9R (S. N. 015000—055999) and 9RX (S.N. 800000—803999) Tractors Diagnostic

DIAGNOSTIC TECHNICAL MANUAL
9R (S. N. 015000—055999) and 9RX (S.N. 800000—803999) Tractors

TM119419 09OCT19 (ENGLISH)

John Deere Waterloo Works
PRINTED IN U.S.A.

Introduction

Foreword

The diagnostic technical manual is written for an experienced technician. Essential tools required to perform certain type of work are identified in Section 300, 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.

This is the safety-alert symbol. When the symbol is shown on the equipment or in a manual, be alert to the potential for personal injury.

Diagnostic technical manuals are comprised of general information, checks, theory of operation, schematic and diagnostic procedures. Sections in a diagnostic technical manual help quickly identify the likely cause of routine failures. Component sections include images of the component or connector and location on the equipment.

The diagnostic technical manual references component manuals and repair technical manuals. Repair technical manuals are organized for various components requiring service instruction.

Both diagnostic and repair technical manuals are concise guides for specific equipment. They are on-the-job instructions containing vital information to diagnose, analyze, test, and repair the equipment.

DX,DIAGTM,IFC -19-08DEC11-1/1

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Original Instructions. All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

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Section 210
General Information

Contents

Recognize Safety Information

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.

T81389 —UN—28JUN13

DX,ALERT -19-29SEP98-1/1

Understand Signal Words

TS187 —19—30SEP88

DANGER; The signal word DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING; The signal word WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION; The signal word CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION may also be used to alert against unsafe practices associated with events which could lead to personal injury.

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.

DX,SIGNAL -19-05OCT16-1/1

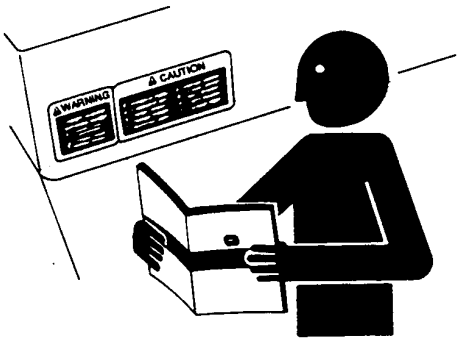
Follow Safety Instructions

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.



TS201 —UN—15APR13

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

DX,READ -19-16JUN09-1/1

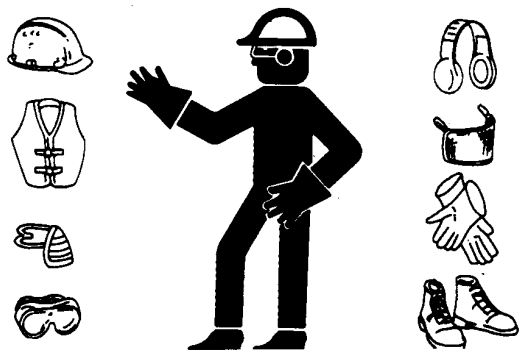
Wear Protective Clothing

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

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.

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



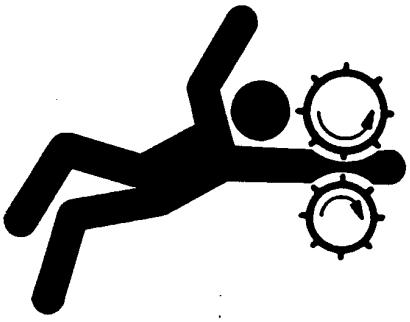
TS206 —UN—15APR13

DX,WEAR -19-10SEP90-1/1

Service Machines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 —UN—23AUG88

DX,LOOSE -19-04JUN90-1/1

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep all shields in place at all times. Make sure rotating shields turn freely.

Wear close-fitting clothing. Stop the engine and be sure that all rotating parts and drivelines are stopped before making adjustments, connections, or performing any type of service on engine or machine driven equipment.

TS1644 —UN—22AUG95

DX,ROTATING -19-18AUG09-1/1

Handle Fluids Safely—Avoid Fires

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 —UN—15APR13

DX,FLAME -19-29SEP98-1/1

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

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

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

TS204 —UN—15APR13

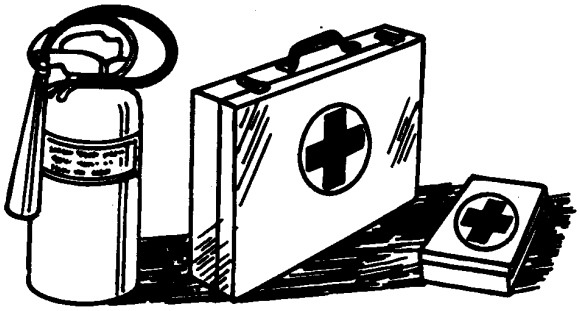
DX,SPARKS -19-03MAR93-1/1

Prepare for Emergencies

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.



TS291 —UN—15APR13

DX,FIRE2 -19-03MAR93-1/1

Remove Paint Before Welding or Heating

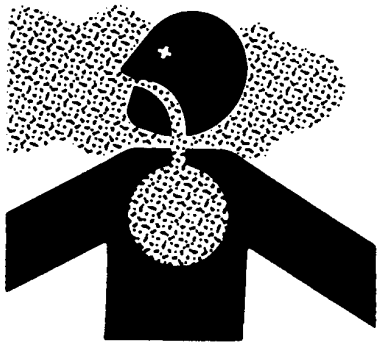
Avoid potentially toxic fumes and dust.

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.



TS220 —UN—15APR13

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

Dispose of paint and solvent properly.

DX,PAINT -19-24JUL02-1/1

Avoid Heating Near Pressurized Fluid Lines

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.

TS953 —UN—15MAY90

DX,TORCH -19-10DEC04-1/1

Handle Starting Fluid 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.

Do not use starting fluid on an engine equipped with glow plugs or an air intake heater.

TS1356 —UN—18MAR92

DX,FIRE3 -19-14MAR14-1/1

In Case of Fire

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:

TS227 —UN—15APR13

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.

DX,FIRE4 -19-22AUG13-1/1

Avoid Static Electricity Risk When Refueling

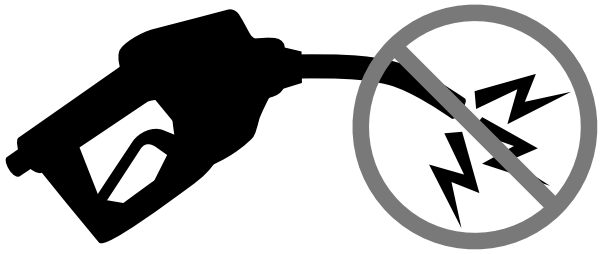
The removal of sulfur and other compounds in Ultra-Low Sulfur Diesel (ULSD) fuel decreases its conductivity and increases its ability to store a static charge.

Refineries may have treated the fuel with a static dissipating additive. However, there are many factors that can reduce the effectiveness of the additive over time.

Static charges can build up in ULSD fuel while it is flowing through fuel delivery systems. Static electricity discharge when combustible vapors are present could result in a fire or explosion.

Therefore, it is important to ensure that the entire system used to refuel your machine (fuel supply tank, transfer pump, transfer hose, nozzle, and others) is properly grounded and bonded. Consult with your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

RG22142 —UN—17MAR14



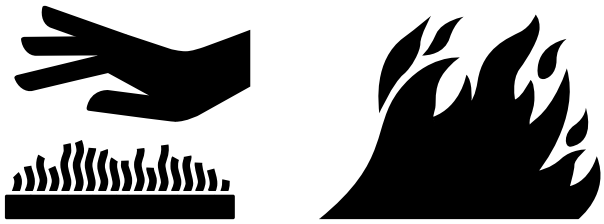
RG21992 —UN—21AUG13

DX,FUEL,STATIC,ELEC -19-12JUL13-1/1

Avoid Hot Exhaust

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.



RG17488 —UN—21AUG09

DX,EXHAUST -19-20AUG09-1/1

Clean Exhaust Filter Safely

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:

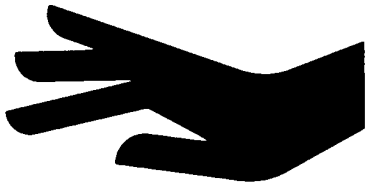
- Only engage power-driven parts required by service procedure
- Ensure that other people are clear of operator station and machine

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

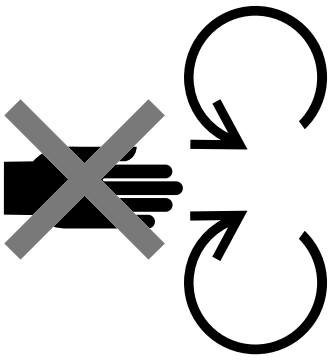
Always disable movement (neutral), set the parking brake or mechanism and disconnect power to attachments or tools before leaving the operator's station.

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

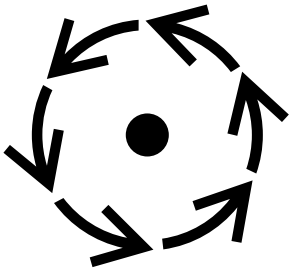
TS227 —UN—15APR13



TS271 —UN—23AUG88



TS1693 —UN—09DEC09



TS1695 —UN—07DEC09

DX,EXHAUST,FILTER -19-12JAN11-1/1

Prevent Acid Burns

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

Avoid the hazard by:

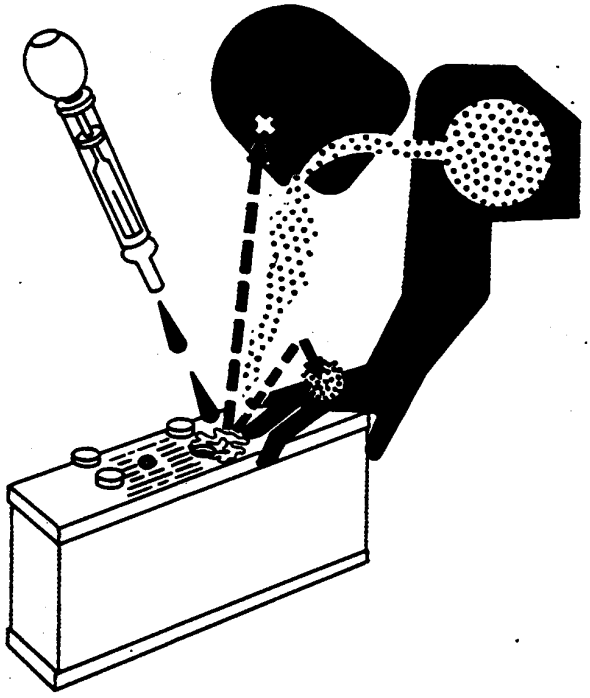
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your 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 quarts).
3. Get medical attention immediately.



TS203 —UN—23AUG88

DX,POISON -19-21APR93-1/1

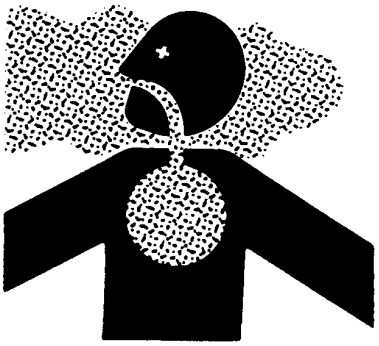
Handle Agricultural Chemicals Safely

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.



TS220 —UN—15APR13

A34471 —UN—11OCT88

- 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.

DX,WW,CHEM01 -19-24AUG10-1/1

Clean Vehicle of Hazardous Pesticides

CAUTION: During application of hazardous pesticides, pesticide residue can build up on the inside or outside of the vehicle. Clean vehicle according to use instructions of hazardous pesticides.

When exposed to hazardous pesticides, clean exterior and interior of vehicle daily to keep free of the accumulation of visible dirt and contamination.

1. Sweep or vacuum the floor of cab.
2. Clean headliners and inside cowlings of cab.
3. Wash entire exterior of vehicle.
4. Dispose of any wash water with hazardous concentrations of active or non-active ingredients according to published regulations or directives.

DX,CABS2 -19-24JUL01-1/1

Handling Batteries Safely

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:

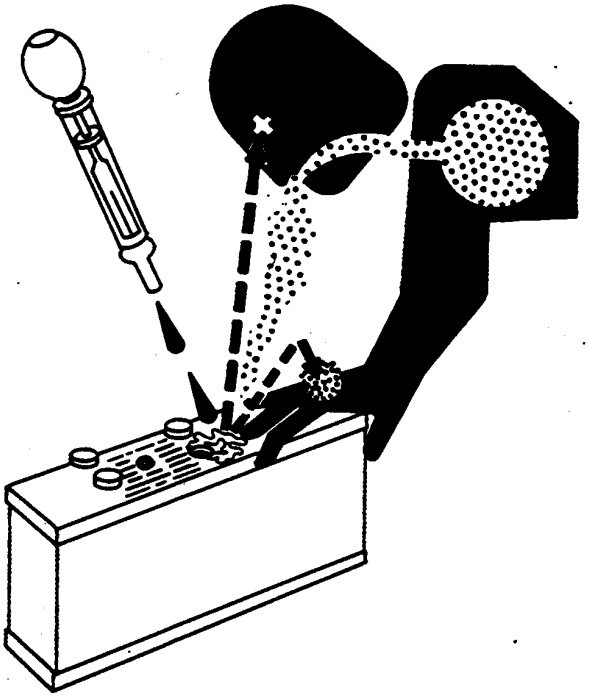
1. Flush skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush eyes with water for 15—30 minutes. Get medical attention immediately.

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.**

TS204 —UN—15APR13



TS203 —UN—23AUG88

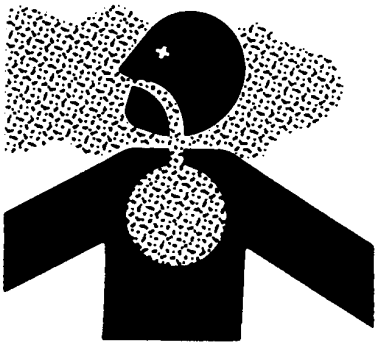
DX,WW,BATTERIES -19-02DEC10-1/1

Avoid Harmful Asbestos Dust

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos.



TS220 —UN—15APR13

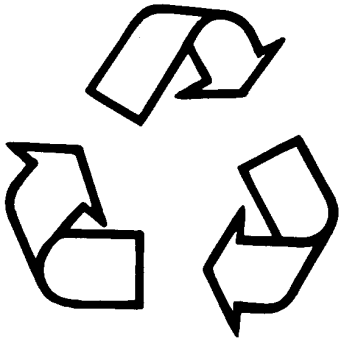
Keep bystanders away from the area.

DX,DUST -19-15MAR91-1/1

Decommissioning — Proper Recycling and Disposal of Fluids and Components

Safety and environmental stewardship measures must be taken into account when decommissioning a machine and/or component. These measures include the following:

- Use appropriate tools and personal protective equipment such as clothing, gloves, face shields or glasses, during the removal or handling of objects and materials.
- Follow instructions for specialized components.
- Release stored energy by lowering suspended machine elements, relaxing springs, disconnecting the battery or other electrical power, and releasing pressure in hydraulic components, accumulators, and other similar systems.
- Minimize exposure to components which may have residue from agricultural chemicals, such as fertilizers and pesticides. Handle and dispose of these components appropriately.
- Carefully drain engines, fuel tanks, radiators, hydraulic cylinders, reservoirs, and lines before recycling components. Use leak-proof containers when draining fluids. Do not use food or beverage containers.
- Do not pour waste fluids onto the ground, down a drain, or into any water source.
- Observe all national, state, and local laws, regulations, or ordinances governing the handling or disposal of waste fluids (example: oil, fuel, coolant, brake fluid);



TS1133 —UN—15APR13

filters; batteries; and, other substances or parts. Burning of flammable fluids or components in other than specially designed incinerators may be prohibited by law and could result in exposure to harmful fumes or ashes.
- Service and dispose of air conditioning systems appropriately. Government regulations may require a certified service center to recover and recycle air conditioning refrigerants which could damage the atmosphere if allowed to escape.
- Evaluate recycling options for tires, metal, plastic, glass, rubber, and electronic components which may be recyclable, in part or completely.
- Contact your local environmental or recycling center, or your John Deere dealer for information on the proper way to recycle or dispose of waste.

DX,DRAIN -19-01JUN15-1/1

Avoid High-Pressure Fluids

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.

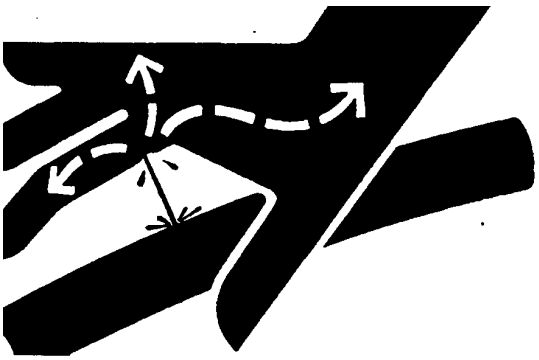
Replace worn or damaged hose assemblies immediately with John Deere approved replacement parts.

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.



X9811 —UN—23AUG88

DX,FLUID -19-12OCT11-1/1

Wait Before Opening High-Pressure Fuel System

High-pressure fluid remaining in fuel lines can cause serious injury. Only technicians familiar with this type of system should perform repairs. Before disconnecting 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, confirm that the fuel pressure is relieved.

TS1343 —UN—18MAR92

DX,WW,HPCR2 -19-09SEP14-1/1

Diesel Exhaust Fluid (DEF) — Use in Selective Catalytic Reduction (SCR) Equipped Engines

In order to maintain the emissions performance of the engine, it is essential to use and refill DEF in accordance with the specification.

Diesel exhaust fluid (DEF) is a high purity liquid that is injected into the exhaust system of engines equipped with selective catalytic reduction (SCR) systems. Maintaining the purity of DEF is important to avoid malfunctions in the SCR system. Engines requiring DEF shall use a product that meets the requirements for aqueous urea solution 32 (AUS 32) according to ISO 22241-1.

The use of John Deere Diesel Exhaust Fluid is recommended. John Deere Diesel Exhaust Fluid is available at your John Deere dealer in a variety of package sizes to suit your operational needs.

If John Deere Diesel Exhaust Fluid is not available, use DEF that is certified by the American Petroleum Institute (API) Diesel Exhaust Fluid Certification Program or by the AdBlue™ Diesel Exhaust Fluid Certification Program. Look for the API certification symbol or the AdBlue™ name on the container.

AdBlue is a trademark of VDA, the German Association of the Automotive Industry.

RG30211 —UN—08MAR18

In some cases, DEF is referred to by one or more of these names:

- Urea
- Aqueous Urea Solution 32
- AUS 32
- AdBlue™
- NOx Reduction Agent
- Catalyst Solution

DX,DEF -19-13JAN18-1/1

Disposal of Diesel Exhaust Fluid (DEF)

Although there is little issue with minor spillage of DEF on the ground, large amounts of DEF should be contained. If large spills occur, contact local environmental authorities for assistance with clean-up.

If a substantial quantity of DEF is not within specification, contact the DEF supplier for assistance with disposal. Do not dump substantial quantities of DEF onto the ground or send DEF to wastewater treatment facilities.

DX,DEF,DISPOSE -19-13JUN13-1/1

Refilling Diesel Exhaust Fluid (DEF) Tank

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

Do not ingest DEF. In the event DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

TS1731 —UN—23AUG13

IMPORTANT: Use only distilled water to rinse components that are used to deliver DEF. Tap water can contaminate DEF. If distilled water is not available, rinse with clean tap water, then thoroughly rinse with ample amounts of DEF.

If DEF is spilled or contacts any surface other than the storage tank, immediately clean the surface with clear water. DEF is corrosive to painted and unpainted metallic surfaces and can distort some plastic and rubber components.

If DEF is filled into engine fuel tank or other fluid compartment, do not operate engine until system is properly purged of DEF. Contact your John Deere dealer immediately to determine how to clean and purge the system.

Reasonable care should be taken when refilling the DEF tank. Ensure that the DEF tank cap area is free of debris before removing the cap. Seal containers of DEF between use to prevent contamination and evaporation.

Avoid splashing DEF and do not allow DEF to come into contact with skin, eyes, or mouth.

DEF is not harmful to handle, but DEF can be corrosive to materials such as steel, iron, zinc, nickel, copper, aluminum, and magnesium. Use suitable containers to transport and store DEF. Containers made of polyethylene, polypropylene, or stainless steel are recommended.

Avoid prolonged contact with skin. In case of accidental contact, wash skin immediately with soap and water.

Keep anything used to store or dispense DEF clean of dirt and dust. Wash and rinse containers or funnels thoroughly with distilled water to remove contaminants.

If an unapproved fluid, such as diesel fuel or coolant is added to the DEF tank, contact your John Deere dealer immediately to determine how to clean and purge the system.

If water has been added to the DEF tank, a tank cleaning is necessary. See Cleaning DEF Tank in this manual. After refilling the tank, check the DEF concentration. See Testing Diesel Exhaust Fluid (DEF).

The operator must maintain appropriate DEF levels at all times. Check the DEF level daily and refill the tank as needed. A typical engine with EGR will consume approximately 40:1 Fuel:DEF and without EGR 15:1 Fuel:DEF (by volume). The filling port is identified by a blue colored cap embossed with the DEF symbol, shown.

DX,DEF,REFILL -19-13JAN18-1/1

Storing Diesel Exhaust Fluid (DEF)

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

Do not ingest DEF. In the event DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

IMPORTANT: It is unlawful to tamper with or remove any component of the aftertreatment system. Do not use DEF that does not meet the required specifications or operate the engine with no DEF.

Never attempt to create DEF by mixing agricultural grade urea with water. Agricultural grade urea does not meet the necessary specifications and can damage the aftertreatment system.

Do not add any chemicals or additives to DEF in an effort to prevent freezing. Any chemicals or additives added to DEF can damage the aftertreatment system.

Never add water or any other fluid in place of, or in addition to DEF. Operating with a modified DEF or using an unapproved DEF can damage the aftertreatment system.

The following storage information is provided for reference and is to be used as a guideline only.

It is preferred to store DEF out of extreme ambient temperatures. DEF freezes at –11 °C (12 °F). Exposure to temperatures greater than 30 °C (86 °F) can degrade DEF over time.

Dedicated DEF storage containers must be sealed between uses to prevent evaporation and contamination. Containers made of polyethylene, polypropylene, or stainless steel are recommended to transport and store DEF.

Ideal conditions for storage of DEF are:
- Store at temperatures between –5 °C and 30 °C (23 °F and 86 °F)
- Store in dedicated containers sealed to avoid contamination and evaporation

Under these conditions, DEF is expected to remain useable for a minimum of 18 months. Storing DEF at higher temperatures can reduce its useful life by approximately 6 months for every 5 °C (9 °F) temperature above 30 °C (86 °F).

If unsure how long or under what conditions DEF has been stored, test DEF. See Testing Diesel Exhaust Fluid (DEF).

Long-term storage in the DEF tank (over 12 months) is not recommended. If long-term storage is necessary, test DEF prior to operating engine. See Testing Diesel Exhaust Fluid (DEF).

It is recommended to purchase DEF in quantities that will be consumed within 12 months.

DX,DEF,STORE -19-13JUN13-1/1

Testing Diesel Exhaust Fluid (DEF)

IMPORTANT: Using DEF with the correct concentration is critical to engine and aftertreatment system performance. Extended storage and other conditions can adversely alter the DEF concentration.

If DEF quality is questionable, draw a sample out of the DEF tank or storage tank into a clear container. DEF must be crystal clear with a light ammonia smell. If DEF appears cloudy, has a colored tint, or has a profound ammonia smell, it is likely not within specification. DEF in this condition should not be used. Drain tank, flush with distilled water and refill with new or good DEF. After refilling the tank, check the DEF concentration.

If the DEF passes the visual and smell test, check the DEF concentration with a handheld refractometer calibrated to measure DEF.

DEF concentration should be checked when the engine has been stored for extended periods, or if there is suspicion the engine or packaged DEF fluid has been contaminated with water.

Two approved tools are available through your John Deere dealer:
- JDG11594 Digital DEF Refractometer—A digital tool providing an easy to read concentration measurement
- JDG11684 DEF Refractometer—Low-cost alternative tool providing an analog reading

Follow instructions included with either tool to obtain the measurement.

The correct DEF concentration is 31.8—33.2% urea. If the DEF concentration is not within specification, drain the DEF tank, flush with distilled water and fill with new or good DEF. If packaged DEF is not within specification, dispose of DEF packages and replace with new or good DEF.

DX,DEF,TEST -19-13JUN13-1/1

Service Accumulator Systems Safely

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.

TS281 —UN—15APR13

DX,WW,ACCLA2 -19-22AUG03-1/1

Protect Against High Pressure Spray

Spray from high pressure nozzles can penetrate the skin and cause serious injury. Keep spray from contacting hands or body.

If an accident occurs, see a doctor immediately. Any high pressure spray 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.

TS1343 —UN—18MAR92

DX,SPRAY -19-16APR92-1/1

Service Cooling System Safely

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.

TS281 —UN—15APR13

DX,WW,COOLING -19-19AUG09-1/1

Prevent Machine 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.

TS177 —UN—11JAN89

DX,BYPAS1 -19-29SEP98-1/1

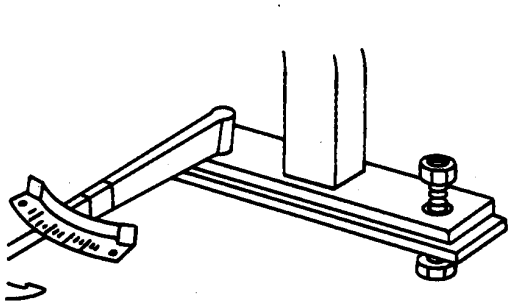
Keep ROPS Installed Properly

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.



TS212 —UN—23AUG88

DX,ROPS3 -19-12OCT11-1/1

Use Seat Belt Properly

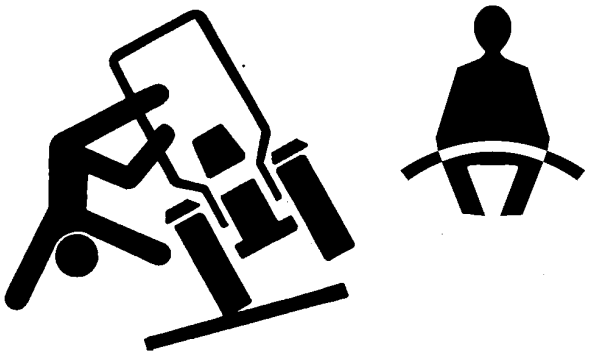
Avoid crushing injury or death during rollover.

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.



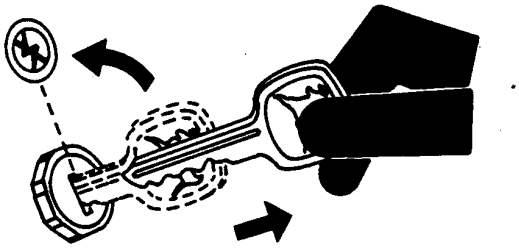
TS1729 —UN—24MAY13

DX,ROPS1 -19-22AUG13-1/1

Park Machine Safely

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.



TS230 —UN—24MAY89

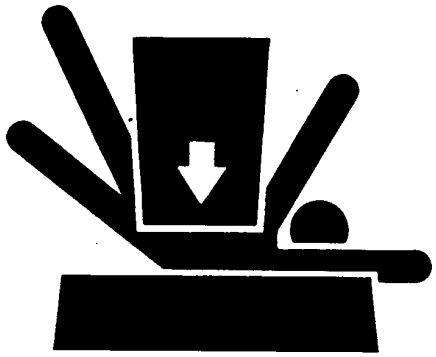
DX,PARK -19-04JUN90-1/1

Support Machine 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.



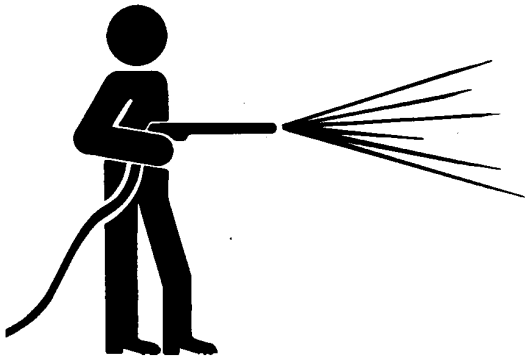
TS229 —UN—23AUG88

DX,LOWER -19-24FEB00-1/1

Work in Clean Area

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



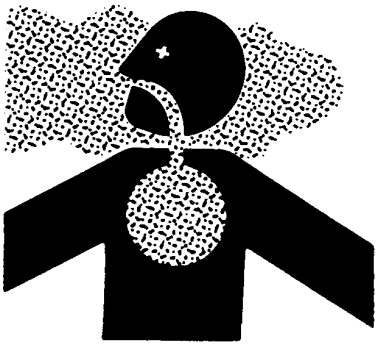
T6642EJ —UN—18OCT88

DX,CLEAN -19-04JUN90-1/1

Work In Ventilated Area

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.

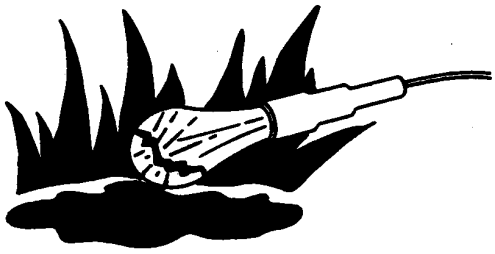


TS220 —UN—15APR13

DX,AIR -19-17FEB99-1/1

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



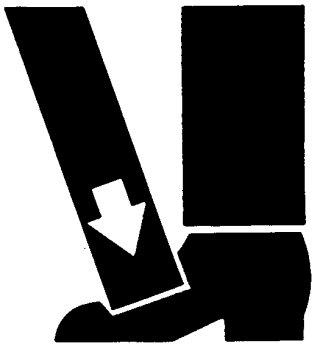
TS223 —UN—23AUG88

DX,LIGHT -19-04JUN90-1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



TS226 —UN—23AUG88

DX,LIFT -19-04JUN90-1/1

Service Tires Safely

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

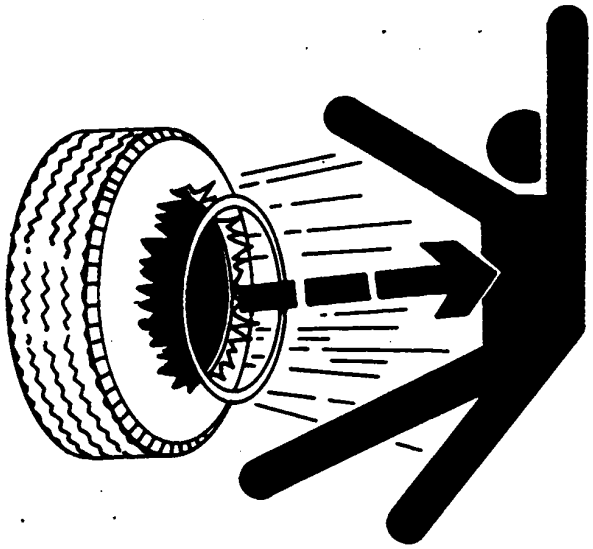
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

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.

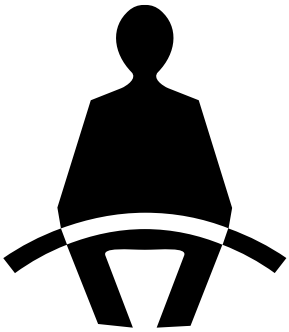


TS211 —UN—15APR13

DX,RIM1 -19-27OCT08-1/1

Instructional Seat

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



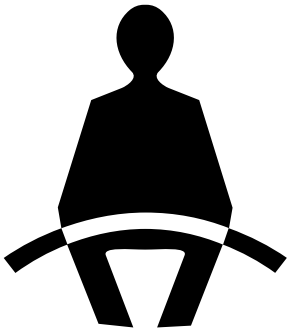
TS1730 —UN—24MAY13

DX,SEAT,NA -19-22AUG13-1/1

Passenger Seat

The passenger seat is intended only for transport of a passenger in on-road operations (that is, transport from farm to field).

If it is necessary to transport a passenger, the passenger seat is the only means of transporting a passenger provided by John Deere.

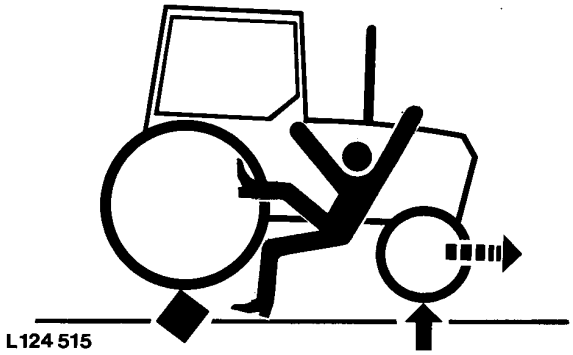


TS1730 —UN—24MAY13

DX,SEAT,EU -19-28FEB17-1/1

Service Front-Wheel Drive Tractor Safely

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.



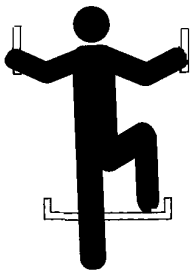
L124515 —UN—06AUG94

DX,WW,MFWD -19-19AUG09-1/1

Use Steps and Handholds Correctly

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.



T133468 —UN—15APR13

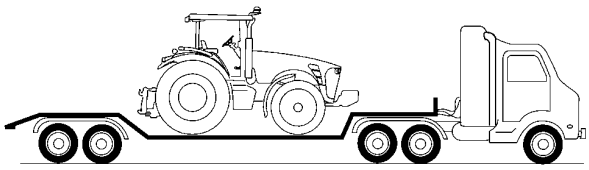
DX,WW,MOUNT -19-12OCT11-1/1

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.



RXA0103709 —UN—01JUL09

DX,WW,TRANSPORT -19-19AUG09-1/1

Practice Safe Maintenance

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 away 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.

Falling while cleaning or working at height can cause serious injury. Use a ladder or platform to easily reach each location. Use sturdy and secure footholds and handholds.

TS218 —UN—23AUG88

DX,SERV -19-28FEB17-1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.

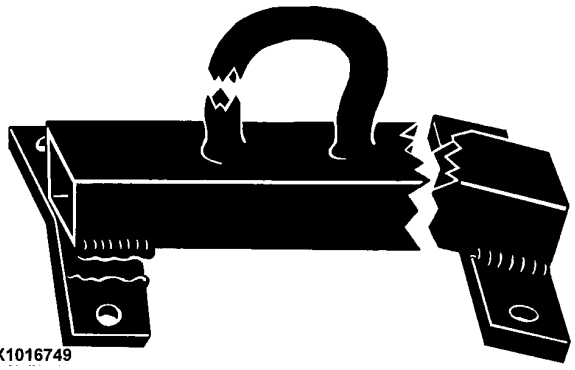
TS779 —UN—08NOV89

DX,REPAIR -19-17FEB99-1/1

Construct Dealer-Made Tools Safely

Faulty or broken tools can result in serious injury. When constructing tools, use proper, quality materials, and good workmanship.

Do not weld tools unless you have the proper equipment and experience to perform the job.

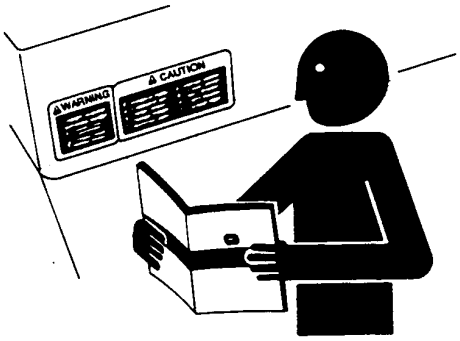


LX1016749 —UN—01JUL97

DX,SAFE,TOOLS -19-10OCT97-1/1

Replace Safety Signs

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



TS201 —UN—15APR13

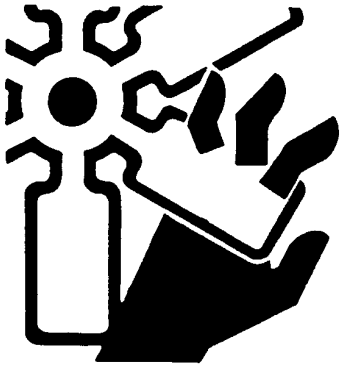
DX,SIGNS1 -19-04JUN90-1/1

Install All Guards

Rotating cooling system fans, belts, pulleys, and drives can cause serious injury.

Keep all guards in place at all times during engine operation.

Wear close-fitting clothes. Stop the engine and be sure fans, belts, pulleys, and drives are stopped before making adjustments, connections, or cleaning near fans and their drive components.



TS677 —UN—21SEP89

DX,GUARDS -19-18AUG09-1/1

Live With Safety

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

TS231 —19—07OCT88

DX,LIVE -19-25SEP92-1/1

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TLS™	Trademark of Deere and Company
TLS™ Plus	Trademark of Deere and Company
TouchSet™	Trademark of Deere and Company
Vari-Cool™	Trademark of Deere and Company
Weather Pack™	Trademark of Packard Electric
YAZAKI™	Trademark of Yazaki Corporation

RX33672,0000DEE -19-19AUG19-2/2

Information Available in Sections, Groups and Subgroups

IMPORTANT: Troubleshoot the equipment one problem at a time. Repairing one system problem could solve a problem in several systems.

NOTE: If it is determined that a problem is not in a specific section (system), the diagnostic procedure references another, more appropriate section.

Each section identifies a major category or system. Sections ending in the number nine contain connector information, component identification, and location photographs for the various systems. For example, Section 249 contains electrical connector and component information and Section 279 contains hydraulic component identification and location.

Within each section, the manual is divided into groups and subgroups with blocks of information.

Groups 05 contain general information, specifications, standard symbols, or other information not associated with a specific system.

Groups 10 contain reference material utilized in diagnostic routines.Groups 10 contain the following information:

- Observable Symptoms/System Diagnostics
- Calibration Procedures
- Preliminary Checks
- Operational Checks
- Tests and Adjustments

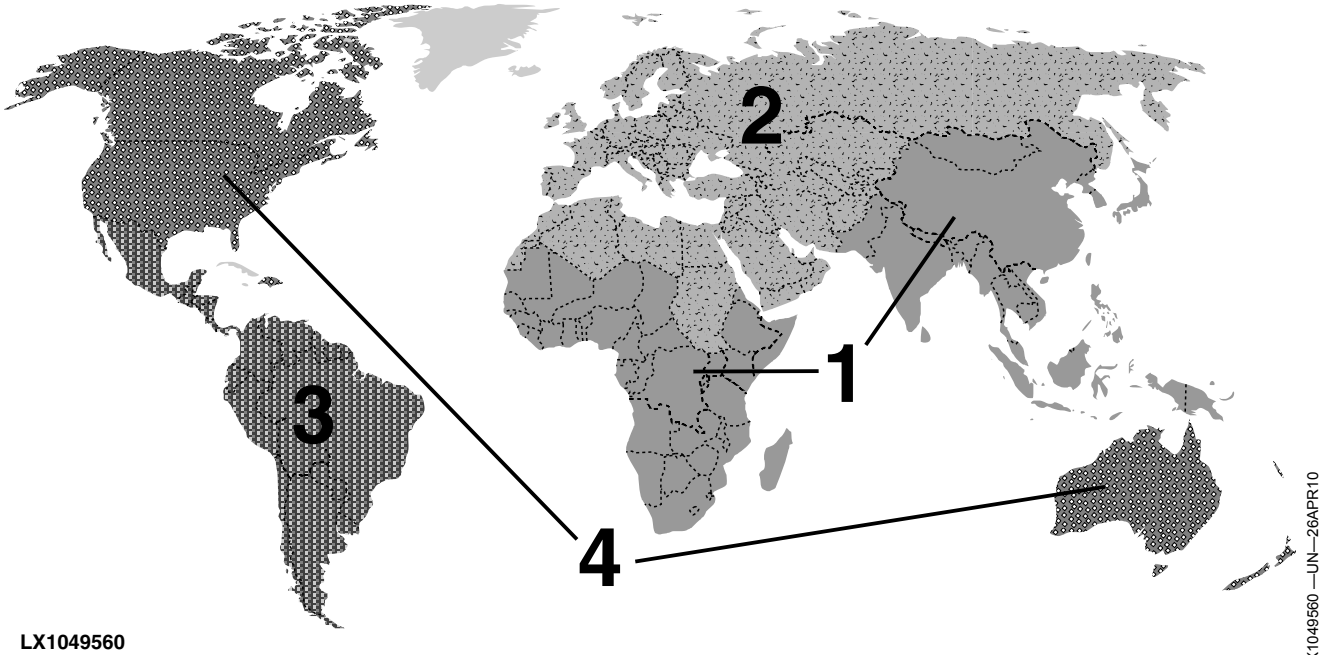
Groups 20 contain THEORY OF OPERATION. The theory of operation gives a quick look at what the system does and more detailed information about how the system operates.

Groups 30 contain SCHEMATICS. The schematic is a graphical representation of the system, components, and layout. Each component represented on the schematic has a unique name and designator used for identifying parts in the diagnostic routine. These names could be different than the names used in conversation or in marketing literature.

Groups 50 contain DIAGNOSTIC ROUTINES. The diagnostic procedures provide detailed step-by-step instructions to help isolate failed components.

DX,TM,SEC,GRP -19-11MAY11-1/1

Regions and Countries



LX1049560

Region 1—China, India, South and East Asia, Africa except for North Africa

Region 2—Europe, GUS States including Russia, North Africa, Near and Middle East

Region 3—South America, Central America

Region 4—North America, Australia, New Zealand

Tractors in Regions 1, 2 and 3 are equipped with **ECE** (ECONOMIC COMMISSION FOR EUROPE) electrical systems.

Tractors in Region 4 are equipped with **SAE** (SOCIETY OF AUTOMOTIVE ENGINEERS) electrical systems.

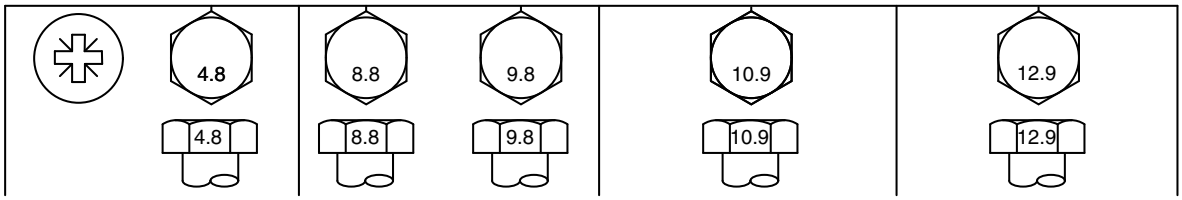
NOTE: The main difference between ECE and SAE electrical systems is the turn-signal light. Tractors with SAE electrics have the turn-signal lights mounted in the cab roof. The turn-signal lights operate in different ways. With SAE electrics, the turn signal flashes on the side selected, while the light on the opposite side comes on but does not flash. With ECE electrics, all that happens is that the turn signal flashes on the side selected.

There is one more difference concerning the lighting system. Tractors with ECE electrics have parking lights while those with SAE electrics do not.

RX33672,0000991 -19-29MAY13-1/1

Metric Bolt and Screw Torque Values

TS1742 —UN—31MAY18



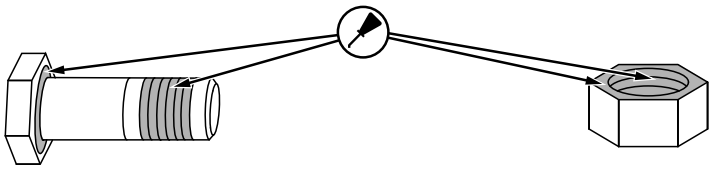
Bolt or Screw Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Hex Head[a]		Flange Head[b]		Hex Head[a]		Flange Head[b]		Hex Head[a]		Flange Head[b]		Hex Head[a]		Flange Head[b]	
	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in
M6	3.6	31.9	3.9	34.5	6.7	59.3	7.3	64.6	9.8	86.7	10.8	95.6	11.5	102	12.6	112
									N·m	lb·ft	N·m	lb·ft	N·m	lb·ft	N·m	lb·ft
M8	8.6	76.1	9.4	83.2	16.2	143	17.6	156	23.8	17.6	25.9	19.1	27.8	20.5	30.3	22.3
			N·m	lb·ft	N·m	lb·ft	N·m	lb·ft								
M10	16.9	150	18.4	13.6	31.9	23.5	34.7	25.6	46.8	34.5	51	37.6	55	40.6	60	44.3
	N·m	lb·ft														
M12	—	—	—	—	55	40.6	61	45	81	59.7	89	65.6	95	70.1	105	77.4
M14	—	—	—	—	87	64.2	96	70.8	128	94.4	141	104	150	111	165	122
M16	—	—	—	—	135	99.6	149	110	198	146	219	162	232	171	257	190
M18	—	—	—	—	193	142	214	158	275	203	304	224	322	245	356	263
M20	—	—	—	—	272	201	301	222	387	285	428	316	453	334	501	370
M22	—	—	—	—	365	263	405	299	520	384	576	425	608	448	674	497
M24	—	—	—	—	468	345	518	382	666	491	738	544	780	575	864	637
M27	—	—	—	—	683	504	758	559	973	718	1080	797	1139	840	1263	932
M30	—	—	—	—	932	687	1029	759	1327	979	1466	1081	1553	1145	1715	1265
M33	—	—	—	—	1258	928	1398	1031	1788	1319	1986	1465	2092	1543	2324	1714
M36	—	—	—	—	1617	1193	1789	1319	2303	1699	2548	1879	2695	1988	2982	2199

The nominal torque values listed are for general use only with the assumed wrenching accuracy of 20%, such as a manual torque wrench.
DO NOT use these values if a different torque value or tightening procedure is given for a specific application.
For lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application.

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 that fastener threads are clean.
- Apply a thin coat of Hy-Gard™ or equivalent oil under the head and on the threads of the fastener, as shown in the following image.
- Be conservative with the amount of oil to reduce the potential for hydraulic lockup in blind holes due to excessive oil.
- Properly start thread engagement.

TS1741 —UN—22MAY18



[a]Hex head column values are valid for ISO 4014 and ISO 4017 hex head, ISO 4162 hex socket head, and ISO 4032 hex nuts.
[b]Hex flange column values are valid for ASME B18.2.3.9M, ISO 4161, or EN 1665 hex flange products.

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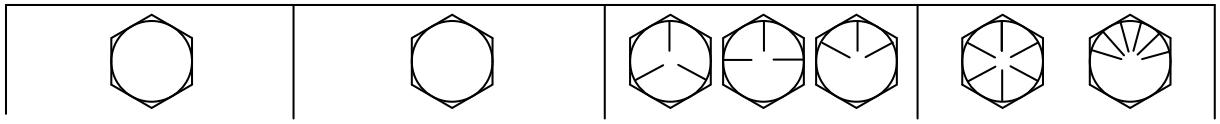
Unified Inch Bolt and Screw Torque Values

TS1671 —UN—01MAY03



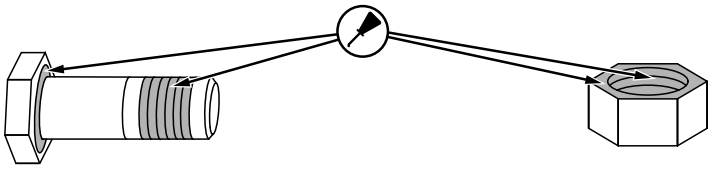
Bolt or Screw Size	SAE Grade 1[a]				SAE Grade 2[b]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
	Hex Head[c]		Flange Head[d]		Hex Head[c]		Flange Head[d]		Hex Head[c]		Flange Head[d]		Hex Head[c]		Flange Head[d]	
	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in	N·m	lb·in
1/4	3.1	27.3	3.2	28.4	5.1	45.5	5.3	47.3	7.9	70.2	8.3	73.1	11.2	99.2	11.6	103
													N·m	lb·ft	N·m	lb·ft
5/16	6.1	54.1	6.5	57.7	10.2	90.2	10.9	96.2	15.7	139	16.8	149	22.2	16.4	23.7	17.5
									N·m	lb·ft	N·m	lb·ft				
3/8	10.5	93.6	11.5	102	17.6	156	19.2	170	27.3	20.1	29.7	21.9	38.5	28.4	41.9	30.9
					N·m	lb·ft	N·m	lb·ft								
7/16	16.7	148	18.4	163	27.8	20.5	30.6	22.6	43	31.7	47.3	34.9	60.6	44.7	66.8	49.3
	N·m	lb·ft	N·m	lb·ft												
1/2	25.9	19.1	28.2	20.8	43.1	31.8	47	34.7	66.6	49.1	72.8	53.7	94	69.3	103	75.8
9/16	36.7	27.1	40.5	29.9	61.1	45.1	67.5	49.8	94.6	69.8	104	77	134	98.5	148	109
5/8	51	37.6	55.9	41.2	85	62.7	93.1	68.7	131	96.9	144	106	186	137	203	150
3/4	89.5	66	98	72.3	149	110	164	121	230	170	252	186	325	240	357	263
7/8	144	106	157	116	144	106	157	116	370	273	405	299	522	385	572	422
1	216	159	236	174	216	159	236	174	556	410	609	449	785	579	860	634
1-1/8	305	225	335	247	305	225	335	247	685	505	751	554	1110	819	1218	898
1-1/4	427	315	469	346	427	315	469	346	957	706	1051	775	1552	1145	1703	1256
1-3/8	564	416	618	456	564	416	618	456	1264	932	1386	1022	2050	1512	2248	1658
1-1/2	743	548	815	601	743	548	815	601	1665	1228	1826	1347	2699	1991	2962	2185

The nominal torque values listed are for general use only with the assumed wrenching accuracy of 20%, such as a manual torque wrench.
DO NOT use these values if a different torque value or tightening procedure is given for a specific application.
For lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application.

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 that fastener threads are clean.
- Apply a thin coat of Hy-Gard™ or equivalent oil under the head and on the threads of the fastener, as shown in the following image.
- Be conservative with the amount of oil to reduce the potential for hydraulic lockup in blind holes due to excessive oil.
- Properly start thread engagement.

TS1741 —UN—22MAY18



[a]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.
[b]Grade 2 applies for hex cap screws (not hex bolts) up to 6 in (152 mm) long.
[c]Hex head column values are valid for ISO 4014 and ISO 4017 hex head, ISO 4162 hex socket head, and ISO 4032 hex nuts.
[d]Hex flange column values are valid for ASME B18.2.3.9M, ISO 4161, or EN 1665 hex flange products.

DX,TORQ1 -19-30MAY18-1/1

Basic Diagnostic Philosophy

SEVEN BASIC STEPS

A good program of diagnosis and testing has seven basic steps:

- Know the System
- Ask the Operator
- Inspect the System
- Operate the Machine (if possible)
- List the Possible Causes
- Reach a Conclusion
- Test Your Conclusion

Know the System

Study as much as possible about electrical, electronic, and hydraulic systems of the machine. Study this manual, especially the schematics of the system.

Schematics are an important tool — know how to read them.

Be familiar with key specifications of the system given in each section of the machine technical manual.

Keep up with the latest service bulletins. Read them and file them. The problem on the machine may be in this month's bulletin, giving the cause and the remedy. Preparation for any problem is knowing the system.

Ask the Operator

What work was the machine doing when the trouble was noticed? Is the trouble erratic or consistent? What did the operator do after the breakdown? Was an attempt made to fix the problem?

These are just a few of the many questions a good troubleshooter asks the operator. Often a comment from the operator provides the key to the problem. Ask about how the machine is used and when it was last serviced. Many problems can be traced to poor periodic maintenance programs or poor operation of the machine.

Inspect the System

Carefully inspect the electrical and electronic components for possible clues into the malfunction. Check to see if the machine can be operated without further damage to the system.

Always check these items before turning on switches or running the machine.

- Look for bare wires that could cause grounds or shorts and dangerous sparks. Shorted wires can damage the charging system.
- Look for loose or broken wires. In the charging system they can damage the regulator.
- Inspect all components, especially battery connection points. Acid film and dirt on the battery can cause current flow between the battery terminals, resulting in current leakage. Check the battery ground strap for proper connection.
- Check the battery electrolyte level. Continued loss of electrolyte indicates overcharging.
- Check the alternator drive belt tension.
- Inspect for overheated parts after machine has stopped for awhile. Overheated parts often smell like burnt insulation. Put hand on the alternator or regulator. Heat in these parts (when machine has not been operated for awhile) is a sure indication there is charging circuit problems.
- Other trouble signs

In general, look for anything unusual. Many electrical failures cannot be detected even if the machine is started. Therefore, a systematic and complete inspection of the electrical and electronic systems is necessary. Many times the problem can be detected without turning on a switch or starting the engine. While inspecting the electrical and electronics systems, make notes of all trouble signs.

Carefully inspect the electrical and electronic components for possible clues to the malfunction. Check to see if machine can be operated without further damage to the system.

Operate the Machine (if possible)

If an inspection determines the machine can be run, first turn key switch to ACCESSORY position. Attempt to use accessory circuits - lights, lighter, and so on. How do each of these circuits work?

Turn key switch to RUN position. Do the proper indicator lights illuminate in the Overhead Display Panel?

Start the machine. Check all gauges and indicators for proper operation.

Operate the system causing the problem. Refer to Operator’s Manual for proper operation of system.

List the Possible Causes

Make a list of the possible causes. What were the signs found while inspecting the machine? What is the most likely cause? Are there other possibilities? Remember that one failure often causes another.

Reach a Conclusion

Look over the list of possible causes and decide which are the most likely and which are the easiest to verify.

Test the Conclusion

Before repairing the system, test conclusions and verify correctness. Many items can be verified without further testing. Attempt to isolate the problem to a particular circuit, but not to an individual component. Test instruments help further isolate the trouble spot.

Continued on next page

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 can 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 or problem occur at the same time as other problems?
- ☐ Does code or problem occur when vehicle is warm or cold?
- ☐ Does code or problem occur during field or transport operation?
- ☐ Does code or problem occur while performing a specific action such as shifting, turning, braking, operating certain hydraulics?
- ☐ When did code or 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 or 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 can 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.

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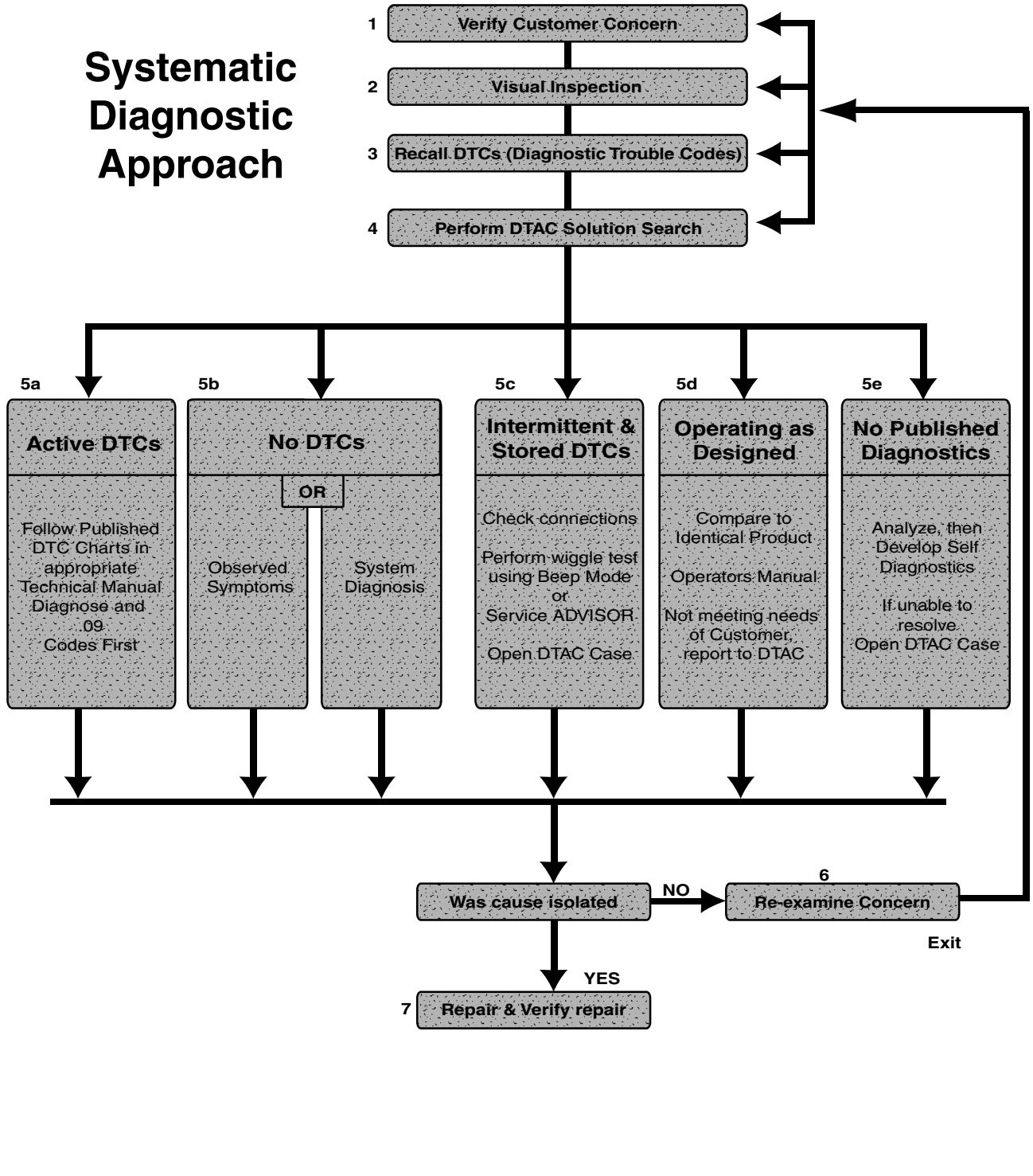
Systematic Diagnostic Approach Overview



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1— Verify Customer Concern
2— Visual Inspection
3— Recall DTCs
4— Perform DTAC Solution Search
5a— Active DTCs
5b— No DTCs
5c— Intermittent or Stored DTCs
5d— Operating as Designed
5e— No Published Diagnostics
6— Re-examine Concern
7— Repair and Verify Repair

1—Verify Customer Concern

- The first step is to gather as much information as possible from your customer about their concern.
- If their concern does not happen all the time, then ask:
  - When does it occur?
  - How long does it occur?
  - What are you doing when it occurs?
- After receiving as much information as possible, operate vehicle and attempt to duplicate your customer concern. If your customer concern cannot be duplicated, it is hard to satisfy this concern.

2—Visual Inspection

- Start with a visual inspection of vehicle, concentrating on area of concern. Many times a problem can be found with a visual inspection. Look for any visual damage to components, wiring, hoses, and hydraulic lines. Look for any modifications that have been made to the system. Look for any field installed options. Note any unusual sounds, smells, vibrations, or noises.

3—Recall DTCs

- At this time check to see if there are any DTCs (Diagnostic Trouble Codes). Record all codes for future reference. Check to see if there are any Snapshot Captures or Recordings before clearing codes. If so, do not clear the codes for that control unit until you have viewed or saved this information. Clear DTCs and then operate the vehicle under the conditions required to set those codes. Once again recall codes and determine if ACTIVE or STORED.
- **Active Code Definition—**An ACTIVE DTC is a code where the fault condition required to set that code is currently present (happening right now). In most cases this will cause a warning light or alarm to sound. However this is not always the case. Some DTCs (Depending upon Priority level) never illuminate a light or sound a warning alarm. Others will not illuminate a light or sound a warning alarm until their circuits are activated.
  To determine if a DTC is ACTIVE first retrieve and record all DTCs. Next clear all DTCs, start and run the vehicle under conditions required to set DTCs in question. Example: A DTC for a PTO solenoid that is currently shorted is an ACTIVE code. This fault condition cannot be detected by the control unit until PTO is turned ON and made active. It is imperative to operate PTO after clearing codes to see if code is currently active. After operating the vehicle under conditions required to set the DTCs, retrieve all DTCs. Any DTCs that returned are considered ACTIVE.
- **Stored Code Definition—**A STORED DTC is one who's fault has previously occurred. This fault is currently not happening. At the time the fault did occur, the control unit stored and saved the code to aid diagnostics. These faults are considered Intermittent because they happened in the past and are not currently active.
  To determine if your DTC is a STORED DTC, first retrieve and record all DTCs. Next clear all DTCs. Start and run the vehicle under the conditions required to set DTCs in question.
  (Example: If your DTC deals a PTO solenoid circuit, that circuit must be activated while operating the vehicle). After operating vehicle under the conditions required to set the DTCs, once again retrieve all DTCs. Any DTCs that do not return are then considered to be STORED DTCs.

4—Perform DTAC Solution Search

- Search for any DTAC solutions that may pertain to your customers concern. Also look for solutions dealing with any of the DTCs you may have found. Follow any published suggested repairs.

5a—Active DTCs

- **Follow Diagnostics in Appropriate Technical Manual. Diagnose any .09 Codes First**
- If any Active DTCs are stored that are associated with your customer concern, follow the published diagnostic procedures for that code.
- If multiple codes are set, diagnose any codes that end with .09 first. Other multiple DTCs should be prioritized. Begin your diagnosis with the highest prioritized DTC.
- **Prioritizing DTCs** Codes that deal with power or grounds should be given top priority. Place these codes at the top of your list.
- View order that codes are listed within Onboard Diagnostics. Onboard Diagnostics list codes in order of priority. Diagnose Multiple DTCs in the order they were listed on Onboard Diagnostics.

5b—No DTCs

- If there are no DTCs associated with your customer concern, then check to see if there are any "Observable Symptom" (if available) associated with this concern. (Observable Symptoms can be found on the Diagnostic shortcut bar of Service ADVISOR™) Follow through All published steps for any observed symptom you have. If there are No Observed symptoms for your customer concern, then go to "System Diagnosis" located in same section in technical manual. Follow any system diagnosis you find for your customer concern. If no System Diagnosis is found for system, look in the appropriate section for that individual system. There you may find a system diagnosis for that system. (Example: In the PowrQuad Transmission section you find a "PowrQuad Transmission System Check.).
- **Observable Symptom and System Diagnostics—**Service ADVISOR™ provides you with a link to Observable Symptom and System Diagnostics.

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- This link is found on the “Diagnostic” shortcut bar of Service ADVISOR™. If the link is unavailable, Observed Symptom and System Diagnostics can be located in Section 212 of the Diagnostic Technical Manual.

5c—Intermittent or Stored DTCs

- **Check Connections, Perform Wiggle Test Using Beep Mode or Service Advisor™, Open DTAC Case**
  With Intermittent issues or Stored DTCs that are not presently occurring, you should NOT follow the published diagnostics word for word. Diagnostics are always written as though the problem is occurring at the time you are using it. In the case of an intermittent, you may use the Published diagnostics as a guide. However when it ask you to check for a voltage or some other value, realize that you will always see the correct value if this problem is not currently occurring. You must do additional work, like wiggling harnesses and connectors. Tapping on switches or what ever it takes to make the problem reoccur while you are testing. In addition you can also use Beep Mode within the control unit involved to help diagnose some intermittent issues. However remember that Beep Mode does not work with all circuits. Another tool to aid in diagnosing intermittent problems is the recording triggers feature found within Service ADVISOR. You may also view Snapshot Capture and Snapshot Recording data to help with diagnosis on intermittent problems. Also utilize DTAC for help with intermittent problems.
- **Note**: After repair is made, report back to DTAC detailing what steps you performed to make this repair.

5d—Operating as Designed

- **Compare to Identical Product, Refer to Operators Manual. If Not Meeting Needs of Customer, Report to DTAC.**
  Sometimes you find that the equipment is operating as it was designed to work. However the customer does not fully understand the proper use of some functions and has concerns about them. You cannot repair a system that is working properly. In these cases, use the operators manual to aid in educating your customer on how the vehicle properly works. If needed, also demonstrate to your customer on an identical piece of equipment that this is how it was intended to work. Once the customer fully understands the operation, if it still does not meet his/her needs, then open a DTAC Case to report the issue
- **Note**: After repair is made, report back to DTAC detailing what steps you performed to make this repair.

5e—No Published Diagnostics

- **Analyze, the Develop Self Diagnostics. If Unable to Resolve Open DTAC Case.**
  From time to time you will run into issues where there are no published diagnostics within the technical manual. In these cases you should always send in a Service ADVISOR™ Report Card to make publications aware of the issue. You then need to analyze the system and then develop your own diagnostic procedure. To aid in this process, read the Theory of Operation for circuit involved. Utilize any Schematics, Wire diagrams, Oil schematics, or flow charts available. Then use the process of elimination to eliminate what parts of the system are working properly. This should then direct you toward your problem area. You should also check for DTAC Solutions that deal with missing information. If unable to resolve these issues on your own, open a DTAC Case.
- **Note**: After repair is made, report back to DTAC detailing what steps you performed to make this repair.

6—Re-examine Concern

- If after following steps above, you were not able to isolate the cause of your concern, you must start over. Start by re-examining your customers concern once again. Return to the top section, step 1 through 4 of overview. If any of these steps were lightly skipped over, place additional effort on those areas.
- Now if this second time through you find a code or some other symptom, take that path on the Systematic Diagnostic Approach chart.
- **Example:** If the first time you skipped a DTAC search, this time do a thorough DTAC search. If the first time through you skipped codes, this time check codes.
- **Note:** Sometimes while you are working on the original customer concern you may notice a different concern. If these two appear to be related, apply the new concern as you return back to the top of the chart.

7—Repair and Verify Repair

- Once you have isolated the cause, make the necessary repairs. Then operate vehicle to verify that it has been properly repaired before returning it to your customer.
- Be sure to clear all DTCs before returning vehicle to the customer.
- **Note:** After a repair is made, if a DTAC case was opened, close the DTAC Case and supply detailed information as to what steps you performed to make this repair. This information is needed by DTAC so that they can assist other technicians that may have the same issues. After the case is closed you will receive a survey, fill this survey out concerning the experience you had with the DTAC analyst on this issue.

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Section 211
Diagnostic Trouble Codes

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