeout panel while removing and installing. Do not over flex or the closeout panel will break.***

Carefully remove closeout from machine.

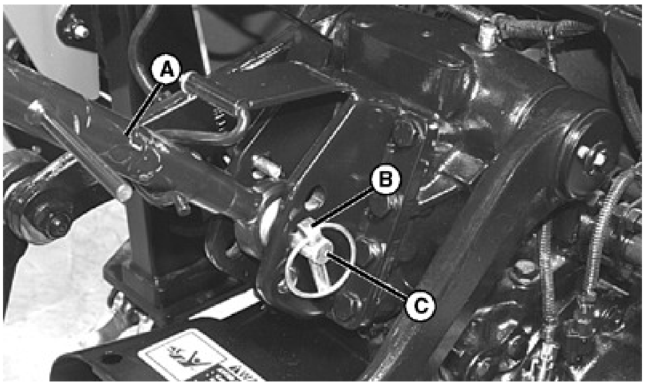
Installation:

Installation is done in the reverse order of removal.

Three Point Hitch Removal and Installation

Center Lift Link Removal:

[1] -



LEGEND:

A	Center Lift Link
B	Lynch Pin
C	Hitch Pin

Center Lift Link

Disconnect center lift link (A) from storage hook.

[2] - Remove lynch pin (B) from hitch pin (C) attaching center lift link to bracket on rockshaft.

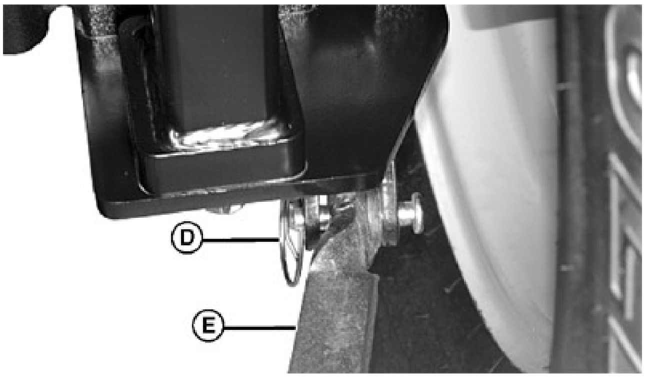
[3] - Support center lift link and remove hitch pin. Remove center lift link.

Installation:

Installation is the reverse of removal.

Draft Arm & Adjustable Sway Bar Removal:

[1] -



LEGEND:

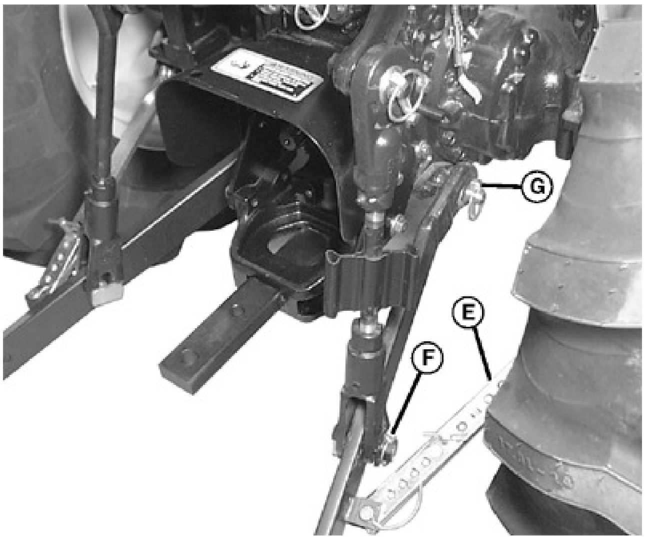
D	Spring Clip
E	Adjustable Sway Bar

Adjustable Sway Bar

Lower draft arms completely.

[2] - Remove spring clip (D) from clevis pin on front of adjustable sway bar (E). Remove clevis pin.

[3] -



LEGEND:

E	Adjustable Sway Bar
F	Lynch Pin
G	Lynch Pin

Lift Link

Remove lynch pin (F) from hitch pin on bottom of lift link. Remove retainer.

[4] - Support draft arm and adjustable sway bar (E) and remove hitch pin.

[5] - Remove lynch pin (G) from anchor pin at front of draft arm.

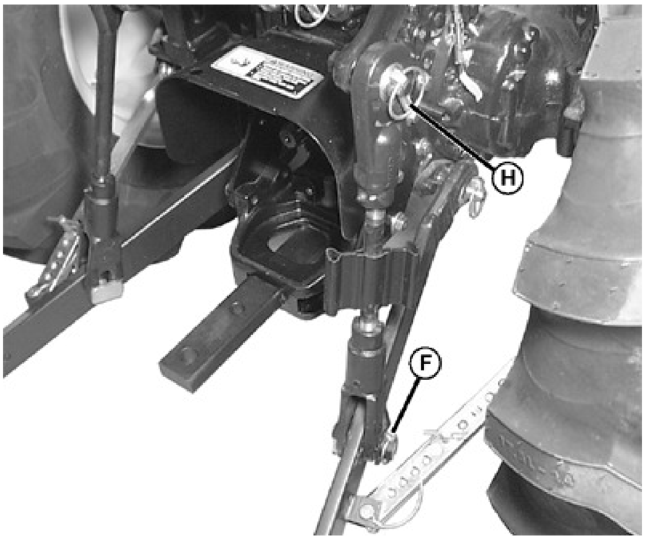
[6] - Remove adjustable sway bar and draft arm.

Installation:

Installation is the reverse of removal.

Adjustable (Right Side) and Fixed (Left Side) Lift Link Removal:

[1] -



LEGEND:

F	Lynch Pin
H	Lynch Pin

Lift Link

Remove lynch pin (F) from hitch pin on bottom of lift link. Remove lynch pin (H) from rockshaft at top of lift link.

[2] - Remove lift link.

Installation:

→NOTE:

Lower hitch pin can be installed horizontally for a fixed connection between the hitch arm and the lift link. The lower hitch pin can be installed vertically to provide movement between the hitch arm and lift link. This allows easier hookup of equipment and rear-mounted equipment to follow ground contours (side-to-side).

Installation is the reverse of removal.

Front Wheel Removal and Installation

Removal:

[1] - Loosen lug bolts slightly before raising front axle.

[2] - Raise front of machine and lower onto support stands so that machine is supported by front axle.

[3] -

→NOTE:

If the front wheels are being removed to perform work on the front axles, lower machine onto suitable stands that will support the machine by the frame.

Remove lug bolts and wheel.

Installation:

[1] - Install wheels onto axle. Insert lug bolts and partially tighten.

[2] - Raise front of machine, remove support stands, and lower machine to floor.

[3] - Tighten lug bolts to specification.

Item	Measurement	Specification
Front Wheel Lug Bolt	Torque	140 N·m (103 lb.-ft.)

Rear Wheel Removal and Installation

Removal:

[1] - Loosen lug bolts slightly before raising machine rear axle.

[2] - Raise rear of machine and lower onto support stands so that machine is supported by rear axle.

[3] - Remove lug bolts and wheel.

Installation:

[1] - Install wheels onto axle, insert lug bolts, and partially tighten.

[2] - Raise rear of machine, remove support stands, and lower machine to floor.

[3] - Tighten lug bolts to specification.

Item	Measurement	Specification
Rear Wheel Lug Bolt	Torque	140 N·m (103 lb.-ft.)