TECHNICAL MANUAL
UNIT MAINTENANCE

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TRUCK, TRACTOR, M1070, 8 X 8, HEAVY EQUIPMENT TRANSPORTER (HET)
NSN 2320-01-318-9902
EIC: B5C

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

WARNING

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU

Carbon monoxide is a colorless, odorless, DEADLY POISONOUS gas and when breathed deprives body of oxygen and causes SUFFOCATION. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Permanent BRAIN DAMAGE or DEATH may result from severe exposure.

The following precautions MUST be followed to ensure personnel are safe whenever personnel heater or main or auxiliary engine is operated for any purpose.

• DO NOT operate personnel heater or engine of vehicle in enclosed area without adequate ventilation.
• DO NOT idle engine for long periods without ventilator blower operation. If tactical situation permits, open hatches.
• DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.
• NEVER sleep in a vehicle when the heater is operating or the engine is idling.
• BE ALERT at all times during vehicle operation for exhaust odors or exposure symptoms. If either are present, IMMEDIATELY EVACUATE AND VENTILATE the area. Affected personnel treatment shall be: expose to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration as described in FM 4-25.11 and get medical attention.
• BE AWARE; neither the gas particulate filter unit nor field mask for nuclear, biological, and chemical protection will protect you from carbon monoxide poisoning.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.

WARNING

Personnel hearing can be PERMANENTLY DAMAGED if exposed to constant high noise levels of 85 dB (A) or greater. Wear approved hearing protection devices when working in high noise level areas. Personnel exposed to high noise levels shall participate in a hearing conservation program in accordance with DA PAM 40-501. Hearing loss occurs gradually but becomes permanent over time.

WARNING

Wear eye protection and use care when replacing snap rings and retaining rings. Snap/retaining rings are under spring tension and can act as projectiles when released and may cause severe eye injury.

WARNING

Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

• Adhesive sealants and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If sealing compound gets on skin or clothing, wash immediately with soap and water.

• Adhesive causes immediate bonding on contact with eyes, skin, or clothing and also gives off harmful vapors. Wear protective goggles and use in well-ventilated area. If adhesive gets in eyes, try to keep eyes open; flush eyes with water for 15 minutes and get immediate medical attention.

• On direct contact, uncured silicone sealant irritates eyes. In case of contact, flush eyes with water and seek medical attention. In case of skin contact, wipe off and flush with water.
WARNING

SOLVENT CLEANING COMPOUND (DRY CLEANING SOLVENT)

Solvent cleaning compound MIL-PRF-680 Type II and III may be irritating to the eyes and skin. Use protective gloves and goggles. Use in well-ventilated areas. Use respirator as needed. Accidental ingestion can cause irritation of digestive tract and respiratory tract, may cause lung and central nervous system damage. Can be fatal if swallowed. Inhalation of high/massive concentrations can cause coma or be fatal. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing. Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention. Keep away from open flames and other sources of ignition. Failure to follow this warning may result in injury or death to personnel.

• The flashpoint for type II solvent cleaning compound is 141-198°F (61-92°C) and type III is 200-241°F (93-116°C).
• Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment.
• Fire extinguishers should be placed nearby when using solvent cleaning compound. Failure to follow this warning may result in injury or death.
• Cloths or rags saturated with solvent cleaning compound must be disposed of IAW authorized facilities’ procedures. Failure to follow this warning may result in injury.
• Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury.

WARNING

When servicing this vehicle, performing maintenance, or disposing of materials such as engine coolant, transmission fluid, lubricants, batteries, battery acid or CARC paint, consult your Unit/local hazardous waste disposal center or safety office for local regulatory guidance. If further information is needed, please contact the Army environmental hotline at 1-800-872-3845. Improper disposal of this material may result in damage to environment or injury to personnel.

WARNING

Observe the following precautions when working on or around engine/transmission components.
• Ensure engine is cool before performing maintenance. Failure to comply may result in severe burns.
• Use caution when draining hot oil. Oil may burn exposed skin and cause injury to personnel. If injured, seek medical attention immediately.
• Never use magnetic plug in center of engine oil pan to drain oil. Failure to comply may result in injury to personnel and could cause oil to drain on vehicle components.
• When working on a running engine, use caution around rotating parts. Tools, clothing, and hands may get caught causing serious injury or death to personnel.
• Use caution when working near hood mounting bracket that extends beyond firewall. Failure to comply may result in injury to personnel.
• Parking brake must be applied, with transmission range selector and transfer case in neutral before starting DDR cylinder cutout test. Failure to comply may result in vehicle moving unexpectedly and injury to personnel.

WARNING

Observe the following precautions when working around fuel.
• Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE.
• Never use fuel to clean parts. Fuel is highly flammable. Serious personnel injury could result if fuel ignites during cleaning.
• Starting fluid is toxic and highly flammable. Container is pressurized. Never heat container or discharge starting fluid in confined areas or near open flame. Failure to comply may result in injury to personnel. If injured, seek immediate medical attention.
• Ether is very flammable and could explode causing serious injury or death. Keep ether cylinders away from heat and open flame.
WARNING
Observe the following precautions when working on or around exhaust system components.

• Ensure exhaust pipe, tube, and muffler are cool before performing maintenance. Failure to comply may result in serious personal injury.
• Do not operate HET Tractor with muffler removed. Toxic exhaust fumes may enter cab, resulting in injury or death to personnel.
• Muffler weighs 91 lb (41 kg). Assistant is required when replacing muffler. Failure to comply may result in injury to personnel.
• Support tail pipe guards when replacing mounting hardware to prevent from falling, possibly causing injury to personnel.

WARNING
Observe the following precautions when working on or around cooling system components.

• Coolant and radiator may be very hot and under pressure from engine operation. Ensure engine and radiator are cool before performing maintenance. Failure to comply may cause serious injury.
• Keep out from under radiator while supported by lifting device to prevent serious injury.
• Keep out from under fan while removing it to prevent serious injury.

WARNING
Observe the following precautions when working on or around electrical system components.

• Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Always wear eye protection when working with batteries.
• Batteries must be disconnected before checking cables and wires on starter or tightening any connections. Failure to comply may result in injury to personnel.
• Battery acid (electrolyte) is extremely harmful. Always wear safety goggles and rubber gloves and do not smoke when performing maintenance on batteries. Injury will result if acid contacts skin or eyes. Wear rubber apron to prevent clothing being damaged.
• Never use open flame to apply heat to heatshrink tubing. Failure to comply may result in injury to personnel.
• Allow solder to cool before handling. Failure to comply may result in injury to personnel.
• Allow heatshrink tubing to cool before handling. Failure to comply may result in injury to personnel.
• Starter weighs 72 lb (33 kg) and is difficult to handle. To prevent injury, use caution when removing.

WARNING
Support propeller shaft while performing maintenance. Personnel may be injured if propeller shaft falls.

WARNING
Observe the following precautions when working on or around brake system components.

• Brake shoes may be coated with dust. Breathing dust may be harmful to personnel. Wear filter mask approved for use against brake dust.
• Do not allow grease or oil to contact brake linings. Linings can absorb grease and oil, causing early glazing and very poor brake action. Failure to comply may result in serious injury or death to personnel.
**WARNING**

Observe the following precautions when working on or around brake system components (cont)

- All brakes must be adjusted when performing brake adjustment procedure. Failure to comply may cause improper braking and result in injury to personnel.
- Brake shoes are installed with strong spring tension. Keep hands clear when installing parts to prevent serious injury.
- Brake drum weighs 135 lb (61 kg). Assistance is required when replacing brake drum. Failure to comply may result in injury to personnel.
- When replacing brake shoes, all four shoes on an axle must be replaced at the same time. Failure to comply may result in improper brake operation and injury to personnel.
- Never attempt to remove upper spring brake clamp ring. Failure to comply will result in personnel injury or death.
- Never try to repair rear brake chamber. High spring tension makes repair dangerous. Severe injury or death may result.
- When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may result in injury or death to personnel.

**WARNING**

Observe the following precautions when working on or around wheels and tires.

- Hydraulic jack and jackstands must be positioned on flat surface. Placing jack or jackstands on unlevel or soft surface may result in truck falling and cause injury or death to personnel.
- If any loose or broken bolts are found after removing the wheel cover, deflate the tire completely before attempting to loosen lug nuts. Failure to comply may result in injury to personnel.
- Tire must be completely deflated before attempting to loosen nuts if any bolts are found loose or broken after removing wheel cover. Failure to comply may result in injury to personnel.
- High pressure air will be released from valve stem when core is removed. Stay clear of valve stem after core is removed. Failure to comply may result in personnel injury.
- Keep hands and fingers from between tire and bead lock. Failure to comply may result in injury to personnel.
- Tire may explode and cause serious injury or death. Place wheel and tire in safety cage before inflating. Stay back 10 ft (0.3 m) from cage when inflating. Minimum hose length is 10 ft (0.3 m).
- When conducting wheel runout check or wheel bearing check, HET Tractor must be on level ground and wheels must be chocked before parking brake is released. Otherwise, HET Tractor may roll and cause personnel injury.
- Wheel assembly weighs 523 lb (237 kg). Use caution when handling wheel. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Observe the following precautions when working on or around steering components.

- Steering reservoir is heavy. Support steering reservoir while performing maintenance. Steering reservoir could fall resulting in injury to personnel.
- Support tee gear box before removing mounting screws to prevent injury.
- Tie rod end must be threaded into tie rod so that threads are beyond slot under clamp. Failure to comply may result in tie rod end separating from tie rod resulting in injury to personnel and loss of vehicle control.
WARNING
Observe the following precautions when working on or around cab and frame components.

- Hood springs may be under tension. Use care when replacing springs to prevent injury.
- Do not use hood as a work platform. Using hood as a work platform may result in injury to personnel and/or equipment damage.
- Hood weighs 235 lb (107 kg). Keep out from under hood. Hood could fall causing serious injury.
- Door is very heavy. If dropped, door may cause serious injury.
- Keep out from under spare wheel/tire carrier while supported by lifting device to prevent injury.

WARNING
Observe the following precautions when working on or around fifth wheel.

- Improper adjustment of fifth wheel may cause trailer to become uncoupled during operation. Serious injury or death may result.
- Fifth wheel plate must be secure before performing maintenance. Failure to do so may result in injury to personnel.
- Fifth wheel weighs 925 lb (420 kg). Use suitable lifting device to prevent injury to personnel.
- Ramp weighs 237 lb (108 kg). Keep out from under heavy parts. Falling parts may cause serious injury or death.

WARNING
Observe the following precautions when working on or around suspension system components.

- Air suspension will lower when air line/hoses are removed. To avoid injury, stay clear of HET Tractor frame until air suspension is completely lowered.
- Do not attempt to inflate air spring when it is removed from vehicle. Failure to comply may result in serious injury to personnel.
- Air suspension system may still be pressurized even though air pressure gage reads 0 psi. Remove air line slowly to allow air to escape. Failure to comply may result in air line blowing off causing serious injury to personnel.

WARNING
Observe the following precautions when working on or around winch system components.

- Always wear heavy duty gloves when handling winch cable. Never let cable run through hands. Frayed cable can cut hands severely.
- Use care when removing winch cable from drum. End of cable can spring up causing injury to personnel.
- Do not operate winch without guard in place.
- Do not place hands or feet near winch during operation.
- Auxiliary winch weighs approximately 130 lb (59 kg). Use lifting device to replace auxiliary winch. Failure to comply may result in injury to personnel.
- Control console panels are heavy. Use care when removing screws to avoid injury to personnel.
**WARNING**

Polyurethane Coating (CARC)

Eye and hearing protection must be worn at all times when using power tools for grinding, cutting, sawing and drilling. Failure to do so may result in injury to personnel. Chemical Agent Resistant Coating (CARC) paint contains isocyanate which is highly irritating to skin and respiratory system. High concentrations of isocyanate can produce symptoms of itching and reddening of skin, a burning sensation in the throat and nose, and watering of the eyes. In extreme concentrations, isocyanate can cause cough, shortness of breath, pain during respiration, increased sputum production, and chest tightness. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing. Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention.

The following precautions must be taken whenever using CARC paint:

- Protective equipment (gloves, goggles, ventilation mask) must be worn when using CARC paint.
- NEVER cut CARC-coated materials without high-efficiency, air-purifying respirators in use.
- DO NOT grind or sand painted equipment without high-efficiency, air-purifying respirators in use.
- BE AWARE of CARC paint exposure symptoms; symptoms can occur a few days after initial exposure. Seek medical help immediately if symptoms are detected.
- Use only in well-ventilated areas. Check with local environmental office for methods and locations approved for painting in accordance with local and state environmental regulations.
- ALWAYS use air line respirators when using CARC paint unless air sampling shows exposure to be below standards. Use chemical cartridge respirator if air sampling is below standards.

**WARNING**

After Nuclear, Biological, or Chemical (NBC) exposure of vehicle, all air filters shall be handled with extreme caution. Unprotected personnel may experience injury or death if residual toxic agents or radioactive material are present. If vehicle is exposed to chemical or biological agents, servicing personnel shall wear protective mask, hood, protective overgarments, and chemical protective gloves and boots in accordance with FM 3-11.4 All contaminated air filters shall be placed in double-lined plastic bags and moved swiftly to a segregation area away from the worksite. The same procedure applies for radioactive dust contamination. The Company NBC team should measure radiation prior to filter removal to determine extent of safety procedures required per the NBC Annex to the unit Standard Operating Procedures (SOP). The segregation area in which the contaminated air filters are temporarily stored shall be marked with appropriate NBC placards. Final disposal of contaminated air filters shall be in accordance with local SOP. Decontamination operation shall be in accordance with FM 3-11.5 and local SOP.

See FM 4-25.11 for additional first aid data.
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UNIT MAINTENANCE

TRUCK, TRACTOR, M1070, 8 X 8,
HEAVY EQUIPMENT TRANSPORTER (HET)
(NSN 2320-01-318-9902)
EIC:B5C

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS
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OVERVIEW

This technical manual (TM) is provided to help you maintain the HET Tractor at the unit maintenance level. Because of its size, it is divided into two volumes. Volume 1 contains the following major sections in order of appearance:

- **WARNING SUMMARY.** Provides a summary of the most important warnings that apply throughout the manual.

- **TABLE OF CONTENTS.** Lists, for both volumes, the chapters, sections, appendixes, and indexes with page numbers in order of appearance.

- **CHAPTER 1, INTRODUCTION.** Describes the HET Tractor and provides equipment data.
• CHAPTER 2, VEHICLE MAINTENANCE. This chapter contains information for finding tools; special tools; test, measurement, and diagnostic equipment (TMDE); and repair parts. It also contains the preventive maintenance checks and services (PMCS) and troubleshooting tables.

• SUBJECT INDEX. Lists important subjects contained in volume 1 in alphabetical order and gives the page numbers on which they are located.

Volume 2 contains the following major sections in order of appearance:

• WARNING SUMMARY. Provides a summary of the most important warnings that apply throughout the manual.

• TABLE OF CONTENTS. Lists, for volume 2, the chapters, sections, appendixes, and index with page numbers in order of appearance.

The maintenance chapters in volume 2 each concern a specific system or group of components.

• CHAPTER 3, ENGINE MAINTENANCE
• CHAPTER 4, FUEL SYSTEM MAINTENANCE
• CHAPTER 5, EXHAUST SYSTEM MAINTENANCE
• CHAPTER 6, COOLING SYSTEM MAINTENANCE
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• CHAPTER 20, NON-ELECTRIC GAGES MAINTENANCE
• CHAPTER 21, CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL (CBR) EQUIPMENT MAINTENANCE

The last part of volume 2 contains information which will assist you in the performance of unit maintenance on the HET Tractor.

• APPENDIX A, REFERENCES. Lists publications used with the HET Tractor.

• APPENDIX B, MAINTENANCE ALLOCATION CHART. The maintenance allocation chart denotes the level of maintenance which performs specific maintenance tasks and the time required. It also lists tools and special tools required for each task.
OVERVIEW (CONT)

- **APPENDIX C, EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST.** Lists expendable and durable items used in the performance of maintenance.
- **APPENDIX D, ILLUSTRATED LIST OF MANUFACTURED ITEMS.** Illustrates and describes items that must be fabricated from bulk materials for repair of the HET Tractor.
- **APPENDIX E, TORQUE VALUES.** Lists the standard torques values for specific attaching hardware.
- **APPENDIX F, COMMON TOOLS, SUPPLEMENTS, AND SPECIAL TOOLS/FIXTURES LIST.** This appendix lists equipment used in the performance of maintenance and references publications which contain information regarding the equipment.
- **APPENDIX G, MANDATORY REPLACEMENT PARTS LIST.** This appendix lists the mandatory replacement parts needed to maintain the HET Tractor.
- **APPENDIX H, DDEC III/IV DIAGNOSTIC TROUBLESHOOTING GUIDE.** This appendix contains the troubleshooting for the DDEC III/IV vehicle.
- **SUBJECT INDEX.** Lists important subjects contained in Volume 2 and 3 in alphabetical order and gives the page numbers on which they are located.

FINDING INFORMATION

There are several ways to find the information you need in this manual. They are as follows:

- **FRONT COVER INDEX.** The front cover index contains a list of the most important topics contained in each volume. It features a black box at the right edge of the cover which corresponds with a black box on the page containing the topic. The topics listed on the front cover are highlighted in the table of contents with a box.
- **TABLE OF CONTENTS.** Lists chapters, sections, appendixes, and indexes with page numbers in order of appearance.
- **CHAPTER INDEXES.** List paragraphs contained in the individual chapters with paragraph and page numbers in order of appearance.
- **SYMPTOM INDEX.** Lists malfunctions contained in the troubleshooting table with page numbers in order of appearance.
- **SUBJECT INDEX.** Lists all important topics with page numbers in alphabetical order.

TROUBLESHOOTING

There are two types of troubleshooting tables contained in this manual, DDEC and vehicle. Always consult the vehicle troubleshooting first when an engine malfunction occurs. Refer to the DDEC troubleshooting logic table in chapter 2 to assist you in fault isolation for DDEC III/IV vehicles and to Appendix H to assist in fault isolation for DDEC III/IV vehicles. When a non-engine malfunction occurs, look at the symptom index for the vehicle troubleshooting table (also in chapter 2). Find the malfunction in the index. Turn to the page number listed for the malfunction in the troubleshooting table. Perform the steps required to correct the malfunction. If you can’t find the malfunction, or the malfunction is not corrected, notify your supervisor. When troubleshooting electrical circuits refer to the electrical schematics for connectors, routing, wire numbers, etc.
MAINTENANCE

- **SCHEDULED MAINTENANCE.** Your scheduled maintenance is located in table 2–1, PMCS. These checks and services are mandatory at the intervals listed. Always follow the WARNINGS and CAUTIONS.

- **UNSCHEDULED MAINTENANCE.** Unscheduled maintenance is located in chapters 3 thru 21. The PMCS and troubleshooting tables often reference you to these procedures. When you perform maintenance, look over the entire procedure before starting. Make sure you have the necessary tools and materials at hand. Always follow the WARNINGS and CAUTIONS.
TRUCK, TRACTOR, M1070, 8 X 8, HEAVY EQUIPMENT TRANSPORTER (HET)
CHAPTER 1
INTRODUCTION

1-1. SCOPE


b. Model Number and Equipment Name. Truck, Tractor, M1070, 8 x 8, Heavy Equipment Transporter (HET).

c. Purpose of Equipment. The HET Tractor and the M1000 Trailer form the Heavy Equipment Transport System (HETS). HETS will be used to load, unload, and transport the M1 Series Main Battle Tank (MBT) during administrative and tactical operations.

1-2. MAINTENANCE FORMS, RECORDS, AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 750-8, The Army Maintenance Management System (TAMMS).

1-3. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Command decision, according to tactical situation, will determine when the destruction of the HET Tractor will be accomplished. A destruction plan will be prepared by the using organization unless one has been prepared by a higher authority. For general destruction procedures for this equipment, refer to TM 750-244-6, Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use (U.S. Army Tank-Automotive Command).
1-4. PREPARATION FOR STORAGE OR SHIPMENT

Instructions for preparation for storage or shipment are provided in paragraph 2-22 of this manual.

1-5. NOMENCLATURE CROSS-REFERENCE

Table 1-1 lists the nomenclature cross-references used in this manual.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Official Nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDR</td>
<td>CTS J 1708 Application</td>
</tr>
<tr>
<td>STE/ICE-R</td>
<td>CTS/ICE</td>
</tr>
<tr>
<td>Cable</td>
<td>Wire rope</td>
</tr>
<tr>
<td>Cold Start System</td>
<td>Ether quick-start system</td>
</tr>
<tr>
<td>Engine Coolant</td>
<td>Antifreeze, ethylene glycol mixture</td>
</tr>
<tr>
<td>Gladhand</td>
<td>Quick-disconnect coupling</td>
</tr>
<tr>
<td>HET Tractor</td>
<td>Truck, Tractor, M1070, 8 x 8, Heavy Equipment Transporter (HET)</td>
</tr>
<tr>
<td>Jacobs Brake</td>
<td>Engine retarder</td>
</tr>
</tbody>
</table>

Table 1-1. Nomenclature Cross-Reference

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your HET Tractor needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don’t like about your equipment. Let us know why you don’t like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Tank-Automotive and Armaments Command, ATTN: AMSTA-QRT, Warren, MI 48397-5000. We’ll send you a reply.

1-7. EQUIPMENT IMPROVEMENT REPORT AND MAINTENANCE DIGEST (EIR MD) AND EQUIPMENT IMPROVEMENT REPORT AND MAINTENANCE SUMMARY (EIR MS)

The quarterly EIR MD, TB 43-001-39 series, contains valuable field information on the equipment covered in this manual. It is compiled from some of the Quality Deficiency Reports that have been prepared on the vehicles covered in this manual. Many of these articles result from comments, suggestions, and improvement recommendations that were submitted to the EIR program. It also contains information on equipment improvements, minor alterations, proposed Modification Work Orders (MWOs), warranties, actions taken on some of the DA Form 2028’s (Recommended Changes to Publications), and advance information on proposed changes that may affect this manual. In addition, the more maintenance significant articles (including minor alterations, field-fixes, etc.) that have a continuing need in the field are republished in the EIR MS for TACOM equipment (TM 43-1043). Refer to both of these publications periodically, especially the TB 43-001-39 series, for the most current and authoritative information on the equipment. The information will help you to do a better job and will advise of the latest changes to this manual. Also refer to DA Pam 25-30 and Appendix A, References, of this manual.

1-8. WARRANTY INFORMATION

The HET Tractor is warranted by Oshkosh Truck Corporation for 12 months; 4 months additional if placed in storage. (Refer to TB 9-2320-360-14, page 3, paragraph i for details.) Warranty starts on the date found in block 21, DD Form 250, in the logbook. Report all defects in material or workmanship to the supervisor, who will take the appropriate action. For complete information covering warranties, refer to Warranty Technical Bulletin for Truck, Tractor, M1070, 8 x 8, Heavy Equipment Transporter (HET) TB 9-2320-360-14.
1-9. METRIC SYSTEM

The equipment described herein contains metric components and requires metric common and special tools, therefore, Metric units in addition to English units will be used throughout this manual. An English-to-metric conversion table is included inside the back cover of this manual.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-10. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

Refer to TM 9-2320-360-10, for equipment characteristics, capabilities, and features.

1-11. LOCATION AND DESCRIPTION OF COMPONENTS

Refer to TM 9-2320-360-10, for location and description of components.

1-12. EQUIPMENT DATA

Refer to TM 9-2320-360-10, for equipment data.

1-13. SAFETY, CARE, AND HANDLING

Significant Hazards and Safety Recommendations. Significant hazards and safety recommendations are listed in table 1-2.

Table 1-2. Significant Hazards and Safety Recommendations

<table>
<thead>
<tr>
<th>Operating Hazard</th>
<th>Safety Recommendation or Precaution</th>
<th>Condition*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low oil pressure/</td>
<td>Stop engine operation when CHECK GAUGES and CHECK ENGINE indicators are lit, engine warning alarm sounds, and gages indicate abnormal readings.</td>
<td>Abnormal</td>
</tr>
<tr>
<td>high coolant temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low air pressure</td>
<td>Do not drive HET Tractor while low air pressure alarm is sounding or LOW AIR indicator is lit.</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Electric shock</td>
<td>Do not wear watches, rings, or other jewelry while working on or near an electrical circuit.</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Refueling vehicle</td>
<td>Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open flame and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post sign that says: NO SMOKING WITHIN 50 FEET OF VEHICLE.</td>
<td>Normal</td>
</tr>
</tbody>
</table>

*Category of hazards as to whether or not they may be expected under normal or abnormal operating conditions.
1-13. SAFETY, CARE, AND HANDLING (CONT)

Table 1-2. Significant Hazards and Safety Recommendations (Cont)

<table>
<thead>
<tr>
<th>Operating Hazard</th>
<th>Safety Recommendation or Precaution</th>
<th>Condition*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting/Disconnecting trailer.</td>
<td>Make sure that position of assistant is known at all times. Make sure no one is standing directly behind tractor or trailer during connection/disconnection.</td>
<td>Normal</td>
</tr>
<tr>
<td>Vehicle instability on a hill.</td>
<td>Avoid driving diagonally across a hill. HET Tractor may roll, causing equipment damage and injury or death to personnel.</td>
<td>Normal</td>
</tr>
<tr>
<td>Winching operations.</td>
<td>Do not use winches for lifting personnel. Always wear heavy gloves when handling winch cable. Never let cable run through hands. Frayed cable can cut severely. Do not operate winch without guard in place. Do not place hands or feet near winch during operation. Ensure that both DRIVER SIDE and PASSENGER SIDE WINCH KICKOUT controls are disengaged prior to paying out winch cables. Failure to disengage KICKOUT controls may result in injury to personnel.</td>
<td>Normal</td>
</tr>
</tbody>
</table>

*Category of hazards as to whether or not they may be expected under normal or abnormal operating conditions.

Section III. PRINCIPLES OF OPERATION

1-14. POWER TRAIN

Power for the HET Tractor is generated by a two-stroke, V-type diesel engine coupled directly to an automatic transmission. The engine is rated at 500 brake horsepower.

The engine is equipped with an electronic control system that regulates fuel delivery to each injector as well as governing engine speed for power takeoff operation. Engine sensors and engine performance can be checked using a plug-in diagnostic reader.

Power from the engine drive shaft transmits torque that is multiplied for greater drive power by a torque converter when needed.

Five forward drive ranges can be manually selected, depending on the terrain and conditions. The transmission will automatically downshift as engine speed and throttle position change.

When the lockup clutch is automatically applied, power is transmitted mechanically through the lockup clutch. A direct drive is engaged from the engine to a converter turbine shaft.

Power from the transmission is directed to the transfer case and propeller shafts forward and rear. The front and rear tridem axles are each equipped with planetary wheel ends. In low range, driver-controlled lockouts in the differentials provide positive drive to all four axles.
1-15. ELECTRICAL SYSTEM

The HET Tractor electrical system consists of two different circuits, 12 V dc and 24 V dc. Four 12-volt storage batteries (1) connected in series parallel provide current to both circuits.
1-15. ELECTRICAL SYSTEM (CONT)

Two belt-driven alternators provide current to the electrical system during normal operation, and recharge the batteries while the engine is operating. The 24 Vdc system utilizes an alternator (2) with 130 amp capacity. The 12 Vdc system utilizes an alternator (3) with 145 amp capacity.

The headlights (4), trailer lights, windshield wipers (5) and washer motors, instrument panel/dash lighting and switches (6), and warning lights and gages inside the cab are operated with the 12 Vdc system.
The starter motor (7), winches (8), Central Tire Inflation System (CTIS), air dryers (9), trailer lights, and ether injection system (10) are operated with the 24 V dc system.

The starter motor solenoid receives 24 V dc from the storage batteries through the engine starter magnetic switch auxiliary contacts and the neutral start relay. If the transmission range selector is not in the N (neutral) position prior to startup, the engine cannot be started.

Warning lights and gages that indicate system malfunctions include: CHECK GAUGES alarm, CHECK ENGINE indicator, and CHECK GAUGES indicator.
1-16. STEERING SYSTEM

The steering system uses two steering axles, one at the front (No. 1) (1) and one at the rear (No. 4) (2). Each axle turns in response to turning the steering wheel (3) in the cab.

Steering power is generated by a steering pump (4) driven directly at the engine providing pressure to two steering gears (5), one at each steering axle. The steering pump delivers fluid to enable the operator to turn the wheels of a fully-loaded truck. An interconnected series of shaft linkages rotate with hydraulic power assist to turn the two axles. In the event of main steering system failure, an auxiliary steering pump (5.1) connected to the transfer case provides power steering.

As the steering wheel is turned, the rotational motion of the upper steering assembly shafts (6) is translated at a tee gear box (7) below the cab to both the front and rear power steering gears (8). A steering reduction gear (8.1) reduces the steering angle on axle no. 4. The steering gears multiply the rotational force to a pair of drag links (9) and four axle steering arms that apply directional motion to turn the axles.

In the event a steering line (10) to no. 4 steering axle is severed or fluid leaks from the system (Power steering is inoperable.), the truck can be steered for short distances in emergency situations.
1-17. AIR SYSTEM

The air system operates the service and parking brakes, rear suspension system, and the CTIS. The air system also enables operation of the transfer case and interaxle lockups, winch tensioners and kickouts, windshield washer, and horns.

The air system on the HET Tractor consists of an engine-driven air compressor (1), a purge tank (2), and five air reservoirs (3 thru 7). Reservoir (3) supplies air to reservoirs (4 thru 7). Three reservoirs (5 thru 7) are interconnected and separated from reservoir (4) with check valves. Air from reservoir (4) is supplied to service brakes on all four axles and parking brakes on the rear tridem axles, transfer case and interaxle lockups, winch tensioners and kickouts, windshield washer, and horns. The service brakes are actuated by relay valves which are controlled by the operator pressing the brake treadle in the cab. The parking brakes are also actuated by relay valves which are controlled by hand controls. In the event of the loss of system air pressure, the spring brake valve will modulate the parking brakes so the HET Tractor can be stopped safely. Reservoirs (5 thru 7) supply air to operate the CTIS, service and parking brakes on rear tridem axles, and rear suspension system. Air is drawn from the engine air intake and routed to the air compressor (1) where it is pressurized. Air dryers (8 and 9) remove moisture from the pressurized air. Air from the dryers goes to the purge reservoir (2) and air reservoir (3).

System protection elements include an air cleaner restriction indicator (10) that determines whether air flow through the air cleaner is impeded. In the cab, air pressure in reservoir (4) is indicated by the green needle on the AIR PRESSURE gage (11). The red needle on the gage (11) indicates air pressure in reservoirs (5 thru 7). If air pressure falls below 60 psi (414 kPa) in any of the reservoirs, warning alarm will sound and LOW AIR indicator will light.

The rear suspension system contains a pair of suspension air springs on each rear axle that automatically inflates or deflates according to load. Air to the air springs is regulated by a height control valve.

Purging the air in the air dryers is automatically done when 125 psi (862 kPa) system pressure is reached at the compressor. The compressor cycle is stopped and air from purge tank clears accumulated water through a valve on the bottom of the air dryer.

Air to the transfer case enables engagement of four-wheel drive in high or low gear range. An interaxle lockup pilot valve also prevents the axles from locking up in high ranges.
1-18. WINCH SYSTEM

The winch system operates hydraulically and consists of two main winches (1 and 2) and an auxiliary winch (3). The main winches operate independently of each other and are used to recover, load, and unload heavy tracked and wheeled vehicles. The main winches are mounted side-by-side directly to the winch platform. The auxiliary winch is used to pull the main winch cable out to the payload. The auxiliary winch is mounted to the winch platform just below the driver’s side main winch.

The winches are controlled from the operator’s station (4). The operator is protected by a personnel guard (5) during winch operations. The main winch controls are the winch kickout control, cable hold down lever, engine idle selector switch, engine high idle lock switch, winch speed control switch, and the winch drum control.

Each main winch incorporates a two-speed hydraulic motor (6 and 7). The hydraulic motor is used to provide power. It converts hydraulic horsepower from the pump and control circuitry to rotary mechanical horsepower for driving the gear system. A single-speed motor (8) is used by the auxiliary winch. A Power Take-Off (PTO) driven hydraulic pump (9) supplies the winch system with hydraulic oil from the reservoir (10). A two-piece driveshaft connects the transmission driven PTO to the hydraulic pump (9). A view gage (11) on the reservoir indicates the hydraulic oil level. All winches have a fail-safe brake and winch brake valve for winch load control.
1-19. CENTRAL TIRE INFLATION SYSTEM (CTIS)

The Central Tire Inflation System (CTIS) allows the HET operator to adjust the vehicle tire pressure to one of four predetermined settings. Each tire pressure setting has a vehicle speed limitation. If the average vehicle speed exceeds this limit, the CTIS will activate an overspeed light.

The CTIS consists of five major components. An electronic controller (1), mounted on the dash, contains the switches and indicator lights for system operation. The controller’s Read Only Memory (ROM) contains the working instructions for the power manifold (2).

The power manifold (2), located under the driver’s seat, contains an inflation valve (3) for increasing tire pressures and a deflation valve (4) to reduce tire pressures. The power manifold’s quick-release valve (5) is closed during checking, inflating, and deflating modes. The quick-release valve opens at the end of a cycle to rapidly exhaust all air pressure from the CTIS, which in turn closes all wheel valves (6).

The power manifold (2) has two other components in addition to the valves. They are a pressure transducer (7) that monitors system pressure for the CTI controller and a low air pressure switch (8) used to shut the CTIS off when chassis air pressure is less than 85 psi. 110 psi is required to restart the system.

Directly under the power manifold (2) is the porting block, to which the air lines to the axles are connected. Air pressure passes through these lines and the axle assemblies to the wheel valves (6). Air pressure is present in the CTIS lines only when the system is monitoring (or adjusting) tire pressures. At all other times, the system has no air pressure.

The CTIS has an automatic routine that checks for moderate to large air leaks or air loss. During the initial start of the CTIS, the quick-release valve (5) is closed and the inflation valve (3) opens to attempt to build system pressure. If the transducer fails to sense that the system is capable of maintaining pressure, the CTIS will shut itself off and display a flashing low air light.

When the CTIS has completed a pressure adjustment cycle, the controller (1) starts an internal timer. If no changes occur during the next 15 minutes, a check cycle is automatically activated, during which tire pressures are measured and adjusted if necessary. This provides for improved tire life as hot tire pressures are adjusted and slowly leaking tires are kept inflated.
Section I. REPAIR PARTS AND SPECIAL TOOLS; TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE) AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

2-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

For a listing of special tools, TMDE, and support equipment, refer to the Maintenance Allocation Chart (MAC), Appendix B, of this manual and to the repair parts and special tools list (RPSTL), TM 9-2320-360-20P.

2-3. REPAIR PARTS

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 9-2320-360-20P, covering Unit maintenance for this equipment.
Section II. SERVICE UPON RECEIPT

2-4. CHECKING UNPACKED EQUIPMENT

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6, Packaging Improvement Report.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 750-8.

c. Check to see whether the equipment has been modified.

2-5. DEPROCESSING UNPACKED EQUIPMENT

Read “Processing and Deprocessing Record of Shipping, Storage, and Issue of Vehicles and Spare Engines,” tag (DD Form 1397) and follow all precautions checked. This tag should be attached to the steering wheel, shifting lever, or ENGINE switch.

2-6. HAND RECEIPT MANUAL AND INVENTORY OF EQUIPMENT

When a new HET Tractor is received by the using organization, it is necessary to inventory the equipment. For detailed procedures, refer to Hand Receipt Manual, TM 9-2320-360-10-HR.

2-7. SERVICE BEFORE OPERATION

a. General

(1) Upon receipt of new, used, or reconditioned HET Tractor, the receiving organization must see if it has been properly prepared for service and is in good condition. Inspect all assemblies, subassemblies, and accessories to ensure they are in proper working order. Secure, clean, correctly adjust, and lubricate as needed (TM 9-2320-360-10 and LO 9-2320-360-12).

(2) Follow general procedures for all services and inspections given in TM 9-2320-360-10.

(3) Refer to TM 9-2320-360-10, for HET Tractor operating instructions.

b. Inspection and Servicing Equipment

(1) General Procedures

NOTE
If HET Tractor has been driven to the using organization, most of the following procedures should have been performed.

(a) When HET Tractor is received, inspect all items for damage that may have occurred during shipping and unloading operations. Pay close attention to any loose or missing nuts, bolts, screws, access plates, drain plugs, drain cocks, oil plugs, assemblies, subassemblies, or components that may be easily lost or broken in transit. Check Basic Issue Items (BII) against checklist to ensure all items are accounted for and in good condition. Carefully list all discrepancies (TM 9-2320-360-10-HR).
(b) Clean all exterior surfaces coated with rust--preventive compound with solvent cleaning compound.

(2) Special Procedures

(a) Activate battery if HET Tractor is delivered with dry-charged battery (TM 9-6140-200-14).

(1) Connect batteries (para 7-61).

(b) Do the semiannual Preventive Maintenance Checks and Services (PMCS) (para 2-8).

(c) Lubricate specific points shown in LO 9-2320-360-12 regardless of interval. Do not lubricate gear cases or engine. Check processing tag for gear case and engine oil. If tag states the oil is good for 500 mi (805 km) of operation and is of the proper grade for local climatic operation, do not change oil.

(d) Schedule a semiannual service in accordance with DA Pam 750-8.

(e) HET Tractor Body and Sheet Metal

- Inspect body and sheet metal for evidence of damage during shipment.
- Check doors, latches, and hinges on compartments for proper operation.
- Check mounting hardware and tighten as necessary.

(f) HET Tractor Cab

- Inspect cab for evidence of damage during shipment.
- Inspect windshield and window glass for cracks or other damage.
- Check door latches, hinges, and windows for proper operation.
- Check seats and seat belts to see that they are securely installed, and that the operator’s seat adjustments are functioning properly.

(g) Engine

- Remove any seals, plugs, or tape used to seal air inlets and ports on the engine during shipping.
- Check crankcase oil level with dipstick.
- Examine air cleaner element for dirty or restricted condition.
- Inspect engine and cooling hose connections for evidence of leakage.
- Clean away any obstruction to cooling air flow to radiator.

**WARNING**

Solvent cleaning compound MIL-PRF-680 Type II and III may be irritating to the eyes and skin. Use protective gloves and goggles. Use in well-ventilated areas. Use respirator as needed. Accidental ingestion can cause irritation of digestive tract and respiratory tract, may cause lung and central nervous system damage. Can be fatal if swallowed. Inhalation of high/massive concentrations can cause coma or be fatal. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing. Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention. Keep away from open flames and other sources of ignition. Failure to follow this warning may result in injury or death to personnel.

- The flashpoint for type II solvent cleaning compound is 141-198°F (61-92°C) and type III is 200-241°F (93-116°C).
- Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment.
- Fire extinguishers should be placed nearby when using solvent cleaning compound. Failure to follow this warning may result in injury or death.
- Cloths or rags saturated with solvent cleaning compound must be disposed of IAW authorized facilities’ procedures. Failure to follow this warning may result in injury.
- Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury.

(b) Clean all exterior surfaces coated with rust--preventive compound with solvent cleaning compound.
2-7. SERVICE BEFORE OPERATION (CONT)

**WARNING**

Radiator is very hot and pressurized during HET Tractor operation. Let radiator cool before removing cap. Be sure to wear the proper eye protection to avoid personal injury. Failure to comply may result in serious burns.

- Check radiator coolant. Check if solution is adequate for expected climatic conditions. Refer to TB 750-651 for preparation of antifreeze solutions. Put tag near filler cap with type of antifreeze and degree of protection written on tag.
- Check engine starter wiring for loose connections and condition of wiring insulation.

(h) Transmission

- Check fluid level with dipstick.
- Check external lines for evidence of leakage.

(i) Transfer Case

- Check level of lubricant at fill plug.
- Inspect lubrication pump and external lines for evidence of leakage.
- Check operation of two-speed shift mechanism.
- Operate DRIVELINE control, observe drive power to front axle.
- Inspect bolts on all driveline U-joints.

(j) Electrical System

- Inspect battery cable connections, and clean and tighten as necessary.
- Check all lights for burned out lamps, loose connections, and dirty or broken lenses.
- Ensure that alternators are charging properly.
- Ensure all electrical equipment functions.
- Replace teflon tachograph chart with paper charts (para 7-15).

(k) Air System

- Drain any water from reservoirs.
- Inspect all accessible air hose and tubing connections for leakage.

(l) Steering System

- Check steering hydraulic reservoir for proper fluid level.
- Examine steering linkage and steering gears for damage incurred during shipment.
- Examine steering hoses and connections for evidence of leakage.
- Check steering system for proper operation during road test.

(m) Chassis and Running-Gear

- Check all lubricant levels.
- Check axle housing pressure vents to ensure freedom from foreign matter.
(n) Tires
- Check tire inflation.
- Inspect tires for serious cuts, bubbles, cracks, bruises, dry-rot, foreign objects, or exposure of internal cords. Remove foreign objects lodged in between tread.
- Check all wheel mounting nuts for proper torque.
- Check front and rear suspension for broken spring leaves, damaged components, or damaged air springs.
- Check winch hydraulic reservoir sight glass for proper fluid level.

(o) Fuel Systems
- Check fuel level and replenish, if necessary.
- Inspect fuel lines, connections, and filters for evidence of leakage.

Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-8. PMCS INTRODUCTION
Table 2-1, PMCS has been provided so you can keep your equipment in good operating condition and ready for its primary mission. The PMCS in TM 9-2320-360-10, must be performed before doing unit PMCS. Lubricate in accordance with LO 9-2320-360-12, while performing checks and services. Operator PMCS will include a 10 mile minimum road test.

2-9. EXPLANATION OF COLUMNS
a. Item Number Column. Numbers in this column shall be used as a source of item numbers for the TM Number Column on DA Form 2404 (Equipment Inspection and Maintenance Worksheet), in recording results of PMCS.
b. Interval Column. The interval column tells you when to do a certain check or service. Semiannual PMCS must be performed every 6 months, and annual PMCS must be performed every 12 months.
c. Item to be Inspected Column. This column tells you the item to be checked/serviced.
d. Procedure Column. The procedure column of your PMCS table tells you how to do the required checks and services.
e. Not Fully Mission Capable If: Column. This column tells you what faults will keep your HET Tractor from being capable of performing its primary mission. If you perform check and service procedures that show faults listed in this column, do not operate the HET Tractor. Follow standard operating procedures for maintaining the HET Tractor or reporting equipment failure.

2-10. GENERAL MAINTENANCE PROCEDURES

**WARNING**
Solvent cleaning compound MIL-PRF-680 Type II and III may be irritating to the eyes and skin. Use protective gloves and goggles. Use in well-ventilated areas. Use respirator as needed. Accidental ingestion can cause irritation of digestive tract and respiratory tract, may cause lung and central nervous system damage. Can be fatal if swallowed. Inhalation of high/massive concentrations can cause coma or be fatal. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing. Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention. Keep away from open flames and other sources of ignition. Failure to follow this warning may result in injury or death to personnel.
- The flashpoint for type II solvent cleaning compound is 141-198°F (61-92C) and type III is 200-241°F (93-116C).
- Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment.
- Fire extinguishers should be placed nearby when using solvent cleaning compound. Failure to follow this warning may result in injury or death.
- Cloths or rags saturated with solvent cleaning compound must be disposed of IAW authorized facilities’ procedures. Failure to follow this warning may result in injury.
- Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury.

a. Cleanliness. Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Use solvent cleaning compound (Item 31, Appendix C) on all metal surfaces and soapy water on rubber.
2-10. GENERAL MAINTENANCE PROCEDURES (CONT)

b. Bolts, Nuts, and Screws. Check bolts, nuts, and screws for obvious looseness, and missing, bent, or broken conditions. Look for chipped paint, bare metal, or rust around bolt heads. If any part seems loose, tighten it. If any part is broken or missing, replace it.

c. Welds. Look for loose or chipped paint, rust, or gaps where parts are welded together. If a bad weld is found, notify your supervisor.

d. Electric Wires and Connectors. Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connectors and ensure wires are in good shape. If a bad wire or connector is found, notify your supervisor.

e. Hydraulic Lines and Fittings. Look for wear, damage, and leaks; ensure clamps and fittings are tight. Wet spots show leaks. Stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, repair or replace it.

f. Damage. Damage is defined as any condition that affects safety or would make the HET Tractor unserviceable for mission requirements.

2-11. FLUID LEAKAGE

a. Leakage Definitions. Fluid leakage is classified and defined as follows:

Class I - Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

Class II - Leakage of fluid great enough to form drops but not enough to cause drops to fall from item being checked/inspected.

Class III - Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

• Equipment operation is allowable with minor leakages (Class I or II). Of course, you must consider the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

• When operating with Class I or Class II leaks, continue to check fluid levels as required in your PMCS.

• Class III leaks should be reported to your supervisor and repaired.

2-12. PMCS TABLE

Refer to table 2-1 for unit PMCS procedures for the HET Tractor. Perform your PMCS (semiannual and annual) starting with the left front and continuing counterclockwise around the HET Tractor.
Table 2–1. Preventive Maintenance Checks and Services

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Semi-annually</td>
<td>EXTERIOR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

Road test should be performed first.


b. Check that fasteners (1), hinges (2), grille (3), and hood (4) are in place and serviceable. If faults are found, refer to hood repair (para 16–7).

c. Check door hinge for damage and loose or missing mounting hardware. If fault is found, refer to door hinge replacement (para 16–5).

b. Hinges or fasteners are broken.
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (cont)</td>
<td>Semi-annually</td>
<td>EXTERIOR (CONT)</td>
<td>d. Check left rear fender (1) for cracks and loose or missing mounting hardware. If faults are found, refer to left rear fender replacement (para 16–30).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Check right rear fender (2) for cracks and loose or missing mounting hardware. If faults are found, refer to right rear fender replacement (para 16–31).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f. Lubricate doors, side panels, hood hinges, locks, latches, and pivot points.</td>
</tr>
</tbody>
</table>

![Diagram of vehicle]

1

2
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Semi-annually</td>
<td>TRANSMISSION COOLING HOSES</td>
<td>Check transmission oil cooling hoses no. 2382 and no. 2393 (1) for cracks or leaks. If cooling hose is cracked or leaking, replace faulty part. Refer to transmission hose replacement (para 8–7).</td>
<td>Any class III leak is found. Hoses are cracked or frayed.</td>
</tr>
</tbody>
</table>
| 3        | Semi-annually | ENGINE                                    | WARNING
Ensure engine is cool before performing maintenance. Be sure to wear the proper eye protection to avoid personal injury. Failure to comply may result in severe burns.

a. Check oil supply hose no. 2758 (1) and oil return hose no. 2761 (2) from engine (3) to fan clutch (4) for cracking or chafing. If faults are found, replace hose. Refer to fan clutch to engine block hose replacement (para 6–12).

b. Check supply hose no. 2682 (5) from engine (3) to AOAP sampling valve (6) for cracks, leaks, or chafing. If faults are found, refer to AOAP sampling valve replacement (para 3–7). | a. Hose leaks or cracks or frays are found.  
b. Hose leaks or cracks or frays are found. |
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (cont)</td>
<td>Semi-annually</td>
<td>ENGINE (CONT)</td>
<td>c. Check dipstick tube (1) for damage. If faults are found, replace dipstick tube (para 3–6).</td>
<td>c. Dipstick is broken or missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Check rocker covers (2) for leakage.</td>
<td></td>
</tr>
</tbody>
</table>

**Procedure Diagrams:**
- STEERING SHAFT REMOVED FOR CLARITY
- Diagrams showing the engine components for inspection.
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (cont)</td>
<td>Semi–annually</td>
<td>ENGINE (CONT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>WARNING</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Always wear eye protection when working with batteries.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e. Check 24–volt alternator belts (1) for proper tension with belt tension gage (2). Belt tension gage reading should be 70–90 lb (310–400 N). If reading is not correct, adjust belts (para 7–7).</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>e. Belts are burned, cracked, ripped, frayed, or cut.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
</table>
| 3        | Semi-annually | ENGINE (CONT)                 | f. Check oil filter adapter (3) for leakage or damage. If fault is found, replace oil filter adapter and/or gasket (para 3–5).  
|          |             |                               | g. Check oil pan (4) for leaks or cracks. If faults are found, notify supervisor. | g. Class III leak is found.   |

**WARNING**

Ensure engine is cool before performing maintenance. Failure to comply may result in severe burns.

<table>
<thead>
<tr>
<th></th>
<th>PROCEDURE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>h.</td>
<td>Check turbocharger supply hose (1) and clamps (2) from turbocharger (3) to engine (4) for cracks, leaks, or chafing.</td>
<td>h. Hose leaks or cracks or frays are found.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (cont)</td>
<td>Semi-annually</td>
<td>ENGINE (CONT)</td>
<td>i. Check oil line no. 2630 (5) and oil line no. 2629 (6) from compressor (7) to engine (4) for cracks, leaks, or chafing. If faults are found, replace oil line (para 11–29).</td>
<td>i. Oil line leaks or cracks or frays are found.</td>
</tr>
</tbody>
</table>

j. Perform all semiannual lubrications as identified in LO 9–2320–360–12.
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Semi-annually</td>
<td>COOLING SYSTEM</td>
<td>a. Check both upper hoses (1) and two clamps (2) from radiator (3) and thermostat covers (4). Tighten clamps to 25–35 lb-in. (2.8–4.0 N·m). If faults are found, replace hose/clamp (para 6–6).</td>
<td>a. Hoses leak or cracks or frays are found.</td>
</tr>
</tbody>
</table>

**WARNING**

Be sure to wear the proper eye protection to avoid personal injury.
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
</table>
| 4 (cont) | Semi-annually | COOLING SYSTEM (CONT) | **WARNING**
Ensure engine is cool before performing maintenance. Failure to comply may result in severe burns. |
|          |          |                                | b. Check hose (1) and two clamps (2) from firewall to pipe (3) for cracks, leaks, or chafing. Tighten loose connections. If faults are found, replace hose/clamp (para 18–14). |
|          |          |                                | c. Deleted. |
|          |          |                                | d. Deleted. |

![Diagram of cooling system components]

b. Hose leaks or cracks or frays are found.
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (cont)</td>
<td>Semi-annually</td>
<td>COOLING SYSTEM (CONT)</td>
<td>e. Check hose (1) and two clamps (2) from control valve to oil cooler (3) for cracks, leaks, or chafing. Tighten loose connections. If fault is found, replace hose/clamp (para 18–14).</td>
<td>e. Hose leaks or cracks or frays are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f. Check hose (4) and two clamps (5) from thermostat (6) to pipe (7) for cracks, leaks, or chafing. Tighten loose connections. If damaged, replace hose/clamp (para 18–14).</td>
<td>f. Hose leaks or cracks or frays are found.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (cont)</td>
<td>Semi-annually</td>
<td>COOLING SYSTEM (CONT)</td>
<td>g. Check hose (1) and two clamps (2) for cracks, leaks, or chafing. Tighten loose connections. If fault is found, replace hose/clamp (para 6–6).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>h. Check hose (3) and two clamps (4) on inlet valve (5) of coolant filter mounting head for cracks, leaks, or chafing. Tighten loose connections. If fault is found, replace hose/clamp (para 6–6).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>i. Check hose (6) and two clamps (7) on outlet valve (8) of coolant filter mounting head for cracks, leaks, or chafing. Tighten loose connections. If fault is found, replace hose/clamp (para 6–6).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g. Hose leaks or cracks or frays are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>h. Hose leaks or cracks or frays are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>i. Hose leaks or cracks or frays are found.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (cont)</td>
<td>Semi-annually</td>
<td>COOLING SYSTEM (CONT)</td>
<td>j. Check two lower hoses (1 and 2), two clamps (3), coolant tubes (4 and 5), and clamps (6) from water pump (7) and radiator (8) for cracks, leaks, or chafing. Tighten clamps to 25–35 lb–in. (2.8–4.0) N·m. If fault is found, replace hose/clamp (para 6–6).</td>
<td>j. Hoses leak or cracks or frays are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>k. Check radiator vent hose (9) and two clamps (10) for cracks, leaks, or chafing. Tighten loosen connections. If fault is found, replace hose/clamp (para 6–6).</td>
<td>k. Hose leaks or cracks or frays are found.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO. (cont)</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Semi-annually</td>
<td>COOLING SYSTEM (CONT)</td>
<td>WARNING</td>
<td>Ensure engine is cool before performing maintenance. Failure to comply may result in severe burns.</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>1. Check overflow hose (1) for cracks or leaks. If fault is found, replace hose (para 6–3).</td>
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<td></td>
<td></td>
<td>m. Test coolant for antifreeze protection, reserve alkalinity (corrosion protection), and cleanliness (para 6–2 and TB 750–651).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>n. Deleted.</td>
</tr>
</tbody>
</table>
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (cont)</td>
<td>Semi-annually</td>
<td>COOLING SYSTEM (CONT)</td>
<td>o. Perform all semiannual lubrications as identified in LO 9-2320-360-12.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Semi-annually</td>
<td>EXHAUST SYSTEM</td>
<td><strong>WARNING</strong> Engine is hot. Use caution when inspecting exhaust system. Failure to comply may result in severe burns.</td>
<td>a. Any exhaust leaks are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. Check both exhaust manifolds (1) for leaks, cracks, and loose or missing mounting hardware.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (cont)</td>
<td>Semi-annually</td>
<td>EXHAUST SYSTEM (CONT)</td>
<td>WARNING</td>
<td>b. Any leaks are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The exhaust pipe and muffler can become very hot during HET Tractor operation. Do not touch these parts with bare hands or allow body to come in contact with pipe or muffler. Failure to comply may result in serious injury to personnel.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check exhaust pipes (1), muffler (2), and tail pipe (3) for cracks or leaks. If cracks or leaks are found, refer to chapter 5.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Check mounting clamps (4) for looseness. Tighten loose clamps.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Check rain cap (5) to ensure it operates freely and closes when engine is not running. If fault is found, replace rain cap (para 5–4 ).</td>
<td></td>
</tr>
</tbody>
</table>

![Diagram of exhaust system with labels 1, 2, 3, 4, 5]
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Semi-annually</td>
<td>AIR INTAKE</td>
<td></td>
<td>NOTE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. Check AIR CLEANER RESTRICTION indicator (1). Press reset button if indicator reads greater than 15. Service air cleaner (2) (para 4–2) if indicator still reads greater than 15 and will not reset.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check hoses (3) and ducting (4) for cracks, leaks, or chafing and loose or missing mounting hardware. Tighten loose connections. Replace damaged parts (para 4–3/4–4).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Any cracks or tears are in ducting or hose. Any hardware is missing.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Semi-annually</td>
<td>WHEELS AND TIRES</td>
<td>a. Inspect for nicks, cuts, and gouges on tread and sidewalls. If tire is badly damaged, replace it (para 12–5).</td>
<td>a. Any two tires are missing. Tire out of round, flat, or cords are exposed.</td>
</tr>
</tbody>
</table>

**NOTE**

- Tread depth measurements should be made at center of tread between the blocks that do not contain bridging. Bridging is a raised portion of rubber at the bottom of the groove that connects two or more blocks.

- Three separate measurements must be taken. Measure depth across tread at outside edge, center, and inside edge.

b. Check tire (1) for wear using tire depth gage. Tread depth should not be less than 1/8 in. (3.2 mm).

b. Tread depth is less than 1/8 in. (3.2 mm).
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 (cont)</td>
<td>Semi-annually</td>
<td>WHEELS AND TIRES (CONT)</td>
<td>c. Check wheels:</td>
<td>c. Nuts are missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1) Remove four nuts (1) and wheel cover (2) from wheel (3).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>WARNING</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tire must be completely deflated before attempting to loosen nuts if any bolts are found loose or broken after removing wheel cover. Failure to comply may result in injury to personnel.</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Check wheels (3) and CTIS valves (4) for damage.</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) Tighten nuts (5) to 450-550 lb-ft (610-746 N·m).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4) Install wheel cover (2) on wheel (3) with four nuts (1).</td>
<td></td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Semi-annually</td>
<td>BRAKE SYSTEM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
Brake shoes, drums, and brake adjustment mechanisms must be cleaned of dirt, mud, and debris before inspection.

a. Measure lining thickness of brake shoe (1). If brake lining is less than 9/32 in. (7 mm) at thinnest point, replace all brake shoes on axle (para 11–3).

b. Start engine and build system air pressure to 120–125 psi (827–862 kPa) (TM 9–2320–360–10).


a. Brake linings are less than 9/32 in. (7 mm).
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 (cont)</td>
<td>Semi–annually</td>
<td>BRAKE SYSTEM (CONT)</td>
<td>d. Measure distance A between center of yoke pin (1) and chamber bracket (2) with brake treadle released. Record measurement.</td>
<td>f. Brakes are inoperative or cannot be adjusted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Measure distance B between center of yoke pin (1) and chamber bracket (2) while assistant holds brake treadle down. Record measurement.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f. Subtract measurement A from measurement B. If difference is 2 in. (50 mm) or more, adjust manual slack adjuster (para 11–2) or troubleshoot automatic slack adjuster.</td>
<td></td>
</tr>
</tbody>
</table>

9 Semi–annually FRAME Check frame crossmembers (1) for cracks, and loose or missing mounting hardware. If faults are found, notify supervisor. Crossmembers are broken, loose, bent, or cracked or mounting hardware is
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Semi-annually</td>
<td>FRAME (CONT)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

Some looseness of the front spring clip is permissible. The clip may rotate on the rivet.

- a. Check front axle (1) for loose or missing mounting hardware.
- b. Check spring (2) for cracked or broken leaves or missing spring clips.
- c. Check shock absorber (3) for cracks, leaks, and loose or missing mounting hardware. If faults are found, replace shock absorber (para 15–3).

- a. Mounting hardware is missing.
- b. Shock absorber is cracked or broken or mounting hardware is missing.
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Semi-annually</td>
<td>AXLES/ S</td>
<td>d. Check no. 2, no. 3, and no. 4 axles (1) for loose or missing mounting hardware.</td>
<td>d. Mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>uspension</td>
<td>e. Check air springs (2) for rips or tears.</td>
<td>e. Air springs are ripped or torn.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(CONT)</td>
<td>f. Check torque rods (3) for cracks and loose or missing mounting hardware. If faults are found, notify your supervisor.</td>
<td>f. Torque rod or hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g. Check input and output shaft seals (4) for leakage (para 2–11).</td>
<td>g. Class III leak is found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>h. Check input and output yoke nuts (5) for looseness and proper staking. Both staked points or nuts should be in slots of pinion shafts.</td>
<td>h. Yoke nut(s) are loose, missing or not staked.</td>
</tr>
</tbody>
</table>

![Diagram of vehicle showing components 1 to 5]
### Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (cont)</td>
<td>Semi-annually</td>
<td>AXLES/ SUSPENSION (CONT)</td>
<td>h. Check wheel bearings for looseness:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1) Raise vehicle from ground with suitable lifting device far enough to position crow bar between tire and ground.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wheel should not be loose on hub.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Brace crow bar on ground and push against tire.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) If there is any wheel bearing play, notify your supervisor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>h. Wheel bearings are frozen, binding, or loose.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wheel bearing play is present. Any parts are missing.</td>
</tr>
</tbody>
</table>
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (cont)</td>
<td>Semi-annually AXLES/ SUSPENSION (CONT)</td>
<td>i. Service axle breather:</td>
<td>i. Any breather missing or unserviceable.</td>
<td></td>
</tr>
</tbody>
</table>

NOTE
All axle breathers are serviced in a similar way. No. 2 axle breather is located at end of nylon tube coming from axle housing.

(1) Check inside axle breather (1) for contamination. Ensure cap moves in and out freely.

CAUTION
Do not attempt to separate breather from adapter. Failure to comply may result in damage to breather.

NOTE
Do steps (2) thru (6) if axle breather is contaminated, stuck, or binding.

(2) Remove axle breather (1) with adapter (1.1) from axle housing (2).
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
</table>
| 10      | Semi-annually | AXLES/ SUSPENSION (CONT) | **WARNING**
Solvent cleaning compound MIL-PRF 680 Type II and III may be irritating to the eyes and skin. Use protective gloves and goggles. Use in well-ventilated areas. Use respirator as needed. Accidental ingestion can cause irritation of digestive tract and respiratory tract, may cause lung and central nervous system damage. Can be fatal if swallowed. Inhalation of high/massive concentrations can cause coma or be fatal. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing. Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention. Keep away from open flames and other sources of ignition. Failure to follow this warning may result in injury or death to personnel.
• The flashpoint for type II solvent cleaning compound is 141-198°F (61-92°C) and type III is 200-241°F (93-116°C)
• Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment.
• Fire extinguishers should be placed nearby when using solvent cleaning compound. Failure to follow this warning may result in injury or death.
• Cloths or rags saturated with solvent cleaning compound must be disposed of IAW authorized facilities' procedures. Failure to follow this warning may result in injury.
• Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury.

(3) Clean axle breather (1) and adapter (1.1) with solvent cleaning compound.

**WARNING**
Compressed air for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc).

(4) Dry axle breather (1) and adapter (1.1) with compressed air.

(3) Clean axle breather (1) and adapter (1.1) with solvent cleaning compound.

(4) Dry axle breather (1) and adapter (1.1) with compressed air.
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (cont)</td>
<td>Semi-annually</td>
<td>AXLES/ SUSPENSION (CONT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
Do steps (4.1) and (4.2) only if breather or adapter are damaged.

(4.1) Remove breather (1) from adapter (1.1).

**WARNING**
Pipe thread sealing compound may burn or give off harmful vapors. It is harmful to skin and clothing. To avoid injury or death, keep away from open flame and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**
Use pipe thread sealing compound sparingly only on pipe threads. Do not apply compound to hose connections. Failure to comply may result in component failure.

(4.2) Coat threads of breather (1) with pipe thread sealing compound and install in adapter (1.1).

(5) Coat threads of adapter (1.1) with pipe thread sealing compound.

(6) Install breather (1) with adapter (1.1) in axle housing (2).
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Semi-annually</td>
<td>PROPELLER SHAFTS</td>
<td>a. Check propeller shafts (1) for missing weights, grease fittings, screws, lock tabs, and leaking seals. If damage is found, repair propeller shaft (para 10–2).</td>
<td>a. Propeller shafts are loose. Weights, grease fittings, or screws are missing.</td>
</tr>
</tbody>
</table>

---

**CAUTION**

Do not pry on grease fittings. Damage to equipment may result.

**NOTE**

To check universal joint play, position pry bar between yoke and propeller shaft. Apply pressure to pry bar and look for movement in universal joint.

b. Check universal joints (2) for bearing play. If bearing play is found, repair propeller shaft (para 10–2).

c. Perform all semiannual lubrications as identified in LO 9–2320–360–12.
### Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Semi-annually</td>
<td>TRANSMISSION</td>
<td>a. Check transmission (1) and oil pan (2) for loose mounting hardware or leakage.</td>
<td>a. Class III leaks are present or mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check drain plug (3) for looseness.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Check output shaft oil seal (4) for leakage (para 2–11).</td>
<td>c. Class III leaks are present.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Check transmission shift cable (5) for kinks, frays, or broken linkage. If faults are found, replace shift cable (para 2–11).</td>
<td>d. Cable is broken, kinked, or frayed, or linkage is broken.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Perform all semiannual lubrications as identified in LO 9–2320–360–12.</td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>INTERVAL</td>
<td>ITEM TO BE CHECKED OR SERVICED</td>
<td>PROCEDURE</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>13</td>
<td>Semi-annually</td>
<td>TRANSFER CASE</td>
<td>a. Check transfer case (1) for cracks and loose or missing mounting hardware.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check transfer case input and output shaft seals (2) for leaks (para 2–11).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Check transfer case shift cable (3) for kinks, frays, or broken linkage. If faults are found, replace shift linkage (para 9–2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Perform all semiannual lubrication as identified in LO 9–2320–360–12.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOT FULLY MISSION CAPABLE IF:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. Mounting hardware is missing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Any class III leaks are found.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Cable is broken, kinked, or frayed, or linkage is broken.</td>
<td></td>
</tr>
</tbody>
</table>
**Table 2–1. Preventive Maintenance Checks and Services (Cont)**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Semi-annually</td>
<td>AIR SYSTEM</td>
<td>a. Start engine and build up air pressure to 120–125 psi (827–862 psi).</td>
<td>d. Any leaks are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Coat fittings with soapy water.</td>
<td>e. Oil is present.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Check air reservoirs (1), valves (2), and air lines (3) for cracks or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>leaks. Tighten loose connections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Drain air reservoirs (1). Check for presence of oil. If oil is present,</td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td>notify supervisor.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Semi-annually</td>
<td>STEERING SYSTEM</td>
<td>a. Check front steering gear (1) for leaks and loose or missing mounting</td>
<td>a. Class III leaks are found</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hardware.</td>
<td>or mounting hardware is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check front steering shafts (2) and U-joints (3) for cracks and loose</td>
<td>missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>or missing mounting hardware. If fault is found, refer to steering shaft</td>
<td>b. U-joints are loose.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>repair (para 13–6).</td>
<td>Bearing caps are cracked</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or missing.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 (cont)</td>
<td>Semi-annually</td>
<td>STEERING SYSTEM (CONT)</td>
<td>b.1. Check front drag link ends (1) for excessive wear, refer to drag link inspection (para 13–14.1).</td>
<td>b.1. Excessive wear on drag link ends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Check front drag link (1) and pitman arm (2) for cracks and loose or missing mounting hardware.</td>
<td>c. Pitman arm is cracked or ripped or mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Check tee gear box (3) for cracks and loose or missing mounting hardware. If fault is found, refer to tee gear box replacement (para 13–8).</td>
<td>d. Tee gear box is cracked or mounting hardware is missing.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 (cont)</td>
<td>Semi-annually</td>
<td>STEERING SYSTEM (CONT)</td>
<td>d.1. Check front tie rod ends (1) for excessive wear, refer to tie rod inspection (para 13–4.1).</td>
<td>d.1. Excessive wear on tie rod ends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Check front tie rod (1) for cracks and loose or missing mounting hardware. If fault is found, refer to tie rod replacement (para 13–4).</td>
<td>e. Cracks are found or mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f. Check front steering lines and hoses (2) for cracks, leaks, or rotting. If faults are found, replace faulty part (para 13–9/13–10).</td>
<td>f. Any leaks are found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g. Check rear steering gear (1) for leaks and loose or missing mounting hardware.</td>
<td>g. Class III leaks are found or mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>h. Check rear steering shafts (2) and U-joints (3) for cracks and loose or missing mounting hardware. If damage is found, repair steering system shaft (para 13–7).</td>
<td>h. U–joints are loose. Bearing caps are cracked or missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>i. Check rear steering lines (4) and hoses (5) for cracks, leaks, or rotting. If faults are found, replace faulty part (para 13–9/13–10).</td>
<td>i. Any leaks are found.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Semi-annually</td>
<td>STEERING SYSTEM (CONT)</td>
<td>i.1. Check rear drag link ends (6) for excessive wear, refer to drag link inspection (para 13-4.1).</td>
<td>i.1. Excessive wear on drag link ends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>j. Check rear drag link (6) and pitman arm (7) for cracks and loose or missing mounting hardware.</td>
<td>j. Pitman arm is cracked or ripped or missing mounting hardware.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>j.1. Check rear tie rod ends (8) for excessive wear, refer to tie rod inspection (para 13-4.1).</td>
<td>j.1. Excessive wear on tie rod ends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>k. Check rear tie rod (8) for cracks and loose or missing mounting hardware. If fault is found, refer to tie rod replacement (para 13–4).</td>
<td>k. Cracks are found or mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>l. Perform semiannual lubrication as identified in LO 9–2320–360–12.</td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>INTERVAL</td>
<td>ITEM TO BE CHECKED OR SERVICED</td>
<td>PROCEDURE</td>
<td>NOT FULLY MISSION CAPABLE IF:</td>
</tr>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Replace secondary fuel filter (para 4-13).</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Semi-annually</td>
<td>BATTERIES</td>
<td><strong>WARNING</strong> Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Always wear eye protection when working with batteries.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>NOTE</strong> Make a separate test for each battery cell.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check and record specific gravity of each cell using antifreeze and battery tester (Item 49, Appendix F):</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1) Using black dipstick, place a few drops of electrolyte on exposed portion of measuring window.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Point tester toward a bright light source.</td>
<td></td>
</tr>
</tbody>
</table>
**Table 2–1. Preventive Maintenance Checks and Services (Cont)**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 (cont)</td>
<td>Semi-annually</td>
<td>BATTERIES (CONT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

- Batteries prepared for a tropical climate will have a 1 in. (25 mm) diameter white spot painted on battery top.
- Full charge is 1.225 specific gravity for tropical batteries and 1.280 specific gravity for all others.

1. Record specific gravity of each cell.
2. Test alternator output (para 7–2) if specific gravity is below 1.180 for tropical batteries and 1.225 for all others.
3. Remove batteries (1) from battery box (2) (para 7–57). Replace battery if specific gravity is below 1.180 for tropical batteries and 1.225 for all others.
4. Check battery box (2) for cracks and debris. Clean battery box (para 2–17). If damaged, replace battery box (para 7–57).
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 (cont)</td>
<td>Semi-annually</td>
<td>BATTERIES (CONT)</td>
<td>e. Check battery cables (1) for frays and splits. Check terminals (2) for looseness. Clean and apply anticorrosion grease to battery connections. If faults are found, replace battery cables and terminals (para 7–57).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f. Install batteries (1) in battery box (2) (para 7–57).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g. Close battery box (TM 9–2320–360–10).</td>
</tr>
</tbody>
</table>

e. Cables are frayed or split.
### Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
</table>
| 18      | Semi-annually  | WINCH AND WINCH HYDRAULICS                           | **WARNING**  
Be sure to wear the proper eye protection to avoid personal injury.  

a. Check main winches (1) for leaks (para 2–11).  

b. Check auxiliary winch (2) for leaks. If leak is found, replace auxiliary winch (para 17–13).  
c. Tighten main winch mounting screws (3) to 600 lb–ft (814 N·m).  
d. Tighten auxiliary winch mounting screws (4) to 45 lb–ft (61 N·m).  
e. Remove winch control console panels (para 17–8).  
f. Check hoses (5) and control valves (6) for leaks, chafing, or cracks. If fault is found, notify supervisor.  

|       |                |                                                       |                                                                          |                               |

#### WARNING
Be sure to wear the proper eye protection to avoid personal injury.

- Check main winches (1) for leaks (para 2–11).
- Check auxiliary winch (2) for leaks. If leak is found, replace auxiliary winch (para 17–13).
- Tighten main winch mounting screws (3) to 600 lb–ft (814 N·m).
- Tighten auxiliary winch mounting screws (4) to 45 lb–ft (61 N·m).
- Remove winch control console panels (para 17–8).
- Check hoses (5) and control valves (6) for leaks, chafing, or cracks. If fault is found, notify supervisor.

#### NOT FULLY MISSION CAPABLE IF:
- Any leak is found.
- Hoses leak or chafes or cracks are found.
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
</table>
| 18 (cont)| Semi-annually | WINCH AND WINCH HYDRAULICS (CONT) | g. Check hydraulic reservoir (1) and hoses (2) for leaks, chafing, or cracks.  

h. Install winch control console panels (para 17-8).  
i. Perform all semiannual lubrication as identified in LO 9–2320–360–12.  
g. Hoses leak or chafes or cracks are found. |

WARNING

- Wire rope can become frayed or contain broken wires. Wear heavy leather-palmed work gloves when handling wire rope. Frayed or broken wires can injure hands.  

- Never let moving wire rope slide through hands, even when wearing gloves. A broken wire may cut through glove and cut hand.  

j. Individually unwind winch cables (1) completely and check for kinks, broken hand.  
j. Winch cable has more than three
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Semi-annually</td>
<td>WINCH AND WINCH HYDRAULICS (CONT)</td>
<td>strands, and wear. If damaged or worn, replace cable (para 17-5/17-13).</td>
<td>broken wires per inch on same strand or more than six broken wires on all strands in a 1 in. running length of cable. Maximum number of broken wires shall not occur in any two consecutive inches of cable; that is, if six wires are broken in 1 in. of cable, none would be allowed in the next consecutive inch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>k. Any leak is found.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STRAND WIRE</td>
<td></td>
<td>l. PTO is cracked or inoperative.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **k.** Inspect hydraulic pump (2) for leaks or obvious damage (para 2-11).
- **l.** Check winch PTO shaft (3) for cracks, wear, or looseness. If fault is found, repair PTO shaft (para 17-15).
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Semi–annually</td>
<td>FIFTH WHEEL</td>
<td>a. Check fifth wheel (1) for gouges or loose or missing mounting hardware.</td>
<td>a. Fifth wheel or mounting hardware is missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Adjust fifth wheel (para 14–3).</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Semi–annually</td>
<td>AUXILIARY EQUIPMENT</td>
<td>a. Remove two rubber latches (1) from brackets (2). Remove battery box cover (3).</td>
<td></td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 (cont)</td>
<td>Semi-annually</td>
<td>ARCTIC KIT BATTERIES (IF EQUIPPED) (CONT)</td>
<td>b. Remove batteries (1) from battery box (2) (para 19–3).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Check battery box (2) for damage and debris. Clean battery box. If</td>
<td>d. Battery cracked or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>damaged, replace battery box (para 19–3).</td>
<td>missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. Check batteries (1) for damage. If damaged, replace battery (para 19–3).</td>
<td></td>
</tr>
</tbody>
</table>
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 (cont)</td>
<td>Semi-annually</td>
<td>ARCTIC KIT BATTERIES (IF EQUIPPED) (CONT)</td>
<td>WARNING</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**

Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Always wear eye protection when working with batteries.

**NOTE**

Make a separate test for each battery cell.

e. Check and record specific gravity of each cell using antifreeze and battery tester (Item 49, Appendix F):

1. Using black dipstick, place a few drops of electrolyte on exposed portion of measuring window.

2. Point tester toward a bright light source.

**NOTE**

Full charge is 1.280 specific gravity.

(3) Record specific gravity of each cell.

(4) Replace battery if specific gravity is below 1.225 (para 19–3).

e. Any battery has one cell below 1.225 specific gravity.
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 (cont)</td>
<td>Semi-annually</td>
<td>ARCTIC KIT BATTERIES (IF EQUIPPED) (CONT)</td>
<td>f. Check battery cables (1) for frays and splits. Check terminals (2) for looseness. Clean and grease battery connections. If damaged, replace battery cables and terminals (para 7–57). g. Install batteries (3) in battery box (4) (para 19–3). h. Install battery box cover (5). Install two rubber latches (6) in brackets (7).</td>
<td>f. Cable frayed or split.</td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>INTERVAL</td>
<td>ITEM TO BE CHECKED OR SERVICED</td>
<td>PROCEDURE</td>
<td>NOT FULLY MISSION CAPABLE IF:</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>---------------------------------</td>
<td>-----------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>21</td>
<td>Semi-annually</td>
<td>INSIDE DOGHOUSE AIR SYSTEM</td>
<td>Remove engine access panels (para 16–2).</td>
<td>b. Air leaks or presence of oil in air system is found.</td>
</tr>
</tbody>
</table>
|         |           |                                 | a. Build system air pressure to 120–125 psi (827–862 kPa) (TM 9–2320–360–10). | \[
|         |           |                                 | b. Check air compressor (1) and hoses (2) for leaks, chafing, or cracks. Tighten loose connections. Replace damaged hoses (para 11–29). | |
| 22      | Semi-annually | STEERING SYSTEM | Check steering pump (1) and hoses (2) for leaks and loose or missing mounting hardware. | Class III oil leaks are found. |
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Semi–annually</td>
<td>ENGINE</td>
<td>Check 12–volt belts (1) for proper tension with belt tension gage (2). Belt tension gage reading should be 70–90 lb (310–400 N). If gage reading is not correct, adjust belts (para 7–6).</td>
<td>Belts are burned, cracked, ripped, frayed, or cut.</td>
</tr>
</tbody>
</table>
### Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Semi-annually</td>
<td>GAS PARTICULATE FILTER UNIT (GPFU)</td>
<td><strong>NOTE</strong>&lt;br&gt;Replace precleaners and particulate filter if any of the following conditions exist: physical damage or water immersion, clogged filter resulting in insufficient air flow, or if the filters exceed criteria established in FM 3–4.&lt;br&gt;&lt;br&gt;a. Inspect and replace, if required, precleaners and particulate filter in accordance with FM 3–4 and local climatic conditions.&lt;br&gt;&lt;br&gt;b. Check operation of GPFU (TM 9–2320–360–10).&lt;br&gt;(1) Listen for gas particulate filter motor operation.&lt;br&gt;&lt;br&gt;(2) Disconnect five air duct breakaway sockets (1) from mounts (2) and feel for steady air flow.</td>
</tr>
</tbody>
</table>
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Semi-annually</td>
<td>STEERING</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

- HET Tractor must be driven a minimum of 10 miles (16 kilometers) during road test.
- Items 25 and 26 will be performed during road test.

**NOTE**

Do not turn tires when turning wheel to check for free play.

a. Turn steering wheel (1) to right until resistance is felt (A). Note location of one of the steering wheel spokes (2). Turn steering wheel (1) to left until resistance is felt (B). Measure distance the noted steering wheel spoke (2) has travelled. Free play is measured at outside edge of steering wheel and should not be more than 2-1/2 in. (6.4 cm).

![Diagram of steering wheel](image-url)
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 (cont)</td>
<td>Semi-annually</td>
<td>STEERING (CONT)</td>
<td>b. With HET Tractor on straight, level road, lightly hold steering wheel (1) to check for pull or wander.</td>
</tr>
</tbody>
</table>

**CAUTION**

Do not hold steering wheel at full right or left position for more than 10 seconds. Failure to comply may result in oil overheating and pump damage.

c. With HET Tractor stopped, transmission in N (neutral), and parking brake applied, turn steering wheel (1) all the way right and then left to check for hard steering. If steering wheel does not operate properly, refer to troubleshooting (para 2–13).
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Semi-annually</td>
<td>ENGINE</td>
<td>CAUTION&lt;br&gt;At full throttle, engine must not exceed 2225 rpm. Failure to comply may result in damage to equipment.&lt;br&gt;a. Press accelerator pedal (electronic throttle) (1) and check engine operation (TM 9–2320–360–10). If engine overspeeds (2225 rpm maximum), notify supervisor.&lt;br&gt;b. Press engine brake retarder ON/OFF switch (2) to ON position. Press engine brake retarder HI/LO switch (3) to LO position. Fully press accelerator pedal (1), then release. There should be low engine braking. Press engine brake retarder HI/LO switch (3) to HI position. Fully press accelerator pedal, then release. There should be high engine braking. If engine brake retarder does not operate properly, refer to troubleshooting (para 2–13).</td>
<td>a. Engine overspeeds. &lt;br&gt;b. Engine overspeeds.</td>
</tr>
</tbody>
</table>
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.1</td>
<td>Semi-annually</td>
<td>SEAT BELTS</td>
<td><strong>WARNING</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Failure to properly inspect and maintain seat belts can cause serious injury or loss of life.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• If the replacement of any part of the seat belt is required, the entire seat belt assembly must be replaced.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. Check for worn webbing (1) at the latch (2) and D-loop (3) areas.</td>
<td>Webbing is cut, frayed, or excessively worn.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Check D-loop (3) for free rotation, deformation, cracks or damage.</td>
<td>D-loop does not rotate freely or is deformed, cracked or broken.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Check comfort latch (4) for proper operation, cracks and damage.</td>
<td>Comfort latch is broken, or does not lock in place easily and does not release by tugging down on webbing.</td>
</tr>
</tbody>
</table>

![Diagram of seat belt components](image)

1. Webbing
2. Latch
3. D-loop
4. Comfort latch
5. Buckle
6. Retractor
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.1 (cont)</td>
<td>Semi-annually</td>
<td>SEAT BELTS (CONT)</td>
<td>d. Check latch (2) and buckle (5) for wear, deformation, damage or broken casing.</td>
<td>Molded plastic around buckle/latch is deformed, cracked or broken.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Check latch (2) and buckle (5) for proper operation.</td>
<td>Buckle/latch does not engage with a solid sounding “click” and/or does not release freely when button is pushed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f. Check that retractor (6) is not locked up and spools out/retracts webbing (1) properly.</td>
<td>Retractor does not operate properly or retractor cover is cracked/broken.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g. Check tethers (7) for proper attachment to seat.</td>
<td>Tethers are loose or missing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>h. Check all seat belt mounting hardware for looseness and other damage.</td>
<td>Hardware is loose, missing, rusted, corroded or damaged.</td>
</tr>
</tbody>
</table>
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
</table>
| 27      | Annually | EXTERIOR                        | a. Check mud flap (1) for rips and loose or missing mounting hardware. If fault is found, refer to mud flap replacement (para 16-6).  
                      b. Check winch personnel guard (2) for cracks, bends, and loose or missing mounting hardware. If faults are found, refer to personnel guard replacement (para 17-8). |
| 27.1    | Annually | COOLING SYSTEM                  | NOTE  
Fan clutch checks must be done when the engine coolant temperature is less than 195°F (91°C).  
                      a. Pull fan blade forward and then toward engine. There should be no forward or rearward movement of fan mounting hub (1). If fault is found, replace fan clutch (para 6-9).  
                      b. Push tip of a fan blade with light force clockwise, then counterclockwise. If rotational movement exceeds 1/2 in. (12.7 mm), replace fan clutch (para 6-9). |
### 2-57 Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.1 (cont)</td>
<td>Annually</td>
<td>COOLING SYSTEM (CONT)</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>28</td>
<td>Annually</td>
<td>TRANSMISSION</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

#### Procedure 28:

- a. Disconnect batteries (para 7–61).

**WARNING**

Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Always wear eye protection when working with batteries.

- b. Check PTO (1) for loose mounting hardware, leakage, or cracks.

- b. Leaks are found.
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 (cont)</td>
<td>Annually</td>
<td>TRANSMISSION (CONT)</td>
<td>c. Service transmission breather:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>NOTE</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Transmission breather can be accessed by reaching under power steering pump, between air compressor and power steering pump.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1) Remove transmission breather (2) from reducer (3).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>WARNING</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Solvent cleaning compound MIL-PRF 680 Type II and III may be irritating to the eyes and skin. Use protective gloves and goggles. Use in well-ventilated areas. Use respirator as needed. Accidental ingestion can cause irritation of digestive tract and respiratory tract, may cause lung and central nervous system damage. Can be fatal if swallowed. Inhalation of high/massive concentrations can cause coma or be fatal. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing, Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention. Keep away from open flames and other sources of ignition. Failure to follow this warning may result in injury or death to personnel.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The flashpoint for type II solvent cleaning compound is 141-198°F (61-92°C) and type III is 200-241°F (93-116°C).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Fire extinguishers should be placed nearby when using solvent cleaning compound. Failure to follow this warning may result in injury or death.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Cloths or rags saturated with solvent cleaning compound must be disposed of IAW authorized facilities’ procedures. Failure to follow this warning may result in injury.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Clean transmission breather (2) with solvent cleaning compound.</td>
<td></td>
</tr>
</tbody>
</table>

![ Illustration of transmission breather locations ]
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 (cont)</td>
<td>Annually</td>
<td>TRANSMISSION (CONT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**
Compressed air for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

1. (3) Dry transmission breather (2) with compressed air.
2. (4) Check inside transmission breather (2) for contamination. Ensure cap moves in and out freely.

**WARNING**
Pipe thread sealing compound may burn or give off harmful vapors. It is harmful to skin and clothing. To avoid injury or death, keep away from open flame and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**
Use pipe thread sealing compound sparingly only on pipe threads. Do not apply compound to hose connections. Failure to comply may result in component failure.

1. (5) Coat threads of breather (2) with pipe thread sealing compound.
2. (6) Install breather (2) in reducer (3).
### Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
</table>
| 29       | Annually  | TRANSFER CASE                  | a. Service transfer case breather.  
(1) Remove transfer case breather (1) from elbow (2). Discard breather.  
**WARNING**  
Pipe thread sealing compound may burn or give off harmful vapors. It is harmful to skin and clothing. To avoid injury or death, keep away from open flame and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.  
**CAUTION**  
Use pipe thread sealing compound sparingly only on pipe threads. Do not apply compound to hose connections. Failure to comply may result in component failure.  
(2) Coat threads of new breather (1) with pipe thread sealing compound.  
(3) Install new breather (1) in elbow (2). |
### Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Annually</td>
<td>AUXILIARY EQUIPMENT&lt;br&gt;ARCTIC KIT (IF EQUIPPED)</td>
<td>Check water jacket (1) and coolant pump (2) for cracks, leaks, and missing mounting hardware. If faults are found, refer to arctic kit water jacket replacement (para 19–9) or arctic kit coolant pump replacement (para 19–6).</td>
<td>Any leaks are found.</td>
</tr>
</tbody>
</table>
Table 2-1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Annually</td>
<td>STEERING</td>
<td>WARNING</td>
</tr>
</tbody>
</table>

**WARNING**
- Auxiliary steering pump is driven by transfer case center shaft. To test operation of auxiliary steering pump, transfer case shafts must be turned by running the engine. Propeller shafts must be disconnected to prevent movement of HET Tractor. Failure to comply may result in injury to personnel.
- Never disconnect any hydraulic hose while engine is running. Allow several minutes after engine is shut off for pressure to drop. Failure to comply may result in injury to personnel.

**NOTE**
Propeller shafts only have to be disconnected from transfer case end. Leave propeller shafts attached at axle end.

a. Remove transfer case to axle no. 1 propeller shaft and transfer case to axle no. 2 propeller shaft from transfer case yokes (para 10-2).
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 (cont)</td>
<td>Annually</td>
<td>STEERING (CONT)</td>
<td>b. Remove hose no. 2879 (1) from auxiliary steering pump manifold (2).</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
Fluid will drip from fitting during test. Do not cap manifold fitting. Auxiliary steering will be intermittent if fitting is capped.

c. Install plug (Item 28.1, Appendix F) in hose no. 2879 (1).

d. Position drain pan under auxiliary steering pump manifold (2).

**WARNING**
Keep out from under vehicle during test. Transfer case output yokes will rotate during test. Failure to comply may result in injury to personnel.

e. Place transfer case shift lever in HIGH range (TM 9–2320–360–10).


g. Place transmission range selector in 2–5 position (TM 9–2320–360–10).
Table 2–1. Preventive Maintenance Checks and Services (Cont)

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 (cont)</td>
<td>Annually</td>
<td>STEERING (CONT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
Transmission must shift from 2nd to 3rd gear before accurate test results can be obtained.

h. Increase engine speed until tachograph indicates approximately 20 mph.

**NOTE**
If steering wheel cannot be turned, refer to direct support maintenance for troubleshooting.

i. Turn steering wheel several times from full right to full left position.


k. Remove plug from hose no. 2879 (1).

l. Install hose no. 2879 (1) on steering pump manifold (2).

m. Install transfer case to axle no. 1 propeller shaft and transfer case to axle no. 2 propeller shaft (para 10–2).

**NOTE**
If steering wheel cannot be turned during test.
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>INTERVAL</th>
<th>ITEM TO BE CHECKED OR SERVICED</th>
<th>PROCEDURE</th>
<th>NOT FULLY MISSION CAPABLE IF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Annually</td>
<td>STEERING (CONT)</td>
<td>n. Check steering stops on no. 1 and no. 4 axles.</td>
<td>n. Steering stop to axle housing clearance is not 1/16–1/8 in. (1.6–3.2 mm). Contact direct support maintenance for steering stop adjustment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1) Apply parking brake (TM 9–2320–360–10).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Chock wheels.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) Start engine (TM 9–2320–360–10).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4) Turn steering wheel to full right position.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5) Inspect for 1/16–1/8 in. (1.6–3.2 mm) clearance between steering stop (1) and axle housing (2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(6) Turn steering wheel to full left position and repeat inspection of left steering stop.</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**
Keep out from under vehicle when assistant turns steering wheel. Failure to comply may result in injury to personnel.

(4) Turn steering wheel to full right position.

(5) Inspect for 1/16–1/8 in. (1.6–3.2 mm) clearance between steering stop (1) and axle housing (2).

(6) Turn steering wheel to full left position and repeat inspection of left steering stop.


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**Table 2–1. Preventive Maintenance Checks and Services (Cont)**
Section IV. TROUBLESHOOTING

2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING

a. Page Layout  The troubleshooting is divided into symptoms peculiar to a vehicle system or component (for example, air system or fifth wheel). This manual cannot list all malfunctions that may occur, nor all tests, inspections, or corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify supervisor.

First, determine the symptom or condition that indicates a problem or failure. Refer to Table 2-5. Engine Electronic Controls (DDEC) Troubleshooting or Table 2-7. Vehicle Troubleshooting following this introduction arranged by major vehicle system.

Go to the referenced page to begin troubleshooting. Open the manual flat so that both the right and left hand pages are displayed before you. The information on all facing pages is important.

All diagnostic logic and flowcharts are on the left hand page, with supporting information, warnings, cautions, notes, and test instructions on the right. (See figure on next page.) Pages are set up so you do not need any more than the necessary information, notes, warnings and cautions about a particular question. The experienced technician can generally read just left hand pages and refer to information on the right page when needed. All critical information for decisions is on the left page. Do the tests and inspections in the order listed, and try to return the vehicle or component to operation after each test, inspection, and corrective action has been performed.

b. How To Begin Troubleshooting

(1) Identify the symptom or fault. Select the applicable symptom (grouped by systems). Follow Vehicle Troubleshooting BEFORE going to DDEC Troubleshooting.

(2) Follow the diagnostic procedure. Answer question no 1. on the left hand page and follow the YES or NO path to either the remedy or the next question. Helpful information about the problem is also on the left page. Look on the right page for additional specific instructions and help.

(3) Observe warnings, cautions, and notes. WARNING is the symbol for a warning statement. If you see this block above a question on the left page, look on the right page for the text of the message. The WARNING message on the right page will also have the symbol above it. CAUTION is the symbol for a caution statement. If you see this block above a question on the left page, look on the right hand page for the text of the message. The CAUTION message on the right hand page will also have the symbol above it. Examples:

WARNING
The ENGINE switch should always be OFF before the harness connectors are disconnected or reconnected. Failure to comply may result in electrical shock.

CAUTION
When disconnecting harness connectors, apply pulling force to the connectors themselves and not the wires extending from them. Failure to comply will damage wire.

NOTE
After harness connectors are reconnected to the DDEC system, the computer diagnostics should be ignored and cleared.

c. Measurements Required for Troubleshooting

(1) Resistance Measurements

(a) Connect the red test lead to the volt–ohm input connector and black lead to the Common (COM) input connector on the meter.
2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)

Known information and possible problems with the system.

Reasons for question. This tells you why the question is being asked. It contains criteria for a troubleshooting test performed e.g. resistance range indication, an open circuit.

Instructions for how to perform a test or make a measurement, usually numbered steps in a box.

Test Options: Other methods you can use to obtain the answer to the question.

Question to be answered.

Question number, so you know where you are in a test chain.

Line art to assist technician on locating suspect component or test point.

Arrows link reference information with questions.
(b) Set the function/range switch to the desired ohm position. If the magnitude of the resistance is not known, set the switch to the highest range, then reduce until a satisfactory reading is obtained.

(c) If the resistance being measured is connected to a circuit, turn ENGINE switch OFF.

(d) Connect test leads to the circuit being measured. When measuring high resistance, be careful not to contact adjacent points, even if they are insulated. Some insulators have a relatively low insulation resistance which can affect the resulting measurement.

(e) Read the resistance value on the digital display.

(2) Continuity Checks

(a) Place the function/range switch in any ohm range.

**NOTE**
Some meters show ‘1+m’, or simply ‘1’ when function/range switch in any ohm position.

(b) Connect the red lead to the volt–ohm connector and black lead to COM input connector on the meter. With the test leads separated or measuring an out-of-range resistance, the digital display will indicate ‘OL’ (overlimit).

(c) Put one test lead probe at one end of the wire or circuit to be tested. Use the other test lead to trace the circuit. When continuity is established, an ohm symbol will appear in the upper left corner of the digital display. If contact in the wire is maintained long enough (about 1/4 of a second), the OL will disappear and the resistance value of the wire or circuit will appear next to the symbol.

(3) Voltage Measurements

(a) Connect the red test lead to the volt–ohm input connector and the black lead to the COM input on the meter. If a DC–AC switch is present, make sure it is switched to the DC position.

(b) Set the function/range switch to the desired volts position. If the magnitude of the voltage is not known, set the switch to highest DC voltage range (50VDC). Then reduce the range until a satisfactory reading is obtained.

(c) Connect the test leads to the circuit being measured. Voltage measurements are always taken at pins, sockets, Battery + or ground. Following the voltage measurement point, the color test lead used is given in parenthesis (red is volt–ohm connection, and black is the COM connection).
2–13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)

d. Contact Test Set (CTS), J1708 Application, Introduction

(1) Connecting CTS to HET M1070

(a) Remove cover (1) from diagnostic connector assembly (DCA)
   (2) by turning counterclockwise.

(b) Install DCA cable on DCA (2).

(c) Prepare CTS for operation (TM – X–XXXX–XXX–XX).

(2) Parts of the Display Window

(a) Control–Menu Box. Located in the upper–left corner of each window. Used to resize, move, maximize, minimize, and close windows, and to switch to other applications.

(b) Title Bar.

(c) Window Title. The name of the application – J1708 Control Panel.

(d) Menu Bar. Lists the available menus. A menu consists of a list of commands, or actions you can carry out.

(e) Scroll Bars. You can move parts of document into view when the entire document does not fit in the window.

(f) Maximize/Minimize Buttons. Maximize is used to enlarge the window so it fills the entire desktop, Minimize is used to reduce the window to an icon.
(g) Restore Button. After you enlarge a window, the maximize button is replaced by the restore button. Clicking the restore button will restore the window to its original size.

(h) Window Border. The outside edge of a window. Used to lengthen or shorten the border on each side of the window. The window corner can be used to shorten or lengthen two sides of the border at the same time.

(i) Insertion Point. Where you are at in the document. The mouse pointer changes position on the screen when you move the tracker ball.

(3) J1708 Menu Commands

(a) Setup Menu Commands. The commands in this section allow the operator to customize to main display area of the program. The operator has the option of selecting a previously displayed format and save a new display format.

1. New. The New command will delete all items that are on the Data Display Window. This includes all display setups and data. Do not use this command if you wish to delete only data information.

2. Load. The Load command allows the user to select and load a Display Setup File which has been previously saved. These file names will be listed on the display and will be identified by the extension "______.jdi". Only files with the ".jdi" extension are allowed to load.

3. Save. The Save command allows the user to save a custom display as a new Display Setup File. The new file name must contain no more than eight characters, followed by the ".jdi" extension.

4. Save As. The Save As command allows the user to save a Display Setup File under a different file name. With this command, the operator can copy a frequently used Display Setup so it can be modified for a new need. The new file name must contain no more than eight characters, followed by the ".jdi" extension.

5. Delete. The Delete command allows the user to delete a Display Setup File. Only a file with a ".jdi" extension is allowed to be deleted.

6. Define. The Define command allows define CTS J1708 options. When Define is selected, four choices are given:

   Connector. Allow user to select the DCA connector or the diagnostic data link (DDL) connector located inside the electrical control box (ECB).

   Bus. Not applicable.

   Data. Allows the user to select and deselect the data lines displayed on the main display area of the screen. The information will be displayed in a text format.

   Graphics. The operator can select between three types of graphics readouts: digital readout, bar graph readout, or gage readout.
**2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)**

(b) Display Menu Commands. The commands in this section allow the operator to control the data that is being displayed.

1. **Start.** The start command allows the user to start the display data after it has been stopped for viewing. The command only affects the data which is being displayed.

2. **Stop.** The Stop command allows the user to stop the constantly changing display data. This allows the operator to freeze the display and study the data.

3. **Clear.** The Clear command allows the operator to clear the data values from the various readouts. New data will be displayed as it becomes available.

(c) Log Menu Commands. The commands in this section allow the operator to control the various log functions. The operator may play back a previously recorded log, or may create a new log to store incoming data. This function is not used in the HET M1070 troubleshooting.

(d) Diagnostics Menu Commands. The commands in this section allow the operator to view the alarms (active codes) and work the status diagnostics.

1. **Alarms (Active Codes).** The Alarms command allows the operator to view all the systems alarms (active codes). When this command is selected, the Current Alarms window is displayed. This window will display all alarms (active codes) that have been detected since system start up or the last time this window was cleared. From this window, the operator can also set the alarm priority for both the Pop-up Window and the Beep Alarm.

2. **Status.** Not applicable.
(e) Simulation Menu Commands. The commands in this section allow the J1708 unit to be used as a training simulator. This application is not used during troubleshooting of the HET M1070.

(f) Transmission Menu Commands. The commands in this section allow the operator to select the modes for ATEC Transmission Data. This application is not used on the HET M1070 Tractor.

(g) Function Menu Commands. The commands in this section allow the operator to reset the J1708 computer board and to choose various DDEC options.

1. Reset. The Reset command is used to reset the J1708 board. When this command is used, all board functions will be reset to zero (0) and the Electronic Control Module (ECM) will run through a self test.

2. Restart Data Time-out. This selection is used to re-start the time-out test sequence for the presence of J1708 data when the "No J1708 Input Data" message is displayed.

3. DDEC-II Option Commands. Refer to paragraph (4) for details.
(h) Help Menu Commands. The commands in this section allow the user to access the on-line help topics.

1. Contents. This section lists the Help items that are available to the operator from this program. These items may be selected directly from this list or from the Help Menu Commands window.

2. Commands. This section allows the operator to access descriptions of the commands found in this program. When the operator selects one of the menu selections listed below, the screen will display descriptions for the commands found under that menu. For instructions on how to use the commands, the operator should go back to the Main Help Menu and select "PROCEDURES".

3. Procedures. This menu allows the user to select the procedures to perform various tasks within the J1708 User Interface program.

4. Using Help. If you are new to Help, choose Help Basics. Use the scroll bar to view information not visible in the Help window. Click on the underlined topic you want to view, or press tab to select a topic, and then press ENTER.

5. About. Information about the J1708 application, such as copyright, version, and application name; the mode Windows is running in; and the amount of memory available on your computer.
2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)

(4) DDEC-II Option Menu. Click on "OK" to return to the main window from the DDEC-II Options Menu.

(a) Engine ID/Calibration. Click on "Engine ID/Calibration". A pop up window will be displayed with the following information:

1. Engine ID (Identification).
2. ECM S/N (Electronic Control Module Serial Number).
3. No. of Cyl (Number of Cylinders).
4. EPA Cert. No. (EPA Certification Number).
5. SW Level (ECM Software Version).
6. Box Type (indicates whether ECM supports 6 or 8 cylinders).
7. Pk Trq (Peak Torque in lb-ft).
8. Spd Pk Trq (RPM at which peak torque is obtained).
10. Shutdown Word Window (status of shutdown words).

(b) View Historical Codes. Click on "Historical Codes". If historical codes are present, they will be displayed in a pop up window. The only codes displayed are those stored by the ECM since the last time the historical codes were cleared. If no codes are stored in the ECM, "No Historical Codes" will be displayed in the pop up window.

(c) Engine/Trip Data. Click on "Engine/Trip Data". A pop up window will be displayed with the following information:

1. Fuel GPH (estimated fuel consumption rate in gallons per hour).
2. Total GAL (estimated total fuel used in gallons).
3. Eng Hours (total hours of engine operation).
4. PTO Hours (total hours of PTO operation).
5. Instant MPG (estimated instantaneous miles per gallon).
6. Ave MPG (estimated average miles per gallon).
7. Trip Miles (total distance since reset).
8. Trip GAL (estimated total fuel used since reset).

(d) Fuel Information. Not applicable.

(e) Injector Response Times. Click on "Injector Response Times". The DDEC Injector Response Time Window will be displayed.

(f) Clear ECM Actions. Click on "Clear ECM Action". A pop up window will be displayed verifying the step. Click on "OK" to clear all ECM actions, click on "CANCEL" to return to the main window.

(g) Clear Historical Codes. Click on "Clear Historical Codes". A pop up window will be displayed verifying the step. Click on "OK" to erase all historical codes, click on "CANCEL" to return to the main window.

(h) Clear Trip Accumulators. Not applicable.

(i) Cylinder Cutout Function.
   1. Click on "Cylinder Cutout".
   2. Click on "Auto" or "1000 RPM". If "AUTO" is selected, the ECM will automatically cutout one cylinder at a time and the test results will be displayed as they occur. If "MANUAL" is selected, the operator must select the individual cylinder to be cutout.
   3. Click on "Idle" or "1000 RPM".
   4. Click on "Start", "Stop" or "Cancel". Selecting "Start" will change display to "Re–Start", and function will run until either "Stop" or "Cancel" is selected. If "Stop" is selected, the function will stop and "Re–Start" will change back to "Start". If "Cancel" is selected, the function will stop and the operator will be returned to the main menu.
d.1. Contact Test Set (CTS), CTS-ICE Application, Introduction

(1) Connecting CTS to HET M1070
   (a) Remove cover (1) from diagnostic connector assembly (DCA) (2) by turning counterclockwise.
   (b) Install DCA cable on DCA (2).
   (c) Prepare CTS for operation (TM - X-XXXX-XXX-XX).

(2) CTS-ICE Menu
   (a) Enter Test Number. Allows the user to enter the desired STE/ICE-R test number. CTS-ICE will display a message if any invalid test numbers are selected.
   (b) Optional Control Functions. CTS-ICE has the capability to perform two STE/ICE-R tests during a single session. For example, if a voltage reading is desired at a specific engine RPM, both STE/ICE-R test #10 (Engine RPM) and test #89 (voltage) can be conducted at the same time. To activate this function, click on the Optional Control Function Box. A message will be displayed if invalid test combinations are selected.
   (c) Click on "O.K." to proceed.
(d) CTS–ICE Test Cable Set-up. Some STE/ICE–R tests can be conducted using either the DCA connector or external leads and transducers. This screen tells the CTS–ICE unit where to look for the test information. Click on "DCA Cable" for all tests except STE/ICE–R tests #45–51, #89 and #91. For these tests, select "TK - Transducer Kit”.

(e) Click on "O.K." to proceed with the CTS–ICE test(s).

(f) Diagnostics. The selected CTS–ICE test(s) will be performed with detailed procedures specific to those tests selected. Follow instructions given by the CTS–ICE program.

(3) On–Line Help. Click on "HELP=F1" or press "F1" to access the on–line help portion of the CTS–ICE program. Provides a quick way to find information, such as how to perform a particular task. Highlighted tasks indicate a topic with additional information. This additional information can be viewed by clicking on the highlighted area.

(a) Using Help. Information on how to use CTS–ICE help.

(b) CTS–ICE System Table Of Contents. An alphabetical list of all CTS–ICE help topics available.

(c) Alphabetical List of CTS–ICE Tests.

(d) Numerical List of CTS–ICE Tests.
2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)

e. Abbreviations And Commonly Used Terms

(1) A/D – Analog to Digital: The computer inside the ECM uses an A/D converter to convert a sensor voltage into a number with which the computer can work.

(2) Active Codes – These are the codes that currently keep the CHECK ENGINE indicator on. They are read using the Diagnostic Data Reader.

(3) BAT – Battery

(4) CEL – CHECK ENGINE indicator: mounted on the instrument dash and used as panel. It has two functions:

   (a) a warning lamp to tell the driver that a problem has occurred, and that the vehicle should be taken in for service as soon as possible.

   (b) as a light bulb check and system check the CHECK ENGINE indicator will come on for about five seconds when the ENGINE switch is turned ON. If the CEL remains on, the self-diagnostic system has detected a problem. If the problem goes away, the light will go out, but the (HISTORICAL) trouble code will be stored in the ECM. (See General Diagnostic Information)

(5) CKT – Circuit

(6) CLS – Coolant Level Sensor: Monitors coolant level at the radiator tank top.

(7) COM – Common

(8) CTS – CONTACT TEST SET: Tool used for troubleshooting DDEC and for STE/ICE-R tests.

(9) DCA – Diagnostic Connector Assembly: An electrical harness on the vehicle which allows the STE/ICE-R to be powered and to make measurements of key vehicle signals from a single connection. In addition to many basic electrical signals such as starter voltage and current, it includes engine speed and fuel supply pressure. The STE/ICE-R can make TK measurements at the same time that it is connected to the DCA.

(10) DDEC – Second generation Engine Electronic Controls

(11) DDL – Diagnostic Data Link: The lines (wires) over which the ECM communicates information to be read by a Diagnostic Data Reader.

(12) Diagnostics: Troubleshooting by following an exact procedure.

(13) DL+ – Data Link, positive side. Used for communications to the Diagnostic Data Reader, as well as other applications.

(14) DL – Data Link, negative side (See above).

(15) DREQ – Diagnostic Request Terminal: The pin on the DDL connector which must be grounded to obtain diagnostic codes (pin M).

(16) ECM – Electronic Control Module: The brains of DDEC. It reads the DDEC sensors and switches, calculates injector firing times and duration (using a built–in computer), and fires the injectors at the appropriate times.

(17) EEPROM – Electronically Erasable Programmable Read Only Memory. Contains the engine calibration.

(18) EFPA – Electronic Food Pedal Assembly: contains the Throttle Positions Sensor

(19) Erratic: intermittent

(20) EUI – Electronic Unit Injector: replaces the Mechanical Unit Injector (MUI)
(21) Historical Codes – All codes kept in ECM memory (may not turn the CHECK ENGINE indicator). These codes can be cleared by using the Diagnostic Data Reader.

(22) OPS – Oil Pressure Sensor: monitors oil pressure at the main oil gallery.

(23) OTS – Oil Temperature Sensor: monitors oil temperature in the turbo oil supply line.

(24) PCB – Protective Control Box: Located on the firewall above the brake pedal.

(25) PW – Pulsewidth: the amount of time in crank degrees that the ECM is requesting the injectors to be turned on.

(26) SEL – CHECK GAUGES Indicator: mounted on the dash, it lights to warn the driver when a potential engine damaging condition has been detected (low oil pressure, low coolant, or engine over temperature). As a light bulb check and system check, the CHECK GAUGES indicator will come on for about five seconds when ignition takes place.

(27) SRS – Synchronous Reference Sensor: detects when the first cylinder in the firing order is about to be fired.

(28) STE/ICE–R – Simplified Test Equipment for Internal Combustion Engines – Reprogrammable: A testing system used for performing tests and measurements on the vehicle. In addition to acting as a conventional digital multimeter to measure voltage, current and resistance, it is also capable of measuring pressure, speed, compression unbalance, engine power, and some specialized battery and starter evaluations. It is powered from the vehicle batteries. The complete system includes a vehicle test meter (VTM), a transducer kit (TK), cables, transit case, and technical publications. STE/ICE tests are referenced.

(29) System: A collection of devices which are all related to each other because they depend on each other to do some function or job. For example, the function of the fuel system is to inject fuel into the cylinders at the correct time in the correct quantity. The collection of devices that are required to do this include the fuel pump, fuel lines, lift pump, fuel filter, injection pump, and injectors.

(30) TBS – Turbo Boost Sensor: used to monitor turbo boost pressure. The sensor generates a voltage (from 0 to 5 volts) which is proportional to pressure.

(31) Test Chain: A series of tests to be followed in a particular order or sequence (numbered).

(32) TPS – Throttle Position Sensor: used to detect throttle request.

(33) Troubleshooting: The process of making measurements and observing the operation of the vehicle to find out if and where any problems exist.

(34) TRS – Timing Reference Sensor: detects whenever any cylinder is about to be fired.

(35) VIN – Vehicle Identification Number

(36) VTM – Vehicle Test Meter: A box which performs the measurement and analysis functions of the STE/ICE–R systems.
### 2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)

Table 2-5. DDEC Troubleshooting

<table>
<thead>
<tr>
<th>KEY SYMPTOM</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECON DARY SYMPTOMS</strong></td>
<td></td>
</tr>
<tr>
<td>A1 CHECK ENGINE indicator on and code 25 on DDR</td>
<td>2–94</td>
</tr>
<tr>
<td>A2 CHECK ENGINE indicator always on, no data link, codes not flashing.</td>
<td>2–98</td>
</tr>
<tr>
<td>A3 DDR display blank or random</td>
<td>2–102</td>
</tr>
<tr>
<td>A4 DDR reads active code other than code 25, and does not read any historic codes.</td>
<td>2–102</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flash Codes:</th>
<th>SAE Codes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 11 P187 4 Vernier Control Signal Voltage Low</td>
<td>2–106</td>
</tr>
<tr>
<td>Code 12 P187 3 Vernier Control Signal Voltage High</td>
<td>2–116</td>
</tr>
<tr>
<td>Code 13 P111 4 Coolant Level Sensor (CLS) Signal Voltage Low</td>
<td>2–122</td>
</tr>
<tr>
<td>Code 14 P175 3 Oil Temperature Sensor (OTS) Signal Voltage High</td>
<td>2–126</td>
</tr>
<tr>
<td>Code 15 P175 4 Oil Temperature Sensor (OTS) Signal Voltage Low</td>
<td>2–130</td>
</tr>
<tr>
<td>Code 16 P111 3 Two Piece Coolant Level Sensor (CLS) Signal Voltage High</td>
<td>2–134</td>
</tr>
<tr>
<td>Code 21 P091 3 Throttle Position Sensor (TPS) Signal Voltage High</td>
<td>2–142</td>
</tr>
<tr>
<td>Code 22 P091 4 Throttle Position Sensor (TPS) Signal Voltage Low</td>
<td>2–148</td>
</tr>
<tr>
<td>Code 24 P174 4 Fuel Temperature Sensor (FTS) Signal Voltage Low</td>
<td>2–162</td>
</tr>
<tr>
<td>Code 31 Fault on Auxiliary Output</td>
<td>2–166</td>
</tr>
<tr>
<td>Code 32 ECM Backup System Failure</td>
<td>2–172</td>
</tr>
<tr>
<td>Code 33 P102 3 Turbo Boost Sensor (TBS) Signal Voltage High</td>
<td>2–174</td>
</tr>
<tr>
<td>Code 34 P102 4 Turbo Boost Sensor (TBS) Signal Voltage Low</td>
<td>2–180</td>
</tr>
<tr>
<td>Code 35 P100 3 Oil Pressure Sensor (OPS) Signal Voltage High</td>
<td>2–188</td>
</tr>
<tr>
<td>Code 36 P100 4 Oil Pressure Sensor (OPS) Signal Voltage Low</td>
<td>2–194</td>
</tr>
<tr>
<td>Code 41 S021 0 Timing Reference Sensor (TRS)</td>
<td>2–204</td>
</tr>
<tr>
<td>Code 42 S021 1 Synchronous Reference Sensor (SRS)</td>
<td>2–216</td>
</tr>
<tr>
<td>Code 43 P111 1 Low Coolant Level</td>
<td>2–228</td>
</tr>
<tr>
<td>Code 44 P175 0 High Oil Temperature</td>
<td>2–234</td>
</tr>
<tr>
<td>Code 45 P100 0 Low Oil Pressure</td>
<td>2–236</td>
</tr>
<tr>
<td>Code 46 P168 1 Low Battery Voltage</td>
<td>2–238</td>
</tr>
<tr>
<td>Code 51 Check Engine Light Comes On and Stays On</td>
<td>2–244</td>
</tr>
<tr>
<td>Code 52 S254 12 ECM – Analog to Digital Failure</td>
<td>2–246</td>
</tr>
<tr>
<td>Code 53 S253 12 EEPROM Failure Affecting Code Memory</td>
<td>2–248</td>
</tr>
<tr>
<td>Code 56 ECM – Analog to Digital Failure</td>
<td>2–250</td>
</tr>
<tr>
<td>Codes 61–68 Sxxx 0 Injector Response Times Too Long</td>
<td>2–254</td>
</tr>
<tr>
<td>Codes 71–78 Sxxx 1 Injector Response Times Too Short</td>
<td>2–256</td>
</tr>
<tr>
<td>Code 85 P190 0 Engine Overspeed</td>
<td>2–265.1</td>
</tr>
<tr>
<td>A4A Check Vehicle Harness +5 Volt Supply</td>
<td>2–266</td>
</tr>
<tr>
<td>A4B Check Engine Harness +5 Volt Supply</td>
<td>2–274</td>
</tr>
</tbody>
</table>
### Table 205. DDEC Troubleshooting (Cont)

<table>
<thead>
<tr>
<th>KEY SYMPTOM</th>
<th>SECONDARY SYMPTOMS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. CHECK ENGINE indicator is out</strong></td>
<td><strong>B</strong> CHECK ENGINE light is off when ENGINE switch is turned ON.</td>
<td>2–282</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KEY SYMPTOM</th>
<th>SECONDARY SYMPTOMS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. CHECK ENGINE indicator comes on for up to five seconds after ENGINE switch is turned to ON, then goes out</strong></td>
<td><strong>C1</strong> Engine cranks but will not start.</td>
<td>2–292</td>
</tr>
<tr>
<td></td>
<td><strong>C2</strong> No DATA link and bulb check OK</td>
<td>2–314</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KEY SYMPTOM</th>
<th>SECONDARY SYMPTOMS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D. CHECK ENGINE indicator is erratic or intermittent</strong></td>
<td><strong>D1</strong> CHECK ENGINE indicator flashing valid code.</td>
<td>2–324</td>
</tr>
<tr>
<td></td>
<td><strong>D2</strong> DDR displays intermittent code.</td>
<td>2–326</td>
</tr>
<tr>
<td></td>
<td><strong>D3</strong> CHECK GAUGES indicator always on and Code 25 on DDR</td>
<td>2–330</td>
</tr>
<tr>
<td></td>
<td><strong>D4</strong> CHECK GAUGES indicator does not light when ENGINE switch is turned ON.</td>
<td>2–334</td>
</tr>
<tr>
<td></td>
<td><strong>D5</strong> Power take-off high idle does not operate.</td>
<td>2–340</td>
</tr>
<tr>
<td></td>
<td><strong>D6</strong> Engine brake always enabled.</td>
<td>2–348</td>
</tr>
<tr>
<td></td>
<td><strong>D7</strong> Engine brake does not operate.</td>
<td>2–352</td>
</tr>
</tbody>
</table>
2-13. INTRODUCTION TO LOGIC TREE TROUBLESHOOTING (CONT)

NOTE
Chart is used only when a DDEC problem is suspected but no codes are displayed on DDR or codes are intermittent.

Table 2-6. DDEC Troubleshooting (No Codes on DDR)

<table>
<thead>
<tr>
<th>KEY SYMPTOM</th>
<th>SECONDARY SYMPTOMS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-94</td>
<td>CHECK ENGINE indicator on and code 25 on DDR</td>
<td>2-94</td>
</tr>
<tr>
<td>2-98</td>
<td>CHECK ENGINE indicator always on, no data link, codes not flashing</td>
<td>2-98</td>
</tr>
<tr>
<td>2-282</td>
<td>CHECK ENGINE indicator does not light when ENGINE switch is positioned to ON</td>
<td>2-282</td>
</tr>
<tr>
<td>2-292</td>
<td>Engine cranks but will not start</td>
<td>2-292</td>
</tr>
<tr>
<td>2-314</td>
<td>No DATA link and bulb check OK</td>
<td>2-314</td>
</tr>
<tr>
<td>2-326</td>
<td>DDR displays intermittent code</td>
<td>2-326</td>
</tr>
<tr>
<td>2-330</td>
<td>CHECK GAUGES indicator always on and code 25 on DDR</td>
<td>2-330</td>
</tr>
<tr>
<td>2-334</td>
<td>No CHECK GAUGES indicator during bulb check</td>
<td>2-334</td>
</tr>
<tr>
<td>2-340</td>
<td>Power take off high idle not working</td>
<td>2-340</td>
</tr>
<tr>
<td>2-348</td>
<td>Engine brake is always on</td>
<td>2-348</td>
</tr>
<tr>
<td>2-354</td>
<td>Engine brake not working</td>
<td>2-354</td>
</tr>
</tbody>
</table>

f. Contact Test Set (CTS)

The troubleshooting for the HET M1070 Tractor was developed utilizing the Digital Data Reader (DDR) and Simplified Test Equipment for Internal Combustion Engines (STE/ICE-R). Since the initial publication of this manual, the Contact Test Set (CTS) has been developed for use as the primary Test, Measurement, and Diagnostic Equipment (TMDE) for the HET M1070, in place of the DDR and STE/ICE-R.

The CTS J1708 programming performs the same function as the DDR and the CTS/ICE programming performs the same tests as the STE/ICE-R unit. The procedural steps contained within this manual still reflect the original test equipment, however, the CTS can be used to troubleshoot the vehicle. The same test results will be obtained using either piece of test equipment.

Some of the detailed test procedures shown on the right-hand pages of the troubleshooting will deviate slightly from the steps required to operate the CTS. For additional information on CTS operating procedures and individual test instructions, refer to the information provided with the CTS unit.
DDEC II TROUBLESHOOTING

TRUCK, TRACTOR, M1070
HEAVY EQUIPMENT TRANSPORTER (HET)
FIRST CHART FOR DIAGNOSIS OF DDEC USING DIAGNOSTIC DATA READER (DDR)

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Contact Test Set, (Item 3.1, Appendix F)
- Jumper Wire (Figure D-20, Appendix D)
- TRS/SRS Alignment Tool, (Item 55, Appendix F)
- Multimeter (Item 20, Appendix F)

---

**KNOWN INFO**

| Problem noted with check engine light, CHECK GAUGES light, engine performance, engine brake, or PTO operation. |
| Vehicle troubleshooting completed |

**TEST OPTIONS**

Visual inspection

---

1. Turn ignition ON while observing CHECK ENGINE indicator.

- If light comes ON and stays ON, go to A (p. 2-91).
- If light is out, go to B (p. 2-281).
- If light comes ON for up to 5 seconds, then goes out, go to C (p. 2-289).
- If light is erratic or intermittent, go to D (p. 2-321).
FIRST CHART FOR DIAGNOSIS OF DDEC WHEN NO DIAGNOSTIC DATA READER (DDR) IS AVAILABLE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Jumper Wire (Figure D–20, Appendix D)
Multimeter (Item 20, Appendix F)

KNOWLEDGE

Problem noted with CHECK ENGINE indicator, CHECK GAUGES indicator, engine performance, engine brake or PTO operation
Vehicle troubleshooting completed

POSSIBLE PROBLEMS
Fault in DDEC system

1.

Does the CHECK ENGINE indicator come on and stay on, or go out after 5 seconds?

YES

NO

Flashing light, or no light, go to step 4.

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Determines whether CHECK ENGINE indicator is working properly or if CHECK ENGINE circuit is faulty.

CAUTION
Read CAUTION on following page.

2.

Do Codes flash with jumper wire installed between pins A and M of PTO connector?

YES

NO

Go to step 8.

TEST OPTIONS
Read DDEC codes using CHECK ENGINE indicator

REASON FOR QUESTION
Determines whether CHECK ENGINE indicator is working properly or if DDL connector circuit is faulty.

START
DDEC Troubleshooting was intended to be used with a Diagnostic Data Reader. Should you need to read out codes, however, and a reader is not available, the following steps will allow you to read codes using the CHECK ENGINE indicator. However, later sections of the DDEC Troubleshooting may require the use of a reader.

(4) Turn engine switch to ON position (TM 9-2320-360-10).

(5) Note operation of CHECK ENGINE indicator.

(6) Turn engine switch to OFF position (TM 9-2320-360-10).

---

**NOTE**

(1) Remove eight screws and cover from electronic control box assembly.

**CAUTION**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

(2) Install suitable wire (paper clip) between pins A and M of the 12 pin DDL connector.

(3) Turn ENGINE SWITCH to ON position (TM 9-2320-360-10).

**NOTE**

- Indicator will flash the first digit of code, followed by a short 1/2 second pause, then the second digit. There will be a long three second pause between codes.
- Indicator will flash all codes in Historic memory, before repeating all codes.
- Indicator will continue to flash as long as pins are jumped and ENGINE switch is in the ON position.

(4) Note operation of CHECK ENGINE indicator.

(5) Turn engine switch to OFF position.
### First Chart for Diagnosis of DDEC When No Diagnostic Data Reader (DDR) Is Available (Cont)

#### Known Info
- Codes flash with jumper installed in DDL connector

#### Possible Problems
- Problem with DDEC indicated by presence of diagnostic code

#### Test Options
- Visual inspection

#### Reason for Question
- Determines proper sequence to follow to correct fault.

---

#### Known Info
- CHECK ENGINE indicator is flashing or never comes on

#### Possible Problems
- Faulty wiring
- Incorrect battery voltage
- Damaged terminals/connectors
- Faulty charging system
- Wire no. 451 shorted to ground

#### Test Options
- Visual inspection

#### Reason for Question
- Determines correct troubleshooting logic chart to follow.

---

#### Known Info
- CHECK ENGINE indicator is flashing

#### Possible Problems
- Faulty connector
- Damaged terminals/connectors
- Faulty charging system
- Wire no. 451 shorted to ground

#### Test Options
- Visual inspection

#### Reason for Question
- Determines correct troubleshooting logic chart to follow.
Note whether the CHECK ENGINE indicator is flashing or never comes on.

Note whether flashing CHECK ENGINE indicator is displaying a valid code or if it's just erratic or intermittent.
**FIRST CHART FOR DIAGNOSIS OF DDEC WHEN NO DIAGNOSTIC DATA READER (DDR) IS AVAILABLE (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK ENGINE indicator is flashing a valid code</td>
<td>Wire no. 451 Continuity Test or STE/ICE Test #91</td>
<td>Less than 200 ohms indicates that wire no. 451 is shorted to ground (either wire no. 150 or chassis ground).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire no. 451 shorted to ground</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wires no. 451 and 901 OK</td>
<td>Visual inspection</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty ECM terminals/connectors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK ENGINE indicator is either on all the time or never comes on.</td>
<td>Visual inspection</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open in wires no. 451 or 901 Faulty ECM terminals/connectors Circuit breaker not set Open in DDL connector Short in indicator driver line</td>
<td></td>
<td>Determines correct troubleshooting logic chart to follow.</td>
</tr>
</tbody>
</table>

### 6.
**Is there greater than 200 ohms or open between pins A and M of DDL connector?**

- **NO**
  - Notify supervisor if short is indicated.

- **YES**
  - Replace ECM (para 7-29).

### 7.
**Are the terminals at the ECM vehicle harness connector and 6-way power harness connector OK?**

- **NO**
  - Repair terminals and connectors (para 7-77).

- **YES**
  - Replace ECM (para 7-29).

### 8.
**Does CHECK ENGINE indicator remain OFF with jumper wire installed?**

- **NO**
  - Indicator is on, no codes flash, go to A2.

- **YES**
  - Notify supervisor if short is indicated.
(1) Remove the 6-way power harness from the ECM.

(2) Check the 6-way power harness connector and the vehicle harness connector (both the ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

**WIRE # 451 CONTINUITY TEST**

(1) Turn ENGINE switch to OFF position (TM 9–2320–360–10).

(2) Remove the vehicle harness connector from the ECM.

(3) Place positive (+) probe of multimeter on pin A of DDL connector.

(4) Place negative (−) probe of multimeter on pin M of DDL connector and note reading on multimeter.
FIRST CHART FOR DIAGNOSIS OF DDEC WHEN NO DIAGNOSTIC DATA READER (DDR) IS AVAILABLE (CONT)

1. **KNOWN INFO**
   - CHECK ENGINE indicator never comes on

   **POSSIBLE PROBLEMS**
   - Open in wires no. 451 or 901
   - Faulty ECM terminals/connectors

   **TEST OPTIONS**
   - Wire no. 451/901 Continuity Test  
     or  
     STE/ICE Test #91

   **REASON FOR QUESTION**
   - Greater than 5 ohms on either reading indicates that wire no. 451 or wire no. 901 is open.

   **REASON FOR QUESTION**
   - Determines whether to proceed to repair diagnostic codes or repair no start condition.

   **TEST OPTIONS**
   - Remove Jumper Wire From DDL Connector and Attempt to Start (TM 9-2320-360-10)

2. **KNOWN INFO**
   - CHECK ENGINE indicator is flashing any code except 14, 23 or 85

   **POSSIBLE PROBLEMS**
   - Problem with DDEC indicated by presence on diagnostic code.

3. **KNOWN INFO**
   - CHECK ENGINE indicator is flashing any code except 14, 23 or 85
   - Engine starts

   **POSSIBLE PROBLEMS**
   - Problem with DDEC indicated by presence on diagnostic code.

   **TEST OPTIONS**
   - Verify Code(s) – Engine Running

   **REASON FOR QUESTION**
   - Determines whether Code is present or is intermittent.

   **CAUTION**
   - Read CAUTION on following page.

   **TEST OPTIONS**
   - Wire no. 451/901 Continuity Test  
     or  
     STE/ICE Test #91

   **REASON FOR QUESTION**
   - Greater than 5 ohms on either reading indicates that wire no. 451 or wire no. 901 is open.

   **REASON FOR QUESTION**
   - Determines whether to proceed to repair diagnostic codes or repair no start condition.

   **TEST OPTIONS**
   - Remove Jumper Wire From DDL Connector and Attempt to Start (TM 9-2320-360-10)
**WIRE # 451/901 CONTINUITY TEST**

1. Remove jumper wire from between pins A and M of the DDL connector.
3. Verify Code(s) – Engine Running
   
   1. Try to get the CHECK ENGINE indicator to come on by warming up the engine and increasing the engine speed from idle speed to 2100 RPM.
   2. Run engine for one minute or until CHECK ENGINE indicator comes on.

   **CAUTION**
   
   Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

   **NOTE**
   
   If CHECK ENGINE indicator came on, do steps (4) through (7).

   4. Install suitable wire (paper clip) between pins A and M of the 12 pin DDL connector.
   5. Turn ENGINE SWITCH to ON position (TM 9–2320–360–10).
   6. Note operation of CHECK ENGINE indicator to read codes.
A CHECK ENGINE LIGHT COMES ON AND STAYS ON

Known Info

Check engine light comes on and stays on.

Test Options

DDR

Start

1. Plug DDR into 12-pin DDL connector. Select Mode 01 and read active codes. Then select Mode 02 and read historical codes.

- If only active code 25 comes up, go to [A1] (p. 2-94).
- If DDR display reads 'NO DDEC DATA RECEIVED', go to [A2] (p. 2-98).
- If DDR display is blank or random, go to [A3] (p. 2-102).
- If active codes (other than Code 25) come up, go to appropriate code in [A4].
- If both active code 25 and historical code 51 come up (other codes may also come up), go to [A4, Code 51] (p. 2-244).
NOTE
The following flow chart should be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
A1 'CHECK ENGINE' INDICATOR ON AND CODE 25 ON DDR

START

1. Does CHECK ENGINE indicator illuminate with engine operating at 2100 RPM?

   NO  → Notify supervisor if short is indicated.

   YES  → TEST OPTIONS

   Visual inspection

   REASON FOR QUESTION
   Erratic or intermittent CHECK ENGINE indicator (with erratic engine operation) indicates short to ground in signal line (Ckt #451).

2. Does CHECK ENGINE indicator go out with harness disconnected at ECM and ENGINE switch positioned to ON (engine not running)?

   NO  → Notify supervisor if short is indicated.

   YES  → TEST OPTIONS

   Visual inspection

   REASON FOR QUESTION
   Wire no. 419 is shorted if light goes on with harness disconnected.

3. Does CHECK ENGINE indicator illuminate continually when jumper wire is installed between socket B1 of harness and ground?

   NO  → Notify supervisor if wiring problem is found.

   YES  → TEST OPTIONS

   Visual inspection

   REASON FOR QUESTION
   If CHECK ENGINE indicator stays off, ignition line (Ckt #439) is not wired correctly to bulb. Bulb may be receiving power from ignition line (Ckt #439) instead of Ckt #419.
NOTE
The following flow chart should be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

(8) Turn ENGINE switch ON. Observe CHECK ENGINE indicator.

(9) Start engine and increase engine speed to 2100 rpm. Observe CHECK ENGINE indicator.

(1) Turn ENGINE switch to OFF.

(2) Disconnect vehicle harness connector at ECM.

(3) Turn ENGINE switch to ON. Observe CHECK ENGINE indicator.

(1) Turn ENGINE switch to OFF.

(2) Install jumper wire between socket B1 of harness connector and ground.

(3) Turn ENGINE switch to ON. Observe CHECK ENGINE indicator.
4. Are terminals at vehicle harness connectors OK?

- **YES**
  - Replace ECM (para 7-29).

- **NO**
  - Repair terminals or connectors (para 7-77). Then go to step 5.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- CHECK ENGINE indicator will not operate properly if harness connectors are damaged.

5. Does the CHECK ENGINE indicator light stay on longer than five seconds?

- **YES**
  - Repair complete.

- **NO**
  - Fault not corrected. Notify supervisor

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
(1) Turn ENGINE switch OFF.
(2) Check terminals at vehicle harness connectors for damage (bent, corroded, and unseated pins or sockets).
(3) Check terminals in connector to be sure wire no. 419 is in socket B1 and wire no. 439 is in socket B3.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A2 'CHECK ENGINE' INDICATOR ALWAYS ON, NO DATA LINK, CODES NOT FLASHING

START

1. Does the CHECK ENGINE light fail to flash out CODES with jumper installed in DDL connector?

   YES
   Codes flash; go to A3, step 2.
   NO

2. Are circuit breakers closed?

   YES
   NO
   Reset circuit breaker.

3. Is there less than 3000 ohms in DDL connector circuit?

   YES
   Notify supervisor if open circuit is indicated.
   NO

POSSIBLE PROBLEMS
- Circuit breakers not set
- Open in DDL connector
- Short in light driver line
- Damaged ECM connectors

REASON FOR QUESTION
- Electrical and/or DDR are suspect.
- DDEC will not operate properly if breaker(s) are tripped. If breakers continue to trip, a short or ground exists in Ckts #240 or #241.
- Any resistance greater than 3000 ohms indicates open in that circuit.

TEST OPTIONS
- Visual inspection
- Continuity Test or STE/ICE-R Test #91

KNOWN INFO
- Check engine indicator always on, or no DATA LINK, or CODES not flashing.
- CHECK ENGINE light fails to flash with jumper wire installed in DDL connector.
NOTE

The following flow chart should be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) Unplug DDR.
(2) Short pin A to Pin M on 12-pin DDL connector.

Check circuit breakers to ECM and reset if needed.

CONTINUITY TEST

(1) Check resistance between cavity A of DDL connector and a known good ground.
(2) Disconnect vehicle harness connector at ECM. Check resistance between pin M of DDL and cavity E1 of ECM 30-pin connector.
(3) Check resistance between pin J of DDL connector and cavity C2 of ECM 30-pin connector.
(4) Check resistance between pin K of DDL connector and cavity C1 of ECM 30-pin connector.
A2 'CHECK ENGINE' INDICATOR ALWAYS ON, NO DATA LINK, CODES NOT FLASHING (CONT)

**KNOWN INFO**
- Circuit breakers OK
- No open in DDL connector

**POSSIBLE PROBLEMS**
- Short in light driver line
- Damaged ECM connectors

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- CHECK ENGINE indicator driver line (Ckt #419) is shorted to ground if CHECK ENGINE indicator comes on and stays on.

---

**KNOWINFO**
- Circuit breakers OK
- No open in DDL connector
- No short in DDL connector
- No short in driver line

**POSSIBLE PROBLEMS**
- Damaged ECM connectors

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damage to terminals is suspect.

---

**KNOWINFO**
- Circuit breakers OK
- No open in DDL connector
- No short in DDL connector
- No short in driver line
- ECM connectors OK

**POSSIBLE PROBLEMS**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
(1) Disconnect vehicle harness connector at ECM.
(2) Turn ENGINE switch ON (engine not running) while observing CHECK ENGINE indicator.

NOTE
Pay special attention to terminals and sockets in 6-pin power connector and sockets B1 and B3 of 30-pin vehicle harness.
(1) Turn ENGINE switch OFF.
(2) Check terminals at vehicle connectors (both ECM and harness side) for damage; bent, corroded and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A3 DDR DISPLAY IS BLANK OR RANDOM

1. Is the voltage correct at DDL connector (greater than or equal to 10.0 volts across 12-pin DDL connector)?
   - YES: Notify supervisor if open is indicated.
   - NO: Is the voltage correct at DDL connector (greater than or equal to 10.0 volts across 12-pin DDL connector)?

2. Is there less than 5 ohms across one or both data lines (Ckt #900 and 901)?
   - YES: Notify supervisor if open circuit is indicated.
   - NO: Is there less than 5 ohms across one or both data lines (Ckt #900 and 901)?

3. Is there greater than 5 ohms in two data lines (Ckt #900 and 901)?
   - YES: Notify supervisor if short is indicated.
   - NO: Is there greater than 5 ohms in two data lines (Ckt #900 and 901)?

- Known Info:
  - DDR display is blank or random

- Possible Problems:
  - Short in DDR or Data Link lines
  - ECM connectors damaged
  - Open in one or both data lines
  - Short to ignition and ground

- Test Options:
  - Voltage Test
  - STE/ICE-R Test #89

- Reason for Question:
  - Reading less than 10.0 volts at DDL connector indicates open in either switched +12 volt line (Ckt #439) or open in ground line to 12-pin DDL connector.

- Known Info:
  - No open in 12-volt line or ground to 12-pin connector

- Possible Problems:
  - Short in DDR or Data Link lines
  - ECM connectors damaged
  - Open in one or both data lines
  - Short to ignition and ground

- Test Options:
  - Resistance Test
  - STE/ICE-R Test #91

- Reason for Question:
  - Reading greater than 5 ohms at vehicle harness connector indicates one or both data lines (Ckts #900 or 901) are open.

- Known Info:
  - No open in 12-volt line or ground to 12-pin connector
  - No open in data lines

- Possible Problems:
  - Short in DDR or Data Link lines
  - ECM connectors damaged
  - Short to ignition and ground

- Test Options:
  - Resistance Test
  - STE/ICE-R Test #91

- Reason for Question:
  - Resistance less than 5 ohms at vehicle harness connector indicates two data lines (ckts 900 and 901) are shorted together.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**

The following flow chart should be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

### VOLTAGE TEST

1. Turn ENGINE switch ON.
2. Read voltage at 12-pin DDL connector from pin H (red lead) to pin A (black lead).

### CAUTION

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

### RESISTANCE TEST

1. Turn ENGINE switch OFF and remove jumpers from 12-pin DDL connector.

### RESISTANCE TEST

1. Remove jumpers from 12-pin DDL connector.
2. Read resistance between sockets C1 and C2 of vehicle harness connector.
4. Is there greater than 5 ohms in ignition (Ckt #439) and ground (Ckt #150) circuits?

   - YES: Notify supervisor if shorted wiring is indicated.
   - NO: Repeat troubleshooting procedure with replacement DDR.

5. Does DDR work on another engine?

   - YES: Repeat troubleshooting procedure with replacement DDR.
   - NO: Defective DDR could be problem.

6. Are there other active codes beside Code 25 (no codes)?

   - YES: Repair complete.

TEST OPTIONS
- Resistance Test or STE/ICE-R Test #91
- DDR
- Visual inspection

REASON FOR QUESTION
- Resistance less than 5 ohms at DDL connector indicates short between data line and ignition (ckt #439) or ground (ckt #150).
- Defective DDR could be problem.
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
RESISTANCE TEST

(1) Remove all jumpers from 12-pin DDL connector.

(1) Connect DDR to another engine
(2) Read PROM ID or any other parameter in menu.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 Code 11 - VERNIER CONTROL SIGNAL VOLTAGE LOW

**START**

1. **Does DDR read Code 11 and not Code 12, 21, or 22?**
   - **NO** Go to vehicle harness check, A4A.
   - **YES**

2. **Does Code 12 fail to display on DDR with jumper installed between sockets B and C of TPS harness connector?**
   - **NO** Go to step 6.
   - **YES**

3. **Is throttle count in acceptable range (133 to 135)?**
   - **NO** Replace vernier control (para 7-76). Then go to step 4.
   - **YES** Go to step 5.

**KNOWN INFO**
- CODE 11 displayed on DDR

**POSSIBLE PROBLEMS**
- Damaged vehicle harness
- Vernier control out of adjustment
- Damaged vernier connectors
- Short or open in signal line
- Damaged ECM harness connector
- Short to another voltage source

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Vehicle harness may be faulty if DDR reads code 12, 21, or 22 along with code 11.

**CAUTION**
- Read CAUTION on following page.

**KNOWN INFO**
- Vehicle harness OK

**POSSIBLE PROBLEMS**
- Vernier control out of adjustment
- Damaged vernier connectors
- Short or open in signal line
- Damaged ECM harness connector
- Short to another voltage source

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Vernier control may be faulty if DDR reads code 12.

**KNOWN INFO**
- Vehicle harness OK

**POSSIBLE PROBLEMS**
- Damaged vernier connectors
- Short or open in signal line
- Damaged ECM harness connector
- Short to another voltage source

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Throttle counts out of range indicate vernier control may be faulty.

Go to step 5.
(1) Turn ENGINE switch OFF.
(2) Disconnect vernier control connector.
(3) Install jumper wire between sockets B and C of TPS harness connector.
(3.1) Click on "Alarms Clear" to clear alarms screen.
(4) Turn ENGINE switch to ON and read active codes on DDR.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

NOTE
The following flow chart should be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) Remove jumper and reconnect vernier control.
(2) Hook DDR to 12-pin DDL connector and select PTO counts (Mode 21).
(3) Read PTO counts.
A4 Code 11–VERNIER CONTROL SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
Vehicle harness OK

**POSSIBLE PROBLEMS**
- Damaged vernier connectors
- Short or open in signal line
- Damaged ECM harness connector
- Short to another voltage source

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
Additional fault such as wiring or terminals may be evident.

4. Are throttle counts still out of correct range after replacement of vernier control?

- **NO**
  - Go to step 14.
- **YES**

5. Are vernier control connectors and terminals OK?

- **NO**
  - Repair terminals or pins (para. 7–77). Then go to step 14.
- **YES**

6. **WARNING**
Read WARNING on following page.

- **NO**
  - If less than 4 volts, go to step 11; if greater than 6 volts, go to step 13.
- **YES**
  - Replace vernier control (para 7–76). Then go to step 14.

**POSSIBLE PROBLEMS**
- Damaged vernier connectors
- Short or open in signal line
- Damaged ECM harness connector
- Short to another voltage source

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Damaged connectors or terminals could affect control signal voltage.

**TEST OPTIONS**
- Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Vehicle harness connection suspect.
Inspect terminals at vernier control connector (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### VOLTAGE TEST

1. Remove jumper.
2. Turn ENGINE switch ON.
3. Read voltage on vernier control harness connector between sockets C and A.
A4 Code 11-VERNIER CONTROL SIGNAL VOLTAGE LOW (CONT)

**Known Info**
- Vehicle harness OK
- Vernier control OK

**Possible Problems**
- Short or open in signal line
- Damaged ECM harness connector
- Short to another voltage source

**Reason for Question**
- Resistance less than or equal to 5 ohms in signal line (Ckt #525) and signal return (Ckt #952) indicates signal line (Ckt #525) or return line (Ckt #952) is open.

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

**Test Options**
- Visual inspection

**Reason for Question**
- Damaged pins or sockets could affect signal to ECM.

---

### 7. Is there greater than 10,000 ohms or open in signal line (Ckt #525) and return line (Ckt #952)?

**NO** Notify supervisor if short is indicated.

**YES**

### 8. Is there less than or equal to 5 ohms in signal line (Ckt #525) and signal return (Ckt #952)?

**NO**

**YES** Are ECM terminals A3, D1, C3 and TPS pins OK? If OK, signal line (Ckt #525) or return line (Ckt #952) is open. Notify supervisor.

### 9. Are ECM, ECM pins and sockets, and ECM vehicle harness connector (both ECM and harness side) OK?

**NO** Repair terminals or connectors (para 7-77).

**YES** Replace ECM (para 7-29). Then go to step 14.
(1) Turn ENGINE switch OFF.
(2) Disconnect vehicle harness connector at ECM.
(3) Read resistance between sockets A and B on the vernier control harness connector.

CONTINUITY TEST

(1) Install a jumper wire between sockets A and B of Vernier Control harness connector.
(2) Read resistance between sockets D1 and C3 on vehicle harness connector.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST
A4 - Code 11 VERNIER CONTROL SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Vehicle harness OK
- ECM harness connector OK
- Vernier control harness connector OK
- Vernier control OK

**POSSIBLE PROBLEMS**
- Short to another voltage source

**TEST OPTIONS**
- Continuity Test
  or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 10,000 ohms in vehicle +5 volt line (Ckt #952) indicates the vehicle +5 volt line (Ckt #952) is shorted to return line (Ckt #952).

---

**KNOWN INFO**
- Vehicle harness OK
- Vernier control OK
- Vernier control harness connector OK
- ECM harness connector OK

**POSSIBLE PROBLEMS**
- Short to another voltage source

**TEST OPTIONS**
- Continuity Test
  or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance greater than 5 ohms indicates vehicle +5 volt line (Ckt #916) is open.

---

**KNOWN INFO**
- Vehicle harness OK
- Vernier control OK
- Vernier control harness connector OK
- ECM harness connector OK

**POSSIBLE PROBLEMS**
- Short to another voltage source

**TEST OPTIONS**
- Continuity Test
  or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 10,000 ohms at vehicle harness connector or 6-way power connector indicates short.
(1) Turn ENGINE switch OFF.
(2) Disconnect vehicle harness connector at ECM.
(3) Read resistance between sockets A and C on vernier control harness connector.

---

**CONTINUITY TEST**

(1) Install a jumper wire between sockets A and C of Vernier Control harness connector.
(2) Read resistance between sockets A3 and C3 on vehicle harness connector.

---

**CAUTION**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

---

**CONTINUITY TEST**

(1) Turn ENGINE switch OFF and disconnect batteries (para 7–61).
(2) Disconnect 6–way power connector at ECM.
(3) Read resistance between sockets D1 and B3 on vehicle harness connector.
(4) Read resistance between socket D1 on vehicle harness connector and sockets C, D, E, and F on 6–way power harness connector.
(5) Connect batteries (para 7–61).

---

**WARNING**

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.

* Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.
A4 - Code 11  VERNIER CONTROL SIGNAL VOLTAGE LOW (CONT)

13.

**KNOWN INFO**
Vehicle harness OK  
Vernier control OK  
Vernier control harness connector OK  
ECM harness connector OK

**POSSIBLE PROBLEMS**
Short to another voltage source

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Voltage Test  
or STE/ICE-R Test #89

**REASON FOR QUESTION**
Possible outside power splice in circuits. A reading greater than or equal to 4.0 volts indicates outside power splice.

**Is there continuity (no outside power splice) in battery +?**

**YES**
Notify supervisor.

**NO**

14.

**KNOWN INFO**
Vehicle harness OK  
Vernier control OK  
Vernier control harness connector OK  
ECM harness connector OK  
Outside power connection OK

**POSSIBLE PROBLEMS**

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

**Does CHECK ENGINE indicator light stay on longer than five seconds?**

**YES**
Fault not corrected. Notify supervisor.

**NO**
Repair complete.
W**ARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**VOLTAGE TEST**

(1) Turn ENGINE switch ON.

(2) Read voltage A3 (red lead) to a good ground (black lead).

(3) Read voltage C3 (red lead) to good ground (black lead).

(1) Turn ENGINE switch OFF.

(2) Reconnect all harness connectors.

(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - CODE 12 VERNIER CONTROL SIGNAL VOLTAGE HIGH

1. Does DDR read Code 12 and not Code 21 or 22?
   - NO: Go to vehicle harness check, A4A.
   - YES: Damaged vehicle harness
   - Possible problem: Sensor connector may be bad
   - Possible problem: Vernier control connectors bad
   - Possible problem: Short or open in +5 volt line
   - Possible problem: ECM connectors damaged

2. Does Code 12 vanish from DDR with vernier control disconnected?
   - NO: Go to step 5.
   - YES: Sensor connector may be bad
   - Possible problem: Possible open in return line
   - Possible problem: Vernier control connectors bad
   - Possible problem: Short or open in +5 volt line
   - Possible problem: ECM connectors damaged

3. Is there continuity in return line (Ckt #952)?
   - NO: Notify supervisor if open is indicated.
   - YES: Resistance greater than 5 ohms on vehicle harness connector indicates open in return line (Ckt #952).
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

**NOTE**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**

1. With transmission in neutral, turn ENGINE switch OFF.
2. Install a jumper wire between pin A and pin B of vernier control harness connector.
3. Disconnect vehicle harness connector at ECM.
4. Turn engine switch ON.
5. Push ENGINE SPEED CONTROL switch to ENGINE HIGH IDLE position (TM 9-2320-360-10).
6. Push and release ENGINE SPEED CONTROL switch forward to engage DDEC HI IDLE relay (TM 9-2320-360-10).
7. Read resistance between sockets C3 and D1 on the vehicle harness connector.
8. Turn engine switch OFF.
A4 - CODE 12 VERNIER CONTROL SIGNAL VOLTAGE HIGH (CONT)

**KNOWN INFO**
- Vehicle harness OK
- Sensor connector OK
- No open in return line

**POSSIBLE PROBLEMS**
- Damaged vernier control connectors bad
- Short or open in +5 volt line
- Damaged ECM connectors

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Damaged connectors could be causing fault.

**TEST OPTIONS**
- Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- Greater than 1.0 volts from harness connector indicates short to vehicle +5 volt line (Ckt #916) or another voltage source.

**TEST OPTIONS**
- Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- Greater than 4.5 volts indicates open in wire no. 952 between vernier control and ECM or bad terminal in ECM connector C3.

---

### 4.
Are vernier control connectors and terminals OK?

- **YES**
  - Repair terminals or connectors (para 7–77). Go to step 8.

- **NO**
  - Replace vernier control (para. 7–76). Go to step 8.

---

### 5.
Is there less than or equal to 1.0 volt at vernier harness connector?

- **YES**
  - Notify supervisor if short is indicated.

- **NO**
  - Notify supervisor if short is indicated.

---

### 6.
Is there an open in wire (Ckt #952) between vernier control and ECM or bad terminal in ECM connector?

- **NO**
  - Repair terminal in C3 (para 7–77). Notify supervisor if open is indicated.

- **YES**
  - Replace vernier control (para. 7–76). Go to step 8.
(1) Connect all connectors to ECM.
(2) Turn ENGINE switch ON.
(3) Read voltage from vernier control harness connector pin B (red lead) to pin A (black lead).

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

VOLTAGETEST

(1) Connect all connectors to ECM.
(2) Turn ENGINE switch ON.
(3) Read voltage from vernier control harness connector pin B (red lead) to pin A (black lead).

VOLTAGETEST

(1) Connect all connectors to ECM.
(2) Read voltage on vernier control harness at pin B (red lead) and pin A (black lead) with ENGINE switch ON
A4 - CODE 12 VERNIER CONTROL SIGNAL VOLTAGE HIGH (CONT)

### KNOWN INFO
- Vehicle harness OK
- Sensor connector OK
- No open in return line
- Vernier control connectors OK
- No short or open in +5 volt line

### POSSIBLE PROBLEMS
- Damaged ECM connectors

### KNOWN INFO
- Vehicle harness OK
- Sensor connector OK
- No open in return line
- Vernier control connectors OK
- No short or open in +5 volt line
- ECM connectors OK

### POSSIBLE PROBLEMS
- None

### TEST OPTIONS
- Visual inspection

### REASON FOR QUESTION
- Terminal and connectors may be damaged.

### 7.
Are ECM vehicle harness connectors (both ECM and harness side) OK?

- **NO**
  - Repair terminal or connectors (para 7-77). Then go to step 8.

- **YES**
  - Replace ECM (para 7-29).

### 8.
Does CHECK ENGINE indicator light stay on longer than five seconds?

- **NO**
  - Repairs complete

- **YES**
  - Fault not corrected. Notify supervisor

### TEST OPTIONS
- Visual Inspection

### REASON FOR QUESTION
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - CODE 13 COOLANT LEVEL SENSOR (CLS) SIGNAL VOLTAGE LOW

1. Is Code 16 one of the active codes displayed on DDR with CLS disconnected?
   - YES: Go to A4-Code 16.
   - NO: Go to step 3.

   **POSSIBLE PROBLEMS**
   - Damage to terminals at CLS connectors
   - Short to return line

2. Are CLS, terminals, and connectors OK?
   - YES: Replace CLS (para 7-10); go to step 4.
   - NO: Repair CLS terminals or connectors (para 7-77). Then go to step 4.

   **POSSIBLE PROBLEMS**
   - Damage to CLS, terminals, or connectors
   - Short to return line

3. Read WARNING on following page.
   - Is there greater than or equal to 10,000 ohms or an open between sockets C and D on CLS harness connector?
     - NO: Notify supervisor if short is indicated.
     - YES: Go to step 2.

   **POSSIBLE PROBLEMS**
   - Short to return line

   **WARNING**
   - Resistance of less than or equal to 10,000 ohms at CLS harness connector indicates signal line (Ckt #115) is shorted to CLS return line.

   **TEST OPTIONS**
   - DDR

   **REASON FOR QUESTION**
   - To check sensor for fault.
(1) Turn ENGINE switch OFF and disconnect CLS.
(2) Start engine (TM 9–2320–360–10).
(3) Read active codes.

Inspect CLS and terminals at CLS connectors (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.

**NOTE**
The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

**WARNING**
- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

**CONTINUITY TEST**
(1) Turn ENGINE switch OFF.
(2) Disconnect vehicle harness connector at ECM.
(3) Read resistance between sockets C and D on ECM side of CLS harness connector.
A4 - CODE 13 COOLANT LEVEL SENSOR (CLS) SIGNAL VOLTAGE LOW (CONT)

KNOWN INFO
Sensor OK
CLS, terminals, and connectors OK
No short to return line

POSSIBLE PROBLEMS

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

4. Does CHECK ENGINE indicator light stay on longer than five seconds?

Repair complete.

NO

Fault not corrected.
Notify supervisor.

YES
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 14 OIL TEMPERATURE SENSOR (OTS) SIGNAL VOLTAGE HIGH

**CHECK CODES**
- Code 14 displayed on DDR
- Code 15

**POSSIBLE PROBLEMS**
- Sensor fault
- Short to +5 volt line
- Damaged OTS terminals and connectors
- Open in signal line
- Damaged terminals at ECM engine harness connector

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- To check sensor for fault.

**TEST OPTIONS**
- Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 10,000 ohms on engine harness connector indicates signal line (Ckt #120) is shorted to engine +5 volt line (Ckt #416) and/or sensor return (Ckt #452).

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damage to connectors could affect signal to OTS.
CAUTION

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

* The following chart should be used only if DDEC troubleshooting was started on pg. 2-80 and you were referred here.
* A false DDEC historical Code 14 may be logged during cold starts in extremely cold environments, -50 to -26°F (-46 to -32°C). Typically, the CHECK ENGINE light will come on 8 minutes after starting and go out 2-3 minutes later. If the vehicle has been operated under these conditions, clear the historical codes and return the vehicle to service.

NOTE

(1) Turn ENGINE switch OFF.
(2) Disconnect OTS and install a jumper between OTS connector sockets A and B.
(2.1) Click on "Alarms Clear" to clear alarms screen.
(3) Turn ENGINE switch ON and read active codes.

WARNING

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
* Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

CONTINUITY TEST

(1) Turn ENGINE switch OFF and remove jumper.
(2) Disconnect engine harness connector at ECM.
(3) Read resistance between sockets R2 and W1 on engine harness connector.

CAUTION

Inspect OTS and terminals at OTS connectors (both sensor and harness sides) for damage; bent, corroded, and unseated pins or sockets.
A4 - Code 14 OIL TEMPERATURE SENSOR (OTS) SIGNAL VOLTAGE HIGH (CONT)

4. **Is there continuity in signal line (Ckt #120) and signal return (Ckt #452)?**

   - **POSSIBLE PROBLEMS**
     - Open in signal line
     - Damaged terminals at ECM engine harness connector

   - **KNOWN INFO**
     - Sensor OK
     - No short to +5 volt line
     - OTS terminal and connectors OK

   - **TEST OPTIONS**
     - Continuity Test
     - STE/ICE-R Test #91

   - **REASON FOR QUESTION**
     - Resistance greater than 5 ohms at engine harness connector indicates signal line (Ckt #120) or return line (Ckt #452) is open.

   - **TEST OPTIONS**
     - Visual inspection

   - **REASON FOR QUESTION**
     - Damage to terminal and connector could affect signal to ECM.

5. **Are terminals at ECM harness connector free from damage?**

   - **POSSIBLE PROBLEMS**
     - Damaged terminals at ECM engine harness connector

   - **KNOWN INFO**
     - No open in signal line
     - Sensor OK
     - No short to +5 volt line
     - OTS terminal and connectors OK

   - **TEST OPTIONS**
     - Visual inspection

   - **REASON FOR QUESTION**
     - Damage to terminal and connector could affect signal to ECM.

6. **Does CHECK ENGINE indicator light stay on longer than five seconds?**

   - **POSSIBLE PROBLEMS**
     - Fault not corrected.

   - **KNOWN INFO**
     - No open in signal line
     - Sensor OK
     - No short to +5 volt line
     - OTS terminal and connectors OK
     - Terminal at ECM harness connector OK

   - **TEST OPTIONS**
     - Visual inspection

   - **REASON FOR QUESTION**
     - Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

   - **TEST OPTIONS**
     - Continuity Test
     - STE/ICE-R Test #91

   - **REASON FOR QUESTION**
     - Resistance greater than 5 ohms at engine harness connector indicates signal line (Ckt #120) or return line (Ckt #452) is open.

   - **TEST OPTIONS**
     - Visual inspection

   - **REASON FOR QUESTION**
     - Damage to terminal and connector could affect signal to ECM.

   - **TEST OPTIONS**
     - Continuity Test
     - STE/ICE-R Test #91

   - **REASON FOR QUESTION**
     - Resistance greater than 5 ohms at engine harness connector indicates signal line (Ckt #120) or return line (Ckt #452) is open.

   - **TEST OPTIONS**
     - Visual inspection

   - **REASON FOR QUESTION**
     - Damage to terminal and connector could affect signal to ECM.

   - **TEST OPTIONS**
     - Continuity Test
     - STE/ICE-R Test #91

   - **REASON FOR QUESTION**
     - Resistance greater than 5 ohms at engine harness connector indicates signal line (Ckt #120) or return line (Ckt #452) is open.
(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.
(2) Read resistance between sockets R2 and Y2 on engine harness connector.

Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.

WARNING

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
* Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

CONTINUITY TEST

(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.
(2) Read resistance between sockets R2 and Y2 on engine harness connector.

Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.

Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.
A4 - Code 15 OIL TEMPERATURE SENSOR (OTS) SIGNAL VOLTAGE LOW

1. Do DDR codes displayed not include Code 14, 23, 24, or 33?
   - NO
     - For codes 14, 23, 24, or 33, go to engine harness 5V check, A4B.
   - YES

2. Is any code except Code 15 displayed on DDR with OTS connector disconnected?
   - NO
     - For Code 15 (and any other codes), go to step 4.
   - YES

3. Are OTS terminals and connectors OK?
   - NO
     - Repair terminals or connectors (para 7-77). Then go to step 6.
   - YES
     - Replace OTS (para 7-34). Then go to step 6.
(1) Turn ENGINE switch OFF and disconnect OTS connector.
(1.1) Click on "Alarms Clear" to clear alarms screen.
(2) Start engine and run until CHECK ENGINE light comes on or after 8 minutes.
(3) Read active codes with engine still running.

Check terminals at OTS connectors (both sensor and harness side) for damage; bent, corroded, and unseated pins or sockets.

NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
**A4 - Code 15 OIL TEMPERATURE SENSOR (OTS) SIGNAL VOLTAGE LOW (CONT)**

### Known Info
- Sensor OK
- OTS terminal and connectors OK

### Possible Problems
- Signal line shorted to return line
- Damaged terminals at ECM engine harness connector

### Reason for Question
- Resistance less than 10,000 ohms at engine harness connector indicates signal line (Ckt #120) is shorted to return line (Ckt #452) or battery ground.

### Test Options
- Continuity Test or STE/ICE-R Test #91

### Known Info
- Sensor OK
- OTS terminal and connectors OK
- No short to return line or ground

### Possible Problems
- Damaged terminals at ECM engine harness connector

### Reason for Question
- Damage to terminal and connector could affect signal to ECM.

### Test Options
- Visual inspection

### Known Info
- No short to return line or ground
- Sensor OK
- OTS terminal and connectors OK
- Terminals at ECM harness connector OK

### Possible Problems
- 

### Reason for Question
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

### Test Options
- Visual inspection

---

### Step 4
**Is there greater than 10,000 ohms or open in signal line (Ckt #120), return line (Ckt #452) and battery ground?**

- **YES**
  - Notify supervisor if short is indicated.

- **NO**
  - Go to step 5.

---

### Step 5
**Are terminals at ECM harness connector OK?**

- **YES**
  - Replace ECM (para 7-29).

- **NO**
  - Repair ECM terminals or connectors (para 7-77). Then go to step 6.

---

### Step 6
**Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **YES**
  - Repair complete.

- **NO**
  - Fault not corrected. Notify supervisor.
(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.

(2) Read resistance between sockets R2 and Y2 on engine harness connector. Also read resistance between socket B of OTS connector and a good ground.

**CONTINUITY TEST**

(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.

(2) Read resistance between sockets R2 and Y2 on engine harness connector. Also read resistance between socket B of OTS connector and a good ground.

Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.

(2) Reconnect all harness connectors.

(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.

---

**CAUTION**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.
A4 - Code 16 TWO PIECE COOLANT LEVEL SENSOR (CLS) SIGNAL VOLTAGE HIGH

START

1. Does engine start with CLS module disconnected and jumper wire installed between sockets D and C of harness connector?
   - NO Go to step 5
   - YES

2. During step 1, was code 16 (and any other codes except code 13) displayed?
   - NO Go to step 4
   - YES

3. Is there less than or equal to 5 ohms resistance in signal line and ground circuit?
   - NO Notify supervisor if open is indicated.
   - YES Go to step 8.
(4) Turn ENGINE switch OFF.
(5) Disconnect CLS module and install a jumper between sockets D and C of CLS harness connector.
(6) Attempt to start and run engine at idle.
(7) Read active codes.
(8) Stop engine.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**NOTE**
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-82 and you were referred here.

**CONTINUITY TEST**
(1) Turn ENGINE switch OFF and disconnect vehicle harness connector.
(2) Read resistance between socket H3 on vehicle harness connector and a good ground.
### A4 - Code 16 TWO PIECE COOLANT LEVEL SENSOR (CLS) SIGNAL VOLTAGE HIGH (CONT)

#### KNOWN INFO
- Sensor OK
- Signal line and ground circuits OK

#### POSSIBLE PROBLEMS
- Damaged terminals at CLS connectors
- Open in ignition circuit
- Short in 12-volt line

---

#### TEST OPTIONS
- Voltage Test or STE/ICE-R Test #89

#### REASON FOR QUESTION
- Reading of 4 to 6 volts indicates 12 volt line is wired to 5 volt supply. Less than 4 volts indicates an open.

---

#### KNOWN INFO
- Sensor OK
- Signal and ground circuits OK

#### POSSIBLE PROBLEMS
- Damaged terminals at CLS connectors
- Open in ignition circuit
- Short in 12-volt line

---

#### TEST OPTIONS
- Visual inspection

#### REASON FOR QUESTION
- Damage to connectors could affect signal to CLS.

---

#### KNOWN INFO
- Sensor OK
- Signal and ground circuits OK
- Terminals at CLS connectors OK

#### POSSIBLE PROBLEMS
- Open in ignition circuit
- Short in ignition circuit
- Short in 12-volt line

---

#### TEST OPTIONS
- Visual inspection

#### REASON FOR QUESTION
- Open is suspect.

---

### Flowchart

1. **Is there greater than 10 volts in switched 12-volt line?**
   - **NO**: Notify supervisor if open is indicated.
   - **YES**: Replace CLS (para 7-10). Then go to step 10.

2. **Are CLS terminals and connectors OK?**
   - **NO**: Repair CLS terminals or connectors (para 7-77). Then go to step 10.
   - **YES**: Reset circuit breaker. Then go to step 7.
Inspect CLS and terminals at CLS connectors (sensor and harness side) for damage; bent, corroded, and unseated pins or sockets.

**VOLTAGE TEST**

1. Remove jumper wire.
2. Turn ENGINE switch ON and read voltage at CLS connector, socket E (red lead) to socket C (black lead).
A4 - Code 16 TWO PIECE COOLANT LEVEL SENSOR (CLS) SIGNAL VOLTAGE HIGH (CONT)

### Known Info
- Sensor OK
- Signal and ground circuits OK
- Terminals at CLS connectors OK

### Possible Problems
- Open in ignition circuit
- Short in ignition circuit

#### Test Options
- Continuity Test or STE/ICE-R Test #91

#### Reason for Question
- Resistance less than 10,000 ohms on vehicle harness connector indicates CLS line (ckt #115) is shorted to DC line.

---

### Known Info
- Sensor OK
- Signal and ground circuits OK
- 12-volt line OK
- Terminals at CLS connectors OK

### Possible Problems
- Open in ignition circuit
- Short in ignition circuit

---

### Known Info
- Sensor OK
- Signal and ground circuits OK
- 12-volt line OK
- Terminals at CLS connectors OK

### Possible Problems
- Open in ignition circuit
- Short in ignition circuit

---

### Known Info
- Sensor OK
- Signal and ground circuits OK
- Terminals at CLS connectors OK

### Possible Problems
- Open in ignition circuit
- Short in ignition circuit

### Test Options
- Voltage Test or STE/ICE-R Test #89

### Reason for Question
- Less than or equal to 10.0 volts at CLS connector indicates open on the 12 volt wire.

---

1. **Caution:** Read caution on following page.

   **Possible Problems**
   - Notify supervisor if short is indicated.

2. **Reason for Question**
   - Resistance less than 10,000 ohms on vehicle harness connector indicates CLS line (ckt #115) is shorted to DC line.

3. **Test Options**
   - Continuity Test or STE/ICE-R Test #91

4. **Reason for Question**
   - Damage to terminals and connectors could affect signal to CLS.

---

5. **Known Info**
   - Repair terminals or connectors (para 7-77). Then go to step 10.

6. **Reason for Question**
   - Resistance less than 10,000 ohms on vehicle harness connector indicates CLS line (ckt #115) is shorted to DC line.

---

7. **Known Info**
   - Notify supervisor if short is indicated.

8. **Reason for Question**
   - Damage to terminals and connectors could affect signal to CLS.

---

9. **Warning:** Read warning on following page.

   **Possible Problems**
   - Notify supervisor if open is indicated.

10. **Reason for Question**
    - Replace ECM (para 7-29).

---

---

---

---

---
(1) Check terminals at vehicle harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

(2) Check terminal and pin H3 at ECM and all terminals and pins in CLS module connectors for damage; bent, corroded, and unseated pins or sockets.

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**CONTINUITY TEST**

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(1) Disconnect vehicle harness connector at ECM
(2) Remove jumper at CLS harness connector
(3) Read resistance between sockets D and E of CLS connector on vehicle harness.

**VOLTAGE TEST**

(1) Turn ENGINE switch OFF and disconnect CLS module connector.
(2) Place red lead of a voltmeter into terminal E of CLS connector vehicle harness side.
(3) Connect black lead to terminal C of CLS connector vehicle harness side
(4) Turn ENGINE switch ON and read voltage.
A4 - Code 16 TWO PIECE COOLANT LEVEL SENSOR (CLS) SIGNAL VOLTAGE HIGH (CONT)

<table>
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<tr>
<th>KNOWN INFO</th>
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<td>Signal and ground circuits OK</td>
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<tr>
<td>12-volt line OK</td>
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<tr>
<td>Terminals at CLS connectors OK</td>
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<tr>
<td>Ignition circuit OK</td>
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<th>POSSIBLE PROBLEMS</th>
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<tr>
<th>TEST OPTIONS</th>
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<td>Visual Inspection</td>
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<th>REASON FOR QUESTION</th>
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<tr>
<td>If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON, fault has been corrected.</td>
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</table>

10. **Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **YES**
  - Repair complete.
  - Fault not corrected. Notify supervisor.

- **NO**
  - Repair complete.
1. Turn ENGINE switch OFF.
2. Reconnect all harness connectors.
3. Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 21 THROTTLE POSITION SENSOR (TPS) SIGNAL VOLTAGE HIGH

**START**

**1.**
**Do DDR codes displayed not include Code 12 or 22?**
- **NO**
  - For Code 12 or 22, go to vehicle harness check, A4A
- **YES**
  - **TEST OPTIONS**
    - DDR
  - **REASON FOR QUESTION**
    - If code 12 or 22 comes up, vehicle harness may be faulty.

**2.**
**Is any code except Code 21 displayed on DDR with TPS connector disconnected?**
- **NO**
  - For Code 21 and any other codes, go to step 6.
- **YES**
  - **CAUTION**
    - Read CAUTION on following page.

**3.**
**Is there less than or equal to 5 ohms in return line (Ckt #952) and/or signal line (Ckt #417)?**
- **NO**
  - Notify supervisor if open is indicated.
- **YES**
  - **TEST OPTIONS**
    - Continuity Test or STE/ICE-R Test #91
  - **REASON FOR QUESTION**
    - Resistance greater than 5 ohms at vehicle harness connector indicates open in return line (Ckt #952) and/or signal line (Ckt #417).
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

CONTINUITY TEST
(1) Turn ENGINE switch OFF.
(2) Install a jumper wire between pins A and B of TPS harness connector at ECM.
(3) Read resistance between sockets D2 and C3 on vehicle harness connector.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

(1) Turn ENGINE switch OFF and disconnect TPS connector.
(1.1) Click on “Alarms Clear” to clear alarms screen.
(2) Turn ENGINE switch ON and read active codes.
A4 - Code 21 THROTTLE POSITION SENSOR (TPS) SIGNAL VOLTAGE HIGH (CONT)

4. Are the TPS counts correct?

   NO
   Check pedal for binding or interference; then go to step 5.

   YES

5. Are TPS terminals and connectors OK?

   NO
   Repair TPS terminals or connectors (para 7-77). Then go to step 9.

   YES

   CAUTION
   Read CAUTION on following page.

6. Is there greater than 10,000 ohms in signal line (Ckt #120) (not shorted to vehicle +5 volt line (Ckt #916))?

   NO
   Notify supervisor if short is indicated.

   YES

TEST OPTIONS

DDR

REASON FOR QUESTION

Throttle counts at closed (idle position) throttle must be between 14 and 36. Throttle counts at full throttle must be between 207 and 240. There must be a minimum of 182 throttle counts between closed (idle) and full throttle.

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Damage to terminal could affect signal to TPS.

TEST OPTIONS

Continuity Test or STE/ICE-R Test #91

REASON FOR QUESTION

Resistance less than or equal to 10,000 ohms at vehicle harness connector indicates signal line (Ckt #417) is shorted to vehicle +5 volt line (Ckt #916).
Inspect TPS and terminals at TPS connectors (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.

**CAUTION**

Never attempt to adjust the electronic throttle by bending the pedal mechanism. Bending can cause internal linkages to bind or extend motion beyond the built-in pedal stops.

1. Reconnect vehicle harness connector and plug TPS back in.
2. Hook up DDR to 12-pin DDL connector and select Throttle Sensor Display.
3. Read throttle counts at both no throttle and at full throttle

**CONTINUITY TEST**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

1. Turn ENGINE switch OFF and disconnect vehicle harness connector at ECM.
2. Read resistance between sockets D2 and A3 on vehicle harness connector.
7. **Is there continuity in vehicle harness connector and the 6-way power harness connector?**

   - **NO**
     - For any reading less than or equal to 10,000 ohms at 6-way power harness connector or vehicle harness connector indicates short.

   - **YES**
     - **TEST OPTIONS**
       - Continuity Test
       - STE/ICE-R Test #91

8. **Are terminals at ECM vehicle harness connector OK?**

   - **NO**
     - Repair ECM terminals or connectors (para 7-77). Then go to step 9.

   - **YES**
     - **TEST OPTIONS**
       - Visual inspection

9. **Does CHECK ENGINE indicator light stay on longer than five seconds?**

   - **NO**
     - Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON, fault has been corrected.

   - **YES**
     - **TEST OPTIONS**
       - Visual inspection

   - **REASON FOR QUESTION**
     - Damage to connectors could affect signal to ECM.

   - **KNOWN INFO**
     - Vehicle harness OK
     - Sensor OK
     - Return line OK
     - TPS terminals OK
     - +5 volt line OK
     - No short to battery +

   - **POSSIBLE PROBLEMS**
     - Damaged terminals at ECM harness connector

   - **REPAIR OPTIONS**
     - Replace ECM (para 7-29).
(1) Disconnect batteries (para 7–61).
(2) Disconnect vehicle harness and 6-way power harness connectors at ECM.
(3) Read resistance between sockets D2 and B3 of vehicle harness connector.
(4) Read resistance between socket D2 on vehicle harness connector and sockets A, B, E, and F on 6-way power harness connector.
(5) Connect batteries (para 7–61).

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.

Check terminals at ECM vehicle harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins and sockets.
A4 - Code 22 THROTTLE POSITION SENSOR (TPS) SIGNAL VOLTAGE LOW

START

1. Do DDR Codes displayed not include 12 or 21?

POSSIBLE PROBLEMS
- Damaged TPS terminals
- Short to +5 volt line or open
- Short or open in signal line
- Damaged terminals at ECM harness connector
- Short to return line
- Short to another voltage source
- Outside power splice

YES

For Codes 12 or 21, go to vehicle harness check, A4A.

NO

2. Is Code 21 one of the active Codes with jumper installed between sockets B and C of TPS harness connector?

POSSIBLE PROBLEMS
- Damaged TPS terminals
- Short to +5 volt line or open
- Short or open in signal line
- Damaged terminals at ECM harness connector
- Short to return line
- Short to another voltage source
- Outside power splice

YES

CAUTION
Read CAUTION on following page.

GO TO STEP 5.

NO

3. Are the TPS counts correct?

POSSIBLE PROBLEMS
- Damaged TPS terminals
- Short to +5 volt line or open
- Short or open in signal line
- Damaged terminals at ECM harness connector
- Short to return line
- Short to another voltage source
- Outside power splice

YES

Check pedal for binding or interference, then go to step 4.

NO

REASON FOR QUESTION
To determine if vehicle harness is at fault.

TEST OPTIONS
DDR

REASON FOR QUESTION
Sensor fault suspect.

TEST OPTIONS
DDR

REASON FOR QUESTION
Throttle counts at closed (idle position) throttle must be between 14 and 36. Throttle counts at full throttle must be between 207 and 240. There must be a minimum of 182 throttle counts between closed (idle) and full throttle.
**NOTE**
The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

1. Turn ENGINE switch OFF and disconnect TPS connector.
2. Install a jumper wire between sockets B and C of TPS harness connector.
3. Click on “Alarms Clear” to clear alarms screen.
4. Turn ENGINE switch ON and read active codes.

**CAUTION**
Never attempt to adjust the electronic throttle by bending the pedal mechanism. Bending can cause internal linkages to bind or extend motion beyond the built-in pedal stops.

1. Remove jumper and reconnect TPS.
2. Hook up DDR to 12-pin DDL connector and select throttle sensor display.
3. Read throttle counts at both no throttle and full throttle.
4. Are TPS terminals and connectors OK?

- **Yes**: Repair TPS terminals or connectors (para 7–77), then go to step 13.
- **No**: Replace electronic throttle (para 7–28), then go to step 13.

5. Is voltage at TPS harness connector in acceptable range (4 to 6 volts)?

- **Yes**: If less than 4 volts, go to step 9; if greater than 6 volts, go to step 11.
- **No**: Incorrect source voltage possible.

6. Is there greater than 10,000 ohms or open in signal line (Ckt #417)?

- **Yes**: Notify supervisor if short is indicated.
- **No**: Resistance less than or equal to 10,000 ohms at TPS harness connector indicates signal line (Ckt #417) is shorted to return line (Ckt #952) or battery ground.
(1) Remove jumper and turn ENGINE switch ON.

(2) Read voltage on TPS harness connector, socket C (red lead) to socket A (black lead).

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**VOLTAGE TEST**

(1) Remove jumper and turn ENGINE switch ON.

(2) Read voltage on TPS harness connector, socket C (red lead) to socket A (black lead).

**CONTINUITY TEST**

(1) Turn ENGINE switch OFF and disconnect vehicle harness connector at ECM.

(2) Read resistance between sockets A and B on TPS harness connector.

(3) Read resistance between Socket B and a good ground.

Inspect TPS and terminals at TPS connectors (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.
7. **Is there greater than 5 ohms or open in signal line (Ckt #417) and signal return (Ckt #952)?**

   - **NO**
     - Check ECM terminals A3, D2, C3 and TPS pins. If ok, notify supervisor.
   - **YES**

8. **Are ECM and terminals at ECM vehicle harness connector OK?**

   - **NO**
     - Repair ECM terminals and connectors (para 7-77), then go to step 13.
   - **YES**
     - Replace ECM if damaged (para 7-29). Then go to step 13.

9. **Is there greater than 10,000 ohms or open in +5 volt line (Ckt #916)?**

   - **NO**
     - Notify supervisor if short is indicated.
   - **YES**

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance greater than 5 ohms at TPS harness connector or vehicle harness connector indicates open in signal (Ckt #417) and/or signal return (Ckt #952).
- Resistance less than or equal to 10,000 ohms at TPS harness connector indicates the vehicle +5 volt line (Ckt #916) is shorted to return line (Ckt #952).
1. Install a jumper wire between sockets A and B of the TPS harness connector.
2. Read resistance between sockets D2 and C3 on vehicle harness connector.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST
(1) Install a jumper wire between sockets A and B of the TPS harness connector.
(2) Read resistance between sockets D2 and C3 on vehicle harness connector.

Check ECM and terminals at ECM vehicle harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins and sockets.

CONTINUITY TEST
(1) Turn ENGINE switch OFF and disconnect vehicle harness connector at ECM.
(2) Read resistance between sockets A and C on TPS harness connector.
A4 - Code 22 THROTTLE POSITION SENSOR (TPS) SIGNAL VOLTAGE LOW (CONT)

KNOWINFO
Vehicle harness OK
TPS terminals OK
No short or open in signal line
ECM terminals OK
No short to +5 volt line

POSSIBLE PROBLEMS
Open in +5 volt line
Short or open in signal line
Short to return line
Short to another voltage source
Outside power splice

10. Is there less than or equal to 5 ohms in +5 volt line (Ckt # 916)?

TEST OPTIONS
Continuity Test or
STE/ICE-R Test #91

REASON FOR QUESTION
Resistance greater than 5 ohms at vehicle harness connector indicates +5 volt line (Ckt #916) is open.

KNOWNINFO
Vehicle harness OK
TPS terminals OK
No short or open in signal line
ECM terminals OK
No short to +5 volt line
No open in +5 volt line

POSSIBLE PROBLEMS
Short or open in signal line
Short to return line
Short to another voltage source
Outside power splice

11. Is there continuity in vehicle harness connector and the 6-way power harness connector?

TEST OPTIONS
Continuity Test or
STE/ICE-R Test #91

REASON FOR QUESTION
Readings less than 10,000 ohms at vehicle harness connector or 6-way power connector indicates short.

KNOWNINFO
Vehicle harness OK
TPS terminals OK
No short or open in signal line
ECM terminals OK
No short to +5 volt line
No open in +5 volt line
No short to another voltage source

POSSIBLE PROBLEMS
Short or open in signal line
Short to return line
Outside power splice

12. Is there less than 4.0 volts in Ckt #952 and Ckt #916?

TEST OPTIONS
Voltage Test or
STE/ICE-R Test #89

REASON FOR QUESTION
Reading greater than or equal to 4.0 volts at ECM vehicle harness indicates outside power splice.
CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST
(1) Install a jumper wire between sockets A and C of the TPS harness connector.
(2) Read resistance between sockets A3 and C3 on vehicle harness connector.

VOLTAGE TEST
(1) Turn ENGINE switch ON and read voltage A3 (red lead) to a good ground (black lead).
(2) Read voltage C3 (red lead) to a good ground (black lead).
A4 - Code 22 THROTTLE POSITION SENSOR (TPS) SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Vehicle harness OK
- TPS terminals OK
- No short or open in signal line
- ECM terminals OK
- No short to +5 volt line
- No open in +5 volt line
- No short to another voltage source
- No outside power splice

**POSSIBLE PROBLEMS**

13. **TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Repair complete.

**Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **NO**
  - Repair complete.

- **YES**
  - Fault not corrected. Notify supervisor.

Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 23 FUEL TEMPERATURE SENSOR (FTS) SIGNAL VOLTAGE HIGH

**KNOWN INFO**
- CODE 23 displayed on DDR

**POSSIBLE PROBLEMS**
- Sensor fault
- Short to +5 volt line
- Damaged OTS terminals and connectors
- Open in signal line
- Damaged terminals at ECM engine harness connector

---

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- To check sensor for fault.

---

**KNOWN INFO**
- Sensor OK

**POSSIBLE PROBLEMS**
- Short to +5 volt line
- Damaged OTS terminals and connectors
- Open in signal line
- Damaged terminals at ECM engine harness connector

---

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 10,000 ohms at engine harness connector indicates signal line (Ckt #472) is shorted to engine +5 volt line (Ckt #416) and/or Ckt #452 and/or ground.

---

**KNOWN INFO**
- Sensor OK
- No short to +5 volt line

**POSSIBLE PROBLEMS**
- Damaged OTS terminals and connectors
- Open in signal line
- Damaged terminals at ECM engine harness connector

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damage to connectors could affect signal to FTS.

---

**START**

1. **Is Code 24 one of the active codes with jumper wire installed between sockets A and B of FTS connector?**
   - **CAUTION**
   - Read CAUTION on following page.
   - For any code except Code 24, go to step 4.
   - **YES**
   - **NO**

2. **Is there greater than 10,000 ohms or open in signal line (Ckt #472)?**
   - **YES**
   - **NO**
   - Notify supervisor if short is indicated.

3. **Are FTS terminals and connectors OK?**
   - **YES**
   - **NO**
   - Repair FTS terminals and connectors (para 7-77). Then go to step 6.

Replace FTS (para 7-33). Then go step 6.
CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

NOTE
- The following chart should be used only if DDEC troubleshooting was started on pg. 2-80 and you were referred here.
- A false DDEC historical Code 23 may be logged during cold starts in extremely cold environments, -50 to -26°F (-46 to -32°C). Typically, the CHECK ENGINE light will come on 8 minutes after starting and go out 2–3 minutes later. If the vehicle has been operated under these conditions, clear the historical codes and return the vehicle to service.

CONTINUITY TEST
(1) Turn ENGINE switch OFF and remove jumper wire.
(2) Disconnect engine harness connector at ECM.
(3) Read resistance between sockets R3 and W1 on engine harness connector.

Inspect FTS and terminals at FTS connectors (both sensor and harness side) for damage; bent, corroded, and unseated pins or sockets.
A4 - Code 23 FUEL TEMPERATURE SENSOR (FTS) SIGNAL VOLTAGE HIGH (CONT)

4. **Is there less than or equal to 5 ohms in signal line (Ckt #472) and signal return (Ckt #452)?**

   - **YES**
   - Notify supervisor if open is indicated.

   - **NO**

5. **Are terminals at ECM harness connector OK?**

   - **YES**
   - Repair terminals or connector (para 7-77), Then go to step 6.

   - **NO**

6. **Does CHECK ENGINE indicator stay on longer than five seconds?**

   - **YES**
   - Repair complete.

   - **NO**

   - **Fault not corrected. Notify supervisor.**
CONTINUITY TEST

(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.

(2) Read resistance between sockets R3 and Y2 on engine harness connector.

Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 24 FUEL TEMPERATURE SENSOR (FTS) SIGNAL VOLTAGE LOW

START

1. Do DDR codes displayed not include 14, 23, or 33?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE 24 displayed on DDR</td>
<td>DDR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor fault</td>
<td>For codes 14, 23 or 33, go to engine harness check, A4B.</td>
</tr>
<tr>
<td>Damaged FTS terminals and connectors</td>
<td></td>
</tr>
<tr>
<td>Signal short to return line</td>
<td></td>
</tr>
<tr>
<td>Damaged terminals at ECM engine harness connector</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

2. Is Code 23 (or any other code except 24) present on DDR with FTS connector disconnected?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine harness OK</td>
<td>DDR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor fault</td>
<td>For Code 24 (and any other codes), go to step 4.</td>
</tr>
<tr>
<td>Damaged FTS terminals and connectors</td>
<td></td>
</tr>
<tr>
<td>Signal short to return line</td>
<td></td>
</tr>
<tr>
<td>Damaged terminals at ECM engine harness connector</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

3. Are FTS and FTS terminals and connectors OK?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine harness OK</td>
<td>DDR</td>
</tr>
<tr>
<td>Sensor OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damaged FTS terminals and connectors</td>
<td></td>
</tr>
<tr>
<td>Signal short to return line</td>
<td></td>
</tr>
<tr>
<td>Damaged terminals at ECM engine harness connector</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

   Replace FTS (para 7–33) if required. Then go to step 6.

   Repair FTS terminals and connectors (para 7–77). Then go to step 6.
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) Turn ENGINE switch OFF and disconnect FTS connector.
(1.1) Click on “Alarms Clear” to clear alarms screen.

(2) Start engine and run until CHECK ENGINE light comes on or for 8 minutes.
(3) Read active codes with engine still running.

(1) Turn ENGINE switch OFF and disconnect FTS connector.
(1.1) Click on “Alarms Clear” to clear alarms screen.

(2) Start engine and run until CHECK ENGINE light comes on or for 8 minutes.
(3) Read active codes with engine still running.

FTS HARNESS CONNECTOR

Inspect FTS and terminals at FTS connectors (both sensor and harness side) for damage; bent, corroded, and unseated pins or sockets.
A4 - Code 24 FUEL TEMPERATURE SENSOR (FTS) SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- FTS terminals and connectors OK

**POSSIBLE PROBLEMS**
- Signal short to return line
- Damaged terminals at ECM engine harness connector

**TEST OPTIONS**
- Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 10,000 ohms at engine harness connector or FTS connector indicates signal line (Ckt #472) is shorted to return line (Ckt #452) or battery ground.

4. **Is there greater than 10,000 ohms or open in the signal line (Ckt #472)?**
   - **NO** Notify supervisor if short is indicated.
   - **YES**

5. **Are terminals at ECM harness connector OK?**
   - **NO** Repair ECM terminals or connectors (para 7-77). Then go to step 6.
   - **YES** Replace ECM (para 7-29).

6. **Does CHECK ENGINE indicator light stay on longer than five seconds?**
   - **NO** Repair complete.
   - **YES** Fault not corrected. Notify supervisor.

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- FTS terminals and connectors OK
- No short to return line

**POSSIBLE PROBLEMS**
- Damaged terminals at ECM engine harness connector

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damage to terminal and connector could affect signal to ECM.

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- FTS terminals and connectors OK
- No short to return line

**POSSIBLE PROBLEMS**
- Damaged terminals at ECM engine harness connector

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON, fault has been corrected.
CONTINUITY TEST

(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.
(2) Read resistance between sockets R3 and Y2 on engine harness connector.
(3) Read resistance between socket B on FTS connector and a good ground.

Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 – Code 31 FAULT ON AUXILIARY OUTPUT

1. Does CHECK ENGINE or CHECK GAUGES Indicator never come on?
   - YES
     - If both indicators go on for five seconds and then go out, go to step 7. If either stays on longer than five seconds, go to step 5.
   - NO
     - Visual inspection

2. Are CHECK ENGINE and/or CHECK GAUGES indicator bulbs OK.
   - YES
     - Replace indicator bulbs (para 7–40), then go to step 9.
   - NO
     - Visual inspection

3. Is there greater than 10 volts in vehicle harness connector?
   - YES
     - Notify supervisor if open is indicated.
   - NO
     - Voltage Test or STE/ICE–R Test #91

Known Info:
- CODE 31 displayed on DDR

Possible Problems:
- Bulb not working
- Open in vehicle harness connector
- Short to open or ignition
- Short to ground
- Short in CP, EB, or actuator wires
- Damaged terminals at ECM connector

Reason for Question:
- Faulty light bulb or circuit is suspect.
- Indicators will not operate if bulbs are burned out.
- Less than 10 volts on any reading at vehicle harness connector indicates open.
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) Turn ENGINE switch OFF.
(2) Turn ENGINE switch ON (engine not running).
(3) Inspect CHECK ENGINE and CHECK GAUGES indicators.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

VOLTAGE TEST
(1) Disconnect vehicle harness connector at ECM.
(2) Turn ENGINE switch ON.
(3) Read voltage on vehicle harness connector, keeping the black lead on a good battery ground and probing both the B1 (CHECK ENGINE indicator) and B2 (CHECK GAUGES indicator) sockets with the red lead.
A4 - Code 31 FAULT ON AUXILIARY OUTPUT (CONT)

4. Can inoperative indicators be forced on by using jumper wires?
   
   NO
   
   Notify supervisor if short or open is indicated.
   
   YES
   
   Check 5 amp circuit breaker. Check wire no 1867 from DDEC 5 amp circuit breaker to DDEC relay.

5. Does reading on DDR display disagree with CHECK ENGINE and CHECK GAUGES indicators?
   
   NO
   
   Go to step 7.
   
   YES
   
   Test options:
   
   TEST OPTIONS
   
   DDR
   
   REASON FOR QUESTION
   
   To verify correct operation of CHECK ENGINE and CHECK GAUGES indicators.

6. Do CHECK ENGINE and CHECK GAUGES indicators stay off with vehicle harness connector disconnected?
   
   NO
   
   Notify supervisor if short is indicated.
   
   YES
   
   Test options:
   
   TEST OPTIONS
   
   Visual inspection
   
   REASON FOR QUESTION
   
   If either CHECK ENGINE or CHECK GAUGES indicators stays ON, short is present in that circuit (Ckt #419 for CEL and Ckt #509 for SEL).
(1) Turn ENGINE switch OFF.
(2) Disconnect 6-way power harness connector.
(3) Install a jumper between socket F on the 6-way power connector and socket B3 on the vehicle harness connector.
(4) Install a second jumper between socket C on the 6-way power connector and the following socket on the vehicle harness connector: Socket B1 (if the CEL didn’t turn ON); socket B2 (if SEL didn’t turn ON).
(5) Observe CHECK ENGINE and CHECK GAUGES indicators.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

SHORT AND OPEN CIRCUIT TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect 6-way power harness connector.
(3) Install a jumper between socket F on the 6-way power connector and socket B3 on the vehicle harness connector.
(4) Install a second jumper between socket C on the 6-way power connector and the following socket on the vehicle harness connector: Socket B1 (if the CEL didn’t turn ON); socket B2 (if SEL didn’t turn ON).
(5) Observe CHECK ENGINE and CHECK GAUGES indicators.

(1) Plug in DDR.
(2) Press (down) key until Mode 30 comes up.
(3) Observe if DDR display agrees with the CEL–SEL.

(1) Unplug DDR.
(2) Turn ENGINE switch to OFF and disconnect vehicle harness connector at the ECM.
(3) Turn ENGINE switch ON and observe CHECK ENGINE and CHECK GAUGES lights.
**A4 - Code 31 FAULT ON AUXILIARY OUTPUT (CONT)**

### Known Info

- **CHECK ENGINE and CHECK GAUGES** indicators do not light.
- Bulbs are OK.
- No short or open to ignition.
- No short to ground.

### Possible Problems

- Short in CP, EB, or actuator wires.
- Damaged terminals at ECM connector.

### Test Options

- **Continuity Test** or **STE/ICE-R Test #91**

### Reason for Question

Resistance less than or equal to 5 ohms at vehicle harness connector indicates short in circuit where reading occurred.

### Known Info

- **CHECK ENGINE and CHECK GAUGES** indicators do not light.
- Bulbs are OK.
- No short or open to ignition.
- No short to ground.
- NO short in CP, EB, or actuator wires.

### Possible Problems

- Damaged terminals at ECM connector.

### Test Options

- Visual inspection

### Reason for Question

Damage to connectors may affect signal to ECM.

### Known Info

- **CHECK ENGINE and CHECK GAUGES** indicators do not light.
- Bulbs are OK.
- No short or open to ignition.
- No short to ground.
- NO short in CP, EB, or actuator wires.
- Terminals at ECM connector OK.

### Possible Problems

- Damaged terminals at ECM connector.

### Test Options

- Visual inspection

### Reason for Question

Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

---

**7.**

Is there greater than 5 ohms in crankshaft position (CP), engine brake (EB) and actuator #1 wires?

- **No**
  - Notify supervisor if short is indicated.
- **Yes**
  - **NO**
    - Replace ECM (para 7–29).
  - **YES**
    - Repair terminals or connector (para 7–77), then go to step 9.

**8.**

Are terminals at ECM harness and engine harness connectors OK?

- **NO**
  - Repair terminals or connector (para 7–77), then go to step 9.
- **YES**
  - Replace ECM (para 7–29).

**9.**

Does CHECK ENGINE indicator light stay on for longer than five seconds?

- **NO**
  - Repair complete.
- **YES**
  - **NO**
    - Repair complete.
  - **YES**
    - Fault not corrected. Notify supervisor.
CONTINUITY TEST

(1) Turn ENGINE switch OFF.
(2) Disconnect vehicle harness connector at ECM.
(3) Read resistance between socket C3 and sockets A1, K2, and J3.
(4) Repeat resistance check between known good ground and sockets A1, K2, and J3.

(1) Disconnect engine harness connector.
(2) Check terminals at ECM vehicle harness and engine harness connectors (both ECM and harness side) for damaged, bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
### A4 - Code 32 ECM BACKUP SYSTEM FAILURE

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE 32 displayed on DDR</td>
<td>DDR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM fault</td>
<td>Backup computer inside ECM has failed if engine does not momentarily run on.</td>
</tr>
<tr>
<td>Reverse EMF present</td>
<td></td>
</tr>
</tbody>
</table>

1. **Does engine “run on” momentarily when ENGINE switch is positioned OFF?**

   - **YES**
     - Replace ECM (para 7-29). Then restart DDEC Troubleshooting (page 2-80).
   - **NO**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM OK</td>
<td>Engine Run On Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse EMF present</td>
<td>Reverse EMF voltage is suspect.</td>
</tr>
</tbody>
</table>

2. **Does engine stop “running on” even after all 12-volt relays are removed?**

   - **YES**
     - Ckt #439 has been shorted, or inappropriately wired to another circuit. Notify supervisor.
   - **NO**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM may be OK</td>
<td>DDR</td>
</tr>
<tr>
<td>Reverse EMF not likely to be present</td>
<td></td>
</tr>
</tbody>
</table>

3. **Does any other code except Code 32 come up?**

   - **YES**
     - External voltage source is supplying Ckt #439. Notify supervisor.
   - **NO**

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDR</td>
<td>If DDR reads Code 32, backup computer inside ECM is faulty. If DDR reads code 25 or any other code external voltage source is supplying Ckt #439.</td>
</tr>
</tbody>
</table>
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

---

ENGINE RUN ON TEST

1. Remove relays R1–R6 and R11 (para 7–27).
2. Turn ENGINE switch ON and clear codes.
3. Restart engine.
4. Turn ENGINE switch OFF.
5. Reinstall relays (para 7–27).

---

Turn ENGINE switch ON and read active codes.
A4 - Code 33  TURBO BOOST SENSOR (TBS) SIGNAL  
VOLTAGE HIGH

1. Do DDR codes displayed not include codes 14, 15, 23, 24, or 34-36?
   - NO
     For codes 14, 15, 23, 24, 34-36, go to engine harness check, A4B
   - YES

2. Is code 34 (and any codes except 33) present on DDR with TBS connector disconnected?
   - NO
     Sensor fault suspect.
   - YES
     Resistance greater than 5 ohms at ECM engine harness connector indicates open in return line (Ckt #452).

3. Is there less than 5 ohms or open in return line (Ckt #452)?
   - NO
     Notify supervisor if open is indicated.
   - YES

CAUTION
Read CAUTION on following page.
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) Turn ENGINE switch OFF and disconnect TBS connector.
(1.1) Click on “Alarms Clear” to clear alarms screen.
(2) Start and run engine at idle.
(3) Read active codes.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST
(1) Turn ENGINE switch OFF
(2) Install a jumper wire between pins A and B of TBS harness connector
(3) Disconnect engine harness connector at ECM.
(4) Read resistance between sockets P1 and Y2 on engine harness connector.
A4 - Code 33  TURBO BOOST SENSOR (TBS) SIGNAL VOLTAGE HIGH (CONT)

KNOWN INFO
- Engine harness OK
- Sensor OK
- Return line OK

POSSIBLE PROBLEMS
- Damaged terminals at TBS connectors
- Short to +5 volt line
- Short to battery +
- Damaged terminals at ECM engine harness connector

TEST OPTIONS
- Visual inspection

REASON FOR QUESTION
- Damage to connectors may affect signal to TBS.

4. Are TBS terminals and connectors OK?

- YES
  - Repair TBS terminals or connectors (para 7-77). Then go to step 8.

- NO
  - Replace TBS sensor (para 7-36). Then go to step 8.

5. Is there continuity in signal line (Ckt #432)?

- YES
  - Notify supervisor if open is indicated.

- NO
  - For any reading less than or equal to 10,000 ohms, notify supervisor if short is indicated.

6. Is there continuity in vehicle harness connector and 6-way power harness connector?

- YES
  - Replace TBS sensor (para 7-36). Then go to step 8.

- NO
  - For any reading less than or equal to 10,000 ohms, notify supervisor if short is indicated.

TEST OPTIONS
- Continuity Test or STE/ICE-R Test #91

REASON FOR QUESTION
- Resistance less than or equal to 10,000 ohms at engine harness connector indicates signal line (Ckt #432) is shorted to engine +5 volt line (Ckt #416).

KNOWN INFO
- Engine harness OK
- Sensor OK
- Return line OK
- Terminals at TBS connectors OK

POSSIBLE PROBLEMS
- Short to +5 volt line
- Short to battery +
- Damaged terminals at ECM engine harness connector

TEST OPTIONS
- Continuity Test or STE/ICE-R Test #91

REASON FOR QUESTION
- Resistance less than or equal to 10,000 ohms at 6-way power connector or vehicle harness connector indicates short.
Inspect terminals at TBS connectors (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.

**CONTINUITY TEST**
1. Turn ENGINE switch OFF.
2. Disconnect engine harness connector at ECM.
3. Read resistance between sockets W1 and P1 on engine harness connector.

**CONTINUITY TEST**
1. Disconnect batteries (para 7-61).
2. Disconnect vehicle harness and 6-way power harness connectors at ECM.
3. Read resistance between sockets P1 of the engine harness and socket B3 on vehicle harness connector.
4. Also read resistance between socket P1 on engine harness connector and sockets A, B, E, and F on 6-way power connector.
5. Connect batteries (para 7-61).
A4 - Code 33  TURBO BOOST SENSOR (TBS) SIGNAL VOLTAGE HIGH (CONT)

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Return line OK
- Terminals at TBS connectors OK
- No short to +5 volt line

**POSSIBLE PROBLEMS**
- Damaged terminals at ECM engine harness connector

---

### 7.

**Are terminals at ECM harness connector OK?**

- **NO**
  - Repair ECM terminals or connectors (para 7–77). Then go to step 8.
  - Replace ECM (para 7–29).

- **YES**
  - Repair ECM terminals or connectors (para 7–77). Then go to step 8.

---

### 8.

**Does CHECK ENGINE indicator light stay on for longer than five seconds?**

- **NO**
  - Repair complete.

- **YES**
  - Fault not corrected. Notify supervisor.

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damage to terminals could affect signal to ECM.

---

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Return line OK
- Terminals at TBS connectors OK
- No short to +5 volt line
- Terminals at ECM engine harness connector OK

**POSSIBLE PROBLEMS**
- Engine harness OK
- Sensor OK
- Return line OK
- Terminals at TBS connectors OK
- No short to +5 volt line
- Terminals at ECM engine harness connector OK

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 34 TURBO BOOST SENSOR (TBS) SIGNAL VOLTAGE LOW

1.
Do DDR codes displayed not include codes 14, 15, 23, 24, or 34–36?

NO

YES

CAUTION
Read CAUTION on following page.

1.
Do DDR codes displayed not include codes 14, 15, 23, 24, or 34–36?

NO

YES

For codes 14, 15, 23, 24, 34–36, go to engine harness check, A4B.

2.
Is Code 33 (and any code except 34) present on DDR with jumper wire installed between sockets B and C of TBS harness connector?

NO

YES

For Code 34 (and any other codes) go to step 4.

3.
Are TBS terminals at TBS connectors (sensor side and harness side) OK?

NO

YES

Repair TBS terminals (para 7–77). Then go to step 11.

Replace TBS (para 7–36). Then go to step 11.
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

(1) Turn ENGINE switch OFF and disconnect TBS connector.
(2) Install a jumper wire between sockets B and C of TBS harness connector.
(2.1) Click on "Alarms Clear" to clear alarms screen.
(3) Turn ENGINE switch ON and read active codes.
(4) Start engine and run until either the CHECK ENGINE indicator comes ON or the engine has been running warm for at least one minute at greater than 1,000 rpm.
(5) Read active codes.

Inspect terminals at TBS connectors (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.
A4 - Code 34 TURBO BOOST SENSOR (TBS) SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK

**POSSIBLE PROBLEMS**
- Open in signal line or signal return line
- Short in signal line
- Damaged terminals at ECM
- Open in signal line
- Shorted +5 volt line
- Short to return line
- Short to battery +

4.

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Voltage Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Incorrect voltage possible.

**Test Options**
- Continuity Test
- or
- STE/ICE-R Test #91

**Reason For Question**
Open in line is suspect. Resistance less than or equal to 10,000 ohms at TBS harness connector indicates open in signal line (Ckt #432) or return line (Ckt #452).

5.

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK

**POSSIBLE PROBLEMS**
- Open in signal line or signal return line
- Short in signal line
- Damaged terminals at ECM
- Open in signal line
- Shorted +5 volt line
- Short to return line
- Short to battery +

**Is there less than or equal to 5 ohms in signal line (Ckt #432) and/or signal return (Ckt #452)?**

**TEST OPTIONS**
- Voltage Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Notify supervisor if open is indicated.

6.

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK

**POSSIBLE PROBLEMS**
- Short in signal line
- Damaged terminals at ECM
- Open in signal line
- Shorted +5 volt line
- Short to return line
- Short to battery +

**Is there greater than 10,000 ohms in signal line (Ckt #432)?**

**TEST OPTIONS**
- Voltage Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Notify supervisor if short is indicated.

Less than or equal to 10,000 ohms at TPS harness connector indicates signal line (Ckt #432) is shorted to return line (Ckt #452).
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove jumper and turn ENGINE switch ON.</td>
</tr>
<tr>
<td>(2) Read voltage on TBS harness connector, pin C (red lead) to pin A (black lead).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTINUITY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch OFF.</td>
</tr>
<tr>
<td>(2) Read resistance between sockets A and B on TBS harness connector.</td>
</tr>
<tr>
<td>(3) Read resistance between Socket B and a good ground.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch ON.</td>
</tr>
<tr>
<td>(2) Read voltage on TPS harness connector, socket C (red lead to socket A (black lead).</td>
</tr>
</tbody>
</table>
A4 - Code 34 TURBO BOOST SENSOR (TBS) SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK
- No open in signal line or signal return line
- No short in signal line

**POSSIBLE PROBLEMS**
- Damaged terminals at ECM
- Open in signal line
- Shorted +5 volt line
- Short to return line
- Short to battery +

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Damage to connectors could affect signal to ECM.

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK
- No open in signal line or signal return line
- No short in signal line
- Terminals at ECM OK

**POSSIBLE PROBLEMS**
- Open in signal line
- Shorted +5 volt line
- Short to return line
- Short to battery +

**TEST OPTIONS**
- Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance greater than 5 ohms at engine harness connector indicates engine +5 volt line (Ckt #416) is shorted to returnline (Ckt #452).

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK
- No open in signal line or signal return line
- No short in signal line
- Terminals at ECM OK

**POSSIBLE PROBLEMS**
- Shorted +5 volt line
- Short to return line
- Short to battery +

**TEST OPTIONS**
- Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
- Short is suspect. Resistance less than or equal to 10,000 ohms at TBS harness connector indicates short.

**7.**
Are terminals at ECM vehicle harness connector OK?
- **YES**
  - Repair ECM terminals or connectors (para 7-77). Go to step 11.
- **NO**
  - Replace ECM if damaged (para 7-29). Then go to step 11.

**CAUTION**
Read CAUTION on following page.

**8.**
Is there less than or equal to 5 ohms in signal line (Ckt #417) and/or signal return (Ckt #952)?
- **YES**
  - Notify supervisor if open is indicated.
- **NO**
  - Notify supervisor if short is indicated.

**9.**
Is there greater than 10,000 ohms or open in +5 volt line (Ckt #416)?
- **YES**
  - Go to step 7.
- **NO**
  - Notify supervisor if open is indicated.
Check terminals at ECM vehicle harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins and sockets.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**

1. Turn ENGINE switch OFF and disconnect engine harness connector at ECM.
2. Install a jumper wire between pins A and C of the TBS harness connector.
3. Read resistance between socket W1 and Y2 on engine harness connector.

**CONTINUITY TEST**

1. Remove jumper wire.
2. Read resistance between pins A and C on TBS harness connector.
A4 - Code 34 TURBO BOOST SENSOR (TBS) SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK
- No open in signal line or signal return line
- No short in signal line
- Terminals at ECM OK
- No open in signal line
- No short in +5 volt line

**POSSIBLE PROBLEMS**
- Short to battery +

---

10. **Is there continuity in engine harness, vehicle harness, and 6-way power harness?**

- **YES**
  - Any reading less than or equal to 10,000 ohms, notify supervisor.
  - Go to step 7.

- **NO**
  - Repair complete

**REASON FOR QUESTION**
- Short is suspect. Resistance less than or equal to 10,000 ohms at TBS, vehicle harness, or 6-way power connector indicates short.

---

11. **Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **YES**
  - Repair complete

- **NO**
  - Fault not corrected. Notify supervisor.

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON, fault has been corrected.

---

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at TBS connectors OK
- No open in signal line or signal return line
- No short in signal line
- Terminals at ECM OK
- No open in signal line
- No short in +5 volt line
- No short in battery +
CONTINUITY TEST

1. Turn ENGINE switch OFF and pull out both DDEC circuit breakers.
2. Disconnect engine harness, vehicle harness, and 6-way power harness connectors at ECM. Read resistance between sockets A and C on TBS harness connector.
3. Read resistance between socket P1 of engine harness connector and socket B3 of vehicle harness connector.
4. Read resistance between socket P1 on engine harness connector and sockets A, B, E, and F on 6-way power connector.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 35 OIL PRESSURE SENSOR (OPS) SIGNAL VOLTAGE HIGH

**Known Info**
- Code 35 displayed on DDR

**Possible Problems**
- Sensor fault
- Open in return line
- Damaged terminals at OPS connectors
- Short to +5 volt line
- Short to battery +

**Reason for Question**
- To check engine harness for fault.

**Test Options**
- DDR

**1.**
- Does DDR code displayed not include codes 14, 15, 23, 24, 33, 34, or 36?
  - **Yes**: For codes 14, 15, 23, 24, 33, 34, or 36, go to engine harness check, A4B.
  - **No**: For Code 35 (and any code), go to step 5.

**2.**
- Is Code 36 (and any codes except 35) present on DDR with OPS connector disconnected?
  - **No**: For Code 35 (and any code), go to step 5.
  - **Yes**: Notify supervisor if open is indicated.

**3.**
- Is there less than or equal to 5 ohms in return line (Ckt #452)?
  - **No**: Notify supervisor if open is indicated.
  - **Yes**: Resistance greater than 5 ohms at engine harness connector indicates open in return line (Ckt #452).

**Test Options**
- Continuity Test or STE/ICE-R Test #91

**Reason for Question**
- Sensor fault suspect.
(1) Turn ENGINE switch OFF.  
(1.1) Remove right inner fender (para 16–34).  
(1.2) Disconnect OPS connector.  
(2) Start engine (TM 9–2320–360–10).  
(3) Select Engine Temperature (OIL TEMP) on DDR.  
(4) Warm up engine until engine temperature reading is greater than 140°F (60°C).  
(4.1) Click on “Alarms Clear” to clear alarms screen.  
(5) Read active codes at idle.

**CAUTION**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**

(1) Turn ENGINE switch OFF and disconnect engine harness connector at ECM.  
(2) Install a jumper wire between pins A and B of OPS harness connector.  
(3) Read resistance between sockets P1 and Y2 on engine harness connector.
A4 - Code 35  OIL PRESSURE SENSOR (OPS) SIGNAL
VOLTAGE HIGH (CONT)

**Known Info**
- Engine harness OK
- Sensor OK
- Return line OK

**Possible Problems**
- Damaged terminals at OPS connectors
- Short to +5 volt line
- Short to battery +

**Test Options**
- Visual inspection

**Reason For Question**
- Damage to connectors could affect signal to OPS.

**Test Options**
- Continuity Test
  or
  STE/ICE-R Test #91

**Reason For Question**
- Resistance less than or equal to 10,000 ohms at engine harness connector indicates signal line (Ckt #530) is shorted to engine +5 volt line (Ckt #416).

**Known Info**
- Engine harness OK
- Sensor OK
- Return line OK
- Terminals at OPS connectors OK

**Possible Problems**
- Short to +5 volt line
- Short to battery +

**Test Options**
- Continuity Test
  or
  STE/ICE-R Test #91

**Reason For Question**
- Resistance less than or equal to 10,000 ohms at vehicle harness, engine harness, or 6-way power connectors indicates short between sockets where measured.

**Known Info**
- Engine harness OK
- Sensor OK
- Return line OK
- Terminals at OPS connectors OK
- +5 volt line OK

**Possible Problems**
- Short to battery +

**Test Options**
- Continuity Test
  or
  STE/ICE-R Test #91

**Reason For Question**
- Resistance less than or equal to 10,000 ohms at vehicle harness, engine harness, or 6-way power connectors indicates short between sockets where measured.

---

### 4.

Are terminals at OPS connectors (sensor side and harness side) OK?

- **Yes**
  - Replace OPS (para 7–35). Then go to step 9.

- **No**
  - Repair OPS terminals and connectors (para 7–35). Then go to step 9.

### 5.

Is there greater than 10,000 ohms or open in signal line (Ckt #530)?

- **Yes**
  - Notify supervisor if short is indicated.

- **No**
  - Go to step 8.

### 6.

Is there continuity in engine harness, vehicle harness, and 6-way power harness?

- **Yes**
  - Go to step 8.

- **No**
  - Any reading less than or equal to 10,000 ohms, notify supervisor if short is indicated.
Inspect terminals at OPS connectors (sensor side and harness side) for damage; bent, corroded, and unseated pins or sockets.

**CONTINUITY TEST**

(1) Turn ENGINE switch OFF.
(2) Disconnect engine harness connector at ECM.
(3) Read resistance between sockets W1 and P2 on engine harness connector.

(1) Disconnect batteries (para 7-61).
(2) Disconnect vehicle harness and 6-way power harness connectors at ECM.
(3) Read resistance between sockets P2 of the engine harness and socket B3 on vehicle harness connector.
(4) Also read resistance between socket P2 on engine harness connector and sockets A, B, E, and F on 6-way power connector.
(5) Connect batteries (para 7-61).
A4-Code 35  OIL PRESSURE SENSOR (OPS) SIGNAL VOLTAGE HIGH (CONT)

7. Does Code 35 come up with all connectors reconnected?

- Yes: Visual inspection
- No: Replace ECM (para 7–29).

If Code 25 comes up, repair is complete. If other codes come up, restart DDEC troubleshooting (page 2–88).

8. Are OPS and terminals at OPS connectors (sensor side and harness side) OK?

- Yes: Repair OPS terminals and connectors (para 7–77). Then go to step 6.
- No: Replace OPS (para 7–35). Then go to step 6.

POSSIBLE PROBLEMS
- Terminals at OPS connectors

9. Does CHECK ENGINE indicator light stay on longer than five seconds?

- Yes: Repair complete
- No: Fault not corrected. Notify supervisor.

POSSIBLE PROBLEMS
- Terminals at OPS connectors

TEST OPTIONS
- Visual Inspection

REASON FOR QUESTION
- ECM is suspect
- Damage to connectors could affect signal to OPS.
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
(1) Reconnect all connectors.
(2) Turn ENGINE switch ON and clear codes.
(3) Start engine.
(4) Run engine for one minute or until CHECK ENGINE indicator comes ON
(5) Stop engine and read active codes.

Inspect OPS and terminals at OPS connectors (sensor side and harness side) form damage; bent, corroded, and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 36 OIL PRESSURE SENSOR (OPS) SIGNAL VOLTAGE LOW

**KNOWN INFO**
- CODE 36 displayed on DDR

**POSSIBLE PROBLEMS**
- Bad sensor
- Damaged terminals at OPS connectors
- Voltage to OPS connector off
- Open in signal line
- Short to return line or ground
- Damaged terminals at ECM connector
- Open +5 volt line
- Short to return line
- Short to battery +
- Short on ground

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Damage to engine harness is suspect.

---

1. Do Codes displayed on DDR not include Codes 14–15, 23–24, 33–35?

   **CAUTION**
   - Read CAUTION on following page.

   **YES**
   - For codes 14–15, 23–24, 33–35, go to engine harness check, A4B.

   **NO**
   - For Code 35 or Code 36 (and any other Codes) go to step 4.

---

2. Is Code 35 (and any other Codes except Code 36) present on DDR with jumper installed between sockets B and C on OPS harness connector?

   **YES**
   - Replace OPS (para 7–35). Then go to step 13.

   **NO**
   - Repair OPS terminals and connectors (para 7–77). Then go to step 13.

---

3. Are OPS terminals OK?

   **YES**
   - Replace OPS (para 7–35). Then go to step 13.

   **NO**
   - Repair OPS terminals and connectors (para 7–77). Then go to step 13.
(1) Turn ENGINE switch OFF.

(1.1) Remove right inner fender (para 16--34).

(2) Disconnect OPS connector and install a jumper wire between sockets B and C of the OPS harness connector.

(2.1) Click on “Alarms Clear” to clear alarms screen.

(3) Turn ENGINE switch ON and read active codes. If active codes 35 or 36 do not exist, start and run engine until either active Code 35 or 36 appears or until engine temperature (Mode 18 OIL TEMP on DDR) is greater than 140°F (60°C) for more than 1 minute.

(1) Turn ENGINE switch OFF.

(2) Inspect terminals at the OPS connectors (sensor side and harness side) for damage; bent, corroded and unseated pins or sockets.
4. **Is voltage in OPS harness connector in acceptable range (4 to 6 volts)?**
   - **NO**
     - If less than 4 volts, go to step 8; if greater than 6 volts, go to step 10.
   - **YES**

5. **Is there less than or equal to 5 ohms in signal line (Ckt #530)?**
   - **NO**
     - Notify supervisor if open is indicated.
   - **YES**
     - Go to step 11.

6. **Is there greater than 10,000 ohms or open in signal line (Ckt #530) and return line (Ckt #452) or battery ground?**
   - **NO**
     - Notify supervisor if short is indicated.
   - **YES**
     - Go to step 12.
**VOLTAGE TEST**

1. Turn ENGINE switch OFF.
2. Remove jumper wire.
3. Connect vehicle harness to OPS connector.
4. Turn ENGINE switch ON and read voltage on OPS harness connector, socket C (red lead) to socket A (black lead).

**CONTINUITY TEST**

1. Turn ENGINE switch OFF.
2. Disconnect engine harness connector at the ECM.
3. Install a jumper wire between sockets A and B of the OPS harness connector.
4. Read resistance between sockets P2 and Y2 on the engine harness connectors.

**CAUTION**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**

1. Remove jumper wire.
2. Disconnect the engine harness connector at the ECM.
3. Read resistance between sockets A and B on the OPS harness connector. Also read resistance between socket B and a good ground.
A4-Code 36 OIL PRESSURE SENSOR (OPS) SIGNAL VOLTAGE LOW (CONT)

7. Are terminals at ECM engine harness connector OK?
   - **NO**
     - Repair ECM harness connector (para 7-77). Then go to step 13.
   - **YES**
     - Replace ECM (para 7-29). Then go to step 13.

8. Is there less than or equal to 5 ohms in +5 volt line (Ckt #416)?
   - **NO**
     - Notify supervisor if open is indicated.
   - **YES**
     - Go to step 12.

9. Is there greater than 10,000 ohms or open in +5 volt line (Ckt #416) and return line (Ckt #452)?
   - **NO**
     - Notify supervisor if open is indicated.
   - **YES**
     - Go to step 12.

KNOWLED INFO
- Engine harness OK
- Sensor OK
- Terminals at OPS connectors OK
- Voltage to OPS connector OK
- No open in signal line
- No short to return line or ground

POSSIBLE PROBLEMS
- Damaged terminals at ECM connector
- Open +5 volt line
- Short to return line
- Short to battery +
- Short on ground

**CAUTION**
Read CAUTION on following page.

TEST OPTIONS
- Visual inspection

REASON FOR QUESTION
- Damage to terminals could affect signal to ECM.

TEST OPTIONS
- Continuity Test
  or
STE/ICE-R Test #91

REASON FOR QUESTION
- Resistance greater than 5 ohms at engine harness connector indicates +5 volt line (Ckt #416) is open.

TEST OPTIONS
- Continuity Test
  or
STE/ICE-R Test #91

REASON FOR QUESTION
- Resistance less than or equal to 10,000 ohms at OPS harness connector indicates +5 volt line (Ckt #416) is shorted to return line (Ckt #452).
Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded and unseated pins or sockets, especially W1, P2 and Y2 terminals and pins at ECM

**CAUTION**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**

1. Turn ENGINE switch OFF.
2. Disconnect engine harness connector at ECM
3. Install a jumper wire between sockets A and C of the OPS harness connector.
4. Read resistance between sockets W1 and Y2 on engine harness connector.

---

**CONTINUITY TEST**

1. Remove jumper wire.
2. Read resistance between sockets A and C of the OPS harness connector.
A4 - Code 36 OIL PRESSURE SENSOR (OPS) SIGNAL VOLTAGE LOW (CONT)

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at OPS connectors OK
- Voltage to OPS connector OK
- No open in signal line
- No short to return line or ground
- ECM connector OK
- No open in +5 volt line
- No short to return line

**POSSIBLE PROBLEMS**
- Short to battery +
- Short on ground

**TEST OPTIONS**
Continuity Test
or
STE/ICE Test #91

**REASON FOR QUESTION**
Resistance less than or equal to 10,000 ohms between engine harness, vehicle harness and 6-way power harness connectors indicates short where measured.

**10.**
Is there continuity in engine harness connector, vehicle harness connector and 6-way power harness connector?

**TEST OPTIONS**
Continuity Test
or
STE/ICE Test #91

**REASON FOR QUESTION**
For any reading less than or equal to 10,000 ohms, notify supervisor if short is indicated.

**11.**
Is there greater than 10,000 ohms in signal line (Ckt #530)?

**TEST OPTIONS**
Continuity Test
or
STE/ICE-R Test #91

**REASON FOR QUESTION**
Resistance less than or equal to 10,00 ohms at engine harness indicates signal line (Ckt #530) and return line (Ckt #452) are shorted together.

**12.**
Replace OPS (para 7-35). Does CHECK ENGINE indicator light fail to come on?

**TEST OPTIONS**
Visual Inspection

**REASON FOR QUESTION**
OPS is suspect.
**CONTINUITY TEST**

1. Pull out both circuit breakers to ECM.
2. Disconnect vehicle harness and 6-way power harness connectors at ECM.
3. Read resistance between socket P2 of engine harness connector and socket B3 of vehicle harness connector. Also read resistance between socket P2 on the engine harness connector and sockets A, B, E, and F on the 6-way power harness connector.

**CONTINUITY TEST**

1. Turn ENGINE switch OFF.
2. Remove jumper wires and measure resistance between sockets P2 and Y2 on engine harness.

1. Turn ENGINE switch OFF.
2. Replace OPS (para 7-35).
3. Reconnect all connectors.
4. Turn ENGINE switch ON
5. Start engine. Run until CHECK ENGINE light comes on or for 1 minute.
**A4−Code 36 OIL PRESSURE SENSOR (OPS) SIGNAL VOLTAGE LOW (CONT)**

**KNOWN INFO**
- Engine harness OK
- Sensor OK
- Terminals at OPS connectors OK
- Voltage to OPS connector OK
- No open in signal line
- No short to return line or ground
- ECM connector OK
- No open in +5 volt line
- No short to return line
- No short on ground

**POSSIBLE PROBLEMS**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

13. Does CHECK ENGINE indicator light stay on longer than five seconds?

- **NO**
  - Repair complete.
- **YES**
  - Fault not corrected. Notify supervisor.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 41  TIMING REFERENCE SENSOR (TRS)

**KNOWN INFO**

- CODE 41 displayed on DDR

**POSSIBLE PROBLEMS**

- Short in TRS connector
- Open in TRS line
- TRS resistance high
- TRS/SRS gap incorrect
- Damaged terminals at ECM
- Resistance at engine harness connector high
- Short to return line
- Open in SRS line
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

**TEST OPTIONS**

- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**

Resistance greater than 200 ohms at engine harness connector indicates open.

---

1. **Is the resistance between socket T1 and T2 on engine harness connector less than 200 ohms?**

   **NO**
   - Go to step 3.

   **YES**
   - Go to step 4.

---

2. **Is there greater than 10,000 ohms or open in Ckt #110?**

   **NO**
   - Notify supervisor if short is indicated.
   - Go to step 4.

   **YES**
   - Notify supervisor if open is indicated.

---

3. **Is there less than or equal to 5 ohms in signal line (Ckt #110) and return line (Ckt #109)?**

   **NO**
   - Notify supervisor if open is indicated.

   **YES**
   - Notify supervisor if short is indicated.

---

**CAUTION**

Read CAUTION on following page.

---

**REASON FOR QUESTION**

Resistance greater than 5 ohms, or open at TRS or engine harness connectors indicates signal line (Ckt #110) or return line (Ckt #109) is open.

---

**KNOWN INFO**

- No short in TRS connector

**POSSIBLE PROBLEMS**

- Open in TRS line
- TRS resistance high
- TRS/SRS gap incorrect
- Damaged terminals at ECM
- Resistance at engine harness connector high
- Short to return line
- Open in SRS line
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

**TEST OPTIONS**

- Continuity Test
- STE/ICE-R Test #91

---

**REASON FOR QUESTION**

Resistance less than or equal to 10,000 ohms at engine harness connector indicates short between Ckt #110 and Ckt #109.
NOTE

- The following chart should be used only if DDEC troubleshooting was started on pg. 2-80 and you were referred here.
- A false DDEC historical Code 41 may be logged during cold starts in extremely cold environments, -50 to -26°F (-46 to -32°C). Typically, the CHECK ENGINE light will come on 8 minutes after starting and go out 2-3 minutes later. If the vehicle has been operated under these conditions, clear the historical codes and return the vehicle to service.

CONTINUITY TEST

(1) Turn ENGINE switch OFF.
(2) Disconnect engine harness connector at ECM.
(3) Read resistance between sockets T1 and T2 of engine harness connector.

CONTINUITY TEST

(1) Remove ECM (para 7-29).
(2) Disconnect TRS connector.
(3) Read resistance between sockets T1 and T2 on engine harness connector.
(4) Read resistance between sockets T1 and ground, then between socket T2 and ground.

CAUTION

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST

(1) Disconnect TRS connector and install a jumper wire between sockets A and B of TRS harness connector.
(2) Read resistance between sockets T1 and T2 on engine harness connector.
4. **Known Info**

<table>
<thead>
<tr>
<th>Possible Problems</th>
<th>Test Options</th>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>No short in TRS connector</td>
<td>Continuity Test or STE/ICE-R Test #91</td>
<td>Resistance may be incorrect.</td>
</tr>
<tr>
<td>No open in TRS line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRS resistance high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRS/SRS gap incorrect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damaged terminals at ECM engine harness connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance at engine harness connector high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short to return line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open in SRS line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damaged TRS connectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damaged SRS connectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cranking voltage insufficient</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Known Info**

<table>
<thead>
<tr>
<th>Possible Problems</th>
<th>Test Options</th>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>No short in TRS connector</td>
<td>TRS/SRS Adjustment Check</td>
<td>Gap affects engine timing. Pulse wheel may be loose or bad, TRS/SRS sensors may be loose.</td>
</tr>
<tr>
<td>No open in TRS line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRS resistance OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Possible Problems**

<table>
<thead>
<tr>
<th>Known Info</th>
<th>Test Options</th>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>No short in TRS connector</td>
<td>DDR</td>
<td>When Code 42 is showing, the fault is caused by improper voltage.</td>
</tr>
<tr>
<td>No open in TRS line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRS resistance OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRS gap OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Possible Problems**

<table>
<thead>
<tr>
<th>Known Info</th>
<th>Test Options</th>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damaged terminals at ECM engine harness connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance at engine harness connector high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short to return line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open in SRS line</td>
<td></td>
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</tr>
<tr>
<td>Damaged TRS connectors</td>
<td></td>
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<tr>
<td>Damaged SRS connectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cranking voltage insufficient</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Is resistance of TRS across sensor pins A and B in acceptable range (100 - 200 ohms)?

If less than 100 ohms or greater than 200 ohms, go to step 12.

5. Is TRS/SRS gap setting correct?

**Caution:** Read CAUTION on following page.

- **Yes:** TRS/SRS needs adjustment, notify supervisor.
- **No:** Go to step 8.

6. Does Code 42 come up?

- **No:** Go to step 15.
- **Yes:** Go to step 8.
CONTINUITY TEST
Read resistance of the TRS across sensor pins A and B.

TRS/SRS ADJUSTMENT CHECK

CAUTION
- Do not touch two screws that go into block from front end plate.
- Only turn the camshaft pulley clockwise. Failure to comply may cause engine damage.

NOTE
The TRS tooth is the double tooth of pulse wheel.
(1) Using the front camshaft pulley, bar the engine over until the TRS tooth of the pulse wheel is in line with the TRS.
(2) Tap front of camshaft rearward with a soft hammer to remove camshaft end play.
(3) Install alignment tool (J-34729) and check that nominal gap of 0.02" (0.5mm) exists.
7. Are terminals at ECM engine harness connector OK?

- **Yes**: Repair terminals and connectors (para 7-77). Then go to step 16.
- **No**: Replace ECM (para 7-29). Then go to step 16.

8. Is resistance between sockets S1 and S2 on engine harness connector in acceptable range?

- **Yes**: Greater than 200 ohms or open, go to step 10.
- **No**: Notify supervisor if short is indicated.

9. Is there greater than 10,000 ohms or open in signal line (Ckt #111)?

- **Yes**: Resistance less than or equal to 10,000 ohms at engine harness connector indicates signal line (Ckt #111) is shorted to return line (Ckt #112).
- **No**: Go to step 11.

**Known Info**
- No short in TRS connector
- No open in TRS line
- TRS resistance OK
- TRS gap OK

**Possible Problems**
- Damaged terminals at ECM engine harness connector
- Resistance at engine harness connector high
- Short to return line
- Open in SRS line
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

**Test Options**
- Visual inspection

**Reason for Question**
- Damage to terminals could affect signal to ECM.

**Known Info**
- Resistance at engine harness connector high
- Short to return line
- Open in SRS line
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

**Possible Problems**
- Resistance less than or equal to 200 ohms at engine harness connector is acceptable.

**Test Options**
- Continuity Test or STE/ICE-R Test #91

**Reason for Question**
- Resistance less than or equal to 10,000 ohms at engine harness connector indicates signal line (Ckt #111) is shorted to return line (Ckt #112).
(1) Disconnect SRS connector.
(2) Read resistance between sockets S1 and S2 on engine harness connector.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**CONTINUITY TEST**
(1) Disconnect SRS connector.
(2) Read resistance between sockets S1 and S2 on engine harness connector.

Check terminals at ECM engine harness connector (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
A4 – Code 41 TIMING REFERENCE SENSOR (TRS) (CONT)

10. Is there less than or equal to 5 ohms in signal line (Ckt #111) and return line (Ckt #112)?

**KNOWN INFO**
- No short in TRS connector
- No open in TRS line
- TRS resistance OK
- TRS gap OK
- Terminals at ECM engine harness connector OK
- Resistance at engine harness connector OK
- No short to return line

**POSSIBLE PROBLEMS**
- Open in SRS line
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

Notify supervisor if open is indicated.

**TEST OPTIONS**
- Continuity Test
  - or
  - STE/ICE-R Test #91

**REASON FOR QUESTION**
Resistance greater than 5 ohms or open at engine harness connector indicates signal line (Ckt #111) or return line (Ckt #112) is open.

11. Is resistance at SRS connector in acceptable range (100 to 200 ohms)?

**KNOWN INFO**
- No short in TRS connector
- No open in TRS line
- TRS resistance OK
- TRS gap OK
- Terminals at ECM engine harness connector OK
- Resistance at engine harness connector OK
- No short to return line
- No open in SRS line

**POSSIBLE PROBLEMS**
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

**TEST OPTIONS**
- Continuity Test
  - or
  - STE/ICE-R Test #91

**REASON FOR QUESTION**
If resistance is not in acceptable range the SRS and/or batteries may be faulty.

12. Are TRS connectors OK?

**KNOWN INFO**
- No short in TRS connector
- No open in TRS line
- TRS resistance OK
- TRS gap OK
- Terminals at ECM engine harness connector OK
- Resistance at engine harness connector OK
- No short to return line
- No open in SRS line

**POSSIBLE PROBLEMS**
- Damaged TRS connectors
- Damaged SRS connectors
- Cranking voltage insufficient

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Damage to connectors could affect signal to ECM.

Repair terminals/ connectors (para 7–77), then go to step 16. Notify supervisor if TRS is damaged or suspect.

TRS sensor requires replacement notify supervisor.
CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST
(1) Install a jumper wire between sockets A and B of SRS harness connectors.
(2) Read resistance between sockets S1 and S2 of engine harness connector.

CONTINUITY TEST
Read resistance of SRS across sensor pins A and B.

Check connectors at TRS (both harness side and TRS side) for damage; bent, corroded, and unseated pins or sockets, or bad contacts.
A4 - Code 41  TIMING REFERENCE SENSOR (TRS) (CONT)

13. Are SRS connectors OK?

   NO
   Repair SRS connectors (para 7-77), then go to step 16.

   YES
   SRS sensor requires replacement, notify supervisor.

14. Does Code 41 reappear after replacement of sensor?

   NO
   SRS was not replaced, go to step 6.

   YES
   If Code 25 comes up, repairs are complete. If codes other than 41 appear, restart DDEC Troubleshooting (page 2-80).

15. With jumper wires connected to 6-pin power connector, does engine start and no Code 41 come up?

   NO
   Engine won't start and/or Code 41 (and other Codes), go to step 7.

   YES
   Replace batteries (para 7-57).
Check connectors at SRS (both harness side and SRS side) for damage; bent, corroded, and unseated pins or sockets, or bad contacts.

(1) Turn ENGINE switch OFF.
(2) Reconnect all connectors.
(3) Turn ENGINE switch ON and clear codes.
(4) Start and run engine until, CHECK ENGINE indicator comes ON for 1 minute
(5) Stop engine and read historical codes.

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

**NOTE**
Refer to Appendix D, Illustrated List of Manufactured Items for fabrication of jumper harness.

(1) Turn ENGINE switch OFF.
(2) Connect 12 volts from a fully charged battery to 6-pin power connector
(3) Connect other connector.
(4) Turn ENGINE switch ON and clear codes.
(5) Start engine and run until CEL appears or for one minute.
(6) Stop engine and read active codes.
A4 - Code 41  TIMING REFERENCE SENSOR (TRS) (CONT)

### KNOWN INFO
- No short in TRS connector
- No open in TRS line
- TRS resistance OK
- TRS gap OK
- Terminals at ECM engine harness connector OK
- Resistance at engine harness connector OK
- No short to return line
- No open in SRS line
- TRS connectors OK
- SRS connectors OK
- Terminals at ECM engine harness connector OK
- Cranking voltage OK

### POSSIBLE PROBLEMS
- Fault not corrected.
  Notify supervisor.

### TEST OPTIONS
- Visual inspection

### REASON FOR QUESTION
- Repair complete.

#### 16.
**Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **NO**
  - Repair complete.
- **YES**
  - Fault not corrected.
  Notify supervisor.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Install ECM (para 7-29).
(4) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
1. Is there resistance between socket S1 and S2 on engine harness connector less than or equal to 200 ohms?

- NO: Go to step 3.
- YES: Resistance greater than 200 ohms at engine harness connector indicates open.

2. Is there greater than 10,000 ohms or open in SRS connector?

- NO: Notify supervisor if short is indicated.
- YES: Notify supervisor if open is indicated.

3. Is there less than or equal to 5 ohms in signal line (Ckt #111) and return line (Ckt #112)?

- NO: Notify supervisor if open is indicated.
- YES: Resistance greater than 5 ohms or open at engine harness connector indicates signal line (Ckt #111) or return line (Ckt #112) is open.
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

CONTINUITY TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect engine harness connector at ECM.
(3) Read resistance between sockets S1 and S2 of engine harness connector.

CONTINUITY TEST
(1) Remove ECM (para 7-29)
(2) Disconnect SRS connector.
(3) Read resistance between sockets S1 and S2 on engine harness connector.
(4) Read resistance between sockets S1 and ground, then between S2 and ground.

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST
(1) Disconnect SRS connector and install a jumper wire between sockets A and B of SRS harness connector.
(2) Read resistance between sockets S1 and S2 on engine harness connector.
4. **Is resistance of SRS across sensor pins A and B acceptable (100–200 ohms)?**

   - **NO**
     - If resistance is less than 100 ohms or greater than 200 ohms, go to step 12.
   - **YES**

5. **Is TRS/SRS gap setting correct?**

   - **NO**
     - TRS/SRS needs adjustment, notify supervisor.
   - **YES**

6. **Was there also a Code 41?**

   - **NO**
     - Go to step 7.
   - **YES**
     - Go to step 8.

---

**KNOWN INFO**

- No short in SRS connector
- No open in SRS line
- SRS resistance OK

**POSSIBLE PROBLEMS**

- SRS resistance high
- TRS/SRS gap incorrect
- Damaged terminals at ECM engine harness connector
- Resistance at engine harness connector high
- Short to return line
- Open in TRS line
- Damaged SRS connectors
- Damaged TRS connectors
- Cranking voltage insufficient

---

**TEST OPTIONS**

- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**

- Resistance may be off.

---

**TEST OPTIONS**

- TRS/SRS Adjustment Check

**REASON FOR QUESTION**

- Gap affects engine timing. Pulse wheel may be loose or bad, TRS/SRS sensors may be loose.

---

**TEST OPTIONS**

- DDR

**REASON FOR QUESTION**

- Fault is isolated to improper cranking voltage if code 42 comes up.

---

**CAUTION**

- Read CAUTION on following page.
CONTINUITY TEST
Read resistance of the SRS across sensor pins A and B.

<table>
<thead>
<tr>
<th>TRS/SRS ADJUSTMENT CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
<tr>
<td>Only turn the camshaft pulley clockwise. Failure to comply may cause engine damage.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>The TRS tooth is the double tooth of pulse wheel.</td>
</tr>
</tbody>
</table>

1. Using the front camshaft pulley, bar the engine over until the TRS tooth of the pulse wheel is in line with the TRS.
2. Tap front of camshaft rearward with a soft hammer to remove camshaft and play.
3. Install alignment tool (J-34729) and check that nominal gap of 0.02" (0.5mm) exists.

**CAUTION**
Do not touch two screws that go into block front end plate.

4. Adjust gap by loosening adjusting screw at top of TRS/SRS mounting bracket.
**A4 - Code 42 SYNCHRONOUS REFERENCE SENSOR (SRS) (CONT)**

**KNOWN INFO**
- No short in SRS connector
- No open in SRS line
- SRS resistance OK
- TRS/SRS gap OK

**POSSIBLE PROBLEMS**
- Resistance at engine harness connector high
- Short to return line
- Open in TRS line
- Damaged SRS connectors
- Damaged TRS connectors
- Cranking voltage insufficient

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damage to terminals could affect signal to ECM.

---

**7.**
Are terminals at ECM engine harness connector OK?

- **YES**
  - Repair terminals and connectors (para 7-77). Then go to step 16.

- **NO**
  - Go to step 15.

---

**8.**
Is resistance between sockets T1 and T2 on engine harness connector in acceptable range?

- **NO**
  - Greater than 200 ohms, go to step 10.

- **YES**
  - Go to step 10.

---

**9.**
Is there greater than 10,000 ohms or open in signal line (Ckt #110)?

- **NO**
  - Notify supervisor if short is indicated.

- **YES**
  - Go to step 11.
Check terminals at ECM engine harness connector (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.

**CONTINUITY TEST**

(1) Read resistance between sockets T1 and T2 on engine harness connector.

**CONTINUITY TEST**

(1) Disconnect TRS connector. 
(2) Read resistance between sockets T1 and T2 on engine harness connector.
10. Is there less than or equal to 5 ohms in signal line (Ckt # 110) and return line (Ckt #109)?

- **Known Info**:
  - No short in SRS connector
  - No open in SRS line
  - SRS resistance OK
  - TRS/SRS gap OK
  - Terminals at ECM engine harness OK
  - Resistance OK
  - No short to return line

- **Possible Problems**:
  - Open in TRS line
  - Damaged SRS connectors
  - Damaged TRS connectors
  - Cranking voltage insufficient

- **Reason for Question**
  - Notify supervisor if open is indicated

- **Test Options**
  - Continuity Test or STE/ICE-R Test #91

11. Is resistance at TRS connector in acceptable range?

- **Known Info**:
  - No short in SRS connector
  - No open in SRS line
  - SRS resistance OK
  - TRS/SRS gap OK
  - Terminals at ECM engine harness OK
  - Resistance OK
  - No short to return line
  - No open in TRS line

- **Possible Problems**:
  - Damaged SRS connectors
  - Damaged TRS connectors
  - Cranking voltage insufficient

- **Reason for Question**
  - Go to step 13 if resistance is less than 100 ohms or greater than 200 ohms

- **Test Options**
  - Continuity Test or STE/ICE-R Test #91

12. Are connectors at SRS OK?

- **Reason for Question**
  - Go to step 7

- **Test Options**
  - Visual inspection

- **Reason for Question**
  - Damage to connectors could affect signal to SRS
(1) Install a jumper wire between sockets A and B of TRS harness connectors.

(2) Read resistance between sockets T1 and T2 of engine harness connector.

Check connectors at SRS (both harness side and SRS side) for damage; bent, corroded, and unseated pins or sockets, or bad contacts.

**CONTINUITY TEST**

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

Read resistance of TRS across sensor pins A and B.

CAUTION

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.
### Known Info

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are connectors at TRS OK?</td>
<td>Repair connectors (para 7-77). Then go to step 16.</td>
<td>TRS sensor requires replacement notify supervisor.</td>
</tr>
<tr>
<td>Does Code 42 reappear after replacement of sensor?</td>
<td>Code 25 repairs are complete. If codes other than 42, go to Start (page 2-80).</td>
<td></td>
</tr>
<tr>
<td>Does engine start with jumper wires connected to 6-way power connector?</td>
<td>Replace batteries (para 7-57).</td>
<td></td>
</tr>
</tbody>
</table>

### Possible Problems

- Damaged TRS connectors
- Cranking voltage insufficient

### Test Options

- Visual inspection
- DDR
- Visual inspection

### Reason for Question

- Damaged connectors could affect signal to TRS.
- To verify SRS/TRS.
- Check cranking voltage.
(1) Turn ENGINE switch OFF.
(2) Reconnect all connectors.
(3) Turn ENGINE switch ON.
(4) Start and run engine until, CHECK ENGINE LIGHT comes ON for 1 minute
(5) Stop engine and read historical codes.

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

(1) Turn ENGINE switch OFF.
(2) Connect all connectors.
(3) Wire 6-pin power connector to a fully charged battery (12 volt).
(4) Connect to ECM and try to start engine.

Check connectors at TRS (both harness side and SRS side) for damage; bent, corroded, and unseated pins or sockets, or bad contacts.

![Diagram of TRS Sensor Connector and 6-Way Power Harness Connector]
16. Does CHECK ENGINE indicator light stay on longer than five seconds?

**KNOWN INFO**
- No short in SRS connector
- No open in SRS line
- SRS resistance OK
- TRS/SRS gap OK
- Terminals at ECM engine harness OK
- Resistance OK
- No short to return line
- No open in TRS line
- SRS connectors OK
- TRS connectors OK

**POSSIBLE PROBLEMS**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Repair complete

- Fault not corrected. Notify supervisor.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Install ECM (para 7-29).
(4) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 43 LOW COOLANT LEVEL

1. Is Code 43 the only active Code?

   Yes
   Service other codes first.

   No

2. Is coolant level OK?

   No
   Check for coolant leaks and fill radiator (LO 9-2320-360-12)

   Yes

3. Does Code 25 (no Codes) come up after cleaning coolant probe?

   No
   If Code 43 (and any other codes) come up, go to step 5. If any codes except 43 come up, restart DDEC Troubleshooting (p. 2-80).

   Yes
   Repairs are complete.
(1) Turn ENGINE switch OFF.
(2) Disconnect wires to Coolant Level Sensor probe.
(3) Remove CLS probe (para 7-10).
(4) Wipe probe clean with a clean rag.
(5) Install CLS probe (para 7-10).
(6) Turn ENGINE switch ON.
(7) Start engine (TM 9-2320-360-10) and run for one minute, or until SEL comes on.
(8) Stop engine and read historical codes.

NOTE

- The following chart should be used only if DDEC troubleshooting was started on pg. 2-80 and you were referred here.
- A false DDEC historical Code 43 may be logged during cold starts in extremely cold environments, -50 to -26°F (-46 to -32°C). Typically, the CHECK ENGINE light will come on 8 minutes after starting and go out 2-3 minutes later. If the vehicle has been operated under these conditions, clear the historical codes and return the vehicle to service.

Check coolant level at sight glass. Sight glass will show green when coolant level is full.
4. Is there less than or equal to 5 ohms in the Coolant Level Sensor?

**POSSIBLE PROBLEMS**
- Ground wire connection bad
- Faulty CLS probe
- Open in CLS module connector
- Connection on CLS probe bad

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Resistance at CLS harness connector of greater than 5 ohms or open indicates bad connection or open.

5. Is the CHECK ENGINE indicator light always on when CLS probe is placed in a cup of water?

**POSSIBLE PROBLEMS**
- Faulty CLS probe
- Open in CLS module connector
- Connection on CLS probe bad

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
CLS probe is suspect.

6. Is there greater than or equal to 2,000 ohms in CLS module connector?

**POSSIBLE PROBLEMS**
- Open in CLS module connector
- Connection on CLS probe bad

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Open is present if a resistance of 2000 ohms or greater is measured.
CONTINUITY TEST

(1) Turn ENGINE switch OFF.
(2) Disconnect CLS connector.
(3) Read resistance between socket C or CLS harness connector and a good battery ground. Try shaking the wire while reading resistance.

(1) Turn ENGINE switch OFF and disconnect CLS module connector.
(2) Measure resistance between pins A and B on the vehicle harness side while probe is in coolant.

NOTE
Engine wiring harness must be connected to sensor.

(2) Place CLS probe in a cup of water, covering threads and probe.
(3) Turn ENGINE switch ON.
(4) Start engine (TM 9–2320–360–10) and run for one minute or until Engine Stop Light comes ON.
(5) If SEL is not ON, remove probe from water.
(6) After 30 seconds, stop engine.
7.

**Is the connection on CLS probe and terminals on connector OK?**

- **NO**: Repair connectors (para 7-77). Then go to step 9.
- **YES**: Bad connection is suspect.

8.

**Is there less than 5 ohms in CLS probe?**

- **NO**: Either reading greater than 5 ohms indicates open.
- **YES**: Notify supervisor if open is indicated.

9.

**Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **NO**: Repair complete.
- **YES**: Fault not corrected. Notify supervisor.

**Test Options**

- Visual inspection
- Continuity Test or STE/ICE-R Test #91
- Visual inspection

**Reason for Question**

- Bad connection is suspect.
- Either reading greater than 5 ohms indicates open.
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
CONTINUITY TEST

(1) Measure resistance between Pin A on CLS module connector and center screw on probe.

(2) Repeat step 1 for Pin B on CLS module connector and screw on side of probe.

(1) Turn ENGINE switch OFF.

(2) Reconnect all harness connectors.

(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 44 HIGH OIL TEMPERATURE

1. Is Code 44 the only active Code?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>CODE 44 displayed on DDR</th>
</tr>
</thead>
</table>

| POSSIBLE PROBLEMS | Oil Loss or pump output problem |

- Service other codes first.

- Go to Engine Troubleshooting - Engine Overheats (a6), to determine causes for high oil temperature.

| TEST OPTIONS | DDR |

| REASON FOR QUESTION | Other potential causes for high oil temperature may exist. Code 44 indicates there was an engine running condition at which the oil temperature was higher than it should have been. |

START
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
A4 - Code 45 LOW OIL PRESSURE

START

1.

Is Code 45 the only active Code?

NO
Service other codes first.

YES

Go to Engine Troubleshooting – Low Engine Oil Pressure (a4) to determine causes for low oil pressure.

KNOWN INFO
CODE 45 displayed on DDR

POSSIBLE PROBLEMS
Oil Loss or pump output problem

TEST OPTIONS
DDR

REASON FOR QUESTION
Other potential causes for low oil pressure may exist. Code 45 indicates there was an engine running condition at which the oil pressure was lower than it should have been.

Service other codes first.
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
NO KNOWNINFO POSSIBLEPROBLEMS REASONFORQUESTION

1. Is battery voltage greater than 10 volts?

NO Replace Battery

YES

TESTOPTIONS

电压测试

或

STE/ICE-R Test #89

READ WARNING on following page.

Battery fault suspect. Reading less than or equal to 10.0 volts is unacceptable.

KNOWNINFO POSSIBLEPROBLEMS REASONFORQUESTION

2. Is voltage at ECM less than or equal to 10.0 volts?

NO

YES

电压测试

或

STE/ICE-R Test #89

READ WARNING on following page.

Battery fault suspect. Reading less than or equal to 10.0 volts is unacceptable.

KNOWNINFO POSSIBLEPROBLEMS REASONFORQUESTION

3. Is voltage at ECM harness less than or equal to 11.5 volts?

NO

YES

电压测试

或

STE/ICE-R Test #89

Voltage may be out of range. Reading less than or equal to 11.5 volts is unacceptable.

WARNING

Read WARNING on following page.
(5) Start and run engine for one minute.

(6) Measure voltage on battery + terminal (red lead) to battery − terminal (black lead).

NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around Het Tractor.

NOTE

DDEC is powered only by right rear battery.

**VOLTAGE TEST**

(1) Keep engine running.

(2) Select ECM INPUT VOLT on DDR for display.

(3) Observe ECM voltage reading on DDR.

**VOLTAGE TEST**

(1) Turn ENGINE switch OFF.

(2) Disconnect 6-way power connector at ECM.

NOTE

Don’t use CKT #150 as ground reference.

(3) Read voltage from socket E, F, A, and B (red lead) of 6-way power harness connector and a good battery ground (black lead).
Is there greater than 11.5 volts present at DDEC circuit breakers?

**KNOWN INFO**
- Battery is OK
- Voltage at ECM OK
- Voltage at ECM harness OK

**POSSIBLE PROBLEMS**
- Bad battery + line
- Bad ground at ECM
- Terminals at ECM power harness connector damaged

**TEST OPTIONS**
- Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Reading less than or equal to 11.5 volts between the breaker indicates open or corroded battery terminal. Greater than 11.5 volts indicates corroded 6-way power connection or open.

**TEST OPTIONS**
- Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Reading less than or equal to 11.5 volts on either reading indicates open in ground wire (Ckt #150).

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damaged terminals could affect signal to ECM.

Replace ECM (para 7-29).
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around Het Tractor.

VOLTAGE TEST

(1) Read voltage at lower breaker terminal to a good ground (black lead).
(2) Repeat voltage reading at other breaker.

OPEN CIRCUIT TEST

(1) Disconnect 6-way power harness connector at ECM.
(2) Read voltage on socket E of harness connector (red lead) to socket D (black lead).
(3) Read voltage on socket A (red lead) to socket C (black lead).

Check terminals at ECM 6-way power harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.
## A4 - Code 46 LOW BATTERY VOLTAGE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery is OK</td>
</tr>
<tr>
<td>Voltage at ECM OK</td>
</tr>
<tr>
<td>Voltage at ECM harness OK</td>
</tr>
<tr>
<td>Battery + line OK</td>
</tr>
<tr>
<td>Bad ground at ECM OK</td>
</tr>
<tr>
<td>Terminals at ECM power harness connector OK</td>
</tr>
</tbody>
</table>

### 7. 
**Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **NO**
  - Repair complete.

- **YES**
  - Fault not corrected. Notify supervisor

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.</td>
</tr>
</tbody>
</table>
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code 51 CHECK ENGINE LIGHT COMES ON AND STAYS ON (ACTIVE CODE 25 AND HISTORICAL CODE 51 COME UP)

1. Is historical Code 51 present, indicating a memory problem in the ECM?

- **NO**: Fault no longer present or intermittent. Notify supervisor.
- **YES**: Replace ECM (para 7–29).

**KNOWN INFO**
- CODE 51 displayed on DDR

**POSSIBLE PROBLEMS**
- Faulty ECM

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Code 51 indicates a memory problem exists in ECM. ECM is using backup memory for operation.
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
A4 - Code 52 ECM - ANALOG TO DIGITAL FAILURE

**KNOWN INFO**
CODE 52 displayed on DDR

**POSSIBLE PROBLEMS**
ECM failure

**TEST OPTIONS**
DDR

**REASON FOR QUESTION**
Code 52 indicates an error has been detected in the ECM

---

1. Is Code 52 the only active Code?

   **YES**
   Replace ECM (para 7-29). Restart DDEC Troubleshooting.

   **NO**
   Service other codes first.
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
A4 - Code 53 ELECTRONICALLY ERASABLE PROGRAMMABLE READ-ONLY MEMORY (EEPROM) FAILURE AFFECTING CODE MEMORY

START

1. Does DDR read Code 53?

YES

Replace ECM (para 7-29).

NO

Fault no longer present or intermittent.

TEST OPTIONS

DDR

REASON FOR QUESTION

Code 53 indicates error in EEPROM could cause failure codes not to be logged or not at all.

KNOWN INFO

CODE 53 displayed on DDR

POSSIBLE PROBLEMS

ECM failure
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
A4 - Code 56 ECM - ANALOG TO DIGITAL FAILURE

1. Is Code 56 the only active Code?

   YES
   Replace ECM (para 7-29). Restart DDEC Troubleshooting (p. 2-80).

   NO
   Service other codes first.

KNOWN INFO
CODE 56 displayed on DDR

POSSIBLE PROBLEMS
ECM failure

TEST OPTIONS
DDR

REASON FOR QUESTION
ECM failure could cause Analog to Digital failure.
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.
**A4 - Code(s) 61-68 INJECTOR RESPONSE TIME TOO LONG**

**START**

1. **Are codes 61 - 68 the only codes displayed by DDR?**
   - **NO** → Service other codes first.
   - **YES** → Go to step 9 if all eight codes (61 thru 68) are displayed by DDR.

2. **Are injector response times for code(s) received 0.80?**
   - **NO** → Fault is intermittent. See note on following page for possible problems.
   - **YES** → Go to step 11 if all four codes 61, 63, 65, 67 or all four codes 62, 64, 66, 68 are displayed by DDR.

3. **Is only one of the codes (61 thru 68) displayed by DDR?**
   - **NO** → Open in injector wires, Short in return lines, Short in injector drive line, Faulty injectors, Damaged terminals, Fault with non-DDEC component, Tripped DDEC circuit breakers, Short in bank A or bank B power lines, Open in bank A or bank B power lines, Open in ground line (Ckt #150), Open in injector return lines (Ckt #619 or 620).
   - **YES** → To isolate problem to injector harness wiring or other electrical wiring.
Check which codes (61–68) are displayed by DDR.

**NOTE**
The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

NOTE
Table 2–7 shows which injector is associated with each of the failure codes.

**Table 2–7. Injector Identification**

<table>
<thead>
<tr>
<th>CODE</th>
<th>FIRING ORDER</th>
<th>CYLINDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>1</td>
<td>1 Left</td>
</tr>
<tr>
<td>62</td>
<td>2</td>
<td>3 Right</td>
</tr>
<tr>
<td>63</td>
<td>3</td>
<td>3 Left</td>
</tr>
<tr>
<td>64</td>
<td>4</td>
<td>4 Right</td>
</tr>
<tr>
<td>65</td>
<td>5</td>
<td>4 Left</td>
</tr>
<tr>
<td>66</td>
<td>6</td>
<td>2 Right</td>
</tr>
<tr>
<td>67</td>
<td>7</td>
<td>2 Left</td>
</tr>
<tr>
<td>68</td>
<td>8</td>
<td>1 Right</td>
</tr>
</tbody>
</table>

(1) Start and warm engine to operating temperature (at least 86°F) (30°C).

(2) Plug in DDR and select INJ RESP TIMES (Mode 10).

**NOTE**
Table 2–7 gives the firing sequence in relation to the code received.

(3) Read DDR display of injector response time (in firing order) through several cycles. Note response time(s) of cylinder by number in fault code.

**NOTE**
If response time(s) is not 0.80 the following may be causing intermittent failures:

a. sticky valve (notify supervisor)
b. air in fuel (refer to fuel system troubleshooting (b))
c. low battery charge (refer to electrical system troubleshooting (e))
d. broken spring or armature on the injector (notify supervisor)
e. problems in the charging system (loose alternator belt, bad grounds, etc.) (refer to electrical system troubleshooting (e))
f. signs of insulation wear on injector harness (remove rocker cover (para 3–2))
4. Is injector resistance (at connectors) greater than one ohm?

**KNOWN INFO**
- Fault is with injector or injector circuit
- Injector response times OK

**POSSIBLE PROBLEMS**
- Open in injector wires
- Short in return lines
- Short in injector drive line
- Faulty injectors
- Damaged terminals
- Fault with non-DDEC component
- Tripped DDEC circuit breakers
- Short in bank A or bank B power lines
- Open in bank A or bank B power lines
- Open in ground line (Ckt #150)
- Open in injector return lines (Ckt #619 or 620)

**TEST OPTIONS**
- Continuity Test or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- For less than or equal to 1 ohm, go to step 6.

**YES**
- Resistance less than or equal to 1 ohm indicates short to return.

**NO**
- Notify supervisor if open is indicated.

5. Is there less than or equal to 1 ohm in the injector harness connector sockets?

**KNOWN INFO**
- Fault is with injector or injector circuit
- Injector response times OK

**POSSIBLE PROBLEMS**
- Open in injector wires
- Short in return lines
- Short in injector drive line
- Faulty injectors
- Damaged terminals
- Fault with non-DDEC component
- Tripped DDEC circuit breakers
- Short in bank A or bank B power lines
- Open in bank A or bank B power lines
- Open in ground line (Ckt #150)
- Open in injector return lines (Ckt #619 or 620)

**TEST OPTIONS**
- Continuity Test or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 1 ohm, indicates faulty injector. Greater than 1 ohm, open exists in wires.

**YES**
- Notify supervisor if open is indicated.

**NO**
- Notify supervisor if short is indicated.

6. Is there greater than or equal to 10,000 ohms in return lines?

**KNOWN INFO**
- Fault is with injector or injector circuit
- Injector response times OK
- Injector wires OK

**POSSIBLE PROBLEMS**
- Short in return lines
- Short in injector drive line
- Faulty injectors
- Damaged terminals
- Fault with non-DDEC component
- Tripped DDEC circuit breakers
- Short in bank A or bank B power lines
- Open in bank A or bank B power lines
- Open in ground line (Ckt #150)
- Open in injector return lines (Ckt #619 or 620)

**TEST OPTIONS**
- Continuity Test or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Resistance less than or equal to 10,000 ohms indicates short in return lines.
CONTINUITY TEST

1. Turn ENGINE switch OFF and unplug DDR.
2. Disconnect both 5-way injector harness connectors at the ECM.
3. Referring to Table 2-8, read resistance between the 5-way injector harness connector sockets associated with the 61-68 code received. (Example: read resistance between sockets G and L for Code 61.)

CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

Table 2-8. Injector Harness Connector Identification

<table>
<thead>
<tr>
<th>CODE</th>
<th>INJECTOR HARNESS CONNECTOR SOCKET</th>
<th>INJECTOR HARNESS CONNECTOR SOCKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>L</td>
<td>G</td>
</tr>
<tr>
<td>62</td>
<td>A</td>
<td>E</td>
</tr>
<tr>
<td>63</td>
<td>K</td>
<td>G</td>
</tr>
<tr>
<td>64</td>
<td>B</td>
<td>E</td>
</tr>
<tr>
<td>65</td>
<td>H</td>
<td>G</td>
</tr>
<tr>
<td>66</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>67</td>
<td>J</td>
<td>G</td>
</tr>
<tr>
<td>68</td>
<td>C</td>
<td>E</td>
</tr>
</tbody>
</table>

CONTINUITY TEST

1. Remove rocker arm cover (para 3-2) corresponding to injector identified by Table 2-7.
2. Disconnect two wires of the injector identified. Short these two wires together.
3. Referring to Table 2-8, read the resistance between the 5-way injector harness connector sockets associated with the faulty injector.

CONTINUITY TEST

1. Remove rocker arm cover (para 3-2) corresponding to injector identified by Table 2-7.
2. Disconnect two wires of injector indicated.
3. Referring to Table 2-8, read the resistance between 5-way injector harness connector sockets associated with faulty injector.
A4 - Code(s) 61-68 INJECTOR RESPONSE TIME TOO LONG (CONT)

**7.** Is there greater than or equal to 10,000 ohms in injector drive line and ground?

- **KNOWN INFO**
  - Fault is with injector or injector circuit
  - Injector response times OK
  - Injector wires OK
  - Return lines OK

- **POSSIBLE PROBLEMS**
  - Short in injector drive line
  - Faulty injectors
  - Damaged terminals
  - Fault with non-DDEC component
  - Tripped DDEC circuit breakers
  - Short in bank A or bank B power lines
  - Open in bank A or bank B power lines
  - Open in ground line (Ckt #150)
  - Open in injector return lines (Ckt #619 or 620)

- **TEST OPTIONS**
  - Continuity Test or
  - STE/ICE Test #91

- **REASON FOR QUESTION**
  - Resistance less than 10,000 ohms between injector drive and ground indicates injector drive wire is shorted to ground. Resistance less than 10,000 ohms from injector to ground indicates short or faulty injector.

- **YES** Notify supervisor.

- **NO**

**8.** Does test light fail to illuminate while engine is being cranked?

- **KNOWN INFO**
  - Fault is with injector or injector circuit
  - Injector response times OK
  - Injector wires OK
  - Return lines OK
  - Injector drive line OK

- **POSSIBLE PROBLEMS**
  - Faulty injectors
  - Damaged terminals
  - Fault with non-DDEC component
  - Tripped DDEC circuit breakers
  - Short in bank A or bank B power lines
  - Open in bank A or bank B power lines
  - Open in ground line (Ckt #150)
  - Open in injector return lines (Ckt #619 or 620)

- **TEST OPTIONS**
  - Visual inspection

- **REASON FOR QUESTION**
  - Injector may be faulty if test light fails to illuminate while engine is being cranked.

- **YES** Light flashes or is steady on, notify supervisor injector may be faulty.

- **NO**

**9.** Are terminals at both 5-way, injector harness connectors (both harness and ECM sides) OK?

- **KNOWN INFO**
  - Fault is with injector or injector circuit
  - Injector response times OK
  - Injector wires OK
  - Return lines OK
  - Injector drive line OK
  - Injectors OK

- **POSSIBLE PROBLEMS**
  - Damaged terminals
  - Fault with non-DDEC component
  - Tripped DDEC circuit breakers
  - Short in bank A or bank B power lines
  - Open in bank A or bank B power lines
  - Open in ground line (Ckt #150)
  - Open in injector return lines (Ckt #619 or 620)

- **TEST OPTIONS**
  - Visual inspection

- **REASON FOR QUESTION**
  - Possible damage to terminals.

- **YES** Repair terminals as required (para 7-77). Then go to step 17.

- **NO**
CONTINUITY TEST

(1) Check for short to ground. Working with injector that has its two wires disconnected, measure the resistance between injector drive wire (injector drive wire is number in the range 611–618) and a good ground.

(2) Measure resistance between one of terminals of injector (injector with disconnected wires) and a good ground.

(1) With a 6-volt test light, monitor injector on return side (where no wire is attached) with respect to ground while cranking engine.

(2) Reconnect both 5-way injector harness connectors at ECM.

(3) Looking at injector with disconnected wires, reattach injector drive wire.

Check terminals at both 5-way, injector harness connectors (both harness and ECM sides) for damage; bent, corroded and unseated pins or sockets.
A4 - Code(s) 61–68 INJECTOR RESPONSE TIME TOO LONG (CONT)

10. Is vehicle free from all problems listed on facing page?

YES: Correct problem. Then go to step 17.

NO: Replace ECM (para 7–29). Then go to step 17.

11. Are DDEC circuit breakers tripped?

YES: Go to step 14.

NO: Go to step 17.

12. Do DDEC circuit breakers trip after engine is started?

YES: Go to step 17.

NO: Go to step 17.

Known Info:
Fault is with injector or injector circuit
Injector response times OK
Injector wires OK
Return lines OK
Injector drive line OK
Injectors OK
Terminals OK
Fault caused by DDEC component

Possible Problems:
Tripped DDEC circuit breakers
Short in bank A or bank B power lines
Open in bank A or bank B power lines
Open in ground line (Ckt #150)
Open in injector return lines (Ckt #619 or 620)

Test Options:
Visual inspection

Reason for Question:
Fault may be caused by non-DDEC engine or chassis component.

Is vehicle free from all problems listed on facing page?

Are DDEC circuit breakers tripped?

Do DDEC circuit breakers trip after engine is started?

Fault is with injector or injector circuit
Injector response times OK
Injector wires OK
Return lines OK
Injector drive line OK
Injectors OK
Terminals OK
Fault caused by DDEC component

Possible Problems:
Tripped DDEC circuit breakers
Short in bank A or bank B power lines
Open in bank A or bank B power lines
Open in ground line (Ckt #150)
Open in injector return lines (Ckt #619 or 620)

If any problems are found, go to step 17.

Correct problem. Then go to step 17.

Replace ECM (para 7–29). Then go to step 17.

Go to step 14.

Go to step 17.

Fault is with injector or injector circuit
Injector response times OK
Injector wires OK
Return lines OK
Injector drive line OK
Injectors OK
Terminals OK
Fault caused by DDEC component

Possible Problems:
Tripped DDEC circuit breakers
Short in bank A or bank B power lines
Open in bank A or bank B power lines
Open in ground line (Ckt #150)
Open in injector return lines (Ckt #619 or 620)

If any problems are found, go to step 17.

Correct problem. Then go to step 17.

Replace ECM (para 7–29). Then go to step 17.

Go to step 17.

Fault is with injector or injector circuit
Injector response times OK
Injector wires OK
Return lines OK
Injector drive line OK
Injectors OK
Terminals OK
Fault caused by DDEC component

Possible Problems:
Tripped DDEC circuit breakers
Short in bank A or bank B power lines
Open in bank A or bank B power lines
Open in ground line (Ckt #150)
Open in injector return lines (Ckt #619 or 620)

If any problems are found, go to step 17.

Correct problem. Then go to step 17.

Replace ECM (para 7–29). Then go to step 17.
Check for any of the following problems:

- Air in fuel or low fuel pressure
- Sticky valve
- Cold fuel
- Low battery charge
- Broken spring or armature on the injector
- Problems in the charging system (loose alternator belt, etc.) or bad grounds
- Signs of insulation wear on injector harness.

Reset breaker(s). Start engine (TM 9–2320–360–10) and check to see if circuit breakers trip again.
**A4 - Code(s) 61-68 INJECTOR RESPONSE TIME TOO LONG (CONT)**

**KNOWN INFO**
- Fault is with injector or injector circuit
- Injector response times OK
- Injector wires OK
- Return lines OK
- Injector drive line OK
- Injectors OK
- Terminals OK
- Fault caused by DDEC component
- DDEC circuit breakers OK

**POSSIBLE PROBLEMS**
- Short in bank A or bank B power lines
- Open in bank A or bank B power lines
- Open in ground line (Ckt #150)
- Open in injector return lines (Ckt #619 or 620)

---

13. Is more than 11.5 volts measured between bank A power (Ckt #240) or bank B power (Ckt #241) and ground?

- **NO**
  - Notify supervisor if short is indicated.
- **YES**
  - Voltage less than 11.5 at 6-way power harness connector indicates short exists between Bank A power (Ckt #240) or Bank B (Ckt #241) and ground.

**TEST OPTIONS**
- Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**

**14.** Is more than 11.5 volts measured in bank A power (Ckt #240) and bank B power (Ckt #241) lines?

- **NO**
  - Either reading less than 11.5 volts, notify supervisor if open is indicated.
- **YES**
  - Open is suspect. If voltage at 6-way power harness connector is less than 11.5, open in bank A power (Ckt #240) or bank B power (Ckt #241) lines is indicated.

**TEST OPTIONS**
- Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**

**15.** Is there less than or equal to 5 ohms in ground line(s) (Ckt #150)?

- **NO**
  - Notify supervisor if open is indicated.
- **YES**
  - Resistance greater than 5 ohms at 6-way power harness connector indicates open in ground line(s) (Ckt #150).

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### VOLTAGE TEST

1. Turn ENGINE switch OFF.
2. Disconnect 6-way power harness connector.
3. Read voltage on socket A (red lead) to a good ground (black lead).
4. Also read voltage on sockets B, E, and F (red lead) to a good ground.

<table>
<thead>
<tr>
<th>6-WAY POWER HARNESS CONNECTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM</td>
</tr>
</tbody>
</table>

### VOLTAGE TEST

1. Read voltage on socket E or F (red lead) to socket C or D (black lead) of 6-way power harness connector.
2. Also read voltage on socket A or B (red lead) to socket C or D (black lead) of 6-way power harness connector.

<table>
<thead>
<tr>
<th>6-WAY POWER HARNESS CONNECTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM</td>
</tr>
</tbody>
</table>

### CONTINUITY TEST

1. Read resistance between socket C of 6-way power harness connector and a good ground.
2. Also read resistance between socket D of 6-way power harness connector and a good ground.
A4 - Code(s) 61–68 INJECTOR RESPONSE TIME TOO LONG (CONT)

16. Is there less than or equal to 5 ohms in injector driver return lines (Ckt #619 or #620)?

17. Does CHECK ENGINE indicator light stay on longer than five seconds?

Known Info

Fault is with injector or injector circuit
Injector response times OK
Injector wires OK
Return lines OK
Injector drive line OK
Injectors OK
Terminals OK
Fault caused by DDEC component
DDEC circuit breakers OK
Bank A and bank B power lines OK
Bank A and bank B power lines OK (no short)
Ground line (Ckt #150) OK

Possible Problems

Open in injector return lines (Ckt #619 or 620)

Test Options

Continuity Test or STE/ICE-R Test #91

Reason for Question

Open is suspect. If resistance is greater than 5 ohms at 5-way injector harness connector, there is an open in injector driver return line (Ckt #619 or CKT #620).

Known Info

Fault is with injector or injector circuit
Injector response times OK
Injector wires OK
Return lines OK
Injector drive line OK
Injectors OK
Terminals OK
Fault caused by DDEC component
DDEC circuit breakers OK
Bank A and bank B power lines OK
Bank A and bank B power lines OK (no short)
Ground line (Ckt #150) OK

Possible Problems

Fault not corrected. Notify supervisor.

Test Options

Visual inspection

Reason for Question

Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
CONTINUITY TEST

(1) Disconnect both 5-way injector harness connectors at ECM.
(2) Read resistance between sockets G and L on 5-way injector harness connector.
(3) Also read resistance between sockets A and E of other 5-way injector harness connector.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4 - Code(s) 71 - 78 INJECTOR RESPONSE TIME TOO SHORT

**KNOWN INFO**
- Code(s) 71-78 displayed on DDR

**POSSIBLE PROBLEMS**
- Fuel or charging system
- Loose ground connection
- Bad injector

**TEST OPTIONS**
- Fuel Return Line Test

**REASON FOR QUESTION**
- Aerated fuel supply to engine may cause Code(s) 71-78.

**START**

**Does clean fuel flow from fuel return line?**

- **NO**
  - Replace fuel lines or fittings (para 4–9).

- **YES**

**2.**

**KNOWN INFO**
- Fuel system OK

**POSSIBLE PROBLEMS**
- Charging system
- Loose ground connection
- Bad injector

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Erratic or insufficient voltage to DDEC system may cause Code(s) 71–78.

**Do battery gauges read between 24 and 28 volts for 24 volt system and 12–14 volts for 12 volt system?**

- **NO**
  - Go to e1. Batteries fail to maintain charge.

- **YES**

**3.**

**KNOWN INFO**
- Fuel and charging system OK

**POSSIBLE PROBLEMS**
- Loose ground connection
- Bad injector

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Loose ground connection will affect DDEC electronics and may cause code(s) 71–78.

**Is the engine to chassis ground strap in good condition (secure, clean and not broken)?**

- **NO**
  - Replace ground strap.

- **YES**

**Injector may be faulty, notify supervisor.**
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

<table>
<thead>
<tr>
<th>FUEL RETURN LINE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4) Remove fuel return line from left side fuel tank.</td>
</tr>
<tr>
<td>(5) Place fuel line in suitable container.</td>
</tr>
<tr>
<td>(7) Inspect fuel for air contamination.</td>
</tr>
<tr>
<td>(8) Install fuel return line on left side fuel tank.</td>
</tr>
</tbody>
</table>

NOTE

Engine must be running to perform this test.

<table>
<thead>
<tr>
<th>12 VOLT BATTERY GAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 VOLT BATTERY GAGE</td>
</tr>
</tbody>
</table>

(1) Check 24 volt battery gage for 24–28 volts dc.
(2) Check 12 volt battery gage for 12–14 volts dc.

(1) Remove left inner fender (para 16-34).
(2) Inspect ground cable for loose hardware, breaks and clean connections.
A4 - Code 85 ENGINE OVERSPEED

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

1. This code is for information purposes only.

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>To get complete information, see procedure on next page.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>This code is logged whenever the engine has been operating over 2500 RPM for at least 2 seconds.</td>
</tr>
</tbody>
</table>
(1) Plug in DDR (p. 2-66).
(2) Turn ENGINE switch to ON (TM 9-2320-360-10).
(3) Select Modes 02 (Historical codes) and 38 (Engine Hours) for display.
(4) At least part of the display will look like the following example (there will be more display if more codes are logged in addition to code 85):

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85 ENG OVERSPEED 02</td>
</tr>
<tr>
<td>2</td>
<td>352 START HR 02</td>
</tr>
<tr>
<td>3</td>
<td>15 SECONDS 02</td>
</tr>
<tr>
<td>4</td>
<td>1 OCCUR 02</td>
</tr>
<tr>
<td>5</td>
<td>368 ENG HOURS 38</td>
</tr>
</tbody>
</table>

**This is what the display means:**

- **Line 1**: A Code 85, engine overspeed, was logged. It is being displayed as part of the Mode 02 display.
- **Line 2**: The Code 85 condition was first seen at 352 engine hours (the number of hours the engine has been in use since coming off the assembly line).
- **Line 3**: The total duration of Code 85 conditions logged was 15 seconds.
- **Line 4**: Only 1 continuous occurrence of Code 85 took place.
- **Line 5**: The total number of engine hours at this time is 368. Subtracting line 2 from line 5 (368 - 352 = 16), means that the first Code 85 condition occurred 16 engine hours ago.
A4A CHECK VEHICLE HARNESS +5 VOLT SUPPLY

1. Does Code 46 (Low Battery Voltage) fail to come up?
   - NO: Go to A4A - Code 46.
   - YES: Continue.

   **POSSIBLE PROBLEMS**
   - +5 volts not present
   - Short to ground
   - Damaged engine +5 volt line
   - Damaged terminals at vernier control connectors
   - TPS out of range
   - Damaged TPS connections
   - Damaged ECM connectors
   - Short to battery +
   - Open in vernier control connector

   **TEST OPTIONS**
   - DDR
   **REASON FOR QUESTION**
   - Low battery voltage is suspect.

2. Is voltage at connectors less than 4.7 volts?
   - NO: Voltages may not be in acceptable range. Acceptable range is 4.7 - 5.6 volts.
   - YES: If between 4.7 and 5.2 volts, go to step 8; if greater than 5.2 volts, go to step 11.

   **POSSIBLE PROBLEMS**
   - +5 volts not present
   - Short to ground
   - Damaged engine +5 volt line
   - Damaged terminals at vernier control connectors
   - TPS out of range
   - Damaged TPS connections
   - Damaged ECM connectors
   - Short to battery +
   - Open in vernier control connector

   **TEST OPTIONS**
   - Voltage Test
   - STE/ICE-R Test #89
   **REASON FOR QUESTION**
   - Battery voltage OK

3. Is there less than or equal to 5 ohms in either engine +5 volt line (Ckt #916) and sensor return line (Ckt #952)?
   - NO: Notify supervisor if open is indicated.
   - YES: Referenced here by DDEC troubleshooting because vehicle harness is suspect.

   **POSSIBLE PROBLEMS**
   - +5 volts not present
   - Short to ground
   - Damaged engine +5 volt line
   - Damaged terminals at vernier control connectors
   - TPS out of range
   - Damaged TPS connections
   - Damaged ECM connectors
   - Short to battery +
   - Open in vernier control connector

   **TEST OPTIONS**
   - Continuity Test
   - STE/ICE-R Test #91
   **REASON FOR QUESTION**
   - Battery voltage OK +5 volts present

---

**CAUTION**

Read CAUTION on following page.
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

VOLTAGE TEST

(5) Turn ENGINE switch OFF and disconnect the Throttle Position Sensor (TPS)

(6) Turn ENGINE switch ON and read voltage on the TPS harness connector, pin C (red lead) to pin A (black lead).

CAUTION

Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

CONTINUITY TEST

(1) Turn ENGINE switch OFF and disconnect vehicle harness connector at ECM.

(2) Install a jumper wire between pins A and C of TPS harness connector.

(3) Read resistance between sockets A3 and C3 of vehicle harness connector.
A4A CHECK VEHICLE HARNESS +5 VOLT SUPPLY (CONT)

### KNOWN INFO
- Battery voltage OK
- +5 volts present
- No open in +5 volt or return

### POSSIBLE PROBLEMS
- Short to ground
- Damaged engine +5 volt line
- Damaged terminals at vernier control connectors
- TPS out of range
- Damaged TPS connections
- Damaged ECM connectors
- Short to battery +
- Open in vernier control connector

### TEST OPTIONS
- Continuity Test or STE/ICE-R Test #91

### REASON FOR QUESTION
- Resistance less than or equal to 10,000 ohms at TPS harness connector indicates short.

#### 4.
**Is there less than or equal to 10,000 ohms in engine +5 volt (no short to ground)?**

- NO
  - Both readings greater than 10,000 ohms or open, go to step 10.
- YES

#### 5.
**Is there greater than or equal to 4.7 volts in engine +5 volt line (Ckt #916) (not shorted to either sensor return line (Ckt #952) or to chassis ground)?**

- NO
  - Notify supervisor if short is indicated.
- YES
  - Go to step 12.

#### 6.
**Are vernier control and vernier control terminals and connectors (sensor side and harness side) OK?**

- NO
  - Repair terminals/ connectors (para 7–77), then go to step 12.
- YES
  - Replace vernier control (para 7–76), then go to step 12.
Inspect terminals at the Vernier Control connectors (sensor side and harness side) for damage; bent, corroded and unseated pins or sockets.

**CONTINUITY TEST**

1. Check for +5 volt short to ground.
2. Remove jumper wire and disconnect Vernier Control.
3. Read resistance between pins A and C of TPS harness connector.
4. Also read resistance between pin C or TPS harness connector and a good ground.

**VOLTAGE TEST**

1. Turn ENGINE switch OFF.
2. Remove Vernier Control (para 7–76).
3. Turn ENGINE switch ON.
4. Read voltage on Vernier Control harness connector, socket C (red lead) to socket A (black lead).
A4A CHECK VEHICLE HARNESS +5 VOLT SUPPLY (CONT)

**KNOWN INFO**
- Battery voltage OK
- +5 volts present
- No open in +5 volt or return
- No short to ground
- Engine +5 volt line OK
- Damaged terminals at vernier control connectors

**POSSIBLE PROBLEMS**
- TPS out of range
- Damaged TPS connections
- Damaged ECM connectors
- Short to battery +
- Open in vernier control connector

**known info**
- Battery voltage OK
- +5 volts present
- No open in +5 volt or return
- No short to ground
- Engine +5 volt line OK
- Damaged terminals at vernier control connectors
- TPS adjustment OK

**POSSIBLE PROBLEMS**
- Damaged TPS connections
- Damaged ECM connectors
- Short to battery +
- Open in vernier control connector

7. Is the TPS adjustment counts incorrect?
- **YES**
  - If getting proper counts, go to step 9.
- **NO**
  - TPS adjustment may be off. 20–30 counts at no throttle and no more than 235 counts at full throttle is acceptable.

8. Are TPS and TPS terminals and connectors (sensor side and harness side) OK?
- **YES**
  - Repair terminals or connectors (para 7–77). Then go to step 12.
- **NO**
  - Replace TPS (para 7–28), then go to step 12.

9. Are ECM and ECM terminals and connectors (sensor side and harness side) OK?
- **YES**
  - Repair terminals or connectors. (para 7–77). Then go to step 12.
- **NO**
  - Replace ECM (para 7–29), then go to step 12.

**Test Options**
- DDR

**Reason for Question**
- Damage to terminals could affect signal to TPS.

**Test Options**
- Visual inspection

**Reason for Question**
- Damage to terminals could affect signal to ECM.
(1) Turn ENGINE switch OFF and reconnect the Throttle Position Sensor (TPS) connector.

(2) Turn ENGINE switch ON and select Throttle Sensor for display on the DDR.

**NOTE**

Engine does not need to be running to check throttle count reading.

(3) Check throttle count reading on DDR with accelerator pedal in idle position and with accelerator pedal fully depressed.

(4) Turn ENGINE switch to OFF.

Disconnect the Throttle Position Sensor (TPS). Check terminals at the TPS connectors (sensor side and harness side) for damage; bent, corroded and unseated pins or sockets.

Disconnect vehicle harness connector at ECM. Check terminals at ECM vehicle harness connector (both ECM and harness side) for damage; bent, corroded and unseated pins or sockets, especially terminals #952, #916, #417, and #510.
10. Is there greater than 10,000 ohms or open in engine +5 volt line (Ckt #916) and Ckt #240, #241, and #439?

- **Known Info**
  - Battery voltage OK
  - +5 volts present
  - No open in +5 volt or return
  - No short to ground
  - Engine +5 volt line OK
  - Damaged terminals at vernier control connectors
  - TPS adjustment OK
  - TPS connections OK
  - ECM connectors OK

- **Possible Problems**
  - Short to battery +
  - Open in vernier control connector

- **Test Options**
  - Continuity Test
    - or
  - STE/ICE-R Test #91

- **Reason for Question**
  - Resistance less than 10,000 ohms at 6-way power or vehicle harness connectors indicates short where measured.

- **Decision Path**
  - **Yes**: Notify supervisor if short is indicated.
  - **Go to step 9.**

11. Is voltage at Pin C of Vernier Control harness connector greater than 4.7 volts and Pin A zero volts?

- **Known Info**
  - Battery voltage OK
  - +5 volts present
  - No open in +5 volt or return
  - No short to ground
  - Engine +5 volt line OK
  - Damaged terminals at vernier control connectors
  - TPS adjustment OK
  - TPS connections OK
  - ECM connectors OK
  - No short to battery +

- **Possible Problems**
  - Open in vernier control connector

- **Test Options**
  - Voltage Test
    - or
  - STE/ICE-R Test #89

- **Reason for Question**
  - Readings of 4.7 – 5.2 volts at 6-way power and vehicle harness connectors indicates open from Ckt #952 to ECM.

- **Decision Path**
  - **Yes**: Notify supervisor if open is indicated.
  - **Go to step 6.**

12. Does CHECK ENGINE indicator light stay on longer than five seconds?

- **Known Info**
  - Battery voltage OK
  - +5 volts present
  - No open in +5 volt or return
  - No short to ground
  - Engine +5 volt line OK
  - Damaged terminals at vernier control connectors
  - TPS adjustment OK
  - TPS connections OK
  - ECM connectors OK
  - No short to battery +
  - No open in vernier control connector

- **Possible Problems**
  - Open in vernier control connector

- **Test Options**
  - Visual inspection

- **Reason for Question**
  - Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.

- **Decision Path**
  - **Yes**: Repair complete.
  - **No**: Fault not corrected. Notify supervisor.
**CONTINUITY TEST**

1. Turn ignition off and trip both circuit breakers to ECM.
2. Disconnect vehicle harness and 6-way power harness connectors at ECM.
3. Read resistance between sockets A3 and B3 on vehicle harness connector.
4. Also read resistance between socket A3 on vehicle harness connector and sockets A, B, E, and F on 6-way power harness connector.

**VOLTAGE TEST**

1. Connect Throttle Position Sensor and turn ENGINE switch ON.
2. Read voltage on Vernier Control harness connector, socket C (red lead) to a good ground (black lead).
3. Repeat step 2 only place red lead in socket A of Vernier Control connector.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
A4B CHECK ENGINE HARNESS +5 VOLT SUPPLY

START

1. Does Code 46 (Low Battery Voltage) fail to come up?

   NO

   Go to A4 - Code 46.

   YES

2. Is voltage at connectors in acceptable range?

   NO

   If less than 4.7 volts, go to step 4; if greater than 5.2, go to step 6.

   YES

3. Are terminals at ECM engine harness connector OK?

   NO

   Replace ECM (para 7–29), then go to step 7.

   YES

   Repair ECM terminals and connectors (para 7–77). Then go to step 7.

4. Are terminals at ECM engine harness connector damaged? Do they need replacement?

   NO

   Replace ECM (para 7–29), then go to step 7.

   YES

   Repair ECM terminals and connectors (para 7–77). Then go to step 7.

5. Is voltage at connectors in acceptable range?

   NO

   Replace ECM (para 7–29), then go to step 7.

   YES

   Go to step 7.

6. Visual Inspection

   Damage to connectors could affect signal to ECM.

7. Is voltage at connectors in acceptable range?

   NO

   Replace ECM (para 7–29), then go to step 7.

   YES

   Go to step 7.

8. Are terminals at ECM engine harness connector damaged? Do they need replacement?

   NO

   Replace ECM (para 7–29), then go to step 7.

   YES

   Repair ECM terminals and connectors (para 7–77). Then go to step 7.

9. Is voltage at connectors in acceptable range?

   NO

   Replace ECM (para 7–29), then go to step 7.

   YES

   Go to step 7.

10. Are terminals at ECM engine harness connector damaged? Do they need replacement?

    NO

    Replace ECM (para 7–29), then go to step 7.

    YES

    Repair ECM terminals and connectors (para 7–77). Then go to step 7.
Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.

**NOTE**

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

**VOLTAGE TEST**

1. Turn ENGINE switch OFF.
2. Disconnect oil pressure sensor (OPS) and turbo boost sensor (TBS) connectors.
3. Turn ENGINE switch ON.
4. At each sensor harness connector, read voltage between socket C (red lead) and socket A (black lead).
A4B CHECK ENGINE HARNESS +5 VOLT SUPPLY (CONT)

**KNOWN INFO**
- Battery voltage OK
- +5 volts present
- Terminals at ECM engine harness connector OK
- No open in engine +5 volt line
- No short to ground

**POSSIBLE PROBLEMS**
- Open in engine +5 volt line or short to sensor return line
- Short to ground
- Short to battery+

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Resistance greater than 5 ohms indicates open in +5 volt line (Ckt #416) or sensor return (Ckt #452).

**4.** Is there less than or equal to 5 ohms in engine +5 volt line (Ckt #416) and return line (Ckt #452)?
- **NO** Notify supervisor if open is indicated.
- **YES** Go to step 3.

**5.** Is there greater than 10,000 ohms or open in engine +5 volt line (Ckt #416)?
- **NO** Notify supervisor if short is indicated.
- **YES** Go to step 3.

**6.** Is there greater than 10,000 ohms or open in battery +? (Ckt #416)?
- **NO** Notify supervisor if short is indicated.
- **YES** Go to step 3.
(1) Turn ENGINE switch OFF.
(2) Disconnect engine harness connector at ECM.
(3) Install jumper wire between sockets A and C of any sensor connector that reads less than 4.7 volts in check 2.
(4) Read resistance between sockets W1 and Y2 of engine harness connector.

(1) Turn ENGINE switch OFF.
(2) Remove jumper wire.
(3) Read resistance between sockets A and C of the sensor connector.
(4) Read resistance between socket C of the sensor connector and a good ground.

(1) Turn ENGINE switch OFF.
(2) Disconnect batteries (para 7–61) and disconnect all five connectors at ECM.
(3) Read resistance between socket W1 on the engine harness connector and B3 on the vehicle harness connector.
(4) Read resistance between socket W1 on the engine harness connector and sockets A, B, E, and F.
(5) Connect batteries (para 7–61).
A4B CHECK ENGINE HARNESS +5 VOLT SUPPLY (CONT)

**KNOWN INFO**
- Battery voltage OK
- +5 volts present
- Terminals at ECM engine harness connector OK
- No open in engine +5 volt line
- No short to ground
- No short to battery +

**POSSIBLE PROBLEMS**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.

---

7. **Does CHECK ENGINE indicator light stay on longer than five seconds?**

- **YES**
  - Repair complete.

- **NO**
  - Fault not corrected. Notify supervisor.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
B  CHECK ENGINE LIGHT IS OFF WHEN IGNITION IS TURNED ON

START

1. Is CHECK ENGINE light OFF with jumper wire installed in vehicle harness connector?
   - NO: Go to step 4.
   - YES: Go to step 2.

2. Is there 10 volts or more present at socket B3 of vehicle harness connector?
   - NO: Reset circuit breaker if necessary, notify supervisor if wiring problem is indicated.
   - YES: Go to step 3.

3. Is CHECK ENGINE indicator bulb OK?
   - NO: Replace bulb (para 7-40), Go to step 8.
   - YES: Notify supervisor if open is indicated.

4. ...

5. ...

6. ...

7. ...

8. ...

CAUTION
Read CAUTION on following page.

WARNING
Read WARNING on following page.

KNOWN INFO
CHECK ENGINE light does not light

POSSIBLE PROBLEMS
Circuit breaker tripped
Ignition line short to ground
Open in drive or ground line
Battery voltage off
Open ignition line
Short or open in Ckts #240 and #241
Open in Ckt #150
Damaged ECM connectors

KNOWN INFO
Check engine does not illuminate with jumper wire installed

POSSIBLE PROBLEMS
Circuit breaker tripped
Open in drive or ground line
Bulb burned out
Open in ignition line

KNOWN INFO
Ignition circuit OK

POSSIBLE PROBLEMS
Bulb burned out
Open in drive or ground line

TEST OPTIONS
Visual inspection

TEST OPTIONS
Voltage Test or STE/ICE-R Test #89

TEST OPTIONS
Continuity Test or STE/ICE-R Test #91

REASON FOR QUESTION
To verify fault.

REASON FOR QUESTION
Less than +10 volts at socket B3 indicates tripped breaker, open or grounded ignition wire, or wire no. 439 wired improperly or grounded.

REASON FOR QUESTION
Resistance of 20 ohms or less indicates bulb is OK. If bulb is OK, driver line (Ckt #419) or ground line (Ckt #150) is open.

CAUTION
Read CAUTION on following page.

WARNING
Read WARNING on following page.

Known Info
POSSIBLE PROBLEMS
TEST OPTIONS
REASON FOR QUESTION

Known Info
POSSIBLE PROBLEMS
TEST OPTIONS
REASON FOR QUESTION

Known Info
POSSIBLE PROBLEMS
TEST OPTIONS
REASON FOR QUESTION
**NOTE**
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

**CAUTION**
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

1. Turn ENGINE switch OFF and disconnect vehicle harness connector at ECM.
2. Install a jumper wire between socket B1 on vehicle harness connector and a good ground.
3. Turn ENGINE switch ON (engine not running).

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**VOLTAGE TEST**
Check for ignition by removing jumper wire and reading voltage on vehicle harness connector, socket B3 (red lead) to a good ground (black lead) with the ignition on and engine off.

**CONTINUITY TEST**
1. Turn ignition OFF.
2. Remove CHECK ENGINE light bulb (para 7-40).
3. Read resistance between terminals of light bulb.
B CHECK ENGINE LIGHT IS OFF WHEN IGNITION IS TURNED ON (CONT)

4. Is there greater than or equal to 10 volts present at socket B3 of vehicle harness connector?

- **NO**: Notify supervisor if open is indicated.
- **YES**: Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**: Reading less than 10.0 volts at vehicle harness connector indicates open in wire no. 439.

**TEST OPTIONS**
- Voltage Test
- STE/ICE-R Test #89

5. Is voltage from 6-way power connector to good ground greater than or equal +10 volts?

- **NO**: Reset breaker if necessary, notify supervisor if open or short is indicated.
- **YES**: Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**: Less than 10.0 volts at power harness connector indicates circuit breaker is tripped or battery power lines (Ckts #240 or 241) has an open or short to ground.

6. Is voltage between socket C and sockets A, B, E, and F of 6-way power connector greater than or equal to +10 volts?

- **NO**: Notify supervisor if open is indicated.
- **YES**: Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**: Less than 10.0 volts at 6-way power harness connector indicates open in wire no. 150.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

VOLTAGE TEST
(1) Remove jumper wire.
(2) With ENGINE switch ON, read voltage on vehicle harness connector, socket B3 (red lead) to a good ground (black lead).

VOLTAGE TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect 6-way power harness connector.
(3) Read voltage at power harness connector socket A (red lead) to a good ground (black lead).
(4) Read voltage at same connector keeping black lead to a good ground and red lead to sockets B, E, and F.

VOLTAGE TEST
(1) Move black lead of voltmeter to socket C of 6-way power harness connector.
(2) Read voltage using red lead at sockets A, B, E, and F of 6-way power harness connector.
(3) Move black lead of voltmeter to socket D of 6-way power harness connector.
(4) Again read voltage at sockets A, B, E, and F of power harness connector.
B  CHECK ENGINE LIGHT IS OFF WHEN IGNITION IS TURNED ON (CONT)

7. Are terminals at vehicle harness (especially B3 and B1) and all terminals in 6-way power harness connectors (both ECM and harness side) OK?
   YES
   NO
   Repair terminals or connectors if damaged (para 7-77).
   Replace ECM (para 7-29).

8. Does CHECK ENGINE indicator light stay on longer than five seconds?
   YES
   NO
   Repair complete
   Fault not corrected. Notify supervisor.

TEST OPTIONS
- Visual inspection

REASON FOR QUESTION
- Damage to connectors could affect signal to ECM.

- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
Check terminals at vehicle harness (especially B3 and B1) and all the terminals in 6-way power harness connectors (both the ECM and harness side) for damage; bent, corroded and unseated pins or sockets.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
C  CHECK ENGINE INDICATOR COMES ON FOR UP TO 5 SECONDS AFTER IGNITION, THEN GOES OUT

5. Plug DDR into 12-pin DDL connector. Read all historical codes by selecting Mode 02 on the DDR

- If codes 14, 23, or 85 come up, Follow appropriate diagnostic chart for code received (see table 2-5, p. 2-76).
- If any code except 14, 23, or 85 comes up, go to C1 (p. 2-292).
- If code 25 (no codes) comes up, go to Table 2-6 (p. 2-78)
- If DDR display reads “NO DDEC DATA RECEIVED” go to C2 (p. 2-314).
- If DDR display is blank or random, go to A3 (p. 2-102).
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

NOTE
Be sure there is no jumper between pins A and M of the DDL connector.
Engine cranks but will not start

**POSSIBLE PROBLEMS**
- Fuel supply
- Cylinder compression/air
- Short in TRS
- SRS/TRS mounting
- Faulty DDEC pulse wheel
- Damaged terminals at ECM
- SRS signal
- Open or short in injector
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- To isolate problem to DDEC system.

**1.** Does engine start?

**TEST OPTIONS**
- Visual Inspection

**REASON FOR QUESTION**
- To isolate problem to ECM (DDEC system).

**2.** Is CHECK ENGINE light off or only flash briefly?

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- To isolate problem to ECM (DDEC system).

**3.** Are any historical codes 31, 41, 42, 51-56, 61-68, or 71-78 displayed?

Follow appropriate diagnostic chart for codes received.

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- To isolate problem to ECM (DDEC system).
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(4) Attempt to start and run engine and get CHECK ENGINE light ON by warming up engine and slowly changing RPM from idle to full throttle.

(5) Run engine for 1 minute or until CHECK ENGINE light comes ON.
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

4. Does CHECK ENGINE light come on and stay on?
   - YES
   - NO

5. Does DDR read an active code 25?
   - YES
   - NO

6. Is fuel supply adequate?
   - YES
   - NO

POSSIBLE PROBLEMS
- Fuel supply
- Cylinder compression/air
- Short in TRS
- SRS/TRS mounting
- Faulty DDEC pulse wheel
- Damaged terminals at ECM
- SRS signal
- Open or short in injector
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

TEST OPTIONS
- Visual Inspection

REASON FOR QUESTION
- To isolate problem to DDEC system.
- To isolate problem to ECM (DDEC system).

TEST OPTIONS
- DDR

REASON FOR QUESTION
- Fuel level suspect.
(1) Turn Engine switch to ON position.
(2) Observe CHECK ENGINE light.
C1 - ENGINE CRANKS BUT WILL NOT NOT START (CONT)

7. **Is there steady fuel flow at return line?**
   - **NO**
     - Clear air from lines or go to Fuel system troubleshooting. Go to step 8.
   - **YES**

8. **Is there white smoke present while cranking engine?**
   - **NO**
     - Go to step 32.
   - **YES**
     - Go to engine troubleshooting (a).

9. **Does engine RPM on DDR sometimes or always read less than 60 while cranking?**
   - **NO**
     - Go to step 13.
   - **YES**

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Visual Inspection or STE/ICE-R Test #

**REASON FOR QUESTION**
Steady fuel flow indicates no air in fuel. If no flow, or flow is intermittent, check fuel filter(s) and supply lines to determine source of problem (Fuel system troubleshooting).

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
If white smoke is present, problem appears to be with cylinder compression or air intake. Go to engine troubleshooting.

**TEST OPTIONS**
DDR

**REASON FOR QUESTION**
SRS signal to ECM may be intermittent or open.
(1) Remove fuel return line from left fuel tank.
(2) Direct fuel into a suitable container.
(3) Observe fuel flow out of line while cranking.
(4) Reconnect fuel line.

Check for white smoke from exhaust while cranking the engine.

NOTE
Battery voltage surges while cranking with electric starters may blank out or reset DDR.
(1) Check TRS status via RPM read-out.
(2) Select ENGINE RPM on DDR.
(3) Crank engine while observing DDR display.

WARNING
Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE.
10. Is there between 100-200 ohms between sockets T1 and T2 at engine harness connector?

- **NO**
  - Less than 100 Ohms, go to A5–Code 41, Step 2.
  - Greater than 100 Ohms, go to A4–Code 41, Step 3.

- **YES**

11. Are SRS/TRS gap and pulse wheel OK?

- **NO**
  - Notify supervisor.

- **YES**

12. Are terminals at ECM connectors OK?

- **NO**
  - Repair terminals (para 7–77). Then go to step 31.

- **YES**
  - Replace ECM. (para 7–29). Then go to step 31.
Inspect DDEC pulse wheel for tightness, as well as for chipped or missing teeth.

CONTINUITY TEST

1. Turn ENGINE switch OFF.
2. Disconnect engine harness at ECM connector.
3. Read resistance between sockets T1 and T1 engine harness connector.

(1) Disconnect all connectors at ECM.
(2) Check terminals at all ECM connectors (both the ECM and harness side) for damaged, bent, corroded and unseated pins or sockets.
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

**Known Info**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK

**Possible Problems**
- SRS signal
- Open or short in injector
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

**Test Options**
- DDR

**Reason for Question**
- SRS signal is suspect if indicated on DDR in Mode 3.

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

**Reason for Question**
- SRS fault suspect.

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

**Reason for Question**
- Resistance greater than 5 ohms at either 5-way injector harness connectors indicates open in one injector power driver or return wires.

13. Is SRS signal bad? ("no SRS received" on display)
   - **No**
     - If display reads YES SRS RECEIVED while cranking, go to step 15.
   - **Yes**

14. Is resistance between sockets S1 and S2 at engine harness connector between 100 - 200 Ohms?
   - **No**
     - If greater than 200 ohms, go to A5 - Code 42, step 2. If less than 100 ohms, go to A4 - Code 42, step 3.
   - **Yes**

15. Is there less than or equal to 5 Ohms in all of the injector power driver or return wires?
   - **No**
     - Notify supervisor if open is indicated.
   - **Yes**

**Known Info**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK

**Possible Problems**
- Open or short in injector
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

**Known Info**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK

**Possible Problems**
- Open or short in injector
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line
NOTE
Battery voltage surges while cranking may blank out or reset DDR.
(1) Check for proper SRS signal.
(2) Select MISC STATUS on DDR (MODE 31).
(3) Crank engine while observing DDR display of “SRS RECEIVED”.

CONTINUITY TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect engine harness connector at ECM.
(3) Read resistance between sockets S1 and S2 at engine harness connector.

CONTINUITY TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect both 5-way injector harnesses at ECM connector.
(3) Read resistance between injector return pin and all the power driver pins on both harness connectors. (example: G-L, and E-A)
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

**KNOWN INFO**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK
- No open in injector

**POSSIBLE PROBLEMS**
- Short in injector
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

**TEST OPTIONS**
- Continuity Test
  or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Resistance less than 10,000 ohms at injector harness connectors indicates short to ground on that wire.

**KNOWN INFO**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK
- No open or short in injector

**POSSIBLE PROBLEMS**
- Injector drive pulse
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

**TEST OPTIONS**
- Injector Drive Pulse Test

**REASON FOR QUESTION**
Drive pulses are suspect. If all injectors pass all tests, the problem is not in DDEC.

**KNOWN INFO**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK
- No open or short in injector
- Injector drive pulse OK

**POSSIBLE PROBLEMS**
- ECM breakers
- Power supply
- Open in ECM ground
- Faulty ignition line

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Open breaker is suspect.
CONTINUITY TEST

1. Disconnect 6-way power harness connector at ECM.
2. Read resistance between socket C of 6-way power harness connector to sockets A, B, C, D, E, G, J, K, and L on injector harness connectors.

INJECTOR DRIVE PULSE TEST

1. Turn ENGINE switch OFF.
2. Reconnect all ECM connectors.
3. Remove rocker arm cover(s) (para 3-2).
4. Disconnect return wire one injector (return wire #619 or #620).
5. Place a 6-volt test light across injector return side (where wire was just removed) and a good ground.
6. Crank engine and note both test light and whether start of plunger motion coincides with light.
7. Reconnect return wire.
8. Repeat steps 2 through 8 with all other injectors until all have been tested or until one test fails. If light and start of plunger motion do not coincide, a mechanical timing adjustment may be required (see engine maintenance).
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

### KNOWN INFO
- Fuel supply OK
- Cylinder compression/ air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK
- No open or short in injector
- Injector drive pulse OK
- ECM breakers OK

### POSSIBLE PROBLEMS
- Power supply
- Open in ECM ground
- Faulty ignition line

---

19. **Is voltage at 6-way power harness connector less than 11.5 volts?**

- **NO**
  - If greater than 11.5 volts, go to step 22.
  - **YES**

---

20. **Is there less than 11.5 volts in Bank A Power (Ckt #240) and Bank B Power (Ckt #241)?**

- **NO**
  - Greater than 11.5 volts on both, notify supervisor if open is indicated.
- **YES**

---

21. **Is battery voltage greater than or equal to 10.0 volts?**

- **NO**
  - Replace or service discharged battery (para 7-57). Go to step 31.
- **YES**

### TEST OPTIONS
- Voltage Test
- STE/ICE-R Test #89

### REASON FOR QUESTION
- Voltage greater than 11.5 at either ECM circuit breaker indicates open in either Bank A Power (Ckt #240) or Bank B Power (Ckt #241).
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### VOLTAGE TEST

1. Check for 12 volts at 6-way, power harness connector.
2. Turn ENGINE switch OFF.
3. Disconnect 6-way power harness connector.
4. Read voltage from socket A and B (red lead) of 6-way power harness connector to a good ground (black lead).
5. Also read voltage from socket E and F (red lead) to a good ground (black lead).

### NOTE
The battery side does not contain the #240 or #241 wires.

1. Read voltage between battery side of one ECM circuit breaker (red lead) and a good ground (black lead).
2. Read voltage reading at other ECM circuit breaker.

### VOLTAGE TEST

1. Connect all connectors.
2. Turn ENGINE switch ON.
3. Try to start engine.
4. Read voltage at battery + terminal (red lead) to battery - terminal (black lead).
22. Is there greater than or equal to 11.5 volts at ignition wire?

- **NO**
  - If voltage is less than 11.5, go to step 24.
- **YES**
  - Notify supervisor if open is indicated.

23. Is there greater than or equal to 11.5 volts in ECM ground wire (Ckt #150)?

- **NO**
  - Notify supervisor if open is indicated.
  - Go to step 12.
- **YES**
  - Voltage less than 11.5 at 6-way power harness connector indicates an open in ECM ground wire (Ckt #150).

24. Is 5 amp ignition circuit breaker closed?

- **NO**
  - If open, go to step 26.
- **YES**
  - Circuit breaker is suspect.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch OFF.</td>
</tr>
<tr>
<td>2</td>
<td>Disconnect vehicle harness connector at ECM.</td>
</tr>
<tr>
<td>3</td>
<td>Turn ENGINE switch ON.</td>
</tr>
<tr>
<td>4</td>
<td>Read voltage between socket B3 on vehicle harness connector (red lead) and a good ground (black lead).</td>
</tr>
</tbody>
</table>

VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Read voltage between socket B3 on vehicle harness connector (red lead) and socket C and D on 6-way, power harness connector (black lead).</td>
</tr>
</tbody>
</table>
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

**KNOWN INFO**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK
- No open or short in injector
- Injector drive pulse OK
- ECM breakers OK
- Power supply OK
- Open in ECM ground

**POSSIBLE PROBLEMS**
- Faulty ignition line

**TEST OPTIONS**
- Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Voltage greater than or equal to 11.5 at ignition circuit breaker indicates open in ignition line (Ckt #3 or #439).

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Open circuit breaker after ignition line test indicates short to ground in ignition line (Ckt #439).

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Intermittent short is suspect. If 5 amp breaker is still OK, no short is currently present.

---

**25.** Is there less than 11.5 volts in ignition line (Ckt #3 or 439)?

- **NO** Notify supervisor if open is indicated.
- **YES** Go to step 28.

**26.** Did 5 amp DDEC breaker stay reset?

- **NO** Notify supervisor if short is indicated.
- **YES** Go to step 28.

**27.** Is ECM still tripping circuit breakers?

- **NO** Go to step 31.
- **YES** Go to step 12.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### VOLTAGE TEST

Read voltage between battery side (hot side) of the 5 amp ignition circuit breaker (red lead) and a good ground (black lead).

1. Reset open circuit breaker.
2. Turn ignition on for at least 10 seconds. Turn ignition off.
3. Check 5 amp ignition circuit breaker again.

### CONTINUITY TEST

**NOTE**

With an intermittent short, the engine will shut down again. Also note that the circuit breaker may have opened due to temporary reverse voltage at battery.

1. Reconnect all harness connectors at ECM.
2. Attempt to start engine. If engine starts, run engine for at least one minute.
3. Turn ENGINE switch OFF.
4. Check 5 amp ignition circuit breaker.
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

**KNOWN INFO**
- Fuel supply OK
- Cylinder compression/air intake OK
- No short in TRS
- SRS/TRS mounting OK
- DDEC pulse wheel OK
- Terminals at ECM OK
- SRS signal OK
- No open or short in injector
- Injector drive pulse OK
- ECM breakers OK
- Power supply OK
- Open in ECM ground
- Ignition line OK

**POSSIBLE PROBLEMS**

28. **Is battery voltage less than 11.5 volts?**

   **YES**
   - Notify supervisor if open or short to ground is present.
   - Replace batteries (para 7-57). Then go to step 31.

   **NO**

29. **Have circuit breakers tripped again?**

   **YES**
   - If breakers are still OK, go to step 27.

   **NO**

30. **Is there greater than or equal to 10,000 Ohms in Ckts #240 and #241?**

   **YES**
   - Notify supervisor if short is indicated.

   **NO**

   - Go to step 12.

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Voltage greater than or equal to 11.5 at battery + to battery - indicates open or short to ground in unfused ignition line.

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
If circuit breakers trip, short is suspect.

**TEST OPTIONS**
- Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
Resistance less than 10,000 ohms (in CKTS #240 or #241) indicates short to ground.
NOTE
If a short to ground exists anywhere in a battery + circuit, vehicle will shut down again if not repaired.

(1) Disconnect battery cables at 12-volt battery.
(2) Read voltage at the battery + terminal (red lead) to battery - terminal (black lead). If voltage is less than 11.5, service discharged battery.

VOLTAGE TEST

(1) Turn ENGINE switch OFF.
(2) Disconnect 6-way power harness connector at ECM.
(3) Reset circuit breaker(s).
(4) Wait 10 seconds. Check if circuit breaker(s) have tripped or opened again.

CONTINUITY TEST

(1) Read resistance between Bank B power (circuit #240) and a good ground.
(2) Read resistance between Bank A power (circuit #241) and a good ground.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
C1 - ENGINE CRANKS BUT WILL NOT START (CONT)

31. Does CHECK ENGINE indicator light stay on longer than five seconds?

- If engine starts and codes other than Code 25 come up, go to step 6.
- Go to page 2-80.

32. Are fuel filters unrestricted and full of clean fuel?

- Go to step 9.

REASON FOR QUESTION

- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.

- Contaminated fuel/water separator or secondary fuel filter will restrict fuel to engine.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.

**WARNING**
Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read *NO SMOKING WITHIN 50 FEET OF VEHICLE*.

(1) Turn ENGINE switch OFF.
(2) Check the fuel/water separator and the secondary fuel filters to be sure they are not clogged and that they are full of clean fuel.
C2 NO DATA LINK AND BULB CHECK OK

START

1. Do no codes flash out on CHECK ENGINE light with jumper wire installed in DDL connector?
   - YES: Codes flash, go to step 4.
   - NO: Open in diagnostic request line
     - Damaged ECM connectors
     - Open in data line
     - Short in data line
     - Short to ignition and ground

2. Is there less than or equal to 5 ohms in diagnostic request line?
   - YES: Resistance greater than 5 ohms at DDL connector indicates open in Diagnostic Request line (Ckt #451) or bad ground at pin A of DDL connector.
   - NO: Notify supervisor.

3. Are ECM connectors OK?
   - YES: Replace ECM (para 7-29), then go to step 8.
   - NO: Repair ECM terminals (para 7-77). Go to step 8.

KNOWLEDGE INFO
- Bulb check OK, no data link or no DDEC data received

POSSIBLE PROBLEMS
- Open in diagnostic request line
- Damaged ECM connectors
- Open in data line
- Short in data line
- Short to ignition and ground

REASON FOR QUESTION
To isolate fault location.

TEST OPTIONS
- Visual inspection
- Continuity Test or STE/ICE-R Test #91

TEST OPTIONS
- Visual inspection

CAUTION
Read CAUTION on following page.
CAUTION
Use jumper wire only between terminals indicated. Failure to comply may result in damage to DDEC components or wiring.

NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) First unplug DDR.
(2) Short pin A to pin M on 12-pin DDL connector and read codes flashing out on the CHECK ENGINE light.

CONTINUITY TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect both vehicle harness and 6-way power connector.
(3) Install jumper wire between E1 of vehicle harness connector and socket D of 6-way power harness connector.
(4) Read resistance between sockets A and M on 12-pin, DDL connector.

Check terminals at both vehicle harness and 6-way power harness connectors (both the ECM and harness side) for damage; bent, corroded and unseated pins or sockets.
4. Is there less than 5 ohms in one or both data lines (Ckt #900 or 901) with jumper across pins J and K of the DDL connector?

   **KNOWLEDGE INFO**
   - Diagnostic request line OK
   - ECM connectors OK

   **POSSIBLE PROBLEMS**
   - Open in data line
   - Short in data line
   - Short to ignition and ground

   **TEST OPTIONS**
   - Continuity Test
   - STE/ICE-R Test #91

   **REASON FOR QUESTION**
   - Resistance greater than 5 ohms at vehicle harness connector indicates open in one or both data lines (Ckts #900 or #901).

   **NOTE**
   - Notify supervisor if open is indicated.

5. Is there greater than 5 ohms in data lines with jumper removed?

   **KNOWLEDGE INFO**
   - Diagnostic request line OK
   - ECM connectors OK
   - No open in data line

   **POSSIBLE PROBLEMS**
   - Short in data line
   - Short to ignition and ground

   **TEST OPTIONS**
   - Continuity Test
   - STE/ICE-R Test #91

   **REASON FOR QUESTION**
   - Resistance less than 5 ohms at vehicle harness connector indicates short between two data lines (Ckts #900 and #901).

   **NOTE**
   - Notify supervisor if short is indicated.

6. Is there greater than 5 ohms in data line and ignition (Ckt #439) and ground (Ckt #150)?

   **KNOWLEDGE INFO**
   - Diagnostic request line OK
   - ECM connectors OK
   - No open in data line
   - No short in data line

   **POSSIBLE PROBLEMS**
   - Short to ignition and ground

   **TEST OPTIONS**
   - Continuity Test
   - STE/ICE-R Test #91

   **REASON FOR QUESTION**
   - Short is suspect. Resistance less than 5 ohms on any reading at DDL connector indicates short between a data line and ignition (Ckt #439) or ground (Ckt #150).

   **NOTE**
   - Notify supervisor if short is indicated.
CONTINUITY TEST
(1) Turn ENGINE switch OFF and remove all jumpers from 12-pin DDL connector.
(2) Place jumper across pins J and K on 12-pin DDL connector.
(3) Unplug vehicle harness connector and measure resistance between sockets C1 and C2.

CONTINUITY TEST
(1) Remove jumper wires from 12-pin DDL connector.
(2) Read resistance between sockets C1 and C2 of vehicle harness connector.

CONTINUITY TEST
(1) Remove all jumpers from 12-pin DDL connector.
(2) Measure resistance between sockets J and A, then J and H next.
(3) Measure resistance between sockets K and A, then K and H of DDL connector.
C2 NO DATA LINK AND BULB CHECK OK

**KNOWN INFO**
- Diagnostic request line OK
- ECM connectors OK
- No open in data line
- No short in data line
- No short to ignition and ground

**POSSIBLE PROBLEMS**
- Faulty DDR

7. Does DDR work correctly when connected to another engine?
- **NO** Replace DDR.
- **YES**

**TEST OPTIONS**
- DDR

**REASON FOR QUESTION**
- Faulty DDR will also cause this symptom, even if there is no problem with DDEC.

**KNOWN INFO**
- Diagnostic request line OK
- ECM connectors OK
- No open in data line
- No short in data line
- No short to ignition and ground

**POSSIBLE PROBLEMS**

8. Does CHECK ENGINE indicator light stay on longer than five seconds?
- **NO** Repair complete.
- **YES**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
Connect DDR to another engine and read PROM ID or any other parameter in the menu.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
D  INTERMITTENT CODE OR A SYMPTOM AND NO CODE

KNOWN INFO

Intermittent DDR CODES or a symptom and no CODES

TEST OPTIONS

DDR

9. Observe whether flashing CHECK ENGINE light is reading a valid code or is just erratic.

- If CEL is flashing a valid code, go to D1 (p. 2-324).
- If code is erratic or intermittent, go to D2 (p. 2-326).
- If engine cranks but will not start, go to C1 (p. 2-292).
- If there is no CEL during bulb check at key on, go to B (p. 2-282).
- If CEL is ON and Code 25 comes up on DDR, go to A1 (p. 2-94).
- If CEL is always ON, there is no data link, and codes won’t flash, go to A2 (p. 2-98).
- If there is no data link and bulb check is OK at key on, go to C2 (p. 2-314).
- If the CHECK GAUGES light is always ON and there are no codes, go to D3 (p. 2-330).
- If there is no CHECK GUAGES light during bulb check at key on, go to D4 (p. 2-334).
- If HIGH IDLE is inoperative, go to D5 (p. 2-340).
- If ENGINE BRAKE is always enabled, go to D6 (p. 2-348).
- If ENGINE BRAKE is inoperative, go to D7 (p. 2-352).
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

NOTE

Check engine light may flash valid codes at times. Codes may be read as follows:

**Code 13**
- One flash
- Short pause, 1/2 second
- Three flashes

**Code 21**
- Two flashes
- Long pause, 3 seconds
- One flash
- Short pause, 1/2 second
D1 VALID CODE IS FLASHING

1. Is resistance between pins A and M of DDL connector greater than 200 ohms or open?
   - NO: Notify supervisor if short is indicated.
   - YES: Diagnostic request line shorted to ground.

2. Are terminals at both 5-way, injector harness connectors (both harness and ECM sides) OK?
   - NO: Repair connectors (para 7-77). Go to step 4.
   - YES: Replace ECM (para 7-29).

3. Does CHECK ENGINE indicator light stay on longer than five seconds?
   - NO: Repair complete.

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Reading less than or equal to 200 ohms at DDL connector indicates diagnostic request line (Ckt #451) is shorted to ground.
- Damaged terminals could affect signal to ECM. Repair connectors (para 7-77). Go to step 4.
- Damaged terminals could affect signal to ECM. Repair connectors (para 7-77). Go to step 4.
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON fault has been corrected.
Check terminals at both 5-way, injector harness connectors (both harness and ECM sides) for damaged, bent, corroded, and unseated pins or sockets.

CONTINUITY TEST

(4) Turn ENGINE switch OFF.
(5) Disconnect vehicle harness connector at ECM.
(6) Read resistance between pins A and M of 12-pin DDL connector.

NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

CHECK ENGINE INDICATOR

INSTRUMENT PANEL

5-WAY INJECTOR HARNESS CONNECTOR

DDL CONNECTOR

VEHICLE HARNESS CONNECTOR

ECM

LOW AIR CHECK ENGINE CHECK GUAGES
D2 INTERMITTENT CODE

1. Are there any historic codes?
   - KNOWN INFO
     Erratic or intermittent CHECK ENGINE light
   - POSSIBLE PROBLEMS
     Faulty connector
     Damaged terminals
     Faulty charging system or electrical relays
   - TEST OPTIONS
     DDR (Mode 2)
   - REASON FOR QUESTION
     Repairs complete. DDEC system is operating properly.
   - NO
   - YES

2. Follow appropriate diagnostic chart for historical code, then continue with step (3).
   - KNOWN INFO
     Erratic or intermittent CHECK ENGINE light
   - POSSIBLE PROBLEMS
     Faulty connector
     Damaged terminals
     Faulty charging system or electrical relays
   - TEST OPTIONS
     Follow appropriate DDEC fault code
   - REASON FOR QUESTION
     DDEC will record when a fault occurs, even though it may not be evident at the present time. If there are no historical codes present, no DDEC fault has occurred.

3. Does CHECK ENGINE indicator light stay on longer than five seconds?
   - KNOWN INFO
     Connectors OK
     Terminals OK
   - POSSIBLE PROBLEMS
     Faulty charging system or electrical relays
   - TEST OPTIONS
     Visual inspection
   - REASON FOR QUESTION
     Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned to ON, fault has been corrected.
   - NO
   - YES

START
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2–82 and you were referred here.

(1) When following appropriate Historic Codes, check for:
   a.) Poor mating of connector halves or terminals not fully seated in the connector body.
   b.) Improperly formed or damaged terminals. All connectors in problem circuit should be checked.
(2) Carefully inspect all wiring in the affected circuit.
(3) Do not replace any components unless you have followed the procedure to completion and have found no faults.
(4) After repairs have been made, clear codes (mode 40) and proceed to question (3).

Turn ENGINE switch ON and observe CHECK ENGINE indicator.
4. Is the electrical system operating properly?

- **Yes**: Repair system or components (see Electrical System Troubleshooting (e)). Then go to step 3.
- **No**: Fault not corrected. Notify supervisor.

**Known Info**
- Connectors OK
- Terminals OK

**Possible Problems**
- Faulty charging system or electrical relays

**Test Options**
- Visual inspection

**Reason for Question**
- Intermittent code can be caused by a voltage surge as the result of electrical system interference, caused by a defective relay or switch, or a charging system problem.
(1) Check 12 volt battery gage for 12–14 volts with engine running.

(2) Check for defective relays, ECM driven solenoid, or switch that may be causing system interference. In some cases the problem can be recreated when the faulty component is operated.
**D3 CHECK GAUGES LIGHT ALWAYS ON AND CODE 25 ON DDR**

1. **Does CHECK GAUGES indicator come on and stay on?**
   - NO: Normal operation.
   - YES: Normal operation.

2. **Does CHECK GAUGES indicator stay off with vehicle harness connector disconnected?**
   - NO: CHECK GAUGES indicator stays on, Notify supervisor if short is indicated.
   - YES: Normal operation.

3. **Are terminals at vehicle harness connectors (both ECM and harness side) OK?**
   - NO: Replace ECM (para 7-29).
   - YES: Repair terminals or connector (para 7-77). Then go to step 4.

**KNOWN INFO**
- CHECK GAUGES light always on and CODE 25 on DDR

**POSSIBLE PROBLEMS**
- CHECK GAUGES indicator driver line shorted
- Damaged ECM connectors

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- CHECK GAUGES indicator should light for approximately five seconds and then go out.

**KNOWN INFO**
- CHECK GAUGES indicator does not operate properly

**POSSIBLE PROBLEMS**
- CHECK GAUGES indicator driver line shorted
- Damaged ECM connectors

**TEST OPTIONS**
- Voltage Test
  - or
  - STE/ICE Test #89

**REASON FOR QUESTION**
- If light stays on, check gauges driver line (Ckt #509) is shorted to ground.

**KNOWN INFO**
- CHECK GAUGES indicator does not operate properly

**POSSIBLE PROBLEMS**
- Damaged ECM connectors

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damaged connectors could affect signal to ECM.

**START**
NOTE
The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

Turn ENGINE switch ON (engine not running) and observe CHECK GAUGES indicator.

VOLTAGE TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect vehicle harness connector at ECM.
(3) Turn ENGINE switch ON (engine not running) while observing CHECK GAUGES indicator.

Check terminals especially at vehicle harness connectors (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets. Pay close attention to B2 and B3.
D3  CHECK GAUGES LIGHT ALWAYS ON AND CODE 25 ON DDR (CONT)

**KNOWN INFO**
CHECK GAUGES indicator does not operate properly
CHECK GAUGES indicator driver line OK
ECM connectors OK

**POSSIBLE PROBLEMS**
None

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.

4. Does CHECK ENGINE indicator light stay on longer than five seconds?

- **YES**
  - Repair complete.

- **NO**
  - Fault not corrected. Notify supervisor.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
D4 NO CHECK GAUGES LIGHT DURING BULB CHECK

1. Does CHECK GAUGES indicator stay OFF when ECM is bypassed?
   - NO
     - CHECK GAUGES indicator on, go to step 4.
   - YES

2. Is there greater than or equal to 11.5 volts in 5 amp ignition circuit breaker and ignition line (Ckt #439)?
   - NO
     - Close circuit breaker. Notify supervisor if open or short is indicated.
   - YES

3. Is CHECK GAUGES light bulb OK?
   - NO
     - Replace bulb (para 7-40), go to step 8
   - YES
     - Notify supervisor if open is indicated.
NOTE

The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

(1) Turn ENGINE switch OFF.
(2) Disconnect vehicle harness connector at ECM.
(3) Install a jumper wire between socket B2 on the vehicle harness connector and a good ground.
(4) Turn ENGINE switch ON (engine not running) and note STOP ENGINE light status.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

VOLTAGETEST

(1) Remove jumper wire.
(2) Read voltage on vehicle harness connector, socket B3 (red lead) to a good ground.

Remove CHECK GAUGES light bulb (para 7-38) and check if burned out or damaged.
### D4 NO CHECK GAUGES LIGHT DURING BULB CHECK (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK GAUGES indicator or circuit faulty</td>
<td>Voltage Test or STE/ICE Test #89</td>
<td>Reading less than 11.5 volts at vehicle harness connector indicates open ignition line (Ckt #439).</td>
</tr>
</tbody>
</table>

4. **Is there greater than or equal to 11.5 volts in ignition line (Ckt #439)?**

   - **YES**: Notify supervisor if open is indicated.
   - **NO**: 

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open in ignition line Battery lines open or shorted Open in ground line Damaged ECM terminals</td>
<td>CHECK GAUGES indicator or circuit faulty Ignition line OK CHECK GAUGES indicator line OK No open in ignition line</td>
<td>Voltage Test or STE/ICE Test #89</td>
<td>Close circuit breaker. Notify supervisor if open or short is indicated.</td>
</tr>
</tbody>
</table>

5. **Is there greater than or equal to 11.5 volts in ECM circuit breaker and battery power lines (Ckts 240 and 241)?**

   - **NO**: Close circuit breaker. Notify supervisor if open or short is indicated.
   - **YES**: 

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery lines open or shorted Open in ground line Damaged ECM terminals</td>
<td>CHECK GAUGES indicator or circuit faulty Ignition line OK CHECK GAUGES indicator line OK No open in ignition line Battery power OK</td>
<td>Voltage Test or STE/ICE Test #89</td>
<td>Less than 11.5 volts at power harness connector indicates open ECM circuit breaker and/or power lines (Ckts #240 and #241) are open or shorted to ground.</td>
</tr>
</tbody>
</table>

6. **Is there greater than or equal to 11.5 volts in ground line (Ckt #150)?**

   - **NO**: Notify supervisor if open is indicated.
   - **YES**: 

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open in ground line Damaged ECM terminals</td>
<td>CHECK GAUGES indicator or circuit faulty Ignition line OK CHECK GAUGES indicator line OK No open in ignition line Battery power OK</td>
<td>Voltage Test or STE/ICE Test #89</td>
<td>Less than 11.5 volts at power harness connector indicates open in ground line (Ckt #150).</td>
</tr>
</tbody>
</table>
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

VOLTAGE TEST
(1) Remove jumper wire.
(2) Read voltage on vehicle harness connector, socket B3 (red lead) to a good ground (black lead).

VOLTAGE TEST
(1) Turn ENGINE switch OFF.
(2) Disconnect 6-way power harness connector at ECM.
(3) Read voltage on 6-way power harness connector socket A (red lead) to a good ground (black lead).
(4) Also read voltage on socket E (red lead) to socket D (black lead).

VOLTAGE TEST
(1) Read voltage on 6-way power harness connector, socket A (red lead) to socket C (black lead).
(2) Read voltage on 6-way power harness connector, socket E (red lead) to socket D (black lead).
### D4 NO CHECK GAUGES LIGHT DURING BULB CHECK (CONT)

#### KNOWN INFO
- CHECK GAUGES indicator or circuit faulty
- Ignition line OK
- CHECK GAUGES indicator line OK
- No open in ignition line
- Battery power OK
- No open in ground line

#### POSSIBLE PROBLEMS
- Damaged ECM terminals

#### TEST OPTIONS
- Visual inspection

#### REASON FOR QUESTION
- Damaged ECM connectors could affect signal to ECM.

#### KNOWN INFO
- CHECK GAUGES indicator or circuit faulty
- Ignition line OK
- CHECK GAUGES indicator line OK
- No open in ignition line
- Battery power OK
- No open in ground line
- Damaged ECM terminals

#### POSSIBLE PROBLEMS

#### TEST OPTIONS
- Visual inspection

#### REASON FOR QUESTION
- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.

---

**7.** Are terminals at ECM harness and engine harness connectors OK?

- **NO**
  - Repair terminals or connector (para 7-77). Then go to step 8.
  - Replace ECM (para 7-29).

- **YES**
  - Fault not corrected. Notify supervisor.

**8.** Does CHECK ENGINE indicator light stay on longer than five seconds?

- **NO**
  - Repair complete.

- **YES**
  - Fault not corrected. Notify supervisor.
(1) Check terminals for damaged, bent, corroded, and unseated pins or sockets.
(2) Pay attention to terminals B2 and B3 of the vehicle harness connector and C and D of the power harness.

(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
D5 POWER TAKE-OFF (PTO) HIGH IDLE NOT WORKING

**KNOWN INFO**
- PTO high idle not working
- Vehicle Troubleshooting completed
- Power on wire no. 510 to ECM

**POSSIBLE PROBLEMS**
- ECM reading Vernier Control sensor
- ECM connectors damaged
- Open in signal or ground line
- +5 volt line open
- Short between signal and ground
- Vernier control connectors or resistance

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**

1. **Is throttle position sensor at 0% at idle?**
   - NO: Go to A4 - Code 22, step 3.
   - YES: Go to step 5.

2. **Does DDR reader display change smoothly from idle to 1500 rpm?**
   - NO: Go to step 5.
   - YES: ECM may be faulty if it fails to read Vernier Control.

3. **Does engine rpm fail to increase when ENGINE SPEED CONTROL switches are positioned to HIGH ENGINE IDLE?**
   - NO: Problem no longer exists. Go to D2.
   - YES: To verify problem.
NOTE

- Vehicle troubleshooting must be performed first before attempting to use this chart.
- The following flow chart should only be used if DDEC troubleshooting was started on p. 2-80 and you were referred here.

1. Turn ENGINE switch ON.
2. Plug in DDR into the 12-pin DDL connector.
3. Read throttle % at idle using the DDR.

---

(1) Start engine (TM 9-2320-360-10).
(2) Position transmission range selector to N (neutral).
(3) Select the PTO RPM on the DDR reader.
(4) Position left ENGINE SPEED CONTROL switch to HIGH ENGINE IDLE and press PUSH TO LOCK ENGINE @ HIGH IDLE switch. Note reading on DDR.
(5) Shut off engine (TM 9-2320-360-10).

---

(1) Start engine (TM 9-2320-360-10) and run at idle.
(2) Using the DDR reader, make sure that vehicle speed is less than 5 mph and % throttle is 0.
(3) Position left ENGINE SPEED CONTROL switch to HIGH ENGINE IDLE and press PUSH TO LOCK ENGINE @ HIGH IDLE switch. Note reading on DDR and tachograph.
D5 POWER TAKE-OFF (PTO) HIGH IDLE NOT WORKING (CONT)

**KNOWN INFO**
ECM not reading Vernier Control

**POSSIBLE PROBLEMS**
ECM connectors damaged
Open in signal or ground line
+5 volt line open
Short between signal and ground
Vernier control connectors or resistance

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Damage to connectors could affect signal to ECM.

---

**KNOWN INFO**
ECM reading Vernier Control OK
ECM connectors OK

**POSSIBLE PROBLEMS**
Open in signal or ground line
+5 volt line open
Short between signal and ground
Vernier control connectors or resistance

**TEST OPTIONS**
Continuity Test or STE/ICE–R Test #91

**REASON FOR QUESTION**
Resistance greater than 5 ohms at vehicle harness connector. Indicates signal line (Ckt # 525 or # 510), ground line (Ckt # 952), or neutral interlock is open.

---

**KNOWN INFO**
ECM reading Vernier Control OK
ECM connectors OK
No open in signal or ground line

**POSSIBLE PROBLEMS**
+5 volt line open
Short between signal and ground
Vernier control connectors or resistance

**TEST OPTIONS**
Continuity Test or STE/ICE–R Test #91

**REASON FOR QUESTION**
Resistance greater than 5 ohms at vehicle harness connector indicates open in + 5 volt line (Ckt # 916).

---

4. Are ECM and ECM harness terminals and connectors OK?

**TEST OPTIONS**

**REASON FOR QUESTION**

---

5. Is there less than or equal to 5 Ohms in signal line (Ckt # 525 or 510), ground line (Ckt # 952), and neutral interlock circuits?

**TEST OPTIONS**

**REASON FOR QUESTION**

---

6. Is there less than or equal to 5 Ohms in +5 volt line (Ckt #916)?

**TEST OPTIONS**

**REASON FOR QUESTION**

---
(1) Turn ENGINE switch OFF.
(2) Position transmission range selector to N (neutral).
(3) Disconnect vehicle harness connector at ECM.
(4) Disconnect vernier control connector.
(5) Install a jumper between pins A and B of vernier control harness connector.
(6) Read resistance between sockets D1 and C3 on vehicle harness connector.

CONTINUITY TEST

(1) Move jumper to between pins C and A of vernier control harness connector.
(2) Read resistance between sockets A3 and C3 on vehicle harness connector.

Check terminals at ECM engine harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.
D5  POWER TAKE-OFF (PTO) HIGH IDLE NOT WORKING (CONT)

7. Is there greater than 10,000 Ohms or open in signal line (Ckt #525 or #510) or neutral interlock circuits (no shorts to ground: either Ckt #952 or chassis ground)?

- **YES**
  - ECM reading Vernier Control OK
  - ECM connectors OK
  - No open in signal or ground line +5 volt line OK
  - No short between signal and ground

  **POSSIBLE PROBLEMS**
  - Vernier control connectors or resistance

  **TEST OPTIONS**
  - Continuity Test
  - STE/ICE--R Test #91

  **REASON FOR QUESTION**
  - Resistance less than or equal to 10,000 ohms at which harness connector indicates short. Signal line (Ckt #525 or #510) or neutral interlock is shorted to ground.

- **NO**
  - Notify supervisor if short is indicated.

8. Is there greater than 10,000 Ohms or open in +5 volt line (Ckt #916) (not shorted to either Ckt #952 or chassis ground)?

- **NO**
  - Notify supervisor if short is indicated.

- **YES**
  - ECM reading Vernier Control OK
  - ECM connectors OK
  - No open in signal or ground line +5 volt line OK
  - No short between signal and ground

  **POSSIBLE PROBLEMS**
  - Vernier control connectors or resistance

  **TEST OPTIONS**
  - Continuity Test
  - STE/ICE--R Test #91

  **REASON FOR QUESTION**
  - Resistance less than 10,000 ohms at which harness connector indicates short in +5 volt line (Ckt #916).

9. Are vernier control connectors OK?

- **YES**
  - ECM reading Vernier Control OK
  - ECM connectors OK
  - No open in signal or ground line +5 volt line OK
  - No short between signal and ground

  **POSSIBLE PROBLEMS**
  - Vernier control connectors or resistance

  **TEST OPTIONS**
  - Visual inspection

  **REASON FOR QUESTION**
  - Damaged connectors could affect signal to vernier control.

- **NO**
  - Repair connectors (para 7–77). Then go to step 11.
CONTINUITY TEST

1. Disconnect vernier control.
2. Read resistance between sockets A3 and C3 on vehicle harness connector.
3. Read resistance between socket A3 and a good ground.

CONTINUITY TEST

1. Remove jumper wire.
2. Read resistance between sockets D1 and C3 on vehicle harness connector.
3. Read resistance between socket D1 and a good ground.

Check terminals (sensor side and harness side) for damaged, bent, corroded, and unseated pins or sockets.
**D5 POWER TAKE-OFF (PTO) HIGH IDLE NOT WORKING (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM reading Vernier Control OK</td>
<td>Continuity Test or STE/ICE-R Test #91</td>
</tr>
<tr>
<td>ECM connectors OK</td>
<td></td>
</tr>
<tr>
<td>No open in signal or ground line</td>
<td></td>
</tr>
<tr>
<td>+5 volt line OK</td>
<td></td>
</tr>
<tr>
<td>No short between signal and ground</td>
<td></td>
</tr>
</tbody>
</table>

**POSSIBLE PROBLEMS**

- Vernier control connectors or resistance

---

10. **Are vernier control resistance readings OK?**

   - **NO**
     - Replace vernier control (para 7-76). Go to step 11.

   - **YES**
     - Repair complete.

---

11. **Does CHECK ENGINE indicator light stay on longer than five seconds?**

   - **NO**
     - Repair complete.

   - **YES**
     - Fault not corrected. Notify supervisor.

**REASON FOR QUESTION**

- Vernier control is faulty if 2000 ohms is not measured between terminals A and B and if 1800 ohms is not measured between terminals B and C.

---

**TEST OPTIONS**

- Visual inspection

**REASON FOR QUESTION**

- Verify repairs. If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.

CONTINUITY TEST

(1) Read resistance between terminals A and B on vernier control.
(2) Read resistance between terminals B and C on vernier control.
D6 ENGINE BRAKE IS ALWAYS ON

START

1. Does DDR indicate that ECM is programmed for engine brake control?
   - YES: Replace ECM (para 7-29). Then go to step 4.
   - NO: ECM not properly programmed
     - Short to ground in vehicle harness
     - Damaged ECM connectors

2. Is there greater than 100 Ohms or open in Ckt. #508?
   - YES: Notify supervisor if short is indicated.
   - NO: Short to ground in vehicle harness
     - Damaged ECM connectors

3. Are terminals at ECM harness and engine harness connectors OK?
   - YES: Repair terminals or connector (para 7-77). Then go to step 4.
   - NO: ECM connectors damaged
     - Short to ground in vehicle harness
     - Damaged ECM connectors

KNOWN INFO
- Engine brake is always on

POSSIBLE PROBLEMS
- ECM not properly programmed
- Short to ground in vehicle harness
- Damaged ECM connectors

TEST OPTIONS
- DDR

REASON FOR QUESTION
- To identify control logic, ECM is programmed incorrectly if ENG BRK ENABLE is on.

TEST OPTIONS
- Continuity Test
- STE/ICE Test #91

REASON FOR QUESTION
- Short is suspect. Reading less than 100 ohms at vehicle harness connector indicates a short to ground in Ckt #508.

TEST OPTIONS
- Visual inspection

REASON FOR QUESTION
- Damaged connectors are suspect and could affect signal to ECM.

KNOWN INFO
- ECM properly programmed
- No short to ground

POSSIBLE PROBLEMS
- ECM connectors damaged
Check terminals and connectors (both ECM and harness side) for damage; bent, corroded, or unseated pins or sockets, especially terminal A1 (Ckt #508).

**NOTE**

The following flow chart should only be used if DDEC troubleshooting was started on p. 2–80 and you were referred here.

1. Start engine (TM 9–2320–360–10) and run at idle.
2. Plug in DDR and select MISC OUTPUTS.
3. Observe DDR display labeled ENG BRK ENABLE.
4. If display reads OFF, ECM is programmed for engine brake control; if display reads ON, ECM programmed for transmission retarder control.

**CONTINUITY TEST**

1. Turn ENGINE switch OFF.
2. Disconnect vehicle harness at ECM connector.
3. Read resistance between socket A1 of vehicle harness connector and a good ground.
D6  ENGINE BRAKE IS ALWAYS ON (CONT)

**KNOWN INFO**
ECM properly programmed
No short to ground
ECM connectors OK

**POSSIBLE PROBLEMS**
None

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.

---

4. Does CHECK ENGINE indicator light stay on longer than five seconds?

- **YES**
- **NO**

** Fault not corrected. Notify supervisor. **

** Repair complete. **
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
D7 ENGINE BRAKE NOT WORKING

1. Does DDR indicate that ECM is programmed for engine brake control?
   - YES
   - NO
     - Replace ECM (para 7-29). Then go to step 4.

2. Is ECM engine brake control operating correctly?
   - YES
   - NO
     - Replace ECM (para 7-29). Then go to step 4.

3. Are terminals and connectors (both ECM and harness side) OK?
   - YES
   - NO
     - Repair terminals or connector (para 7-77). Then go to step 4.

**Known Info**
- Engine brake not working
- Vehicle Troubleshooting completed

**Possible Problems**
- ECM not properly programmed
- ECM not operating
- Damaged ECM connectors

**Reason for Question**
- DDR
- To verify control logic. ECM is programmed incorrectly if ENG BRK ENABLE is on.

**Test Options**
- DDR

**Reason for Question**
- If DDR always reads OFF, ECM is faulty.

**Reason for Question**
- Damaged connectors are suspect could affect signal to ECM.

**Known Info**
- ECM properly programmed
- ECM operating OK

**Possible Problems**
- ECM not operating
- Damaged ECM connectors

**Test Options**
- Visual inspection

**Reason for Question**
- There is an open in Ckt # 508 or the fault exists outside the DDEC system.
Check terminals and connectors at vehicle harness connector (both ECM and harness side) for damage; bent, corroded, or unseated pins or sockets, especially terminal A1 (Ckt #508).

NOTE

• Vehicle troubleshooting must be performed first, before attempting to use this chart.

• The following flow chart should only be used if DDEC troubleshooting was started on p. 2-82 and you were referred here.

(1) Start engine (TM 9-2320-360-10) and run at idle.
(2) Plug in DDR and select MISC OUTPUTS.
(3) Observe DDR display labeled ENG BRK ENABLE.
(4) If display reads OFF, ECM is programmed for engine brake control; if display reads ON, ECM programmed for transmission retarder control.

(1) Rev up the engine, then quickly take foot off throttle.

NOTE

DDR should read OFF when engine is started and while increasing or holding throttle. When throttle is released, display should change to ON. When engine returns to idle, DDR should read OFF.

(2) Observe DDR display line labeled ENG BRK ENABLE.
D7 ENGINE BRAKE NOT WORKING (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM properly programmed</td>
</tr>
<tr>
<td>ECM operating OK</td>
</tr>
<tr>
<td>ECM connectors OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

4. Does CHECK ENGINE indicator light stay on longer than five seconds?

- **YES**
  - Fault not corrected. Notify supervisor.

- **NO**
  - Repair complete.

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>If CHECK ENGINE indicator lights for approximately five seconds and then goes out after ENGINE switch is turned ON fault has been corrected.</td>
</tr>
</tbody>
</table>
(1) Turn ENGINE switch OFF.
(2) Reconnect all harness connectors.
(3) Turn ENGINE switch ON and observe CHECK ENGINE indicator.
VEHICLE TROUBLESHOOTING

TRUCK, TRACTOR, M1070
HEAVY EQUIPMENT TRANSPORTER (HET)
### Table 2-7. Vehicle Troubleshooting

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. ENGINE</strong></td>
<td></td>
</tr>
<tr>
<td>a1. Engine fails to crank</td>
<td>2-366</td>
</tr>
<tr>
<td>a2. Engine cranks but fails to start</td>
<td>2-386</td>
</tr>
<tr>
<td>a3. Engine does not develop full power</td>
<td>2-390</td>
</tr>
<tr>
<td>a4. Low engine oil pressure</td>
<td>2-392</td>
</tr>
<tr>
<td>a5. Excessive engine oil consumption</td>
<td>2-396</td>
</tr>
<tr>
<td>a6. Engine overheats (WATER TEMP gage continuously reads over 230°F (110°C)</td>
<td>2-400</td>
</tr>
<tr>
<td>a7. Excessive black or gray exhaust smoke (engine at normal operating</td>
<td>2-402</td>
</tr>
<tr>
<td>temperature)</td>
<td></td>
</tr>
<tr>
<td>a8. Blue exhaust smoke (engine at normal operating temperature)</td>
<td>2-404</td>
</tr>
<tr>
<td>a9. White exhaust smoke (engine at normal operating temperature)</td>
<td>2-406</td>
</tr>
<tr>
<td>a10. Deleted</td>
<td></td>
</tr>
<tr>
<td><strong>b. FUEL SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>b1. Engine cranks but fails to start or engine stalls after starting</td>
<td>2-414</td>
</tr>
<tr>
<td>b2. Engine starts but misfires, runs rough, or lacks power</td>
<td>2-418</td>
</tr>
<tr>
<td>b3. Ether starting aid does not operate</td>
<td>2-422</td>
</tr>
<tr>
<td><strong>c. EXHAUST SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>c1. Exhaust system unusually noisy or vibrates excessively during engine</td>
<td>2-428</td>
</tr>
<tr>
<td>operation</td>
<td></td>
</tr>
<tr>
<td>c2. Exhaust fumes in cab</td>
<td>2-432</td>
</tr>
<tr>
<td><strong>d. COOLING SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>d1. Engine overheats (WATER TEMP gage continuously reads over 230°F (110°C)</td>
<td>2-438</td>
</tr>
</tbody>
</table>
### Table 2-7. Vehicle Troubleshooting (Cont)

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>e. ELECTRICAL SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>e1. Alternator(s) undercharging</td>
<td>2-460</td>
</tr>
<tr>
<td>e1.1. Alternator(s) overcharging</td>
<td>2-466</td>
</tr>
<tr>
<td>e2. Electrical components (12 volt and 24 volt) do not operate</td>
<td>2-468</td>
</tr>
<tr>
<td>e3. 12 volt electrical components do not operate</td>
<td>2-472</td>
</tr>
<tr>
<td>e4. All 12 volt electric gages do not operate</td>
<td>2-476</td>
</tr>
<tr>
<td>e5. One electric gage does not operate or is inaccurate</td>
<td>2-480</td>
</tr>
<tr>
<td>e6. Ether starting aid does not operate</td>
<td>2-484</td>
</tr>
<tr>
<td>e7. Horn (city) does not operate</td>
<td>2-490</td>
</tr>
<tr>
<td>e8. Instrument panel gage and switch lights do not operate</td>
<td>2-498</td>
</tr>
<tr>
<td>e9. Windshield wipers do not operate</td>
<td>2-502</td>
</tr>
<tr>
<td>e10. Windshield wipers do not operate in high speed</td>
<td>2-506</td>
</tr>
<tr>
<td>e11. Windshield washer does not operate</td>
<td>2-510</td>
</tr>
<tr>
<td>e12. Low air indicator light and/or alarm do not operate when air</td>
<td>2-514</td>
</tr>
<tr>
<td>pressure is below 65 psi (448 kPa)</td>
<td></td>
</tr>
<tr>
<td>e13. Headlights do not operate</td>
<td>2-520</td>
</tr>
<tr>
<td>e14. Headlight low/high beam does not operate</td>
<td>2-528</td>
</tr>
<tr>
<td>e15. Turn signal light does not operate</td>
<td>2-534</td>
</tr>
<tr>
<td>e15.1. Turn signal indicator light does not operate</td>
<td>2-545.1</td>
</tr>
<tr>
<td>e16. Clearance, marker, parking, or tail light does not operate</td>
<td>2-546</td>
</tr>
<tr>
<td>e17. All blackout lights do not operate</td>
<td>2-554</td>
</tr>
<tr>
<td>e18. Blackout clearance, marker, or tail lights does not operate</td>
<td>2-558</td>
</tr>
<tr>
<td>e19. Blackout drive light does not operate</td>
<td>2-564</td>
</tr>
<tr>
<td>e20. Trailer blackout tail lights do not operate (Blackout lights on HET</td>
<td>2-568</td>
</tr>
<tr>
<td>Tractor operate)</td>
<td></td>
</tr>
<tr>
<td>e21. Stop lights do not operate</td>
<td>2-576</td>
</tr>
<tr>
<td>e22. Blackout stop lights do not operate</td>
<td>2-582</td>
</tr>
<tr>
<td>e23. Engine brake does not operate</td>
<td>2-586</td>
</tr>
<tr>
<td>e24. Dome light does not operate</td>
<td>2-594</td>
</tr>
<tr>
<td>e25. Map light(s) do not operate</td>
<td>2-598</td>
</tr>
<tr>
<td>e26. Beacon light does not operate</td>
<td>2-602</td>
</tr>
<tr>
<td>e27. Backup light/alarm do not operate</td>
<td>2-610</td>
</tr>
<tr>
<td>e28. Speedometer does not operate</td>
<td>2-616</td>
</tr>
<tr>
<td>e29. Tachometer does not operate</td>
<td>2-620</td>
</tr>
<tr>
<td>e30. Clock does not operate</td>
<td>2-624</td>
</tr>
<tr>
<td>e31. All trailer lights do not operate (lights on HET Tractor operate)</td>
<td>2-628</td>
</tr>
<tr>
<td>e32. Ventilator does not operate</td>
<td>2-628.2</td>
</tr>
</tbody>
</table>
Table 2-7. Vehicle Troubleshooting (Cont)

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>f. TRANSMISSION</strong></td>
<td></td>
</tr>
<tr>
<td>f1. Transmission overheats (TRANS TEMP gage continuously reads over 250°F (121°C).)</td>
<td>2–630</td>
</tr>
<tr>
<td>f2. Transmission unusually noisy when operating</td>
<td>2–634</td>
</tr>
<tr>
<td>f3. Transmission will not shift into gear, slips out of gear, or operates erratically</td>
<td>2–638</td>
</tr>
<tr>
<td>f4. Vehicle moves in neutral</td>
<td>2–640</td>
</tr>
<tr>
<td>f5. Transmission shifts rough</td>
<td>2–642</td>
</tr>
<tr>
<td>f6. Transmission slips in all forward gears</td>
<td>2–646</td>
</tr>
<tr>
<td>f7. Automatic shifts occur at too high or low a speed</td>
<td>2–648</td>
</tr>
<tr>
<td>f8. Engine stalls at idle when in gear</td>
<td>2–652</td>
</tr>
<tr>
<td><strong>g. TRANSFER CASE</strong></td>
<td></td>
</tr>
<tr>
<td>g1. Transfer case unusually noisy when operating</td>
<td>2–656</td>
</tr>
<tr>
<td>g2. Transfer case does not shift into HIGH or LOW, or slips out of gear</td>
<td>2–660</td>
</tr>
<tr>
<td>g3. Transfer case overheats. (T–CASE TEMP gage continuously reads over 250°F (121°C).)</td>
<td>2–662</td>
</tr>
<tr>
<td>g4. Transfer case does not engage front axle when transfer case shift lever is positioned to LOW</td>
<td>2–666</td>
</tr>
<tr>
<td>g5. Transfer case does not engage front axle when transfer case shift lever is in HIGH position, and DRIVELINE control is positioned to LOCK</td>
<td>2–670</td>
</tr>
<tr>
<td><strong>h. PROPELLER SHAFTS AND UNIVERSAL JOINTS</strong></td>
<td></td>
</tr>
<tr>
<td>h1. Propeller shafts or universal joints unusually noisy when operating</td>
<td>2–676</td>
</tr>
<tr>
<td>h2. Propeller shafts do not supply torque to axles or hydraulic pump</td>
<td>2–680</td>
</tr>
<tr>
<td><strong>i. POWER TAKEOFF (PTO)</strong></td>
<td></td>
</tr>
<tr>
<td>i1. PTO does not engage</td>
<td>2–684</td>
</tr>
<tr>
<td>i2. PTO makes excessive or unusual noise during operation</td>
<td>2–694</td>
</tr>
<tr>
<td>i3. PTO indicator does not light when PTO is engaged</td>
<td>2–696</td>
</tr>
<tr>
<td><strong>j. AIR BRAKE SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>j1. Spring brake(s) will not release</td>
<td>2–706</td>
</tr>
<tr>
<td>j2. Service brake(s) will not respond properly</td>
<td>2–712</td>
</tr>
<tr>
<td>j3. Uneven braking (pulling)</td>
<td>2–714</td>
</tr>
<tr>
<td>j4. Service brake(s) fail to release/release slowly</td>
<td>2–718</td>
</tr>
<tr>
<td>j5. Service brake(s) grabbing</td>
<td>2–722</td>
</tr>
<tr>
<td>j6. Excessive loss of air pressure when braking</td>
<td>2–724</td>
</tr>
<tr>
<td>j7. Brake(s) overheat</td>
<td>2–728</td>
</tr>
<tr>
<td>j8. Spring brakes will not apply</td>
<td>2–732</td>
</tr>
<tr>
<td>j9. Automatic slack adjuster does not operate</td>
<td>2–736</td>
</tr>
</tbody>
</table>
### Table 2-7. Vehicle Troubleshooting (Cont)

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>k. AIR SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>k1. Air system looses pressure during operation or air pressure buildup is slow</td>
<td>2-750</td>
</tr>
<tr>
<td>k2. Large quantity of moisture expelled from reservoirs</td>
<td>2-758</td>
</tr>
<tr>
<td>k3. Air dryer(s) continually purge</td>
<td>2-762</td>
</tr>
<tr>
<td>k3.1 Air dryer(s) fail to purge</td>
<td>2-762.4</td>
</tr>
<tr>
<td>k4. Relief valve on air dryer releasing air</td>
<td>2-764</td>
</tr>
<tr>
<td>k4.1 Relief valve on aftercooler releasing air</td>
<td>2-765.1</td>
</tr>
<tr>
<td>k5. Compressor fails to unload. (Air system pressure builds up to more than 125 psi (862 kPa))</td>
<td>2-766</td>
</tr>
<tr>
<td>k6. Noisy air compressor operation</td>
<td>2-768</td>
</tr>
<tr>
<td>k7. Coolant and/or lubricant leaks from compressor</td>
<td>2-772</td>
</tr>
<tr>
<td>k8. Air pressure drops rapidly after engine shutdown</td>
<td>2-776</td>
</tr>
<tr>
<td>k9. Windshield washer does not operate</td>
<td>2-780</td>
</tr>
<tr>
<td>k10. Horn (country) does not operate</td>
<td>2-786</td>
</tr>
<tr>
<td>k11. Horn (city) does not operate</td>
<td>2-790</td>
</tr>
<tr>
<td>k12. Transfer case does not engage front axle when transfer case shift lever is positioned to LOW</td>
<td>2-796</td>
</tr>
<tr>
<td>k13. Transfer case does not engage front axle when transfer case shift lever is positioned to HIGH and driveline control is positioned to LOCK</td>
<td>2-800</td>
</tr>
<tr>
<td><strong>m. WHEELS, TIRES, AND HUBS</strong></td>
<td></td>
</tr>
<tr>
<td>m1. Tires wear unevenly or excessively</td>
<td>2-806</td>
</tr>
<tr>
<td>m2. Wheel wobbles or shimmies</td>
<td>2-808</td>
</tr>
<tr>
<td><strong>n. CENTRAL TIRE INFLATION SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>n1. One tire will not inflate</td>
<td>2-812</td>
</tr>
<tr>
<td>n2. Excess inflation time, CTI indicator flashes too long or continually</td>
<td>2-816</td>
</tr>
<tr>
<td>n3. CTIS inoperative</td>
<td>2-826</td>
</tr>
<tr>
<td>n4. Tires do not deflate to lower pressure setting</td>
<td>2-830</td>
</tr>
<tr>
<td>n5. Tire pressures do not agree with CTI settings</td>
<td>2-836</td>
</tr>
<tr>
<td>n6. Power manifold clicks continually</td>
<td>2-840</td>
</tr>
<tr>
<td>n7. Deleted</td>
<td></td>
</tr>
<tr>
<td>n8. Tires deflate upon completion of adjustment cycle</td>
<td>2-852</td>
</tr>
<tr>
<td>n9. CTI low air indicator stays on over 90 psi (621 kPa)</td>
<td>2-858</td>
</tr>
<tr>
<td>n10. Overspeed light does not function</td>
<td>2-862</td>
</tr>
<tr>
<td>n11. Deleted</td>
<td></td>
</tr>
<tr>
<td><strong>p. AXLES</strong></td>
<td></td>
</tr>
<tr>
<td>p1. Axle unusually noisy when operating</td>
<td>2-876</td>
</tr>
<tr>
<td>p2. Interaxle lockup does not engage</td>
<td>2-882</td>
</tr>
</tbody>
</table>
### Table 2-7. Vehicle Troubleshooting (Cont)

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>q. STEERING SYSTEM</td>
<td></td>
</tr>
<tr>
<td>q1. Hard to steer</td>
<td>2–888</td>
</tr>
<tr>
<td>q2. Wanders, pulls to one side, or shimmies</td>
<td>2–896</td>
</tr>
<tr>
<td>q3. Excessive play when turning steering wheel</td>
<td>2–902</td>
</tr>
<tr>
<td>q4. No response when turning steering wheel</td>
<td>2–906</td>
</tr>
<tr>
<td>q5. No response at no. 1 axle when turning steering wheel</td>
<td>2–908</td>
</tr>
<tr>
<td>q6. No response at no. 4 axle when turning steering wheel</td>
<td>2–912</td>
</tr>
<tr>
<td>q7. Steering binds, does not return to straight ahead after turns</td>
<td>2–916</td>
</tr>
<tr>
<td>r. FIFTH WHEEL</td>
<td></td>
</tr>
<tr>
<td>r1. Fifth wheel will not lock when coupling trailer to HET Tractor</td>
<td>2–918</td>
</tr>
<tr>
<td>r2. Excessive movement of trailer king pin in fifth wheel</td>
<td>2–922</td>
</tr>
<tr>
<td>r3. Fifth wheel will not unlock when disconnecting trailer from HET Tractor</td>
<td>2–924</td>
</tr>
<tr>
<td>s. SUSPENSION SYSTEM</td>
<td></td>
</tr>
<tr>
<td>s1. Wanders, pulls to one side, or shimmies</td>
<td>2–928</td>
</tr>
<tr>
<td>s2. Leans to one side, or rear of vehicle sags</td>
<td>2–934</td>
</tr>
<tr>
<td>t. WINCH SYSTEM</td>
<td></td>
</tr>
<tr>
<td>t1. Both main winches and auxiliary winch do not operate</td>
<td>2–940</td>
</tr>
<tr>
<td>t2. One main winch does not operate in either direction</td>
<td>2–944</td>
</tr>
<tr>
<td>t3. Both main winches do not operate</td>
<td>2–948</td>
</tr>
<tr>
<td>t4. Auxiliary winch does not operate</td>
<td>2–950</td>
</tr>
<tr>
<td>t5. Cable hold down does not operate</td>
<td>2–954</td>
</tr>
<tr>
<td>t6. Main winch high speed will not work</td>
<td>2–958</td>
</tr>
<tr>
<td>t7. Engine does not operate at high idle when engine speed control switches are properly positioned</td>
<td>2–962</td>
</tr>
<tr>
<td>t8. Main winch or auxiliary winch makes excessive or unusual noise operates slowly, or jerks</td>
<td>2–970</td>
</tr>
<tr>
<td>t9. One main winch will not pull load</td>
<td>2–974</td>
</tr>
<tr>
<td>t10. One main winch will not pay out (using control valve)</td>
<td>2–976</td>
</tr>
<tr>
<td>u. ARCTIC KIT</td>
<td></td>
</tr>
<tr>
<td>u1. Arctic kit coolant pump does not operate</td>
<td>2–978</td>
</tr>
</tbody>
</table>
## a. ENGINE

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a1. Engine fails to crank</td>
<td>2–366</td>
</tr>
<tr>
<td>a2. Engine cranks but fails to start</td>
<td>2–386</td>
</tr>
<tr>
<td>a3. Engine does not develop full power</td>
<td>2–390</td>
</tr>
<tr>
<td>a4. Low engine oil pressure</td>
<td>2–392</td>
</tr>
<tr>
<td>a5. Excessive engine oil consumption</td>
<td>2–396</td>
</tr>
<tr>
<td>a6. Engine overheats (WATER TEMP gage continuously reads over 230°F (110°C)</td>
<td>2–400</td>
</tr>
<tr>
<td>a7. Excessive black or gray exhaust smoke (engine at normal operating</td>
<td>2–402</td>
</tr>
<tr>
<td>temperature)</td>
<td></td>
</tr>
<tr>
<td>a8. Blue exhaust smoke (engine at normal operating temperature)</td>
<td>2–404</td>
</tr>
<tr>
<td>a9. White exhaust smoke (engine at normal operating temperature)</td>
<td>2–406</td>
</tr>
<tr>
<td>a10. Deleted</td>
<td></td>
</tr>
</tbody>
</table>
a1. ENGINE FAILS TO CRANK

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE-R (Item 47, Appendix F)
- Tester, Battery (Item 49, Appendix F)

---

**KNOWLEDGE INFO**
- Fault not corrected from TM 9–2320–360–10 troubleshooting

**POSSIBLE PROBLEMS**
- Faulty batteries
- Faulty wiring
- Faulty starter
- Loose engine switch wires
- Faulty engine switch
- Faulty neutral safety switch circuit
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch

---

**TEST OPTIONS**
- Visual inspection
- STE/ICE-R Test #67

**REASON FOR QUESTION**
- Starter will not operate if insufficient voltage is supplied to it.

---

**KNOWLEDGE INFO**
- Fault not corrected from TM 9–2320–360–10 troubleshooting
- Battery gage reads less than 22 volts

**POSSIBLE PROBLEMS**
- Battery(ies) have low specific gravity
- Battery(ies) have low voltage

---

**TEST OPTIONS**
- Battery Specific Gravity Test

**REASON FOR QUESTION**
- Battery(ies) require service if specific gravity measures less than 1.225 (1.180).
NOTE
ENGINE switch must be positioned to ON to perform this test.

Check BATTERY gage (24 volt system). BATTERY gage should read greater than 22 volts.

WARNING
Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Always wear eye protection when working with batteries.

BATTERY SPECIFIC GRAVITY TEST

NOTE
Separate test for each battery cell must be made.

(1) Remove caps from battery.
(2) Place a few drops of electrolyte on exposed portion of measuring window using black dipstick.
(3) Point tester toward light source and note reading.
(4) Install caps on battery.
(5) Repeat steps (1) thru (4) for remaining battery(ies).
a1. ENGINE FAILS TO CRANK (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault not corrected from TM 9-2320-360-10 troubleshooting</td>
<td>Battery Voltage Test or STE/ICE-R Test #89</td>
</tr>
<tr>
<td>Battery gage reads less than 22 volts</td>
<td></td>
</tr>
<tr>
<td>Battery specific gravity OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery(ies) have low voltage</td>
<td>Battery(ies) require service if individual batteries measure less than 10.5 volts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault not corrected from TM 9-2320-360-10 troubleshooting</td>
<td>Cables and Wires Check or STE/ICE-R Test #68</td>
</tr>
<tr>
<td>Batteries OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty wiring</td>
<td>Engine may fail to crank if cables and/or wires on starter are loose or damaged. If STE/ICE-R Test #68 is used, a reading of less than 21.7 volts indicates faulty connections.</td>
</tr>
<tr>
<td>Faulty starter</td>
<td></td>
</tr>
<tr>
<td>Loose engine switch wires</td>
<td></td>
</tr>
<tr>
<td>Faulty engine switch</td>
<td></td>
</tr>
<tr>
<td>Faulty neutral safety switch circuit</td>
<td></td>
</tr>
<tr>
<td>Faulty neutral relay</td>
<td></td>
</tr>
<tr>
<td>Faulty ignition relay</td>
<td></td>
</tr>
<tr>
<td>Faulty ignition circuit breaker</td>
<td></td>
</tr>
<tr>
<td>Faulty starter magnetic switch</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault not corrected from TM 9-2320-360-10 troubleshooting</td>
<td>Starter Voltage Test or STE/ICE-R Test #89</td>
</tr>
<tr>
<td>Batteries OK</td>
<td></td>
</tr>
<tr>
<td>Starter wires/cables OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty starter</td>
<td>Engine will not crank without voltage to starter from ignition control circuit.</td>
</tr>
<tr>
<td>Faulty wiring</td>
<td></td>
</tr>
<tr>
<td>Loose engine switch wires</td>
<td></td>
</tr>
<tr>
<td>Faulty engine switch</td>
<td></td>
</tr>
<tr>
<td>Faulty neutral safety switch circuit</td>
<td></td>
</tr>
<tr>
<td>Faulty neutral relay</td>
<td></td>
</tr>
<tr>
<td>Faulty ignition relay</td>
<td></td>
</tr>
<tr>
<td>Faulty ignition circuit breaker</td>
<td></td>
</tr>
<tr>
<td>Faulty starter magnetic switch</td>
<td></td>
</tr>
</tbody>
</table>

3. Is voltage of each battery over 10.5 volts?

- **YES**: Fault not corrected. Notify supervisor.
- **NO**: Replace battery(ies) (para 7-57).

4. Are cables and wires connected to starter secure and free from damage?

- **YES**: Secure loose connections. Replace damaged cable(s) (para 7-57). Notify supervisor if damaged wiring is found.
- **NO**: Fault not corrected. Notify supervisor.

5. Are 22-28 volts measured on SW terminal (wire no. 1045) at starter solenoid?

- **YES**: Go to step 8.
- **NO**: Fault not corrected from TM 9-2320-360-10 troubleshooting.
**BATTERY VOLTAGE TEST**

1. Place positive (+) probe of multimeter on positive (+) terminal of battery.
2. Place negative (-) probe of multimeter on negative (-) terminal of battery and look for over 10.5 volts on multimeter.
3. Repeat steps (1) and (2) for remaining battery(ies).

**CABLES AND WIRES CHECK**

**WARNING**

Batteries must be disconnected before checking cables and wires on starter. Failure to comply may result in personnel injury.

1. Disconnect batteries (para 7-57).
2. Remove left inner fender (para 16-34).
3. Check cables and wires on starter for loose connections or damage.
4. Connect batteries (para 7-57).

**STE/ICE TEST #68**

1. Connect STE/ICE test cable to STE/ICE receptacle in cab.
2. Set STE/ICE test select switch to "68".
3. Remove DDEC 6-way power harness connector from ECM.
4. Press and release TEST button.
5. Attempt to crank engine while observing STE/ICE display for test results.
6. Install DDEC 6-way power harness connector on ECM.

**STARTER VOLTAGE TEST**

**NOTE**

ENGINE switch must be positioned and held to START to perform this test.

1. Turn and hold ENGINE switch to START.
2. Place positive (+) probe of multimeter on wire no. 1045 at starter.
3. Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.
4. Turn ENGINE switch to OFF.
a1. ENGINE FAILS TO CRANK (CONT)

**KNOWN INFO**
- Fault not corrected from TM 9-2320-360-10 troubleshooting
- Batteries OK
- Engine switch OK
- Neutral safety switch circuit OK
- Neutral relay OK
- Ignition relay OK
- Ignition circuit breaker OK
- Starter magnetic switch OK

**POSSIBLE PROBLEMS**
- Faulty starter solenoid switch
- Faulty starter

**TEST OPTIONS**
- Solenoid Switch Test
  - STE/ICE-R Test #70

**REASON FOR QUESTION**
- Starter solenoid switch is faulty if low voltage is measured on wire no. 1819.

---

6. Are 22 to 28 volts measured at starter?

**TEST OPTIONS**
- STE/ICE-R Test #71
  - STE/ICE-R Test #72

**REASON FOR QUESTION**
- Starter is faulty if greater than 330 amps are measured when using STE/ICE-R Test #71, or if greater than 1561 amps are measured when using STE/ICE-R Test #72.

---

7. Does starter motor pass test?

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Engine may not crank if wires connected to ENGINE switch are loose or damaged.
SOLENOID SWITCH TEST

NOTE
ENGINE switch must be positioned and held to START to perform this test.

(1) Turn and hold ENGINE switch to START.
(2) Place positive (+) probe of multimeter on wire no. 1819 at starter solenoid.
(3) Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.
(4) Check wire no. 1819 on starter solenoid for loose connections or damage if no voltage is measured.

STE/ICE TEST #70

(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.
(2) Set STE/ICE test select switch to "70".
(3) Remove DDEC 6-way power harness connector from ECM.
(4) Press and release TEST button.
(5) Attempt to crank engine while observing STE/ICE display for test results.
(6) Install DDEC 6-way power harness connector on ECM.

STE/ICE TEST #71

(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.
(2) Set STE/ICE test select switch to "71".
(3) Remove DDEC 6-way power harness connector from ECM.
(4) Press and hold TEST button until "CAL" appears in display.
(5) Release TEST button and wait for offset value to appear in display.
(6) Press and release TEST button.
(7) Attempt to crank engine while observing STE/ICE display for test results.
(8) Install DDEC 6-way power harness connector on ECM.

STE/ICE TEST #72

(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.
(2) Set STE/ICE test select switch to "72".
(3) Remove DDEC 6-way power harness connector from ECM.
(4) Press and hold TEST button until "CAL" appears in display.
(5) Release TEST button and wait for offset value to appear in display.
(6) Press and release TEST button.
(7) Crank engine until "OFF" appears on STE/ICE display.
(8) Install DDEC 6-way power harness connector on ECM.

Check wires on ENGINE switch for loose connections.
a1. ENGINE FAILS TO CRANK (CONT)

**Known Info**
- Fault not corrected from TM 9-2320-360-10 troubleshooting
- Batteries OK

**Possible Problems**
- Loose engine switch wires
- Faulty engine switch
- Faulty neutral safety switch circuit
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch
- Faulty wiring

**Test Options**
- Engine Switch Feed Test or STE/ICE Test #89

**Reason for Question**
- Engine will not crank if low voltage is measured at BAT terminal (wire no. 1431) on ENGINE switch.

**Known Info**
- Fault not corrected from TM 9-2320-360-10 troubleshooting
- Batteries OK
- Engine switch wires OK

**Possible Problems**
- Faulty engine switch
- Faulty neutral safety switch circuit
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch
- Faulty wiring

**Test Options**
- Engine Switch Test or STE/ICE Test #89

**Reason for Question**
- ENGINE switch is faulty if low voltage is measured at IGN terminal (wire no. 1872).

**Known Info**
- Fault not corrected from TM 9-2320-360-10 troubleshooting
- Batteries OK
- Engine switch wires OK

**Possible Problems**
- Faulty engine switch
- Faulty neutral safety switch circuit
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch
- Faulty wiring

**Test Options**
- Engine Switch Test or STE/ICE Test #89

**Reason for Question**
- ENGINE switch is faulty if low voltage is measured at ST terminal (wire no. 1021).
**ENGINE SWITCH FEED TEST**

(1) Turn ENGINE switch to OFF.
(2) Place positive (+) probe of multimeter on BAT terminal (wire no. 1431) at ENGINE switch.
(3) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.
(4) Check for voltage at the following points if no voltage is measured at BAT terminal (wire no. 1431) of ENGINE switch.
   a) Check wire no. 1431 at 150 amp, 24 V circuit breaker. If no voltage is measured, circuit breaker is faulty.
   b) Check wire no. 1274 at 150 amp, 24 V circuit breaker. If no voltage is measured, circuit breaker is faulty.
   c) Check wire no. 1274 at starter motor. If no voltage is measured, there is an open in wire no. 1274.

**ENGINE SWITCH TEST**

**NOTE**
ENGINE switch must be positioned to ON to perform this test.
(1) Turn ENGINE switch to ON.
(2) Place positive (+) probe of multimeter on wire no. 1872 at IGN terminal of ENGINE switch.
(3) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.
(4) Turn ENGINE switch to OFF.

**ENGINE SWITCH TEST**

**NOTE**
ENGINE switch must be positioned and held to START to perform this test.
(1) Turn and hold ENGINE switch to START.
(2) Place positive (+) probe of multimeter on wire no. 1021 at ST terminal of ENGINE switch.
(3) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.
(4) Turn ENGINE switch to OFF.
a1. ENGINE FAILS TO CRANK (CONT)

**KNOWN INFO**
- Fault not corrected from TM 9–2320–360–10 troubleshooting
- Batteries OK
- Engine switch OK

**POSSIBLE PROBLEMS**
- Faulty wiring
- Faulty neutral safety switch circuit
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch

**TEST OPTIONS**
- Neutral Safety Circuit Test
- STE/ICE–R Test #91

**REASON FOR QUESTION**
- Go to step 23.

**12.**
Is there continuity between wire no. 1458 on NEUTRAL relay and ground?

**KNOWN INFO**
- Fault not corrected from TM 9–2320–360–10 troubleshooting
- Batteries OK
- Engine switch OK
- Neutral safety switch circuit OK

**POSSIBLE PROBLEMS**
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch
- Faulty wiring

**TEST OPTIONS**
- Ignition Circuit Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**
- Go to step 16.

**13.**
Are 10–14 volts measured on wire no. 1871 at NEUTRAL relay?

**KNOWN INFO**
- Fault not corrected from TM 9–2320–360–10 troubleshooting
- Batteries OK
- Engine switch OK
- Neutral safety switch circuit OK

**POSSIBLE PROBLEMS**
- Faulty neutral relay
- Faulty ignition relay
- Faulty ignition circuit breaker
- Faulty starter magnetic switch
- Faulty wiring

**TEST OPTIONS**
- Wire No. 1021 Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**
- Engine will not crank if wire no. 1021 from ENGINE switch to NEUTRAL relay is loose or damaged.

**14.**
Are 22–28 volts measured on wire no. 1021 at neutral relay?

**POSSIBLE PROBLEMS**
- Wire no. 1021 loose or damaged
- Faulty neutral relay
- Faulty starter magnetic switch

**TEST OPTIONS**
- Wire No. 1021 Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**
- Go to step 16.
IGNITION CIRCUIT TEST

NOTE
ENGINE switch must be positioned and held to START to perform this test.

(1) Turn and hold ENGINE switch to START.
(2) Place positive (+) probe of multimeter on wire no. 1871 at NEUTRAL relay.
(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF.

WIRE NO. 1021 TEST

NOTE
ENGINE switch must be positioned and held to START to perform this test.

(1) Turn and hold ENGINE switch to START.
(2) Place positive (+) probe of multimeter on wire no. 1021 at NEUTRAL relay.
(3) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.
(4) Turn ENGINE switch to OFF.
(5) Inspect wire no. 1021 between neutral relay and engine switch if no voltage is measured.

NEUTRAL SAFETY SWITCH CIRCUIT TEST

CAUTION
ENGINE switch must be positioned to OFF to perform this test. Failure to comply may result in damage to test equipment.

NOTE
Relay can be pulled out of socket slightly to provide easier access for test.

(1) Turn ENGINE switch to OFF.
(2) Set multimeter to ohms position.
(3) Place positive (+) probe of multimeter on wire no. 1458 at NEUTRAL relay.
(4) Place negative (−) probe of multimeter on ground and check multimeter for continuity.
a1. ENGINE FAILS TO CRANK (CONT)

**KNOWN INFO**
Fault not corrected from TM 9-2320-360-10 troubleshooting
Batteries OK
Engine switch OK
Neutral safety switch circuit OK
Ignition relay OK
Ignition circuit breaker OK
Wire no. 1021 OK

**POSSIBLE PROBLEMS**
Wires no. 1055 or 1284 loose or damaged
Faulty neutral relay
Faulty starter magnetic switch

---

**TEST OPTIONS**
NEUTRAL Relay Test
or
STE/ICE-R Test #89

**REASON FOR QUESTION**
NEUTRAL relay is faulty if low voltage is measured on wire no. 1055.

---

**KNOWN INFO**
Fault not corrected from TM 9-2320-360-10 troubleshooting
Batteries OK
Engine switch OK
Neutral safety switch circuit OK

**POSSIBLE PROBLEMS**
Faulty ignition relay
Faulty ignition circuit breaker
Faulty wiring

---

**TEST OPTIONS**
Wire no. 1872 Test
or
STE/ICE-R Test #89

**REASON FOR QUESTION**
Engine will not crank if wire no. 1872 from IGN terminal on ENGINE switch to IGNITION relay is loose or damaged.

---

**KNOWN INFO**
Fault not corrected from TM 9-2320-360-10 troubleshooting
Batteries OK
Engine switch OK
Neutral safety switch circuit OK
Wire no. 1872 OK

**POSSIBLE PROBLEMS**
Faulty ignition relay
Faulty ignition circuit breaker
Wires no. 1871 or 1536 loose or damaged

---

**TEST OPTIONS**
Wire no. 1871 Test
or
STE/ICE-R Test #89

**REASON FOR QUESTION**
Engine will not crank if wire no. 1871 from IGNITION relay to NEUTRAL relay is loose or damaged.
**NEUTRAL RELAY TEST**

<table>
<thead>
<tr>
<th>NOTE</th>
<th>ENGINE switch must be positioned and held to START to perform this test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Turn and hold ENGINE switch to START.</td>
</tr>
<tr>
<td>(2)</td>
<td>Place positive (+) probe of multimeter on wire no. 1055 at NEUTRAL relay.</td>
</tr>
<tr>
<td>(3)</td>
<td>Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.</td>
</tr>
<tr>
<td>(4)</td>
<td>Turn ENGINE switch to OFF.</td>
</tr>
</tbody>
</table>

**WIRE NO. 1872 TEST**

<table>
<thead>
<tr>
<th>NOTE</th>
<th>ENGINE switch must be positioned and held to START to perform this test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Turn and hold ENGINE switch to START.</td>
</tr>
<tr>
<td>(2)</td>
<td>Place positive (+) probe of multimeter on wire no. 1872 at IGNITION relay.</td>
</tr>
<tr>
<td>(3)</td>
<td>Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.</td>
</tr>
<tr>
<td>(4)</td>
<td>Turn ENGINE switch to OFF.</td>
</tr>
<tr>
<td>(5)</td>
<td>Inspect wire no. 1872 between ignition relay and ignition switch if no voltage is measured.</td>
</tr>
</tbody>
</table>

**WIRE NO. 1871 TEST**

<table>
<thead>
<tr>
<th>NOTE</th>
<th>ENGINE switch must be positioned and held to START to perform this test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Turn and hold ENGINE switch to START.</td>
</tr>
<tr>
<td>(2)</td>
<td>Place positive (+) probe of multimeter on wire no. 1871 at IGNITION relay.</td>
</tr>
<tr>
<td>(3)</td>
<td>Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.</td>
</tr>
<tr>
<td>(4)</td>
<td>Turn ENGINE switch to OFF.</td>
</tr>
<tr>
<td>(5)</td>
<td>Inspect wire no. 1871 between ignition relay and ignition switch if no voltage is measured.</td>
</tr>
</tbody>
</table>
a1. ENGINE FAILS TO CRANK (CONT)

**Known Info**
- Fault not corrected from TM 9-2320-360-10 troubleshooting
- Batteries OK
- Engine switch OK
- Neutral safety switch circuit OK
- Wires no. 1871 and 1872 OK

**Possible Problems**
- Faulty ignition relay
- Wire no 1536 loose or damaged
- Faulty ignition circuit breaker

**Test Options**
- Ignition Relay Test
- STE/ICE-R Test #89

**Reason for Question**
IGNITION relay is faulty if 10–14 volts are measured on wire no. 1536.

---

18. Are less than 10–14 volts measured on wire no. 1536 at IGNITION relay?

- **No**
  - Replace IGNITION relay (para 7–27).
- **Yes**

---

19. Are 10–14 volts present at IGNITION circuit breaker?

- **No**
  - Replace IGNITION circuit breaker (para 7–27).
- **Yes**
  - Secure loose connections. Notify supervisor if damaged wiring is found.

---

20. Are 22–28 volts measured on wire no. 1055 on starter magnetic switch?

- **No**
  - Secure loose connections. Notify supervisor if damaged wiring is found.
- **Yes**

---
### IGNITION RELAY TEST

**NOTE**
ENGINE switch must be positioned and held to START to perform this test.

1. Turn and hold ENGINE switch to START.
2. Place positive (+) probe of multimeter on wire no. 1536 at IGNITION relay.
3. Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
4. Turn ENGINE switch to OFF.
5. Inspect wire no. 1536 between ignition relay and ignition circuit breaker if no voltage is measured.

### CIRCUIT BREAKER TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on lower terminal of circuit breaker.
3. Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
4. Turn ENGINE switch to OFF position.

### WIRE NO. 1055 VOLTAGE TEST

**NOTE**
ENGINE switch must be positioned and held to START to perform this test.

1. Turn and hold ENGINE switch to START.
2. Place positive (+) probe of multimeter on wire no. 1055 at starter magnetic switch.
3. Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
4. Turn ENGINE switch to OFF.
5. Inspect wire no. 1055 between magnetic switch and neutral relay for loose connections and damage if voltage is measured.
a1. ENGINE FAILS TO CRANK (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire no. 1284 loose or damaged Faulty starter magnetic switch</td>
<td>Wire No. 1284 Voltage Test or STE/ICE-R Test #89</td>
<td>Engine will not crank if wire no. 1284 from starter magnetic switch to 24 volt magnetic switch is loose or damaged.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries OK Engine switch OK Neutral safety switch circuit OK Ignition relay OK Ignition circuit breaker OK Wire no. 1055 OK</td>
<td>Starter Magnetic Switch Test or STE/ICE-R Test #89</td>
<td>Starter magnetic switch is faulty if low voltage is measured on wire no. 1045. Engine will not crank if wire no. 1045 from starter magnetic switch to starter is loose or damaged.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries OK Engine switch OK Neutral safety switch circuit OK Ignition relay OK Ignition circuit breaker OK</td>
<td>Continuity Test or STE/ICE-R Test #91</td>
<td>Engine will not crank if wire no. 1458 from neutral safety switch to NEUTRAL relay is loose or damaged.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire no. 1458 Faulty neutral safety switch Faulty ground wire no. 1435</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

21. Are 22-28 volts measured on wire no. 1284 at starter magnetic switch?  

- **YES**: Secure loose connections. Notify supervisor if damaged wiring is found.
- **NO**: Wire no. 1284 loose or damaged Faulty starter magnetic switch

22. Are 22-28 volts measured on wire no. 1045 at starter magnetic switch?  

- **YES**: Replace starter magnetic switch (para 7-37).  
  - Secure loose connections. Notify supervisor if damaged wiring is found.
- **NO**: Wire no. 1045 loose or damaged Faulty starter magnetic switch

23. Is wire no. 1458 from neutral safety switch to NEUTRAL relay secure and free from damage?  

- **YES**: Wire no. 1458 Faulty neutral safety switch Faulty ground wire no. 1435
- **NO**: Wire no. 1458 loose or damaged Faulty starter magnetic switch

CAUTION  
Read CAUTION on following page.
WIRE NO. 1284 VOLTAGE TEST

NOTE
ENGINE switch must be positioned and held to START to perform this test.

1) Turn and hold ENGINE switch to START.
2) Place positive (+) probe of multimeter on wire no. 1284 at starter magnetic switch.
3) Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
4) Turn ENGINE switch to OFF.
5) Inspect wire no. 1284 between magnetic switches for loose connections and damage if no voltage is measured.

STARTER MAGNETIC SWITCH TEST

NOTE
ENGINE switch must be positioned and held to START to perform this test.

1) Turn and hold ENGINE switch to START.
2) Place positive (+) probe of multimeter on wire no. 1045 at starter magnetic switch.
3) Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
4) Turn ENGINE switch to OFF.
5) Inspect wire no. 1045 between magnetic switch and starter solenoid for loose connections and damage if voltage is measured.

Check wire no. 1458 from neutral safety switch to NEUTRAL relay for loose connections, damage, and continuity.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1) Disconnect wire no. 1458 from neutral safety switch and NEUTRAL relay.
2) Set multimeter to ohms position.
   NOTE
   A reading of infinity indicates an open circuit.
3) Connect multimeter leads to each end of wire no. 1458 and note reading on multimeter.
   NOTE
   A reading of other than infinity indicates a grounded wire.
4) Remove multimeter lead from one end of wire and connect to chassis ground and check multimeter for continuity.
5) Connect wire no. 1458 to neutral safety switch and NEUTRAL relay.
a1. ENGINE FAILS TO CRANK (CONT)

### Known Info
- Fault not corrected from TM 9-2320-360-10 troubleshooting
- Batteries OK
- Engine switch OK
- Wire no. 1458 OK

### Possible Problems
- Faulty neutral safety switch
- Faulty ground wire no. 1435

#### 24. Is neutral safety switch and receptacle secure and free from damage?

**Test Options**
- Visual inspection

**Reason for Question**
- Engine will not crank if neutral safety switch or receptacle is loose or damaged.

**Yes**
- Secure loose connections. Notify supervisor if damaged wiring is found.

**No**
- Fault not corrected. Notify supervisor.

#### 25. Is there continuity between terminals C and E on neutral safety switch?

**Test Options**
- Neutral Safety Switch Test
- STE/ICE-R Test #91

**Reason for Question**
- Neutral safety switch is faulty if there is no continuity between terminals C and E.

**Yes**
- Replace neutral safety switch (para 7-25).

**No**
- Fault not corrected. Notify supervisor.

#### 26. Is ground wire no. 1435 from neutral safety switch secure and free from damage?

**Test Options**
- Visual inspection

**Reason for Question**
- Engine will not crank if ground wire no. 1435 from neutral safety switch is loose or damaged.

**Yes**
- Secure loose connections. Notify supervisor if damaged wiring is found.

**No**
- Fault not corrected. Notify supervisor.
Check neutral safety switch and receptacle for loose connections or damage.

### NEUTRAL SAFETY SWITCH TEST

1. Disconnect neutral safety switch from receptacle at transmission shift linkage.
2. Set multimeter to ohms position.
3. Place positive (+) probe of multimeter on terminal C at neutral safety switch.
4. Place negative (--) probe of multimeter on terminal E at neutral safety switch, and check multimeter for continuity.
5. Connect neutral safety switch to receptacle if there is continuity between terminals C and E.

Check ground wire no. 1435 from neutral safety switch to ground for loose connections and damage.
a2. ENGINE CRANKS BUT FAILS TO START

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

**Personnel required**
- Two

---

**KNOWN INFO**

- DDEC circuit breakers OK
- Fuel quantity in tanks OK
- Fuel shut off valve open
- Air cleaner restriction OK

**POSSIBLE PROBLEMS**

- Faulty fuel system
- Faulty electrical system
- Faulty DDEC system

---

**TEST OPTIONS**

**REASON FOR QUESTION**

**Is engine cranking at normal speed?**

**YES**

- Refer to Engine Troubleshooting (a1. Engine fails to crank).

**NO**

- Perform DDEC troubleshooting (p. 2–80).

---

**Check Engine and Check Gauges lights come on for five seconds and then go off?**

**YES**

- Visual inspection

**NO**

- If CHECK ENGINE and CHECK GAUGES lights stay on longer than 5 seconds, the malfunction may be DDEC related.

---

- Visual Inspection Of Tachograph
- STE/ICE Test #10

**If engine cranking speed is normal (approximately 300 rpm), there is a malfunction with the fuel system. If engine cranking speed is low (less than 300 rpm), there is a malfunction with the electrical system.**
Turn ENGINE switch ON and observe CHECK ENGINE and CHECK GAUGES indicator lights.
a2. ENGINE CRANKS BUT FAILS TO START

3. **Is ether starting aid required?**

   **KNOWLEDGE**
   - CHECK ENGINE and CHECK GAUGES lights OK
   - Engine cranking speed OK

   **POSSIBLE PROBLEMS**
   - Fuel system or DDEC system

   **TEST OPTIONS**
   - Temperature Check

   **REASON FOR QUESTION**
   - Ether start is only required below 45°F (7°C).

4. **Is ether starting aid working?**

   **KNOWLEDGE**
   - CHECK ENGINE and CHECK GAUGES lights OK
   - Engine cranking speed OK

   **POSSIBLE PROBLEMS**
   - Fuel system or DDEC system

   **WARNING**
   - Read WARNING on following page.

   **TEST OPTIONS**
   - Visual inspection

   **REASON FOR QUESTION**
   - If ether start is required and doesn't work, the engine will start hard.

5. **Does fuel flow from fuel return line?**

   **KNOWLEDGE**
   - CHECK ENGINE and CHECK GAUGES lights OK
   - Engine cranking speed OK
   - Ether start system OK

   **POSSIBLE PROBLEMS**
   - Fuel system or DDEC system

   **TEST OPTIONS**
   - Fuel Return Line Test or STE/ICE-R Test #25

   **REASON FOR QUESTION**
   - There is no malfunction in fuel system if fuel flows from fuel line. Malfunction is in electrical system. If STE/ICE-R Test #25 is used, pressure should be more than 11.5 psi (79.3 kPa).

   **WARNING**
   - Read WARNING on following page.
NOTE

- The ether start system has a thermostatic switch that will not let the system work if the engine is above 55°F (12°C).
- Ether start is only required below 45°F (7°C). If outside temperature is over 45°F (7°C) go to step (5).

Attempt to start the engine using the cold engine starting procedure (TM 9–2320–360–10).

WARNING
Fuel is very flammable and can explode easily. To avoid serious injury or death keep flame away from fuel and keep fire extinguisher within easy reach. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE.

FUEL RETURN LINE TEST

(1) Remove fuel return line from left side fuel tank.
(2) Place fuel line in suitable container.
(3) While assistant attempts to start engine (TM 9–2320–360–10), observe fuel flow from fuel return line.
(4) Install fuel return line on left side fuel tank.

STE/ICE TEST #25

(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.
(2) Set STE/ICE test select switch to "25".
(3) Press and hold TEST button until "CAL" appears in display.
(4) Release TEST button and wait for offset value to appear in display.
(5) Press and release TEST button.
(6) Start engine (TM 9–2320–360–10) and observe STE/ICE display for test results.
a3. ENGINE DOES NOT DEVELOP FULL POWER

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**
Fuel/water separator bowl clean

**POSSIBLE PROBLEMS**
Restricted air cleaner
Faulty air intake hose
Faulty engine exhaust tubes

---

**TEST OPTIONS**
Restriction Indicator Check

**REASON FOR QUESTION**
Engine may misfire, run rough, or lack power if air flow to engine is restricted.

---

**KNOWN INFO**
Fuel/water separator bowl clean
Air restriction indicator OK

**POSSIBLE PROBLEMS**
Faulty air intake hose
Faulty engine exhaust tubes

---

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Faulty air intake hose may contribute to low power by not providing the engine with sufficient air. A kinked hose will restrict air flow. A loose or out of position hose will cause the engine to draw higher temperature air from inside the engine compartment, rather than from the air cleaner.

---

START

1. Does AIR CLEANER RESTRICTION indicator read below yellow area?
   - **YES**
   - **NO** Service air cleaner (para 4–2).

2. Is the air intake hose installed properly, in good condition and are the clamps tight?
   - **YES**
   - **NO** Replace air intake hose (para 4–4).

Refer to Fuel System Troubleshooting (b2, Engine starts but misfires, runs rough or lacks power).
RESTRICTION INDICATOR CHECK

1. Check reading on AIR CLEANER RESTRICTION INDICATOR.
2. Press RESET button on AIR CLEANER RESTRICTION indicator if reading is above 15.
3. Start engine (TM 9-2320-360-10) and check AIR CLEANER RESTRICTION INDICATOR again.

(1) Check air intake hose for proper positioning. There should be no kinks anywhere on the hose.
(2) Check the hose for chaffing, cuts, holes, tears, etc.
(3) Check the clamps for proper positioning on hose.
(4) Check for loose clamps. If loose, torque to 75-80 lb-in. (8-9 N-m).
**a3. ENGINE DOES NOT DEVELOP FULL POWER (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel/water separator bowl clean</td>
<td>Faulty engine exhaust tubes</td>
</tr>
<tr>
<td>Air restriction indicator OK</td>
<td></td>
</tr>
<tr>
<td>Air intake hose OK</td>
<td></td>
</tr>
</tbody>
</table>

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Loose or leaking exhaust tubes will allow exhaust gases to escape before reaching the turbocharger. This will reduce efficiency of the turbocharger and contribute to low power.

---

**WARNING**
Read WARNING on following page.

Are the engine exhaust tubes installed properly, in good condition and are the clamps tight?

- **NO**
  - Replace engine exhaust tubes (para 5-5).

- **YES**
  - Refer to Fuel System Troubleshooting (b2, Engine starts but misfires, runs rough or lacks power).

---

**WARNING**
Read WARNING on following page.
WARNING

Ensure exhaust tubes are cool before performing maintenance. Failure to comply may result in serious personal injury.

1. Inspect engine exhaust tubes for proper positioning.
2. Inspect for bent flanges at ends of tubes.
3. Check clamps for proper positioning around tubes.
4. Check for loose clamps. Tighten loose clamps.
a4. LOW ENGINE OIL PRESSURE

INITIAL SETUP

Equipment Conditions
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
STE/ICE-R (optional) (Item 47, Appendix F)
Wrench, Torque, 0-175 Lb-Ft (Item 73, Appendix F)

TEST OPTIONS
Check oil according to LO 9-2320-360-12

REASON FOR QUESTION
Low oil level will cause low engine oil pressure.

TEST OPTIONS
Engine Oil Inspection

REASON FOR QUESTION
Oil will lose viscosity if contaminated and cause low oil pressure.
**NOTE**

Engine oil pressures may be slightly lower when engine is at maximum operating temperature (WATER TEMP gage reads 210 °F (100 °C)).

---

**ENGINE OIL CHECK**

**NOTE**

Capacity of engine oil pan is approximately 28 qt (26.5 L).

1. Position drain pan under engine oil pan.
2. Remove drain plug from engine oil pan.
3. Drain engine oil into drain pan.
4. Observe condition of engine oil.
5. Install drain plug in engine oil pan.

---

Oil pressure can go as low as 5 psi (34 kPa) at engine idle.

Check engine oil level on dipstick. Proper oil level is between LOW mark and FULL mark.
a4. LOW ENGINE OIL PRESSURE (CONT)

**DDEC DDR Oil Pressure Check**

1. **Does DDR verify oil pressure gage reading?**
   - **YES**
     - **Reason for Question:** Defective wiring, sending unit, or gage will indicate low oil pressure even though engine oil psi is good.
   - **NO**
     - Refer to Electrical Troubleshooting (e5, Oil pressure gage does not operate or is inaccurate).

2. **Are engine oil filter or oil lines free from leaks or damage?**
   - **YES**
     - **Reason for Question:** Leaking oil filter or oil lines will cause low oil level and result in low engine oil pressure.
     - Replace damaged oil lines and fittings. Replace damaged oil filter (para 3–3).
   - **NO**
     - Replace damaged oil filter or oil lines OK

3. **Are engine rocker covers and gaskets free from leaks or damage?**
   - **YES**
     - **Reason for Question:** Leaking engine rocker covers and gaskets will cause low oil level and result in low engine oil pressure.
     - Replace damaged rocker covers and gaskets (para 3–2). Tighten loose rocker covers to 15–20 lb-ft (20–27 N-m).
   - **NO**
     - Damaged engine oil filter or oil lines
     - Damaged rocker covers and/or gaskets
     - Damaged oil pan, oil pump mounting, air compressor, cylinder heads, air box covers, or sending units
Check engine rocker covers and gaskets for leakage or damage.

Check engine oil filter and oil lines for leakage or damage.

DDEC DDR OIL PRESSURE CHECK

(1) Refer to para 2-13d for DDR installation and usage instructions
(2) Check DDEC mode 17.

Check engine oil filter and oil lines for leakage or damage.
a4. LOW ENGINE OIL PRESSURE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oil level is OK</td>
</tr>
<tr>
<td>Engine oil condition is OK</td>
</tr>
<tr>
<td>Correct reading from oil pressure gage</td>
</tr>
<tr>
<td>Engine oil filter or oil lines OK</td>
</tr>
<tr>
<td>Rocker covers and gaskets OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damaged oil pan, oil pump mounting, air compressor, cylinder heads, air box covers, or sending units</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaking oil pan, oil pump mounting, air compressor, cylinder heads, air box covers, or sending units will cause low oil level and result in low engine oil pressure.</td>
</tr>
</tbody>
</table>

6. Are oil pan, air compressor, cylinder heads, air box covers, and sending units free from leaks or damage?

- **NO**: Notify supervisor.

- **YES**: Fault not corrected. Notify supervisor.
Check oil pan, air compressor, cylinder heads, air box covers, and sending units for leakage or damage.
a5. EXCESSIVE ENGINE OIL CONSUMPTION

INITIAL SETUP

Equipment Conditions

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F) STE/ICE–R (optional) (Item 47, Appendix F) Wrench, Torque, 0–175 Ft–Lb (Item 73, Appendix F)

KNOWLEDGE INFO

Nothing

POSSIBLE PROBLEMS

- Oil level too high
- Damaged engine oil filter or oil lines
- Damaged rocker covers or gaskets
- Damaged oil pan, oil pump mounting, air compressor, cylinder heads, air box covers, or sending units
- Engine overheating

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Oil will be burned by engine and possible engine damage will result if oil level is too high.

1. Is engine oil at the correct level?

   NO

   Remove oil to correct level (LO 9–2320–360–12)

   YES

2. Are engine oil filter or oil lines secure from leaks or damage?

   NO

   Replace damaged oil lines and fittings. Replace damaged oil filter (para 3–3)

   YES

   Replace damaged oil filter (para 3–3)
NOTE

Oil consumption is normal if engine uses less than 10 qt (9 L) of oil in 1000 mi (1609 km) of operation.

Check engine oil level on dipstick. Correct oil level is between LOW mark and FULL mark.

Check engine oil filter and oil lines for leakage or damage.
**a5. EXCESSIVE ENGINE OIL CONSUMPTION (CONT)**

**KNOWN INFO**
- Engine oil level is not high.
- Engine oil filter or oil lines are not leaking or damaged.

**POSSIBLE PROBLEMS**
- Damaged rocker covers or gaskets
- Damaged oil pan, oil pump mounting, air compressor, cylinder heads, air box covers, or sending units
- Engine overheating

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Leaking engine rocker covers and gaskets will cause excessive oil consumption.

3. **Are engine rocker covers and gaskets free from leaks or damage?**

   - **NO**
   - **YES**


4. **Are oil pan, air compressor, cylinder heads, air box covers, and sending units free from leaks or damage?**

   - **NO**
   - **YES**

   Notify supervisor.

5. **Is engine operating at normal temperature?**

   - **NO**
   - **YES**

   Refer to Cooling System Troubleshooting (d1. Engine overheats).

   Fault not corrected. Notify supervisor.

**REASON FOR QUESTION**
- Leaking oil pan, air compressor, cylinder heads, air box covers, and sending units will cause excessive oil consumption.

**TEST OPTIONS**
- Monitor Gages or STE/ICE-R Test #37 (Oil Temperature) or STE/ICE-R Test #38 (Coolant Temperature)

**REMARK**
- Excessive engine temperature will contribute to increased oil consumption. If STE/ICE-R tests are used, excessive engine temperatures are 250°F (121°C) for Test #37 (oil temperature) and 230°F (110°C) for Test #38 (coolant temperature).
Check engine rocker covers and gaskets for leakage or damage.

Check oil pan, air compressor, cylinder heads, air box covers, and sending units for leakage or damage.

**STE/ICE TEST #37/38**

1. Connect STE/ICE test cable to STE/ICE receptacle in cab.
2. Set STE/ICE test select switch to “37” (oil temperature) or “38” (coolant temperature).
4. Move STE/ICE Zero Offset switch to ON position.
5. Press and hold TEST button until "CAL" appears in display.
7. Move STE/ICE Zero Offset switch to OFF position.
8. Press and release TEST button to obtain test results.
a6. ENGINE OVERHEATS (WATER TEMP GAGE CONTINUOUSLY READS OVER 230°F (110°C))

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)

**KNOWN INFO**
- Upper and lower radiator hoses OK

**POSSIBLE PROBLEMS**
- Low coolant level
- Faulty temperature sending unit or gage

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Low coolant level may cause engine to overheat. Add coolant (LO 9–2320–360–12) if coolant level is low.

**TEST OPTIONS**
- STE/ICE-R Test #38

**REASON FOR QUESTION**
- If STE/ICE-R confirms gage reading, cooling system is at fault. If STE/ICE-R indicates normal operating temperature, electric gage is at fault.

---

1. **Is coolant level at proper level?**

   **YES**
   
   **NO**

2. **Is engine operating at normal temperature (less than 230°F (110°C))?**

   **YES**
   - Refer to Cooling System Troubleshooting (d1, Engine Overheats).

   **NO**
   - Refer to Electrical System Troubleshooting (e5, Electric gage does not operate or is inaccurate).
NOTE
STE/ICE-R Test #37 measures oil temperature; STE/ICE-R Test #38 measures engine coolant temperature.

Verify water temperature gage reading with STE/ICE-R Test #38.

<table>
<thead>
<tr>
<th>STE/ICE TEST #38</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.</td>
</tr>
<tr>
<td>(2) Set STE/ICE test select switch to “38”.</td>
</tr>
<tr>
<td>(3) Start engine (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>(4) Move STE/ICE Zero Offset switch to ON position.</td>
</tr>
<tr>
<td>(5) Press and hold TEST button until “CAL” appears in display.</td>
</tr>
<tr>
<td>(6) Release TEST button and wait for offset value to appear in display.</td>
</tr>
<tr>
<td>(7) Move STE/ICE Zero Offset switch to OFF position.</td>
</tr>
<tr>
<td>(8) Press and release TEST button to obtain test results.</td>
</tr>
<tr>
<td>(9) Shut off engine (TM 9-2320-360-10).</td>
</tr>
</tbody>
</table>

WARNING
Antifreeze may be very hot and under pressure from engine operation. Be sure to wear the proper eye protection and ensure the engine is cool before performing maintenance. Failure to comply may cause serious personnel injury.

CAUTION
Engine oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating engine and is indicated by discoloration, strong odor, and oil analysis.

Coolant should be visible in sight glass.

CAUTION
Engine oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating engine and is indicated by discoloration, strong odor, and oil analysis.

NOTE
STE/ICE-R Test #37 measures oil temperature; STE/ICE-R Test #38 measures engine coolant temperature.

Verify water temperature gage reading with STE/ICE-R Test #38.

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.</td>
</tr>
<tr>
<td>(2) Set STE/ICE test select switch to “38”.</td>
</tr>
<tr>
<td>(3) Start engine (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>(4) Move STE/ICE Zero Offset switch to ON position.</td>
</tr>
<tr>
<td>(5) Press and hold TEST button until “CAL” appears in display.</td>
</tr>
<tr>
<td>(6) Release TEST button and wait for offset value to appear in display.</td>
</tr>
<tr>
<td>(7) Move STE/ICE Zero Offset switch to OFF position.</td>
</tr>
<tr>
<td>(8) Press and release TEST button to obtain test results.</td>
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WARNING
Antifreeze may be very hot and under pressure from engine operation. Be sure to wear the proper eye protection and ensure the engine is cool before performing maintenance. Failure to comply may cause serious personnel injury.

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Engine oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating engine and is indicated by discoloration, strong odor, and oil analysis.

Coolant should be visible in sight glass.

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NOTE
STE/ICE-R Test #37 measures oil temperature; STE/ICE-R Test #38 measures engine coolant temperature.

Verify water temperature gage reading with STE/ICE-R Test #38.

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</tr>
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</table>
a7. EXCESSIVE BLACK OR GRAY EXHAUST SMOKE (ENGINE AT NORMAL OPERATING TEMPERATURE)

**INITIAL SETUP**

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine shut off (TM 9–2320–360–10).</td>
<td>Tool Kit, Genl Mech (Item 54, Appendix F)</td>
</tr>
<tr>
<td>Wheels chocked.</td>
<td></td>
</tr>
</tbody>
</table>

**KNOWN INFO**

Fuel/water separator bowl clean

**POSSIBLE PROBLEMS**

Air cleaner

**TEST OPTIONS**

Restriction Indicator Check or STE/ICE-R Test #28

**REASON FOR QUESTION**

Exhaust smoke may be black or gray if air flow to engine is restricted. If STE/ICE-R Test #28 is used, more than 15 H₂O indicates restricted air cleaner.

START

1. Does AIR CLEANER RESTRICTION indicator read below yellow area?

   YES

   Service air cleaner (para 4-2).

   Fault not corrected. Notify supervisor.

   NO
RESTRICTION INDICATOR CHECK

1. Check reading on AIR CLEANER RESTRICTION INDICATOR.
2. Press RESET button on AIR CLEANER RESTRICTION indicator if reading is above 15.
3. Start engine (TM 9-2320-360-10) and check AIR CLEANER RESTRICTION INDICATOR again.

NOTE
Results for STE/ICE-R Test #28 must be obtained at 2100 rpm.

STE/ICE TEST #28

1. Connect STE/ICE test cable to STE/ICE receptacle in cab.
2. Set STE/ICE test select switch to "28".
4. Press and hold TEST button until "CAL" appears in display.
5. Release TEST button and wait for offset value to appear in display.
6. Increase engine speed to approximately 2100 rpm.
7. Press and release TEST button to obtain test results.
8. Shut off engine (TM 9-2320-360-10).
a8. BLUE EXHAUST SMOKE (ENGINE AT NORMAL OPERATING TEMPERATURE)

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

---

START

1. Is engine oil at proper level?

   YES

   Fault not corrected. Notify supervisor.

   NO

   Remove oil to correct level.

---

TEST OPTIONS

Visual inspection

---

POSSIBLE PROBLEMS

Oil level too high

---

KNOWN INFO

Fuel/water separator bowl clean
Air cleaner restriction OK
Check engine oil level on dipstick. Proper oil level is between LOW mark and FULL mark.
**a9. WHITE EXHAUST SMOKE (ENGINE AT NORMAL OPERATING TEMPERATURE)**

### INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**START**

1. Is coolant clean (contains no oil and does not appear milky)?

   - **NO** → Notify supervisor.
   - **YES** → **Coolant Check**

   **WARNING**
   - Read WARNING on following page.

2. Is engine oil clean (contains no presence of coolant)?

   - **NO** → Notify supervisor.
   - **YES** → **Engine Oil Check**

   **REASON FOR QUESTION**
   - Contaminated coolant indicates faulty head gasket(s) and/or oil cooler.

**KNOWN INFO**
- Fuel/water separator bowl clean
- Air cleaner restriction OK

**POSSIBLE PROBLEMS**
- Contaminated coolant
- Contaminated engine oil
- Head gasket leak
- Faulty injector

**TEST OPTIONS**
- Coolant Check
- Engine Oil Check

**KNOWN INFO**
- Coolant OK

**POSSIBLE PROBLEMS**
- Contaminated engine oil
- Head gasket leak
- Faulty injector

**REASON FOR QUESTION**
- Engine oil contaminated with coolant indicates faulty head gasket(s) and/or oil cooler.
WARNING
Do not remove radiator cap when engine is warm. Coolant may be very hot and under pressure. Be sure to wear the proper eye protection to avoid personal injury. Failure to comply may result in injury to personnel.

(1) Open hood (TM 9-2320-360-10).
(2) Remove radiator cap from radiator.
(3) Observe condition of coolant inside radiator.
(4) Install radiator cap on radiator.

ENGINE OIL CHECK

NOTE
Capacity of engine oil pan is approximately 28 qt (26.5 L).

(1) Position drain pan under engine oil pan.
(2) Remove drain plug from engine oil pan.
(3) Drain engine oil into drain pan.
(4) Observe condition of engine oil.
(5) Install drain plug in engine oil pan.
(6) Refill engine oil (LO 9-2320-360-12).
a9. WHITE EXHAUST SMOKE (ENGINE AT NORMAL OPERATING TEMPERATURE) (CONT)

**3. Are there no bubbles visible in coolant with radiator cap removed?**

- **NO** Notify supervisor.
- **YES**

**WARNING**
Read WARNING on following page.

**CAUTION**
Read WARNING and CAUTION on following page.

**POSSIBLE PROBLEMS**
- Head gasket leak
- Faulty injector

**KNOWN INFO**
- Coolant OK
- Engine oil OK

**TEST OPTIONS**
- Coolant check

**REASON FOR QUESTION**
Bubbles present in coolant indicates compression leaking into cooling system from faulty head gasket(s).

---

**4. Is cylinder balance even?**

- **NO** Notify supervisor.
- **YES**

**WARNING**

**CAUTION**

**POSSIBLE PROBLEMS**
- Faulty injector

**KNOWN INFO**
- Coolant OK
- Engine oil OK
- Head gasket OK

**TEST OPTIONS**
- DDR Cylinder Cutout Test

**REASON FOR QUESTION**
Uneven cylinder balance indicates faulty injector or internal engine problem.
COOLANT CHECK

**WARNING**
Do not remove radiator cap when engine is warm. Be sure to wear the proper eye protection to avoid personal injury. Coolant may be very hot and under pressure. Failure to comply may result in injury to personnel.

1. Remove radiator cap from radiator.
2. Start engine (TM 9–2320–360–10) and allow engine to reach operating temperature.
3. Observe coolant circulating in radiator.
5. Install radiator cap on radiator.

**DDR CYLINDER CUTOUT TEST**

**WARNING**
Parking brake must be applied, with transmission range selector and transfer case in neutral before starting this test. Failure to comply may result in vehicle moving unexpectedly and injury to personnel.

**NOTE**
Detailed instructions on the use of the DDR can be found in para 2–13.

1. Remove eight screws and cover from electronic control box assembly.
2. Connect data cable to DDR with two thumb screws.
3. Connect data cable to vehicle adapter.

**CAUTION**
Vehicle adapter can only be installed on connector one way. Installing adapter backward will result in damage to vehicle and test equipment.

**NOTE**
Vehicle adapter must be connected to DDL connector with slot facing down.

4. Connect vehicle adapter with data cable to DDL connector.
6. Select mode 11 (Cylinder Cutout) on DDR.
8. Disconnect data cable with vehicle adapter from DDL connector.
9. Disconnect data cable from vehicle adapter.
10. Disconnect data cable from DDR.
11. Install cover on electronic control box assembly with eight screws.
b. **FUEL SYSTEM**

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>b1. Engine cranks but fails to start or engine stalls after starting</td>
<td>2–414</td>
</tr>
<tr>
<td>b2. Engine starts but misfires, runs rough, or lacks power</td>
<td>2–418</td>
</tr>
<tr>
<td>b3. Ether starting aid does not operate</td>
<td>2–422</td>
</tr>
</tbody>
</table>
b1. ENGINE CRANKS BUT FAILS TO START OR ENGINE STALLS AFTER STARTING

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

Personnel Required
Two

WARNING
Read WARNING on following page.

Is fuel supply adequate at fuel return line. Is fuel free from air bubbles?

1. Yes
   
   NO
   Go to step 3.

2. Is fuel in fuel water separator clean and is fuel water separator bowl free from leaks or damage?

   YES
   
   NO
   Service or repair fuel water separator (para 4–11 or 4–12).

   Fault not corrected. Notify supervisor.

   YES
   
   NO
   Visual inspection

REASON FOR QUESTION
To isolate problem between filters, fuel pump and fuel lines.

TEST OPTIONS
Fuel System Test
or
STE/ICE–R Test # 24

POSSIBLE PROBLEMS
Inadequate fuel supply
Air bubbles in fuel
Fuel lines or fittings loose or damaged
Fuel contamination, damaged or leaking fuel water separator
Restricted or damaged secondary fuel filter
Faulty fuel pump

KNOWN INFO
Engine cranking speed OK

Adequate fuel supply
No air bubbles in fuel

KNOWN INFO
Fuel contamination, damaged or leaking fuel water separator

REASON FOR QUESTION
Engine will not start if fuel is contaminated. Engine may not be getting adequate fuel supply if fuel water separator is leaking or damaged.

TEST OPTIONS
Visual inspection
WARNING
Fuel is very flammable and can explode easily. To avoid serious injury or death keep flame away from fuel and keep fire extinguisher within easy reach. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE.

NOTE
Perform Engine Troubleshooting (a2, Engine Cranks but Fails to Start) before starting here.

FUEL SYSTEM TEST
(1) Remove fuel return line from left fuel tank.
(2) Place fuel line in suitable container.

NOTE
Fuel pump should deliver approximately 6 oz (177cc) of fuel in 15 seconds at cranking speed.

(3) Observe fuel flow from return line while assistant attempts to start engine (TM 9–2320–360–10).
(4) Install fuel return line on left fuel tank.

STE/ICE TEST #24
(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.
(2) Set STE/ICE test select switch to “24”.
(3) Press and hold TEST button until “CAL” appears in display.
(4) Release TEST button and wait for offset value to appear in display.
(5) Press and release TEST button.
(6) Start engine (TM 9–2320–360–10) and observe test results on STE/ICE display.

Check for clean fuel in fuel water separator and separator bowl for leaks or damage.
b1. ENGINE CRANKS BUT FAILS TO START OR ENGINE STALLS AFTER STARTING (CONT)

**KNOWN INFO**
- Engine cranking speed OK

**POSSIBLE PROBLEMS**
- Inadequate fuel supply
- Air bubbles in fuel
- Fuel lines or fittings loose or damaged
- Fuel contamination, damaged or leaking fuel water separator
- Restricted or damaged secondary fuel filter
- Faulty fuel pump

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Air bubbles present in fuel lines usually indicate loose, damaged, or leaking fuel lines.

3. Were there air bubbles in fuel at fuel return line during step no. 1?

   **WARNING**
   Read WARNING on following page.

   - NO
     Go to step 5.
   - YES
     Go to step 1.

4. Are fuel lines and fittings in good condition, free from kinks, cracks, leakage, or damage?

   **TEST OPTIONS**
   - Visual inspection

   **REASON FOR QUESTION**
   Engine will start/stall if fuel lines are allowing air to enter fuel system.

   - NO
     Replace fuel lines or fittings (para 4-9 and/or 4-10).
     Go to step 2.
   - YES
     Go to step 5.

5. Does fuel supply improve with new secondary fuel filter installed?

   **TEST OPTIONS**
   - Fuel System Test
   - or
   - STE/ICE Test # 24

   **REASON FOR QUESTION**
   Fuel pump has failed if fuel pressure/volume are still low after installing new secondary fuel filter.

   - NO
     Fuel pump is faulty. Notify supervisor.
   - YES
     Fault corrected.
WARNING
Fuel is very flammable and can explode easily. To avoid serious injury or death keep flame away from fuel and keep fire extinguisher within easy reach. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE. Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Fuel lines and fittings may be loose allowing air to be drawn into fuel system.

Check fuel lines and fittings for leaks and damage.

---

FUEL SYSTEM TEST

(1) Remove fuel return line from left fuel tank.

(2) Place fuel line in suitable container.

NOTE
Fuel pump should deliver approximately 6 oz (177cc) of fuel in 15 seconds at cranking speed.

(3) Observe fuel flow from return line while assistant attempts to start engine (TM 9-2320-360-10).

(4) Install fuel return line on left fuel tank.

---

STE/ICE TEST #24

(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.

(2) Set STE/ICE test select switch to "24".

(3) Press and hold TEST button until "CAL" appears in display.

(4) Release TEST button and wait for offset value to appear in display.

(5) Press and release TEST button.

(6) Start engine (TM 9-2320-360-10) and observe test results on STE/ICE display.

(7) Shut off engine (TM 9-2320-360-10).
b2. ENGINE STARTS BUT MISFIRES, RUNS ROUGH, OR LACKS POWER

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**
- Air restriction indicator OK

**POSSIBLE PROBLEMS**
- Fuel system requires priming
- Inadequate fuel pressure/volume
- Fuel lines or fittings loose or damaged
- Damaged or leaking fuel water separator
- Contaminated fuel
- Faulty injector(s)

---

1. **Has fuel system been primed?**

    **TEST OPTIONS**
    - Prime Fuel System

    **REASON FOR QUESTION**
    - Engine may be misfiring, running rough, or lacking power because of air in fuel lines.

    **KNOWN INFO**
    - Air restriction indicator OK
    - Fuel system primed

    **POSSIBLE PROBLEMS**
    - Inadequate fuel pressure/volume
    - Fuel lines or fittings loose or damaged
    - Damaged or leaking fuel water separator
    - Contaminated fuel
    - Faulty injector(s)

    **TEST OPTIONS**
    - Fuel Supply Test
    - or
    - STE/ICE-R Test #24

    **REASON FOR QUESTION**
    - Engine is not getting adequate fuel supply if fuel pressure is less than 31 psi (214 kPa) or less than one gallon per minute at 2100 rpm.
WARNING
Fuel is very flammable and can explode easily. To avoid serious injury or death keep flame away from fuel and keep fire extinguisher within easy reach. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE.

NOTE
Perform Engine Troubleshooting (a3, ENGINE STARTS BUT MISFIRES, RUNS ROUGH, OR LACKS POWER) before starting here.

Push in and turn fuel primer pump 1/4 turn in either direction to release. Pump fuel primer pump until resistance is felt to purge air from fuel system. Push in and turn fuel primer pump 1/4 turn in either direction to lock.

FUEL SUPPLY TEST
(1) Remove fuel return line from left side fuel tank.
(2) Place fuel line in suitable container.
(3) Start engine (TM 9–2320–360–10).
(4) Observe fuel flow into container while assistant operates engine at 2100 rpm.
(6) Install fuel return line from left side fuel tank.

STE/ICE TEST #24
(1) Connect STE/ICE test cable to STE/ICE receptacle in cab.
(2) Set STE/ICE test select switch to "24".
(3) Press and hold TEST button until "CAL" appears in display.
(4) Release TEST button and wait for offset value to appear in display.
(5) Press and release TEST button.
(6) Start engine (TM 9–2320–360–10) and observe test results on STE/ICE display.
b2. ENGINE STARTS BUT MISFIRES, RUNS ROUGH, OR LACKS POWER (CONT)

**KNOWN INFO**
- Air restriction indicator OK
- Fuel system primed
- Adequate fuel pressure/volume

**POSSIBLE PROBLEMS**
- Fuel lines or fittings loose or damaged
- Damaged or leaking fuel water separator
- Contaminated fuel
- Faulty injector(s)

3. Are fuel lines and fittings free from leaks or damage?
   - NO
     - Replace fuel line(s) and/or fitting(s) (para 4-9 and/or 4-10).
   - YES

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Engine may not be getting adequate fuel if fuel lines or fittings are leaking or damaged.

**POSSIBLE PROBLEMS**
- Damaged or leaking fuel water separator
- Contaminated fuel
- Faulty injector(s)

4. Is fuel water separator bowl free from leaks or damage?
   - NO
     - Repair fuel water separator (para 4-12).
   - YES

**TEST OPTIONS**
- Visual inspection
- STE/ICE-R Test #26

**REASON FOR QUESTION**
- Engine may not be getting adequate fuel if fuel water separator is leaking or damaged.

**KNOWN INFO**
- Air restriction indicator OK
- Fuel system primed
- Adequate fuel pressure/volume
- Fuel lines and fittings OK

5. Is clean fuel in fuel water separator?
   - NO
     - Service fuel/water separator (para 4-11). Replace secondary fuel filter (para 4-13), drain contaminated fuel from tanks, and replace with clean fuel.
   - YES

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Engine may be misfiring, running rough, or lacking power due to contaminated fuel.
Check fuel water separator bowl for leaks, or damage.

**STE/ICE TEST #26**

1. Connect STE/ICE test cable to STE/ICE receptacle in cab.
2. Set STE/ICE test select switch to "26".
4. Press and release TEST button and wait for "PASS" or "FAIL" appears in display.
5. Shut off engine (TM 9-2320-360-10).

Check for presence of contaminants in bowl of fuel water separator.
b2. ENGINE STARTS BUT MISFIRES, RUNS ROUGH, OR LACKS POWER (CONT)

---

**KNOWN INFO**
- Air restriction indicator OK
- Fuel system primed
- Adequate fuel pressure/volume
- Fuel lines and fittings OK
- Fuel water separator OK
- Contaminated fuel

**POSSIBLE PROBLEMS**
- Faulty injector(s)

---

6. **Are injector response times OK?**

   - **NO**
     - Injectors faulty. Notify supervisor.
   - **YES**
     - Notify supervisor. Refer to TM 9-2320-360-34 Troubleshooting.

---

**TEST OPTIONS**
- Injector Response Time Test

---

**REASON FOR QUESTION**
Faulty injector will be indicated by a response time that is less than the others. A response time of .80 millisecond indicates a faulty injector.

---

**KNOWLEDGE INFO**
- Air restriction indicator OK
- Fuel system primed
- Inadequate fuel pressure/volume

**POSSIBLE PROBLEMS**
- Faulty fuel pump

---

7. **Does fuel pressure/volume improve with new secondary fuel filter installed?**

   - **NO**
     - Fuel pump is faulty. Notify supervisor.
   - **YES**
     - Fault corrected.

---

**TEST OPTIONS**
- Fuel Supply Test
  - or
  - STE/ICE-R Test #24

---

**REASON FOR QUESTION**
Fuel pump is faulty if fuel pressure remains less than 31 psi (214 kPa) or less than one gallon per minute at 2100 rpm.
WARNING
Fuel is very flammable and can explode easily. To avoid serious injury or death keep flame away from fuel and keep fire extinguisher within easy reach. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET OF VEHICLE. Be sure to wear the proper eye protection to avoid personal injury.

FUEL SUPPLY TEST
(1) Remove fuel return line from left side fuel tank.
(2) Place fuel line in suitable container.
(3) Start engine (TM 9-2320-360-10).
(4) Observe fuel flow into container while assistant operates engine at 2100 rpm.
(5) Shut off engine (TM 9-2320-360-10).
(6) Install fuel return line from left side fuel tank.

INJECTOR RESPONSE TIME TEST
(1) Connect DDR to DDL connector (page 2-67).
(2) Start engine (TM 9-2320-360-10).
(3) Select Fuel Injector Response Times on DDR.
(4) Compare injector response times of all eight injectors.
(5) Shut off engine (TM 9-2320-360-10).
(6) Disconnect DDR from DDL connector.
b3. ETHER STARTING AID DOES NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**WARNING**
Read WARNING on following page.

---

**TEST OPTIONS**
Ether Supply Cylinder Inspection

---

**REASON FOR QUESTION**
No ether will be available to start engine if supply cylinder is empty.

---

**TEST OPTIONS**
Visual inspection

---

**REASON FOR QUESTION**
If ether supply cylinder is loose, ether may be leaking and not going to engine.
WARNING
Ether is very flammable and could explode causing serious injury or death. Keep cylinder away from heat and open flame. Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Temperature at engine block must be below 55 °F (13 °C) before ether starting aid will work.

ETHER SUPPLY CYLINDER INSPECTION
(1) Remove ether supply cylinder (para 4–14).
(2) Shake ether supply cylinder to determine if ether is present.

Check that ether supply cylinder is screwed securely into ether injector valve.
b3. ETHER STARTING AID DOES NOT OPERATE (CONT)

**KNOWLEDGE INFO**
Ether supply cylinder not empty
Ether supply cylinder not loose

**POSSIBLE PROBLEMS**
Faulty ether injector valve
Ether line loose

**TEST OPTIONS**
Ether Injector Valve Test

**REASON FOR QUESTION**
Ether injector valve and/or electrical system is faulty if click is not heard when ETHER START control is pressed.

**WARNING**
Read WARNING on following page.

3. Does ether injector valve operate properly?

- NO
- YES

Refer to Electrical System Troubleshooting (e6. Ether starting aid does not operate).

4. Is ether line between supply cylinder and engine in good condition, free from kinks, cracks, leakage, or damage?

- NO
  - Replace ether line (para 4-14).
- YES

Fault not corrected. Notify supervisor.

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Ether will not go to engine if it is leaking from ether line. Replace ether line if kinked, cracked, leaking, or damaged.
WARNING
Ether is very flammable and could explode causing serious injury or death. Keep cylinder away from heat and open flame.

ETHER INJECTOR VALVE TEST

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2)</td>
<td>Press ETHER START control and listen for ether injector valve to click.</td>
</tr>
<tr>
<td>(3)</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

Check ether line between supply cylinder and engine for leaks and damage.
c. EXHAUST SYSTEM

Malfunction

**c1. Exhaust system unusually noisy or vibrates excessively during engine operation** ................................................. 2-428

**c2. Exhaust fumes in cab** ................................................. 2-432
c1. EXHAUST SYSTEM UNUSUALLY NOISY OR VIBRATES EXCESSIVELY DURING ENGINE OPERATION

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

WARNING
Read WARNING on following page.

1. Are the exhaust pipe, muffler, tailpipe, or aspiration hose secure and free from damage?

   NO

   YES

   Tighten connection(s). Replace leaking component(s) (para 5–2 thru 5–5).

2. Are the engine exhaust tubes free from damage or leaks?

   NO

   Replace exhaust tube(s) (para 5–5).

   YES

   Test Options

   Visual inspection

   Reason for Question

   Engine may operate with excessive noise or vibration if exhaust pipe, muffler, tailpipe, or aspiration hose are loose or leaking.

   Test Options

   Visual inspection

   Reason for Question

   Engine may operate with excessive noise or vibration if engine exhaust tubes are loose or leaking.

Known Info

All engine access panels in place and secure

Possible Problems

Loose or leaking exhaust pipe, muffler, tailpipe, or aspiration hose
Loose or leaking exhaust tubes
Loose or leaking exhaust manifold

Known Info

Exhaust pipe, muffler, tailpipe, and aspiration hose OK

Possible Problems

Loose or leaking exhaust tubes
Loose or leaking exhaust manifold

WARNING
Read WARNING on following page.

START
WARNING
Make sure exhaust pipe and muffler are cool before performing troubleshooting checks. Failure to comply may result in serious personnel injury.

Check exhaust pipe, muffler, tailpipe, and aspiration hose for loose connections and leaks.

Check engine exhaust tubes for loose connections or leaks.
c1. EXHAUST SYSTEM UNUSUALLY NOISY OR VIBRATES EXCESSIVELY DURING ENGINE OPERATION (CONT)

**KNOWN INFO**
- Exhaust pipe, muffler, tailpipe, and aspiration hose OK
- Exhaust tubes OK

**POSSIBLE PROBLEMS**
- Loose or leaking exhaust manifold

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Engine may operate with excessive noise or vibration when exhaust manifolds are loose or leaking.

3. Are the exhaust manifolds free from damage or leaks?

   - **NO** → Notify supervisor.
   - **YES** → Fault not corrected. Notify supervisor.
Check exhaust manifold for looseness or leaks.
c3. EXHAUST FUMES IN CAB

INITIAL SETUP

Equipment Conditions

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

KNOWN INFO
- All engine access panels in place and secure

POSSIBLE PROBLEMS
- Loose or leaking exhaust pipe, muffler, tailpipe, or aspiration hose
- Loose or leaking exhaust tubes
- Loose or leaking exhaust manifold

TEST OPTIONS
- Visual inspection

REASON FOR QUESTION
- Exhaust fumes may enter cab if exhaust pipe, muffler, tailpipe, or aspiration hose are loose or leaking.

WARNING
- Read WARNING on following page.

1. Are the exhaust pipe, muffler, tailpipe, or aspiration hose secure and free from damage?

- NO
  - Tighten connection(s). Replace leaking component(s) (para 5–2 thru 5–6).

- YES

2. Are the engine exhaust tubes free from damage or leaks?

- NO
  - Replace exhaust tube(s) (para 5–5).

- YES
WARNING
Make sure exhaust pipe and muffler are cool before performing troubleshooting checks. Failure to comply may result in serious personnel injury.

Check exhaust pipe, muffler, tailpipe, and aspiration hose for loose connections and leaks.

Check engine exhaust tubes for loose connections or leaks.
c2. EXHAUST FUMES IN CAB (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaust pipe, muffler, tailpipe, and aspiration hose OK</td>
<td>Loose or leaking exhaust manifold</td>
</tr>
<tr>
<td>Exhaust tubes OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaust fumes may enter cab if exhaust manifolds are loose or leaking.</td>
</tr>
</tbody>
</table>

3. Are the exhaust manifolds free from damage or leaks?

- **NO**  
  Notify supervisor.

- **YES**  
  Fault not corrected. Notify supervisor.

**WARNING**  
Read **WARNING** on following page.
WARNING
Make sure exhaust pipe and muffler are cool before performing troubleshooting checks. Failure to comply may result in serious personnel injury.

Check exhaust manifold for looseness or leaks.
d. COOLING SYSTEM

Malfunction

d1. Engine overheats (WATER TEMP gage continuously reads over 230 °F (110 °C)) ............................ 2-438
d1. ENGINE OVERHEATS (WATER TEMP GAGE CONTINUOUSLY READS OVER 230 °F (110 °C))

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
STE/ICE–R (Item 47, Appendix F)
Gage, Belt Tension (Item 12, Appendix F)
Pressure Tester (Item 32, Appendix F)
Adapter, Radiator (Item 1, Appendix F)

KNOWLEDGE INFO

Possible Problems
Low coolant level
Damaged coolant hoses
Loose or broken fan belts
Cooling fins plugged
Damaged radiator
Damaged fan assembly or shroud
Faulty fan control valve
Faulty thermostats
Faulty head gasket(s) or oil cooler
Faulty water pump
Faulty coolant temperature gage or sending unit

TEST OPTIONS

Reason for Question
Low coolant level may cause engine to overheat.

TEST OPTIONS

Reason for Question
Leaking or damaged coolant hoses may cause low coolant level and lead to engine overheating. Replace hoses or clamps if damaged or leaking.
Check all coolant hoses and clamps for leakage and damage, including hoses to heaters and coolant filter.

**WARNING**
Antifreeze may be very hot and under pressure from engine operation. Be sure to wear the proper eye protection and ensure engine is cool before performing maintenance. Failure to comply may cause serious personnel injury.

**NOTE**
The following flow chart should only be used if Engine Troubleshooting a6. was started on p. 2−400 and you were referred here.

Coolant should be visible in sight glass.
### KNOWN INFO
- Engine overheats
- Coolant level OK
- Coolant hoses OK
- Fan belts OK
- Cooling fins OK

### POSSIBLE PROBLEMS
- Loose or broken fan belts
- Cooling fins plugged
- Damaged radiator
- Damaged fan assembly or shroud
- Faulty fan control valve
- Faulty thermostats
- Faulty head gasket(s) or oil cooler
- Faulty water pump
- Faulty coolant temperature gage or sending unit

### TEST OPTIONS
- Visual inspection

### REASON FOR QUESTION
- Radiator will not operate if fan belts are damaged or not properly adjusted, and airflow to cool engine coolant will be restricted.

### 3. Are fan belts properly installed, adjusted, and free from damage?

#### ARE FAN BELTS PROPERLY INSTALLED, ADJUSTED, AND FREE FROM DAMAGE?

- **NO**
  - Adjust fan belt(s) (para 6-10) if loose. Replace fan belt(s) (para 6-11) if damaged.

- **YES**

### TEST OPTIONS
- Visual inspection

### REASON FOR QUESTION
- Radiator fan will not operate if fan belts are damaged or not properly adjusted, and airflow to cool engine coolant will be restricted.

### 4. Are radiator cooling fins free from dirt, mud, or other debris?

#### ARE RADIATOR COOLING FINS FREE FROM DIRT, MUD, OR OTHER DEBRIS?

- **NO**
  - Clear radiator cooling fins.

- **YES**

### TEST OPTIONS
- Visual inspection

### REASON FOR QUESTION
- Airflow to cool engine coolant will be restricted if radiator cooling fins are plugged with debris. Clear cooling fins if plugged with dirt, mud, or other debris.

### 5. Is radiator free from leakage or damage?

#### IS RADIATOR FREE FROM LEAKAGE OR DAMAGE?

- **NO**
  - Replace radiator (para 6-3).

- **YES**

### TEST OPTIONS
- Visual inspection
  - or
  - Cooling System Pressure Test

### REASON FOR QUESTION
- Leaking or damaged radiator may cause low coolant level and lead to engine overheating.
Check radiator for leaks or damage.

**COOLING SYSTEM PRESSURE TEST**

1. Remove radiator cap from radiator.
2. Install adapter on radiator.
3. Install radiator tester on adapter.

**CAUTION**

Do not pressurize over 10 psi (69 kPa). Failure to comply may result in damage to cooling system.

4. Pressurize radiator, using tester, to 10 psi.
5. Observe radiator and hoses for coolant leaks.

**NOTE**

Pressure loss without external leaks indicates internal coolant leaks.

6. Observe radiator tester for loss of pressure.
7. Remove tester and adapter from radiator.
8. Install radiator cap on radiator.

Check if radiator cooling fins are plugged with dirt, mud, or other debris.

Using a belt tension gauge, check that fan belt tension is 70–90 lb (310–400 N). Visually check for damaged or worn fan belts.
d1. ENGINE OVERHEATS (WATER TEMP GAGE CONTINUOUSLY READS OVER 230 °F (110 °C)) (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine overheats</td>
<td>Visual inspection</td>
<td></td>
</tr>
<tr>
<td>Coolant level OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coolant hoses OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan belts OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling fins OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiator OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POSSIBLE PROBLEMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damaged fan assembly or shroud</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty fan control valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty thermostats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty head gasket(s) or oil cooler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty water pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty coolant temperature gage or sending unit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Are fan assembly or shroud free from damage?

- **YES**: Replace fan assembly (para 6–8) or shroud (para 6–3).
- **NO**: 

7. Does fan control valve remain airtight when hose fitting is removed from valve?

- **YES**: Fan Control Valve Test
- **NO**: Replace fan control valve (para 6–13).

8. Do thermostats operate properly?

- **YES**: Visual inspection
- **NO**: Replace thermostat(s) (para 6–5).

**WARNING**

Read WARNING on following page.

**POSSIBLE PROBLEMS**

Faulty thermostats
Faulty head gasket(s) or oil cooler
Faulty water pump
Faulty coolant temperature gage or sending unit

**POSSIBLE PROBLEMS**

Faulty fan control valve
Faulty thermostats
Faulty head gasket(s) or oil cooler
Faulty water pump
Faulty coolant temperature gage or sending unit

**POSSIBLE PROBLEMS**

Faulty thermostats
Faulty head gasket(s) or oil cooler
Faulty water pump
Faulty coolant temperature gage or sending unit

**REASON FOR QUESTION**

- Airflow to cool engine coolant will be restricted if fan assembly or shroud are damaged.
- Fan will not operate if fan control valve does not operate properly. Fan control valve has failed if there is air pressure in hose no. 2759 when water temperature is over 195°F (91°C).
- Engine may overheat if thermostats do not operate properly.
Check fan assembly and shroud for damage.

**WARNING**
Always use caution when approaching a hot engine. Failure to do so may result in serious burns.

Feel upper radiator hoses when engine is hot. Thermostats are working properly if hoses feel warm.

---

**FAN CONTROL VALVE TEST**

**NOTE**
- WATER TEMP gage must read approximately 195 °F (91 °C) and AIR PRESS gage read between 100–120 psi (690–827 kPa) before fan control valve can be checked.

2. Run engine until WATER TEMP gage reads 195 °F (91 °C) and AIR PRESS gage reads between 100–120 psi (690–827 kPa).
4. Loosen air hose no. 2759 on fan control valve.
5. Check if air is coming out of fitting on fan control valve.
6. Tighten air hose no. 2759 on fan control valve.
d1. ENGINE OVERHEATS (WATER TEMP GAGE CONTINUOUSLY READS OVER 230 °F (110 °C)) (CONT)

**KNOWN INFO**
- Engine overheats
- Coolant level OK
- Coolant hoses OK
- Fan belts OK
- Cooling fins OK
- Radiator OK
- Fan assembly and shroud OK
- Fan control valve OK
- Thermostats OK

**POSSIBLE PROBLEMS**
- Faulty head gasket(s) or oil cooler
- Faulty water pump
- Faulty coolant temperature gage or sending unit

**TEST OPTIONS**
- Coolant Check

**REASON FOR QUESTION**
Contaminated coolant indicates faulty head gasket(s) and/or oil cooler and may cause engine to overheat.

9. **Is coolant clean (contains no oil and does not appear milky)?**

   **NO**
   - Notify supervisor.

   **YES**

10. **Is engine oil clean (contains no presence of coolant)?**

    **NO**
    - Notify supervisor.

    **YES**

11. **Is water pump operating properly?**

    **NO**
    - Notify supervisor.

    **YES**

**WARNING**
Read WARNING on following page.

**POSSIBLE PROBLEMS**
- Faulty head gasket(s) or oil cooler
- Faulty water pump
- Faulty coolant temperature gage or sending unit

**TEST OPTIONS**
- Engine Oil Check

**REASON FOR QUESTION**
Engine oil contaminated with coolant indicates faulty head gasket(s) and/or oil cooler and may cause engine to overheat.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Leaking or damaged water pump may cause engine to overheat.
**WARNING**
Do not remove radiator cap when engine is warm. Coolant may be very hot and under pressure. Be sure to wear the proper eye protection to avoid personal injury. Failure to comply may result in injury to personnel.

2. Remove radiator cap from radiator.
3. Observe condition of coolant inside radiator.
4. Install radiator cap on radiator.

---

**COOLANT CHECK**

**ENGINE OIL CHECK**

**NOTE**
Capacity of engine oil pan is approximately 28 qt (26.5 L).

1. Position drain pan under engine oil pan.
2. Remove drain plug from engine oil pan.
3. Drain engine oil into drain pan.
4. Observe condition of engine oil.
5. Install drain plug in engine oil pan.

---

Check water pump for leaks or damage.
d1. ENGINE OVERHEATS (WATER TEMP GAGE CONTINUOUSLY READS OVER 230 °F (110 °C)) (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine overheats</td>
</tr>
<tr>
<td>Coolant level OK</td>
</tr>
<tr>
<td>Coolant hoses OK</td>
</tr>
<tr>
<td>Fan belts OK</td>
</tr>
<tr>
<td>Cooling fins OK</td>
</tr>
<tr>
<td>Radiator OK</td>
</tr>
<tr>
<td>Fan assembly and shroud OK</td>
</tr>
<tr>
<td>Fan control valve OK</td>
</tr>
<tr>
<td>Thermostats OK</td>
</tr>
<tr>
<td>Head gasket(s) or oil cooler OK</td>
</tr>
<tr>
<td>Water pump OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty coolant temperature gage or sending unit</td>
</tr>
</tbody>
</table>

12. **Does WATER TEMP gage indicate the same temperature as STE/ICE-R test #38?**

- **NO**
  - Refer to Electric System Troubleshooting, (e5. One electric gage does not operate or is inaccurate).

- **YES**
  - Fault not corrected. Notify supervisor.

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STE/ICE-R Test #38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine may be operating at normal operating temperature, even though gage indicates an overheat condition. STE/ICE-R test uses different sending unit than gage circuit.</td>
</tr>
</tbody>
</table>
Verify WATER TEMP gage reading by comparing it to results from STE/ICE-R Test #38.

**STE/ICE TEST #38**

1. Connect STE/ICE test cable to STE/ICE receptacle in cab.
2. Set STE/ICE test select switch to “38”.
4. Move STE/ICE Zero Offset switch to ON position.
5. Press and hold TEST button until “CAL” appears in display.
7. Move STE/ICE Zero Offset switch to OFF position.
8. Press and release TEST button to obtain test results.
TRAILER BLACK OUT LIGHTS CIRCUIT

- From 24-volt magnetic switch 1299
- Trailer lighting circuit breaker 1676
- Trailer black out trailer relay 85
- MC4 connector 1680
- MC1 connector 1680
- MC25 connector 1680c
- MC15 connector
- Chassis
- DASH
- CAB
- Electronic Control Box
ELECTRIC HORN CIRCUIT

HORN SWITCH

CITY HORN SOLENOID

MC2 CONNECTOR

1168
E
F
1016

1435

1016

HORN RELAY

87A 87 85 2 VDC
30 88
1026 1031

FROM 12-VOLT MAGNETIC SWITCH

WORK LIGHT HORN CIRCUIT BREAKER

ELECTRONIC CONTROL BOX
### e. ELECTRICAL SYSTEM

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e1. Alternator(s) undercharging</td>
<td>2–460</td>
</tr>
<tr>
<td>e1.1. Alternator(s) overcharging</td>
<td>2–466</td>
</tr>
<tr>
<td>e2. Electrical components (12 volt and 24 volt) do not operate</td>
<td>2–468</td>
</tr>
<tr>
<td>e3. 12 volt electrical components do not operate</td>
<td>2–472</td>
</tr>
<tr>
<td>e4. All 12 volt electric gages do not operate</td>
<td>2–476</td>
</tr>
<tr>
<td>e5. One electric gage does not operate or is inaccurate</td>
<td>2–480</td>
</tr>
<tr>
<td>e6. Ether starting aid does not operate</td>
<td>2–484</td>
</tr>
<tr>
<td>e7. Horn (city) does not operate</td>
<td>2–490</td>
</tr>
<tr>
<td>e8. Instrument panel gage and switch lights do not operate</td>
<td>2–498</td>
</tr>
<tr>
<td>e9. Windshield wipers do not operate</td>
<td>2–502</td>
</tr>
<tr>
<td>e10. Windshield wipers do not operate in high speed</td>
<td>2–506</td>
</tr>
<tr>
<td>e11. Windshield washer does not operate</td>
<td>2–510</td>
</tr>
<tr>
<td>e12. Low air indicator light and/or alarm do not operate when air pressure is below 65 psi (448 kPa)</td>
<td>2–514</td>
</tr>
<tr>
<td>e13. Headlights do not operate</td>
<td>2–520</td>
</tr>
<tr>
<td>e14. Headlight low/high beam does not operate</td>
<td>2–528</td>
</tr>
<tr>
<td>e15. Turn signal light does not operate</td>
<td>2–534</td>
</tr>
<tr>
<td>e15.1. Turn signal indicator light does not operate</td>
<td>2–545.1</td>
</tr>
<tr>
<td>e16. Clearance, marker, parking, or tail light does not operate</td>
<td>2–546</td>
</tr>
<tr>
<td>e17. All blackout lights do not operate</td>
<td>2–554</td>
</tr>
<tr>
<td>e18. Blackout clearance, marker, or tail lights does not operate</td>
<td>2–558</td>
</tr>
<tr>
<td>e19. Blackout drive light does not operate</td>
<td>2–564</td>
</tr>
<tr>
<td>e20. Trailer blackout tail lights do not operate (Blackout lights on HET Tractor operate)</td>
<td>2–568</td>
</tr>
<tr>
<td>e21. Stop lights do not operate</td>
<td>2–576</td>
</tr>
<tr>
<td>e22. Blackout stop lights do not operate</td>
<td>2–582</td>
</tr>
<tr>
<td>e23. Engine brake does not operate</td>
<td>2–586</td>
</tr>
<tr>
<td>e24. Dome light does not operate</td>
<td>2–594</td>
</tr>
<tr>
<td>e25. Map light(s) do not operate</td>
<td>2–598</td>
</tr>
<tr>
<td>e26. Beacon light does not operate</td>
<td>2–602</td>
</tr>
<tr>
<td>e27. Backup light/alarm do not operate</td>
<td>2–610</td>
</tr>
<tr>
<td>e28. Tachograph Speedometer does not operate</td>
<td>2–616</td>
</tr>
<tr>
<td>e28.1. Speedometer does not operate</td>
<td>2–618.2</td>
</tr>
<tr>
<td>e29. Tachograph Tachometer does not operate</td>
<td>2–620</td>
</tr>
<tr>
<td>e29.1. Tachometer does not operate</td>
<td>2–622.2</td>
</tr>
<tr>
<td>e30. Clock does not operate</td>
<td>2–624</td>
</tr>
<tr>
<td>e31. All trailer lights do not operate (lights on HET Tractor operate)</td>
<td>2–628</td>
</tr>
<tr>
<td>e32. Ventilator does not operate</td>
<td>2–628.2</td>
</tr>
</tbody>
</table>
e1. ALTERNATOR(S) UNDERCHARGING

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Personnel Required**
- Two

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Gage, Belt Tension, (Item 12, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**
- Trailer lighting and wiper circuit breakers OK
- Battery fluid level OK

**POSSIBLE PROBLEMS**
- Faulty gage(s)
- Low battery specific gravity
- Loose or worn alternator belts
- Damaged or loose battery terminal connections
- Wires loose or damaged
- Alternator cables loose or damaged
- Faulty voltage regulators
- Faulty batteries

---

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Charging System Voltage Test
  or
  STE/ICE–R Test #89

**REASON FOR QUESTION**
A defective gage will indicate undercharging even though charging system is operating properly.

---

1. Are both BATTERY gages reading correctly?

**NO**
Replace gage (para 7–18).

**YES**

---

2. Is specific gravity for all batteries greater than 1.180 for tropical batteries and 1.225 for all others?

**NO**
Replace battery(ies) (para 7–57).

**YES**

---

**TEST OPTIONS**
- Specific Gravity Test

**REASON FOR QUESTION**
Checking specific gravity will help determine the condition of the batteries. The charging system may not function properly if the specific gravity is below specifications.
CHARGING SYSTEM VOLTAGE TEST

**WARNING**

Use extreme care when measuring voltage while engine is running. Rotating fan blade and hot engine parts may cause injury.

1. Connect multimeter leads across positive (+) terminal and negative (-) terminals of 12 volt alternator.
2. Start and operate engine at idle with aid of assistant (TM 9--2320--360--10).
3. Record voltage reading displayed on multimeter and compare with voltage reading on 12 volt BATTERY gage.
4. Shut off engine (TM 9--2320--360--10).
5. Connect multimeter leads across positive (+) terminal and negative (-) terminals of 24 volt alternator.
6. Start and operate engine at idle with aid of assistant (TM 9--2320--360--10).
7. Record voltage reading displayed on multimeter and compare with voltage reading on 24 volt BATTERY gage.
8. Shut off engine (TM 9--2320--360--10).

Refer to Table 2--1, Item 17 (PMCS) to check specific gravity of each battery cell.
### e1. ALTERNATOR(S) UNDERCHARGING (CONT)

####KNOWN INFO
- Trailer lighting and wiper circuit breakers OK
- Battery fluid level OK
- Gage(s) OK
- Battery specific gravity OK

####POSSIBLE PROBLEMS
- Loose or worn alternator belts
- Damaged or loose battery terminal connections
- Wires loose or damaged
- Alternator cables loose or damaged
- Faulty voltage regulators
- Faulty batteries

####WARNING
Read WARNING on following page.

3. Are alternator belts adjusted to the correct tension and free from excessive wear?

   - **NO**
     - Adjust loose alternator belts. Replace worn belts (para 7-6 or 7-7).
   - **YES**

4. Are battery terminals clean and free from damage, loose connections, or corrosion?

   - **NO**
     - Clean, tighten, or replace battery terminals (para 7-57) as necessary.
   - **YES**

5. Is the voltage drop between the alternators and the batteries less than 0.10 volt?

   - **NO**
     - Secure loose connections. Notify supervisor if damaged cables are found.
   - **YES**

####TEST OPTIONS

**TEST OPTIONS**

- Alternator Belt Adjustment
- Visual inspection
- Voltage Drop Test or STE/ICE-R Test #84 (for 24 volt alternator)

**REASON FOR QUESTION**

- Batteries may not charge if alternator belts are loose, missing, or worn.
- Batteries may fail to charge if battery terminals are damaged, loose, corroded, or dirty.
- Voltage drop decreases the voltage by the time it reaches the batteries. Voltage drop occurs when there is a bad connection or corrosion in the circuit.

####WARNING
Read WARNING on following page.

- Batteries may not charge if alternator belts are loose, missing, or worn.
- Batteries may fail to charge if battery terminals are damaged, loose, corroded, or dirty.
- Voltage drop decreases the voltage by the time it reaches the batteries. Voltage drop occurs when there is a bad connection or corrosion in the circuit.
Check battery terminals for damaged, loose, corroded, or dirty connections.

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Refer to para 7-6 or 7-7 to adjust alternator belt.

**WARNING**

Batteries can explode from a spark. Battery acid is harmful to skin and eyes. Be sure to wear the proper eye protection to avoid personal injury. If skin is exposed to battery electrolyte, flush with cold water, and seek immediate medical attention. Check battery terminals for damaged, loose, corroded, or dirty connections.

---

**VOLTAGE DROP TEST**

1. Start and operate engine at idle with aid of assistant (TM 9-2320-360-10).
2. Connect multimeter leads to positive (+) terminal and negative (−) terminals of 12 volt batteries. Record voltage displayed on multimeter.
3. Connect multimeter leads to positive (+) terminal and negative (−) terminals of 24 volt batteries. Record voltage displayed on multimeter.
4. Shut off engine (TM 9-2320-360-10).
5. Subtract voltage measured at alternators (step 1) from voltage measured at batteries. The difference is the voltage drop.
6. If the voltage drop is greater than 0.10 volt, check the following cables for loose or corroded connections:
   - Cable no. 1831 from positive (+) terminal on 24 volt alternator to 24 volt alternator circuit breaker.
   - Cable no. 1274 from 24 volt alternator circuit breaker to positive (+) terminal on starter.
   - Cable no. 1139 from positive (+) terminal on starter to batteries.
   - Cable no. 1831A from positive (+) terminal on 12 volt alternator to 12 volt alternator circuit breaker.
   - Cable no. 1622 from 12 volt alternator circuit breaker to batteries.
e1. ALTERNATOR(S) UNDERCHARGING (CONT)

**KNOWN INFO**
- Trailer lighting and wiper circuit breakers OK
- Battery fluid level OK
- Gage(s) OK
- Battery specific gravity OK
- Alternator belts OK
- Battery terminal connections OK
- Wires OK

**POSSIBLE PROBLEMS**
- Alternator cables loose or damaged
- Faulty voltage regulators
- Faulty batteries

6. **Is more than 2 volts measured at IGN terminal on alternators?**

   **WARNING**
   - Read WARNING on following page.
   - Secure loose connections. Notify supervisor if damaged cables are found.

   **TEST OPTIONS**
   - Ignition Wire Voltage Test
   - STE/ICE-R Test #98
   - STE/ICE-R Test #83

   **REASON FOR QUESTION**
   - Alternators require voltage to the IGN terminal to magnetize the field. Alternators will not charge batteries if there is less than 2 volts present at IGN terminal.

7. **Can the voltage regulators be adjusted to the proper voltages?**

   **TEST OPTIONS**
   - Refer to para 7-2(b) to adjust voltage regulators.

   **REASON FOR QUESTION**
   - Low output voltage from the alternators will decrease the potential for the batteries to charge.

8. **Do all batteries pass load test?**

   **TEST OPTIONS**
   - STE/ICE-R Test #73
   - STE/ICE-R Test #75

   **REASON FOR QUESTION**
   - Batteries may not maintain charge if servicing is required.

   **POSSIBLE PROBLEMS**
   - Faulty batteries

   **KNOWN INFO**
   - Battery fluid level OK
   - Gage(s) OK
   - Battery specific gravity OK
   - Alternator belts OK
   - Battery terminal connections OK
   - Wires OK
   - Alternator cables OK

   **POSSIBLE PROBLEMS**
   - Faulty voltage regulators
   - Faulty batteries
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE

- STE/ICE-R Test #98 measures voltage to 12-volt regulator.
- STE/ICE-R Test #83 measures voltage to 24-volt regulator.

**IGNITION WIRE VOLTAGE TEST**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>2</td>
<td>Place positive (+) probe of multimeter on IGN terminal of alternator.</td>
</tr>
<tr>
<td>3</td>
<td>Place negative (−) probe of multimeter on ground and check for over 2 volts on multimeter.</td>
</tr>
<tr>
<td>4</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

**STE/ICE TEST #98/83**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connect STE/ICE test cable to STE/ICE receptacle in cab.</td>
</tr>
<tr>
<td>2</td>
<td>Set STE/ICE test select switch to &quot;98&quot; or &quot;83&quot;.</td>
</tr>
<tr>
<td>4</td>
<td>Press and release TEST button to obtain test results.</td>
</tr>
</tbody>
</table>

NOTE

- The operation of the 12 volt and 24 volt alternators are related. It is possible for one of the alternators to influence the gage reading of the other. During normal operation the BATTERY gages should read 14 volts and 28 volts.
- A reading of 25 volts and 14 volts indicates that the 24 volt system has failed.
- If readings appear normal but the batteries on the 12 volt side are low, the 12 volt system is not charging enough to keep up with the loads applied. The gages are appearing normal because of the operation of the 24 volt alternator. Refer to para 7–2b to adjust voltage regulators.

NOTE

- Results of STE/ICE-R Tests #73 and #75 must both be obtained in order to determine condition of battery.
- Engine must be capable of cranking to perform STE/ICE-R Tests #73 and 75.

**STE/ICE TEST #73/75**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connect STE/ICE test cable to STE/ICE receptacle in cab.</td>
</tr>
<tr>
<td>2</td>
<td>Set STE/ICE test select switch to &quot;73&quot; or &quot;75&quot;.</td>
</tr>
<tr>
<td>3</td>
<td>Remove DDEC 6–way power harness connector from ECM.</td>
</tr>
<tr>
<td>4</td>
<td>Press and hold TEST button until &quot;CAL&quot; appears in display.</td>
</tr>
<tr>
<td>5</td>
<td>Release TEST button and wait for offset value to appear in display.</td>
</tr>
<tr>
<td>6</td>
<td>Press and release TEST button.</td>
</tr>
<tr>
<td>7</td>
<td>Attempt to crank engine while observing STE/ICE display for test results.</td>
</tr>
<tr>
<td>8</td>
<td>Install DDEC 6–way power harness connector on ECM.</td>
</tr>
</tbody>
</table>
**e1.1. ALTERNATOR(S) OVERCHARGING**

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Personnel Required**
- Two

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)
- Tape, Insulation, Electrical (Item 33, Appendix C)

---

**KNOWLEDGE INFO**

- Trailer lighting and wiper circuit breakers OK
- Battery fluid level OK

**POSSIBLE PROBLEMS**

- Faulty gage(s)
- Low battery specific gravity
- Damaged or loose battery terminal connections
- Wires loose or damaged
- Faulty voltage regulator
- Faulty 24v alternator
- Faulty 12v alternator

---

1. Are both BATTERY gages reading correctly?

   **WARNING**
   
   Read WARNING on following page.

   **TEST OPTIONS**
   - Charging System Voltage Test
   - STE/ICE–R Test #89

   **REASON FOR QUESTION**
   - A defective gage will indicate overcharging even though charging system is operating properly.

---

2. Is specific gravity for all batteries greater than 1.180 for tropical batteries and 1.225 for all others?

   **KNOWLEDGE INFO**
   
   - Trailer lighting and wiper circuit breakers OK
   - Battery fluid level OK
   - Gage(s) OK

   **POSSIBLE PROBLEMS**

   - Low battery specific gravity
   - Damaged or loose battery terminal connections
   - Wires loose or damaged
   - Faulty voltage regulator
   - Faulty 24v alternator
   - Faulty 12v alternator

---

   **TEST OPTIONS**
   - Specific Gravity Test

   **REASON FOR QUESTION**
   - Checking specific gravity will help determine the condition of the batteries. The charging system may not function properly if the specific gravity is below specifications.
CHARGING SYSTEM VOLTAGE TEST

WARNING
Use extreme care when measuring voltage while engine is running. Rotating fan blade and hot engine parts may cause injury.

1. Connect multimeter leads across positive (+) terminal and negative (-) terminals of 12 volt alternator.
3. Record voltage reading displayed on multimeter and compare with voltage reading on 12 volt BATTERY gage.
5. Connect multimeter leads across positive (+) terminal and negative (-) terminals of 24 volt alternator.
7. Record voltage reading displayed on multimeter and compare with voltage reading on 24 volt BATTERY gage.

Refer to Table 2–1, Item 17 (PMCS) to check specific gravity of each battery cell.
e1.1. ALTERNATOR(S) OVERCHARGING (CONT)

3. **WARNING**
   - Read WARNING on following page.

   **Are battery terminals clean and free from damage, loose connections, or corrosion?**

   **TEST OPTIONS**
   - Visual inspection

   **REASON FOR QUESTION**
   - Batteries may fail to charge if battery terminals are damaged, loose, corroded, or dirty.

4. **Is the voltage drop between the alternators and the batteries less than 0.10 volt?**

   **TEST OPTIONS**
   - Voltage Drop Test
   - STE/ICE-R Test #84 (for 24 volt alternator)

   **REASON FOR QUESTION**
   - Voltage drop occurs when there is a bad connection or corrosion in a circuit. Voltage drop can cause overcharging.

5. **Can the voltage regulators be adjusted to the proper voltages?**

   **TEST OPTIONS**
   - Refer to para 7-2(b) to adjust voltage regulators.

   **REASON FOR QUESTION**
   - A voltage regulator out of adjustment can cause overcharging. If the voltage regulators do not adjust properly, the faulty alternator must be isolated.

---

**KNOWN INFO**
- Trailer lighting and wiper circuit
- Breakers OK
- Battery fluid level OK
- Gage(s) OK
- Battery specific gravity OK

**POSSIBLE PROBLEMS**
- Damaged or loose battery terminal connections
- Wires loose or damaged
- Faulty voltage regulator
- Faulty 24v alternator
- Faulty 12v alternator

---

**KNOWN INFO**
- Trailer lighting and wiper circuit
- Breakers OK
- Battery fluid level OK
- Gage(s) OK
- Battery specific gravity OK
- Battery terminal connections OK

**POSSIBLE PROBLEMS**
- Wires loose or damaged
- Faulty voltage regulator
- Faulty 24v alternator
- Faulty 12v alternator

---

**KNOWN INFO**
- Trailer lighting and wiper circuit
- Breakers OK
- Battery fluid level OK
- Gage(s) OK
- Battery specific gravity OK
- Battery terminal connections OK
- Wires OK

**POSSIBLE PROBLEMS**
- Faulty voltage regulator
- Faulty 24v alternator
- Faulty 12v alternator
Check battery terminals for damaged, loose, corroded, or dirty connections.

**WARNING**

- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
- Batteries can explode from a spark. Battery acid is harmful to skin and eyes. If skin is exposed to battery electrolyte, flush with cold water, and seek immediate medical attention. Be sure to wear the proper eye protection to avoid personal injury.

Check battery terminals for damaged, loose, corroded, or dirty connections.

**VOLTAGE DROP TEST**

(1) Start and operate engine at idle with aid of assistant (TM 9-2320-360-10).

(2) Connect multimeter leads to positive (+) terminal and negative (-) terminals of 12 volt batteries. Record voltage displayed on multimeter.

(3) Connect multimeter leads to positive (+) terminal and negative (-) terminals of 24 volt batteries. Record voltage displayed on multimeter.

(4) Shut off engine (TM 9-2320-360-10).

(5) Subtract voltage measured at alternators (step 1) from voltage measured at batteries. The difference is the voltage drop.

(6) If the voltage drop is greater than 0.10 volt, check the following cables for loose or corroded connections:
   - Cable no. 1831 from positive (+) terminal on 24 volt alternator to 24 volt alternator circuit breaker.
   - Cable no. 1274 from 24 volt alternator circuit breaker to positive (+) terminal on starter.
   - Cable no. 1139 from positive (+) terminal on starter to batteries.
   - Cable no. 1831A from positive (+) terminal on 12 volt alternator to 12 volt alternator circuit breaker.
   - Cable no. 1622 from 12 volt alternator circuit breaker to batteries.

**NOTE**

Do not replace either alternator until the faulty alternator has been isolated in steps 6, 7, and 8. It is unlikely that both alternators have failed.

Refer to para 7-2b to adjust voltage regulators.
**e1.1. ALTERNATOR(S) OVERCHARGING (CONT)**

**WARNING**
Read **WARNING** on following page.

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
If the 24 volt BATTERY gage reads exactly twice the 12 volt gage (for example 16 volts and 32 volts), it is likely that the 24 volt alternator has failed.

**TEST OPTIONS**
24 Volt Alternator Test

**REASON FOR QUESTION**
The 24 volt alternator is faulty if the 12 volt BATTERY gage returns to normal. The overcharging 24 volt alternator was affecting the 12 volt gage reading.

**TEST OPTIONS**
12 Volt Alternator Test

**REASON FOR QUESTION**
The 12 volt alternator is faulty if the 24 volt BATTERY gage returns to normal. The overcharging 12 volt alternator was affecting the 24 volt gage reading.
NOTE

- The operation of the 12 volt and 24 volt alternators are related. It is possible for one of the alternators to influence the gage reading of the other. During normal operation the BATTERY gages should read 14 volts and 28 volts.
- It is likely that the 24 alternator has failed if the 24 volt BATTERY gage reads exactly twice the 12 volt gage, for example: 16 volts and 32 volts. The amount of overcharge on the 24 volt gage is twice the overcharge on the 12 volt gage.
- It is likely that the 12 alternator has failed if the 24 volt BATTERY gage does not read exactly twice the 12 volt gage. For example: 16 volts and 30 volts. The amount of overcharge is equal for both the 12 volt and the 24 volt gages.

ALTERNATOR TEST

1. Remove wire no. 1020 from IGN terminal of alternator.

CAUTION

IGN wire must be secured and insulated prior to starting engine. Failure to comply will result in damage to wire harness and equipment.

2. Secure and insulate wire no. 1020 with electrical tape.


4. Record the 12 volt and 24 volt BATTERY gage readings.

5. Shut off engine (TM 9-2320-360-10).

6. Install wire no. 1020 on IGN terminal of alternator.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
e2. ELECTRICAL COMPONENTS (12 VOLT AND 24 VOLT) DO NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**

Circuit breakers OK
System controls in correct position

**POSSIBLE PROBLEMS**

Faulty ENGINE switch
Loose or damaged wire connections
Faulty 24 volt magnetic switch

---

**TEST OPTIONS**

ENGINE Switch Test
or
STE/ICE–R Test #89

**REASON FOR QUESTION**

Either the ENGINE switch or wire no. 1431 from the 24 volt alternator circuit breaker to ENGINE switch is loose or damaged if low voltage is measured on wire no. 1640 with ENGINE switch positioned to ON.

---

**TEST OPTIONS**

Wire No. 1640 Voltage Test
or
STE/ICE–R Test #89

**REASON FOR QUESTION**

Wire no. 1640 from ENGINE switch to 24 volt magnetic switch is loose or damaged if low voltage is measured.

---

**START**

1. Are 22–28 volts measured on wire no. 1640 at ENGINE switch?

   - **NO** Go to step 6.

   - **YES**
     
     2. Are 22–28 volts measured on wire no. 1640 at 24 volt magnetic switch?

       - **NO** Secure loose connections. Notify supervisor if damaged wires are found.

       - **YES**

       1. Are 22–28 volts measured on wire no. 1640 at 24 volt magnetic switch?
NOTE
Batteries must be fully charged before performing the following checks.

<table>
<thead>
<tr>
<th>ENGINE SWITCH TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1640 at ENGINE switch.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE NO. 1640 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1640 at 24 volt magnetic switch.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e2. ELECTRICAL COMPONENTS (12 VOLT AND 24 VOLT) DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers OK
- System controls in correct position
- ENGINE switch OK

**POSSIBLE PROBLEMS**
- Loose or damaged wire connections
- Faulty 24 volt magnetic switch

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- 24 volt magnetic switch will not operate if wire no. 1435 is loose or damaged.

---

**3.**

Is wire no. 1435 from 24 volt magnetic switch to ground a closed circuit?

**TEST OPTIONS**
- Wire No. 1280 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1280 from 24 volt alternator to 24 volt magnetic switch is loose or damaged if low voltage is measured.

---

**4.**

Are 22–28 volts measured on wire no. 1280 at 24 volt magnetic switch?

**TEST OPTIONS**
- 24 Volt Magnetic Switch Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- 24 volt magnetic switch is faulty if low voltage is measured on no. 1072 wire.

---

**5.**

Are 22–28 volts measured on wire no. 1072 at 24 volt magnetic switch?

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Fault not corrected. Notify supervisor.

---

**WARNING**

**CAUTION**
Read WARNING and CAUTION on following page.

Secure loose connections. Notify supervisor if damaged wires are found.

---

Secure loose connections. Notify supervisor if damaged wires are found.

---

Fault not corrected. Notify supervisor.

---

---
(1) Turn ENGINE switch to ON position.

(2) Place positive (+) probe of multimeter on wire no. 1072 at 24 volt magnetic switch.

(3) Place negative (--) probe of multimeter on ground and look for 22–28 volts on multimeter.

(4) Turn ENGINE switch to OFF position.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from 24 volt magnetic switch for loose connections or damage.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

WIRE NO. 1280 VOLTAGE TEST

1. Place positive (+) probe of multimeter on wire no. 1280 at 24 volt magnetic switch.
2. Place negative (–) probe of multimeter on ground and check for 22–28 volts on multimeter.

24 VOLT MAGNETIC SWITCH TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1072 at 24 volt magnetic switch.
3. Place negative (–) probe of multimeter on ground and look for 22–28 volts on multimeter.
4. Turn ENGINE switch to OFF position.
**e2. ELECTRICAL COMPONENTS (12 VOLT AND 24 VOLT) DO NOT OPERATE (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breakers OK</td>
<td>Wire No. 1431 Voltage Test or STE/ICE-R Test #89</td>
<td>Wire no. 1431 from 24 volt alternator circuit breaker to ENGINE switch is loose or damaged if low voltage is measured. Engine switch is faulty if 22–28 volts are measured on wire no. 1431 at engine switch.</td>
</tr>
<tr>
<td>System controls in correct position</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty ENGINE switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loose or damaged wire connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WARNING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read WARNING on following page.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Are 22–28 volts measured on wire no. 1431 at ENGINE switch?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES: Replace engine switch (para 7–22).</td>
</tr>
<tr>
<td>NO: Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
</tbody>
</table>
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1431 VOLTAGE TEST
(1) Place positive (+) probe of multimeter on wire no. 1431 at ENGINE switch.
(2) Place negative (−) probe of multimeter on ground and check for 22-28 volts on multimeter.
**e3. 12 VOLT ELECTRICAL COMPONENTS DO NOT OPERATE**

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)

---

**START**

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Wire No. 1430 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Wire no. 1430 from 12 volt alternator to 12 volt magnetic switch is loose or damaged if low voltage is measured.

---

**KNOWN INFO**
- 24 volt components OK
- Lights OK

**POSSIBLE PROBLEMS**
- Faulty 12 volt magnetic switch
- Loose or damaged wire connections

1. Are 10–14 volts measured on no. 1430 wire at 12 volt magnetic switch?

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.

- **NO**

---

**KNOWN INFO**
- 24 volt components OK
- Lights OK
- Wire no. 1430 OK

**POSSIBLE PROBLEMS**
- Faulty 12 volt magnetic switch
- Loose or damaged wire connections

2. Are 22–28 volts measured on no. 1072 wire at 12 volt magnetic switch?

- **YES**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.

---

**TEST OPTIONS**
- Wire No. 1072 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Wire no. 1072 from 24 volt magnetic switch to 12 volt magnetic switch is loose or damaged if low voltage is measured.
(1) Remove thirteen screws and three panels from console.

(2) Place positive (+) probe of multimeter on wire no. 1430 at 12 volt magnetic switch.

(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE

Batteries must be fully charged before performing the following checks.

### WIRE NO. 1430 VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Remove thirteen screws and three panels from console.</td>
</tr>
<tr>
<td>(2)</td>
<td>Place positive (+) probe of multimeter on wire no. 1430 at 12 volt magnetic switch.</td>
</tr>
<tr>
<td>(3)</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
</tbody>
</table>

### WIRE NO. 1072 VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Position ENGINE switch to ON.</td>
</tr>
<tr>
<td>(2)</td>
<td>Place positive (+) probe of multimeter on wire no. 1072 at 12 volt magnetic switch.</td>
</tr>
<tr>
<td>(3)</td>
<td>Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.</td>
</tr>
<tr>
<td>(4)</td>
<td>Position ENGINE switch to OFF.</td>
</tr>
</tbody>
</table>
e3. 12 VOLT ELECTRICAL COMPONENTS DO NOT OPERATE (CONT)

3. Is wire no. 1435 from 12 volt magnetic switch to ground a closed circuit?

- **KNOWN INFO**
  - 24 volt components OK
  - Lights OK
  - Wire no. 1430 OK
  - Wire no. 1072 OK

- **POSSIBLE PROBLEMS**
  - Faulty 12 volt magnetic switch
  - Loose or damaged wire connections

- **TEST OPTIONS**
  - Continuity Test
  - STE/ICE-R Test #89

- **REASON FOR QUESTION**
  - Replace magnetic switch (para 7–37).

- **RESULT**
  - NO
    - Secure loose connections. Notify supervisor if damaged wires are found.

- **RESULT**
  - YES
    - Notify supervisor if damaged wires are found.

4. Are 10–14 volts measured on wire no. 1075A at 24 volt magnetic switch?

- **KNOWN INFO**
  - 24 volt components OK
  - Lights OK
  - Wire no. 1430 OK
  - Wire no. 1072 OK
  - Wire no. 1435 OK

- **POSSIBLE PROBLEMS**
  - Faulty 12 volt magnetic switch
  - Loose or damaged wire connections

- **TEST OPTIONS**
  - 12 Volt Magnetic Switch Test
  - STE/ICE-R Test #89

- **REASON FOR QUESTION**
  - Twenty four volt magnetic switch is faulty if low voltage is measured on wire no. 1075A.

- **RESULT**
  - NO
    - Replace magnetic switch (para 7–37).

- **RESULT**
  - YES
    - Secure loose connections. Notify supervisor if damaged wires are found.

5. Are 10–14 volts measured on wire no. 1075A at WIPER circuit breaker?

- **KNOWN INFO**
  - 24 volt components OK
  - Lights OK
  - Wire no. 1430 OK
  - Wire no. 1072 OK
  - Wire no. 1435 OK
  - 12 volt magnetic switch OK

- **POSSIBLE PROBLEMS**
  - Loose or damaged wire connections

- **TEST OPTIONS**
  - Wire No. 1075A Voltage Test
  - STE/ICE-R Test #89

- **REASON FOR QUESTION**
  - Wire no. 1075A from 12 volt magnetic switch to 12 volt circuit breakers is loose or damaged if low voltage is measured.

- **RESULT**
  - NO
    - Secure loose connections. Notify supervisor if damaged wires are found.

- **RESULT**
  - YES
    - Notify supervisor if damaged wires are found.

**WARNING**

- Read WARNING and CAUTION on following page.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from 12 volt magnetic switch for loose connections or damage.

---

**CONTINUITY TEST**

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

---

**12 VOLT MAGNETIC SWITCH TEST**

1. Remove thirteen screws and three panels from console.
2. Turn ENGINE switch to ON position.
3. Place positive (+) probe of multimeter on no. 1075A wire at 12 volt magnetic switch.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Turn ENGINE switch to OFF position.

---

**WIRE NO. 1075A VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1075A at WIPER circuit breaker.
3. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
4. Turn ENGINE switch to OFF position.
e4. ALL 12 VOLT ELECTRIC GAGES DO NOT OPERATE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**
Circuit breaker not tripped

**POSSIBLE PROBLEMS**
- Tripped circuit breaker
- Loose or damaged wire harness
- Loose or damaged wire connections

---

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Circuit Breaker Test

**REASON FOR QUESTION**
All 12 volt electric gages will not operate if low voltage is present at lower terminal of GAUGES WARN LTS. circuit breaker.

---

1. Are 10-14 volts present at GAUGES WARN LTS. circuit breaker?
   - **NO** Replace circuit breaker (para 7–12).
   - **YES**

---

**KNOWN INFO**
Circuit breaker OK

**POSSIBLE PROBLEMS**
- Loose or damaged wire harnesses
- Loose or damaged wire connections

---

2. Is cab wire harness connected securely to instrument panel wire harness at connector?
   - **NO** Tighten harness connector.
   - **YES**

---

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
All 12 volt electric gages will not operate if cab wire harness is not connected securely to instrument panel wire harness.
NOTE

WATER TEMP gage, OIL PRESS gage, TRANS TEMP gage, T-CASE TEMP gage, BATTERY gage (12 volt system), and FUEL gage are 12 volt electric gages.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CIRCUIT BREAKER TEST

| (1) Remove eight screws and panel from console. |
| (2) Turn ENGINE switch to ON position. |
| (3) Place positive (+) probe of multimeter on lower terminal of circuit breaker. |
| (4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter. |
| (5) Turn ENGINE switch to OFF position. |

Remove instrument panel (para 7–13) and check if cab wire harness is connected securely to instrument panel wire harness.

CAB WIRE HARNESS

INSTUMENT PANEL WIRE HARNESS

INSTUMENT PANEL
4. ALL 12 VOLT ELECTRIC GAGES DO NOT OPERATE (CONT)

**known info**
- Circuit breaker OK
- Cab wire harness and instrument panel wire harness OK
- Wire no. 1276 OK

**possible problems**
- Loose or damaged wire connections

---

**warning**
- Are 10-14 volts measured on wire no. 1276 at harness connector (pin K)?
- Read WARNING on following page.
- Secure loose connections. Notify supervisor if damaged wires are found.

---

**test options**
- Wire No. 1276 Voltage Test or STE/ICE-R Test #89

**reason for question**
- Wire no. 1276 from GAUGES WARN LTS. circuit breaker to harness connector (pin K) is loose or damaged if low voltage is measured.

---

**known info**
- Circuit breaker OK
- Cab wire harness and instrument panel wire harness OK
- Wire no. 1276 OK

**possible problems**
- Loose or damaged wire connections

---

**caution**
- Is wire no. 1435 from cab harness connector (pin C) to ground a closed circuit?
- Read CAUTION on following page.
- Secure loose connections. Notify supervisor if damaged wires are found.
- YES

---

**test options**
- Continuity Test or STE/ICE-R Test #91

**reason for question**
- All 12 volt electric gages will not operate if ground wire no. 1435 from instrument panel is loose or damaged.

---

**fault not corrected. notify supervisor.**

---

**caution**
- Wire no. 1276 Voltage Test or STE/ICE-R Test #89
- Secure loose connections. Notify supervisor if damaged wires are found.
- NO

---

**test options**
- Wire No. 1276 Voltage Test or STE/ICE-R Test #89

**reason for question**
- Wire no. 1276 from GAUGES WARN LTS. circuit breaker to harness connector (pin K) is loose or damaged if low voltage is measured.

---

**known info**
- Circuit breaker OK
- Cab wire harness and instrument panel wire harness OK
- Wire no. 1276 OK

**possible problems**
- Loose or damaged wire connections

---

**known info**
- Circuit breaker OK
- Cab wire harness and instrument panel wire harness OK
- Wire no. 1276 OK

**possible problems**
- Loose or damaged wire connections

---

**known info**
- Circuit breaker OK
- Cab wire harness and instrument panel wire harness OK
- Wire no. 1276 OK

**possible problems**
- Loose or damaged wire connections

---

**test options**
- Continuity Test or STE/ICE-R Test #91

**reason for question**
- All 12 volt electric gages will not operate if ground wire no. 1435 from instrument panel is loose or damaged.

---

**fault not corrected. notify supervisor.**
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1276 VOLTAGE TEST
1. Remove instrument panel (para 7-14).
2. Turn ENGINE switch to ON position.
3. Place positive (+) probe of multimeter on wire no. 1276 (pin K) at cab harness connector.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Turn ENGINE switch to OFF position.

Check ground wire no. 1435 from instrument panel for loose connections or damage.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.
e5. ONE ELECTRIC GAGE DOES NOT OPERATE OR IS INACCURATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWLEDGMENT INFO**

Circuit breakers not tripped

**POSSIBLE PROBLEMS**

Faulty sending unit
Loose or damaged wire connections
Faulty gage

**TEST OPTIONS**

Electric Gage Test

**REASON FOR QUESTION**

If gage reads full scale, but still does not operate properly the sending unit is defective.

---

1. Does gage read less than full scale when wire going to sending unit is touched to ground?

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Gage may not operate if wires are not correctly connected to gage, or if wires are loose or damaged.

---

2. Are wires connected to gage free from loose connections or damage, and are wires connected to gage at correct terminals?

**TEST OPTIONS**

Connect wires to gage at correct terminals. Secure loose connections. Notify supervisor if damaged wires are found.

---

**WARNING**

Read WARNING on following page.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**

Refer to FO--4 (p. FP--21) Electric Dash Panel wiring diagram of instruments.

Check wires connected to electric gages for loose connections or damage. Check that wires are connected to gages at correct terminals.

---

**ELECTRIC GAGE TEST**

1. Remove wire from sending unit of defective gage and secure to ground.
   **NOTE**
   Gage should read full scale when wire is touched to ground.

2. Turn ENGINE switch to ON position and note reading on gage.

3. Turn ENGINE switch to OFF position.
e5. ONE ELECTRIC GAGE DOES NOT OPERATE OR IS INACCURATE (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Sending unit OK
- Wires at gage OK

**POSSIBLE PROBLEMS**
- Loose or damaged wire connections between gage and sending unit
- Faulty gage

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Gage may not operate if wire from gage to sending unit is loose or damaged. Gage is defective if wires are correctly connected and not loose or damaged.

**CAUTION**
Read CAUTION on following page.

**Is wire from gage to sending unit a closed circuit?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.
  - Replace gage (para 7-18).

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
NOTE
BATTERY gages do not have sending units.

Check wire from gage to sending unit for loose connections or damage.

**CONTINUITY TEST**

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.
3. Connect multimeter leads to each end of wire and check multimeter for continuity.
4. Remove multimeter lead from one end of wire and connect to chassis ground.

**NOTE**
A reading of infinity indicates an open circuit.

Any reading besides infinity indicates a grounded wire.

Table 2-9. Electric Gage Sending Unit Location

<table>
<thead>
<tr>
<th>ELECTRIC GAGE</th>
<th>WIRE NO.</th>
<th>SENDING UNIT LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER TEMP gage</td>
<td>1320</td>
<td>in left thermostat housing</td>
</tr>
<tr>
<td>OIL PRESS gage</td>
<td>1113</td>
<td>near rear of 24 volt alternator</td>
</tr>
<tr>
<td>TRANS TEMP gage</td>
<td>1068</td>
<td>on top right of transmission (next to transmission breather)</td>
</tr>
<tr>
<td>T-CASE TEMP gage</td>
<td>1063</td>
<td>on front of transfer case (lower left side)</td>
</tr>
<tr>
<td>FUEL gage</td>
<td>1318</td>
<td>in left fuel tank</td>
</tr>
</tbody>
</table>
**e6. ETHER STARTING AID DOES NOT OPERATE**

**INITIAL SETUP**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**

- Circuit breaker not tripped
- Ether supply cylinder OK
- Ether line OK
- Ether injector valve inoperative

**POSSIBLE PROBLEMS**

- Damaged circuit breaker
- Wire no. 1487 loose or damaged
- Faulty ETHER START switch
- Wire no. 1036 loose or damaged
- Wire no. 1926 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty ETHER START temperature switch

---

**TEST OPTIONS**

**REASON FOR QUESTION**

Are less than 22–28 volts measured on no. 1487 wire at ETHER START switch?

**NO**

Go to step 3.

**YES**

1. **TEST OPTIONS**

   - Wire No. 1487 Voltage Test
   - STE/ICE-R Test #89

   **REASON FOR QUESTION**

   F/W SEP XMSN MOD ETHER START circuit breaker or wire no. 1487 is loose or damaged if low voltage is measured.

---

**KNOWN INFO**

- Circuit breaker not tripped
- Ether supply cylinder OK
- Ether line OK
- Low voltage at ether start switch

**POSSIBLE PROBLEMS**

- Damaged circuit breaker
- Wire no. 1487 loose or damaged

---

**TEST OPTIONS**

- Circuit Breaker Test

**REASON FOR QUESTION**

Are 22–28 volts present at fuel/water separator, transmission modulator, and ether start (F/W SEP XNSM MOD ETHER START) circuit breaker?

**NO**

2. **TEST OPTIONS**

   - Ether starting aid will not operate if low voltage is present at lower terminal of F/W SEP XMSN MOD ETHER START circuit breaker. Wire no. 1487 from F/W SEP XMSN MOD ETHER START circuit breaker to ETHER START switch is loose or damaged if 22–28 volts are measured at F/W SEP XMSN MOD ETHER START circuit breaker.

**YES**

Replace circuit breaker (para 7–12).

Secure loose connections. Notify supervisor if damaged wires are found.
**WARNING**

- Ether is very flammable and could explode causing serious injury or death. Keep cylinder away from heat and open flame.

- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**

- Perform Fuel System Troubleshooting (b3, Ether starting aid does not operate) before starting steps given below.

- Temperature at engine block must be less than 55 °F (13 °C) before ether starting aid will work.

---

### WIRE NO. 1487 VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1487 at ETHER START switch.
3. Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
4. Turn ENGINE switch to OFF position.

---

### CIRCUIT BREAKER TEST

1. Remove eight screws and panel from console.
2. Place positive (+) probe of multimeter on lower terminal of circuit breaker.
3. Turn ENGINE switch to ON position.
4. Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
5. Turn ENGINE switch to OFF position.
e6. ETHER STARTING AID DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Ether supply cylinder OK
- Ether line OK
- Circuit breaker OK
- Wire no. 1487 OK

**POSSIBLE PROBLEMS**
- Faulty ETHER START switch
- Faulty ETHER START temperature switch
- Wire no. 1036 loose or damaged
- Wire no. 1926 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty ether injector valve

**TEST OPTIONS**
- ETHER START switch Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
ETHER START switch is faulty if low voltage is measured on wire no. 1036.

---

**TEST OPTIONS**
- Ether Start Temperature Switch Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Ether start temperature switch is faulty if there is an open circuit through switch when temperature of engine block is less than 55 °F (13 °C).

---

**KNOWN INFO**
- Circuit breaker not tripped
- Ether supply cylinder OK
- Ether line OK
- Ether injector valve inoperative
- Circuit breaker OK
- Wire no. 1487 OK
- ETHER START switch OK

**POSSIBLE PROBLEMS**
- Wire no. 1036 loose or damaged
- Wire no. 1926 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty ether injector valve

**TEST OPTIONS**
- Wire No. 1036 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Wire no. 1036 from ETHER START switch to ether injector valve is loose or damaged if low voltage is measured.
(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1036 at ETHER START switch.
(3) Place negative (-) probe of multimeter on ground.
(4) Press and hold ETHER START switch and check for 22–28 volts on multimeter.
(5) Release ETHER START switch.
(6) Turn ENGINE switch to OFF position.

**ETHER START SWITCH TEST**

**WARNING**
- Ether is very flammable and could explode causing serious injury or death. Keep cylinder away from heat and open flame. Be sure to wear the proper eye protection to avoid personal injury.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**WARNING**
- Ether is very flammable and could explode causing serious injury or death. Keep cylinder away from heat and open flame. Be sure to wear the proper eye protection to avoid personal injury.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**ETHER START TEMPERATURE SWITCH TEST**

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

**NOTE**
Temperature at engine block must be less than 55 °F (13 °C) to perform this test.

(1) Set multimeter to ohms position.
(2) Connect multimeter lead to end of wire no. 1926 on ether start temperature switch.

**NOTE**
A reading of infinity indicates an open circuit.

(3) Connect multimeter lead to end of wire no. 1435 on ether start temperature switch and check multimeter for continuity.

**WIRE NO. 1036 VOLTAGE TEST**

(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1036 at ether injector valve.
(3) Place negative (-) probe of multimeter on ground.
(4) Press and hold ETHER START switch and check for 22–28 volts on multimeter.
(5) Release ETHER START switch.
(6) Turn ENGINE switch to OFF position.
e6. ETHER STARTING AID DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Ether supply cylinder OK
- Ether line OK
- Circuit breaker OK
- Wire no. 1487 OK
- ETHER START switch OK
- ETHER START temperature switch OK
- Wire no. 1036 OK

**POSSIBLE PROBLEMS**
- Wire no. 1926 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty ether injector valve

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Wire no. 1926 from ether injector valve to ether start temperature switch is loose or damaged if no voltage is measured.

---

**6.**

**CAUTION**
Read WARNING and CAUTION on following page.

**Is there continuity on wire no. 1926 between ether injector valve and temperature switch?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.

- **NO**
  - Replace ether injector valve (para 4-14).

**REASON FOR QUESTION**
- Wire no. 1926 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty ether injector valve

---

**7.**

**CAUTION**
Read CAUTION on following page.

**Is wire no. 1435 from ether start temperature switch to ground a closed circuit?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.

- **NO**
  - Replace ether injector valve (para 4-14).

**REASON FOR QUESTION**
- Ether starting aid will not operate if ground wire no. 1435 from ether start temperature switch is loose or damaged. Ether injector valve is faulty if wire is connected and not damaged.
Contingency Test

Check ground wire no. 1435 from ether start temperature switch for loose connections or damage.

**Caution**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Remove left inner fender (para 16-34).
2. Disconnect wiring from components at each end of wire.
3. Set multimeter to ohms position.

**Note**

A reading of infinity indicates an open circuit.

4. Connect multimeter leads to each end of wire and check multimeter for continuity.

**Note**

Any reading besides infinity indicates a grounded wire.

5. Remove multimeter lead from one end of wire and connect to chassis ground.

**Warning**

- Ether is very flammable and could explode causing serious injury or death. Keep cylinder away from heat and open flame. Be sure to wear the proper eye protection to avoid personal injury.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
e7. HORN (CITY) DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

Personnel Required
Two

POSSIBLE PROBLEMS
Faulty city horn air system
City horn solenoid ground wire no. 1435 loose or damaged
Faulty city horn solenoid
Faulty circuit breaker
Wires no. 1031 and/or 1026 loose or damaged
Wire no. 1016 loose or damaged
Horn button ground wire no. 1435 loose or damaged
Faulty horn button
Faulty horn relay
Wire no. 1168 loose or damaged

KIND OF SERVICE

WARNING
Read WARNING on following page.

TEST OPTIONS

1. Does city horn sound when air control valve is activated with pull chain?

   YES

   NO

   Go to step 4.

   OR

   STE/ICE–R Test #89

2. Are 10–14 volts measured on wire no. 1168 at city horn solenoid?

   YES

   Go to Air System Troubleshooting (k11. Horn (city) does not operate).

   NO

   Go to step 4.

TEST OPTIONS

Visual inspection

REASON FOR QUESTION
If city horn sounds when activated by air control valve, electrical circuit is faulty.

TEST OPTIONS

Wire No. 1168 Voltage Test or STE/ICE–R Test #89

REASON FOR QUESTION
City horn solenoid is faulty or ground wire no. 1435 is loose or damaged if 10–14 volts are measured on wire no. 1168.
(1) Activate air horn control valve with pull chain.
(2) Have assistant see if city horn sounds.

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1168 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1168 at city horn solenoid.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on ground.</td>
</tr>
<tr>
<td>(4) Press horn button and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
### e7. HORN (CITY) DOES NOT OPERATE (CONT)

#### KNOWN INFO
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- 10–14 volts on wire no. 1168 at horn solenoid

#### POSSIBLE PROBLEMS
- City horn solenoid ground wire no. 1435 loose or damaged
- Faulty city horn solenoid

#### TEST OPTIONS
- Continuity Test
- STE/ICE-R Test #91

#### REASON FOR QUESTION
- City horn may not operate if ground wire no. 1435 from city horn solenoid is loose or damaged. City horn solenoid is faulty if ground wire no. 1435 is OK.

---

#### KNOWN INFO
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- Low voltage at city horn solenoid

#### POSSIBLE PROBLEMS
- Faulty circuit breaker
- Wires no. 1031 and/or 1026 loose or damaged
- Wire no. 1016 loose or damaged
- Horn button ground wire no. 1435 loose or damaged
- Faulty horn button
- Faulty horn relay
- Wire no. 1168 loose or damaged

#### TEST OPTIONS
- Circuit Breaker Test

#### REASON FOR QUESTION
- City horn will not operate if low voltage is present at lower terminal of WORK LTS. HORN circuit breaker.

---

#### KNOWN INFO
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- Low voltage at city horn solenoid
- Circuit breaker OK

#### POSSIBLE PROBLEMS
- Wires no. 1031 and/or 1026 loose or damaged
- Wire no. 1016 loose or damaged
- Horn button ground wire no. 1435 loose or damaged
- Faulty horn button
- Faulty horn relay
- Wire no. 1168 loose or damaged

#### TEST OPTIONS
- Wires No. 1031 & No. 1026 Voltage Test
  - or
  - STE/ICE Test # 89

#### REASON FOR QUESTION
- City horn will not operate if low voltage is present at lower terminal of WORK LTS. HORN circuit breaker.

---

### WARNING
- Read WARNING and CAUTION on following page.

<table>
<thead>
<tr>
<th>3.</th>
<th>Is wire no. 1435 from city horn solenoid to ground a closed circuit?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
<tr>
<td>NO</td>
<td>Replace city horn solenoid (para 11–37).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.</th>
<th>Are 10–14 volts present at WORK LTS. HORN circuit breaker?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Replace circuit breaker (para 7–12).</td>
</tr>
<tr>
<td>YES</td>
<td>Replace city horn solenoid (para 11–37).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5.</th>
<th>Are 10–14 volts measured on no. 1031 and no. 1026 wires at HORN relay?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
<tr>
<td>YES</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
</tbody>
</table>
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from city horn solenoid for loose connections or damage.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.

CIRCUIT BREAKER TEST

(1) Remove eight screws and panel from console.
(2) Turn ENGINE switch to ON position.
(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.
(4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Turn ENGINE switch to OFF position.

WIRE NO. 1031 & NO. 1026 VOLTAGE TEST

(1) Remove eight screws and panel from console.
(2) Turn ENGINE switch to ON position.
(3) Place positive (+) probe of multimeter on wire no. 1031 at HORN relay.
(4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place positive (+) probe of multimeter on wire no. 1026 at HORN relay and note reading on multimeter.
(6) Turn ENGINE switch to OFF position.
e7. HORN (CITY) DOES NOT OPERATE (CONT)

**Known Info**
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- Low voltage at city horn solenoid
- Circuit breaker OK
- Wires no. 1031 and 1026 OK

**Possible Problems**
- Wire no. 1016 loose or damaged
- Horn button ground wire no. 1435 loose or damaged
- Faulty horn button
- Faulty horn relay
- Wire no. 1168 loose or damaged

**Known Info**
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- Low voltage at city horn solenoid
- Circuit breaker OK
- Wires no. 1031 and 1026 OK

**Possible Problems**
- Wire no. 1016 loose or damaged
- Horn button ground wire no. 1435 loose or damaged
- Faulty horn button
- Faulty horn relay
- Wire no. 1168 loose or damaged

**Known Info**
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- Low voltage at city horn solenoid
- Circuit breaker OK
- Wires no. 1031 and 1026 OK
- Wire no. 1016 OK

**Possible Problems**
- Horn button ground wire no. 1435 loose or damaged
- Faulty horn button
- Faulty horn relay
- Wire no. 1168 loose or damaged

**Test Options**
- Wire no. 1016 Continuity Check
- Wire No. 1016 Voltage Test or STE/ICE Test # 89
- Continuity Test or STE/ICE-R Test #91

**Reason for Question**
- City horn will not operate if wire no. 1016 is loose or damaged, horn button is faulty or horn button is not grounded.
- Wire no. 1016 from HORN relay to horn button is loose or damaged if low voltage is measured.
- City horn may not operate if ground wire no. 1435 from city horn solenoid is loose or damaged.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

## WIRE NO. 1016 CONTINUITY TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unplug horn relay.</td>
</tr>
<tr>
<td>2</td>
<td>Disconnect horn button ground wire no. 1435 from ground.</td>
</tr>
<tr>
<td>3</td>
<td>Set multimeter to ohms.</td>
</tr>
<tr>
<td>4</td>
<td>Place positive (+) probe of multimeter on wire no. 1016 at HORN relay.</td>
</tr>
<tr>
<td>5</td>
<td>Place negative (-) probe of multimeter on wire no. 1435.</td>
</tr>
<tr>
<td>6</td>
<td>Press horn button and check multimeter for continuity.</td>
</tr>
<tr>
<td>7</td>
<td>Connect horn button ground wire no. 1435 to ground.</td>
</tr>
<tr>
<td>8</td>
<td>Plug in horn relay</td>
</tr>
</tbody>
</table>

## WIRE NO. 1016 VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>2</td>
<td>Place positive (+) probe of multimeter on wire no. 1016 at horn button.</td>
</tr>
<tr>
<td>3</td>
<td>Place negative (-) probe of multimeter on ground.</td>
</tr>
<tr>
<td>4</td>
<td>Press horn button and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>5</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

Check ground wire no. 1435 from horn button for loose connections or damage.

## CONTINUITY TEST

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>2</td>
<td>Set multimeter to ohms position.</td>
</tr>
</tbody>
</table>

**NOTE**

A reading of infinity indicates an open circuit.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Connect multimeter leads to each end of wire and check multimeter for continuity.</td>
</tr>
</tbody>
</table>

**NOTE**

Any reading besides infinity indicates a grounded wire.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Remove multimeter lead from one end of wire and connect to chassis ground.</td>
</tr>
</tbody>
</table>
e7. CITY HORN DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Green needle on air pressure gage over 65 psi (448 kPa)
- Country horn OK
- City horn air system OK
- Low voltage at city horn solenoid
- Circuit breaker OK
- Wires no. 1031 and 1026 OK
- Wire no. 1016 OK
- Horn button ground wire no. 1435 OK

**POSSIBLE PROBLEMS**
- Faulty horn button
- Faulty horn relay
- Wire no. 1168 loose or damaged

**TEST OPTIONS**
- Horn Button Test
- STE/ICE-R Test #91

**WARNING**
Read WARNING and CAUTION on following page.

**9.** Is there continuity thru horn button when horn button is pressed?

**CAUTION**

- NO: Replace horn button (para 18-9).

**TEST OPTIONS**
- HORN Relay Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Horn button is faulty if there is an open circuit when horn button is pressed.

**POSSIBLE PROBLEMS**
- Faulty horn relay
- Wire no. 1168 loose or damaged

**10.** Are 10-14 volts measured on wire no. 1168 at HORN relay?

**CAUTION**

- NO: Replace HORN relay (para 7-27).
- YES: Secure loose connections. Notify supervisor if damaged wires are found.

**REASON FOR QUESTION**
- HORN relay is faulty if low voltage is measured on wire no. 1168. Wire no. 1168 from HORN relay to city horn solenoid is loose or damaged if 10-14 volts are measured at HORN relay.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

HORN BUTTON TEST
1. Disconnect horn switch connector at steering column.
2. Set multimeter to ohms position.
3. Connect multimeter leads to each pin in connector.
4. Press horn button and check multimeter for continuity.

HORN RELAY TEST
1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1168 at HORN relay.
3. Place negative (−) probe of multimeter on ground.
4. Press horn button and look for 10–14 volts on multimeter.
5. Turn ENGINE switch to OFF position.
e8. INSTRUMENT PANEL GAGE AND SWITCH LIGHTS DO NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

WARNING
Read WARNING on following page.

TEST OPTIONS
Circuit Breaker Test

REASON FOR QUESTION
Instrument panel gage and switch lights will not operate if low voltage is present at lower terminal of BLK. OUT LIGHTS circuit breaker.

START

Are 10–14 volts present at BLK. OUT LIGHTS circuit breaker?

YES

NO

Replace circuit breaker (para 7–12).

Are 10–14 volts measured on wire no. 1084 at rheostat?

YES

NO

Secure loose connections. Notify supervisor if damaged wires are found.

Are 10–14 volts measured on wire no. 1084 at rheostat?

YES

NO

Secure loose connections. Notify supervisor if damaged wires are found.

Circuit Breaker Test

Wire No. 1084 Voltage Test
or
STE/ICE–R Test #89

REASON FOR QUESTION
Wire no. 1084 from BLK. OUT LIGHTS circuit breaker to rheostat is loose or damaged if low voltage is measured.

KNOWLEDGED INFO
Circuit breakers not tripped
Light bulbs OK

POSSIBLE PROBLEMS
Damaged circuit breaker
Loose or damaged wire connections
Faulty rheostat

KNOWLEDGED INFO
Circuit breakers not tripped
Light bulbs OK
Circuit breaker OK

POSSIBLE PROBLEMS
Loose or damaged wire connections
Faulty rheostat
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CIRCUIT BREAKER TEST

(1) Remove eight screws and panel from console.
(2) Turn ENGINE switch to ON position.
(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Turn ENGINE switch to OFF position.

WIRE NO. 1084 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1084 at rheostat.
(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.
e8. INSTRUMENT PANEL GAGE AND SWITCH LIGHTS DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Light bulbs OK
- Circuit breaker OK
- Wire no. 1084 OK

**POSSIBLE PROBLEMS**
- Faulty rheostat

**TEST OPTIONS**
- Rheostat Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
Rheostat is faulty if low voltage is measured on wire no. 1052.

**3.**
Are 10–14 volts measured on no. 1052 wire at rheostat?

---

**WARNING**
Read WARNING on following page.

Fault not corrected.
Notify supervisor.

---
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th><strong>RHEOSTAT TEST</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1052 at rheostat.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
## e9. WINDSHIELD WIPERS DO NOT OPERATE

### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**TEST OPTIONS**

<table>
<thead>
<tr>
<th>Wire No. 1916 Voltage Test</th>
<th>STE/ICE–R Test #89</th>
</tr>
</thead>
</table>

**REASON FOR QUESTION**

Windshield wiper motor will not operate if low voltage is measured on wire no. 1916 at windshield wiper motor.

---

**TEST OPTIONS**

<table>
<thead>
<tr>
<th>Continuity Test</th>
<th>STE/ICE–R Test #91</th>
</tr>
</thead>
</table>

**REASON FOR QUESTION**

Windshield wipers may not operate if no. 1435 ground wire from windshield wiper motor is loose or damaged. If ground wire no. 1435 is OK, wiper motor is defective.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1916 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place windshield wiper switch in the intermediate speed position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1916 at windshield wiper motor.</td>
</tr>
<tr>
<td>(4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place windshield wiper switch in the off position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

Check ground wire no. 1435 from windshield wiper motor for loose connections or damage.

**CONTINUITY TEST**

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.
e9. WINDSHIELD WIPERS DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers are not tripped
- Low voltage on wire no. 1916 at wiper motor

**POSSIBLE PROBLEMS**
- Damaged circuit breaker
- Wire no. 1118 loose or damaged
- Faulty windshield wiper switch
- Wire no. 1916 loose or damaged

**TEST OPTIONS**
- Circuit Breaker Test

**REASON FOR QUESTION**
- Windshield wipers will not operate if low voltage is present at lower terminal of WIPER circuit breaker.

---

**Are 10–14 volts present at WIPER circuit breaker?**

- **NO**
  - Replace circuit breaker (para 7–12).
- **YES**

---

**KNOWN INFO**
- Circuit breakers are not tripped
- Low voltage on wire no. 1916 at wiper motor
- Circuit breaker OK

**POSSIBLE PROBLEMS**
- Wire no. 1118 loose or damaged
- Faulty windshield wiper switch
- Wire no. 1916 loose or damaged

**TEST OPTIONS**
- Wire No. 1118 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1118 from WIPER circuit breaker to windshield wipers switch is loose or damaged if low voltage is measured.

---

**Are 10–14 volts measured on wire no. 1118 at windshield wiper switch?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**

---

**KNOWN INFO**
- Circuit breakers are not tripped
- Low voltage on wire no. 1916 at wiper motor
- Circuit breaker OK
- Wire no. 1118 OK

**POSSIBLE PROBLEMS**
- Faulty windshield wiper switch
- Wire no. 1916 loose or damaged

**TEST OPTIONS**
- Windshield Wiper Switch Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Windshield wiper switch is faulty if low voltage is measured on wire no. 1916. Wire no. 1916 from windshield wiper switch to windshield wiper motor is loose or damaged if 10–14 volts are measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove eight screws and panel from console.</td>
</tr>
<tr>
<td>(2) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire no. 1118 is spliced with wire no. 1919.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE NO. 1118 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1118 at windshield wiper switch.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WINDSHIELD WIPER SWITCH TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place windshield wiper switch in the intermediate speed position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1916 at windshield wiper switch.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place windshield wiper switch in the off position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
**e10. WINDSHIELD WIPERS DO NOT OPERATE IN HIGH SPEED**

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**START**

- **WARNING**
  - Read WARNING on following page.

**1.** Are 10–14 volts measured on no. 1950 wire at windshield wiper switch?

  - **NO** Secure loose connections. Notify supervisor if damaged wires are found.
  - **YES**

**2.** Are 10–14 volts measured on wire no. 1917 at windshield wiper switch?

  - **NO** Replace windshield wiper switch (para 7–16).
  - **YES**

---

**KNOWN INFO**

- Circuit breakers not tripped
- Wipers work on low speed

**POSSIBLE PROBLEMS**

- Wire no. 1950 loose or damaged
- Faulty windshield wiper switch
- Faulty windshield wiper motor

---

**KNOWN INFO**

- Circuit breakers not tripped
- Wipers work on low speed
- Wire no. 1950 OK

**POSSIBLE PROBLEMS**

- Faulty windshield wiper switch
- Faulty windshield wiper motor

---

**TEST OPTIONS**

- Wire No. 1950 Voltage Test or STE/ICE–R Test #89

**REASON FOR QUESTION**

- Wire no. 1950 from windshield wiper motor to windshield wiper switch is loose or damaged if low voltage is measured.

---

**TEST OPTIONS**

- Windshield Wiper Switch (High Speed) Test or STE/ICE–R Test #89

**REASON FOR QUESTION**

- Windshield wiper switch is faulty if low voltage is measured on no. 1917 wire.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1950 VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Position windshield wiper switch in the high speed position.
3. Place positive (+) probe of multimeter on wire no. 1950 at windshield wiper switch.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Position windshield wiper switch in the off position.
6. Turn ENGINE switch to OFF position.

WINDSHIELD WIPER SWITCH (HIGH SPEED) TEST

1. Turn ENGINE switch to ON position.
2. Position windshield wiper switch in the high speed position.
3. Place positive (+) probe of multimeter on wire no. 1917 at windshield wiper switch.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Position windshield wiper switch in the off position.
6. Turn ENGINE switch to OFF position.
e10. WINDSHIELD WIPERS DO NOT OPERATE IN HIGH SPEED (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Wipers work on low speed
- Wire no. 1950 OK
- Windshield wiper switch OK

**POSSIBLE PROBLEMS**
- Faulty windshield wiper motor

**TEST OPTIONS**
- Wire No. 1917 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1917 from windshield wiper switch to windshield wiper motor is loose or damaged if low voltage is measured. Wiper motor is faulty if voltage is present on wire no. 1917 at wiper motor.

---

3. Are 10–14 volts measured on wire no. 1917 at windshield wiper motor?

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
  - Replace windshield wiper motor (para 18–2).

- **YES**

**WARNING**
Read WARNING on following page.

Circuit breakers not tripped
Wipers work on low speed
Wire no. 1950 OK
Windshield wiper switch OK

Faulty windshield wiper motor

Secure loose connections. Notify supervisor if damaged wires are found.

Replace windshield wiper motor (para 18–2).
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1917 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Position windshield wiper switch in the high speed position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1917 at windshield wiper motor.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Position windshield wiper switch in the off position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

WINDSHIELD WIPER MOTOR
11. WINDSHIELD WASHER DOES NOT OPERATE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

**TEST OPTIONS**

Are 10–14 volts measured on wire no. 1314 at windshield washer switch?

**REASON FOR QUESTION**

- Wire no. 1314 loose or damaged
- Faulty windshield washer switch

**TEST OPTIONS**

- Wire No. 1314 Voltage Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**

- Wire no. 1314 from windshield wiper switch to windshield washer switch is loose or damaged if low voltage is measured.

**TEST OPTIONS**

- Windshield Washer Switch Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**

- Windshield washer switch is faulty if low voltage is measured on wire no. 1921.
NOTE
- Perform Air System Troubleshooting (k9, Windshield washer does not operate) before performing steps given below.
- Windshield wipers must be on for washers to operate.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1314 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1314 at windshield washer switch.
(3) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.

WINDSHIELD WASHER SWITCH TEST
(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1921 at windshield washer switch.
(3) Place negative (–) probe of multimeter on ground.
(4) Press windshield washer switch and look for 10–14 volts on multimeter.
(5) Turn ENGINE switch to OFF position.
**e11. WINDSHIELD WASHER DOES NOT OPERATE (CONT)**

**KNOWN INFO**
- Windshield wipers OK
- Washer reservoir filled
- Washer spray openings clean
- Green needle on air pressure gage over 65 psi (448 kPa)
- No voltage at windshield washer solenoid valve
- Wire no. 1314 OK
- Windshield washer switch OK

**POSSIBLE PROBLEMS**
- Wire no. 1921 loose or damaged
- Faulty windshield washer solenoid valve

**TEST OPTIONS**
- Wire No. 1921 Voltage Test
  or
  STE/ICE–R Test #89

**REASON FOR QUESTION**
Wire no. 1921 wire from windshield washer switch to windshield washer solenoid valve is loose or damaged if low voltage is measured.

**WARNING**
- Read WARNING on following page.

**TEST OPTIONS**
- Continuity Test
  or
  STE/ICE–R Test #91

**REASON FOR QUESTION**
Windshield washer may not operate if ground wire no. 1435 from windshield washer solenoid valve is loose or damaged. Windshield washer solenoid valve is faulty if ground wire no. 1435 is OK.

---

**3.**
Are 10–14 volts measured on wire no. 1921 at windshield washer solenoid valve?

- **YES**
  - NO
  - Secure loose connections. Notify supervisor if damaged wires are found.

**4.**
Is wire no. 1435 from windshield washer solenoid valve to ground a closed circuit?

- **YES**
  - NO
  - Replace windshield washer solenoid valve (para 11–37).

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
### WIRE NO. 1921 VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1921 at windshield washer solenoid valve.
3. Place negative (−) probe of multimeter on ground.
4. Press windshield washer switch and look for 10-14 volts on multimeter.
5. Turn ENGINE switch to OFF position.

---

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

---

### CONTINUITY TEST

#### CAUTION

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

---

Check ground wire no. 1435 from washer control valve for loose connections or damage.


**e12. LOW AIR INDICATOR LIGHT AND/OR BUZZER DO NOT OPERATE WHEN AIR PRESSURE IS BELOW 65 PSI (448 KPA)**

### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

### KNOWN INFO

**Circuit breakers not tripped**
- Gages OK

### POSSIBLE PROBLEMS

- Wire no. 1276 loose or damaged
- Faulty low air buzzer
- Wire no. 1120 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty low air pressure switch

---

### TEST OPTIONS

**Wire No. 1120 Test**

---

### REASON FOR QUESTION

Low air pressure switches or ground wire no. 1435 are faulty if LOW AIR indicator light comes on and low air buzzer operates when wire no. 1120 is grounded.

---

### KNOWN INFO

**Circuit breakers not tripped**
- Gages OK
- Light/buzzer do not operate when grounding wire no. 1120

### POSSIBLE PROBLEMS

- Wire no. 1276 loose or damaged
- Faulty low air buzzer
- Wire no. 1120 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty low air pressure switch

---

### TEST OPTIONS

**Wire No. 1276 Voltage Test**
- or
- STE/ICE–R Test #89

---

### REASON FOR QUESTION

Wire no. 1276 from GAUGES WARN LTS. circuit breaker to LOW AIR indicator light and low air buzzer is loose or damaged if low voltage is measured.
WIRE NO. 1276 VOLTAGE TEST

NOTE
Air system pressure must be below 65 psi (448 kPa) to perform test.

(1) Drain air system (TM 9-2320-360-10) until AIR PRESS gage reads less than 65 psi (448 kPa) if necessary.

(2) Turn ENGINE switch to ON position.

(3) Place positive (+) probe of multimeter on wire no. 1276 at LOW AIR indicator.

(4) Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.

(5) Place positive (+) probe of multimeter on wire no. 1276 at low air buzzer and note reading on multimeter.

(6) Turn ENGINE switch to OFF position.

WIRE NO. 1120 TEST

NOTE
Air system pressure must be below 65 psi (448 kPa) to perform test.

(1) Drain air system (TM 9-2320-360-10) until AIR PRESS gage reads less than 65 psi (448 kPa) if necessary.

(2) Turn ENGINE switch to ON position.

(3) Remove wire no. 1120 from low air pressure switches.

(4) Place wire no. 1120 on ground and see if LOW AIR indicator and low air buzzer operate.

(5) Turn ENGINE switch to OFF position.

(6) Install wire no. 1120 on low air switches.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
e12. LOW AIR INDICATOR LIGHT AND/OR BUZZER DO NOT OPERATE WHEN AIR PRESSURE IS BELOW 65 PSI (448 KPA) (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Gages OK
- Light/buzzer do not operate when grounding wire no. 1120
- Wire no. 1276 OK

**POSSIBLE PROBLEMS**
- Faulty low air buzzer
- Wire no. 1120 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty low air pressure switch

**TEST OPTIONS**
- Low Air Buzzer Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
- Low air buzzer is faulty if low voltage is measured on wire no. 1120.

---

3. Are 10–14 volts measured on wire no. 1120 at low air buzzer?

**WARNING**
Read WARNING on following page.

- Replace low air buzzer (para 7–54).

---

4. Is there continuity on wire no. 1120 between low air indicator/buzzer and low air pressure switches?

**CAUTION**
Read CAUTION on following page.

- Wire no. 1120 from LOW AIR indicator and low air buzzer to low air pressure switches is loose or damaged if no voltage is measured.

---

5. Are wires no. 1435 from low air pressure switches to ground a closed circuit?

**CAUTION**
Read CAUTION on following page.

- LOW AIR indicator light and/or alarm may not operate if ground wire no. 1435 from low air pressure switch is loose or damaged.

---

- Secure loose connections. Notify supervisor if damaged wires are found.

---

- Secure loose connections. Notify supervisor if damaged wires are found.

---

- Secure loose connections. Notify supervisor if damaged wires are found.
LOW AIR BUZZER TEST

NOTE
Air system pressure must be below 65 psi (448 kPa) to perform test.

1. Drain air system (TM 9-2320-360-10) until AIR PRESS gage reads less than 65 psi (448 kPa) if necessary.
2. Turn ENGINE switch to ON position.
3. Place positive (+) probe of multimeter on wire no. 1120 at low air buzzer.
4. Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
5. Turn ENGINE switch to OFF position.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

Check ground wire no. 1435 from low air pressure switches for loose connections or damage.
e12. LOW AIR INDICATOR LIGHT AND/OR BUZZER DO NOT OPERATE WHEN AIR PRESSURE IS BELOW 65 PSI (448 KPA) (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Gages OK
- Light/buzzer operate when grounding wire no. 1120
- Wire no. 1435 OK

**POSSIBLE PROBLEMS**
- Faulty low air pressure switch

**TEST OPTIONS**
- Low Air Pressure Switch Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**
- Low air pressure switch is faulty if there is no continuity across switch terminals.

**WARNING**
Read WARNING on following page.

6. Is continuity measured across both low air pressure switches?

- **NO**
  - Replace low air pressure switch (para 7–56).

- **YES**
  - Fault not corrected. Notify supervisor.
### LOW AIR PRESSURE SWITCH TEST

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air system pressure must be below 65 psi (448 kPa) to perform test.</td>
</tr>
</tbody>
</table>

1. Drain air system (TM 9–2320–360–10) until AIR PRESS gage reads less than 65 psi (448 kPa) if necessary.
2. Set multimeter to ohms position.
3. Place positive (+) probe of multimeter on wire no. 1435 at low air pressure switch.
4. Place negative (−) probe of multimeter on ground and check multimeter for continuity.
5. Repeat steps (3) and (4) for other low air pressure switch.

### WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
e13. HEADLIGHTS DO NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

KNOWN INFO

Circuit breaker not tripped
No low or high beam

POSSIBLE PROBLEMS
Burned out headlight bulb
Faulty headlights switch
Damaged circuit breaker
Wire no. 1292 loose or damaged
Wire no. 1049 loose or damaged
Wire no. 1435 loose or damaged
Wire no. 1927 loose or damaged
Faulty HEAD LTS relay
Wire no. 1017 loose or damaged
Faulty DIMMER relay
Wires no. 1006/1007 loose or damaged

TEST OPTIONS

HEADLIGHTS BULB TEST

HEADLIGHTS SWITCH TEST

HEADLIGHTS BULB TEST

HEADLIGHTS SWITCH TEST

HEADLIGHTS BULB TEST

HEADLIGHTS SWITCH TEST

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HEADLIGHTS SWITC
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE
Headlights will not operate if BLACK OUT LIGHTS switch is in the on position.

HEADLIGHT BULB TEST

(1) Turn ENGINE switch to ON position.
(2) Place HEADLIGHT switch in the ON position.
(3) Place HEADLIGHT DIMMER switch in the low beam position (TM 9–2320–360–10).
(4) Place positive (+) probe of multimeter on wire no. 1006 at headlight bulb.
(5) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(6) Place HEADLIGHT DIMMER switch in the high beam position (TM 9–2320–360–10).
(7) Place positive (+) probe of multimeter on wire no. 1007 at headlight bulb.
(8) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(9) Place HEADLIGHT switch in the OFF position.
(10) Turn ENGINE switch to OFF position.

HEADLIGHTS SWITCH TEST

(1) Turn ENGINE switch to ON position.
(2) Place headlights switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1049 at headlights switch.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place headlights switch in the off position.
(6) Turn ENGINE switch to OFF position.
e13. HEADLIGHTS DO NOT OPERATE (CONT)

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- No low or high beam
- Headlight bulbs OK
- Headlights switch OK
- Circuit breaker OK
- Wire no. 1292 OK
- Wire no. 1049 OK

**POSSIBLE PROBLEMS**
- Wire no. 1049 loose or damaged
- Wire no. 1435 loose or damaged
- Wire no. 1927 loose or damaged
- Faulty HEAD LTS relay
- Wire no. 1017 loose or damaged
- Faulty DIMMER relay
- Wires no. 1006/1007 loose or damaged

---

**TEST OPTIONS**
- Wire No. 1049 Voltage Test
  or
  STE/ICE–R Test #89

**REASON FOR QUESTION**
- Wire no. 1049 wire from
  headlights switch to HEAD
  LTS. relay is loose or
  damaged if low voltage is
  measured.

---

**WARNING**
Read WARNING on following page.

Are 10–14 volts measured on wire no. 1049 at HEAD LTS. relay?

- YES
- NO

---

**TEST OPTIONS**
- Continuity Test
  or
  STE/ICE–R Test #91

**REASON FOR QUESTION**
- Headlights may not operate if
  no. 1435 ground wire from
  HEAD LTS. relay is loose or
  damaged.

---

**CAUTION**
Read CAUTION on following page.

Is wire no. 1435 from HEAD LTS. relay to ground a closed circuit?

- YES
- NO

---

**TEST OPTIONS**
- Wire No. 1927 Voltage Test
  or
  STE/ICE–R Test #89

**REASON FOR QUESTION**
- Wire no. 1927 from
  HEADLIGHTS circuit breaker
to HEAD LTS. relay is loose or
  damaged if low voltage is
  measured.

---

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- No low or high beam
- Headlight bulbs OK
- Headlights switch OK
- Circuit breaker OK
- Wire no. 1292 OK
- Wire no. 1049 OK

**POSSIBLE PROBLEMS**
- Wire no. 1435 loose or damaged
- Wire no. 1927 loose or damaged
- Faulty HEAD LTS relay
- Wire no. 1017 loose or damaged
- Faulty DIMMER relay
- Wires no. 1006/1007 loose or damaged

---

**TEST OPTIONS**
- Wire No. 1927 Voltage Test
  or
  STE/ICE–R Test #89

**REASON FOR QUESTION**
- Wire no. 1927 from
  HEADLIGHTS circuit breaker
to HEAD LTS. relay is loose or
  damaged if low voltage is
  measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1049 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place headlights switch in the on position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1049 at HEAD LTS relay.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place headlights switch in the off position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

Check ground wire no. 1435 from HEAD LTS relay for loose connections or damage.

<table>
<thead>
<tr>
<th>CONTINUITY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION</td>
</tr>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
<tr>
<td>(1) Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>(2) Set multimeter to ohms position.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>A reading of infinity indicates an open circuit.</td>
</tr>
<tr>
<td>(3) Connect multimeter leads to each end of wire and check multimeter for continuity.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>Any reading besides infinity indicates a grounded wire.</td>
</tr>
<tr>
<td>(4) Remove multimeter lead from one end of wire and connect to chassis ground.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE NO. 1927 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place headlights switch in the on position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1927 at HEAD LTS relay.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place headlights switch in the off position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e13. HEADLIGHTS DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- No low or high beam
- Headlight bulbs OK
- Headlights switch OK
- Circuit breaker OK
- Wire no. 1292 OK
- Wire no. 1049 OK
- Wire no. 1435 OK
- Wire no. 1927 OK

**POSSIBLE PROBLEMS**
- Faulty HEAD LTS relay
- Wire no. 1017 loose or damaged
- Faulty DIMMER relay
- Wires no. 1006/1007 loose or damaged

**WARNING**
Read WARNING on following page.

6. Are 10–14 volts measured on wire no. 1017 at HEAD LTS. relay?

- **NO** Replace HEAD LTS. relay (para 7–27).
- **YES**

**TEST OPTIONS**
HEAD LTS. Relay Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
HEAD LTS. relay is faulty if low voltage is measured on wire no. 1017.

7. Are 10–14 volts measured on wire no. 1017 at DIMMER relay?

- **NO** Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**

**TEST OPTIONS**
Wire no. 1017 Voltage Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
Wire no. 1017 from headlight relay to DIMMER relay is open if voltage is measured.

8. Are 10–14 volts measured on wire no. 1006 or wire no. 1007 at DIMMER relay?

- **NO** Replace DIMMER relay (para 7–27).
- **YES** Secure loose connections. Notify supervisor if damaged wires are found.

**TEST OPTIONS**
DIMMER Relay Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
DIMMER relay is faulty if low voltage is measured on wires no. 1006/1007 at dimmer relay. Wires no. 1006/1007 are loose or damaged if 10–14 volts are measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

HEAT LTS. RELAY TEST

(1) Turn ENGINE switch to ON position.
(2) Place headlights switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1017 at HEAD LTS. relay.
(4) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place headlights switch in the off position.
(6) Turn ENGINE switch to OFF position.

WIRE NO. 1017 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Place headlights switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1017 at DIMMER relay.
(4) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place headlights switch in the off position.
(6) Turn ENGINE switch to OFF position.

DIMMER RELAY TEST

(1) Turn ENGINE switch to ON position.
(2) Place HEADLIGHT switch in the ON position.
(3) Place HEADLIGHT DIMMER switch in the low beam position.
(4) Place positive (+) probe of multimeter on wire no. 1006 at DIMMER relay.
(5) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(6) Place HEADLIGHT DIMMER switch in the high beam position.
(7) Place positive (+) probe of multimeter on wire no. 1007 at DIMMER relay.
(8) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(9) Place HEADLIGHT switch in the OFF position.
(10) Turn ENGINE switch to OFF position.
e13. HEADLIGHTS DO NOT OPERATE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
</tr>
<tr>
<td>No low or high beam</td>
</tr>
<tr>
<td>Headlight bulbs OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty headlights switch</td>
</tr>
<tr>
<td>Damaged circuit breaker</td>
</tr>
<tr>
<td>Wire no. 1292 loose or damaged</td>
</tr>
</tbody>
</table>

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Wire No. 1292 Voltage Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
Headlight switch is faulty if 10–14 volts are measured on wire no. 1292.

**9.** Are 10–14 volts measured on wire no. 1292 at headlights switch?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
</tr>
<tr>
<td>No low or high beam</td>
</tr>
<tr>
<td>Headlight bulbs OK</td>
</tr>
<tr>
<td>Headlights switch OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damaged circuit breaker</td>
</tr>
<tr>
<td>Wire no. 1292 loose or damaged</td>
</tr>
</tbody>
</table>

**TEST OPTIONS**
Circuit Breaker Test

**REASON FOR QUESTION**
Circuit breaker is faulty if low voltage is present at lower terminal of HEADLIGHTS circuit breaker. Wire no. 1292 from HEADLIGHTS circuit breaker to HEADLIGHTS switch is loose or damaged if low voltage is measured.

**10.** Are 10–14 volts present at HEADLIGHTS circuit breaker?

- YES -> Secure loose connections. Notify supervisor if damaged wires are found.
- NO -> Go to step 10.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1292 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1292 at headlights switch.</td>
</tr>
<tr>
<td>(3) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove eight screws and panel from console.</td>
</tr>
<tr>
<td>(2) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.</td>
</tr>
<tr>
<td>(4) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
### e14. HEADLIGHTS LOW/HIGH BEAM DOES NOT OPERATE

#### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

#### KNOWN INFO

- Circuit breaker not tripped
- At least one headlight works on high or low beam

#### POSSIBLE PROBLEMS

- Burned out headlight bulb
- Faulty headlight dimmer switch
- Faulty DIMMER relay
- Loose or damaged wire connections

#### TEST OPTIONS

**Visual inspection**

- Are headlight bulbs OK?

**Reason for Question**
- Headlights will not operate if bulb is burned out.

#### REASON FOR QUESTION

**Dimmer Switch Test**

- Do high beam headlights fail to operate with jumper wire installed between pins A and B of MC9 connector at headlight dimmer switch?

**Reason for Question**
- Dimmer switch is faulty if headlights function on high beam with jumper wire installed between pins A and B of MC9 connector at headlight dimmer switch.

**START**

1. **WARNING**
   - Read WARNING on following page.
   - Are headlight bulbs OK?

   **YES**
   - Replace headlights (para 7–39).

   **NO**
   - Replace dimmer switch (para 7–17).

2. **WARNING**
   - Read WARNING on following page.
   - Do high beam headlights fail to operate with jumper wire installed between pins A and B of MC9 connector at headlight dimmer switch?

   **YES**
   - Replace dimmer switch (para 7–17).

   **NO**
   - Replace headlights (para 7–39).
Check headlights for burned out bulb if only one headlight does not operate.

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check headlights for burned out bulb if only one headlight does not operate.

**DIMMER SWITCH TEST**

1. Unplug MC9 connector at headlight dimmer switch.
2. Install jumper wire between pins A and B of MC9 connector.
3. Turn ENGINE switch to ON position.
4. Place headlights switch in the ON position.
5. Observe to see if headlights operate on high beam.
6. Place headlights switch in the off position.
7. Turn ENGINE switch to OFF position.
8. Remove jumper wire and plug in MC9 connector.
e14. HEADLIGHTS LOW/HIGH BEAM DOES NOT OPERATE (CONT)

- **KNOWN INFO**
  - Circuit breaker not tripped
  - At least one headlight works on high or low beam
  - Headlight bulb OK
  - Dimmer switch OK

- **POSSIBLE PROBLEMS**
  - Wire no. 1017 (from HEAD LTS. relay to headlight dimmer switch) loose or damaged
  - Faulty DIMMER relay
  - Loose or damaged wire connections

---

3. **TEST OPTIONS**
   - Wire No. 1017 Voltage Test
   - STE/ICE–R Test #89

- **REASON FOR QUESTION**
  - Wire no. 1017A (from HEAD LTS. relay to headlight dimmer switch) is loose or damaged if low voltage is measured.

- **TEST OPTIONS**
  - Wire No. 1017A Voltage Test
  - STE/ICE–R Test #89

- **REASON FOR QUESTION**
  - Wire no. 1017A from headlight dimmer switch to DIMMER relay is loose or damaged if low voltage is measured.

---

4. **TEST OPTIONS**
   - Wire No. 1017 Voltage Test
   - STE/ICE–R Test #89

- **REASON FOR QUESTION**
  - Wire no. 1017 from HEAD LTS. relay to headlight dimmer switch is loose or damaged if low voltage is measured.

---

5. **TEST OPTIONS**
   - Wire No. 1017 Voltage Test
   - STE/ICE–R Test #89

- **REASON FOR QUESTION**
  - Wire no. 1017 from HEAD LTS. relay to DIMMER relay is loose or damaged if low voltage is measured.
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**WIRE NO. 1017 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place headlights switch in the on position.
3. Place positive (+) probe of multimeter on wire no. 1017 at headlight dimmer switch.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Place headlights switch in the off position.
6. Turn ENGINE switch to OFF position.

**WIRE NO. 1017A VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place headlights switch in the on position.
3. Place headlight dimmer switch in the high beam position.
4. Place positive (+) probe of multimeter on wire no. 1017A at DIMMER relay.
5. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
6. Place headlights switch in the off position.
7. Turn ENGINE switch to OFF position.

**WIRE NO. 1017 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place headlights switch in the on position.
3. Place headlight dimmer switch in the high beam position.
4. Place positive (+) probe of multimeter on wire no. 1017 at DIMMER relay.
5. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
6. Place headlights switch in the off position.
7. Turn ENGINE switch to OFF position.
### e14. HEADLIGHTS LOW/HIGH BEAM DOES NOT OPERATE (CONT)

#### Known Info
- Circuit breaker not tripped
- At least one headlight works on high or low beam
- Headlight bulb OK
- Wire no. 1017 (from HEAD LTS. relay to headlight dimmer switch) OK
- Headlight dimmer switch OK
- Wire no. 1017A OK
- Wire no. 1017 (from HEAD LTS. relay to DIMMER relay) OK

#### Possible Problems
- Faulty DIMMER relay
- Loose or damaged wire connections

#### Known Info
- Circuit breaker not tripped
- At least one headlight works on high or low beam
- Headlight bulb OK
- Wire no. 1017 (from HEAD LTS. relay to headlight dimmer switch) OK
- Headlight dimmer switch OK
- Wire no. 1017A OK
- Wire no. 1017 (from HEAD LTS. relay to DIMMER relay) OK
- Ground wire no. 1435 OK

#### Possible Problems
- Faulty DIMMER relay
- Loose or damaged wire connections

### Test Options
- Continuity Test or STE/ICE–R Test #91

### Reason for Question
- Headlights may not operate if ground wire no. 1435 from DIMMER relay is loose or damaged.

### Test Options
- DIMMER Relay Test or STE/ICE–R Test #89

### Reason for Question
- DIMMER relay is faulty if low voltage is measured on wires no. 1435, 1006, and no. 1007.

### Test Options
- Wires No. 1006 & No. 1007 Voltage Test or STE/ICE–R Test #89

### Reason for Question
- Wires no. 1006 and no. 1007 wires from DIMMER relay to headlights are loose or damaged if low voltage is measured.
Check ground wire no. 1435 from HEAD LTS relay for loose connections or damage.

**DIMMER RELAY TEST**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>2</td>
<td>Place headlights switch in the on position.</td>
</tr>
<tr>
<td>3</td>
<td>Place headlight dimmer switch in the low beam position.</td>
</tr>
<tr>
<td>4</td>
<td>Place positive (+) probe of multimeter on wire no. 1435 at DIMMER relay.</td>
</tr>
<tr>
<td>5</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>6</td>
<td>Place positive (+) probe of multimeter on wire no. 1006 at DIMMER relay.</td>
</tr>
<tr>
<td>7</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>8</td>
<td>Place headlight dimmer switch in the high beam position.</td>
</tr>
<tr>
<td>9</td>
<td>Place positive (+) probe of multimeter on wire no. 1007 at DIMMER relay.</td>
</tr>
<tr>
<td>10</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>11</td>
<td>Place headlights switch in the off position.</td>
</tr>
<tr>
<td>12</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

**CONTINUITY TEST**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>2</td>
<td>Set multimeter to ohms position.</td>
</tr>
<tr>
<td>3</td>
<td>Connect multimeter leads to each end of wire and check multimeter for continuity.</td>
</tr>
</tbody>
</table>

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

**NOTE**

A reading of infinity indicates an open circuit.

**NOTE**

Any reading besides infinity indicates a grounded wire.

**VOLTAGE TEST**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>2</td>
<td>Place headlights switch in the on position.</td>
</tr>
<tr>
<td>3</td>
<td>Place headlight dimmer switch in the low beam position.</td>
</tr>
<tr>
<td>4</td>
<td>Place positive (+) probe of multimeter on wire no. 1006 at headlights.</td>
</tr>
<tr>
<td>5</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>6</td>
<td>Place headlight dimmer switch in the high beam position.</td>
</tr>
<tr>
<td>7</td>
<td>Place positive (+) probe of multimeter on wire no. 1007 at headlights.</td>
</tr>
<tr>
<td>8</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>9</td>
<td>Place headlights switch in the off position.</td>
</tr>
<tr>
<td>10</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e15. TURN SIGNAL LIGHT DOES NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**START**

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
If all lights are out, control circuit is at fault, if only one light is out, individual circuit is faulty.

**1.**

**DO ANY OF THE TURN SIGNAL LIGHTS OPERATE?**

**KNOWN INFO**
- Circuit breaker not tripped

**POSSIBLE PROBLEMS**
- Faulty control circuit
- Burned out turn signal bulb
- Power wire loose or damaged
- Wire no. 1435 loose or damaged

**GO TO STEP 5.**

**2.**

**ARE THE TURN SIGNAL LIGHT BULBS OK?**

**KNOWN INFO**
- Circuit breaker not tripped
- Control circuit OK

**POSSIBLE PROBLEMS**
- Burned out turn signal bulb
- Power wire loose or damaged
- Wire no. 1435 loose or damaged

**NO**

**Replace bulb (para 7–41, 7–49, or 7–50).**

**YES**

---

**If all lights are out, control circuit is at fault, if only one light is out, individual circuit is faulty.**

**Clearance, marker, parking, and tail lights will not operate if bulb is burned out.**
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE
Turn signal will not operate if BLACK OUT LIGHTS switch is in the on position.

Check turn signal lights for operation (TM 9-2320-360-10).

Check turn signals for burned out bulb if only one turn signal does not operate.
**e15. TURN SIGNAL LIGHT DOES NOT OPERATE (CONT)**

### 3. Are 10–14 volts measured on power wire at light that does not operate?

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Power Wire Voltage Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**
Wire from turn signal switch to inoperative lights is loose or damaged turn signal switch is faulty if low voltage is measured.

### 4. Is wire no. 1435 from light that does not operate to ground, a complete circuit?

**CAUTION**
Read CAUTION on following page.

**TEST OPTIONS**
- Continuity Test
- STE/ICE–R Test #91

**REASON FOR QUESTION**
Turn signal lights may not operate if wire no. 1435 is faulty.

### 5. Are 10–14 volts present at TURN SIGNAL circuit breaker?

**TEST OPTIONS**
- Circuit Breaker Test

**REASON FOR QUESTION**
Turn signals will not operate if low voltage is present at lower terminal of TURN SIGNAL circuit breaker.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE
Power wire for right front turn signal is wire no. 1001, left front is wire no. 1002, right rear is wire no. 1004A, and left rear is wire no. 1003A.

<table>
<thead>
<tr>
<th>WIRE NO. 1012 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place turn signal switch in left or right position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on power wire at inoperative light.</td>
</tr>
<tr>
<td>(4) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place turn signal switch in center position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTINUITY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION</td>
</tr>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
<tr>
<td>(1) Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>(2) Set multimeter to ohms position.</td>
</tr>
<tr>
<td>NOTE</td>
</tr>
<tr>
<td>A reading of infinity indicates an open circuit.</td>
</tr>
<tr>
<td>(3) Connect multimeter leads to each end of wire and check multimeter for continuity.</td>
</tr>
<tr>
<td>NOTE</td>
</tr>
<tr>
<td>Any reading besides infinity indicates a grounded wire.</td>
</tr>
<tr>
<td>(4) Remove multimeter lead from one end of wire and connect to chassis ground.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove eight screws and panel from console.</td>
</tr>
<tr>
<td>(2) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.</td>
</tr>
<tr>
<td>(4) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
**e15. TURN SIGNAL LIGHT DOES NOT OPERATE (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td>Wire no. 1925 loose or damaged</td>
</tr>
<tr>
<td>Circuit breaker OK</td>
<td>Wire no. 1435 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Faulty turn signal flasher</td>
</tr>
<tr>
<td></td>
<td>Wire no. 1080 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Faulty turn signal switch</td>
</tr>
<tr>
<td></td>
<td>Wires no. 1001 and/or 1002 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Wires no. 1003 and/or 1004 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Faulty L.H. TURN relay</td>
</tr>
<tr>
<td></td>
<td>Faulty R.H. TURN relay</td>
</tr>
<tr>
<td></td>
<td>Wires no. 1003A and/or 1004A loose or damaged</td>
</tr>
</tbody>
</table>

**TEST OPTIONS**
Wire No. 1925 Voltage Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
Wire no. 1925 from TURN SIGNAL circuit breaker to turn signal flasher is loose or damaged if low voltage is measured.

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Continuity Test or STE/ICE–R Test #91

**REASON FOR QUESTION**
Turn signals may not operate if ground wire no. 1435 from turn signal flasher is loose or damaged.

**KNOWN INFO**
Circuit breaker not tripped
Circuit breaker OK

**POSSIBLE PROBLEMS**
Faulty turn signal flasher
Wire no. 1080 loose or damaged
Faulty turn signal switch
Wires no. 1001 and/or 1002 loose or damaged
Wires no. 1003 and/or 1004 loose or damaged
Faulty L.H. TURN relay
Faulty R.H. TURN relay
Wires no. 1003A and/or 1004A loose or damaged

**TEST OPTIONS**
Turn Signal Flasher Test or STE/ICE–R Test #89

**REASON FOR QUESTION**
Turn signal flasher is faulty if low voltage is measured on wire no. 1080.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1925 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1925 at turn signal flasher.
(3) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.

TURN SIGNAL FLASHER TEST

(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1080 at turn signal flasher.
(3) Place negative (–) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.
### e15. TURN SIGNAL LIGHT DOES NOT OPERATE (CONT)

#### KNOWN INFO
- Circuit breaker not tripped
- Circuit breaker OK
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK

#### POSSIBLE PROBLEMS
- Wire no. 1080 loose or damaged
- Faulty turn signal switch
- Wires no. 1001 and/or 1002 loose or damaged
- Wires no. 1003 and/or 1004 loose or damaged
- Faulty L.H. TURN relay
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

#### TEST OPTIONS
- Wire No. 1080 Voltage Test or STE/ICE–R Test #89

#### REASON FOR QUESTION
- Wire no. 1080 from turn signal flasher to turn signal switch is loose or damaged if low voltage is measured. Turn signal switch is defective if voltage is between 10–14 volts.

---

#### KNOWN INFO
- Circuit breaker not tripped
- Circuit breaker OK
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK

#### POSSIBLE PROBLEMS
- Faulty turn signal switch
- Wires no. 1001 and/or 1002 loose or damaged
- Wires no. 1003 and/or 1004 loose or damaged
- Faulty L.H. TURN relay
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

#### TEST OPTIONS
- Turn Signal Switch Test (Right Turn) or STE/ICE–R Test #89

#### REASON FOR QUESTION
- Turn signal switch is faulty if low voltage is measured on wires no. 1001 and no. 1004.

---

#### KNOWN INFO
- Circuit breaker not tripped
- Circuit breaker OK
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK

#### POSSIBLE PROBLEMS
- Faulty turn signal switch
- Wires no. 1001 and/or 1002 loose or damaged
- Wires no. 1003 and/or 1004 loose or damaged
- Faulty L.H. TURN relay
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

#### TEST OPTIONS
- Turn Signal Switch Test (Left Turn) or STE/ICE–R Test #89

#### REASON FOR QUESTION
- Turn signal switch is faulty if low voltage is measured on wires no. 1002 and no. 1003.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1080 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1080 at turn signal switch.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

**TURN SIGNAL SWITCH TEST (RIGHT TURN)**

(1) Turn ENGINE switch to ON position.

(2) Place turn signal switch in right turn position.

**NOTE**

Wire no. 1001 operates right turn signal indicator and right front turn signal.

(3) Place positive (+) probe of multimeter on wire no. 1001 at turn signal switch.

(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.

**NOTE**

Wire no. 1004 operates right rear turn signal.

(5) Place positive (+) probe of multimeter on wire no. 1004 at turn signal switch.

(6) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.

(7) Place turn signal switch in off position.

(8) Turn ENGINE switch to OFF position.

**TURN SIGNAL SWITCH TEST (LEFT TURN)**

(1) Turn ENGINE switch to ON position.

(2) Place turn signal switch in left turn position.

**NOTE**

Wire no. 1002 operates left turn signal indicator and left front turn signal.

(3) Place positive (+) probe of multimeter on wire no. 1002 at turn signal switch.

(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.

**NOTE**

Wire no. 1003 operates left rear turn signal.

(5) Place positive (+) probe of multimeter on wire no. 1003 at turn signal switch.

(6) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.

(7) Place turn signal switch in off position.

(8) Turn ENGINE switch to OFF position.
12. Are 10–14 volts measured on wires no. 1001 and no. 1002 at front turn signals?

**Known Info**
- Circuit breaker not tripped
- Circuit breaker OK
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK
- Turn signal switch OK

**Possible Problems**
- Wires no. 1001 and/or 1002 loose or damaged
- Wires no. 1003 and/or 1004 loose or damaged
- Faulty L.H. TURN relay
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

**Test Options**
- Wires No. 1001 & No. 1002 Voltage Test
- STE/ICE–R Test #89

**Reason for Question**
- Wires no. 1001 and no. 1002 wires from turn signal switch to front turn signals are loose or damaged if low voltage is measured.

**Result**
- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**

13. Are 10–14 volts measured on wires no. 1003 and no. 1004 at L.H. TURN and R.H. TURN relays?

**Known Info**
- Circuit breaker not tripped
- Circuit breaker OK
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK
- Turn signal switch OK
- Wires no. 1001 and 1002 OK

**Possible Problems**
- Wires no. 1003 and/or 1004 loose or damaged
- Faulty L.H. TURN relay
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

**Test Options**
- Wires No. 1003 & No. 1004 Voltage Test
- STE/ICE–R Test #89

**Reason for Question**
- Wires no. 1003 and no. 1004 wires from turn signal switch to L.H. TURN and R.H. TURN relays are loose or damaged if low voltage is measured.

**Result**
- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**
### WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRES NO. 1001 &amp; NO. 1002 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place turn signal switch in left turn position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1002 at left front turn signal.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place turn signal switch in right turn position.</td>
</tr>
<tr>
<td>(6) Place positive (+) probe of multimeter on wire no. 1001 at right front turn signal.</td>
</tr>
<tr>
<td>(7) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(8) Place turn signal switch in off position.</td>
</tr>
<tr>
<td>(9) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRES NO. 1003 &amp; NO. 1004 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place turn signal switch in left turn position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1003 at L.H. TURN relay.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place turn signal switch in right turn position.</td>
</tr>
<tr>
<td>(6) Place positive (+) probe of multimeter on wire no. 1004 at R.H. TURN relay.</td>
</tr>
<tr>
<td>(7) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(8) Place turn signal switch in off position.</td>
</tr>
<tr>
<td>(9) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
15. TURN SIGNAL LIGHT DOES NOT OPERATE (CONT)

**Known Info**
- Circuit breaker not tripped
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK
- Turn signal switch OK
- Wires no. 1001 and 1002 OK
- Wires no. 1003 and 1004 OK

**Possible Problems**
- Faulty L.H. TURN relay
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

**Reason for Question**
Is there continuity between wire no. 1003 and wire no. 1003A on L.H. TURN relay?

- **NO**
  - NO TEST OPTIONS
  - **Reason for Question** Is there continuity between wire no. 1003 and wire no. 1003A on L.H. TURN relay?
  - **YES**
  - NO **Reason for Question** Is there continuity between wire no. 1003 and wire no. 1003A on L.H. TURN relay?
  - Replace L.H. TURN relay (para 7–27).

**Known Info**
- Circuit breaker not tripped
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK
- Turn signal switch OK
- Wires no. 1001 and 1002 OK
- Wires no. 1003 and 1004 OK
- L.H. TURN relay OK

**Possible Problems**
- Faulty R.H. TURN relay
- Wires no. 1003A and/or 1004A loose or damaged

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

**Reason for Question**
Is there continuity between wire no. 1004 and wire no. 1004A on R.H. TURN relay?

- **NO**
  - NO TEST OPTIONS
  - **Reason for Question** Is there continuity between wire no. 1004 and wire no. 1004A on R.H. TURN relay?
  - **YES**
  - NO **Reason for Question** Is there continuity between wire no. 1004 and wire no. 1004A on R.H. TURN relay?
  - Replace R.H. TURN relay (para 7–27).

**Known Info**
- Circuit breaker not tripped
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK
- Turn signal switch OK
- Wires no. 1001 and 1002 OK
- Wires no. 1003 and 1004 OK
- L.H. TURN relay OK
- R.H. TURN relay OK

**Possible Problems**
- Wires no. 1003A and/or 1004A loose or damaged

**Test Options**
- Wires No. 1003A & No. 1004A Voltage Test
- STE/ICE-R Test #89

**Reason for Question**
Are 10–14 volts measured on wires no. 1003A and no. 1004A at rear turn signals?

- **NO**
  - NO TEST OPTIONS
  - **Reason for Question** Are 10–14 volts measured on wires no. 1003A and no. 1004A at rear turn signals?
  - Secure loose connections. Notify supervisor if damaged wires are found.
  - Fault not corrected. Notify supervisor.
  - **YES**
  - NO TEST OPTIONS
  - Secure loose connections. Notify supervisor if damaged wires are found.
  - Fault not corrected. Notify supervisor.

**Known Info**
- Circuit breaker not tripped
- Circuit breaker OK
- Wire no. 1925 OK
- Wire no. 1435 OK
- Turn signal flasher OK
- Wire no. 1080 OK
- Turn signal switch OK
- Wires no. 1001 and 1002 OK
- Wires no. 1003 and 1004 OK
- L.H. TURN relay OK
- R.H. TURN relay OK

**Possible Problems**
- Wires no. 1003A and/or 1004A loose or damaged
CONTINUITY TEST

CAUTION

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE

A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to terminal 30 and terminal 87A and check multimeter for continuity.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check for continuity between terminal 30 and terminal 87A on L.H. TURN relay.

Check for continuity between terminal 30 and terminal 87A on R.H. TURN relay.

Wires No. 1003A & No. 1004A

VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Place turn signal switch in left turn position.
(3) Place positive (+) probe of multimeter on wire no. 1003A at left rear turn signal.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place turn signal switch in right turn position.
(6) Place positive (+) probe of multimeter on wire no. 1004A at right rear turn signal.
(7) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(8) Place turn signal switch in off position.
(9) Turn ENGINE switch to OFF position.
e15.1. TURN SIGNAL INDICATOR LIGHT DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

KNOWLEDGMENT

Known INFO
- Turn signals OK

Possible Problems
- Burned out indicator bulb
- Power wire loose or damaged
- Ground wire loose or damaged

TEST OPTIONS

Reason for Question

Indicated bulb is burned out if a reading of infinity is obtained.

1. Is indicator light bulb OK?

TEST OPTIONS

Indicator Bulb Test
- STE/ICE–R Test #91

Reason for Question

Power wire loose or damaged
- Ground wire loose or damaged
- Turn signals OK

2. Are 10–14 volts measured on wire no. 1001/1002 at indicator light?

TEST OPTIONS

Wire no. 1001/1002 Test
- STE/ICE–R Test #89

Reason for Question

Power wire loose or damaged
- Ground wire loose or damaged
- Wire no. 1001/1002 is loose or damaged if low voltage is measured.

START

WARNING
- Read WARNING on following page.

Replace indicator bulb (para 7–40).

Secure loose connections. Notify supervisor if damaged wires are found.
INDICATOR BULB TEST

1. Unplug right/left indicator bulb from socket.
2. Set multimeter to ohms position.
   
   NOTE
   A reading of infinity indicates an open circuit.
3. Connect multimeter leads to bulb terminals and check multimeter for continuity.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1001/1002 TEST

1. Turn ENGINE switch to ON position.
2. Place turn signal switch in right/left turn position.
3. Place positive (+) probe of multimeter on wire no. 1001/1002 at indicator light.
4. Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
5. Place turn signal in off position.
6. Turn ENGINE switch to OFF position.
e15.1. TURN SIGNAL INDICATOR LIGHT DOES NOT OPERATE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn signals OK</td>
</tr>
<tr>
<td>Indicator bulb OK</td>
</tr>
<tr>
<td>Power wire OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground wire loose or damaged</td>
</tr>
</tbody>
</table>

3. Is wire no. 1435 from indicator light to ground a complete circuit?

   YES

   NO

   Secure loose connections. Notify supervisor if damaged wires are found.

   Fault not corrected. Notify supervisor.

   NO

   YES

   Turn signals OK
   Indicator bulb OK
   Power wire OK

   Fault not corrected.
   Notify supervisor.

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuity Test</td>
</tr>
<tr>
<td>or</td>
</tr>
<tr>
<td>STE/ICE-R Test #91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator light may not operate if wire no. 1435 is faulty.</td>
</tr>
</tbody>
</table>
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

---

**CONTINUITY TEST**

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
</tbody>
</table>

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

---

Check ground wire no. 1435 from indicator light for loose connections or damage.

---

**INDICATOR LIGHT**

**INSTRUMENT PANEL**
e16. CLEARANCE, MARKER, PARKING, OR TAIL LIGHT DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

WARNING
Read WARNING on following page.

START

1. Do any of the clearance, marker, parking, or tail lights operate?

   NO
   → Go to step 5.

   YES

2. Are clearance, marker, parking, or tail light bulbs or LEDs OK?

   NO
   → Replace bulb or LED (para 7–41, 7–42, 7–49, or 7–50).

   YES

   REASON FOR QUESTION

   If all lights are out, control circuit is at fault. If only one light is out, individual circuit is faulty.

   TEST OPTIONS
   - Visual inspection

   REASON FOR QUESTION

   Clearance, marker, parking, and tail lights will not operate if bulb or LED is burned out.

   TEST OPTIONS
   - Visual inspection

   KNOWN INFO

   Circuit breakers not tripped
   Headlight OK

   POSSIBLE PROBLEMS

   Faulty control circuit
   Burned out clearance, marker, parking, and/or tail light bulb or LED
   Wire no. 1012 loose or damaged
   Wire no. 1435 loose or damaged

   KNOWN INFO

   Circuit breakers not tripped
   Headlight OK
   Control circuit OK

   POSSIBLE PROBLEMS

   Burned out clearance, marker, parking, and/or tail light bulb or LED
   Wire no. 1012 loose or damaged
   Wire no. 1435 loose or damaged
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check clearance, marker, parking, and tail lights for operation (TM 9-2320-360-10).

Check clearance, marker, parking, or tail lights for burned out bulb or LED if only one light does not operate.
e16. CLEARANCE, MARKER, PARKING, OR TAIL LIGHT DOES NOT OPERATE (CONT)

### KNOWN INFO
- Circuit breakers not tripped
- Headlight OK
- Control circuit OK
- Clearance, marker, parking, and tail light bulbs or LED OK
- Wire no. 1012 OK

### POSSIBLE PROBLEMS
- Wire no. 1012 loose or damaged
- Wire no. 1435 loose or damaged

### KNOWN INFO
- Circuit breakers not tripped
- Headlight OK
- Control circuit OK
- Clearance, marker, parking, and tail light bulbs or LED OK
- Wire no. 1435 OK

### POSSIBLE PROBLEMS
- Wire no. 1435 loose or damaged

---

### 3.
**WARNING**
Read WARNING on following page.

**Are 10-14 volts measured on wire no. 1012 at light that does not operate?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**
  - Go to step 9.

### TEST OPTIONS
- Wire No. 1012 Voltage Test or STE/ICE--R Test #89

### REASON FOR QUESTION
- Wire no. 1012 from CL. LTS. relay to inoperative lights is loose or damaged if low voltage is measured.

### 4.
**CAUTION**
Read CAUTION on following page.

**Is wire no. 1435 from light that does not operate to ground, a complete circuit?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
  - Replace clearance, marker, parking or tail light bulbs or LEDs (paras 7–41, 7–42, 7–49, or 7–50).
- **YES**
  - Go to step 9.

### TEST OPTIONS
- Continuity Test or STE/ICE--R Test #91

### REASON FOR QUESTION
- Clearance, marker, parking, or tail lights may not operate if wire no. 1435 is faulty.

### 5.
**Are 10-14 volts measured on wire no. 1835 at CL. LTS. relay?**

- **NO**
  - Go to step 9.
- **YES**
  - Go to step 9.

### TEST OPTIONS
- Wire No. 1835 Voltage Test or STE/ICE--R Test #89

### REASON FOR QUESTION
- CL. LIGHTS circuit breaker is faulty or wire no. 1835 wire from CL. LIGHTS circuit breaker to CL. LTS. relay is loose or damaged if low voltage is measured.
## WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### WIRE NO. 1012 VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place headlights switch in center position.
3. Place positive (+) probe of multimeter on wire no. 1012 at inoperative light.
4. Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
5. Place headlights switch in off position.
6. Turn ENGINE switch to OFF position.

### CONTINUITY TEST

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

### WIRE NO. 1835 VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place headlights switch in center position.
3. Place positive (+) probe of multimeter on wire no. 1835 at CL LTS relay.
4. Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
5. Place headlights switch in off position.
6. Turn ENGINE switch to OFF position.
e16. **CLEARANCE, MARKER, PARKING, OR TAIL LIGHT DOES NOT OPERATE (CONT)**

### KNOWN INFO
- Circuit breakers not tripped
- Headlight OK
- CL. LIGHTS circuit breaker OK
- Wire no. 1835 OK

### POSSIBLE PROBLEMS
- Faulty headlights switch
- Wire no. 1008 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty CL. LTS. relay

### TEST OPTIONS
- Wire No. 1008 Voltage Test or STE/ICE-R Test #89

### REASON FOR QUESTION
- Wire no. 1008 from headlights switch to CL. LTS. relay is loose or damaged if low voltage is measured or headlights switch is faulty.

### KNOWN INFO
- Circuit breakers not tripped
- Headlight OK
- CL. LIGHTS circuit breaker OK
- Wire no. 1835 OK
- Headlights switch OK
- Wire no. 1008 OK

### POSSIBLE PROBLEMS
- Wire no. 1435 loose or damaged
- Faulty CL. LTS. relay

### TEST OPTIONS
- CL. LTS. Relay Test or STE/ICE-R Test #89

### REASON FOR QUESTION
- CL. LTS. relay or wire no. 1435 is faulty if low voltage is found on wire no. 1012.

### KNOWN INFO
- Circuit breakers not tripped
- Headlight OK
- CL. LIGHTS circuit breaker OK
- Wire no. 1835 OK
- Headlights switch OK
- Wire no. 1008 OK

### POSSIBLE PROBLEMS
- Wire no. 1435 loose or damaged
- Faulty CL. LTS. relay

### TEST OPTIONS
- Continuity Test or STE/ICE-R Test #91

### REASON FOR QUESTION
- Clearance, marker, parking, and tail lights may not operate if ground wire no. 1435 from CL. LTS. relay is loose or damaged. CL. LTS. relay is faulty if low voltage is measured on wire no. 1012.

---

6. **WARNING**

Read WARNING on following page.

Are 10-14 volts measured on wire no. 1008 at CL. LTS. relay?

- **NO**
  - Go to step 10.
- **YES**
  - Fault not corrected. Notify supervisor.

7. Are 10-14 volts measured on wire no. 1012 at CL. LTS. relay?

- **NO**
  - Go to step 8.
- **YES**
  - Fault not corrected. Notify supervisor.

8. **CAUTION**

Read CAUTION on following page.

Is wire no. 1435 from CL. LTS. relay to ground a closed circuit?

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**
  - Replace CL. LTS. relay (para 7–27).
WIRE NO. 1008 VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place headlights switch in center position.
3. Place positive (+) probe of multimeter on wire no. 1008 at CL. LTS. relay.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Place headlights switch in off position.
6. Turn ENGINE switch to OFF position.

CL. LTS. RELAY TEST

1. Turn ENGINE switch to ON position.
2. Place headlights switch in center position.
3. Place positive (+) probe of multimeter on wire no. 1012 at CL. LTS. relay.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Place headlights switch in off position.
6. Turn ENGINE switch to OFF position.

Check ground wire no. 1435 from CL. LTS. relay for loose connections or damage.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.
e16. CLEARANCE, MARKER, PARKING, OR TAIL LIGHT DOES NOT OPERATE (CONT)

**Known Info**
- Circuit breakers not tripped
- Headlight OK

**Possible Problems**
- Damaged CL. LIGHTS circuit breaker
- Wire no. 1835 loose or damaged

---

**Warning**
Read WARNING on following page.

**Test Options**
Circuit Breaker Test

**Reason for Question**
- Clearance, marker, parking, and tail lights will not operate if low voltage is present at lower terminal of CL. LIGHTS circuit breaker. Wire no. 1835 from CL. LIGHTS circuit breaker to CL. LTS. relay is loose or damaged if 10–14 volts are measured.

---

**Know Info**
- Circuit breakers not tripped
- Headlight OK
- CL. LIGHTS circuit breaker OK
- Wire no. 1835 OK

**Possible Problems**
- Faulty headlights switch
- Wire no. 1008 loose or damaged

---

**Test Options**
- Headlights Switch Test
- STE/ICE-R Test #89

**Reason for Question**
- Headlights switch is faulty if low voltage is measured on wire no. 1008. Wire no. 1008 from headlight switch to CL. LTS. relay is loose or damaged if 10–14 volts are measured.
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove eight screws and panel from console.</td>
</tr>
<tr>
<td>(2) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.</td>
</tr>
<tr>
<td>(4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HEADLIGHT SWITCH TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place headlights switch in center position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1008 at headlights switch.</td>
</tr>
<tr>
<td>(4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place headlights switch in OFF position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e17. ALL BLACKOUT LIGHTS DO NOT OPERATE

INITIAL SETUP
Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE-R (optional) (Item 47, Appendix F)

START

WARNING
Read WARNING on following page.

1. Are 10–14 volts present at BLK OUT LIGHTS circuit breaker?
   - NO
     Replace circuit breaker (para 7–12).
   - YES

2. Are 10–14 volts measured on wire no. 1674 at BLACK OUT LIGHTS switch?
   - NO
     Replace BLACK OUT LIGHTS switch (para 7–16).
   - YES

KNOWN INFO
- Circuit breakers not tripped
- Dome light OK

POSSIBLE PROBLEMS
- Damaged circuit breaker
- Faulty BLACK OUT LIGHTS switch
- Loose or damaged wire connections

KNOWN INFO
- Circuit breakers not tripped
- Dome light OK
- Circuit breaker OK

POSSIBLE PROBLEMS
- Faulty BLACK OUT LIGHTS switch
- Loose or damaged wire connections

TEST OPTIONS
- Circuit Breaker Test

REASON FOR QUESTION
Black out lights will not operate if low voltage is present at lower terminal of BLK. OUT LIGHTS circuit breaker.

TEST OPTIONS
- BLACK OUT LIGHTS Switch Test
  or
  STE/ICE-R Test #89

REASON FOR QUESTION
BLACK OUT LIGHTS switch is faulty if low voltage is measured on wire no. 1674.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER TEST</th>
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<tr>
<td>(1) Remove eight screws and panel from console.</td>
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<td>(2) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BLACK OUT LIGHTS SWITCH TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place BLACK OUT LIGHTS switch to on position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1674 at BLACK OUT LIGHTS switch.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place BLACK OUT LIGHTS switch to off position.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e17. ALL BLACKOUT LIGHTS DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Dome light OK
- Circuit breaker OK
- BLACK OUT LIGHTS switch OK

**POSSIBLE PROBLEMS**
- Loose or damaged wire connections

**TEST OPTIONS**
- Wire no. 1674 Voltage Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
- Black out lights will not operate if there is an open circuit between black out lights switch and other switches.

---

**3.** Are 10-14 volts measured on wire no. 1674 at black out drive and black out marker switches?

**WARNING**
Read WARNING on following page.

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.

- **NO**
  - Fault not corrected. Notify supervisor.
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>BLACK OUT LIGHTS SWITCH TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place BLACK OUT LIGHTS switch to on position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on wire no. 1674 at BLACK OUT DRIVE switch.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Place positive (+) probe of multimeter on wire no. 1674 at BLACK OUT MARKER switch.</td>
</tr>
<tr>
<td>(6) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(7) Place BLACK OUT LIGHTS switch to off position.</td>
</tr>
<tr>
<td>(8) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

INSTRUMENT PANEL

TYPICAL BLACKOUT LIGHT SWITCH
e18. BLACK OUT CLEARANCE, MARKER, OR TAIL LIGHT DOES NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**

- Circuit breakers not tripped
- Black out drive light OK

**POSSIBLE PROBLEMS**

- Faulty control circuit
- Burned out light bulb
- Wire no. 1680 loose or damaged
- Wire no. 1435 loose or damaged
- Wire no. 1674 loose or damaged
- Faulty BLACK OUT MARKER switch

---

**TEST OPTIONS**

**Visual inspection**

**REASON FOR QUESTION**

If all lights are out, control circuit is at fault. If only one light is out, individual circuit is faulty.

---

**KNOWN INFO**

- Circuit breakers not tripped
- Black out drive light OK
- Control circuit OK

**POSSIBLE PROBLEMS**

- Burned out light bulb
- Wire no. 1680 loose or damaged
- Wire no. 1435 loose or damaged
- Wire no. 1674 loose or damaged
- Faulty BLACK OUT MARKER switch

---

**TEST OPTIONS**

**Visual inspection**

**REASON FOR QUESTION**

Black out clearance, marker, and tail lights will not operate if bulb is burned out.
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check black out, clearance, marker, or tail lights for operation (TM 9–2320–360–10).

Check black out, clearance, marker, or tail lights for burned out bulb if only one light does not operate.
e18. BLACK OUT CLEARANCE, MARKER, OR TAIL LIGHT DOES NOT OPERATE (CONT)

3. Are 10-14 volts measured on wire no. 1680 at lights that do not operate?
   - YES: Test Options
     - Wire No. 1680 Voltage Test or STE/ICE-R Test #89
   - NO: POSSIBLE PROBLEMS
     - Wire no. 1680 loose or damaged
     - Wire no. 1435 loose or damaged
     - Wire no. 1674 loose or damaged
     - Faulty BLACK OUT MARKER switch
     - Secure loose connections. Notify supervisor if damaged wires are found.

4. Is wire no. 1435 from light that does not operate to ground, a complete circuit?
   - YES: CAUTION
     - Replace black out, clearance, marker, or tail light bulbs (paras 7-41, 7-43, 7-44, or 7-50).
   - NO: POSSIBLE PROBLEMS
     - Wire no. 1680 loose or damaged
     - Wire no. 1674 loose or damaged
     - Faulty BLACK OUT MARKER switch
     - Secure loose connections. Notify supervisor if damaged wires are found.

5. Are 10-14 volts measured on wire no. 1674 at BLACK OUT MARKER switch?
   - YES: POSSIBLE PROBLEMS
     - Wire no. 1674 loose or damaged
     - Faulty BLACK OUT MARKER switch
   - NO: POSSIBLE PROBLEMS
     - Wire no. 1674 loose or damaged
     - Faulty BLACK OUT MARKER switch
     - Secure loose connections. Notify supervisor if damaged wires are found.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1680 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place BLACK OUT LIGHTS switch to on position.</td>
</tr>
<tr>
<td>(3) Place BLACK OUT MARKER switch to on position.</td>
</tr>
<tr>
<td>(4) Place positive (+) probe of multimeter on wire no. 1680 at inoperative light.</td>
</tr>
<tr>
<td>(5) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(6) Place BLACK OUT MARKER switch to off position.</td>
</tr>
<tr>
<td>(7) Place BLACK OUT LIGHTS switch to off position.</td>
</tr>
<tr>
<td>(8) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTINUITY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
<tr>
<td>(1) Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>(2) Set multimeter to ohms position.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>A reading of infinity indicates an open circuit.</td>
</tr>
<tr>
<td>(3) Connect multimeter leads to each end of wire and check multimeter for continuity.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>Any reading besides infinity indicates a grounded wire.</td>
</tr>
<tr>
<td>(4) Remove multimeter lead from one end of wire and connect to chassis ground.</td>
</tr>
</tbody>
</table>
e18. BLACK OUT CLEARANCE, MARKER, OR TAIL LIGHT DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Black out drive light OK
- Control circuit OK
- Light bulbs OK
- Wire no. 1680 OK
- Wire no. 1435 OK
- Wire no. 1674 OK

**POSSIBLE PROBLEMS**
- Faulty BLACK OUT MARKER switch

**TEST OPTIONS**
- BLACK OUT MARKER Switch Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- BLACK OUT MARKER switch is faulty if low voltage is measured on wire no. 1680.

**WARNING**
Read WARNING on following page.

Are 10-14 volts measured on wire no. 1680 at BLACK OUT MARKER switch?

- YES
  - Replace BLACK OUT MARKER switch (para 7-16).

- NO
  - Fault not corrected. Notify supervisor.
(1) Turn ENGINE switch to ON position.
(2) Place BLACK OUT LIGHTS switch to on position.
(3) Place BLACK OUT MARKER switch to on position.
(4) Place positive (+) probe of multimeter on wire no. 1680 at BLACK OUT MARKER switch.
(5) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
(6) Place BLACK OUT MARKER switch to off position.
(7) Place BLACK OUT LIGHTS switch to off position.
(8) Turn ENGINE switch to OFF position.
e19. BLACK OUT DRIVE LIGHT DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

NOTE
Model A, bulb type, or Model B, LED type, blackout drive light may be installed on vehicle.

START

WARNING
Read WARNING on following page.

1. Is black out drive light bulb OK?

   YES
   If Model A light installed, repair black out drive light (para 7–48). If Model B light installed, go to step 4 of this fault.

   NO

2. Are 10–14 volts measured on wire no. 1674 at BLACK OUT DRIVE switch?

   YES
   Secure loose connections. Notify supervisor if damaged wires are found.

   NO

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Black out drive light will not operate if bulb is burned out.

TEST OPTIONS
Wire No. 1674 Voltage Test or STE/ICE–R Test #89

REASON FOR QUESTION
Wire no. 1674 from BLACK OUT LIGHTS switch to BLACK OUT DRIVE switch is loose or damaged if low voltage is measured.
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

If Model A, light installed, check black out drive light for burned out bulb. If Model B light installed, go to step 4 of this fault.

WIRE NO. 1674
VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place BLACK OUT LIGHTS switch to on position.
3. Place positive (+) probe of multimeter on wire no. 1674 at BLACK OUT DRIVE switch.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Place BLACK OUT LIGHTS switch to off position.
6. Turn ENGINE switch to OFF position.
3. **Are 10–14 volts measured on wire no. 1679 at BLACK OUT DRIVE switch?**

- **NO**
  - Replace BLACK OUT DRIVE switch (para 7–16).

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.

4. **Are 10–14 volts measured on wire no. 1679 at black out drive light?**

- **NO**
  - Wire no. 1679 voltage test or STE/ICE-R Test #89.

- **YES**
  - Replace black out drive light (para 7–48).
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>BLACK OUT DRIVE SWITCH TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place BLACK OUT LIGHTS switch to on position.</td>
</tr>
<tr>
<td>(3) Place BLACK OUT DRIVE switch to on position.</td>
</tr>
<tr>
<td>(4) Place positive (+) probe of multimeter on wire no. 1679 at BLACK OUT DRIVE switch.</td>
</tr>
<tr>
<td>(5) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(6) Place BLACK OUT DRIVE switch to off position.</td>
</tr>
<tr>
<td>(7) Place BLACK OUT LIGHTS switch to off position.</td>
</tr>
<tr>
<td>(8) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE NO. 1679 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(2) Place BLACK OUT LIGHTS switch to on position.</td>
</tr>
<tr>
<td>(3) Place BLACK OUT DRIVE switch to on position.</td>
</tr>
<tr>
<td>(4) Place positive (+) probe of multimeter on wire no. 1679 at black out drive light.</td>
</tr>
<tr>
<td>(5) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(6) Place BLACK OUT DRIVE switch to off position.</td>
</tr>
<tr>
<td>(7) Place BLACK OUT LIGHTS switch to off position.</td>
</tr>
<tr>
<td>(8) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e20. TRAILER BLACK OUT TAIL LIGHTS DO NOT OPERATE (BLACK OUT LIGHTS ON HET TRACTOR OPERATE)

INITIAL SETUP
Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

---

START

1. WARNING
Read WARNING on following page.

Are 10–14 volts measured on wire no. 1680C at 12-pin trailer electrical connector?

NO

Go to step 3.

YES

2. CAUTION
Read CAUTION on following page.

Is continuity measured thru intervehicular cable?

NO

Repair intervehicular cable (para 7–95).

YES

Refer to trailer manual (TM 9–2320–381–14&P).

---

TEST OPTIONS

1. Wire No. 1680C Voltage Test or
STE/ICE–R Test #89

2. Continuity Check or
STE/ICE–R Test #91

REASON FOR QUESTION

Faulty TRAILER LIGHTS circuit breaker, faulty TRAILER B.O. tail relay or loose or damaged wires will cause low voltage on wire no. 1680C at 12 pin trailer electrical connector.

Faulty intervehicular cable

CAUTION
Read CAUTION on following page.

Intervehicular cable is faulty if there is no continuity.
WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**WIRE NO. 1680C VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place BLACK OUT LIGHTS switch in the on position.
3. Place BLACK OUT MARKER switch in the on position.
4. Place positive (+) probe of multimeter on wire no. 1680C at 12-pin trailer electrical connector.
5. Place negative (−) probe of multimeter on ground and look for 10-14 volts on multimeter.
6. Place BLACK OUT LIGHTS switch in the off position.
7. Place BLACK OUT MARKER switch in the off position.
8. Turn ENGINE switch to OFF position.

Check intervehicular cable for continuity.

**CONTINUITY TEST**

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Unplug trailer cable from HET Tractor and trailer.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wires and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.
e20. TRAILER BLACK OUT TAIL LIGHTS DO NOT OPERATE (BLACK OUT LIGHTS ON HET TRACTOR OPERATE) (CONT)

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Wire No. 1676 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
TRAILER LIGHTS circuit breaker is faulty or wire no. 1676 from TRAILER LIGHTS circuit breaker to TRAILER B.O. TAIL relay is loose or damaged if low voltage is measured.

**TEST OPTIONS**
Wire No. 1680 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Wire no. 1680 wire from BLACK OUT MARKER switch to TRAILER B.O. TAIL relay is loose or damaged if low voltage is measured.

**TEST OPTIONS**
Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
Trailer black out tail lights may not operate if ground wire no. 1435 from TRAILER B.O. TAIL relay is loose or damaged.

**Known Info**
Circuit breakers not tripped
Low voltage at trailer electrical connector

**Possible Problems**
Wires loose or damaged
Faulty TRAILER B.O. TAIL relay
Faulty TRAILER LIGHTS circuit breaker

**Known Info**
Circuit breakers not tripped
Low voltage at trailer electrical connector
TRAILER LIGHTS circuit breaker OK
Wire no. 1676 OK

**Possible Problems**
Wires loose or damaged
Faulty TRAILER B.O. TAIL relay

**Known Info**
Circuit breakers not tripped
Low voltage at trailer electrical connector
TRAILER LIGHTS circuit breaker OK
Wire no. 1676 OK
Wire no. 1680 OK

**Possible Problems**
Wires loose or damaged
Faulty TRAILER B.O. TAIL relay

Are 10-14 volts measured on wire no. 1676 at TRAILER B.O. TAIL relay?

- **NO** Go to step 7.
- **YES**

Are 10-14 volts measured on wire no. 1680 at TRAILER B.O. TAIL relay?

- **NO**
- **YES** Secure loose connections. Notify supervisor if damaged wires are found.

Is wire no. 1435 from TRAILER B.O. TAIL relay to ground a closed circuit?

- **NO**
- **YES** Secure loose connections. Notify supervisor if damaged wires are found.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

---

**WIRE NO. 1676 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1676 at TRAILER B.O. TAIL relay.
3. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
4. Turn ENGINE switch to OFF position.

---

**WIRE NO. 1680 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place BLACK OUT LIGHTS switch in the on position.
3. Place BLACK OUT MARKER switch in the on position.
4. Place positive (+) probe of multimeter on wire no. 1680 at TRAILER B.O. TAIL relay.
5. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
6. Place BLACK OUT LIGHTS switch in the off position.
7. Place BLACK OUT MARKER switch in the off position.
8. Turn ENGINE switch to OFF position.

---

Check ground wire no. 1435 from TRAILER B.O. TAIL relay for loose connections or damage.

---

**CONTINUITY TEST**

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**

Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.
e20. TRAILER BLACK OUT TAIL LIGHTS DO NOT OPERATE (BLACK OUT LIGHTS ON HET TRACTOR OPERATE) (CONT)

**Known Info**
- Circuit breakers not tripped
- Low voltage at trailer electrical connector
- TRAILER LIGHTS circuit breaker OK
- Wire no. 1676 OK
- Wire no. 1680 OK
- Wire no. 1435 OK

**Possible Problems**
- Faulty TRAILER B.O. TAIL relay
- Wires loose or damaged

**Test Options**
- TRAILER B.O. TAIL Relay Test
- STE/ICE-R Test #89

---

**Reason for Question**

**Test Options**
- Circuit Breaker Test

---

**Reason for Question**

- Trailer black out tail lights will not operate if low voltage is present at lower terminal of TRAILER LIGHTS circuit breaker. Wire no. 1676 from TRAILER LIGHT circuit breaker to TRAILER B.O. TAIL relay is loose or damaged if 10–14 volts are measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

TRAILER B.O. TAIL RELAY TEST
(1) Turn ENGINE switch to ON position.
(2) Place BLACK OUT LIGHTS switch in the on position.
(3) Place BLACK OUT MARKER switch in the on position.
(4) Place positive (+) probe of multimeter on wire no. 1680C at TRAILER B.O. TAIL relay.
(5) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(6) Place BLACK OUT LIGHTS switch in the off position.
(7) Place BLACK OUT MARKER switch in the off position.
(8) Turn ENGINE switch to OFF position.

CIRCUIT BREAKER TEST
(1) Remove eight screws and panel from console.
(2) Turn ENGINE switch to ON position.
(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Turn ENGINE switch to OFF position.
e21. STOP LIGHTS DO NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

**Personnel Required**
- Two

---

**KNOWN INFO**

- Circuit breaker not tripped
- Blackout lights switch in OFF position
- Turn signal lights OK

**POSSIBLE PROBLEMS**

- Faulty STOP LIGHTS circuit breaker
- Wire no. 1009 loose or damaged
- Faulty stop light switch
- Wire no. 1005 loose or damaged
- Wire no. 1005A loose or damaged
- Faulty turn signal switch
- Wire no. 1189 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty STOP LIGHTS relay

---

**TEST OPTIONS**

- Visual inspection

---

**REASON FOR QUESTION**

- Stop light switches on treadle valve are faulty or wire no. 1009 is loose or damaged if stop lights work with trailer hand brake.

---

**TEST OPTIONS**

- Wire No. 1009 Voltage Test
  or
- STE/ICE–R Test #89

---

**REASON FOR QUESTION**

- Wire no. 1009 wire from STOP LIGHTS circuit breaker to stop light switch is loose or damaged if low voltage is measured.
STOP LIGHTS

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1009 VOLTAGE TEST

| (1) Turn ENGINE switch to ON position. |
| (2) Place positive (+) probe of multimeter on wire no. 1009 at stop light switch. |
| (3) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter. |
| (4) Turn ENGINE switch to OFF position. |
### e21. STOP LIGHTS DO NOT OPERATE (CONT)

#### KNOWN INFO
- Circuit breaker not tripped
- Blackout lights switch in OFF position
- Turn signal lights OK
- STOP LIGHTS circuit breaker OK
- Wire no. 1005A OK
- Wire no. 1189 OK
- Wire no. 1435 OK
- STOP LIGHTS relay OK
- Wire no. 1009 OK

#### POSSIBLE PROBLEMS
- Faulty stop light switch
- Wire no. 1005 loose or damaged

---

**WARNING**
Read WARNING on following page.

### 3.
Are 10-14 volts measured on wire no. 1005 wire at stop light switch?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace stop light switch (para 7-23).</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
</tbody>
</table>

### TEST OPTIONS
- Stop Light Switch Test
  - STE/ICE-R Test #89

### REASON FOR QUESTION
- Stop light switch is faulty if low voltage is measured on wire no. 1005. Wire no. 1005 from stoplight switch is loose or damaged if 10-14 volts are measured.

---

### 4.
Are 10-14 volts measured on wire no. 1005A at STOP LIGHTS relay?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to step 6.</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
</tbody>
</table>

### TEST OPTIONS
- STOP LIGHTS Relay Test
  - STE/ICE-R Test #89

### REASON FOR QUESTION
- STOP LIGHTS relay or circuit breaker is faulty if low voltage is measured on wire no. 1005A.

---

### 5.
Are 10-14 volts measured on wire no. 1005A at turn signal switch?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
<td>Notify supervisor.</td>
</tr>
</tbody>
</table>

### TEST OPTIONS
- Wire No. 1005A Voltage Test
  - STE/ICE-R Test #89

### REASON FOR QUESTION
- Wire no. 1005A from STOP LIGHTS relay to turn signal switch is loose or damaged if low voltage is measured on wire no. 1005A.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### STOP LIGHT SWITCH TEST

**NOTE**

There are two stop light switches. One stop light switch is for the front brakes, and the other is for the rear brakes.

1. Turn ENGINE switch to ON position.
2. Press and hold brake pedal with aid of assistant.
3. Place positive (+) probe of multimeter on wire no. 1005 at stop light switch.
4. Place negative (--) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Repeat steps (3) and (4) for other stop light switch.
7. Turn ENGINE switch to OFF position.

### STOP LIGHTS RELAY TEST

1. Turn ENGINE switch to ON position.
2. Press and hold brake pedal with aid of assistant.
3. Place positive (+) probe of multimeter on wire no. 1005A at STOP LIGHTS relay.
4. Place negative (--) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Release brake pedal.
6. Turn ENGINE switch to OFF position.

### WIRE NO. 1005A VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Press and hold brake pedal with aid of assistant.
3. Place positive (+) probe of multimeter on wire no. 1005A at turn signal switch.
4. Place negative (--) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Release brake pedal.
6. Turn ENGINE switch to OFF position.
e21. **STOP LIGHTS DO NOT OPERATE (CONT)**

### Known Info
- Circuit breaker not tripped
- Blackout lights switch in OFF position
- Turn signal lights OK

### Possible Problems
- Faulty STOP LIGHTS circuit breaker
- Wire no. 1009 loose or damaged
- Faulty stop light switch
- Wire no. 1005 loose or damaged
- Wire no. 1189 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty STOP LIGHTS relay

---

#### 6.
- **WARNING**
- Read WARNING on following page.

**Are 10-14 volts measured on wire no. 1005 at STOP LIGHTS relay?**

- **NO**
  - Go to step 9.

- **YES**
  - **Caution**
  - Read CAUTION on following page.

#### 7.
- **Are 10-14 volts measured on wire no. 1189 at STOP LIGHTS relay?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.

- **YES**
  - Wire no. 1189 loose or damaged
  - Secure loose connections. Notify supervisor if damaged wires are found.
  - Notify supervisor if damaged wires are found.

#### 8.
- **Is wire no. 1435 from STOP LIGHTS relay to ground, a complete circuit?**

- **NO**
  - Replace STOP LIGHTS relay (para 7-27).

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.

---

### Test Options
- Wire No. 1005 Voltage Test or STE/ICE-R Test #89

### Reason for Question
- Stop lights circuit breaker is faulty or wire no. 1005 is loose or damaged if low voltage is measured.

---

### Known Info
- Circuit breaker not tripped
- Blackout lights switch in OFF position
- Turn signal lights OK
- STOP LIGHTS circuit breaker OK

### Possible Problems
- Wire no. 1189 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty STOP LIGHTS relay

---

### Test Options
- Wire No. 1189 Voltage Test or STE/ICE-R Test #89

### Reason for Question
- Wire no. 1189 is loose or damaged if low voltage is measured.

---

### Known Info
- Circuit breaker not tripped
- Blackout lights switch in OFF position
- Turn signal lights OK
- STOP LIGHTS circuit breaker OK
- Wire no. 1189 OK

### Possible Problems
- Wire no. 1435 loose or damaged
- Faulty STOP LIGHTS relay

---

### Test Options
- Continuity Test or STE/ICE-R Test #91

### Reason for Question
- STOP LIGHTS relay will not function if wire no. 1435 is loose or damaged.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1005 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Press and hold brake pedal with aid of assistant.
(3) Place positive (+) probe of multimeter on wire no. 1005 at STOP LIGHTS relay.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Release brake pedal.
(6) Turn ENGINE switch to OFF position.

WIRE NO. 1189 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Press and hold brake pedal with aid of assistant.
(3) Place positive (+) probe of multimeter on wire no. 1189 at STOP LIGHTS relay.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Release brake pedal.
(6) Turn ENGINE switch to OFF position.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.

Check ground wire no. 1435 from STOP LIGHTS relay for loose connections or damage.
## e21. STOP LIGHTS DO NOT OPERATE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>9. Are 10-14 volts present at STOP LIGHTS circuit breaker?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td>Replace circuit breaker (para 7-12).</td>
</tr>
<tr>
<td>Blackout lights switch in OFF position</td>
<td></td>
</tr>
<tr>
<td>Turn signal lights OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty STOP LIGHTS circuit breaker</td>
<td></td>
</tr>
<tr>
<td>Wire no. 1009 loose or damaged</td>
<td></td>
</tr>
<tr>
<td>Faulty stop light switch</td>
<td></td>
</tr>
<tr>
<td>Wire no. 1005 loose or damaged</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Breaker Test</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop lights will not operate if low voltage is present at lower terminal of STOP LIGHTS circuit breaker.</td>
<td></td>
</tr>
</tbody>
</table>
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove eight screws and panel from console.</td>
</tr>
<tr>
<td>(2) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.</td>
</tr>
<tr>
<td>(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e22. BLACK OUT STOP LIGHTS DO NOT OPERATE (STOP LIGHTS AND OTHER BLACK OUT LIGHTS OPERATE)

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)

Personnel Required
Two

KNOWLEDGE

Circuit breakers not tripped
Stop lights work when not in blackout mode

POSSIBLE PROBLEMS
Burned out black out stop light bulb
Faulty STOP LIGHTS relay
Loose or damaged wire connections

START

Are black out stop light bulbs OK?

WARNING
Read WARNING on following page.

TEST OPTIONS
Visual inspection

REASON FOR QUESTION

Black out stop lights will not operate if bulbs are burned out.

YES

NO

Replace black out stop light bulb (para 7–50).

Are 10–14 volts measured on wire no. 1678 at STOP LIGHTS relay?

TEST OPTIONS
STOP LIGHTS Relay Test or
STE/ICE–R Test #89

REASON FOR QUESTION

STOP LIGHTS relay is faulty if low voltage is measured on wire no. 1678.

YES

NO

Replace STOP LIGHTS relay (para 7–27).
Check black out stop light for burned out bulb if only one black out stop light does not operate.

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

STOP LIGHTS RELAY TEST

1. Turn ENGINE switch to ON position.
2. Place BLACK OUT LIGHTS switch in the on position.
3. Press and hold brake pedal with aid of assistant.
4. Place positive (+) probe of multimeter on wire no. 1678 at STOP LIGHTS relay.
5. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
7. Place BLACK OUT LIGHTS switch in the off position.
8. Turn ENGINE switch to OFF position.
### e22. BLACK OUT STOP LIGHTS DO NOT OPERATE (STOP LIGHTS AND OTHER BLACK OUT LIGHTS OPERATE)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breakers not tripped</td>
</tr>
<tr>
<td>Stop lights work when not in blackout mode</td>
</tr>
<tr>
<td>Black out stop light bulbs OK</td>
</tr>
<tr>
<td>STOP LIGHTS relay OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose or damaged wire connections</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire No. 1678 Voltage Test or STE/ICE-R Test #89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire no. 1678 from STOP LIGHTS relay to black out stop lights is loose or damaged if low voltage is measured. Rear composite light is faulty if voltage is measured on wire no. 1678.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read WARNING on following page.</td>
</tr>
</tbody>
</table>

3. Are 10–14 volts measured on wire no. 1678 at black out stop lights?

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.

- **YES**
  - Replace rear composite light (para 7–50).
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1678 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place BLACK OUT LIGHTS switch in the on position.
(3) Press and hold brake pedal with aid of assistant.
(4) Place positive (+) probe of multimeter on wire no. 1678 at black out stop lights.
(5) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(6) Release brake pedal.
(7) Place BLACK OUT LIGHTS switch in the off position.
(8) Turn ENGINE switch to OFF position.
e23. ENGINE BRAKE DOES NOT OPERATE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Data Reader, Diagnostic (Item 7, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWLEDGE INFO**

Nothing

**POSSIBLE PROBLEMS**
- Faulty electronic throttle
- Faulty ENGINE BRAKE RETARDER ON/OFF switch
- Faulty circuit breaker
- Wires no. 1713, 1711, and/or 1712 loose or damaged
- Faulty ENGINE BRAKE relay
- Fault in DDEC system

---

1. **Does the electronic throttle return completely to idle position?**

**TEST OPTIONS**
- Visual inspection
- DDR

**REASON FOR QUESTION**

The DDEC Electronic Control Module (ECM) will not operate the engine brake circuit if the electronic throttle does not return completely to idle position.

NO

Replace electronic throttle (para 7–28)

YES

Replace electronic throttle (para 7–28)
(1) Visually inspect the throttle pedal for proper operation. Note any differences when pedal is released to idle position quickly or slowly.

(2) Connect Diagnostic Data Reader (DDR) (para 2-13).

(3) Select throttle sensor display on DDR.

(4) Fully depress throttle pedal and then let pedal quickly return to idle. Record throttle counts at idle.

(5) Fully depress throttle pedal and then let pedal slowly return to idle. Record throttle counts at idle.

(6) Throttle counts should be between 14 and 36 at idle. A significant difference between throttle counts taken in steps (4) and (5) indicates that electronic throttle is faulty.
e23. ENGINE BRAKE DOES NOT OPERATE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic throttle OK</td>
<td>Engine Brake Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty ENGINE BRAKE RETARDER ON/OFF switch</td>
<td>ON/OFF switch, breaker, relay or DDEC is faulty if engine brake is inoperative. HI/LO switch, wiring or solenoid is faulty if engine brake only operates with low engine braking.</td>
</tr>
<tr>
<td>Faulty circuit breaker</td>
<td></td>
</tr>
<tr>
<td>Wires no. 1713, 1711, and/or 1712 loose or damaged</td>
<td></td>
</tr>
<tr>
<td>Faulty ENGINE BRAKE relay</td>
<td></td>
</tr>
<tr>
<td>Fault in DDEC system</td>
<td></td>
</tr>
</tbody>
</table>

1.1 Does engine brake fail to operate when ENGINE BRAKE RETARDER HI/LOW switch is in both the LOW or HIGH position?

NO → Engine brake operates with low engine braking in either HI or LO, go to step 8.

YES

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine brake does not operate with ENGINE BRAKE RETARDER HI/LOW switch in either position</td>
<td>Wire No. 1713 Voltage Test or STE/ICE-R Test #89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty ENGINE BRAKE RETARDER ON/OFF switch</td>
<td>ENGINE BRAKE RETARDER ON/OFF switch, breaker or wiring is faulty if there is no voltage on wire no. 1713.</td>
</tr>
<tr>
<td>Faulty circuit breaker</td>
<td></td>
</tr>
<tr>
<td>Wires no. 1713, 1711, and/or 1712 loose or damaged</td>
<td></td>
</tr>
<tr>
<td>Faulty ENGINE BRAKE relay</td>
<td></td>
</tr>
<tr>
<td>Fault in DDEC system</td>
<td></td>
</tr>
</tbody>
</table>

2. Are 10–14 volts measured on wire no. 1713 at ENGINE BRAKE RETARDER ON/OFF switch?

NO → Go to step 6.

YES

WARNING
Read WARNING on following page.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

ENGINE BRAKE TEST
(1) Start engine (TM 9–2320–360–10).
(2) Press accelerator pedal to floor and release.
(3) Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
(4) Place ENGINE BRAKE RETARDER HI/LOW switch in the LO position.
(5) Press accelerator pedal to floor and release. Listen for engine brake to engage.
(6) Place ENGINE BRAKE RETARDER HI/LOW switch in the HI position.
(7) Press accelerator pedal to floor and release. Listen for engine brake to engage.
(8) Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
(9) Shut off engine (TM 9–2320–360–10).

WIRE NO. 1713 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
(3) Place positive (+) probe of multimeter on wire no. 1713 at ENGINE BRAKE RETARDER ON/OFF switch.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
(6) Turn ENGINE switch to OFF position.
e23. ENGINE BRAKE DOES NOT OPERATE (CONT)

3. Are 10-14 volts measured on wire no. 1713 at ENGINE BRAKE relay?
   - NO
     - Repair terminals or connectors (para 7-77). Notify supervisor if damaged wire harness is found.
   - YES

4. Are 10-14 volts measured on wire no. 1711 at ENGINE BRAKE relay?
   - NO
     - Repair terminals or connectors (para 7-77). Notify supervisor if damaged wire harness is found.
   - YES

5. Are 10-14 volts measured on wire no. 1716 and/or wire no. 1714, when wire no. 508/988 is jumped to a ground?
   - NO
     - Replace ENGINE BRAKE relay (para 7-27).
   - YES

**TEST OPTIONS**
- Wire No. 1713 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1713 from ENGINE BRAKE RETARDER ON/OFF switch to ENGINE BRAKE relay is faulty if no voltage is measured on wire no. 1713.

**TEST OPTIONS**
- Wire No. 1711 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1711 from DDEC relay to ENGINE BRAKE relay is faulty if no voltage is measured on wire no. 1711.

**TEST OPTIONS**
- Engine Brake Relay Test

**REASON FOR QUESTION**
- ENGINE BRAKE relay in faulty if no voltage is measured on wires no. 1716/1714. Vehicle electrical system is good if voltage is measured, fault therefore is DDEC related.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1713 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
(3) Place positive (+) probe of multimeter on wire no. 1713 at ENGINE BRAKE relay.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
(6) Turn ENGINE switch to OFF position.

WIRE NO. 1711 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1711 at ENGINE BRAKE relay.
(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.

ENGINE BRAKE RELAY TEST
NOTE
Wire No. 508 is for DDEC II vehicles; wire No. 988 is for DDEC III/IV vehicles.
(1) Remove wire no. 508/988 from ENGINE BRAKE relay.
(2) Install jumper wire from terminal 85 on ENGINE BRAKE relay to known good ground.
(3) Turn ENGINE switch to ON position.
(4) Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
(5) Place positive (+) probe of multimeter on wire no. 1716/1714 at ENGINE BRAKE relay.
(6) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(7) Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
(8) Turn ENGINE switch to OFF position.
(9) Remove jumper wire from ENGINE BRAKE relay.
(10) Install wire no. 508/988 on ENGINE BRAKE relay.
23. ENGINE BRAKE DOES NOT OPERATE (CONT)

**Known Info**
- Engine brake does not operate with ENGINE BRAKE RETARDER ON/OFF switch in either position

**Possible Problems**
- Faulty ENGINE BRAKE RETARDER ON/OFF switch
- Faulty circuit breaker
- Wire no. 1712 loose or damaged

**Warning**
Read WARNING on following page.

**Test Options**
Wire No. 1712 Voltage Test
or
STE/ICE-R Test #89

**Reason for Question**
ENGINE BRAKE ON/OFF switch is faulty if voltage is measured on wire no. 1712. Breaker or wiring is faulty if no voltage is measured.

---

**Test Options**
Circuit Breaker Test

**Reason for Question**
Circuit breaker is faulty if no voltage is present at lower terminal of ENGINE BRAKE RETARDER ON/OFF switch. Wire no. 1712 is faulty if voltage is measured.

---

**Test Options**
Wire No. 1715 Voltage Test
or
STE/ICE-R Test #89

**Reason for Question**
ENGINE BRAKE HI/LO switch or wiring is faulty if no voltage is measured on wire no. 1715.

---

6. Are 10-14 volts measured on wire no. 1712 at ENGINE BRAKE RETARDER ON/OFF switch?

**Test Options**
Wire No. 1712 Voltage Test
or
STE/ICE-R Test #89

**Reason for Question**
Circuit breaker is faulty if no voltage is present at lower terminal of ENGINE BRAKE circuit breaker. Wire no. 1712 is faulty if voltage is measured.

**Known Info**
- Engine brake does not operate with ENGINE BRAKE RETARDER HI/LOW switch in either position
- ENGINE BRAKE RETARDER ON/OFF switch OK

**Possible Problems**
- Faulty circuit breaker
- Wire no. 1712 loose or damaged

**Test Options**
Circuit Breaker Test

**Reason for Question**
Circuit breaker is faulty if no voltage is present at lower terminal of ENGINE BRAKE circuit breaker. Wire no. 1712 is faulty if voltage is measured.

7. Are 10-14 volts present at ENGINE BRAKE circuit breaker?

**Test Options**
Wire No. 1715 Voltage Test
or
STE/ICE-R Test #89

**Reason for Question**
ENGINE BRAKE HI/LO switch or wiring is faulty if no voltage is measured on wire no. 1715.

**Known Info**
- Engine brake operates on low with ENGINE BRAKE RETARDER HI/LOW switch in either position

**Possible Problems**
- Faulty engine brake wire harness
- Wires no. 1716, 1715, and/or 1714 loose or damaged
- Faulty ENGINE BRAKE RETARDER HI/LOW switch

8. Are 10-14 volts measured on wire no. 1715 at right cylinder head?

**Test Options**
Wire No. 1715 Voltage Test
or
STE/ICE-R Test #89

**Reason for Question**
ENGINE BRAKE HI/LO switch or wiring is faulty if no voltage is measured on wire no. 1715.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1712 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1712 at ENGINE BRAKE RETARDER ON/OFF switch.
(3) Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.

CIRCUIT BREAKER TEST

(1) Remove eight screws and panel from console.
(2) Turn ENGINE switch to ON position.
(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.
(4) Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
(5) Turn ENGINE switch to OFF position.

WIRE NO. 1715 VOLTAGE TEST

(1) Remove wire no. 1715 from connector on right cylinder head.

NOTE
Wire No. 508 is for DDEC II vehicles; wire No. 988 is for DDEC III/IV vehicles.
(2) Remove wire no. 508/988 from ENGINE BRAKE relay.
(3) Install jumper wire from terminal 85 on ENGINE BRAKE relay to known good ground.
(4) Turn ENGINE switch to ON position.
(5) Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
(6) Place ENGINE BRAKE RETARDER HI/LOW switch in the HI position.
(7) Place positive (+) probe of multimeter on wire no. 1715 at right cylinder head.
(8) Place negative (-) probe of multimeter on ground and look for 10-14 volts on multimeter.
(9) Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
(10) Turn ENGINE switch to OFF position.
(11) Remove jumper wire from ENGINE BRAKE relay.
(12) Install wire no. 508/988 on ENGINE BRAKE relay.
(13) Install wire no. 1715 on connector at right cylinder head.
e23. ENGINE BRAKE DOES NOT OPERATE (CONT)

WARNING
Read WARNING on following page.

9. Are 4–6 ohms of resistance measured between right cylinder head engine brake terminal and ground?

- **NO** Notify supervisor.
- **YES**

TEST OPTIONS
- Engine Brake Retarder Wiring Harness Test
- STE/ICE-R Test #91

REASON FOR QUESTION
A reading of infinity indicates there is an open circuit under the valve cover. A reading of 10 ohms indicates that one of the engine brake wire harness connectors is open.

10. Are 10–14 volts measured on wire no. 1716 at left cylinder head?

- **NO** Repair terminals or connectors (para 7–77). Notify supervisor if damaged wire harness is found.
- **YES**

TEST OPTIONS
- Wire No. 1716 Voltage Test
- STE/ICE-R Test #89

REASON FOR QUESTION
Wire no. 1716 form ENGINE BRAKE relay to left cylinder head is faulty if no voltage is measured on wire no. 1716.

11. Are 4–6 ohms of resistance measured between left cylinder head engine brake terminal and ground?

- **NO** Notify supervisor.
- **YES**

TEST OPTIONS
- Engine Brake Retarder Wiring Harness Test
- STE/ICE-R Test #91

REASON FOR QUESTION
A reading of infinity indicates there is an open circuit under the valve cover. A reading of 10 ohms indicates that one of the engine brake wire harness connectors is open.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

ENGINE BRAKE RETARDER WIRING HARNESS TEST

1. Remove wire no. 1715 from connector on right cylinder head.
2. Set multimeter to ohms position.
3. Connect multimeter leads to connector terminal and known good ground.
4. Observe resistance reading displayed on multimeter.
5. Remove multimeter leads from terminal and ground.
6. Install wire no. 1715 on connector at right cylinder head.

WIRE NO. 1716 VOLTAGE TEST

1. Remove wire no. 1716 from connector on left cylinder head.
2. Remove wire no. 508/988 from ENGINE BRAKE relay.
3. Install jumper wire from terminal 85 on ENGINE BRAKE relay to known good ground.
4. Turn ENGINE switch to ON position.
5. Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
6. Place positive (+) probe of multimeter on wire no. 1716 at left cylinder head.
7. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
8. Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
9. Turn ENGINE switch to OFF position.
10. Remove jumper wire from ENGINE BRAKE relay.
11. Install wire no. 508/988 on ENGINE BRAKE relay.
12. Install wire no. 1716 on connector at left cylinder head.

ENGINE BRAKE RETARDER WIRING HARNESS TEST

1. Remove wire no. 1715 from connector on right cylinder head.
2. Set multimeter to ohms position.
3. Connect multimeter leads to connector terminal and known good ground.
4. Observe resistance reading displayed on multimeter.
5. Remove multimeter leads from terminal and ground.
6. Install wire no. 1715 on connector at right cylinder head.
**e23. ENGINE BRAKE DOES NOT OPERATE (CONT)**

### KNOWLEDGE INFO
- **Engine brake operates on low with ENGINE BRAKE RETARDER HI/LOW switch in either position**
- **Wire no. 1716 loose or damaged**
- **Engine brake wire harness OK**

### POSSIBLE PROBLEMS
- **Wire no. 1715 loose or damaged**
- **Wire no. 1714 loose or damaged**
- **Faulty ENGINE BRAKE RETARDER HI/LOW switch**

### TEST OPTIONS
- **Wire No. 1715 Voltage Test**
  - or
  - STE/ICE-R Test #89

### REASON FOR QUESTION
- ENGINE BRAKE HI/LO switch or wire no. 1714 is faulty if no voltage is measured on wire no. 1715 at ENGINE BRAKE HI/LO switch. Wire no. 1715 is faulty if voltage is measured.

---

**WARNING**
Read **WARNING** on following page.

### 12. Are 10–14 volts measured on wire no. 1715 at ENGINE BRAKE HI/LO switch?

- **YES**
  - Repair terminals or connectors (para 7–77). Notify supervisor if damaged wire harness is found.
- **NO**
  - Go to step 13.

### 13. Are 10–14 volts measured on wire no. 1714 at ENGINE BRAKE HI/LO switch?

- **YES**
  - Replace ENGINE BRAKE HI/LO switch (para 7–16).
- **NO**
  - Repair terminals or connectors (para 7–77). Notify supervisor if damaged wire harness is found.
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### WIRE NO. 1715 VOLTAGE TEST
1. Remove wire no. 508/988 from ENGINE BRAKE relay.
2. Install jumper wire from terminal 85 on ENGINE BRAKE relay to known good ground.
3. Turn ENGINE switch to ON position.
4. Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
5. Place ENGINE BRAKE RETARDER HI/LOW switch in the HI position.
6. Place positive (+) probe of multimeter on wire no. 1715 at ENGINE BRAKE RETARDER HI/LOW switch.
7. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
8. Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
9. Turn ENGINE switch to OFF position.
10. Remove jumper wire from ENGINE BRAKE relay.
11. Install wire no. 508/988 on ENGINE BRAKE relay.

### WIRE NO. 1714 VOLTAGE TEST
1. Remove wire no. 508/988 from ENGINE BRAKE relay.
2. Install jumper wire from terminal 85 on ENGINE BRAKE relay to known good ground.
3. Turn ENGINE switch to ON position.
4. Place ENGINE BRAKE RETARDER ON/OFF switch in the ON position.
5. Place ENGINE BRAKE RETARDER HI/LOW switch in the HI position.
6. Place positive (+) probe of multimeter on wire no. 1714 at ENGINE BRAKE RETARDER HI/LOW switch.
7. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
8. Place ENGINE BRAKE RETARDER ON/OFF switch in the OFF position.
9. Turn ENGINE switch to OFF position.
10. Remove jumper wire from ENGINE BRAKE relay.
11. Install wire no. 508/988 on ENGINE BRAKE relay.
e24. DOME LIGHT DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

WARNING
Read WARNING on following page.

Is dome light bulb OK?

- NO
  - Replace dome light (para 7–45).
- YES

Are 10–14 volts measured on wire no. 1153 (red) at dome light?

- NO
  - Go to step 4.
- YES

Possible Problems
- Burned out dome light bulb
- Wire no. 1189 loose or damaged
- Faulty dome light switch
- Wire no. 1153 loose or damaged
- Wire no. 1435 loose or damaged

Reason for question
- Dome light will not operate if bulb is burned out.

Possible Problems
- Wire no. 1189 loose or damaged
- Faulty dome light switch
- Wire no. 1153 loose or damaged
- Wire no. 1435 loose or damaged

Reason for question
- Dome light switch is faulty or wires are loose or damaged if low voltage is measured.
Check dome light for burned out bulb.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE
BLACK OUT LIGHTS switch must be in the off position for dome light to operate.

WIRE NO. 1153 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place dome light switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1153 (red) at dome light.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place dome light switch in the off position.
(6) Turn ENGINE switch to OFF position.
e24. DOME LIGHT DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Tractor beacon light OK
- Dome light bulb OK
- Wire no. 1189 OK
- Dome light switch OK
- Wire no. 1153 OK

**POSSIBLE PROBLEMS**
- Wire no. 1435 loose or damaged

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Dome light may not operate if ground wire no. 1435 (black) from dome light is loose or damaged.

---

**KNOWN INFO**
- Circuit breaker not tripped
- Tractor beacon light OK
- Dome light bulb OK
- Low voltage on wire no. 1153 at dome light

**POSSIBLE PROBLEMS**
- Wire no. 1189 loose or damaged
- Faulty dome light switch
- Wire no. 1153 loose or damaged

**TEST OPTIONS**
- Wire No. 1189 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1189 from BLACK OUT LIGHTS switch to dome light switch is loose or damaged if low voltage is measured.

---

**KNOWN INFO**
- Circuit breaker not tripped
- Tractor beacon light OK
- Dome light bulb OK
- Low voltage on wire no. 1153 at dome light
- Wire no. 1189 OK

**POSSIBLE PROBLEMS**
- Faulty dome light switch
- Wire no. 1153 loose or damaged

**TEST OPTIONS**
- Dome Light Switch Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Dome light switch is faulty if low voltage is measured on wire no. 1153. Wire no. 1153 (red) from dome light switch to dome light is loose or damaged if low voltage is measured.

---

**e24. DOME LIGHT DOES NOT OPERATE (CONT)**

3. **Is wire no. 1435 (black) from dome light to ground a closed circuit?**
   - **YES**
   - **NO**

   **YES**
   - Fault not corrected. Notify supervisor.

   **NO**
   - Secure loose connections. Notify supervisor if damaged wires are found.

---

4. **Are 10–14 volts measured on wire no. 1189 at dome light switch?**
   - **YES**
   - Secure loose connections. Notify supervisor if damaged wires are found.
   - **NO**

   **YES**
   - Secure loose connections. Notify supervisor if damaged wires are found.
   - **NO**

---

5. **Are 10–14 volts measured on wire no. 1153 wire at dome light switch?**
   - **YES**
   - Secure loose connections. Notify supervisor if damaged wires are found.
   - **NO**

   **YES**
   - Replace dome light switch (par 7-16).
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 (black) from dome light for loose connections or damage.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.

WIRE NO. 1189 VOLTAGE TEST

(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1189 at dome light switch.
(3) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.

DOME LIGHT SWITCH TEST

(1) Turn ENGINE switch to ON position.
(2) Place dome light switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1153 at dome light switch.
(4) Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place dome light switch in the off position.
(6) Turn ENGINE switch to OFF position.
e25. MAP LIGHT(S) DO NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

WARNING
Read WARNING on following page.

KNOWLEDGE

Is map light bulb OK?

POSSIBLE PROBLEMS

Burned out map light bulb
Loose or damaged wire connections
Faulty map light switch

YES
Replace map light bulb (para 7–46).

NO

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Map light will not operate if bulb is burned out.

2.

Are 10–14 volts measured on wire no. 1189 at map light?

POSSIBLE PROBLEMS

Loose or damaged wire connections
Faulty map light switch

NO
Secure loose connections. Notify supervisor if damaged wires are found.

YES

TEST OPTIONS

Wire No. 1189 Voltage Test
or
STE/ICE–R Test #89

REASON FOR QUESTION

Wire no. 1189 from dome light switch to map light is loose or damaged if low voltage is measured.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**

- BLACK OUT LIGHTS switch must be in the off position for map light to operate.
- Troubleshooting procedures are the same for the right side and left side map lights.

Check map light for burned out bulb.

---

**WIRE NO. 1189 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1189 at map light.
3. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
4. Turn ENGINE switch to OFF position.
e25. MAP LIGHT(S) DO NOT OPERATE (CONT)

3. Is wire no. 1435 from map light to ground a closed circuit?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
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<tbody>
<tr>
<td>Map light bulb OK</td>
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<tr>
<td>Wire no. 1189 OK</td>
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<tr>
<th>POSSIBLE PROBLEMS</th>
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<tbody>
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<tr>
<td>Faulty map light switch</td>
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<tbody>
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<td>Continuity Test or STE/ICE-R Test #91</td>
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<tr>
<th>REASON FOR QUESTION</th>
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<tr>
<td>Map light may not operate if ground wire no. 1435 from map light is loose or damaged.</td>
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<tr>
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<tbody>
<tr>
<td>Map light switch is faulty if there is an open circuit when map light is in the ON position</td>
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4. Is there continuity thru map light switch when switch is in the ON position?

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<tr>
<td>Read WARNING and CAUTION on following page.</td>
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<tr>
<th>CAUTION</th>
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<tr>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
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<th>YES</th>
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<th>NO</th>
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Fault not corrected. Notify supervisor.
CONTINUITY TEST

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**
Any reading besides infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

---

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from map light for loose connections or damage.

---

**MAP LIGHT SWITCH TEST**

1. Disconnect map light connector.
2. Set multimeter to ohms position.
3. Connect multimeter leads to each pin in connector.
4. Turn map light on and check multimeter for continuity.

---

**MAP LIGHT CONNECTOR**
### INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)

---

#### KNOWN INFO
- Circuit breakers not tripped
- Dome light OK

#### POSSIBLE PROBLEMS
- Burned out beacon light bulb/fuse
- Wire no. 1094 loose or damaged
- Faulty beacon light switch
- Wire no. 1184, 1435, or 1413 loose or damaged
- Faulty TRACTOR BEACON relay
- Wire no. 1029 loose or damaged
- Beacon light ground wire no. 1435 loose or damaged
- Faulty beacon light

#### TEST OPTIONS
- Visual inspection

#### REASON FOR QUESTION
- Beacon will not operate if bulb is burned out.

---

#### KNOWN INFO
- Circuit breakers not tripped
- Dome light OK
- Beacon light bulb/fuse OK

#### POSSIBLE PROBLEMS
- Wire no. 1094 loose or damaged
- Faulty beacon light switch
- Wire no. 1184 loose or damaged
- Wire no. 1435 loose or damaged
- Wire no. 1413 loose or damaged
- Faulty TRACTOR BEACON relay
- Wire no. 1029 loose or damaged
- Beacon light ground wire no. 1435 loose or damaged
- Faulty beacon light

#### TEST OPTIONS
- Wire No. 1029 Voltage Test or STE/ICE-R Test #89

#### REASON FOR QUESTION
- Wire no. 1029 from TRACTOR BEACON relay to beacon may be loose or damaged if low voltage is measured. Tractor beacon relay or beacon light switch may be faulty if low voltage is measured. Wires may be loose or damaged.
Check beacon light for burned out bulb.

**WARNING**

- Capacitor inside strobe-type beacon light assembly may contain high voltage. Ensure light has been turned off for at least five minutes before servicing. Failure to comply may result in injury to personnel.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**

HET M1070's are equipped with either a rotating or strobe type beacon light. Rotating beacons have two light bulbs, strobe beacons have one.

Check beacon light for burned out bulb.

---

**WIRE NO. 1029 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place beacon light switch in the on position.
3. Place positive (+) probe of multimeter on wire no. 1029 at beacon.
4. Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Place beacon light switch in the off position.
6. Turn ENGINE switch to OFF position.
e26. BEACON LIGHT DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Dome light OK
- Beacon light bulb/fuse OK
- Wire no. 1094 OK
- Beacon light switch OK
- Wire no. 1184 OK
- Wire no. 1435 OK
- Wire no. 1413 OK
- TRACTOR BEACON relay OK
- Wire no. 1029 OK

**POSSIBLE PROBLEMS**
- Beacon light ground wire no. 1435 loose or damaged
- Faulty beacon light

**TEST OPTIONS**
- Continuity Test
  or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Rotating beacon may not operate if ground wire no. 1435 from beacon is loose or damaged. Rotating beacon is faulty if ground wire no. 1435 is OK.

---

Is wire no. 1435 from beacon to ground a closed circuit?

- YES: Secure loose connections. Notify supervisor if damaged wires are found.
- NO: Repair beacon (para 7-53 or 7-53.1).

**TEST OPTIONS**
- Wire no. 1184 Voltage Test
  or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Beacon light switch is faulty or wire no. 1184 from beacon light switch to TRACTOR BEACON relay is loose or damaged if low voltage is measured.

---

Are 10-14 volts measured on wire no. 1184 at TRACTOR BEACON relay?

- NO: Go to step 8.
- YES: Secure loose connections. Notify supervisor if damaged wires are found.

**TEST OPTIONS**
- Continuity Test
  or
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Beacon may not operate if ground wire no. 1435 from TRACTOR BEACON relay is loose or damaged.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from beacon for loose connections or damage.

WIRE NO. 1184 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place beacon light switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1184 at TRACTOR BEACON relay.
(4) Place negative (--) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place beacon light switch in the off position.
(6) Turn ENGINE switch to OFF position.

Check ground wire no. 1435 from TRACTOR BEACON relay for loose connections or damage.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.
e26. BEACON LIGHT DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers not tripped
- Dome light OK
- Beacon light bulb/fuse OK
- Low voltage on wire no. 1029 at beacon light
- Wire no. 1094 OK
- Beacon light switch OK
- Wire no. 1184 OK
- Wire no. 1435 OK

**POSSIBLE PROBLEMS**
- Wire no. 1413 loose or damaged
- Faulty TRACTOR BEACON relay
- Wire no. 1029 loose or damaged

**TEST OPTIONS**
- Wire No. 1413 Voltage Test
  or
  STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1413 from BEACON BACK UP circuit breaker to TRACTOR BEACON relay is loose or damaged if low voltage is measured.

---

**6.**

**Are 10-14 volts measured on wire no. 1413 at TRACTOR BEACON relay?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **NO**
  - Replace TRACTOR BEACON relay (para 7-27).

---

**7.**

**Are 10-14 volts measured on wire no. 1029 at TRACTOR BEACON relay?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **NO**
  - Replace TRACTOR BEACON relay (para 7-27).

---

**8.**

**Are 10-14 volts measured on wire no. 1094 at beacon light switch?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **NO**
  - Replace TRACTOR BEACON relay (para 7-27).
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**WIRE NO. 1413 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1413 at TRACTOR BEACON relay.
3. Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
4. Turn ENGINE switch to OFF position.

**TRACTOR BEACON RELAY TEST**

1. Turn ENGINE switch to ON position.
2. Place beacon light switch in the on position.
3. Place positive (+) probe of multimeter on wire no. 1029 at TRACTOR BEACON relay.
4. Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
5. Place beacon light switch in the off position.
6. Turn ENGINE switch to OFF position.

**WIRE NO. 1094 VOLTAGE TEST**

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on wire no. 1094 at beacon light switch.
3. Place negative (-) probe of multimeter on ground and look for 10–14 volts on multimeter.
4. Turn ENGINE switch to OFF position.
### Known Info
- Circuit breakers not tripped
- Dome light OK
- Beacon light bulb/fuse OK
- Low voltage on wire no. 1184 at TRACTOR BEACON relay
- Wire no. 1094 OK

### Possible Problems
- Faulty beacon light switch
- Wire no. 1184 loose or damaged

### Known Info
- Circuit breakers not tripped
- Dome light OK
- Beacon light bulb OK

### Possible Problems
- Burned out beacon light fuse
- Wire no. 1094 loose or damaged
- Faulty beacon light switch
- Wire no. 1184, 1435 or 1413 loose or damaged
- Faulty TRACTOR BEACON relay
- Wire no. 1029 loose or damaged
- Beacon light ground wire no. 1435 loose or damaged
- Faulty beacon light

### Known Info
- Circuit breakers not tripped
- Dome light OK
- Beacon light bulb OK

### Possible Problems
- Burned out beacon light fuse
- Wire no. 1094 loose or damaged
- Faulty beacon light switch
- Wire no. 1184, 1435 or 1413 loose or damaged
- Faulty TRACTOR BEACON relay
- Wire no. 1029 loose or damaged
- Beacon light ground wire no. 1435 loose or damaged
- Faulty beacon light

### Reason for Question
- 9.
  - Are 10–14 volts measured on wire no. 1184 at beacon light switch?
  
  **TEST OPTIONS**
  - Beacon Light Switch Test
  - or
  - STE/ICE-R Test #89

  **REASON FOR QUESTION**
  - Beacon light switch is faulty if low voltage is measured on wire no. 1184. Wire no. 1184 is loose or damaged if 10–14 volts are measured.

### Visual Inspection

### Reason for Question
- 10.
  - Is the vehicle equipped with a rotating or strobe type beacon light?
  
  **TEST OPTIONS**
  - Visual Inspection

  **REASON FOR QUESTION**
  - The strobe type rotating beacon has a 5 ampere fuse, the rotating type beacon does not.

### Reason for Question
- 11.
  - Is the strobe light’s internal 5 ampere fuse OK?

  **TEST OPTIONS**
  - Visual Inspection
  - or
  - Continuity Test
  - or
  - STE/ICE-R Test #91

  **REASON FOR QUESTION**
  - Strobe light will not function if the fuse is burned out.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

---

BEACON LIGHT SWITCH TEST

(1) Turn ENGINE switch to ON position.
(2) Place beacon light switch in the on position.
(3) Place positive (+) probe of multimeter on wire no. 1184 at beacon light switch.
(4) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(5) Place beacon light switch in the off position.
(6) Turn ENGINE switch to OFF position.

---

Remove fuse from strobe type beacon light and visually inspect. A fuse will usually "blow" in the center, at the inverted U-shape area. Fuse can also be checked with a multimeter.
e27. BACKUP LIGHT/ALARM DO NOT OPERATE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWLEDGMENT INFO**
- Circuit breakers OK
- Rotating beacon OK
- Engine starts in neutral

**POSSIBLE PROBLEMS**
- Faulty control circuit
- Wire no. 1891 loose or damaged
- Faulty reverse light switch
- Burned out backup light bulb
- Wire no. 1149 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty backup alarm
- Faulty backup light assembly

---

**TEST OPTIONS**

**Visual inspection**

**REASON FOR QUESTION**
- If both the backup light and backup alarm are inoperative, control circuit is at fault, if only one is inoperative, individual circuit is faulty.

---

**KNOWLEDGMENT INFO**
- Circuit breakers OK
- Rotating beacon OK
- Engine starts in neutral
- Light and alarm inoperative

**POSSIBLE PROBLEMS**
- Wire no. 1891 loose or damaged
- Faulty reverse light switch
- Burned out backup light bulb
- Wire no. 1149 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty backup alarm
- Faulty backup light assembly

---

**TEST OPTIONS**

- Wire No. 1891 Voltage Test
- STE/ICE–R Test #89

**REASON FOR QUESTION**
- Wire no. 1891 from BEACON BACK UP circuit breaker to reverse light switch is loose or damaged if low voltage is measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check backup light and alarm for operation (TM 9-2320-360-10).

WIRE NO. 1891 VOLTAGE TEST
(1) Turn ENGINE switch to ON position.
(2) Place positive (+) probe of multimeter on wire no. 1891 at reverse light switch.
(3) Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.
(4) Turn ENGINE switch to OFF position.
e27. BACKUP LIGHT/ALARM DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers OK
- Rotating beacon OK
- Engine starts in neutral
- Light and alarm inoperative
- Wire no. 1891 OK

**POSSIBLE PROBLEMS**
- Faulty reverse light switch
- Burned out backup light bulb
- Wire no. 1149 loose or damaged
- Wire no. 1435 loose or damaged
- Faulty backup alarm
- Faulty backup light assembly

**TEST OPTIONS**
- Reverse light Switch Test or
  STE/ICE-R Test #89

**REASON FOR QUESTION**
- Reverse light switch is faulty if
  low voltage measured on wire
  no. 1149.

---

**3.** Are 10–14 volts measured on wire no. 1149 at reverse light switch?

**NO**
- Replace reverse light switch (para 7–26).

**YES**
- Secure loose connections. Notify supervisor if damaged wires are found.

**TEST OPTIONS**
- Wire No. 1149 Voltage Test or
  STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1149 from reverse light switch to backup light and backup alarm is loose or damaged if low voltage is measured.

---

**4.** Is backup light bulb OK?

**NO**
- Replace backup light bulb (para 7–51).

**YES**
- Visual inspection

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Backup light will not operate if bulb is burned out.

---

**5.** Are 10–14 volts measured on wire no. 1149 at backup light and alarm?

**NO**
- Secure loose connections. Notify supervisor if damaged wires are found.

**YES**
- Visual inspection

**TEST OPTIONS**
- Wire No. 1149 Voltage Test or
  STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1149 from reverse light switch to backup light and backup alarm is loose or damaged if low voltage is measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

REVERSE LIGHT SWITCH TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>2</td>
<td>Place transmission range selector to reverse (R).</td>
</tr>
<tr>
<td>3</td>
<td>Place positive (+) probe of multimeter on wire no. 1149 at reverse light switch.</td>
</tr>
<tr>
<td>4</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>5</td>
<td>Place transmission range selector to neutral (N).</td>
</tr>
<tr>
<td>6</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

Check backup light for burned out bulb if backup light does not operate, but backup alarm sounds.

WIRE NO. 1149 VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>2</td>
<td>Place transmission range selector to reverse (R).</td>
</tr>
<tr>
<td>3</td>
<td>Place positive (+) probe of multimeter on wire no. 1149 at backup light.</td>
</tr>
<tr>
<td>4</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>5</td>
<td>Place positive (+) probe of multimeter on wire no. 1149 at backup alarm.</td>
</tr>
<tr>
<td>6</td>
<td>Place negative (−) probe of multimeter on ground and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>7</td>
<td>Place transmission range selector to neutral (N).</td>
</tr>
<tr>
<td>8</td>
<td>Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>
e27. BACKUP LIGHT/ALARM DO NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breakers OK
- Rotating beacon OK
- Engine starts in neutral
- Control circuit OK
- Wire no. 1891 OK
- Reverse light switch OK
- Backup light bulb OK
- Wire no. 1149 OK

**POSSIBLE PROBLEMS**
- Wire no. 1435 loose or damaged
- Faulty backup alarm
- Faulty backup light assembly

---

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
- Backup light or backup alarm may not operate if ground wire no. 1435 from backup light or backup alarm is loose or damaged.

---

**REASON FOR QUESTION**
- Backup alarm is faulty if there is voltage to backup alarm and ground is good.

---

**REASON FOR QUESTION**
- Backup light assembly is faulty if there is voltage to backup alarm and ground is good.
CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
Any reading besides infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from backup light and backup alarm for loose connections or damage.

BACKUP ALARM TEST

(1) Turn ENGINE switch to ON position.
(2) Place transmission range selector in reverse (R) position.
(3) Listen for operation of backup alarm.
(4) Place transmission range selector in neutral (N) position.
(5) Turn ENGINE switch to OFF position.

BACKUP LIGHT TEST

(1) Turn ENGINE switch to ON position.
(2) Place transmission range selector in reverse (R) position.
(3) Check for operation of backup light.
(4) Place transmission range selector in neutral (N) position.
(5) Turn ENGINE switch to OFF position.
e28. SPEEDOMETER DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

Personnel Required:
Two

KNOWLEDGE

Nothing

POSSIBLE PROBLEMS

Faulty tachograph
Faulty speedometer adapter
Faulty CTI signal generator
Faulty speedometer cable
Faulty angle drive

TEST OPTIONS

Angle Drive Shaft Test

REASON FOR QUESTION

Tachograph is faulty if angle drive shaft rotates. If angle drive shaft does not rotate, CTI signal generator, speedometer adapter, speedometer cable, and/or angle drive is faulty.

KNOWED INFO

Angle drive shaft does not turn

POSSIBLE PROBLEMS

Faulty speedometer adapter
Faulty CTI signal generator
Faulty speedometer cable
Faulty angle drive

TEST OPTIONS

Speedometer Adapter Test

REASON FOR QUESTION

Rotation of transfer case shaft is transmitted thru CTI signal generator to speedometer adapter. A faulty speedometer adapter will prevent speedometer from working properly.
ANGLE DRIVE SHAFT TEST

(1) Remove seven screws from instrument panel.
(2) Remove angle drive from tachograph.
(3) Start engine (TM 9-2320-360-10).
(4) Drive HET Tractor for 10 ft. (3.05 m) while watching angle drive shaft for rotation.
(5) Shut off engine (TM 9-2320-360-10).

SPEEDOMETER ADAPTER TEST

(1) Remove speedometer adapter (para 20-6).

**NOTE**

Ends of speedometer adapter should be square, not rounded off.

(2) Inspect ends of adapter for damage or worn parts.
(3) Turn one end of adapter while checking to see if other end turns.
(4) Install speedometer adapter (para 20-6).
e28. SPEEDOMETER DOES NOT OPERATE (CONT)

**KNOW**n INFO
Angle drive shaft does not turn
Speedometer adapter OK
CTI signal generator OK
Speedometer cable OK

**POSSIBLE PROBLEMS**
Faulty CTI signal generator
Faulty speedometer cable
Faulty angle drive
Faulty speedometer angle drive

**TEST OPTIONS**
CTI Signal Generator Test
Speedometer Cable Check
Angle Drive Check

**REASON FOR QUESTION**
CTI signal generator transmits rotation from transfer case to speedometer adapter. A faulty CTI signal generator will prevent speedometer from working properly.

1. Does CTI signal generator work properly?
   - **YES**
   - **NO**
     - Replace CTI signal generator (para 20-7).

2. Does speedometer cable turn (without kinks or binding)?
   - **YES**
   - **NO**
     - Replace speedometer cable (para 20-5).

3. Does the speedometer angle drive work properly?
   - **YES**
   - **NO**
     - Replace speedometer angle drive (para 20-5).

**Fault not corrected. Notify supervisor.**
CTI SIGNAL GENERATOR TEST

(1) Remove CTI signal generator (para 20–7).

NOTE

Ends of CTI signal generator should be square, not rounded off.

(2) Inspect ends of CTI signal generator for damage or worn parts.

(3) Turn one end of generator while checking to see if other end turns.

(4) Install CTI signal generator (para 20–7).

SPEEDOMETER CABLE CHECK

(1) Remove speedometer cable from angle drive.

(2) Remove speedometer cable from speedometer adapter.

NOTE

Ends of speedometer cable should be square, not rounded off.

(3) Inspect ends of speedometer cable for damage or worn parts.

(4) Turn one end of speedometer cable while assistant checks other end.

(5) Install speedometer cable on speedometer adapter.

SPEEDOMETER ANGLE DRIVE CHECK

(1) Remove speedometer angle drive (para 20–5).

NOTE

Ends of speedometer angle drive should be square, not rounded off.

(2) Inspect ends of speedometer angle drive for damage or worn parts.

(3) Turn one end of speedometer angle drive while checking to see if other end turns.

(4) Install speedometer angle drive (para 20–5).
e28.1. SPEEDOMETER DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F) Multimeter (Item 20, Appendix F) STE/ICE–R (optional) (Item 47, Appendix F)

---

TEST OPTIONS

Are 10–14 volts measured on wire no. 1276 at speedometer terminal 1?

- NO
  - Wire no. 1276 loose or damaged
  - Wire no. 1519 (black) loose or damaged
  - Wire no. 1519 (white) loose or damaged
  - Speedometer generator faulty

- YES
  - Start

TEST OPTIONS

Is wire no. 1435 from speedometer terminal to ground a closed circuit?

- NO
  - Wire no. 1435 loose or damaged
  - Wire no. 1519 (black) loose or damaged
  - Wire no. 1519 (white) loose or damaged
  - Signal generator faulty
  - Speedometer faulty

- YES
  - Secure loose connections. Notify supervisor if damaged wires are found.

---

WARNING

Read WARNING and CAUTION on following page.

CAUTION

Secure loose connections. Notify supervisor if damaged wires are found.

---

TEST OPTIONS

- Wire no. 1276 voltage test or STE/ICE–R Test #89

REASON FOR QUESTION

Wire no. 1276 from speedometer terminal 1 to splice is faulty if low voltage is measured.

TEST OPTIONS

- Continuity Test or STE/ICE–R Test #91

REASON FOR QUESTION

Speedometer may not operate if ground wire no. 1435 is loose or damaged.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1276 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove seven screws from instrument panel and tilt instrument panel towards steering wheel.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1276 at speedometer terminal 1.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on a known good ground.</td>
</tr>
<tr>
<td>(4) Turn ENGINE switch to ON position.</td>
</tr>
<tr>
<td>(5) Look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(6) Turn ENGINE switch to OFF position.</td>
</tr>
</tbody>
</table>

CONTINUITY TEST

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A reading of infinity indicates an open circuit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTINUITY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>(2) Set multimeter to ohms position.</td>
</tr>
<tr>
<td>(3) Connect multimeter leads to speedometer terminal 4 and known good ground and check multimeter for continuity.</td>
</tr>
</tbody>
</table>
3. Is there continuity between wire no. 1519 (black) from speedometer terminal 2 to chassis wire harness connector SU4, terminal B?

   - **NO** Go to step 5.
   - **YES**

4. Is there continuity between wire no. 1519 (white) from speedometer terminal 3 to chassis wire harness connector SU4, terminal A?

   - **NO** Go to step 8.
   - **YES**

Replace speedometer (para 7–14.1). Go to step 11 and verify repair.
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**CONTINUITY TEST**

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to speedometer terminal 2 and chassis wire harness connector SU4, terminal B, and check multimeter for continuity.

**CONTINUITY TEST**

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to speedometer terminal 3 and chassis wire harness connector SU4, terminal A, and check multimeter for continuity.
**SPEEDOMETER DOES NOT OPERATE (CONT)**

**KNOWN INFO**
- Circuit breaker no. 8 not tripped
- Wire no. 1276 OK
- Wire no. 1435 OK

**POSSIBLE PROBLEMS**
- Wire no. 1519 (black) from chassis wire harness connector SU4, terminal B, and chassis wire harness connector MC3, terminal Q, loss or damaged
- Wire no. 1519 (black) from cab wire harness connector MC8, terminal B, to speedometer, terminal 2, loose or faulty
  
**NOTICE**

- Wire no. 1519 (black) from chassis wire harness connector SU4 to chassis wire harness connector MC3, terminal Q, OK

**KNOWN INFO**
- Circuit breaker no. 8 not tripped
- Wire no. 1519 (black) from chassis wire harness connector SU4, terminal B, to chassis wire harness connector MC3, terminal Q, OK

**POSSIBLE PROBLEMS**
- Wire no. 1519 (black) from cab wire harness connector MC3 to cab wire harness connector MC8 loose or damaged
- Wire no. 1519 (black) from dash wire harness connector MC8 to speedometer loose or damaged

**NOTICE**

- Wire no. 1519 (black) from chassis wire harness connector SU4 to chassis wire harness connector MC3, terminal Q, OK

**TEST OPTIONS**
- Continuity Test
- STE/ICE--R Test #91

**REASON FOR QUESTION**
- Wire no. 1519 (black) from cab wire harness connector MC3, terminal Q, to cab wire harness connector MC8, terminal B?

**KNOWN INFO**
- Circuit breaker no. 8 not tripped
- Wire no. 1519 (black) from chassis wire harness connector SU4 to chassis wire harness connector MC3, terminal Q, OK

**POSSIBLE PROBLEMS**
- Wire no. 1519 (black) from dash wire harness connector MC8 to speedometer loose or damaged

**NOTICE**

- Wire no. 1519 (black) from dash wire harness connector MC8 to speedometer, terminal 2?

**TEST OPTIONS**
- Continuity Test
- STE/ICE--R Test #91

**REASON FOR QUESTION**
- Wire no. 1519 (black) is faulty if there is no continuity between dash wire harness connector MC8, terminal B, and speedometer, terminal 2
## WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### CONTINUITY TEST

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
</tbody>
</table>

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to chassis wire harness connector, terminal B, and chassis wire harness connector MC3, terminal SU4 and check multimeter for continuity.

---

### CONTINUITY TEST

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
</tbody>
</table>

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to cab wire harness connector MC3, terminal Q, and cab wire harness connector MC8, terminal B, and check multimeter for continuity.

---

### CONTINUITY TEST

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.</td>
</tr>
</tbody>
</table>

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to dash wire harness connector MC8, terminal B, and speedometer, terminal 2, and check multimeter for continuity.
e28.1. SPEEDOMETER DOES NOT OPERATE (CONT)

### 8.

**Is there continuity between wire no. 1519 (white) from chassis wire harness connector SU4, terminal A, and chassis wire harness connector MC3, terminal P?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**
  - Continuity Test
  - STE/ICE-R Test #91

### 9.

**Is there continuity between wire no. 1519 (white) from cab wire harness connector MC3, terminal P, to cab wire harness connector MC8, terminal A?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**
  - Continuity Test
  - STE/ICE-R Test #91

### 10.

**Is there continuity between wire no. 1519 (white) from dash wire harness connector MC8, terminal A, to speedometer, terminal 3?**

- **NO**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **YES**
  - Continuity Test
  - STE/ICE-R Test #91
### WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### CONTINUITY TEST

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to chassis wire harness connector SU4, terminal A, and chassis wire harness connector MC3, terminal P, and check multimeter for continuity.

### CONTINUITY TEST

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to cab wire harness connector MC3, terminal P, and cab wire harness connector MC8, terminal A, and check multimeter for continuity.

### CONTINUITY TEST

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to dash wire harness connector MC8, terminal A, and speedometer, terminal 3, and check multimeter for continuity.
e28.1. SPEEDOMETER DOES NOT OPERATE (CONT)

11. Does speedometer operate properly?

**KNOWN INFO**
- Circuit breaker no. 8 not tripped
- Wire no. 1276 OK
- Wire no. 1435 OK
- Wire no. 1519 (black) OK
- Wire no. 1519 (white) OK

**POSSIBLE PROBLEMS**
- Speedometer signal generator faulty

**TEST OPTIONS**
- Visual

**REASON FOR QUESTION**
- If speedometer does operate properly, signal generator is faulty

**WARNING**
Read WARNING on following page.

- **NO**: Replace signal generator (para 7-14c).
- **YES**: Problem fixed.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

SPEEDOMETER TEST

1. Ensure vehicle is in proper operating condition.
3. Operate vehicle and observe speedometer for proper operation.
e29. TACHOMETER DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

Personnel Required:
- Two

KNOWLEDGE OF INFO

Does tachometer angle drive shaft rotate while engine is running?

POSSIBLE PROBLEMS
- Faulty tachograph
- Faulty tachograph sending unit
- Faulty tachograph cable
- Faulty angle drive

TEST OPTIONS
- Angle Drive Shaft Test

REASON FOR QUESTION
- Tachograph is faulty if angle drive shaft rotates. If angle drive shaft does not rotate, tachograph sending unit, tachograph cable, and/or angle drive is faulty.

KNOWLEDGE OF INFO

Does tachometer sending unit work properly?

POSSIBLE PROBLEMS
- Faulty tachograph sending unit
- Faulty tachograph cable
- Faulty angle drive

TEST OPTIONS
- Tachometer Sending Unit Test

REASON FOR QUESTION
- Rotation of blower shaft shaft is transmitted thru tachometer sending unit to tachometer cable. A faulty sending unit will prevent tachometer from working properly.

Replace tachograph (para 7-14)

Replace tachometer sending unit (para 7-89).
ANGLE DRIVE SHAFT TEST

1. Remove seven screws from instrument panel.
2. Remove angle drive from tachograph.
4. Watch angle drive shaft for rotation.

TACHOMETER SENDING UNIT TEST

1. Remove tachometer sending unit (para 7–89).

   **NOTE**
   
   Ends of speedometer adapter should be square, not rounded off.

2. Inspect ends of adapter for damage or worn parts.
3. Turn one end of sending unit while checking to see if other end turns.
4. Install tachograph sending unit (para 7–89).
e29. TACHOMETER DOES NOT OPERATE (CONT)

**KNOW INFO**  
Angle drive shaft does not turn  
Tachograph sending unit OK

**POSSIBLE PROBLEMS**  
Faulty tachograph cable  
Faulty angle drive

**TEST OPTIONS**  
Tachometer Cable Check

**REASON FOR QUESTION**  
Tachometer cable transmits rotation from sending unit to angle drive. Tachometer cable must rotate at both ends and be able to move smoothly (free from kinks and binding) for tachometer to work properly.

---

**KNOW INFO**  
Angle drive shaft does not turn  
Tachograph sending unit OK  
Tachograph cable OK

**POSSIBLE PROBLEMS**  
Faulty angle drive

**TEST OPTIONS**  
Angle Drive Check

**REASON FOR QUESTION**  
Angle drive transmits tachometer cable rotation to tachograph. Angle drive must be working properly for the tachometer to work.

---

3. **Does tachometer cable turn (without kinks or binding)?**

   - **NO**  
     - Replace tachometer cable (para 20–4).

   - **YES**  
     - Fault not corrected. Notify supervisor.

4. **Does the tachometer angle drive work properly?**

   - **NO**  
     - Replace tachometer angle drive (para 20–4).

   - **YES**  
     - Fault not corrected. Notify supervisor.
TACHOMETER CABLE CHECK

(1) Remove tachometer cable from angle drive.
(2) Remove tachometer cable from tachometer sending unit.

NOTE

Ends of tachometer cable should be square, not rounded off.

(3) Inspect ends of tachometer cable for damage or worn parts.
(4) Turn one end of tachometer cable while assistant checks other end.
(5) Install tachometer cable on tachometer adapter.

TACHOMETER ANGLE DRIVE CHECK

(1) Remove tachometer angle drive (para 20–4).

NOTE

Ends of tachometer angle drive should be square, not rounded off.

(2) Inspect ends of tachometer angle drive for damage or worn parts.
(3) Turn one end of tachometer angle drive while checking to see if other end turns.
(4) Install tachometer angle drive (para 20–4).
e29.1. TACHOMETER DOES NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

**Tools and Special Tools**
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)
STE/ICE-R (optional) (Item 47, Appendix F)

---

**START**

**WARNING**
Read WARNING and CAUTION on following page.

**1.** Are 10-14 volts measured on wire no. 1276 on tachometer terminal 1?

<table>
<thead>
<tr>
<th><strong>KNOWN INFO</strong></th>
<th>Circuit breaker no. 8 not tripped</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td>Wire no. 1276 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Wire no. 1435 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Wire no. 505 loose or damaged</td>
</tr>
<tr>
<td></td>
<td>Tachometer faulty</td>
</tr>
</tbody>
</table>

**TEST OPTIONS**
Wire no. 1276 voltage test or STE/ICE-R Test #89

**REASON FOR QUESTION**
Wire no. 1276 from speedometer terminal 1 to splice is faulty if low voltage is measured

**CAUTION**
Secure loose connections. Notify supervisor if damaged wires are found.

**YES**

| **2.** Is there continuity between wire no. 1435 and a known good ground? |
|----------------|----------------------------------|
| **KNOWN INFO** | Circuit breaker no. 8 not tripped |
| | Wire no. 1276 OK |

**TEST OPTIONS**
Continuity Test or STE/ICE-R Test #91

**REASON FOR QUESTION**
Wire no. 1435 from tachometer terminal 6 to splice is faulty if there is no continuity to ground

**NO**

Secure loose connections. Notify supervisor if damaged wires are found.

---

WARNING
CAUTION
Read WARNING and CAUTION on following page.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.
(3) Connect multimeter leads to tachometer terminal no. 6 and ground and check multimeter for continuity.
e29.1. TACHOMETER DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker no. 8 not tripped
- Wire no. 1276 OK
- Wire no. 1435 OK

**POSSIBLE PROBLEMS**
- Wire no. 505 loose or damaged
- Tachometer faulty

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Wire no. 505 is loose or damaged if there is no continuity between engine wire harness connector MC18, terminal K1, and tachometer terminal 3

---

**KNOWLEDGE TABLE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Is there continuity between wire no. 505 at engine wire harness connector MC18 terminal K1, and tachometer, terminal 3?</td>
</tr>
<tr>
<td>YES</td>
<td>Go to step 4.</td>
</tr>
<tr>
<td>NO</td>
<td>Replace tachometer (para 7-14.2).</td>
</tr>
</tbody>
</table>

**KNOWLEDGE TABLE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Is there continuity between wire no. 505 at engine wire harness connector MC18, terminal K1, and engine wire harness connector MC21, terminal U?</td>
</tr>
<tr>
<td>YES</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
<tr>
<td>NO</td>
<td>Go to step 4.</td>
</tr>
</tbody>
</table>

**KNOWLEDGE TABLE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Is there continuity between wire no. 505 at cab wire harness connector MC21, terminal U and cab wire harness connector MC8, terminal U?</td>
</tr>
<tr>
<td>YES</td>
<td>Secure loose connections. Notify supervisor if damaged wires are found.</td>
</tr>
<tr>
<td>NO</td>
<td>Go to step 4.</td>
</tr>
</tbody>
</table>

---

**WARNING**

- Read WARNING and CAUTION on following page.

**CAUTION**

- Wire no. 505 loose or damaged
- Tachometer faulty
- Circuit breaker no. 8 not tripped
- Wire no. 1276 OK
- Wire no. 1435 OK

---

**NONE**

- Wire no. 505 from engine wire harness connector MC18 to engine wire harness connector MC21 loose or damaged
- Wire no. 505 from cab wire harness connector MC21 to cab connector MC8 loose or damaged
- Wire no. 505 from dash connector MC8 to tachometer terminal 3 loose or damaged

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Wire no. 505 is loose or damaged if there is no continuity between engine wire harness connector MC18, terminal K1, and tachometer terminal 3

---

**NONE**

- Wire no. 505 from engine wire harness connector MC18 to engine wire harness connector MC21 loose or damaged
- Wire no. 505 from cab wire harness connector MC21 to cab connector MC8 loose or damaged
- Wire no. 505 from dash connector MC8 to tachometer terminal 3 loose or damaged

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Wire no. 505 is loose or damaged if there is no continuity between engine wire harness connector MC18, terminal K1, and engine wire harness connector MC21, terminal U

---

**NONE**

- Wire no. 505 from engine wire harness connector MC18 to engine wire harness connector MC21 loose or damaged
- Wire no. 505 from cab wire harness connector MC21 to cab connector MC8 loose or damaged
- Wire no. 505 from dash connector MC8 to tachometer terminal 3 loose or damaged

**TEST OPTIONS**
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Wire no. 505 is loose or damaged if there is no continuity between cab wire harness connector MC21, terminal U, and cab wire harness connector MC8, terminal U
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CONTINUITY TEST

**CAUTION**
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to engine wire harness connector MC18, terminal K1, and tachometer, terminal 3, and check multimeter for continuity.
e29.1. TACHOMETER DOES NOT OPERATE (CONT)

**Known Info**
- Wire no. 505 MC18 to MC21 OK
- Wire no. 505 to MC21 to MC8 OK

**Possible Problems**
- Wire no. 505 from dash harness connector MC8 to tachometer terminal 3 loose or damaged

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

**Reason for Question**
- Wire no. 505 is loose or damaged if there is no continuity between dash wire harness connector MC8, terminal U, and tachometer, terminal 3

---

**Known Info**
- Circuit breaker no. 8 not tripped
- Wire no. 1276 OK
- Wire no. 1435 OK
- Tachometer OK
- Wire no. 505 OK

**Possible Problems**

---

**Reason for Question**
- If tachometer operates properly, problem is fixed

---

**Test Options**
- Visual

---

**Reason for Question**
- If tachometer operates properly, problem is fixed

---

**Test Options**
- Continuity Test
- STE/ICE-R Test #91

---

**Reason for Question**
- Wire no. 505 is loose or damaged if there is no continuity between dash wire harness connector MC8, terminal U, and tachometer, terminal 3
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**CONTINUITY TEST**

**CAUTION**

Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to dash wire harness connector MC8, terminal U, and tachometer, terminal 3, and check multimeter for continuity.

**TACHOMETER TEST**

1. Ensure vehicle is in proper operating condition.
3. Observe tachometer for proper operation.
**e30. CLOCK DOES NOT OPERATE**

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (optional) (Item 47, Appendix F)

---

**KNOWLEDGE**

Circuit breaker not tripped

**POSSIBLE PROBLEMS**
- Tachograph chart installed incorrectly
- Faulty tachograph
- Faulty circuit breaker
- Wire no. 1931 loose or damaged

---

**TEST OPTIONS**

Refer to para 7–16

**REASON FOR QUESTION**

Tachograph chart must be installed correctly for clock to operate.

---

**TEST OPTIONS**

Wire No. 1931 Voltage Test or STE/ICE–R Test #89

**REASON FOR QUESTION**

Tachograph circuit breaker is faulty or wire no. 1931 from TACHOGRAPH circuit breaker to tachograph is loose or damaged if no voltage is measured.

---

**START**

1. **Is tachograph chart installed correctly?**
   - **NO** Install tachograph chart (para 7–15).
   - **YES**

2. **Is voltage measured on wire no. 1931 at tachograph?**
   - **NO** Go to step 3.
   - **YES** Replace tachograph (para 7–14)
Refer to paragraph 7-15 for tachograph chart installation.

**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**WIRE NO. 1931 VOLTAGE TEST**

(1) Remove seven screws and tilt instrument panel toward steering wheel

(2) Place positive (+) probe of multimeter on wire no. 1931 at tachograph.

(3) Place negative (-) probe of multimeter on ground and note reading on multimeter.
e30. CLOCK DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Tachograph chart installed correctly

**POSSIBLE PROBLEMS**
- Faulty circuit breaker
- Wire no. 1931 loose or damaged

**WARNING**
Read WARNING on following page.

**Is voltage present at TACHOGRAPH circuit breaker?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **NO**
  - Replace circuit breaker (para 7-12).

**TEST OPTIONS**
Circuit Breaker Test

**REASON FOR QUESTION**
Tachograph will not operate if no voltage is present at lower terminal of TACHOGRAPH circuit breaker. Wire no. 1931 is loose or damaged if voltage is measured.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CIRCUIT BREAKER TEST

1. Remove eight screws and panel from console.
2. Place positive (+) probe of multimeter on lower terminal of circuit breaker.
3. Place negative (--) probe of multimeter on ground and note reading on multimeter.
### e31. ALL TRAILER LIGHTS DO NOT OPERATE (LIGHTS ON HET TRACTOR OPERATE)

#### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)

#### KNOWN INFO

- Intervehicular wiring harness connected and no signs of visual damage

#### POSSIBLE PROBLEMS

- Wire no. 1435c loose or damaged
- Intervehicular cable faulty

#### TEST OPTIONS

- Continuity Test
- STE/ICE-R Test #91

#### REASON FOR QUESTION

Trailer lights will not operate if ground wire no. 1435c from splice SP 19 is not grounded.

#### 1. Is wire no. 1435c from splice SP 19 to ground a closed circuit?

- **YES**
  - Secure loose connections. Notify supervisor if damaged wires are found.
- **NO**
  - Wire no. 1435c ground circuit OK
  - Intervehicular cable faulty

#### KNOWN INFO

- Wire no. 1435c ground circuit OK

#### POSSIBLE PROBLEMS

- Intervehicular cable faulty

#### TEST OPTIONS

- Intervehicular Cable Test
- STE/ICE-R Test #91

#### REASON FOR QUESTION

Trailer lights will not operate if there is an open circuit in the intervehicular cable.
CONTINUITY TEST

CAUTION
Electrical power must be disconnected from circuit before continuity can be checked. Failure to comply may result in damage to test equipment or electrical system.

(1) Disconnect intervehicular wire harness from 12 pin electrical connector.
(2) Set multimeter to ohms position.
(3) Connect one multimeter leads to pin D on 12 pin electrical connector.

NOTE
A reading of infinity indicates an open circuit.

(4) Connect other multimeter lead to known good ground and check reading on multimeter.

INTERVEHICULAR CABLE TEST

(1) Set multimeter to ohms position.
(2) Connect one multimeter leads to pin A of intervehicular cable.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect other multimeter lead to socket A at other end of intervehicular cable.
(4) Repeat steps (2) and (3) for remaining pins and sockets B thru N.
e32. VENTILATOR DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)

---

START

1.

Does at least one of the blower fans operate properly?

---

KNOWN INFO
Circuit breaker not tripped

TEST OPTIONS
Visual inspection

POSSIBLE PROBLEMS
Faulty speed control resistor
Faulty blower fan motor
Faulty cab wire harness
Faulty ECB wire harness
Faulty ventilator wire harness
Faulty blower fan switch
Faulty circuit breaker

REASON FOR QUESTION
If at least one of the blower fans operate the problem is with the motor, speed control resistor or the wiring from the switch to the motor.

YES

Both blower fans not operating properly, go to step 4.

NO

2.

Does the inoperative blower fan fail to operate at all speeds?

---

KNOWN INFO
Circuit breaker not tripped
At least one of the blower fans operates properly

TEST OPTIONS
Visual inspection

POSSIBLE PROBLEMS
Faulty speed control resistor
Faulty ventilator wire harness
Faulty blower fan motor

REASON FOR QUESTION
If the inoperative blower fan operates at some speeds but not others, the problem is with the speed control resistor. If blower fan does not operate at all the problem is with the blower fan motor or wire harness.

YES

Replace speed control resistor (para 7–96).

NO
There are two blower fan motors contained within the ventilator. One motor operates the two blower wheels on the driver’s side, the other motor operates the two blower wheels on the passenger’s side.

The rectangular louvers are removed for access to troubleshooting test points, while allowing the ventilator to remain operational.

(1) Remove six rectangular louvers from plenum chamber.
(2) Turn engine switch to ON position.
(3) Operate ventilator on high (H), medium (M), and low (L) (TM 9–2320–360–10) and check the operation of the passenger and driver side blower wheels.
(4) Turn engine switch to OFF position.

(1) Turn engine switch to ON position.
(2) Operate ventilator on high (H), medium (M), and low (L) (TM 9–2320–360–10) and check the operation of the faulty blower fan motor.
(3) Turn engine switch to OFF position.
### Known Info
- Circuit breaker not tripped
- At least one of the blower fans operates properly
- Other blower fan does not work at any speed

### Possible Problems
- Faulty ventilator wire harness
- Faulty blower fan motor

### Test Options
**Blower Fan Motor Test**
- or
**STE/ICE-R Test #89**

### Reason for Question
Blower fan motor has failed if voltage is present. If no voltage is measured there is an open in the wire harness from the blower fan switch to the motor.

### Known Info
- Circuit breaker not tripped
- Problem is present with both blower fans

### Possible Problems
- Faulty cab wire harness
- Faulty ECB wire harness
- Faulty ventilator wire harness
- Faulty blower fan switch
- Faulty circuit breaker

### Test Options
**Visual inspection**

### Reason for Question
Both blower fan motors have separate speed control resistors past the speed control switch. If both blower fans don’t work on all speeds, the problem is with the switch which is common to both motors.

### Known Info
- Circuit breaker not tripped
- Both blower fans inoperative

### Possible Problems
- Faulty cab wire harness
- Faulty ECB wire harness
- Faulty ventilator wire harness
- Faulty blower fan switch
- Faulty circuit breaker

### Test Options
**Cab Wire Harness Voltage Test**
- or
**STE/ICE-R Test #89**

### Reason for Question
If there is no voltage measured at MC91 connector there is an open circuit in the Electronic Control Box (ECB), cab or cab rear wire harnesses. If voltage is present the problem is within the electrical components of the ventilator.

### Test Options

#### Test Options
- Replace ventilator wire harness (para 7-96).

#### Reason for Question
- Blower Fan Motor Test
- or
- STE/ICE-R Test #89

#### Reason for Question
- Both blower fans inoperative, go to step 5.

#### Reason for Question
- Go to step 9.
**BLOWER FAN MOTOR TEST**

1. Remove eight screws and cover from upper case.
2. Remove electrical tape from spade connectors of fan motor wire harness.
3. Turn engine switch to ON position.
4. Operate ventilator on high (H), medium (M), and low (L) (TM 9–2320–360–10).
5. Place positive (+) probe of multimeter on orange spade connector.
6. Place negative (−) probe of multimeter on black spade connector and look for 22–28 volts on multimeter.
7. Turn engine switch to OFF position.

**CAB WIRE HARNESS VOLTAGE TEST**

1. Turn engine switch to ON position.
2. Operate ventilator (TM 9–2320–360–10) and check the operation of the faulty blower fan motors.
3. Turn engine switch to OFF position.
e32. VENTILATOR DOES NOT OPERATE (CONT)

### Known Info
- Circuit breaker not tripped
- Both blower fans inoperative
- 22-28 volts present at MC91 connector

### Possible Problems
- Faulty ventilator wire harness
- Faulty blower fan switch
- Faulty circuit breaker

### Test Options
- Wire Harness Voltage Test
- STE/ICE-R Test #89

### Reason for Question
- No voltage at the circuit breaker indicates an open circuit between the MC91 connector and the circuit breaker.

---

#### 6.
- **Are there 22-28 volts measured at screw terminal of circuit breaker?**
- **Yes:** Replace ventilator wire harness (para 7-96)
- **No:**

#### 7.
- **Are there 22-28 volts measured at spade terminal of circuit breaker?**
- **Yes:** Replace ventilator wire harness (para 7-96)
- **No:**

#### 8.
- **Are there 22-28 volts measured on green wire at blower fan switch?**
- **Yes:** Replace blower fan switch (para 7-96)
- **No:** Replace ventilator wire harness (para 7-96)
WIRE HARNESS VOLTAGE TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on screw terminal of circuit breaker.
3. Place negative (-) probe of multimeter on known good ground and look for 22–28 volts.
4. Turn ENGINE switch to OFF position.

CIRCUIT BREAKER TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on spade terminal of circuit breaker.
3. Place negative (-) probe of multimeter on known good ground and look for 22–28 volts.
4. Turn ENGINE switch to OFF position.

BLOWER FAN SWITCH TEST

1. Turn ENGINE switch to ON position.
2. Place positive (+) probe of multimeter on green wire terminal of ventilator wire harness at blower fan switch.
3. Place negative (-) probe of multimeter on known good ground and look for 22–28 volts.
4. Turn ENGINE switch to OFF position.
e32. VENTILATOR DOES NOT OPERATE (CONT)

9. Are there 22-28 volts measured at position A, wire no. 1488, of MC90 connector?
   - **NO**: Secure loose connections. Notify supervisor if damaged wires are found.
   - **YES**: Fault not corrected. Notify supervisor.

### KNOWN INFO
- Circuit breaker not tripped
- Both blower fans inoperative
- No voltage to MC91 connector

### POSSIBLE PROBLEMS
- Faulty cab wire harness
- Faulty ECB wire harness

### TEST OPTIONS
- Cab Wire Harness Voltage Test
- STE/ICE-R Test #89

### REASON FOR QUESTION
- No voltage at MC90 connector indicates an open circuit in the cab wire harness.

10. Are there 22-28 volts measured at position C, wire no. 1488, of MC89 connector?
   - **NO**: Secure loose connections. Notify supervisor if damaged wires are found.
   - **YES**: Fault not corrected. Notify supervisor.

### KNOWN INFO
- Circuit breaker not tripped
- Both blower fans inoperative
- No voltage to MC91 connector
- 22-28 volts present at MC90 connector

### POSSIBLE PROBLEMS
- Faulty ECB wire harness

### TEST OPTIONS
- ECB Wire Harness Voltage Test
- STE/ICE-R Test #89

### REASON FOR QUESTION
- No voltage at MC89 connector indicates an open circuit in the ECB wire harness.
(1) Remove 13 screws and panel from dash.

(2) Remove rear cab harness MC90 connector from cab wire harness.

(3) Turn ENGINE switch to ON position.

(4) Place positive (+) probe of multimeter on position A of MC90 connector.

(5) Place negative (--) probe of multimeter on known good ground and look for 22–28 volts.

(6) Turn ENGINE switch to OFF position.

(1) Remove 19 screws and three panels from electronic control box (ECB).

(2) Remove cab harness MC89 connector from ECB wire harness.

(3) Turn ENGINE switch to ON position.

(4) Place positive (+) probe of multimeter on position C of MC89 connector.

(5) Place negative (--) probe of multimeter on known good ground and look for 22–28 volts.

(6) Turn ENGINE switch to OFF position.
f. TRANSMISSION

Malfunction

f1. Transmission overheats (TRANS TEMP gage continuously reads over 250°F (121°C)) ................................................... 2–630
f2. Transmission unusually noisy when operating .................................... 2–634
f3. Transmission will not shift into gear, slips out of gear, or operates erratically ..................................................... 2–638
f4. Vehicle moves in neutral ............................................................. 2–640
f5. Transmission shifts rough .......................................................... 2–642
f6. Transmission slips in all forward gears ......................................... 2–646
f7. Automatic shifts occur at too high or low a speed ............................. 2–648
f8. Engine stalls at idle when in gear ................................................. 2–652
f1. TRANSMISSION OVERHEATS (TRANS TEMP GAGE CONTINUOUSLY READS OVER 250 °F (121 °C))

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Transmission oil level OK</td>
<td>Transmission oil contamination</td>
</tr>
<tr>
<td>Transmission oil not contaminated</td>
<td>Plugged radiator cooling fins</td>
</tr>
<tr>
<td></td>
<td>Damaged transmission oil lines or fittings</td>
</tr>
<tr>
<td></td>
<td>Faulty transmission oil cooler</td>
</tr>
<tr>
<td></td>
<td>Restricted transmission oil filter</td>
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<tr>
<th>TEST OPTIONS</th>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Oil Inspection</td>
<td>Contaminated transmission oil may cause transmission to overheat.</td>
</tr>
</tbody>
</table>

---

### Question 1

Is transmission oil free from contamination (dirt, dark, or milky color)?

- **Transition:** Notify supervisor.

---

### Question 2

Are radiator cooling fins free from dirt, mud, or other debris?

- **Transition:** Clear radiator fins.

---

### Test Options

**Visual inspection**

**Reason for Question**

Transmission may overheat if radiator cooling fins are plugged with debris or if transmission oil cooler is damaged.
**TRANSMISSION OIL INSPECTION**

**WARNING**
Do not drain transmission oil when transmission is hot. Severe injury to personnel may result.

**CAUTION**
Transmission oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating transmission and is indicated by discoloration, strong odor, or oil analysis.

**NOTE**
Transmission fluid capacity is 33 qt (31 L).

1. Place suitable container under transmission drain plug.
2. Remove drain plug from transmission and allow approximately 1 qt (0.9 L) of oil to drain into container.
3. Install drain plug on transmission.
4. Inspect oil for contaminants.

Check if radiator cooling fins are plugged with dirt, mud, or other debris.
f1. TRANSMISSION OVERHEATS (TRANS TEMP GAGE CONTINUOUSLY READS OVER 250 °F (121 °C)) (CONT)

**KNOWLEDGE INFO**
- Transmission oil level OK
- Transmission oil not contaminated
- Radiator cooling fins OK

**POSSIBLE PROBLEMS**
- Damaged transmission oil lines or fittings
- Faulty transmission oil cooler
- Restricted transmission oil filter

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Leaking or damaged oil lines may cause low oil level and lead to transmission overheating.

---

3. Are transmission oil lines and fittings free from leaks or damage?

- **YES**
  - Replace damaged oil lines and fittings (para 8-7).

- **NO**
  - Replace radiator (para 6-3) if oil cooler is damaged or leaking.

---

4. Is transmission oil cooler free from damage and not restricted?

- **YES**
  - Replace transmission oil filter (para 8-2).

- **NO**
  - Visual inspection

**REASON FOR QUESTION**
- Transmission may overheat if transmission oil cooler is damaged or restricted.

---

5. Is transmission oil filter free from leaks or damage?

- **YES**
  - Replace transmission oil filter (para 8-2).

- **NO**
  - Go to Electrical Troubleshooting (e5, Electric gage does not operate or is inaccurate) to check gage operation.
WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil lines and fittings for leakage and damage.

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.

TRANSMISSION ENGINE REMOVED FOR CLARITY

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR
HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

WARNING
Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission oil cooler is contained inside radiator bottom tank
(1) Check radiator bottom tank for obvious damage.
(2) Remove transmission oil cooler hoses and elbows (para 8–7).
(3) Inspect oil cooler passages for restrictions.
(4) Replace elbows and transmission oil cooler hoses (para 8–7).

Check transmission oil filter for leaks and damage.
f2. TRANSMISSION UNUSUALLY NOISY WHEN OPERATING

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**

| PTO OFF |

**POSSIBLE PROBLEMS**

- Low transmission oil level
- Transmission oil contamination
- Damaged transmission oil lines or fittings

---

**TEST OPTIONS**

| Transmission Oil Level Check |

**REASON FOR QUESTION**

- Low oil level may cause transmission to overheat.

---

**KNOWN INFO**

| PTO OFF |
- Transmission oil level OK

**POSSIBLE PROBLEMS**

- Transmission oil contamination
- Damaged transmission oil lines or fittings

---

**TEST OPTIONS**

| Transmission Oil Inspection |

**REASON FOR QUESTION**

- Oil will lose lubricating qualities if contaminated and cause transmission to make noise.
WARNING
Be sure to wear the proper eye protection to avoid personal injury.

CAUTION
Transmission oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating transmission and is indicated by discoloration, strong odor, or oil analysis.

TRANSMISSION OIL LEVEL CHECK
With engine running and transmission in neutral (N), check transmission fluid level on dipstick.

a. If transmission fluid temperature is below 160 °F (71 °C), fluid level should be within COLD RUN area.

b. If transmission fluid temperature is above 160 °F (71 °C), fluid level should be within HOT RUN area.

TRANSMISSION OIL INSPECTION

WARNING
Do not drain transmission oil when transmission is hot. Severe injury to personnel may result. Be sure to wear the proper eye protection to avoid personal injury.

NOTE
Transmission fluid capacity is 33 qt (31 L).

(1) Place suitable container under transmission drain plug.

(2) Remove drain plug from transmission and allow approximately 1 qt (0.9 L) of oil to drain into container.

(3) Install drain plug on transmission.

(4) Inspect oil for correct type and for contaminants.

(5) Fill Transmission (LO 9-2320-360-12).
f2. TRANSMISSION UNUSUALLY NOISY WHEN OPERATING (CONT)

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<thead>
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<tr>
<td>PTO OFF</td>
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<tr>
<td>Transmission oil level OK</td>
</tr>
<tr>
<td>Transmission oil not contaminated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damaged transmission oil lines or fittings</td>
</tr>
</tbody>
</table>

3. Are transmission oil lines and fittings free from leaks or damage?

- **NO**
  - Replace damaged oil lines and fittings (para 8-7).

- **YES**
  - Go to Propeller Shafts And Universal Joints Troubleshooting (h1. Propeller shafts or universal joints unusually noisy when operating).

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
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<tbody>
<tr>
<td>Visual inspection</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaking or damaged oil lines may cause low oil level and lead to transmission overheating.</td>
</tr>
</tbody>
</table>
Check transmission oil lines and fittings for leakage and damage.

TRANSMISSION REMOVED FOR CLARITY

HOSE NO. 2311 TO FILTER
HOSE NO. 2311 FROM FILTER

HOSE NO. 2382 TO RADIATOR
HOSE NO. 2393 FROM RADIATOR

TRANSMISSION/ENGINE REMOVED FOR CLARITY
3. TRANSMISSION WILL NOT SHIFT INTO GEAR, SLIPS OUT OF GEAR, OR OPERATES ERRATICALLY

---

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**

Transmission oil level OK

**POSSIBLE PROBLEMS**

Transmission oil contaminated
- Transmission shift cable connection
- Transmission shift cable adjustment

---

**KNOWN INFO**

Transmission oil level OK
- Transmission oil not contaminated

**POSSIBLE PROBLEMS**

Transmission shift cable connection
- Transmission shift cable adjustment

---

**TEST OPTIONS**

Transmission Oil Inspection

**REASON FOR QUESTION**

Contaminated transmission oil may cause transmission to overheat.

---

**WARNING**

- Read WARNING and CAUTION on following page.

---

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Transmission may not shift into gear, slip out of gear, or not respond to range selector movement if shift cable has loose, missing, or damaged parts.
Check transmission shift cable for loose, worn, missing, or damaged parts.

---

**TRANSMISSION OIL INSPECTION**

**WARNING**
Do not drain transmission oil when transmission is hot. Severe injury to personnel may result.

**CAUTION**
Transmission oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating transmission and is indicated by discoloration, strong odor, or oil analysis.

**NOTE**
Transmission fluid capacity is 33 qt (31 L).

1. Place suitable container under transmission drain plug.
2. Remove drain plug from transmission and allow approximately 1 qt (0.9 L) of oil to drain into container.
3. Install drain plug on transmission.
4. Inspect oil for contaminants.
5. Fill transmission (LO 9-2320-360-12).
f3. TRANSMISSION WILL NOT SHIFT INTO GEAR, SLIPS OUT OF GEAR, OR OPERATES ERRATICALLY (CONT)

**KNOWN INFO**
- Transmission oil level OK
- Transmission oil not contaminated
- Transmission shift cable connection OK

**POSSIBLE PROBLEMS**
- Transmission shift cable adjustment

**TEST OPTIONS**
- Refer to shift cable adjustment/replacement procedure (para 8-5)

**REASON FOR QUESTION**
- Transmission may not shift into gear, slip out of gear, or not respond to range selector movement if shift cable is out of adjustment.

**3. Is transmission shift cable properly adjusted?**

- **YES**
  - Fault not corrected. Notify supervisor.

- **NO**
  - Adjust shift cable (para 8-5).
Refer to para 8-5 to adjust transmission shift cable.
f4. VEHICLE MOVES IN NEUTRAL

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

Known Info
- Transmission oil level OK

Possible Problems
- Transmission shift cable connection
- Transmission shift cable adjustment

Test Options
- Visual inspection

Reason for Question
- HET Tractor may move on level terrain while in neutral if transmission shift cable has loose, missing, or damaged parts.

Test Options
- Refer to shift cable adjustment/replacement procedure (para 8–6)

Reason for Question
- HET Tractor may move on level terrain while in neutral if transmission shift cable is out of adjustment.

Flowchart:

1. **Is transmission shift cable free from loose, worn, missing, or damaged parts?**
   - **YES**: Replace damaged shift cable parts (para 8–5).
   - **NO**: Is transmission shift cable properly adjusted?

2. **Is transmission shift cable properly adjusted?**
   - **YES**: Adjust shift cable (para 8–5).
   - **NO**: Fault not corrected. Notify supervisor.
Check transmission shift cable for loose, worn, missing, or damaged parts.

Refer to para 8-5 to adjust transmission shift cable.
f5. TRANSMISSION SHIFTS ROUGH

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE–R (Item 47, Appendix F)

Materials/Parts
- Compound, Sealing, Pipe Thread (Item 15, Appendix C)

---

FLowsheet:

1. CAUTION
   Read CAUTION on following page.

   Is modulator solenoid valve operating correctly?

   NO
   Replace modulator solenoid valve (para 11-39).

   YES

2. Is air line no. 2857 free from leaks, kinks, or damage?

   NO
   Replace air line (para 11-40).

   YES

---

KNOWN INFO

Transmission oil level OK
Modulator solenoid valve OK

POSSIBLE PROBLEMS

Faulty modulator solenoid valve
Damaged or leaking air line
Faulty transmission modulator valve
Misadjusted/defective transmission air pressure regulator.

TEST OPTIONS

Modulator Solenoid Valve Test

REASON FOR QUESTION

Modulator solenoid valve is faulty if air does not flow through valve when valve is energized.

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Leaking air line to modulator will cause improper operation.
Inspect air line no. 2857 in doghouse, at manifold block and outside cab for leaks, kinks, or damage.

**WARNING**
Be sure to wear the proper eye protection to avoid personal injury.

<table>
<thead>
<tr>
<th>MODULATOR SOLENOID VALVE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove 13 screws and dash access panel from dash.</td>
</tr>
<tr>
<td>(2) Remove hose no. 2857 from modulator solenoid valve.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
<tr>
<td>Use care when supplying power to solenoid valve. Crossing terminals will result in damage to solenoid valve and test equipment.</td>
</tr>
<tr>
<td>(3) Apply external 24 volt power supply to solenoid valve.</td>
</tr>
<tr>
<td>(4) Check for air flow through modulator solenoid valve</td>
</tr>
<tr>
<td>(5) Install hose no. 2857 on solenoid valve.</td>
</tr>
</tbody>
</table>
3. Is transmission modulator valve operating properly and free from leaks?

- **YES**
  - Transmission modulator valve (para 8-9).

- **NO**
  - Replace transmission modulator valve (para 8-9).

**POSSIBLE PROBLEMS**
- Faulty transmission modulator valve
- Misadjusted/defective transmission air pressure regulator

**TEST OPTIONS**
- Transmission Modulator Valve Test

**REASON FOR QUESTION**
- Defective transmission modulator valve may cause rough shifting.

4. Is there 70 psi (483 kPa) air pressure measured at transmission modulator air pressure regulator?

- **YES**
  - Adjust/replace transmission regulator (para 11-37).

- **NO**
  - Fault not corrected. Notify supervisor.

**POSSIBLE PROBLEMS**
- Misadjusted/defective transmission air pressure regulator

**TEST OPTIONS**
- Pressure Test

**REASON FOR QUESTION**
- Misadjusted/defective transmission regulator may cause rough shifting.
### TRANSMISSION MODULATOR VALVE TEST

1. Remove air line no. 2857 from transmission modulator valve.
2. Inspect for external transmission fluid leaks and presence of transmission fluid inside air line no. 2857.
3. Remove transmission modulator valve (para 8-9).
4. Apply air pressure to air line fitting. Center plunger should move out when air pressure is applied.
5. Install transmission modulator valve (para 8-9).

### PRESSURE TEST

1. Remove plug from regulator.
2. Install adapter and STE/ICE transducer on regulator.
3. Start engine (TM 9-2320-360-10) and allow air system pressure to build up to 120-125 psi (827-862 kPa).
4. Shut off engine (TM 9-2320-360-10).
5. Perform STE/ICE test #50 and observe pressure displayed.
6. Pull regulator knob to unlock air pressure regulator.
7. Adjust air pressure regulator to proper air pressure using STE/ICE Test #50. Turn knob clockwise to increase pressure or counterclockwise to decrease pressure.
8. Push in knob to lock air pressure regulator.
9. Drain air system (TM 9-2320-360-10).
10. Remove adapter and STE/ICE transducer from regulator.

**WARNING**

Pipe thread sealing compound can burn easily, can give off harmful vapors, and is harmful to skin and clothing. To avoid injury or death, keep compound away from open fire and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**

Use pipe thread sealing compound sparingly, only on pipe threads. Do not apply compound at hose connections. Failure to comply may result in component damage.

11. Coat threads of plug with pipe thread sealing compound.
12. Install plug on regulator.
13. Install dash access panel on dash with 13 screws.
f6. TRANSMISSION SLIPS IN ALL FORWARD GEARS

INITIAL SETUP

Equipment Conditions
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

KNOWN INFO

Is transmission oil level at proper level?

POSSIBLE PROBLEMS

Low transmission oil level
Contaminated transmission oil

TEST OPTIONS

Transmission Oil Level Check

REASON FOR QUESTION

Transmission may slip in all gears if oil level is low. An internal transmission fault is indicated if transmission slips when oil level is OK.

Known Info

Transmission oil level OK

POSSIBLE PROBLEMS

Contaminated transmission oil

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Transmission may slip in all gears if oil is contaminated. An internal transmission fault is indicated if transmission slips when oil is free from contamination.

Known Info

Nothing

POSSIBLE PROBLEMS

Low transmission oil level
Contaminated transmission oil

CAUTION

Read CAUTION on following page.

YES

NO

Add oil (LO 9-2320-360-12).

Notify supervisor.

Fault not corrected. Notify supervisor.

YES

NO

Notify supervisor.
With engine running and transmission in neutral (N), check transmission fluid level on dipstick.

a. If transmission fluid temperature is below 160°F (71°C), fluid level should be within COLD RUN area.

b. If transmission fluid temperature is above 160°F (71°C), fluid level should be within HOT RUN area.

**CAUTION**

Transmission oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating transmission and is indicated by discoloration, strong odor, or oil analysis.

**TRANSMISSION OIL LEVEL CHECK**

With engine running and transmission in neutral (N), check transmission fluid level on dipstick.

a. If transmission fluid temperature is below 160°F (71°C), fluid level should be within COLD RUN area.

b. If transmission fluid temperature is above 160°F (71°C), fluid level should be within HOT RUN area.

**NOTE**

Use clean suitable container to obtain sample.

(1) Obtain 1 qt. (0.9L) transmission oil sample from AOAP sampling valve.

(2) Inspect oil for contaminants.
f7. Automatic shifts occur at too high or too low a speed

**Initial Setup**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.
- Air system drained (TM 9-2320-360-10).

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE-R (Item 47, Appendix F)

**Materials/Parts**
- Compound, Sealing, Pipe Thread (Item 15, Appendix C)

---

**Known Info**

- Transmission oil level OK

**Possible Problems**

- Faulty modulator solenoid valve
- Air line no. 2857 damaged or leaking
- Faulty transmission modulator valve
- Misadjusted/defective transmission air pressure regulator.

---

**Test Options**

**Reason for Question**

- Modulator Solenoid Valve Test

---

**Known Info**

- Transmission oil level OK
- Modulator solenoid valve OK

**Possible Problems**

- Air line no. 2857 damaged or leaking
- Faulty transmission modulator valve
- Misadjusted/defective transmission air pressure regulator.

---

**Test Options**

**Reason for Question**

- Visual inspection

---

**Modulator Solenoid Valve Test**

1. Is modulator solenoid valve operating correctly?
   - **Yes**: Replace solenoid valve (para 11-37).
   - **No**: Read CAUTION on following page.

2. Is air line no. 2857 free from leaks, kinks, or damage?
   - **Yes**: Replace air line (para 11-40).
   - **No**: Replace air line (para 11-40).
(1) Remove 13 screws and dash access panel from dash.
(2) Remove hose no. 2857 from modulator solenoid valve.

**CAUTION**
Use care when supplying power to solenoid valve. Crossing terminals will result in damage to solenoid valve and test equipment.

(3) Apply external 24 volt power supply to solenoid valve.
(4) Check for air flow through modulator solenoid valve.
(5) Install hose no. 2857 on solenoid valve.
(6) Install dash access panel on dash with 13 screws.

Inspect air line no. 2857 in doghouse, at manifold block and outside cab for leaks, kinks, or damage.
f7. AUTOMATIC SHIFTS OCCUR AT TOO HIGH OR TOO LOW A SPEED (CONT)

**KNOWN INFO**
- Transmission oil level OK
- Modulator solenoid valve OK
- Air line no. 2857 OK

**POSSIBLE PROBLEMS**
- Faulty transmission modulator valve
- Misadjusted/defective transmission air pressure regulator.

**TEST OPTIONS**
- Transmission Modulator Valve Test

**REASON FOR QUESTION**
- Defective transmission modulator valve may cause rough shifting.

---

3. Is transmission modulator valve operating properly and free from leaks?

- **YES**
  - Replace transmission modulator valve (para 8-9).
- **NO**
  - **Reason for Question**: Misadjusted/defective transmission modulator valve may cause rough shifting.

---

4. Is there 70 psi (483 kPa) air pressure measured at transmission modulator air pressure regulator?

- **YES**
  - Adjust/replace transmission regulator (para 11-37).
- **NO**
  - **Reason for Question**: Misadjusted/defective transmission regulator may cause rough shifting.

---

**KNOWN INFO**
- Transmission oil level OK
- Modulator solenoid valve OK
- Air line no. 2857 OK
- Transmission modulator valve OK

**POSSIBLE PROBLEMS**
- Misadjusted/defective transmission air pressure regulator.
WARNING
Be sure to wear the proper eye protection to avoid personal injury.

TRANSMISSION MODULATOR VALVE TEST

(1) Remove air line no. 2857 from transmission modulator valve.
(2) Inspect for external transmission fluid leaks and presence of transmission fluid inside air line no. 2857.
(3) Remove transmission modulator valve (para 8-9).
(4) Apply air pressure to air line fitting. Center plunger should move out when air pressure is applied.
(5) Install transmission modulator valve (para 8-9).

PRESSURE TEST

(1) Remove plug from regulator.
(2) Install adapter and STE/ICE transducer on regulator.
(3) Start engine (TM 9-2320-360-10) and allow air system pressure to build up to 120-125 psi (827-862 kPa).
(4) Shut off engine (TM 9-2320-360-10).
(5) Perform STE/ICE test #50 and observe pressure displayed.
(6) Pull regulator knob to unlock air pressure regulator.
(7) Adjust air pressure regulator to proper air pressure using STE/ICE Test #50. Turn knob clockwise to increase pressure or counterclockwise to decrease pressure.
(8) Push in knob to lock air pressure regulator.
(9) Drain air system (TM 9-2320-360-10).
(10) Remove adapter and STE/ICE transducer from regulator.

WARNING
Pipe thread sealing compound can burn easily, can give off harmful vapors, and is harmful to skin and clothing. To avoid injury or death, keep compound away from open fire and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

CAUTION
Use pipe thread sealing compound sparingly, only on pipe threads. Do not apply compound at hose connections. Failure to comply may result in component damage.

(11) Coat threads of plug with pipe thread sealing compound.
(12) Install plug on regulator.
(13) Install dash access panel on dash with 13 screws.
f8. ENGINE STALLS AT IDLE WHEN IN GEAR

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

KNOWN INFO
- Transmission oil level OK

1. Refer to direct support maintenance for troubleshooting of this fault.

TEST OPTIONS
- TM 9-2320-360-34

REASON FOR QUESTION
- If vehicle stalls when pulling to a stop, there is a possible problem with the lockup torque converter circuit.
### g. TRANSFER CASE

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure</th>
</tr>
</thead>
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</tr>
<tr>
<td>g2. Transfer case does not shift into HIGH or LOW, or slips out of gear.</td>
<td>2–660</td>
</tr>
<tr>
<td>g3. Transfer case overheats. (T–CASE TEMP gage continuously reads over 250°F (121 °C).)</td>
<td>2–662</td>
</tr>
<tr>
<td>g4. Transfer case does not engage front axle when transfer case shift lever is positioned to LOW.</td>
<td>2–666</td>
</tr>
<tr>
<td>g5. Transfer case does not engage front axle when transfer case shift lever is in HIGH position, and DRIVELINE control is positioned to LOCK.</td>
<td>2–670</td>
</tr>
</tbody>
</table>
g1. TRANSFER CASE UNUSUALLY NOISY WHEN OPERATING

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

**KNOWN INFO**

Nothing

**POSSIBLE PROBLEMS**

- Damaged or leaking transfer case oil lines or fittings
- Low transfer case oil level
- Faulty transfer case lubrication pump
- Transfer case oil contamination

**KNOW ABOUT**

- Transfer case oil lines and fittings OK

**POSSIBLE PROBLEMS**

- Low transfer case oil level
- Faulty transfer case lubrication pump
- Transfer case oil contamination

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Leaking or damaged oil lines may cause low oil level and lead to unusually noisy transfer case operation.

**TEST OPTIONS**

Transfer Case Oil Level Check

**REASON FOR QUESTION**

Low oil level may cause transfer case to operate unusually noisy.
CAUTION
Transfer case oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating transfer case and is indicated by discoloration, strong odor, or oil analysis.

Check transfer case oil lines and fittings for leakage and damage.

TRANSFER CASE OIL LEVEL CHECK

(1) Turn engine off and chock wheels (TM 9-2320-360-10).
(2) Place suitable container under transmission drain plug.
(3) Remove oil level plug from transfer case.
(4) Inspect oil for contaminants.
(5) Install oil level plug on transfer case.
g1. TRANSFER CASE UNUSUALLY NOISY WHEN OPERATING (CONT)

**KNOWN INFO**
- Transfer case oil lines and fittings OK
- Transfer case oil level OK

**POSSIBLE PROBLEMS**
- Faulty transfer case lubrication pump
- Transfer case oil contamination

### 3. Is transfer case lubrication pump mounting secure?

**Test Options**
- Visual inspection

**Reason for Question**
- Damaged pump or loose pump mounting may cause transfer case to operate unusually noisy.

**Yes**
- Notify supervisor.

**No**
  - Change oil (LO 9-2320-360-12)
  - Go to Propeller Shafts and Universal Joints Troubleshooting (h1. Propeller shafts or universal joints unusually noisy when operating).

**KNOWN INFO**
- Transfer case oil lines and fittings OK
- Transfer case oil level OK
- Transfer case lubrication pump OK

**POSSIBLE PROBLEMS**
- Transfer case oil contamination
Check transfer case lubrication pump for damage, and for loose or missing mounting hardware.

**TRANSFER CASE OIL DRAIN/CHECK/REFILL**

1. Place clean suitable container under transfer case drain plug.

   **NOTE**
   Transfer case fluid capacity is 5 qts (4 L).

2. Remove drain plug from transfer case and allow approximately 1 qt (0.9 L) of oil to drain into container.

3. Install drain plug on transfer case.

4. Inspect oil for contaminants.

5. Add oil that was removed to transfer case if it is not contaminated.
g2. TRANSFER CASE DOES NOT SHIFT INTO HIGH OR LOW, OR SLIPS OUT OF GEAR

INITIAL SETUP

Equipment Conditions
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

---

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Transfer case may not shift or may slip out of gear if shift linkage has loose, missing, or damaged parts.

---

TEST OPTIONS
Refer to two-speed shift linkage adjustment/replacement procedure (para 9-2).

REASON FOR QUESTION
Transfer case may not shift or may slip out of gear if shift linkage is out of adjustment.

---

1. Is transfer case shift linkage free from worn, loose, missing, or damaged parts?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer case shift cable clean</td>
<td>Faulty transfer case shift linkage</td>
</tr>
<tr>
<td>Transfer case shift linkage adjustment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace shift linkage (para 9-2).</td>
<td>Transfer case may not shift or may slip out of gear if shift linkage has loose, missing, or damaged parts.</td>
</tr>
</tbody>
</table>

---

2. Is transfer case shift linkage properly adjusted?

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer case shift linkage OK</td>
<td>Transfer case shift linkage adjustment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjust shift linkage (para 9-2).</td>
<td>Transfer case may not shift or may slip out of gear if shift linkage is out of adjustment.</td>
</tr>
</tbody>
</table>

Fault not corrected. Notify supervisor.
Check transfer case shift linkage for worn, loose, missing, or damaged parts.

Refer to para 9-2 to adjust transfer case shift linkage.
g3. TRANSFER CASE OVERHEATS (T-CASE TEMP GAGE CONTINUOUSLY READS OVER 250 °F (121 °C))

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

START

1. Are transfer case oil lines or fittings leaking or damaged?

   - NO
     - Replace damaged oil line(s) and/or fitting(s) (para 9–4).
   - YES

2. Is transfer case oil level low?

   - NO
   - YES

---

TEST OPTIONS

- Visual inspection

REASON FOR QUESTION

- Leaking or damaged oil lines may cause low oil level and lead to transfer case overheating.

---

TEST OPTIONS

- Transfer Case Oil Level Check

REASON FOR QUESTION

- Low oil level may cause transfer case to overheat.
**CAUTION**
Transfer case oil must be changed whenever there is evidence of oil breakdown or contamination. Oil breakdown or contamination may be caused from overheating transfer case and is indicated by discoloration, strong odor, or oil analysis.

Check transfer case oil lines and fittings for leakage and damage.

---

**TRANSFER CASE OIL LEVEL CHECK**

1. Turn engine off and chock wheels (TM 9-2320-360-10).
2. Place suitable container under transmission drain plug.
3. Remove oil level plug from transfer case.
4. Inspect oil for contaminants.
5. Change oil (LO 9-2320-360-12) if required.
6. Install oil level plug on transfer case.
g3. TRANSFER CASE OVERHEATS (T-CASE TEMP GAGE CONTINUOUSLY READS OVER 250 °F (121 °C)) (CONT)

**KNOWN INFO**
Transfer case oil lines and fittings are not damaged.
Transfer case oil level OK

**POSSIBLE PROBLEMS**
Faulty transfer case oil pump
Transfer case oil contamination

---

**KNOWN INFO**
Transfer case oil lines and fittings are not damaged.
Transfer case oil level OK
Transfer case oil pump OK

**POSSIBLE PROBLEMS**
Transfer case oil contamination

---

3. **Is transfer case oil pump mounting secure?**

- **NO** Notify supervisor.
- **YES**

---

4. **Is transfer case oil free from contamination (dirt, dark, or milky oil)?**

- **NO** Change oil (LO 9-2320-360-12)
- **YES**

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Damaged pump or loose pump mounting may cause transfer case to overheat.

**TEST OPTIONS**
Transfer Case Oil Drain/Check/Refill

**REASON FOR QUESTION**
Oil will lose lubricating qualities if contaminated and may cause transfer case to overheat.

Go to electrical troubleshooting (E5, ELECTRIC GAGE DOES NOT OPERATE OR IS INACCURATE) to check gage operation.
Check transfer case oil pump for damage, and for loose or missing mounting hardware.

---

**TRANSFER CASE OIL DRAIN/CHECK/REFILL**

1. Place clean suitable container under transfer case drain plug.

   **NOTE**
   
   Transfer case fluid capacity is 5 qts (4 L).

2. Remove drain plug from transfer case and allow approximately 1 qt (0.9 L) of oil to drain into container.

3. Install drain plug on transfer case.

4. Inspect oil for contaminants.

5. Add oil that was removed to transfer case if it is not contaminated.
g4. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS POSITIONED TO LOW

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**
- Circuit breakers OK
- Air pressure over 65 psi (448 kPa)

**POSSIBLE PROBLEMS**
- Faulty transfer case shift linkage
- Transfer case shift linkage adjustment
- Internal damage to transfer case
- Lockout shift chamber hose connections loose or damaged
- Faulty transfer case lockup air chamber

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Transfer case may not shift or may slip out of gear if shift linkage has loose, missing, or damaged parts.

---

**KNOWN INFO**
- Circuit breakers OK
- Air pressure over 65 psi (448 kPa)
- Transfer case shift linkage OK

**POSSIBLE PROBLEMS**
- Transfer case shift linkage adjustment
- Internal damage to transfer case
- Lockout shift chamber hose connections loose or damaged
- Faulty transfer case lockup air chamber

---

**TEST OPTIONS**
- Refer to two-speed shift linkage adjustment/replacement procedure (para 9-2).

**REASON FOR QUESTION**
- Transfer case may not engage front axle if shift linkage is out of adjustment.
Check transfer case shift linkage for worn, loose, missing, or damaged parts.

NOTE
Perform Air System Troubleshooting before starting steps given below.

Refer to para 9-2 to adjust transfer case shift linkage.
g4. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS POSITIONED TO LOW

**KNOWN INFO**
- Circuit breakers OK
- Air pressure over 65 psi (448 kPa)
- Transfer case shift linkage OK

**POSSIBLE PROBLEMS**
- Internal damage to transfer case
- Lockout shift chamber hose connections loose or damaged
- Faulty transfer case lockup air chamber

---

**3.** Does the ALL WHEEL DRIVE indicator come on when the transfer case shift lever is moved to LOW position?

- **NO**
- **YES**

  **REASON FOR QUESTION**
  - Go to Air System Troubleshooting (k12, Transfer case does not engage front axle when transfer case shift lever is positioned to LOW).

---

**KNOWN INFO**
- Circuit breakers OK
- Air pressure over 65 psi (448 kPa)
- Transfer case shift linkage OK
- Transfer case OK

**POSSIBLE PROBLEMS**
- Lockout shift chamber hose connections loose or damaged
- Faulty transfer case lockup air chamber

---

**4.** Are hose connections on transfer case lockout shift chamber secure and free from damage?

- **NO**
  - Tighten loose hose connections (para 11–40).
- **YES**

  **REASON FOR QUESTION**
  - Transfer case may not engage front axle if hose connections are loose or damaged.

---

**KNOWN INFO**
- Circuit breakers OK
- Air pressure over 65 psi (448 kPa)
- Transfer case shift linkage OK
- Transfer case OK
- Lockout shift chamber hose connections OK

**POSSIBLE PROBLEMS**
- Faulty transfer case lockup air chamber

---

**5.** Is lockout shift chamber operating properly?

- **NO**
  - Replace lockout shift chamber if faulty (para 9–8).
- **YES**

  **REASON FOR QUESTION**
  - Transfer case may not engage front axle if lockout shift chamber is faulty or damaged.

---

**FAULT NOT CORRECTED. NOTIFY SUPERVISOR.**
(1) Turn engine switch to ON position (TM 9-2320-360-10).
(2) Move transfer case shift lever to LOW position (TM 9-2320-360-10), and observe light.
(3) Turn engine switch to OFF position (TM 9-2320-360-10).

Check transfer case lockout shift chamber for loose hose connections and damage.

**LOCKOUT SHIFT CHAMBER TEST**

1. Remove lockout shift chamber (para 9-8).
2. Apply air pressure to inlet port.
3. Chamber is good if rod moves when air pressure is applied.
g5. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS IN HIGH POSITION, AND DRIVELINE CONTROL IS POSITIONED TO LOCK

INITIAL SETUP

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
</tr>
</thead>
</table>

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
If the ALL WHEEL DRIVE indicator comes on, control circuit is working properly. Problem is with transfer case.

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Transfer case may not engage front axle hose connections are loose or damaged.

**KNOWN INFO**
Circuit breakers OK
Air pressure over 65 psi (448 kPa)

**POSSIBLE PROBLEMS**
Internal damage to transfer case
Loose or damaged transfer case lockout shift chamber hose connections
Faulty lockout shift chamber

---

**1.**
Does the ALL WHEEL DRIVE indicator come on when the drive line control is positioned to lock?

**TEST OPTIONS**

**REASON FOR QUESTION**
Go to Air System Troubleshooting (k13, Transfer case does not engage front axle when transfer case shift lever is positioned to HIGH and driveline control is positioned to LOCK).

**KNOWN INFO**
Circuit breakers OK
Air pressure over 65 psi (448 kPa)
Transfer case OK

**POSSIBLE PROBLEMS**
Loose or damaged transfer case lockout shift chamber hose connections
Faulty lockout shift chamber

---

**2.**
Are hose connections on transfer case lockout shift chamber secure and free from damage?

**TEST OPTIONS**

**REASON FOR QUESTION**
Tighten loose hose connections (para 11-40).
(1) Turn engine switch to ON position (TM 9-2320-360-10).
(2) Move driveline control valve to LOCK position (TM 9-2320-360-10), and observe light.
(3) Turn engine switch to OFF position (TM 9-2320-360-10).

Check transfer case lockout shift chamber for loose hose connections and damage.
g5. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS IN HIGH POSITION, AND DRIVELINE CONTROL IS POSITIONED TO LOCK (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breakers OK</td>
<td>Lockout Shift Chamber Test</td>
<td>Transfer case may not engage front axle if lockout shift chamber is faulty or damaged.</td>
</tr>
<tr>
<td>Air pressure over 65 psi (448 kPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer case OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer case lockout shift chamber hose connections OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty lockout shift chamber</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3.** Is lockout shift chamber operating properly?

- **NO** Replace lockout shift chamber if faulty (para 9-8).
- **YES** Fault not corrected. Notify supervisor.
**LOCKOUT SHIFT CHAMBER TEST**

1. Remove lockout shift chamber (para 9-8).
2. Apply air pressure to inlet port.
3. Lockout shift chamber is good if rod moves when air pressure is applied.

---

**Diagram:**

- **LOCKOUT SHIFT CHAMBER**
- **INLET PORT**
h. PROPELLER SHAFTS AND UNIVERSAL JOINTS

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
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<tr>
<td>h2. Propeller shafts do not supply torque to axles or hydraulic pump.</td>
<td>2–680</td>
</tr>
</tbody>
</table>
h1. PROPELLE R SHAFTS OR UNIVERSAL JOINTS UNUSUALLY NOISY WHEN OPERATING

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**
- Nothing

**POSSIBLE PROBLEMS**
- Propeller shafts require lubrication
- Loose propeller shaft(s) lockstrap screws and bearing strap cap screws
- Worn universal joints
- Faulty propeller shafts (external damage)
- Faulty propeller shaft slip joints

---

**KNOWN INFO**
- Propeller shafts adequately lubricated.

**POSSIBLE PROBLEMS**
- Loose propeller shaft(s) lockstrap screws and bearing strap cap screws
- Worn universal joints
- Faulty propeller shafts (external damage)
- Faulty propeller shaft slip joints

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Propeller shafts may operate unusually noisy if not adequately lubricated.

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Propeller shafts may operate unusually noisy if lockstrap screws or bearing strap cap screws are loose.
Refer to LO 9-2320-360-12 to lubricate propeller shafts.

Check propeller shaft(s) lockstrap screws and bearing strap cap screws for looseness. Tighten all screws to proper torque value.

Table 2-10. Torque Requirements

<table>
<thead>
<tr>
<th>Lockstrap Screw Torque Requirements</th>
<th>Torque Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propeller Shaft</td>
<td></td>
</tr>
<tr>
<td>Transmission to Transfer Case</td>
<td>32–42 lb. ft. (43–57 N·m)</td>
</tr>
<tr>
<td>Transfer Case to #1 Axle</td>
<td>17–24 lb. ft. (23–33 N·m)</td>
</tr>
<tr>
<td>Transfer Case to #2 Axle</td>
<td>32–42 lb. ft. (43–57 N·m)</td>
</tr>
<tr>
<td>#2 Axle to #3 Axle</td>
<td>32–42 lb. ft. (43–57 N·m)</td>
</tr>
<tr>
<td>#3 Axle to #4 Axle</td>
<td>17–24 lb. ft. (23–33 N·m)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bearing Strap Cap Screw Torque Requirements</th>
<th>Torque Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propeller Shaft</td>
<td></td>
</tr>
<tr>
<td>Transmission to Transfer Case</td>
<td>130–135 lb. ft. (176–183 N·m)</td>
</tr>
<tr>
<td>Transfer Case to #1 Axle</td>
<td>55–60 lb. ft. (75–81 N·m)</td>
</tr>
<tr>
<td>Transfer Case to #2 Axle</td>
<td>130–135 lb. ft. (176–183 N·m)</td>
</tr>
<tr>
<td>#2 Axle to #3 Axle</td>
<td>130–135 lb. ft. (176–183 N·m)</td>
</tr>
<tr>
<td>#3 Axle to #4 Axle</td>
<td>55–60 lb. ft. (75–81 N·m)</td>
</tr>
</tbody>
</table>
h1. PROPELLER SHAFTS OR UNIVERSAL JOINTS UNUSUALLY NOISY WHEN OPERATING (CONT)

### Known Info
- Propeller shafts adequately lubricated.
- Lockstrap screws and bearing strap cap screws are tight.
- Universal joints not loose
- Propeller shafts OK

### Possible Problems
- Faulty propeller shaft slip joints

### Test Options
- Visual inspection

### Reason for Question
- Propeller shafts may operate unusually noisy if there is movement at universal joints.

---

#### 3. Are universal joints free from excessive movement?

- **NO**
  - Replace universal joint(s) (para 10-2).

- **YES**
  - Replace universal joint(s) (para 10-2).

---

#### 4. Are propeller shafts free from damage?

- **NO**
  - Replace propeller shaft(s) (para 10-2).

- **YES**
  - Replace propeller shaft(s) (para 10-2).

---

#### 5. Are propeller shaft slip joints or splines free from excessive wear?

- **NO**
  - Replace propeller shaft(s) (para 10-2).

- **YES**
  - Fault not corrected. Notify supervisor.

---

### Possible Problems
- Worn universal joints
- Faulty propeller shafts (external damage)
- Faulty propeller shaft slip joints

### Reason for Question
- Propeller shafts may operate unusually noisy if there is movement at universal joints.
- Propeller shafts may operate unusually noisy if damaged.
- Propeller shafts may operate unusually noisy if slip joints or splines are excessively worn.
Check propeller shafts for excessive movement at universal joints. Any movement may indicate worn universal joints.

Check propeller shafts for damaged splined shaft, bent tubing, or missing balance weights.

Inspect slip yoke for broken, damaged, or missing teeth. Check universal joint cross for wear.
h2. PROPELLER SHAFTS DO NOT SUPPLY TORQUE TO AXLES OR HYDRAULIC PUMP

<table>
<thead>
<tr>
<th>INITIAL SETUP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment Conditions</strong></td>
</tr>
<tr>
<td>Engine shut off (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>Parking brake on (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>Wheels chocked.</td>
</tr>
</tbody>
</table>

![Decision Tree Diagram](image)

**Known Info**
- Nothing

**Possible Problems**
- Faulty propeller shafts and universal joints (external damage)

**Test Options**
- Visual inspection

**Reason for Question**
- Propeller shafts may not supply torque to axles or hydraulic pump if damaged.

**Flowchart:**
1. Are propeller shafts or universal joints free from damage?
   - **Yes**: Fault not corrected. Notify supervisor.
   - **No**: Repair propeller shafts (para 10-2).

START
Check propeller shafts for damaged splined shaft or bent tubing.
## i. POWER TAKEOFF (PTO)

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure</th>
<th>Page</th>
</tr>
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<tbody>
<tr>
<td>i1. PTO does not engage</td>
<td>2-684</td>
<td></td>
</tr>
<tr>
<td>i2. PTO makes excessive or unusual noise during operation</td>
<td>2-694</td>
<td></td>
</tr>
<tr>
<td>i3. PTO indicator does not light when PTO is engaged</td>
<td>2-696</td>
<td></td>
</tr>
</tbody>
</table>
1. PTO DOES NOT ENGAGE

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- Pan, Oil Drain (Item 26, Appendix F)

KNOWLEDGE INFO

Is the PTO indicator light OFF when the PTO is engaged?

If indicator lights, notify supervisor.

1.

KNOWLEDGE INFO

Are 22-28 volts measured on wire no. 1719C at PTO solenoid?

If no, go to step 5.

2.

TEST OPTIONS

- Visual inspection

REASON FOR QUESTION

- It is likely that PTO is faulty if PTO indicator illuminates, but PTO does not engage.

TEST OPTIONS

- PTO Solenoid Valve Test
  - or
  - STE/ICE-R Test #89

REASON FOR QUESTION

- PTO solenoid valve control devices may be faulty or wires may be loose or damaged if low voltage is measured.
WARNING

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

CAUTION

Batteries must be disconnected before tightening any connections. Failure to comply may result in damaged equipment.

NOTE

- Transmission range selector must be positioned to N (neutral) and PARKING BRAKE control pulled out before PTO will engage. If engine starts in neutral and reverse lights operate, neutral safety interlock circuit is operating properly.
- Engine must be running and PTO control switch placed in the ON position to perform this test.

Check if PTO indicator lights.

PTO SOLENOID VALVE TEST

NOTE

Engine must be running and PTO control switch placed in the on position to perform this test.

1. Place positive (+) probe of multimeter on no. 1719C wire at PTO solenoid valve.
2. Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
i1. PTO DOES NOT ENGAGE (CONT)

---

**KNOWN INFO**
Engine starts in neutral
Main and aux winches inoperative
PTO assembly OK
Circuit breaker OK
Wires no. 1719 and 1739 OK
Wire no. 1871 OK
PTO HI IDLE relay OK
Wire no. 1458 OK
Wire no. 1719A OK
PTO control switch OK
Wire no. 1719B OK
Parking brake pressure switch OK
Wire no. 1719C OK

---

**POSSIBLE PROBLEMS**
Wire no. 1435 loose or damaged
Faulty PTO solenoid
Plugged PTO solenoid screen adapter

---

**WARNING**
Read WARNING on following page.

---

3. Is ground wire no. 1435 from PTO solenoid valve secure and free from damage?

- **NO**
  - Secure loose connections. Notify supervisor if damaged wiring is found.

- **YES**
  - Replace PTO solenoid (para 7-73).

---

**TEST OPTIONS**
Visual inspection
or
Continuity Test
or
STE/ICE-R Test #91

---

**REASON FOR QUESTION**
PTO will not engage if ground wire no. 1435 from PTO solenoid valve is loose or damaged.

---

**KNOWN INFO**
Engine starts in neutral
Main and aux winches inoperative
PTO assembly OK
Circuit breaker OK
Wires no. 1719 and 1739 OK
Wire no. 1871 OK
PTO HI IDLE relay OK
Wire no. 1458 OK
Wire no. 1719A OK
PTO control switch OK
Wire no. 1719B OK
Parking brake pressure switch OK
Wire no. 1719C OK
Wire no. 1435 OK

---

**POSSIBLE PROBLEMS**
Faulty PTO solenoid
Plugged PTO solenoid screen adapter

---

4. Is the screen adapter at the PTO adapter restricted or plugged?

- **NO**
  - Replace PTO solenoid (para 7-73).

- **YES**
  - Replace screen adapter (para 7-73).

---

**TEST OPTIONS**
Screen Adapter Check

---

**REASON FOR QUESTION**
Oil supply to PTO solenoid must pass through screen adapter. If screen adapter is plugged, PTO cannot engage. If screen adapter is OK, PTO solenoid is faulty.

---

**KNOWN INFO**
Engine starts in neutral
Main and aux winches inoperative
PTO assembly OK

---

**POSSIBLE PROBLEMS**
Faulty circuit breaker
Wires no. 1719 and 1739 loose or damaged
Wire no. 1871 loose or damaged
Faulty PTO HI IDLE relay
Wire no. 1458 loose or damaged
Wire no. 1719A loose or damaged
Faulty PTO control switch
Wire no. 1719B loose or damaged
Faulty parking brake pressure switch
Wire no. 1719C loose or damaged

---

5. Are 22-28 volts measured on wire no. 1719A at PTO control switch?

- **NO**
  - Go to step 9.

- **YES**
  - Wire No. 1719A Voltage Test
  or
  STE/ICE-R Test #89

---

**REASON FOR QUESTION**
PTO control switch will not operate if low voltage is measured.
WARNING

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

Check ground wire no. 1435 from PTO solenoid valve for loose connections, damage, and continuity.

### CONTINUITY TEST

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

#### NOTE

A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

#### NOTE

A reading of other than infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.

### SCREEN ADAPTER CHECK

1. Place drain pan under PTO solenoid.
2. Remove hose no. 2851 from screen adapter.
3. Remove screen adapter from elbow.
4. Inspect screen adapter for restriction, foreign material or damage.

#### NOTE

If screen adapter is OK, do not perform steps (5) and (6).

5. Install screen adapter on elbow.
6. Install hose no. 2851 on screen adapter.

### WIRE NO. 1719A VOLTAGE TEST

#### NOTE

Engine must be running to perform this test.

1. Place positive (+) probe of multimeter on wire no. 1719A at PTO control switch.
2. Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.
i1. PTO DOES NOT ENGAGE (CONT)

**KNOWN INFO**
- Engine starts in neutral
- Main and aux winches inoperative
- PTO assembly OK
- Circuit breaker OK
- Wires no. 1719 and 1739 OK
- Wire no. 1871 OK
- PTO HI IDLE relay OK
- Wire no. 1458 OK
- Wire no. 1719A OK

**POSSIBLE PROBLEMS**
- Faulty PTO control switch
- Wire no. 1719B loose or damaged
- Faulty parking brake pressure switch
- Wire no. 1719C loose or damaged

**WARNING**
Read WARNING on following page.

**6.**
Are 22-28 volts measured on wire no. 1719B at PTO control switch?

**TEST OPTIONS**
- PTO Control Switch Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Pto will not engage if low voltage is measured on wire no. 1719B at PTO control switch. (PTO control switch defective.)

**7.**
Are 22-28 volts measured on wire no. 1719B at parking brake pressure switch?

**TEST OPTIONS**
- Wire No. 1719B Voltage Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Wire no. 1719B is loose or damaged if 22-28 volts are measured.

**8.**
Are 22-28 volts measured on wire no. 1719C at parking brake pressure switch?

**TEST OPTIONS**
- Parking Brake Pressure Switch Test

**REASON FOR QUESTION**
PTO will not engaged if low voltage is measured on wire no. 1719C at parking brake pressure switch. (Parking brake pressure switch defective). Wire no. 1719C is loose or damaged if 22-28 volts are measured.
WARNING

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

PTO CONTROL SWITCH TEST

NOTE
Engine must be running and PTO control switch placed in the ON position to perform this test.

(1) Place positive (+) probe of multimeter on no. 1719B wire at PTO control switch.

(2) Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.

WIRE NO 1719B VOLTAGE TEST

NOTE
Engine must be running and PTO control switch placed in the ON position to perform this test.

(1) Place positive (+) probe of multimeter on wire no. 1719B at parking brake pressure switch.

(2) Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.

PARKING BRAKE PRESSURE SWITCH TEST

NOTE
Engine must be running and PTO control switch placed in the ON position to perform this test.

(1) Place positive (+) probe of multimeter on wire no. 1719C at parking brake pressure switch.

(2) Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.
i1. PTO DOES NOT ENGAGE (CONT)

**KNOWN INFO**
Engine starts in neutral
Main and aux winches inoperative
PTO assembly OK

**POSSIBLE PROBLEMS**
Faulty circuit breaker
Wires no. 1719 and 1739 loose or damaged
Wire no. 1871 loose or damaged
Faulty PTO HI IDLE relay
Wire no. 1458 loose or damaged
Wire no. 1719A loose or damaged

**TEST OPTIONS**
Wire No. 1719 Voltage Test
or
STE/ICE-R Test #89

**REASON FOR QUESTION**
WINCH SYSTEM/PTO HI IDLE/AIR DRYERS GPFU circuit breaker is faulty or wires no. 1739 and 1719 are loose or damaged if low voltage is measured.

**TEST OPTIONS**
Hi Idle Relay Test
or
STE/ICE-R Test #89

**REASON FOR QUESTION**
Pto will not engage if low voltage is measured on wire no. 1719A at PTO HI IDLE relay. (PTO HI IDLE relay defective.) Wire no. 1719A is loose or damaged if 22-28 volts are measured.

**KNOWN INFO**
Engine starts in neutral
Main and aux winches inoperative
PTO assembly OK
Wires no. 1719 and 1739 OK

**POSSIBLE PROBLEMS**
Wire no. 1871 loose or damaged
Faulty PTO HI IDLE relay
Wire no. 1458 loose or damaged
Wire no. 1719A loose or damaged

**TEST OPTIONS**
Circuit Breaker Test

**REASON FOR QUESTION**
PTO will not operate if low voltage is present at lower terminal of WINCH SYSTEM/PTO HI IDLE/AIR DRYERS GPFU circuit breaker. PTO will not engage if wires no. 1719A and 1739 are loose or damaged.

---

**9.**
Are 22-28 volts measured on wire no. 1719 at PTO HI IDLE relay?

**P1.**
Are 22-28 volts measured on wire no. 1719A at PTO HI IDLE relay?

**11.**
Are 22-28 volts present at WINCH SYSTEM/PTO HI IDLE/AIR DRYERS GPFU circuit breaker?

NO
Go to step 11.

YES

NO
Secure loose connections. Notify supervisor if damaged wiring is found.

YES
Replace circuit breaker (para 7-12).

Secure loose connections. Notify supervisor if damaged wiring is found.
**WARNING**

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.

* Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

### WIRE NO. 1719 VOLTAGE TEST

**NOTE**

Engine must be running and PTO control switch placed in the on position to perform this test.

1. Place positive (+) probe of multimeter on no. 1719 wire at P.T.O. HI IDLE relay.
2. Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.

### PTO HI IDLE RELAY TEST

**NOTE**

Engine must be running and PTO control switch placed in the on position to perform this test.

1. Place positive (+) probe of multimeter on no. 1719A wire at P.T.O. HI IDLE relay.
2. Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.

### CIRCUIT BREAKER TEST

1. Remove eight screws and panel from console.
2. Turn ENGINE switch to ON position.
3. Place positive (+) probe of multimeter on lower terminal of circuit breaker.
4. Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.
5. Turn ENGINE switch to OFF position.
i1. PTO DOES NOT ENGAGE (CONT)

**KNOWN INFO**
- Engine starts in neutral
- Main and aux winches inoperative
- PTO assembly OK
- Circuit breaker OK
- Wires no. 1719 and 1739 OK

**POSSIBLE PROBLEMS**
- Wire no. 1871 loose or damaged
- Faulty PTO HI IDLE relay
- Wire no. 1458 loose or damaged

**12.**

**WARNING**
Read WARNING on following page.

### Are 10-14 volts measured on wire no. 1871 at PTO HI IDLE relay?

**YES**
- Secure loose connections. Notify supervisor if damaged wiring is found.

**NO**
- Wire No. 1871 Voltage Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- Wire no. 1871 is loose or damaged if low voltage is measured.

**KNOWN INFO**
- Engine starts in neutral
- Main and aux winches inoperative
- PTO assembly OK
- Circuit breaker OK
- Wires no. 1719 and 1739 OK
- Wire no. 1871 OK

**POSSIBLE PROBLEMS**
- Faulty PTO HI IDLE relay
- Wire no. 1458 loose or damaged

**13.**

### Are 10-14 volts measured on wire no. 1458 at PTO HI IDLE relay?

**YES**
- Secure loose connections. Notify supervisor if damaged wiring is found.

**NO**
- Replace PTO HI IDLE relay (para 7-27).

**TEST OPTIONS**
- PTO Hi Idle Relay Test or STE/ICE-R Test #89

**REASON FOR QUESTION**
- PTO HI IDLE relay is faulty if low voltage is measured. Wire no. 1458 is loose or damaged if 10-14 volts are measured.
**WARNING**

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

<table>
<thead>
<tr>
<th>WIRE NO. 1871 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>Engine must be running and PTO control switch placed in the on position to perform this test.</td>
</tr>
<tr>
<td>(1) Place positive (+) probe of multimeter on no. 1871 wire at P.T.O. HI IDLE relay.</td>
</tr>
<tr>
<td>(2) Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PTO HI IDLE RELAY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>Engine must be running and PTO control switch placed in the on position to perform this test.</td>
</tr>
<tr>
<td>(1) Place positive (+) probe of multimeter on no. 1458 wire at P.T.O. HI IDLE relay.</td>
</tr>
<tr>
<td>(2) Place negative (-) probe of multimeter on ground and look for 22-28 volts on multimeter.</td>
</tr>
</tbody>
</table>
i2. PTO MAKES EXCESSIVE OR UNUSUAL NOISE DURING OPERATION

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**

1. Is transmission oil level at proper level?

- **POSSIBLE PROBLEMS**
  - Low transmission oil level
  - Damaged PTO oil lines or fittings

  - **TEST OPTIONS**
    - Visual inspection

  - **REASON FOR QUESTION**
    - Low oil level may cause PTO to operate unusually noisy.

2. Are PTO oil lines and fittings free from leaks or damage?

- **POSSIBLE PROBLEMS**
  - Damaged PTO oil lines or fittings

  - **TEST OPTIONS**
    - Visual inspection

  - **REASON FOR QUESTION**
    - Leaking or damaged oil lines may cause low oil level and lead to unusually noisy PTO operation.

---

**Known Info**

- Transmission oil level OK

**Possible Problems**

- Fault not corrected. Notify supervisor.
With engine running and transmission in neutral (N), check transmission fluid level on dipstick.

a. If transmission fluid temperature is below 160°F (71°C), fluid level should be within COLD RUN area.

b. If transmission fluid temperature is above 160°F (71°C), fluid level should be within HOT RUN area.

Check PTO oil lines and fittings for leakage and damage.
1. **WARNING**
Read WARNING on following page.

**Is PTO shaft turning?**

[Flowchart diagram showing decision points and test options]

**KNOWLEDGE INFO**
Engine starts in neutral

**POSSIBLE PROBLEMS**
- PTO not engaged
- Faulty PTO indicator bulb
- Loose or damaged wire connections
- Faulty PTO oil pressure sending unit

**TEST OPTIONS**
PTO Shaft Test

**REASON FOR QUESTION**
PTO indicator will not light if PTO is not engaged.

---

2. **Is PTO indicator bulb OK?**

[Flowchart diagram showing decision points and test options]

**KNOWLEDGE INFO**
PTO shaft turns

**POSSIBLE PROBLEMS**
- Faulty PTO indicator bulb
- Loose or damaged wire connections
- Faulty PTO oil pressure sending unit

**TEST OPTIONS**
- Visual inspection
- Bulb Test

**REASON FOR QUESTION**
PTO indicator will not light if bulb is burned out. Resistance of 20 ohms or less indicates bulb is OK.
**WARNING**
Stay clear of moving parts. Failure to comply may result in injury or death to personnel.

**NOTE**
Transmission range selector must be positioned to N (neutral) and PARKING BRAKE control pulled out before PTO will engage. If engine starts in neutral and reverse lights operate, neutral safety interlock circuit is operating properly.

### PTO SHAFT TEST

1. Start engine (TM 9-2320-360-10).
2. Press PTO switch to ON position.
3. Check if PTO propeller shaft is turning.

### BULB TEST

1. Turn engine switch to OFF position.
2. Remove PTO indicator bulb (para 7-40).
3. Read resistance between terminals of bulb.
i3. PTO INDICATOR DOES NOT LIGHT WHEN PTO IS ENGAGED (CONT)

**KNOWN INFO**
PTO shaft turns  
PTO indicator bulb OK  
PTO oil pressure sending unit OK  

**POSSIBLE PROBLEMS**  
Loose or damaged wire connections  
Faulty PTO oil pressure sending unit

---

3. Does PTO indicator light come on with jumper wire installed in connector?

- **YES**
  - Go to step 4.
  - Replace PTO oil pressure sending unit (para 7-74).

- **NO**
  - NO

---

**TEST OPTIONS**
PTO Oil Pressure Sending Unit Test

**REASON FOR QUESTION**
PTO oil pressure sending unit is defective if light comes on with switch bypassed.

---

4. Is ground wire no. 1435 from PTO oil pressure sending unit secure and free from damage?

- **YES**
  - Secure loose connections. Repair damaged wire.

- **NO**
  - NO

---

**TEST OPTIONS**
Visual inspection  
or  
Continuity Test  
or  
STE/ICE-R Test #91

**REASON FOR QUESTION**
PTO indicator will not light if ground wire no. 1435 from PTO oil pressure switch is loose or damaged.

---

5. Is wire no. 1276 from GAUGES WARN LTS. circuit breaker to PTO indicator secure and free from damage?

- **YES**
  - Secure loose connections. Notify supervisor if damaged wiring is found.

- **NO**
  - NO

---

**TEST OPTIONS**
Visual inspection  
or  
Continuity Test  
or  
STE/ICE-R Test #91

**REASON FOR QUESTION**
PTO indicator will not light if wire no. 1276 from GAUGES WARN LTS. circuit breaker to PTO indicator is loose or damaged.
WARNING

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
* Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

CAUTION

Batteries must be disconnected before tightening any connections. Failure to comply may result in damaged equipment.

PTO OIL PRESSURE SENDING UNIT TEST

(1) Remove connector from PTO oil pressure sending unit.
(2) Install jumper wire between pins on PTO connector.
(3) Turn engine switch to ON position and observe light.
(4) Turn engine switch to OFF position.
(5) Install connector on PTO oil pressure sending unit.

Check ground wire no. 1435 from PTO oil pressure sending unit for loose connections, damage, and continuity.

CONTINUITY TEST

(1) Disconnect wiring from components at each end of wire.
(2) Set multimeter to ohms position.
(3) Connect multimeter leads to each end of wire and check multimeter for continuity.
(4) Remove multimeter lead from one end of wire and connect to chassis ground.

Check wire no. 1276 from GAUGES WARN LTS, circuit breaker to PTO indicator for loose connections, damage, and continuity.
i3. PTO INDICATOR DOES NOT LIGHT WHEN PTO IS ENGAGED (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTO shaft turns</td>
</tr>
<tr>
<td>PTO indicator bulb OK</td>
</tr>
<tr>
<td>PTO oil pressure sending unit OK</td>
</tr>
<tr>
<td>Wire no. 1276 OK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose or damaged wire connections</td>
</tr>
</tbody>
</table>

6. Is wire no. 1129 from PTO indicator to PTO oil pressure sending unit secure and free from damage?

- YES
  - Secure loose connections. Notify supervisor if damaged wiring is found.

- NO
  - Fault not corrected. Notify supervisor.

WARNING
Read WARNING and CAUTION on following page.

CAUTION

TEST OPTIONS
- Visual inspection
  - or
- Continuity Test
  - or
- STE/CE-P Test #91

REASON FOR QUESTION
PTO indicator will not light if wire no. 1129 from PTO indicator to PTO oil pressure sending unit is loose or damaged.
WARNING

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.

* Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry contacts electrical terminals a direct short may result in an instant heating of tools, damage to equipment, and injury to personnel.

CAUTION

Batteries must be disconnected before tightening any connections. Failure to comply may result in damaged equipment.

Check wire no. 1129 from PTO indicator to PTO oil pressure sending unit for loose connections or damage.

CONTINUITY TEST

(1) Disconnect wiring from components at each end of wire.

(2) Set multimeter to ohms position.

NOTE
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE
A reading of other than infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.
Brake Air Hose Diagram (sheet 1 of 2)
### j. AIR BRAKE SYSTEM

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>j1. Spring brake(s) will not release</td>
<td>2–706</td>
</tr>
<tr>
<td>j2. Service brake(s) will not respond properly</td>
<td>2–712</td>
</tr>
<tr>
<td>j3. Uneven braking (pulling)</td>
<td>2–714</td>
</tr>
<tr>
<td>j4. Service brake(s) fail to release/release slowly</td>
<td>2–718</td>
</tr>
<tr>
<td>j5. Service brake(s) grabbing</td>
<td>2–722</td>
</tr>
<tr>
<td>j6. Excessive loss of air pressure when braking</td>
<td>2–724</td>
</tr>
<tr>
<td>j7. Brake(s) overheat</td>
<td>2–728</td>
</tr>
<tr>
<td>j8. Spring brakes will not apply</td>
<td>2–732</td>
</tr>
<tr>
<td>j9. Automatic slack adjuster does not operate</td>
<td>2–736</td>
</tr>
</tbody>
</table>
j1. SPRING BRAKE(S) WILL NOT RELEASE

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Materials/Parts**
- Pin, Cotter (Item 155, Appendix G)

**Personnel Required**
- Two

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**
- Nothing

**POSSIBLE PROBLEMS**
- Loose or damaged air line
- Spring brake chamber
- Spring brake relay valve
- Parking brake valve
- Spring brake valve
- Cam shaft binding
- Brakes out of adjustment

---

**TEST OPTIONS**
- Visual inspection
- Audible inspection

**REASON FOR QUESTION**
- Loose or damaged air lines will cause the brakes to operate improperly or fail due to a lack of sufficient air pressure.

---

**KNOWN INFO**
- Brake system air lines OK

**POSSIBLE PROBLEMS**
- Spring brake chamber
- Spring brake relay valve
- Parking brake valve
- Spring brake control valve
- Cam shaft binding
- Brakes out of adjustment

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Only one spring brake chamber which fails to release indicates faulty brake chamber. Slack adjusters should move toward brake chambers when brakes are released.
NOTE
Air system pressure must be in the 90-125 psi operating range to begin brake system troubleshooting. If the air pressure cannot be maintained within operating range proceed to AIR SYSTEM TROUBLESHOOTING.

WARNING
When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

Push in parking valve while assistant observes spring brake chambers.

WARNING
Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury.
j1. SPRING BRAKE(S) WILL NOT RELEASE (CONT)

3. Do both spring brake chambers on axle no. 2 operate properly?
   - **YES**
   - **NO** Replace axle no. 2 spring brake relay valve (para 11-12).

4. Do all four spring brake chambers on axle no. 3 and no. 4 operate properly?
   - **YES**
   - **NO** Replace axle no. 3 and no. 4 spring brake relay valve (para 11-13).

5. Is air pressure present at parking brake discharge port?
   - **YES**
   - **NO** Replace parking brake valve (para 11-17).

**WARNING** Read WARNING on following page.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Both spring brake chambers on axle no. 2 failing to release indicates faulty axle no. 2 spring brake relay valve. Slack adjusters should move toward brake chambers when brakes are released.
- Four brake chambers on axles no. 3 and no. 4 failing to release indicates faulty axle no. 3 and no. 4 spring brake relay. Slack adjusters should move toward brake chambers when brakes are released.

**KNOWN INFO**
- Brake system air lines OK
- Spring brake chambers OK
- Spring brake relay valve
- Parking brake valve
- Spring brake control valve
- Cam shaft binding
- Brakes out of adjustment

**POSSIBLE PROBLEMS**
- Parking brake valve
- Spring brake control valve
- Cam shaft binding
- Brakes out of adjustment

**TEST OPTIONS**
- Parking Brake Valve Test

**REASON FOR QUESTION**
- No air pressure present at discharge port indicates faulty parking brake valve.
WARNING
When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

Push in parking valve while assistant observes spring brake chambers.

---

<table>
<thead>
<tr>
<th>PARKING BRAKE VALVE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Push in parking brake valve (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>(2) Loosen hose no. 2612 on parking brake valve and check for air escaping.</td>
</tr>
<tr>
<td>(3) Tighten hose no. 2612 on parking brake valve.</td>
</tr>
<tr>
<td>(4) Pull out parking brake valve (TM 9-2320-360-10).</td>
</tr>
</tbody>
</table>
### j1. SPRING BRAKE(S) WILL NOT RELEASE (CONT)

#### KNOWN INFO
- Brake system air lines are OK
- Spring brake chambers OK
- Spring brake relay valves OK
- Parking brake valve OK

#### POSSIBLE PROBLEMS
- Spring brake control valve
- Cam shaft binding
- Brakes out of adjustment

---

#### TEST OPTIONS
6. **Is air pressure present at spring brake control valve discharge port?**

- **NO**
  - Replace spring brake control valve (para 11-16).
- **YES**

---

#### KNOWN INFO
- Brake system air lines OK
- Spring brake chambers OK
- Parking brake relay valve OK
- Spring brake control valve OK

#### POSSIBLE PROBLEMS
- Cam shaft binding
- Broken or damaged cam shaft
- Brakes out of adjustment

---

#### TEST OPTIONS
7. **Do cam shafts rotate freely?**

- **NO**
  - Free up and lubricate any binding cam shafts (LO 9-2320-360-12).
- **YES**

---

#### KNOWN INFO
- Brake system air lines OK
- Spring brake chambers OK
- Parking brake relay valve OK
- Spring brake control valve OK
- Cam shafts OK

#### POSSIBLE PROBLEMS
- Brakes out of adjustment

---

#### TEST OPTIONS
8. **Are brakes adjusted properly?**

- **NO**
  - Adjust brakes (para 11-2 or 11-2.1).
- **YES**

---

#### WARNING
- Read WARNING on following page.

---

#### TEST OPTIONS
- Brake System Test

---

#### REASON FOR QUESTION
- Air pressure must be present at "R" port on control valve before it will function. If air is not present, refer to Air System Troubleshooting.

---

#### TEST OPTIONS
- Spring Brake Control Valve Test

---

#### REASON FOR QUESTION
- Cam shafts may bind or fail to rotate due to a lack of lubrication.

---

#### TEST OPTIONS
- Brake Camshaft Check

---

#### REASON FOR QUESTION
- Brakes which are adjusted too tight may cause brake shoes to drag and not release.

---

#### TEST OPTIONS
- Spring Brake System Test
**WARNING**
Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury.

**SPRING BRAKE CONTROL VALVE TEST**

**NOTE**
Air pressure must be present at "R" port on control valve before it will function.

1. Loosen hose no. 2621 at "R" port on spring brake control valve and check for escaping air.
2. Tighten hose no. 2621 on spring brake control.
4. Loosen hose no. 2622 "D" (discharge) port on spring brake control valve and check for escaping air.
5. Tighten hose no. 2622 on spring brake control.

**BRAKE CAMSHAFT CHECK**

1. Remove cotter pin and clevis pin from slack adjuster. Discard cotter pin.

**NOTE**
Slack adjuster and camshaft should move with minimum effort away from brake chamber.

2. Lubricate brake camshaft (LO–2320–360–12) and move slack adjuster through range of travel.
3. Install clevis pin in slack adjuster and brake chamber with new cotter pin.

**WARNING**
When working on parking break control system, vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

**BRAKE SYSTEM TEST**


**NOTE**
Slack adjuster should move up to 2 in. (5 cm).

2. Check for movement of slack adjuster while assistant applies and releases treadle valve.
3. Repeat test at seven other slack adjusters.
j2. SERVICE BRAKE(S) WILL NOT RESPOND PROPERLY

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

Personnel Required
- Two

NOTE INFO
- Nothing

POSSIBLE PROBLEMS
- Brakes out of adjustment
- Loose or damaged air line
- Treadle valve

TEST OPTIONS
- Brake System Test

REASON FOR QUESTION
- Brakes which are not adjusted correctly will cause brakes to operate improperly.

1. Are brakes adjusted properly?

   NO
   Adjust brakes (para 11-2 or 11-2.1).

   YES

2. Does vehicle slow to a stop when treadle valve is applied and no air leaks are heard?

   NO
   Secure loose connections. Repair damaged air lines (para 11-40).

   YES

NOTE INFO
- Brakes adjusted properly

POSSIBLE PROBLEMS
- Loose or damaged air line
- Treadle valve

TEST OPTIONS
- Visual inspection
- and/or
- Audible inspection

REASON FOR QUESTION
- Service brakes will not apply if air line connections are loose or lines are damaged and sufficient air pressure is not available to operate the brakes.
NOTE
Air system pressure must be in the 90–125 psi operating range to begin brake system troubleshooting. If the air pressure cannot be maintained within operating range proceed to AIR SYSTEM TROUBLESHOOTING.

WARNING
Due to the air system pressure be sure to wear the proper eye protection to avoid personal injury. When working on parking break control system, vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

BRAKE SYSTEM TEST
(2) Check for movement of slack adjusters while assistant applies and releases treadle valve.
(3) Apply parking brake (TM 9–2320–360–10).
j2. SERVICE BRAKE(S) WILL NOT RESPOND PROPERLY (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
</table>
| Brakes adjusted properly  
Brake system air lines OK | Visual inspection | Treadle valve is separated into two sections, one section for axle no. 1 and one section for axles no. 2, 3, and 4. If either section of treadle valve fails, brakes will not respond correctly. |

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treadle valve</td>
<td><strong>Do all eight brake chambers operate when treadle valve is applied?</strong></td>
</tr>
</tbody>
</table>

- **NO**
  - Replace treadle valve (para 11–7).
  - Fault not corrected. Notify supervisor.

- **YES**
Apply service brake while assistant observes the eight brake chambers for movement of rod.
j3. UNEVEN BRAKING (PULLING)

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

Personnel Required
Two

TEST OPTIONS

Slack Adjuster Test

REASON FOR QUESTION
Vehicle will brake unevenly if all brake chambers, slack adjusters and brake camshafts are not operating or adjusted properly.

Brake System Test

REASON FOR QUESTION
Vehicle will brake unevenly if brake slack adjusters are not adjusted properly.

WARNING
Read WARNING on following page.

START

1. Do the slack adjusters move on all eight wheels when the treadle valve is applied?

NO

Go to step 3.

YES

2. Do the slack adjusters move an equal amount on all eight wheels?

NO

Adjust the brakes (para 11–2 or 11–2.1).

YES

3. Faults not corrected.
Notify supervisor.
When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

**WARNING**
Due to the air system pressure be sure sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

**SLACK ADJUSTER TEST**

2. Observe the rotation of all brake camshafts and slack adjusters while assistant applies and releases treadle valve.

**DISTANCE A**

**DISTANCE B**

**CHAMBER BRACKET**

**YOKE PIN**

**BRAKE SYSTEM TEST**

2. Measure distance A between center of yoke pin and chamber bracket with brake treadle released. Record measurement.
3. Measure distance B between center of yoke pin and chamber bracket while assistant holds brake treadle down. Record measurement.
4. Subtract measurement A from measurement B. If difference is 2 in (50 mm) or more, adjust brakes (para 11–2).
j3. UNEVEN BRAKING (PULLING) (CONT)

**KNOW INFO**

At least one slack adjuster is inoperative

**POSSIBLE PROBLEMS**

- Faulty brake chamber
- Binding brake camshaft
- Faulty slack adjuster
- Faulty load sensing valve
- Faulty relay valve

**TEST OPTIONS**

- Slack Adjuster Test

**REASON FOR QUESTION**

Faulty relay valve or load sensing valve is indicated if both slack adjusters/brake chambers on the same axle are inoperative. Faulty brake chamber or camshaft is indicated if at least one slack adjuster/brake chamber operates.

---

**3.**

Does at least one slack adjuster on each axle operate with the treadle valve applied?

<table>
<thead>
<tr>
<th>YES</th>
<th>Go to step 5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Go to step 5.</td>
</tr>
</tbody>
</table>

---

**KNOW INFO**

At least one slack adjuster on each axle operates

**POSSIBLE PROBLEMS**

- Faulty brake chamber
- Binding brake camshaft
- Faulty slack adjuster

**TEST OPTIONS**

- Brake Chamber Test

**REASON FOR QUESTION**

Brake chamber is faulty if rod doesn't move with slack adjuster removed. Slack adjuster or brake camshaft is faulty if brake chamber rod moves.

---

**4.**

Does the brake chamber rod move with the slack adjuster removed? Is the slack adjuster OK?

<table>
<thead>
<tr>
<th>YES</th>
<th>Replace brake chamber (para 11-5 or 11-6).</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Replace brake chamber (para 11-5 or 11-6).</td>
</tr>
</tbody>
</table>

Free up and lubricate (LO 9–2320–360-12) binding cam shafts. Replace broken slack adjusters (para 11-4).

---

**5.**

Do any of the brake chambers on axles no. 2, no. 3 and no. 4 operate when the treadle valve is applied?

<table>
<thead>
<tr>
<th>YES</th>
<th>Replace load sensing valve (para 11-38).</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Replace load sensing valve (para 11-38).</td>
</tr>
</tbody>
</table>

Replace relay valve (para 11-8, 11-9, 11-10 or 11-11).

---

**WARNING**

Read WARNING on following page.

---

**REASON FOR QUESTION**

Faulty brake chamber or camshaft is indicated if at least one slack adjuster/brake chamber operates.

---

**REASON FOR QUESTION**

Service brake relay valve is faulty if both brake chambers on any one axle are inoperative. Load sensing valve is faulty if all six brake chambers on the rear axles are faulty.
When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

**WARNING**

Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

---

**SLACK ADJUSTER TEST**

2. Observe the rotation of all brake camshafts and slack adjusters while assistant applies and releases treadle valve.

---

**SLACK ADJUSTER TEST**

2. Observe the rotation of all brake camshafts and slack adjusters while assistant applies and releases treadle valve.

---

**SLACK ADJUSTER TEST**

2. Observe the rotation of all brake camshafts and slack adjusters while assistant applies and releases treadle valve.

---

**BRAKE CHAMBER TEST**

NOTE

Notify supervisor if brake camshaft is binding and will not free up after lubricating.

1. Remove the slack adjuster which does not move form the brake camshaft (para 11–4).
4. Check for movement of brake chamber rod while assistant applies and releases treadle valve.
7. Install slack adjuster (para 11–4).
j4. SERVICE BRAKE(S) FAIL TO RELEASE/RELEASE SLOWLY

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

**Personnel Required**
- Two

---

**WARNING**
Read WARNING on following page.

---

**TEST OPTIONS**
- Visual inspection

---

**REASON FOR QUESTION**
- Brakes will not stop vehicle properly if out of adjustment.

---

**KNOWN INFO**
- Brake system air lines OK

---

**POSSIBLE PROBLEMS**
- Binding cam shafts/slack adjusters
- Treadle valve
- Axle no. 1 relay valve
- Quick release valve
- Axle no. 2, no. 3, or no. 4 relay valve

---

**TEST OPTIONS**
- Visual inspection

---

**REASON FOR QUESTION**
- Brake chambers will not release if treadle valve is not operating properly.

---

**KNOWN INFO**
- Brake system air lines OK
- Cam shafts/slack adjusters OK

---

**POSSIBLE PROBLEMS**
- Treadle valve
- Axle no. 1 relay valve
- Quick release valve
- Axle no. 2, no. 3, or no. 4 relay valve

---

**TEST OPTIONS**
- Visual inspection

---

**REASON FOR QUESTION**
- Replace treadle valve (para 11–7).

---

**REASON FOR QUESTION**
- Replace broken slack adjusters (para 11–4, 11–4.1 or 11–4.2).
WARNING
Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

SERVICE BRAKE CHECK
(1) Apply service brake while assistant observes the eight cam shafts and slack adjusters.
(2) Observe rotation of all cam shafts.
(3) Free and lubricate any binding camshafts.
(4) Observe the movement of all slack adjusters.

Release service brakes while assistant observes the eight brake chambers.
j4. SERVICE BRAKE(S) FAIL TO RELEASE/RELEASE SLOWLY (CONT)

3. Do both brake chambers on axle no. 1 release when treadle valve is released?

- **Known Info**: Brake system air lines OK, camshafts/slack adjusters OK, treadle valve OK, axle no. 1 relay valve OK
- **Possible Problems**: Axle no. 1 relay valve, quick release valve, axle no. 2, no. 3, or no. 4 relay valve

   - **Reason for Question**: Brake chambers will not release if quick release valve is not operating properly. Quick release valve is operating properly if air exhausts when brake pedal is released.

   - **Test Options**: Relay Valve Test

   - **Result**: Replace quick release valve (para 11-14).

4. Does air pressure exhaust from quick release valves when air pressure is released?

   - **Known Info**: Brake system air lines OK, camshafts/slack adjusters OK, treadle valve OK, axle no. 1 relay valve OK
   - **Possible Problems**: Quick release valve, axle no. 2, no. 3, or no. 4 relay valve

   - **Reason for Question**: Brake chambers will not release if quick release valve is not operating properly. Quick release valve is operating properly if air exhausts when brake pedal is released.

   - **Test Options**: Visual Inspection

   - **Result**: Replace quick release valve (para 11-14).

5. Do both brake chambers on the same axle release when treadle valve is released?

   - **Known Info**: Brake system air lines OK, camshafts/slack adjusters OK, treadle valve OK, axle no. 1 relay valve OK, quick release valve
   - **Possible Problems**: Axle no. 2, no. 3, or no. 4 relay valve

   - **Reason for Question**: Brake chambers will not release if relay valve is not operating properly. Relay valve is working properly if air pressure is exhausted out bottom when brake pedal is released.

   - **Test Options**: Visual Inspection

   - **Result**: Replace relay valve (para 11-8 thru 11-11).

Fault not corrected. Notify supervisor.
Release service brakes while assistant checks quick release valves for exhausted air.

**RELAY VALVE TEST**

1. Release service brakes while assistant observes the two front brake chambers.
2. Observe no. 1 relay valve for air pressure exhausting when brake is released.

Release service brakes while assistant observes the six brake chambers on the three rear axles.
j5. SERVICE BRAKE(S) GRABBING

INITIAL SETUP
Equipment Conditions
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

Personnel Required
Two

---

START

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake system air lines OK</td>
<td>Brake chamber</td>
</tr>
<tr>
<td>Treadle valve OK</td>
<td>Brake adjustment</td>
</tr>
<tr>
<td>Brake relay valve OK</td>
<td></td>
</tr>
<tr>
<td>Quick release valve OK</td>
<td></td>
</tr>
<tr>
<td>Relay valve OK</td>
<td></td>
</tr>
<tr>
<td>Brake chambers OK</td>
<td></td>
</tr>
</tbody>
</table>

1. Do both brake chambers on the same axle release at the same time when treadle valve is released?

   - NO: Replace brake chamber (para 11-5 or 11-6).
   - YES:

2. Do brake chambers and brakes operate normally when treadle valve is released?

   - NO: Adjust brakes (para 11-2 or 11-2.1).

---

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Service brake will not release if brake chamber is not operating properly.

---

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Brakes will not operate properly if brakes are out of adjustment.

2-722
Release service brakes while assistant observes the eight brake chambers.
6. EXCESSIVE LOSS OF AIR PRESSURE WHEN BRAKING

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

Personnel Required
- Two

---

**KNOWN INFO**

- Nothing

**POSSIBLE PROBLEMS**

- Treadle valve leaking
- Brake chamber leaking
- Brake system valve leaking
- Air line loose or damaged

**TEST OPTIONS**

- Visual inspection
- Audible inspection

**REASON FOR QUESTION**

- Treadle valve will not operate properly if leaking.

---

**1.**

Is the treadle valve free from air leaks when the brakes are applied?

- **NO**
  - Replace treadle valve (para 11-20).
- **YES**

---

**2.**

Are brake chambers free from air leaks?

- **NO**
  - Replace brake chamber (para 11-5 and 11-6).
- **YES**

---

**POSSIBLE PROBLEMS**

- Brake chamber leaking
- Brake system valve leaking
- Air line loose or damaged

**TEST OPTIONS**

- Visual inspection
- Audible inspection

**REASON FOR QUESTION**

- Brake chambers will not operate properly if leaking.
NOTE
Air system pressure must be in the 90-125 psi operating range to begin brake system troubleshooting. If the air pressure cannot be maintained within operating range proceed to AIR SYSTEM TROUBLESHOOTING.

Press and hold treadle valve while checking for air leaks.

Press and hold treadle valve while assistant checks brake chambers for air leaks.
4. **Visual inspection** and/or **Audible inspection**

**WARNING**

*Read WARNING on following page.*

**Reason for Question**

Excessive loss of air pressure will occur if brake system valves are leaking through pressure relief ports.

**TEST OPTIONS**

- Brake System Valve Test

- Treadle valve OK
- Brake chamber OK
- Brake system valve OK

**POSSIBLE PROBLEMS**

- Air line loose or damaged

---

3.

**Are brake system valves free from air leaks?**

- **NO**
  - Replace brake system valve (para 11-8 thru 11-17).
- **YES**
  - Secure loose connections. Repair damaged air lines (para 11-40).

---

---

2.

**Are all air lines secure and free from air leaks?**

- **NO**
  - Fault not corrected. Notify supervisor.
- **YES**
WARNING
Due to the air system pressure be sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

NOTE
Refer to brake air hose diagram (in front of this Troubleshooting section) for service relay valve locations.

<table>
<thead>
<tr>
<th>BRAKE SYSTEM VALVE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Push in parking brake control.</td>
</tr>
<tr>
<td>(2) Check service brake relay valves for air leaks, while assistant presses on treadle valve.</td>
</tr>
<tr>
<td>(3) Pull out parking brake valve.</td>
</tr>
</tbody>
</table>

NOTE
Air system pressure must be in the 90-125 psi operating range to begin brake system troubleshooting. If the air pressure cannot be maintained within operating range proceed to AIR SYSTEM TROUBLESHOOTING.

Operate treadle valve while assistant observes the air lines for audible noise or movement of the eight brake chambers.

WARNING
Due to the air system pressure be sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.
## j7. BRAKE(S) OVERHEAT

### INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

### KNOWN INFO

<table>
<thead>
<tr>
<th>Nothing</th>
</tr>
</thead>
</table>

### POSSIBLE PROBLEMS

- Brake adjustment
- Binding S-Cam or other moving parts
- Faulty service brake relay valves

### TEST OPTIONS

#### Test Options
- **Brake System Test**

#### Reason for Question
- Brakes which are adjusted too tight will cause brake shoes to drag, resulting in overheating.

### KNOWLEDGE INFO

<table>
<thead>
<tr>
<th>Brake adjustment OK</th>
</tr>
</thead>
</table>

### POSSIBLE PROBLEMS

- Binding S-Cam or other moving parts
- Faulty service brake relay valves

### TEST OPTIONS

#### Test Options
- **Visual Inspection**

#### Reason for Question
- S-Cam or other moving parts which do not return readily to released position may cause brakes to drag, resulting in overheating.

### WARNING

- Read WARNING on following page.

### Are brakes adjusted properly?

- **NO** Adjust brakes (para 11-2 or 11-2.1).
- **YES**

### Are S-Cams and other moving parts free from binding or damage?

- **NO** S-Cam faulty. Notify supervisor.
- **YES**
When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

**WARNING**
Due to the air system pressure, be sure to wear proper eye protection to avoid personal injury. When working on parking brake control system vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

**BRAKE SYSTEM TEST**

(1) Release parking brake (TM 9-2320-360-10).
(2) Check for movement of slack adjusters while assistant applies and releases treadle valve.
(3) Apply parking brake (TM 9-2320-360-10).

(1) Remove brake drum(s) (para 11-3).
(2) Check S-Cam and other moving parts for binding or damage.
(3) Lubricate S-cam (LO 9-2320-360-12).
j7. BRAKE(S) OVERHEAT (CONT)

**KNOWLEDGE INFO**
- Brake adjustment OK
- S Cam or other moving parts OK

**POSSIBLE PROBLEMS**
- Faulty service brake relay valves

---

**WARNING**
Read WARNING on following page.

3. Do service brake relay valve close off air supply to brake chambers?

- **NO**
  - Fault not corrected. Notify supervisor.

- **YES**
  - Replace service brake relay valve (para 11-8 thru 11-11).

---

**TEST OPTIONS**
- Service Brake Relay Valve Test

**REASON FOR QUESTION**
- If air is present in service lines to brake chambers with treadle valve released, relay valve is faulty.
### SERVICE BRAKE RELAY VALVE TEST

1. Start engine (TM 9-2320-360-10).
2. Build up air pressure to 125 psi (862 kPa).
4. Apply and release service brake (TM 9-2320-360-10).

**WARNING**

Do not remove air line from relay valve. Air pressure may be present at air line. Failure to comply may result in injury to personnel.

5. Shut off engine (TM 9-2320-360-10).
6. Loosen air line on service port of service brake relay valve. No air should be present.
7. Tighten air line on service port of service brake relay valve.
8. Apply parking brake (TM 9-2320-360-10).
j8. SPRING BRAKE(S) WILL NOT APPLY

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Personnel Required
  - Two

**Known Info**
- Nothing

**Possible Problems**
- Brakes out of adjustment
  - Parking brake valve
  - Spring brake relay valve

**Known Info**
- Brakes adjustment OK

**Possible Problems**
- Parking brake valve
- Spring brake relay valve

**Test Options**

1. **Are brakes properly adjusted?**
   - **Yes**: Adjust brakes (para 11-2 or 11-2.1).
   - **No**: Replace parking brake valve (para 11-17).

2. **Does any brake chamber operate when parking brake is applied?**
   - **Yes**: Parking Brake Valve Test
   - **No**: Replace parking brake valve (para 11-17).

**Reason for Question**

- If all six slack adjusters move when parking brake is applied the air system is OK, an adjustment problem is indicated. Slack adjusters should move away from brake chambers when brakes are applied.
- Air pressure present at discharge port with parking brake valve pulled out indicates faulty valve.
**WARNING**

Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system, vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

Apply parking brake while assistant observes the six spring brake chambers.
j8. SPRING BRAKE(S) WILL NOT APPLY (CONT)

3. Do axle no. 2 brake chambers apply while axle no. 3 and no. 4 brake chambers fail to apply when parking brake is applied?

   **KNOWN INFO**
   - Brake system air lines OK
   - Parking brake valve OK

   **POSSIBLE PROBLEMS**
   - Spring brake relay valve

   **TEST OPTIONS**
   - Visual inspection

   **REASON FOR QUESTION**
   - Four brake chambers on axles no. 3 and no. 4 failing to apply indicates faulty axle no. 3 and no. 4 spring brake relay. Slack adjusters should move toward brake chambers when brakes are released.

   **WARNING**
   - Read WARNING on following page.

   - Replace axle no. 3 and no. 4 spring brake relay valves (para 11-13).

4. Does any brake chamber on axle no. 2 operate when parking brake is applied?

   **KNOWN INFO**
   - Brake system air lines OK
   - Parking brake valve OK

   **POSSIBLE PROBLEMS**
   - Spring brake relay valve

   **TEST OPTIONS**
   - Visual inspection

   **REASON FOR QUESTION**
   - Both spring brake chambers on axle no. 2 failing to apply indicates faulty axle no. 2 spring brake relay. Slack adjusters should move toward brake chambers when brakes are released.

   **WARNING**
   - Read WARNING on following page.

   - Replace axle no. 2 spring brake relay valve (para 11-12).

   **NO**

   **YES**

   Fault not corrected. Notify supervisor.
**WARNING**

Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury. When working on parking brake control system, vehicle may roll. Vehicle must be parked on level ground. Wheel chocks must be positioned in front of and behind one of the rear wheels to keep it from rolling. Failure to comply may cause serious injury or death to personnel.

Push in parking valve while assistant observes spring brake chambers.

---

Push in parking valve while assistant observes spring brake chambers.
9. AUTOMATIC SLACK ADJUSTER DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Wrench, Torque 0–200 lb-in (Item 72, Appendix F)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing</td>
<td>Ratchet clutch faulty</td>
</tr>
<tr>
<td></td>
<td>Actuation rod seized</td>
</tr>
<tr>
<td></td>
<td>Camshaft spline or adjusting shaft binding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratchet clutch OK</td>
<td>Actuation rod seized</td>
</tr>
<tr>
<td></td>
<td>Camshaft spline or adjusting shaft binding</td>
</tr>
</tbody>
</table>

CAUTION
Read CAUTION on following page.

1. Is the torque required to rotate the adjusting shaft hex nut counter-clockwise less than 12 lb-ft (16.27 Nm)?

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>If the torque reading is less than the specification, the slack adjuster’s ratchet clutch will not be able to maintain brake adjustment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace slack adjuster (para 11-4.1).</td>
<td>Replace slack adjuster (para 11-4.1).</td>
</tr>
</tbody>
</table>

2. Does the slack adjuster actuation rod move when the adjusting shaft hex nut is rotated?

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>If slack adjuster actuation rod cannot or does not move, the slack adjuster will be unable to make adjustments.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace slack adjuster (para 11-4.1).</td>
<td>Replace slack adjuster (para 11-4.1).</td>
</tr>
</tbody>
</table>
Using a torque wrench, turn the adjusting shaft hex nut counter-clockwise. The torque will increase to a peak value, then return to zero as the ratchet clutch disengages. Observe the peak reading displayed on the torque wrench.

**NOTE**

This troubleshooting fault should only be used to troubleshoot Model A automatic slack adjusters.

**CAUTION**

Automatic slack adjusters cannot be disassembled. Never attempt to repair the assembly. Failure to comply may result in damage to slack adjuster.

Using a torque wrench, turn the adjusting shaft hex nut counter-clockwise. The torque will increase to a peak value, then return to zero as the ratchet clutch disengages. Observe the peak reading displayed on the torque wrench.

1. Remove slack adjuster (para 11-4.1).
2. Rotate the adjusting shaft hex nut. A quarter turn of the adjusting shaft hex nut will result in full movement of the actuation shaft.
3. Observe whether actuation rod moves as slight force is used to turn the adjusting shaft. Turning the adjusting shaft clockwise will move the actuation rod into the slack adjuster; turning the shaft counter-clockwise will move the rod out.
j9. AUTOMATIC SLACK ADJUSTER DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Ratchet clutch OK
- Actuation rod OK

**POSSIBLE PROBLEMS**
- Ratchet clutch faulty
- Actuation rod seized
- Camshaft spline or adjusting shaft binding

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
The slack adjuster is faulty if the splined shaft does not rotate or if the torque readings are greater than 75 lb-in (8.48 Nm).

**3.**
Is the torque required to rotate the adjusting shaft hex clockwise less than 75 lb-in (8.48 Nm)? Does the spline shaft rotate when turning adjusting shaft hex?

- **YES**
  - Replace slack adjuster (para 11-4.1).

- **NO**
  - Fault not corrected. Notify supervisor.
(1) Using a torque wrench, rotate the adjusting shaft hex nut thru six full revolutions. The torque will increase to peak value, then return to zero several times during each revolution.

(2) Note the torque readings and movement of the splined shaft while rotating adjusting shaft.

(3) Install slack adjuster (para 11-4.1).
WINDSHIELD WASHER SYSTEM

TO NOZZLE

WINDSHIELD WASHER BOTTLE

2

1

3

WINDSHIELD WASHER VALVE

PRESSURE REGULATOR (130 PSI)

2766

TO HORN VALVE

AIR MANIFOLD
Air Supply Hose Diagram
Notes:
1) See sheet 2 for detail.
2) See sheet 3 for detail.

Front View of Cab Interior

Cab Air Hose Diagram (sheet 1 of 3)
Top View of Cab Air Valve Assembly and Manifold

Cab Air Hose Diagram (sheet 2 of 3)
CTIS Air Hose Diagram
RH Height Control Valve

LH Height Control Valve

Load Sensing Valve

No. 3 Air Reservoir

Pressure Protection Valve (65 PSI)

Suspension Air Hoses
Brake Air Hose Diagram (sheet 1 of 2)
Brake Air Hose Diagram (sheet 2 of 2)
k. AIR SYSTEM

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>k1. Air system loses pressure during operation or air pressure buildup is slow</td>
<td>2–750</td>
</tr>
<tr>
<td>k2. Large quantity of moisture expelled from reservoirs</td>
<td>2–758</td>
</tr>
<tr>
<td>k3. Air dryer(s) continually purge</td>
<td>2–762</td>
</tr>
<tr>
<td>k3.1. Air dryer(s) fail to purge</td>
<td>2–762.4</td>
</tr>
<tr>
<td>k4. Relief valve on air dryer releasing air</td>
<td>2–764</td>
</tr>
<tr>
<td>k4.1. Relief valve on aftercooler releasing air</td>
<td>2–765.1</td>
</tr>
<tr>
<td>k5. Compressor fails to unload. (Air system pressure builds up to more than 125 psi (862 kPa))</td>
<td>2–766</td>
</tr>
<tr>
<td>k6. Noisy air compressor operation</td>
<td>2–768</td>
</tr>
<tr>
<td>k7. Coolant and/or lubricant leaks from compressor</td>
<td>2–772</td>
</tr>
<tr>
<td>k8. Air pressure drops rapidly after engine shutdown</td>
<td>2–776</td>
</tr>
<tr>
<td>k9. Windshield washer does not operate</td>
<td>2–780</td>
</tr>
<tr>
<td>k10. Horn (country) does not operate</td>
<td>2–786</td>
</tr>
<tr>
<td>k11. Horn (city) does not operate</td>
<td>2–790</td>
</tr>
<tr>
<td>k12. Transfer case does not engage front axle when transfer case shift lever is positioned to LOW</td>
<td>2–796</td>
</tr>
<tr>
<td>k13. Transfer case does not engage front axle when transfer case shift lever is positioned to HIGH and driveline control is positioned to LOCK</td>
<td>2–800</td>
</tr>
</tbody>
</table>
K1. AIR SYSTEM LOOSES PRESSURE DURING OPERATION OR AIR PRESSURE BUILDUP IS SLOW

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

1. Is drain valve on air reservoirs free from leaks or damage?

   - KNOWN INFO
     Air hoses and fittings OK
     Brake lines OK
     Trailer air supply control OFF
     Drain valves OK

   - POSSIBLE PROBLEMS
     Leaking drain valves
     Leaking purge valves
     Air compressor inlet hose leaking or restricted
     Air compressor discharge hose leaking or restricted
     Faulty air governor
     Faulty air dryer/check valve
     Leaking aftercooler/coalescing filter
     Leaking air inlet check valves
     Faulty air compressor

   - TEST OPTIONS
     Visual inspection

   - REASON FOR QUESTION
     Air pressure buildup will be slow if air is continually leaking from air reservoir drain valves.

   - YES
   - NO
     Replace drain valve(s) (para 11–19 thru 11–23).

2. Is purge valve on air dryers and aftercooler free from leaks or damage?

   - KNOWN INFO
     Air hoses and fittings OK
     Brake lines OK
     Trailer air supply control OFF
     Drain valves OK

   - POSSIBLE PROBLEMS
     Leaking purge valves
     Air compressor inlet hose leaking or restricted
     Air compressor discharge hose leaking or restricted
     Faulty air governor
     Faulty air dryer/check valve
     Leaking aftercooler/coalescing filter
     Leaking air inlet check valves
     Faulty air compressor

   - TEST OPTIONS
     Visual inspection

   - REASON FOR QUESTION
     Air pressure buildup will be slow if air is continually leaking from air dryer purge valves.

   - YES
   - NO
     Repair air dryer(s)/aftercooler (para 11–33, 11–34 and/or 11–34.1).
NOTE
It takes approximately eight to ten minutes for air pressure to increase from 0 psi (0 kPa) to 125 psi (862 kPa) when engine is at idle.

Check drain valve on air reservoirs for air leakage and damage.

Check purge valve on air dryers for air leakage and damage.
k1. AIR SYSTEM LOSES, PRESSURE DURING OPERATION OR AIR PRESSURE BUILDUP IS SLOW (CONT)

**KNOWN INFO**
- Air hoses and fittings OK
- Brake lines OK
- Trailer air supply control OFF
- Drain valves OK
- Purge valves OK

**POSSIBLE PROBLEMS**
- Air compressor inlet hose leaking or restricted
- Air compressor discharge hose leaking or restricted
- Faulty air governor
- Faulty air dryer/air dryer check valve
- Leaking aftercooler/coalescing filter
- Leaking air inlet check valves
- Faulty air compressor

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Air will not flow freely to air reservoirs if air compressor inlet hose no. 2600 or fittings are restricted or damaged.

**KNOLEDG INFO**
- Air hoses and fittings OK
- Brake lines OK
- Trailer air supply control OFF
- Drain valves OK
- Purge valves OK
- Air compressor inlet hose OK

**POSSIBLE PROBLEMS**
- Air compressor discharge hose leaking or restricted
- Faulty air governor
- Faulty air dryer/air dryer check valve
- Leaking aftercooler/coalescing filter
- Leaking air inlet check valves
- Faulty air compressor

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
Air will not flow freely to air reservoirs if air compressor discharge hose no. 2001 or fittings are restricted or damaged. Air pressure buildup will be slow if air is continually leaking from air compressor discharge hose no. 2001.

**KNOLEDG INFO**
- Air hoses and fittings OK
- Brake lines OK
- Trailer air supply control OFF
- Drain valves OK
- Purge valves OK
- Air compressor inlet hose OK
- Air compressor discharge hose OK

**POSSIBLE PROBLEMS**
- Faulty air governor
- Faulty air dryer/air dryer check valve
- Leaking aftercooler/coalescing filter
- Leaking air inlet check valves
- Faulty air compressor

**TEST OPTIONS**
- Air Governor Test

**REASON FOR QUESTION**
Air pressure buildup may be slow if air governor cuts out at too low psi. Adjust air governor if air governor fails test. Replace air governor if it can not be adjusted.
Check air compressor inlet hose no. 2600 and fittings for restrictions and damage.

**WARNING**
Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury. Air compressor discharge hose no. 2001 gets extremely hot during normal air compressor operation. Allow sufficient time for hose to cool before performing inspection. Failure to comply may result in personnel injury.

Check air compressor discharge hose no. 2001 and fittings for restrictions, leakage, and damage.

**AIR GOVERNOR TEST**

1. Start engine (TM 9-2320-360-10).
2. Watch AIR PRESS gage. Green and red needles should move up scale as pressure builds up.

   **NOTE**
   Air will be released from air dryers when air governor cuts out.

3. Check AIR PRESS gage when air governor cuts out. AIR PRESS gage should read 120–125 psi (827–862 kPa) when air governor cuts out. Air governor fails test if it does not cut out at 120–125 psi (827–862 kPa).
### Air System Loses Pressure During Operation or Air Pressure Buildup is Slow (Cont)

#### Known Info
- Air hoses and fittings OK
- Brake lines OK
- Trailer air supply control OFF
- Drain valves OK
- Purge valves OK
- Air compressor inlet hose OK
- Air compressor discharge hose OK
- Air governor OK

#### Possible Problems
- Faulty air dryer/air dryer check valve
- Leaking aftercooler/coalescing filter
- Leaking air inlet check valves
- Faulty air compressor

### Test Options

**Reason for Question**
- Service or repair air dryer (para 11-32 thru 11-34).
- Replace aftercooler and/or coalescing filter (para 11-34.1 or 11-34.2).  

**Test Options**
- Air Dryer Test
- Visual inspection

### Test Options

**Reason for Question**
- Air pressure buildup will be slow if air is leaking from aftercooler or coalescing filter.

**Test Options**
- Air Inlet Check Valve Inspection

### Test Options

**Reason for Question**
- Air pressure buildup will be slow if air reservoir check valves on no. 2 and no. 3 air reservoirs are leaking or damaged. Replace check valves if leaking.
**AIR DRYER TEST**

(1) Drain air system (TM 9-2320-360-10).

(2) Remove air dryer discharge lines no. 2996 from left and right air dryers.

**NOTE**

There is no problem with air dryers if air flows from discharge ports.

(3) Start engine (TM 9-2320-360-10) and check for air flow from left and right air dryer discharge ports.

(4) Shut off engine (TM 9-2320-360-10).

(5) Remove air dryer check valves if no air flows from discharge ports. Repeat steps (3) and (4).

(6) Install air dryer discharge lines no. 2996 and check valves (if removed) on left and right air dryers.

---

**AIR INLET CHECK VALVE INSPECTION**

(1) Remove air line no. 2184 from no. 2 air reservoir check valve.

(2) Remove air line no. 2613 from no. 3 air reservoir check valve.

(3) Inspect check valves on no. 2 and no. 3 air reservoirs for air leakage.

(4) Install air line no. 2613 on no. 2 air reservoir check valve.

(5) Install air line no. 2184 on no. 3 air reservoir check valve.
k1. AIR SYSTEM LOOSES PRESSURE DURING OPERATION OR AIR PRESSURE BUILDUP IS SLOW (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
</table>
| Air hoses and fittings OK  
Brake lines OK  
Trailer air supply control OFF  
Drain valves OK  
Purge valves OK  
Air compressor inlet hose OK  
Air compressor discharge hose OK  
Air governor OK  
Air dryer/air dryer check valve OK  
Aftercooler/coalescing filter OK  
Air inlet check valves OK | Faulty air compressor |

WARNING
Read WARNINGS on following page.

Is the amount of oil discharged by the air compressor within acceptable limits?

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Compressor Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air compressor has failed if it passes more than 6 cc of oil per hour (spot on test card is larger than 2 in. and/or has heavy splatter)</td>
</tr>
</tbody>
</table>
(1) Drain air system (TM 9-2320-360-10).

(2) Remove drain plug from no. 3 air tank.

**WARNING**
Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury. Air compressor discharge hose no. 2001 gets extremely hot during normal air compressor operation. Allow sufficient time for hose to cool before performing inspection. Failure to comply may result in injury to personnel.

(3) Remove air compressor discharge hose no. 2001 and inlet hose no. 2600 from air compressor.

(4) Start engine (TM 9-2320-360-10).

(5) Operate engine at 2100 RPM for five minutes to bring air compressor up to operating temperature.

(6) Reduce engine speed to 1800 RPM and maintain that speed.

**WARNING**
Use extreme care while holding cardboard when engine is running. Rotating engine accessories and hot engine parts may cause injury.

(7) Hold a 5 in. x 10 in. (12.7 cm x 25.4 cm) piece of cardboard 1 in. (2.54 cm) from the discharge port for 1 minute.

(8) Shut off engine (TM 9-2320-360-10).

(9) Compare cardboard to the following:
   a. No oil spot – compressor OK
   b. Oil spot 2 in. (5 cm) or less, splatter off to one side, or light splatter – compressor OK
   c. Oil spot greater than 2 in. (5 cm) and/or heavy splatter – compressor faulty

(10) Install air compressor discharge hose no. 2001 and inlet hose no. 2600 on air compressor.

**WARNING**
Pipe thread sealing compound can burn easily, can give off harmful vapors, and is harmful to skin and clothing. To avoid injury or death, keep compound away from open fire and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**
Use pipe thread sealing compound sparingly, only on pipe threads. Do not apply compound at hose connections. Failure to comply may result in component damage.

(11) Coat threads of drain plug with pipe thread sealing compound.

(12) Install drain plug in no. 3 air tank.
k2. LARGE QUANTITY OF MOISTURE EXPELLED FROM AIR RESERVOIRS

INITIAL SETUP

Equipment Conditions
Engine shut off (TM 9-2320-360-10).
Parking brake on (TM 9-2320-360-10).
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

KNOWLEDGE

1. Is air pressure present at air governor unloading port?

   - NO
     - Replace air governor (para 11-31).
   - YES

2. Do air dryers purge?

   - NO
     - Replace air dryer(s) (para 11-33 and 11-34).
   - YES

TEST OPTIONS

- Air Governor Pressure Test
- Air Dryer Purge Test

REASON FOR QUESTION

Defective air governor will cause air dryers not to purge and may result in excess moisture in the air system. Replace air governor if no air flows from unloading port when air pressure is 120-125 psi (827-862 kPa).

Defective air dryers will not purge moisture from the air system. Replace air dryer(s) if they fail to purge when air pressure is 120-125 psi (827-862 kPa).

POSSIBLE PROBLEMS

- Faulty air governor
- Faulty air dryers
- Leaking or restricted air dryer air lines
- Faulty air compressor

- Faulty air dryers
- Leaking or restricted air dryer air lines
- Faulty air compressor

KNOWN INFO

- Nothing
- Air governor OK

- Air governor OK
**AIR GOVERNOR PRESSURE TEST**

1. Remove hose no. 2114 from air governor.

   **NOTE**
   Air should escape from air governor port when hose no. 2114 is removed and air pressure is at 120–125 psi (827–862 kPa).

2. Start engine (TM 9-2320-360-10) and allow air system pressure to build up to 120–125 psi (827–862 kPa).

3. Shut off engine (TM 9-2320-360-10) when air pressure builds up to 120–125 psi (827–862 kPa).

4. Install hose no. 2114 on air governor.

**AIR DRYER PURGE TEST**

- **NOTE**
  Air dryers should purge when air pressure is at 120–125 psi (827–862 kPa).

1. Start engine (TM 9-2320-360-10) and allow air system pressure to build up to 120–125 psi (827–862 kPa).

2. Listen for both air dryers to purge.

3. Shut off engine (TM 9-2320-360-10) when air pressure builds up to 120–125 psi (827–862 kPa).
k2. LARGE QUANTITY OF MOISTURE EXPELLED FROM AIR RESERVOIRS (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air governor OK</td>
<td></td>
<td>Air Line Pressure Test</td>
</tr>
<tr>
<td>Air dryers OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th>3. Is air pressure present at air lines no. 2080 and no. 2097?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaking or restricted air dryer air lines</td>
<td></td>
</tr>
<tr>
<td>Faulty air compressor</td>
<td></td>
</tr>
</tbody>
</table>

Replace air line no. 2080 and/or no. 2097 (para 11-40).

Air dryers may not purge if air lines no. 2080 or no. 2097 are restricted, leaking, or damaged. Replace air lines no. 2080 and/or no. 2097 if no air pressure is present.
## AIR LINE PRESSURE TEST

1. Remove hoses no. 2097 and no. 2080 from air dryers.

   **NOTE**
   Air should escape from hoses no. 2096 and no. 2097 when air pressure is at 120-125 psi (827-862 kPa).

2. Start engine (TM 9-2320-360-10) and allow air system pressure to build up to 120-125 psi (827-862 kPa).

3. Check for air pressure at air lines no. 2080 and no. 2097.

4. Shut off engine (TM 9-2320-360-10) when air pressure builds up to 120-125 psi (827-862 kPa).

5. Install hoses no. 2080 and no. 2097 on air dryers.
k2. LARGE QUANTITY OF MOISTURE EXPELLED FROM AIR RESERVOIRS (CONT)

**KNOWN INFO**
- Air governor OK
- Air dryers OK
- Air dryer air lines OK

**POSSIBLE PROBLEMS**
- Faulty air compressor

**TEST OPTIONS**
- Air Compressor Test

**REASON FOR QUESTION**
Air compressor has failed if it passes more than 6 cc of oil per hour (spot on test card is larger than 2 in. and/or has heavy splatter)

**WARNING**
Read WARNINGS on following page.

4. Is the amount of oil discharged by the air compressor within acceptable limits?

- YES
  - Notify supervisor.
- NO
  - Fault not corrected. Notify supervisor.
### AIR COMPRESSOR TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Drain air system (TM 9-2320-360-10).</td>
</tr>
</tbody>
</table>
| (2)    | Remove drain plug from no. 3 air tank.  
**WARNING**  
Air compressor discharge hose no. 2001 gets extremely hot during normal air compressor operation. Allow sufficient time for hose to cool before performing inspection. Failure to comply may result in injury to personnel. |
| (3)    | Remove air compressor discharge hose no. 2001 and inlet hose no. 2600 from air compressor. |
| (4)    | Start engine (TM 9-2320-360-10). |
| (5)    | Operate engine at 2100 RPM for five minutes to bring air compressor up to operating temperature. |
| (6)    | Reduce engine speed to 1800 RPM and maintain that speed.  
**WARNING**  
Use extreme care while holding cardboard when engine is running. Rotating engine accessories and hot engine parts may cause injury. |
| (7)    | Hold a 5 in. x 10 in. (12.7 cm x 25.4 cm) piece of cardboard 1 in. (2.54 cm) from the discharge port for 1 minute. |
| (8)    | Shut off engine (TM 9-2320-360-10). |
| (9)    | Compare cardboard to the following:  
a. No oil spot - compressor OK  
b. Oil spot 2 in. (5 cm) or less, splatter off to one side, or light splatter - compressor OK  
c. Oil spot greater than 2 in. (5 cm) and/or heavy splatter - compressor faulty |
| (10)   | Install air compressor discharge hose no. 2001 and inlet hose no. 2600 on air compressor.  
**WARNING**  
Pipe thread sealing compound can burn easily, can give off harmful vapors, and is harmful to skin and clothing. To avoid injury or death, keep compound away from open fire and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.  
**CAUTION**  
Use pipe thread sealing compound sparingly, only on pipe threads. Do not apply compound at hose connections. Failure to comply may result in component damage. |
| (11)   | Coat threads of drain plug with pipe thread sealing compound. |
| (12)   | Install drain plug in no. 3 air tank. |

![Diagram of air compressor components](image)
k3. AIR DRYER(S) CONTINUALLY PURGE

INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**K3. AIR DRYER(S) CONTINUALLY PURGE**

**START**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- The air dryer purge cycle is controlled by the air governor. If both air dryers purge continually, it is likely that the air governor has failed.

---

1. **Do both air dryers purge continually?**
   - **YES**
     - Go to step 2.
   - **NO**
     - Go to step 4.

---

2. **Is the air dryer heater operating?**
   - **YES**
     - Replace air dryer lower cover (para 11-33 or 11-34).
   - **NO**
     - **FAULTY AIR DRYER HEATER**

---

**POSSIBLE PROBLEMS**
- Faulty air governor
- Faulty air dryer heater
- Faulty purge valve
- Faulty purge valve seat

---

**KNOWLEDGE INFO**
- Air hoses and fittings OK

---

**POSSIBLE PROBLEMS**
- Faulty air dryer heater
- Faulty purge valve
- Faulty purge valve seat
Check purge valve on both air dryers for air leakage.

### AIR DRYER HEATER TEST

1. Remove chassis wire harness connector (MC 34 or MC 35) from air dryer wire harness connector.
2. Connect multimeter leads to positions A and B of air dryer wire harness.

   **NOTE**
   - A reading of infinity indicates an open circuit.
   - An open circuit should be indicated at temperatures above 32°F (0°C).
   - A complete circuit should be indicated at temperatures below 32°F (0°C).
3. Observe multimeter readings.
4. Install chassis wire harness connector on air dryer wire harness connector.
k3. AIR DRYER(S) CONTINUALLY PURGE (CONT)

3. Are purge valve seals and valve seat OK?

- **Known Info**
  - Air hoses and fittings OK
  - Only one air dryer purges continually
  - Air dryer heater OK

- **Possible Problems**
  - Faulty purge valve
  - Faulty purge valve seat

- **Test Options**
  - Visual inspection

- **Reason for Question**
  - Faulty purge valve seals or foreign material on the purge valve seat may cause the purge valve to leak.

4. Do the air dryers stop purging when the air line from the governor to the air dryers is removed?

- **Known Info**
  - Air hoses and fittings OK
  - Both air dryers purge continually

- **Possible Problems**
  - Faulty air governor

- **Test Options**
  - Air Governor Test

- **Reason for Question**
  - If the air dryer(s) stop purging when the air governor air line is removed, the problem is with the governor. If the air dryer(s) continue to purge the problem is with the dryer(s).
(1) Remove three screws, gasket and exhaust tube from bottom cover.
(2) Remove purge valve from bottom cover.
(3) Inspect purge valve seals and purge valve seat.

**AIR GOVERNOR TEST**

(1) Remove air line (no. 2080 or no. 2097) from air dryer.
(2) Check operation of purge valve.
k3.1. AIR DRYER(S) FAIL TO PURGE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**

Air hoses and fittings OK

**POSSIBLE PROBLEMS**
- Faulty air governor
- Faulty air line no. 2096, 2097, and/or 2080
- Faulty purge valve or seals

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

The air dryer purge cycle is controlled by the air governor. If both air dryers fail to purge, it is likely that the air governor has failed.

---

3.

Do both air dryers fail to purge?

**KNOWN INFO**

Air hoses and fittings OK

**POSSIBLE PROBLEMS**
- Faulty air governor
- Faulty air line no. 2096, 2097, and/or 2080
- Faulty purge valve or seals

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

A restricted or frozen air line between the air governor and the air dryer(s) will prevent the air dryers from purging.

---

4.

Is the air line from the governor to the air dryer OK?

**KNOWN INFO**

Air hoses and fittings OK
- Only one air dryer fails to purge

**POSSIBLE PROBLEMS**
- Faulty air line no. 2096, 2097, and/or 2080
- Faulty purge valve or seals

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Replace air line (para 11-40).
(1) Drain air system to less than 100 psi (690 kPa).
(2) Start engine (TM 9-2320-360-10).

**WARNING**
Keep out from under HET M1070 during test. Air exits air dryers at high velocity during purging. Failure to comply may result in injury to personnel.

(3) Build air pressure to 120-125 psi (827-862 kPa) and observe for air dryers purging.

(1) Remove lower engine access panel (para 16-2).
(2) Inspect air lines no. 2096, 2080, and 2097 for kinks or other damage.
k3.1. AIR DRYER(S) FAIL TO PURGE (CONT)

### KNOWN INFO
- Air hoses and fittings OK
- Only one air dryer fails to purge
- Air lines no. 2096, 2097, and 2080 OK

### POSSIBLE PROBLEMS
- Faulty purge valve or seals

#### 3. Are purge valve and purge valve seals OK?

- **YES**
  - Repair air dryer(s) (para 11-33 or 11-34).
  - Fault not corrected. Notify supervisor

- **NO**
  - Repair air dryer(s) (para 11-33 or 11-34).

### KNOWN INFO
- Air hoses and fittings OK
- Both air dryers fail to purge

### POSSIBLE PROBLEMS
- Faulty air governor

#### 4. Is air pressure present at the unloader port of the air governor when the compressor unloads?

- **YES**
  - Replace air governor (para 11-31).

- **NO**
  - Repair air dryer(s) (para 11-33 or 11-34).

### TEST OPTIONS
- Visual inspection

### WARNING
Read WARNING on following page.

### TEST OPTIONS
- Air Governor Test

### REASON FOR QUESTION
- Faulty purge valve seals may cause the purge valve to stick in the closed position.

- Fault not corrected. Notify supervisor

- If no air is present when the air governor air line is removed, the problem is with the governor. If air is present, the problem is with the air dryer(s).
(1) Remove three screws, gasket and exhaust tube from bottom cover.
(2) Remove purge valve from bottom cover.
(3) Inspect purge valve and seals for damage.

---

**AIR GOVERNOR TEST**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drain air system to less than 100 psi (690 kPa).</td>
</tr>
<tr>
<td>2</td>
<td>Remove lower engine access panel (para 16-2).</td>
</tr>
<tr>
<td>3</td>
<td>Remove air line no 2096 from air compressor.</td>
</tr>
</tbody>
</table>

**WARNING**

When working on a running engine, use caution around rotating parts. Tools, clothing, and hands may get caught causing serious injury or death to personnel.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Start engine (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>5</td>
<td>After several minutes, air pressure gage should stop at 120–125 psi (827–862 kPa) as air compressor cuts out.</td>
</tr>
<tr>
<td>6</td>
<td>When compressor cuts out air should come out of governor port.</td>
</tr>
<tr>
<td>7</td>
<td>Shut off engine (TM 9-2320-360-10).</td>
</tr>
</tbody>
</table>
k4. RELIEF VALVE ON AIR DRYER RELEASING AIR

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

FLOW DIAGRAM

START

1. Is air dryer(s) desiccant cartridge free from obstructions?
   - YES
   - NO
     - Service air dryer(s) (para 11–32).

2. Is relief valve on air dryers free from leaks or damage?
   - YES
   - NO
     - Repair air dryer(s) (para 11–33 and 11–34).

---

KNOWN INFO

Air hoses and fittings OK

POSSIBLE PROBLEMS

- Clogged air dryer(s) desiccant cartridge
- Leaking relief valve
- Faulty air line no. 2002, 2996

TEST OPTIONS

Refer to para 11–33 to check air dryer desiccant cartridge

REASON FOR QUESTION

Relief valve on air dryer(s) will remain open if desiccant cartridge is clogged.

---

KNOWN INFO

Air hoses and fittings OK
- Air dryer(s) desiccant cartridge OK

POSSIBLE PROBLEMS

- Leaking relief valve
- Faulty air line no. 2002, 2996

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Damaged air dryer relief valve may leak.
Refer to para 11-32 to service air dryers.

Check relief valve on air dryers for air leakage and damage.
k4. RELIEF VALVE ON AIR DRYER RELEASING AIR (CONT)

3. Are the air lines from the air dryer(s) to air reservoir no. 1 OK?

- **Known Info**
  - Air hoses and fittings OK
  - Air dryer(s) desiccant cartridge OK
  - Air dryer(s) relief valve OK

- **Possible Problems**
  - Faulty air line no. 2002, 2996

- **Test Options**
  - Visual inspection

- **Reason for Question**
  - A restricted or frozen air line between the air dryer(s) and air reservoir no. 1 may cause excessive pressure at air dryer.

- **Flow Chart**
  - **YES**
    - Fault not corrected. Notify supervisor.
  - **NO**
    - Replace air line (para 11-40).
Inspect sir lines no. 2002 and 2996 for kinks or other damage.
**K4.1 RELIEF VALVE ON AFTERCOOLER RELEASING AIR**

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**START**

1. **Is aftercooler foil filter free from obstructions?**
   - **YES**
     - Service aftercooler (para 11–34.3).
   - **NO**
     - Refer to para 11–34.3 to check aftercooler foil filter.

2. **Is relief valve on aftercooler free from leaks or damage?**
   - **YES**
     - Repair aftercooler (para 11–34.1).
   - **NO**
     - Visual inspection.

   **Reason for Question**
   - Relief valve on aftercooler will remain open if foil filter is clogged.
   - Damaged aftercooler relief valve may leak.

**Known Info**
- Air hoses and fittings OK
- Aftercooler foil filter OK

**Possible Problems**
- Clogged aftercooler foil filter
- Leaking relief valve
- Leaking relief valve
Check relief valve on aftercooler for air leakage and damage.

Refer to para 11-34.3 to check foil filter in aftercooler.
**k5. COMPRESSOR FAILS TO UNLOAD. (AIR SYSTEM PRESSURE BUILDS UP TO MORE THAN 125 PSI (862 KPA))**

### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWLEDGE INFO**

1. **Are governor signal air line no. 2159 or fittings free of leaks or damage?**

   **POSSIBLE PROBLEMS**
   - Leaking air governor signal line
   - Faulty air governor

   **TEST OPTIONS**
   - Visual inspection

   **REASON FOR QUESTION**
   - Compressor will fail to unload if governor signal air line no. 2159 is leaking.

2. **Does air governor pass test?**

   **POSSIBLE PROBLEMS**
   - Faulty air governor

   **TEST OPTIONS**
   - Air Governor Test

   **REASON FOR QUESTION**
   - Compressor will fail to unload if air governor is out of adjustment or is defective.

   **YES**
   - Adjust or replace air governor (para 11–30 or 11–31).

   **NO**
   - Replace air governor signal air line or fittings (para 11–40).

**KNOWLEDGE INFO**

- Nothing

**TEST OPTIONS**

- Nothing

**FAULT NOT CORRECTED. NOTIFY SUPERVISOR.**
Check no. 2159 governor signal air line and fittings at governor and no. 1 air tank for air leakage and damage.

**AIR GOVERNOR TEST**

1. Start engine (TM 9-2320-360-10).
2. Watch AIR PRESS gage. Green and red needles should move up scale as pressure builds up.

   **NOTE**
   Air will be released from air dryers when air governor cuts out.

3. Check AIR PRESS gage when air governor cuts out. AIR PRESS gage should read 120–125 psi (827–862 kPa) when air governor cuts out. Air governor fails test if it does not cut out at 120–125 psi (827–862 kPa).
**k6. NOISY AIR COMPRESSOR OPERATION**

**INITIAL SETUP**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**START**

1. Are air compressor oil lines or fittings free from leaks or damage?
   - **POSSIBLE PROBLEMS**
     - Leaking air compressor oil lines
     - Leaking air compressor coolant lines
     - Faulty or damaged air compressor or air compressor mounting
     - Faulty air compressor
   - **TEST OPTIONS**
     - Visual inspection
   - **REASON FOR QUESTION**
     - Leaking air compressor oil lines may cause noisy compressor operation.
   - **YES**
     - Replace air compressor oil lines or fittings (App D).
   - **NO**
     - Replace air compressor oil lines or fittings (App D).

2. Are air compressor coolant lines or fittings free from leaks or damage?
   - **POSSIBLE PROBLEMS**
     - Leaking air compressor coolant lines
     - Faulty or damaged air compressor or air compressor mounting
     - Faulty air compressor
   - **TEST OPTIONS**
     - Visual inspection
   - **REASON FOR QUESTION**
     - Leaking air compressor coolant lines may cause noisy compressor operation.
   - **YES**
     - Replace air compressor coolant lines or fittings (App D).
   - **NO**
     - Replace air compressor coolant lines or fittings (App D).
Check air compressor oil lines and fittings for leakage and damage.

Check air compressor coolant lines and fittings for leakage and damage.
k6. NOISY AIR COMPRESSOR OPERATION (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air compressor oil lines OK</td>
<td>Visual inspection</td>
<td>Damaged air compressor or mounting may cause noisy operation.</td>
</tr>
<tr>
<td>Air compressor coolant lines OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POSSIBLE PROBLEMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty or damaged air compressor or air compressor mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty air compressor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Is air compressor free from damage, and is air compressor mounting hardware secure?

- **YES**
  - Notify supervisor.

- **NO**
  - Notify supervisor.
Check air compressor for damage, and for loose or damaged mounting hardware.
k6. NOISY AIR COMPRESSOR OPERATION (CONT)

**KNOWN INFO**
- Air compressor oil lines OK
- Air compressor coolant lines OK

**POSSIBLE PROBLEMS**
- Faulty air compressor

---

**4.**

**WARNING**
Read WARNINGS on following page.

Is the amount of oil discharged by the air compressor within acceptable limits?

**TEST OPTIONS**
- Air Compressor Test

---

**REASON FOR QUESTION**
Air compressor has failed if it passes more than 6 cc of oil per hour (spot on test card is larger than 2 in. and/or has heavy splatter)

---

**NOTIFY SUPERVISOR**

Fault not corrected. Notify supervisor.
## AIR COMPRESSOR TEST

1. Drain air system (TM 9-2320-360-10).
2. Remove drain plug from no. 3 air tank.

**WARNING**

Air compressor discharge hose no. 2001 gets extremely hot during normal air compressor operation. Allow sufficient time for hose to cool before performing inspection. Failure to comply may result in injury to personnel.

3. Remove air compressor discharge hose no. 2001 and inlet hose no. 2600 from air compressor.
4. Start engine (TM 9-2320-360-10).
5. Operate engine at 2100 RPM for five minutes to bring air compressor up to operating temperature.
6. Reduce engine speed to 1800 RPM and maintain that speed.

**WARNING**

Use extreme care while holding cardboard when engine is running. Rotating engine accessories and hot engine parts may cause injury.

7. Hold a 5 in. x 10 in. (12.7 cm x 25.4 cm) piece of cardboard 1 in. (2.54 cm) from the discharge port for 1 minute.
8. Shut off engine (TM 9-2320-360-10).
9. Compare cardboard to the following:
   a. No oil spot - compressor OK
   b. Oil spot 2 in. (5 cm) or less, splatter off to one side, or light splatter - compressor OK
   c. Oil spot greater than 2 in. (5 cm) and/or heavy splatter - compressor faulty
10. Install air compressor discharge hose no. 2001 and inlet hose no. 2600 on air compressor.

**WARNING**

Pipe thread sealing compound can burn easily, can give off harmful vapors, and is harmful to skin and clothing. To avoid injury or death, keep compound away from open fire and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**

Use pipe thread sealing compound sparingly, only on pipe threads. Do not apply compound at hose connections. Failure to comply may result in component damage.

11. Coat threads of drain plug with pipe thread sealing compound.
12. Install drain plug in no. 3 air tank.
### k7. COOLANT AND/OR LUBRICANT LEAKS FROM COMPRESSOR

#### INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9–2320–360–10)
- Parking brake on (TM 9–2320–360–10)
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

#### KNOWN INFO

- **Nothing**

#### POSSIBLE PROBLEMS

- Faulty or damaged air compressor or air compressor mounting
- Leaking air compressor oil lines
- Leaking air compressor coolant lines

#### TEST OPTIONS

- **Visual inspection**

#### REASON FOR QUESTION

- Coolant and/or lubricant may leak from compressor if compressor or compressor mounting is defective.

#### KNOWN INFO

- **Air compressor and air compressor mounting OK**

#### POSSIBLE PROBLEMS

- Leaking air compressor oil lines
- Leaking air compressor coolant lines

#### TEST OPTIONS

- **Visual inspection**

#### REASON FOR QUESTION

- Oil lines which supply air compressor with lubricant may leak.

---

**Start**

1. **Is air compressor free from leaks, and is air compressor mounting hardware secure?**

   - NO: Notify supervisor.
   - YES: **Are air compressor oil lines or fittings free from leaks or damage?**

2. **Are air compressor oil lines or fittings free from leaks or damage?**

   - NO: Replace air compressor oil lines or fittings (App D).
   - YES: **Are air compressor oil lines or fittings free from leaks or damage?**

---

2-772
Check air compressor for leaks, and for loose or damaged mounting hardware.

Check air compressor oil lines and fittings for leakage and damage.
K7. COOLANT AND/OR LUBRICANT LEAKS FROM COMPRESSOR (CONT)

Are air compressor coolant lines or fittings free from leaks or damage?

- YES
- NO

Fault not corrected. Notify supervisor.

Replace air compressor coolant lines or fittings (App D).

Test Options

Visual inspection

Reason for Question

Leaking air compressor coolant lines

Air compressor and air compressor mounting OK
Air compressor oil lines OK

Possible Problems

Coolant lines which supply air compressor with coolant may leak.

Known Info

YES

No problems found.

NO

Leaking air compressor coolant lines
Check air compressor coolant lines and fittings for leakage and damage.
k8. AIR PRESSURE DROPS RAPIDLY AFTER ENGINE SHUTDOWN

INITIAL SETUP

Equipment Conditions
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

1. **Is drain valve on air reservoirs free from leaks or damage?**

   - **NO**
     - Replace drain valve(s) (para 11-19 through 11-23).
   - **YES**

2. **Are air lines or fittings free from leaks or damage?**

   - **NO**
     - Replace damaged air lines and fittings (para 11-40).
   - **YES**

---

TEST OPTIONS

- Visual inspection

REASON FOR QUESTION

- Air pressure will drop rapidly after engine shutdown if drain valve on air reservoirs is leaking.
- Air pressure will drop rapidly after engine shutdown if air lines or fittings are leaking.
Check drain valve on air reservoirs for leakage and damage.

Check air lines and fittings for leakage and damage.
k8. AIR PRESSURE DROPS RAPIDLY AFTER ENGINE SHUTDOWN (CONT)

- **KNOWN INFO**
  - Trailer air supply control OFF
  - Drain valves OK
  - Air lines and fittings OK

- **POSSIBLE PROBLEMS**
  - Leaking air inlet check valves

- **TEST OPTIONS**
  - Air Inlet Check Valve Inspection

- **REASON FOR QUESTION**
  - Air pressure will drop rapidly after engine shutdown if check valves on no. 2 or no. 3 air reservoirs are leaking.

---

<table>
<thead>
<tr>
<th>3.</th>
<th>Are check valves at no. 2 and no. 3 air reservoirs free from leaks or damage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Replace check valves (para 11–20 or 11–21).</td>
</tr>
<tr>
<td>YES</td>
<td>Fault not corrected. Notify supervisor.</td>
</tr>
</tbody>
</table>
AIR INLET CHECK VALVE INSPECTION

(1) Remove air line no. 2184 from no. 2 air reservoir check valve.
(2) Remove air line no. 2613 from no. 3 air reservoir check valve.
(3) Inspect check valves on no. 2 and no. 3 air reservoirs for air leakage.
(4) Install air line no. 2613 on no. 3 air reservoir check valve.
(5) Install air line no. 2184 on no. 2 air reservoir check valve.
### k9. WINDSHIELD WASHER DOES NOT OPERATE

#### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter, (Item 20, Appendix F)

#### KNOWN INFO

<table>
<thead>
<tr>
<th>Washer spray openings clean</th>
<th>Horns (city and country ) OK</th>
<th>Green needle on air pressure gage over 65 psi (448 kPa)</th>
<th>Circuit breaker OK</th>
<th>Washer fluid level OK</th>
</tr>
</thead>
</table>

#### POSSIBLE PROBLEMS

- Faulty electrical circuit
- Air hose no. 2785 leaking or damaged
- Faulty air fittings
- Faulty windshield washer solenoid
- Windshield washer hoses leaking or damaged
- Faulty windshield washer reservoir

#### TEST OPTIONS

**Is air pressure present at windshield washer reservoir?**

**Reason for Question**
- No air pressure at reservoir indicates hose from valve to reservoir is faulty.

#### KNOWN INFO

<table>
<thead>
<tr>
<th>Washer spray openings clean</th>
<th>Horns (city and country ) OK</th>
<th>Green needle on air pressure gage over 65 psi (448 kPa)</th>
<th>Circuit breaker OK</th>
<th>Washer fluid level OK</th>
<th>Electrical circuit OK</th>
<th>Air hose no. 2785 OK</th>
<th>Air fittings OK</th>
<th>Windshield washer solenoid OK</th>
</tr>
</thead>
</table>

#### POSSIBLE PROBLEMS

- Windshield washer hoses leaking or damaged
- Faulty windshield washer reservoir

#### TEST OPTIONS

**Are windshield washer fluid hoses free from leaks and restrictions?**

**Reason for Question**
- Windshield washer will not operate if windshield washer hoses are leaking or restricted. Windshield washer reservoir is faulty if hoses are not leaking or restricted.

#### TEST OPTIONS

**Reason for Question**
- Windshield Washer Reservoir Test

**Reason for Question**
- Visual inspection
Check windshield washer hoses for leakage and restrictions.

**NOTE**
Windshield washer will not operate until AIR PRESS gage reads greater than 65 psi (448 kPa).

<table>
<thead>
<tr>
<th>WINDSHIELD WASHER RESERVOIR TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1)</strong> Turn engine switch to ON position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td><strong>(2)</strong> Remove air supply hose from reservoir.</td>
</tr>
<tr>
<td><strong>(3)</strong> Press windshield washer switch while assistant checks for air.</td>
</tr>
<tr>
<td><strong>(4)</strong> Install air supply hose on reservoir.</td>
</tr>
<tr>
<td><strong>(5)</strong> Turn engine switch to OFF position (TM 9–2320–360–10).</td>
</tr>
</tbody>
</table>
k9. WINDSHIELD WASHER DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Washer spray openings clean
- Horns (city and country) OK
- Green needle on air pressure gage over 65 psi (448 kPa)
- Circuit breaker OK
- Washer fluid level OK

**POSSIBLE PROBLEMS**
- Faulty electrical circuit
- Air hose no. 2785 leaking or damaged
- Faulty air fittings
- Faulty windshield washer solenoid

---

**TEST OPTIONS**
- Wire no. 1921 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- If low voltage is measured on wire no. 1921 at windshield washer solenoid, electrical circuit is faulty.

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Air pressure may not be available to operate windshield washer if air hose no. 2785 is leaking or damaged.

---

**KNOWN INFO**
- Washer spray openings clean
- Horns (city and country) OK
- Green needle on air pressure gage over 65 psi (448 kPa)
- Circuit breaker OK
- Washer fluid level OK
- Electrical circuit OK

**POSSIBLE PROBLEMS**
- Air hose no. 2785 leaking or damaged
- Faulty air fittings
- Faulty windshield washer solenoid

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Windshield washer may not operate if fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve are leaking or damaged.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>WIRE NO. 1921 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Turn engine switch to ON position.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on wire no. 1921 at windshield washer solenoid valve.</td>
</tr>
<tr>
<td>(3) Place negative (-) probe of multimeter on ground.</td>
</tr>
<tr>
<td>(4) Press windshield washer switch and look for 10–14 volts on multimeter.</td>
</tr>
<tr>
<td>(5) Turn engine switch to OFF position.</td>
</tr>
</tbody>
</table>

Check air hose no. 2785 and fittings from air manifold to air manifold for leakage and damage.

Check fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve for leakage or damage.
Is air pressure present at outlet port of windshield washer solenoid valve?

**KNOW LED INFO**
- Washer spray openings clean
- Horns (city and country) OK
- Green needle on air pressure gage over 65 psi (448 kPa)
- Circuit breaker OK
- Washer fluid level OK
- Electrical circuit OK
- Air hose no. 2785 OK
- Air fittings OK

**POSSIBLE PROBLEMS**
- Faulty windshield washer solenoid

**TEST OPTIONS**
- Windshield Washer Solenoid Valve Test

**REASON FOR QUESTION**
- Windshield washer solenoid valve is defective if no air flows from outlet port of valve when windshield washer switch is pressed.

**Fault not corrected. Notify supervisor.**
- Replace windshield washer solenoid valve (para 11-37).
### WINDSHIELD WASHER SOLENOID VALVE TEST

**NOTE**
Air pressure must be at least 65 psi (448 kPa) to perform test.

1. Remove clip and rubber hose from windshield washer solenoid valve.
2. Turn ENGINE switch to ON
3. Press windshield washer switch and check for air at outlet port of windshield washer solenoid valve.
4. Turn ENGINE switch to OFF.
5. Install rubber hose on windshield washer solenoid valve with clip.
k10. HORN (COUNTRY) DOES NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

**Personnel Required**
- Two

---

**KNOWN INFO**

**Horn valve lever operates freely**
- Green needle on air pressure gage over 65 psi (448 kPa)

**POSSIBLE PROBLEMS**
- Faulty air horns
- Leaking or restricted air line
- Faulty air horn control valve

---

**TEST OPTIONS**

**Air Horn Inspection**

**REASON FOR QUESTION**
- Air pressure reaching horns indicates system is operating correctly and air horns are defective. NO air pressure at horns indicates faulty air lines or faulty control valve.

---

**KNOWLEDGE**

1. **Does air flow from air lines no. 2036 and no. 2039 air lines when air horn chain is pulled?**

   **YES**
   - Go to step 2.

   **NO**
   - Replace air horn(s) (para 18-7).

---

2. **Is air pressure present at air line no. 2037 at air horn control valve?**

   **YES**
   - Replace air line or fittings (para 11-40).

   **NO**
   - Replace air line or fittings (para 11-40).

---

**POSSIBLE PROBLEMS**
- Leaking or restricted air line
- Faulty air horn control valve

---

**TEST OPTIONS**

**Visual Inspection**

**REASON FOR QUESTION**
- Country horn may not operate if no. 2037 air line or fittings are leaking or restricted.
NOTE

- Country horn will not operate until AIR PRESS gage reads greater than 65 psi (448 kPa).
- Both air horns should operate when air horn control valve is activated with pull chain.

<table>
<thead>
<tr>
<th>AIR HORN INSPECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove air lines no. 2036 and no. 2039 from air horns.</td>
</tr>
<tr>
<td>(2) Pull air horn chain (TM 9-2320-360-10) while assistant checks for air at no. 2036 and no. 2039 air lines.</td>
</tr>
<tr>
<td>(3) Install air lines no. 2036 and no. 2039 on air horns.</td>
</tr>
</tbody>
</table>

(1) Check air line no. 2037 and fittings from air manifold to air horn control valve for leakage or damage.
(2) Loosen air line no. 2037 at air horn control valve to check for air pressure.
3. Does air flow through air horn control valve when air horn chain is pulled?

- **NO**
  - Replace air horn control valve (para 18-8).

- **YES**
  - Replace air lines or fittings (para 11-40).

**KNOWN INFO**
- Horn valve lever operates freely
- Green needle on air pressure gage over 65 psi (448 kPa)
- Air horns OK
- Air line no. 2037 OK

**POSSIBLE PROBLEMS**
- Leaking or restricted air line
- Faulty air horn control valve

**TEST OPTIONS**
- Air Horn Control Valve Test

**REASON FOR QUESTION**
- Air horn control valve is defective if no air flows through air horn control valve when air horn chain is pulled. Country horn may not operate if air lines no. 2036 and no. 2039 are leaking or damaged.
<table>
<thead>
<tr>
<th><strong>AIR HORN CONTROL VALVE TEST</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove air line no. 2039 from air horn control valve.</td>
</tr>
<tr>
<td>(2) Pull air horn chain and check for air at control valve outlet port.</td>
</tr>
<tr>
<td>(3) Install air line no. 2039 on air horn control valve.</td>
</tr>
</tbody>
</table>
k11. HORN (CITY) DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Personnel Required
- Two

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

Start

1. Does air fail to flow from air line no. 2036 when horn button is pressed?

   NO
   - Replace air horn (para 18–7).

   YES

2. Is air line no. 2036 at city air horn free from leaks or restrictions?

   NO
   - Replace air line (para 11–40).

   YES

reason for question

TEST OPTIONS

City Horn Inspection

TEST OPTIONS

Visual inspection

reason for question

KNOWN INFO
- Green needle on air pressure gage over 65 psi (448 kPa)

POSSIBLE PROBLEMS
- Faulty air horn
- Leaking or restricted air horn air line
- Damaged fittings connecting air manifold, windshield washer/ city horn pressure regulator, and windshield washer solenoid valve
- Incorrect windshield washer/city horn air pressure
- Faulty city horn solenoid valve
- Faulty air horn double check valve

KNOWN INFO
- Green needle on air pressure gage over 65 psi (448 kPa)
- Air horn OK

POSSIBLE PROBLEMS
- Leaking or restricted air horn air line
- Damaged fittings connecting air manifold, windshield washer/ city horn pressure regulator, and windshield washer solenoid valve
- Incorrect windshield washer/city horn air pressure
- Faulty city horn solenoid valve
- Faulty air horn double check valve

Green needle on air pressure gage over 65 psi (448 kPa)

Air horn OK

Leaking or restricted air horn air line

Damaged fittings connecting air manifold, windshield washer/ city horn pressure regulator, and windshield washer solenoid valve

Incorrect windshield washer/city horn air pressure

Faulty city horn solenoid valve

Faulty air horn double check valve

Damaged fittings connecting air manifold, windshield washer/ city horn pressure regulator, and windshield washer solenoid valve

Incorporate windshield washer/city horn air pressure

Faulty city horn solenoid valve

Faulty air horn double check valve

City horn may not operate if air line no. 2036 is leaking or restricted.
NOTE

- Perform Electrical System Troubleshooting (e7. Horn (city) does not operate) before performing steps below.
- City horn will not operate until AIR PRESS gage reads greater than 65 psi (448 kPa).
- City horn is the top air horn.

**CITY HORN INSPECTION**

1. Remove air lines no. 2036 from city horn.
2. Turn ENGINE switch to ON (TM 9-2320-360-10).
3. Press horn button while assistant checks for air pressure at air line no. 2036.
4. Turn ENGINE switch to OFF (TM 9-2320-360-10).
5. Install air line no. 2036 on city horn.

Check air line no. 2036 at city air horn for leakage and restrictions.
**k11. HORN (CITY) DOES NOT OPERATE (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green needle on air pressure gage over 65 psi (448 kPa)</td>
<td>Visual inspection</td>
<td>City horn may not operate if fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve are leaking or damaged.</td>
</tr>
<tr>
<td>Air horn OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air horn air line OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damaged fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect windshield washer/city horn air pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty city horn solenoid valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty air horn double check valve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TEST OPTIONS**

<table>
<thead>
<tr>
<th>Test Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>City horn may not operate if fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve are leaking or damaged.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green needle on air pressure gage over 65 psi (448 kPa)</td>
<td>Refer to air pressure regulators adjustment procedure (para 11–37)</td>
<td>City horn and windshield washers share a common air source at the air pressure regulator. If the windshield washers also do not work, pressure regulator is faulty.</td>
</tr>
<tr>
<td>Air horn OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air horn air line OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect windshield washer/city horn air pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty city horn solenoid valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty air horn double check valve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to air pressure regulators adjustment procedure (para 11–37)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green needle on air pressure gage over 65 psi (448 kPa)</td>
<td>City Horn Solenoid Valve Test</td>
<td>City horn solenoid valve is defective if no air is present at outlet side of valve when horn button is pressed. Air horn double check valve is faulty if air is present.</td>
</tr>
<tr>
<td>Air horn OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air horn air line OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty city horn solenoid valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faulty air horn double check valve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Horn Solenoid Valve Test</td>
<td></td>
</tr>
</tbody>
</table>

| REASON FOR QUESTION | |
|----------------------| |
| City horn and windshield washers share a common air source at the air pressure regulator. If the windshield washers also do not work, pressure regulator is faulty. | |
Check fittings connecting air manifold, windshield washer/city horn pressure regulator, and windshield washer solenoid valve for leakage and damage.

Refer to para 11–37 to adjust or replace windshield washer/city horn air pressure regulator.

CITY HORN SOLENOID VALVE TEST

1. Remove air line no. 2040 from city horn solenoid valve.
2. Turn ENGINE switch to ON (TM 9–2320–360–10).
3. Press horn button and check for air at outlet port of city horn solenoid valve.
5. Install air line no. 2040 on city horn solenoid valve.
INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

k12. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS POSITIONED TO LOW

<table>
<thead>
<tr>
<th>INITIAL SETUP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment Conditions</strong></td>
</tr>
<tr>
<td>Wheels chocked.</td>
</tr>
<tr>
<td><strong>Tools and Special Tools</strong></td>
</tr>
<tr>
<td>Tool Kit, Genl Mech (Item 54, Appendix F)</td>
</tr>
</tbody>
</table>

**KNOWN INFO**
Fault not corrected from transfer case troubleshooting, section g4.
All wheel drive indicator out

**POSSIBLE PROBLEMS**
Leaking air lines or fittings
Faulty push valve
Faulty check valve

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Transfer case will not lock up if air lines or fittings are leaking or damaged.

**KNOWN INFO**
Air lines and fittings OK

**POSSIBLE PROBLEMS**
Faulty push valve
Faulty check valve

**TEST OPTIONS**
Push Valve Test

**REASON FOR QUESTION**
Push valve is defective or requires adjustment if no air flows thru valve with TRANSFER CASE shift lever positioned in LOW.
NOTE

- Transfer case will not lockup until AIR PRESS gage reads greater than 65 psi (448 kPa).
- Perform Transfer Case Troubleshooting (g4, Transfer case dies not engage front axle when shift lever is positioned to LOW) before starting steps given below.
- Refer to air hose diagrams in front of this system troubleshooting section for air line locations.

Check the following air lines and fittings for leakage and damage.

- Air line no. 2074 from no. 2 air reservoir to air manifold
- Air line no. 2785 from air manifold to air manifold
- Air line no. 2765 from air manifold to driveline lockup valve
- Air line no. 2761 from air manifold to push valve
- Air line no. 2762 from push valve to interaxle lockup pilot valve
- Air line no. 2769 from interaxle lockup pilot valve to check valve
- Air line no. 2769 from check valve to transfer case lockout shift air chamber
- Air line no. 2766 from driveline lockup valve to interaxle lockup pilot valve

---

**PUSH VALVE TEST**

1. Start engine (TM 9–2320–360–10) and allow air pressure to build greater than 65 psi (448 kPa).
3. Position TRANSFER CASE shift lever to LOW.
4. Loosen air line no. 2762 from push valve and check for air flow from push valve.
5. Tighten air line no. 2762 on push valve.
**k12. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS POSITIONED TO LOW (CONT)**

**KNOWN INFO**
- Air lines and fittings OK
- Push valve OK

**POSSIBLE PROBLEMS**
- Faulty check valve

**3.**
Does air flow from check valve?

- **YES**: Fault not corrected. Notify supervisor.
- **NO**: Replace check valve (para 11-37).

**TEST OPTIONS**
- Check Valve Test

**REASON FOR QUESTION**
Check valve is defective if no air flows thru valve with TRANSFER CASE shift lever positioned in LOW.
**WARNING**
Due to the air system pressure, be sure to wear the proper eye protection to avoid personal injury.

### CHECK VALVE TEST

1. Start engine (TM 9–2320–360–10) and allow air pressure to build greater than 65 psi (448 kPa).
3. Position TRANSFER CASE shift lever to LOW.
4. Loosen air line no. 2769 from check valve and check for air flow from check valve.
5. Tighten air line no. 2769 on check valve.
k13. TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS POSITIONED IN HIGH AND DRIVELINE CONTROL IS POSITIONED IN LOCK

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)

TEST OPTIONS
- Driveline Lockup Valve Test

POSSIBLE PROBLEMS

Leaking air lines or fittings
Faulty driveline lockup valve
Faulty check valve

SELECTED ACTIONS

1. Are transfer case lockup air lines and fittings free from leaks or damage?
   - NO: Replace damaged air lines or fittings (para 11–46).
   - YES: Replace driveline lockup valve (para 11–37).

2. Does air flow from driveline lockup valve?
   - NO: Replace driveline lockup valve with DRIVELINE control positioned in LOCK.
   - YES: Driveline lockup valve is defective if no air flows thru valve with DRIVELINE control positioned in LOCK.
NOTE

- Transfer case will not engage front axle until AIR PRESS gage reads greater than 65 psi (448 kPa).
- Perform Transfer Case Troubleshooting (g5, Transfer case does not engage front axle when shift lever is positioned in HIGH and driveline control is positioned to LOCK) before starting steps given below.
- Refer to air hose diagrams in front of this system troubleshooting section for air line locations.

Check the following air lines and fittings for leakage and damage.

- Air line no. 2074 from no. 2 air reservoir to air manifold
- Air line no. 2785 from air manifold to air manifold
- Air line no. 2765 from air manifold to driveline lockup valve
- Air lines no. 2766 and no. 2769 from driveline lockup valve to transfer case lockout shift air chamber.

DRIVELINE LOCKUP VALVE TEST

(1) Start engine (TM 9-2320-360-10) and allow air pressure to build greater than 65 psi (448 kPa).
(2) Shut off engine (TM 9-2320-360-10).
(3) Position DRIVELINE control to LOCK.
(4) Loosen air line no. 2766 on driveline lockup valve and check for air flow from driveline lockup valve.
(5) Tighten air line no. 2766 on driveline lockup valve.
k13. **TRANSFER CASE DOES NOT ENGAGE FRONT AXLE WHEN TRANSFER CASE SHIFT LEVER IS POSITIONED IN HIGH AND DRIVELINE CONTROL IS POSITIONED IN LOCK (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>All wheel drive indicator out</td>
<td>Faulty check valve</td>
</tr>
<tr>
<td>Air lines and fittings OK</td>
<td></td>
</tr>
<tr>
<td>Driveline lockup valve OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check Valve Test</td>
<td>Check valve is defective if no air flows thru valve with TRANSFER CASE shift lever positioned in HIGH and DRIVELINE control positioned in LOCK.</td>
</tr>
</tbody>
</table>

3. **Does air flow from check valve?**

- **YES**
  - Fault not corrected. Notify supervisor.

- **NO**
  - Replace check valve (para 11-37).
**CHECK VALVE TEST**

1. Start engine (TM 9–2320–360–10) and allow air pressure to build greater than 65 psi (448 kPa).
3. Position TRANSFER CASE shift lever to LOW.
4. Loosen air line no. 2769 from check valve and check for air flow from check valve.
5. Tighten air line no. 2769 on check valve.
### m. WHEELS, TIRES, AND HUBS

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>m1. Tires wear unevenly or excessively</td>
<td>2–806</td>
</tr>
<tr>
<td>m2. Wheel wobbles or shimmies</td>
<td>2–808</td>
</tr>
</tbody>
</table>
m1. TIRES WEAR UNEVENLY OR EXCESSIVELY

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**
- Tire pressure is OK

**POSSIBLE PROBLEMS**
- Shock absorbers damaged or leaking
- Improper toe-in

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Faulty shock absorbers may lead to uneven tire wear.

---

**KNOWN INFO**
- Tire pressure is OK
- Shock absorbers OK

**POSSIBLE PROBLEMS**
- Improper toe-in

---

**TEST OPTIONS**
- Tie rod adjustment

**REASON FOR QUESTION**
- Tie rods adjusted incorrectly (improper toe-in) will cause tires to wear unevenly or excessively.

---

**START**

1. Are shock absorbers free from leaks or damaged?

   - **NO**
     - **Replace shock absorber (para 15–3).**

   - **YES**

2. Are the no. 1 axle and no. 4 axle tie rods adjusted correctly?

   - **NO**
     - Notify supervisor

   - **YES**

Fault not corrected. Notify supervisor.
Inspect tires for excessive wear. Tires that have flat spots indicate a defective shock absorber. Inspect shock absorbers for leaks or damage.

Refer to tie rod adjustment procedure (para 13-4).
m2. WHEEL WOBBLIES OR SHIMMIES

INITIAL SETUP
Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

TOOKN INFO
Nothing

POSSIBLE PROBLEMS
Missing or damaged lugnuts
Bent wheel
Tie rods bent or out of adjustment

Lugnuts OK

POSSIBLE PROBLEMS
Bent wheel
Tie rods bent or out of adjustment

WARNING
Read WARNING on following page.

Are lugnuts secure and free from damage?

Replace missing or damaged lugnut(s). Tighten loose lugnut(s) 450–550 lb-ft (610–746 N·m).

YES

NO

REASON FOR QUESTION
Loose, missing, or damaged lugnuts may cause wheel to wobble or shimmy.

TEST OPTIONS
Lugnut Check

TEST OPTIONS
Wheel Runout Check

REASON FOR QUESTION
Bent wheel will wobble or shimmy.

WARNING
Read WARNING on following page.

Is wheel free from damage?

Replace damaged wheel(s) (para 12–5).

YES

NO
### LUGNUT CHECK

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Remove four nuts and wheel cover from tire assembly.</td>
</tr>
<tr>
<td></td>
<td><strong>WARNING</strong> After removing the wheel cover, if any bolts are found loose or broken, deflate the tire completely before attempting to loosen lugnuts. Failure to comply may result in injury to personnel.</td>
</tr>
<tr>
<td>2.</td>
<td>Check if any lugnuts are loose, missing, or damaged.</td>
</tr>
<tr>
<td>3.</td>
<td>Tighten loose lugnuts 450–550 lb-ft (610–746 N-m).</td>
</tr>
<tr>
<td>4.</td>
<td>Install wheel cover on tire assembly with four nuts.</td>
</tr>
</tbody>
</table>

### WHEEL RUNOUT CHECK

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>WARNING</strong> HET Tractor must be on level ground and wheels must be chocked before parking brake is released. Otherwise, HET Tractor may roll and cause personnel injury.</td>
</tr>
<tr>
<td>3.</td>
<td>Rotate tire to check for bent wheel.</td>
</tr>
</tbody>
</table>
m2. WHEEL WOBBLING OR SHIMMIES (CONT)

**KNOWN INFO**

- Lugnuts OK
- Wheel OK

**POSSIBLE PROBLEMS**

- Tie rods bent or out of adjustment

3. **Are tie rod ends free from damage and adjusted properly?**

   - **NO**
   - Inspect/adjust or replace tie rod(s) (para 13-4).

   - **YES**
   - Fault not corrected. Notify supervisor.

**TEST OPTIONS**

- Inspect/Adjust Or Replace Tie Rod(s) (para 13-4).

**REASON FOR QUESTION**

- If tie rod is out of adjustment or damaged, wheels may wobble or shimmy.
Check front and rear tie rods for cracks, bends, and/or loose or damaged mounting hardware. Refer to para 13-4 for tie rod adjustment and/or replacement procedures.
### CENTRAL TIRE INFLATION SYSTEM

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n1. One tire will not inflate</td>
<td>2–812</td>
</tr>
<tr>
<td>n2. Excess inflation time, CTIS green indicator flashes too long or continually</td>
<td>2–816</td>
</tr>
<tr>
<td>n3. CTIS inoperative</td>
<td>2–826</td>
</tr>
<tr>
<td>n4. Tires do not deflate to lower pressure setting</td>
<td>2–830</td>
</tr>
<tr>
<td>n5. Tire pressures do not agree with CTIS settings</td>
<td>2–836</td>
</tr>
<tr>
<td>n6. Power manifold clicks continually/LOW AIR light flashing</td>
<td>2–840</td>
</tr>
<tr>
<td>n7. Deleted</td>
<td></td>
</tr>
<tr>
<td>n8. Tires deflate upon completion of adjustment cycle</td>
<td>2–852</td>
</tr>
<tr>
<td>n9. CTIS low air indicator stays on over 90 psi (621 kPa)</td>
<td>2–858</td>
</tr>
<tr>
<td>n10. Overspeed light does not function</td>
<td>2–862</td>
</tr>
<tr>
<td>n11. Deleted</td>
<td></td>
</tr>
</tbody>
</table>
n1. ONE TIRE WILL NOT INFLATE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Gage, Tire Pressure (Item 13, Appendix F)
- Goggles, Industrial (Item 14, Appendix F)

**Materials/Parts**
- Chips, Soap (Item 13, Appendix C)

---

**TEST OPTIONS**

**TEST OPTIONS**

**REASON FOR QUESTION**

Tire will not inflate if there are air leaks to wheel valve.

---

**WARNING**

Read WARNING on following page.

---

1. Are air lines, fittings, and bulkhead connections to affected wheel OK?

   **POSSIBLE PROBLEMS**
   - Faulty air lines and fittings
   - Faulty CTIS hoses or tubes
   - Faulty CTIS wheel valve
   - Faulty wheel/tire assembly

   **KNOWLEDGE**
   - Nothing

   **TEST OPTIONS**
   - Visual inspection

   **REACTION FOR QUESTION**
   - Repair air lines and fittings (para 11–40).

2. Are CTIS hoses from wheel hub to CTIS wheel valve OK?

   **POSSIBLE PROBLEMS**
   - Faulty CTIS hoses or tubes
   - Faulty CTIS wheel valve
   - Faulty wheel/tire assembly

   **KNOWLEDGE**
   - Air lines and fittings OK

   **TEST OPTIONS**
   - Visual inspection

   **REACTION FOR QUESTION**
   - Repair CTIS hose(s) (para 12–4).
NOTE
Excessive inflation time, sometimes accompanied by low air light is normal with engine at idle and/or with use of air operated accessories.

Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.

CTIS air lines are pressurized only when CTIS is in inflate, deflate, or test cycles.

Tests 1 thru 4 can be made consecutively while the CTI system is in the inflate cycle.

Soap solution may be used to detect air leaks.

WARNING
Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.

Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.
n1. ONE TIRE WILL NOT INFLATE (CONT)

**KNOWN INFO**
- Air lines and fittings OK
- CTIS hoses OK

**POSSIBLE PROBLEMS**
- Faulty CTIS tubes
- Faulty CTIS wheel valve
- Faulty wheel/tire assembly

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Tire will not properly inflate if CTIS wheel valve is leaking high volume of air.

3. Are CTIS tubes from wheel valve to tire OK?

- YES
  - **TEST OPTIONS**
    - Pressure Check
  - **REASON FOR QUESTION**
    - Faulty CTIS tubes
    - Faulty CTIS wheel valve
    - Faulty wheel/tire assembly

- NO
  - **TEST OPTIONS**
    - Visual inspection
  - **REASON FOR QUESTION**
    - Tire will not properly inflate if CTIS wheel valve is leaking high volume of air.

4. Is the CTIS wheel valve OK (not damaged)?

- YES
  - **TEST OPTIONS**
    - Visual inspection
  - **REASON FOR QUESTION**
    - Faulty CTIS wheel valve
    - Faulty wheel/tire assembly

- NO
  - **TEST OPTIONS**
    - Repair CTIS tube(s) (para 12-4).
  - **REASON FOR QUESTION**
    - Tire will not properly inflate if CTIS wheel valve is leaking high volume of air.

5. Is inflation pressure measured at valve stem when CTIS is activated?

- YES
  - **TEST OPTIONS**
    - Pressure Check
  - **REASON FOR QUESTION**
    - Faulty CTIS tubes
    - Faulty CTIS wheel valve
    - Faulty wheel/tire assembly

- NO
  - **TEST OPTIONS**
    - Repair CTIS tube(s) (para 12-4).
  - **REASON FOR QUESTION**
    - Tire will not properly inflate if tubes to tire are leaking air.

**WARNING**
- Read WARNING on following page.
- Repair CTIS tube(s) (para 12-4).
• Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
• Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

**NOTE**
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).</td>
<td></td>
</tr>
<tr>
<td>3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).</td>
<td></td>
</tr>
<tr>
<td>4) Check CTIS wheel valves for air leaks, damage, or crimps.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
Some air leakage may occur at breather during inflation/deflation cycles. Rapid exhaust of air at breather indicates a faulty valve.

• Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Remove cap from valve stem.</td>
<td></td>
</tr>
<tr>
<td>3) Connect tire pressure gage to valve stem and record pressure.</td>
<td></td>
</tr>
<tr>
<td>4) Set CTIS switch to HIGHWAY position (TM 9–2320–360–10).</td>
<td></td>
</tr>
<tr>
<td>5) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).</td>
<td></td>
</tr>
<tr>
<td>6) Reconnect tire pressure gage to valve stem and check for increased inflation pressure.</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**
Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death. 

Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.
## n1. ONE TIRE WILL NOT INFLATE (CONT)

### Known Info
- Air lines and fittings OK
- CTIS hoses and tubes OK
- CTIS wheel valve OK

### Possible Problems
- Faulty wheel/tire assembly

### Test Options
- Visual inspection

### Reason for Question
Tire will not properly inflate if there are air leaks on tire side of wheel valve.

---

**Diagram:**

1. **Do wheel/tire assemblies hold air pressure?**
   - **YES:** Repair wheel/tire assembly (para 12-5).
   - **NO:** Faults not corrected. Notify supervisor.

2. **Known Info**
   - Air lines and fittings OK
   - CTIS hoses and tubes OK
   - CTIS wheel valve OK

3. **Possible Problems**
   - Faulty wheel/tire assembly

---

**Form:**

<table>
<thead>
<tr>
<th>Known Info</th>
<th>Test Options</th>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air lines and fittings OK</td>
<td>Visual inspection</td>
<td>Tire will not properly inflate if there are air leaks on tire side of wheel valve.</td>
</tr>
<tr>
<td>CTIS hoses and tubes OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTIS wheel valve OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Apply soap solution to wheel and tire. Check for air leaks or damage.
n2. EXCESS INFLATION TIME, CTIS GREEN INDICATOR FLASHES TOO LONG OR CONTINUALLY, AIR LEAK DURING CTIS OPERATION

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Goggles, Industrial (Item 14, Appendix F)
Multimeter (Item 20, Appendix F)

Materials/Parts
Chips, Soap (Item 13, Appendix C)

-----------------------------------

WARNING
Read WARNING on following page.

START

1. Is air line no. 2100 OK (not leaking or damaged)?

   NO
   Repair air line and/or fitting (para 11–40).

   YES

2. Is exhaust port (hose no. 2120) quiet (no air leaking)?

   NO
   Air leaking from hose no. 2120, go to step 13.

   YES

-----------------------------------

KNOWING INFO

1. Circuit breaker not tripped
2. Air line no. 2100 OK

POSSIBLE PROBLEMS

1. Axle manifold faulty
2. Air lines faulty
3. CTIS hoses or tubes faulty
4. CTIS wheel valve faulty
5. Power manifold faulty
6. Relief valve faulty
7. Wheel hub seals faulty

-----------------------------------

TEST OPTIONS

Visual inspection.

REASON FOR QUESTION

1. Air pressure leaking from air lines and/or fittings will increase inflation times.
2. Air pressure leaking from exhaust port will increase inflation time.
WARNING
- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE
- The CTI system initially and periodically checks for system air leaks. The CTIS will display a flashing LOW AIR light and shut off if 6 psi cannot be maintained by the CTI system. The manifold will click during this test for approximately 1.5 minutes.
- Excessive inflation times (without low air light) are caused by minor leaks in CTI system.
- CTIS air lines are pressurized only when CTIS is in inflate, deflate, or test cycles.
- Tests 1 thru 5 can be made consecutively while the CTI system is in the inflate cycle.
- Normal inflation time from EMERGENCY to HIGHWAY setting is approximately 12 minutes at high idle.
- Excess inflation times, sometimes accompanied by a LOW AIR light is normal if engine is at idle RPM and/or air operated accessories are being used.
- Soap solution may be used to detect air leaks.

(1) Deflate tire to 60 psi (414 kPa or less).
(2) Start engine (TM 9–2320–360–10).
(3) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(4) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(5) Check air line no. 2100 from reservoir to supply port for air leaks, damage, or crimps.

NOTE
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check exhaust air line no. 2120 from porting block for air escaping.
n2. EXCESS INFLATION TIME, CTIS GREEN INDICATOR FLASHES TOO LONG OR CONTINUALLY, AIR LEAK DURING CTIS OPERATION (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Air line no. 2100 OK
- Air exhausted from porting block

**POSSIBLE PROBLEMS**
- Axle manifold faulty
- Air lines faulty
- CTIS hoses or tubes faulty
- CTIS wheel valve faulty
- Power manifold faulty
- Relief valve faulty
- Wheel hub seals faulty

---

3. **WARNING**
Read WARNING on following page.

Are the air lines from the porting block to the axle manifolds OK?

If NO, Repair air lines and fittings (para 11-40).

If YES, TEST OPTIONS

**TEST OPTIONS**
- Visual inspection.

**REASON FOR QUESTION**
- Air pressure leaking from air lines or fittings will increase inflation times.

---

4. Are the axle manifolds OK (not leaking or damaged)?

If NO, Replace axle manifold (para 12-2).

If YES, TEST OPTIONS

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Air pressure leaking from axle manifolds will increase inflation times.

---

5. Are air lines, fittings, and bulkhead connectors from axle manifolds OK?

If NO, Repair air lines and fittings (para 11-40).

If YES, TEST OPTIONS

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Air pressure leaking from air lines or fittings will increase inflation times.
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).

(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).

(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).

(4) Check air lines from the porting block to the axle manifolds for air leaks.


NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).

(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).

(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).

(4) Check axle manifolds for air leaks.


NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).

(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).

(3) Move CTIS switch to ON position (TM 9–2320–360–10).

(4) Check air lines, fittings and bulkhead connections from axle manifold to axle spindle for air leaks, damage, or crimps.

n2. EXCESS INFLATION TIME, CTIS GREEN INDICATOR FLASHES TOO LONG OR CONTINUALLY, AIR LEAK DURING CTIS OPERATION (CONT)

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- Air line no. 2100 OK
- Air exhausted from porting block
- Axle manifold OK

**POSSIBLE PROBLEMS**
- CTIS hoses or tubes faulty
- CTIS wheel valve faulty
- Power manifold faulty
- Relief valve faulty
- Wheel hub seals faulty

**TEST OPTIONS**
- Visual inspection

**WARNING**
Read WARNING on following page.

**REASON FOR QUESTION**
- Replace CTIS hose (para 12-4).

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- Air line no. 2100 OK
- Air exhausted from porting block
- Axle manifold OK
- CTIS hoses OK

**POSSIBLE PROBLEMS**
- CTIS tubes faulty
- CTIS wheel valve faulty
- Power manifold faulty
- Relief valve faulty
- Wheel hub seals faulty

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Repair CTIS tube(s) (para 12-4).

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- Air line no. 2100 OK
- Air exhausted from porting block
- Axle manifold OK
- CTIS hoses and tubes OK

**POSSIBLE PROBLEMS**
- CTIS wheel valve faulty
- Power manifold faulty
- Relief valve faulty
- Wheel hub seals faulty

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Replace CTIS wheel valve (para 12-3).

**WARNING**
Read WARNING on following page.
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Remove four nuts and wheel cover.
(2) Start engine (TM 9–2320–360–10).
(3) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(4) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(5) Check CTIS hoses from wheel hub to CTIS wheel valve for air leaks, damage, or crimps.

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check CTIS tubes from wheel valve to tire for air leaks, damage, or crimps.

NOTE

- Tire must be deflated to 60 psi (414 kPa) or less to perform this test.
- Some air leakage may occur at breather during inflation/deflation cycles.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check CTIS wheel valves for air leaks or damage.
n2. EXCESS INFLATION TIME, CTIS GREEN INDICATOR FLASHES TOO LONG OR CONTINUALLY, AIR LEAK DURING CTIS OPERATION (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td>Power manifold faulty</td>
</tr>
<tr>
<td>Air line no. 2100 OK</td>
<td>Relief valve faulty</td>
</tr>
<tr>
<td>Air exhausted from porting block</td>
<td>Wheel hub seals faulty</td>
</tr>
<tr>
<td>Axle manifold OK</td>
<td></td>
</tr>
<tr>
<td>CTIS hoses and tubes OK</td>
<td></td>
</tr>
<tr>
<td>CTIS wheel valve OK</td>
<td></td>
</tr>
</tbody>
</table>

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<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td>Relief valve faulty</td>
</tr>
<tr>
<td>Air line no. 2100 OK</td>
<td>Wheel hub seals faulty</td>
</tr>
<tr>
<td>Air exhausted from porting block</td>
<td></td>
</tr>
<tr>
<td>Axle manifold OK</td>
<td></td>
</tr>
<tr>
<td>CTIS hoses and tubes OK</td>
<td></td>
</tr>
<tr>
<td>CTIS wheel valve OK</td>
<td></td>
</tr>
<tr>
<td>No air leaks from power manifold</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td>Wheel hub seals faulty</td>
</tr>
<tr>
<td>Air line no. 2100 OK</td>
<td></td>
</tr>
<tr>
<td>Air exhausted from porting block</td>
<td></td>
</tr>
<tr>
<td>Axle manifold OK</td>
<td></td>
</tr>
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<td>CTIS hoses and tubes OK</td>
<td></td>
</tr>
<tr>
<td>CTIS wheel valve OK</td>
<td></td>
</tr>
<tr>
<td>No air leaks from power manifold</td>
<td></td>
</tr>
<tr>
<td>Relief valve OK</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Air pressure leaking from power manifold or preformed packings will increase inflation times.

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Pressure relief valve which is damaged or leaking will cause excess inflation times.

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
If the inside CTIS wheel seal is leaking, the inflation time may be excessive.
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check CTIS power manifold casting and mounting base area for air leaks.

NOTE

- Tire must be deflated to 60 psi (414 kPa) or less to perform this test.
- Pressure relief valve remains closed unless pressure to tires exceeds 85 psi (586 kPa)

POWER MANIFOLD

PRESSURE RELIEF VALVE

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check pressure relief valve for air leaks.

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check for air escaping from the inside portion of the wheel and tire assemblies.
n2. EXCESS INFLATION TIME, CTIS GREEN INDICATOR FLASHES TOO LONG OR CONTINUALLY, AIR LEAK DURING CTIS OPERATION (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>TEST OPTIONS</th>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td>Visual inspection</td>
<td>If the outside CTIS wheel seal is leaking, the inflation time may be excessive.</td>
</tr>
<tr>
<td>Air line no. 2100 OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air exhausted from porting block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axle manifold OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTIS hoses and tubes OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTIS wheel valve OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No air leaks from power manifold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relief valve OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| POSSIBLE PROBLEMS | |
|-------------------| |
| Wheel hub seals faulty | |

12. Are outside CTIS wheel seals OK?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel seals faulty. Notify supervisor.</td>
<td></td>
</tr>
</tbody>
</table>

Faults not corrected. Notify supervisor.

13. Is the deflation valve operating properly?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace deflation valve (para 7-68).</td>
<td></td>
</tr>
</tbody>
</table>

Deflation valve which remains in the open position or leaks will increase inflation time or prevent inflation.

14. Is the release valve operating properly?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace release valve (para 7-70).</td>
<td></td>
</tr>
</tbody>
</table>

Release valve which remains in the open position or leaks will increase inflation time or prevent inflation.

Fault not corrected. Notify supervisor.

| KNOWN INFO | |
|------------| |
| Circuit breaker not tripped | |
| Air line no. 2100 OK | |
| No Air exhausted from porting block | |
| Deflation valve OK | |

| POSSIBLE PROBLEMS | |
|-------------------| |
| Deflation valve faulty | |
| Release valve faulty | |
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check axle breathers for escaping air.

(1) Remove deflation valve (para 7–68).
(2) Inspect valve assembly for a broken spring, damaged diaphragm, sticking, or any other physical damage.
(3) Install deflation valve (para 7–68).

(1) Remove release valve (para 7–70).
(2) Inspect valve assembly for a broken spring, damaged diaphragm, sticking, or any other physical damage.
(3) Install release valve (para 7–70).
n3. CTIS INOPERATIVE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)

---

**Known Info**
- Circuit breaker not tripped
- No lights on controller

**Possible Problems**
- CTIS wire harness connection faulty
  - Wire no. 1886 loose or damaged
  - Faulty ground circuit (wire no. 1435)
  - Faulty CTIS controller
  - Faulty CTIS wire harness
  - Faulty CTIS power manifold
  - Faulty CTIS circuit breaker

---

**Test Options**

1. Are all CTIS connectors fully connected?
   - **No**
     - Secure loose connections.
   - **Yes**

---

2. Are 22–28 volts present at position 10, wire no. 1886, of power connector on rear of CTIS controller?
   - **No**
     - Go to step 7.
   - **Yes**

---

**Reason for Question**
- CTIS will not operate if connectors are loose or unplugged.

---

**Test Options**

- Wire No. 1886 Voltage Test
- STE/ICE-R Test #89

---

**Reason for Question**
- Voltage present at CTIS controller indicates vehicle's electrical system is OK. Problem is with CTIS electrical system.
NOTE
Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.

Inspect CTIS power manifold and controller to see that all connectors are fully plugged in.

WIRE NO. 1886 VOLTAGE TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove cab wire harness connector from CTIS Controller.</td>
</tr>
<tr>
<td>2</td>
<td>Turn engine switch to ON position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>3</td>
<td>Place positive (+) probe of multimeter on position 10, wire no. 1886, of power connector.</td>
</tr>
<tr>
<td>4</td>
<td>Place negative (−) probe of multimeter on known good ground and look for 22–28 volts on multimeter.</td>
</tr>
<tr>
<td>5</td>
<td>Turn engine switch to OFF position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>6</td>
<td>Install cab wire harness connector on CTIS controller.</td>
</tr>
</tbody>
</table>
**n3. CTIS INOPERATIVE (CONT)**

**KNOWN INFO**
- Circuit breaker not tripped
- CTIS wire harness connections OK
- Wire no. 1886 OK

**POSSIBLE PROBLEMS**
- Faulty ground circuit (wire no. 1435)
- Faulty CTIS controller
- Faulty CTIS wire harness
- Faulty CTIS power manifold
- Faulty CTIS circuit breaker

**TEST OPTIONS**
- Ground Circuit Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
CTIS will not operate properly if the CTIS electrical system is not properly grounded to chassis ground.

---

**CAUTION**
Read CAUTION on following page.

**3.**
Is there continuity between position 8, wire no. 1435, and chassis ground?

- **NO**
  - Secure loose connections. Notify supervisor if damaged wiring is found.
- **YES**

**TEST OPTIONS**
- CTIS Controller Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Failure to have 22–28 volts out of CTIS controller indicates controller has failed internally. Power manifold will not operate as a result.

---

**4.**
Are 22–28 volts present at position 10 of MC33 connector on rear of controller?

- **NO**
  - Replace CTIS controller (para 7-63).
- **YES**

**TEST OPTIONS**
- CTIS Wire Harness Continuity Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
CTIS controller cannot supply power manifold with vehicle voltage or power manifold cannot supply regulated voltage to controller if CTIS harness is defective.

---

**5.**
Is there continuity through all positions on CTIS wire harness? Are terminals and connectors OK?

- **NO**
  - Replace CTIS wire harness (para 7-66).
- **YES**

**KNOWN INFO**
- Circuit breaker not tripped
- CTIS wire harness connections OK
- Wire no. 1886 OK
- Ground circuit OK
- CTIS controller OK

**POSSIBLE PROBLEMS**
- Faulty CTIS wire harness
- Faulty CTIS power manifold
- Faulty CTIS circuit breaker

**TEST OPTIONS**
- CTIS Controller Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Faulty CTIS controller
Faulty CTIS wire harness
Faulty CTIS power manifold
Faulty CTIS circuit breaker
Circuit breaker not tripped
CTIS wire harness connections OK
Wire no. 1886 OK
Ground circuit OK
CTIS controller OK

**CAUTION**
Read CAUTION on following page.

**WARNING**
Read WARNING on following page.

**CAUTION**
Read CAUTION on following page.

**WARNING**
Read WARNING on following page.

---

**NOTICE**
Read NOTICE on following page.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

GROUND CIRCUIT CONTINUITY TEST
(1) Disconnect CTIS wire harness connector from CTIS Controller.
(2) Turn engine switch to ON position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position (TM 9-2320-360-10).
   CAUTION
   Probe only terminals indicated in step (4).
   Failure to comply may result in damage to CTIS components, wiring or test equipment.
(4) Place positive (+) probe of multimeter on position 10 of CTIS controller.
(5) Place negative (-) probe of multimeter on known good ground and look for 22–28 volts on multimeter.
(6) Move CTIS switch to OFF position (TM 9-2320-360-10).
(7) Turn engine switch to OFF position (TM 9-2320-360-10).
(8) Install CTIS wire harness connector on CTIS controller.

CTIS CONTROLLER VOLTAGE TEST
(1) Remove CTIS wire harness connector from CTIS Controller.
(2) Turn engine switch to ON position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position (TM 9-2320-360-10).
   CAUTION
   Probe only terminals indicated in step (4).
   Failure to comply may result in damage to CTIS components, wiring or test equipment.
(4) Place positive (+) probe of multimeter on position 10 of CTIS controller.
(5) Place negative (-) probe of multimeter on known good ground and look for 22–28 volts on multimeter.
(6) Move CTIS switch to OFF position (TM 9-2320-360-10).
(7) Turn engine switch to OFF position (TM 9-2320-360-10).
(8) Install CTIS wire harness connector on CTIS controller.

CTIS WIRE HARNESS CONTINUITY TEST
(1) Disconnect CTIS wire harness connector from power manifold.
(2) Disconnect CTIS wire harness connector from controller.
   NOTE
   Pay special attention to positions 1, 9, & 10.
(3) Place positive (+) probe of multimeter on position 1 of connector at controller end.
(4) Place negative (-) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
(5) Repeat steps (3) and (4) for remaining positions 2 thru 10.
(6) Install CTIS wire harness connectors back on power manifold and controller.
n3. CTIS INOPERATIVE (CONT)

**WARNING**
Read WARNING on following page.

### 6. Are there 13–14 volts present at position 9, wire no. 1064 (orange), on power manifold?

- **YES**
  - Replace CTIS controller (para 7–63).

- **NO**
  - Replace power manifold (para 7–64).

**POSSIBLE PROBLEMS**
- Faulty CTIS power manifold
- Faulty CTIS circuit breaker

**KNOWN INFO**
- Circuit breaker not tripped
- CTIS wire harness connections OK
- Wire no. 1886 OK
- Ground circuit OK
- CTIS controller OK
- CTIS wire harness OK

**TEST OPTIONS**
- Power Manifold Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Power manifold is faulty if 13–14 volts are not present. If voltage is present to controller, controller is faulty.

### 7. Are 22–28 volts present at CTIS circuit breaker?

- **YES**
  - Secure loose connections. Notify supervisor if damaged wiring is found.

- **NO**
  - Replace circuit breaker (para 7–12).

**POSSIBLE PROBLEMS**
- Faulty CTIS circuit breaker

**KNOWN INFO**
- Circuit breaker not tripped
- CTIS wire harness connections OK
- Wire no. 1886 OK
- Ground circuit OK
- CTIS controller OK
- CTIS wire harness OK
- CTIS power manifold OK

**TEST OPTIONS**
- Circuit Breaker Test

**REASON FOR QUESTION**
CTIS will not operate if low voltage is present at lower terminal of CTIS circuit breaker.
CIRCUIT BREAKER TEST
(1) Remove eight screws and panel from electric control box.
(2) Turn engine switch to ON position (TM 9-2320-360-10).
(3) Place positive (+) probe of multimeter on lower terminal of circuit breaker.
(4) Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.
(5) Turn engine switch to OFF position (TM 9-2320-360-10).

POWER MANIFOLD VOLTAGE TEST
NOTE
CTIS wiring harness must remain installed to controller and power manifold when performing this test.
(1) Turn engine switch to ON position (TM 9-2320-360-10).
(2) Move CTIS switch to ON position (TM 9-2320-360-10).
(3) Place positive (+) probe of multimeter on position 9, wire no. 1064 (orange), of CTIS wire harness connector at power manifold.
(4) Place negative (-) probe of multimeter on known good ground and look for 13–14 volts on multimeter.
(5) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9-2320-360-10).

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.
n4. TIRES DO NOT DEFLATE TO LOWER PRESSURE SETTING

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)

---

**START**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th><strong>1.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td></td>
</tr>
<tr>
<td>CTIS inflates tires OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CTIS wire harness connection faulty</td>
<td></td>
</tr>
<tr>
<td>Faulty CTIS power manifold</td>
<td></td>
</tr>
<tr>
<td>Faulty deflation valve solenoid coil</td>
<td></td>
</tr>
<tr>
<td>Faulty deflation valve</td>
<td></td>
</tr>
<tr>
<td>Faulty CTIS wire harness</td>
<td></td>
</tr>
<tr>
<td>Faulty CTIS controller</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**
Read WARNING on following page.

**Are all CTIS connectors fully connected?**

**NO**
- Secure loose connections.

**YES**

---

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th><strong>2.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit breaker not tripped</td>
<td></td>
</tr>
<tr>
<td>CTIS inflates tires OK</td>
<td></td>
</tr>
<tr>
<td>CTIS wire harness connection OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty CTIS power manifold</td>
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</tr>
<tr>
<td>Faulty deflation valve solenoid coil</td>
<td></td>
</tr>
<tr>
<td>Faulty deflation valve</td>
<td></td>
</tr>
<tr>
<td>Faulty CTIS wire harness</td>
<td></td>
</tr>
<tr>
<td>Faulty CTIS controller</td>
<td></td>
</tr>
</tbody>
</table>

**Are 22–28 volts present at deflation valve?**

**NO**
- Go to step 5.

**YES**

---

**TEST OPTIONS**

**REASON FOR QUESTION**

- Visual inspection

**TEST OPTIONS**

- Deflation Valve Voltage Test
  or
  STE/ICE-R Test #89

**REASON FOR QUESTION**

- CTIS will not operate if a connector is loose or unplugged.

- If voltage is present at deflation valve, problem is with valve or power manifold ground circuit. Low voltage indicates wiring, controller or power manifold problem.
(1) Manually set tire pressures to 75 psi (517 kPa).

(2) Disconnect deflation valve connector from power manifold.

(3) Place positive (+) probe of multimeter on deflation valve connector, position 2.

(4) Place negative (--) probe of multimeter on known good ground.

(5) Turn CTIS selector switch to CROSS COUNTRY position (TM 9–2320–360–10).

(6) Turn engine switch to ON position (TM 9–2320–360–10).

(7) Move CTIS switch to ON position and/or press START button (TM 9–2320–360–10). Look for 22–28 volts on multimeter.

(8) Turn engine switch to OFF position (TM 9–2320–360–10).

(9) Connect deflation valve connector to power manifold.

**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**

- Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.

- CTIS air lines are pressurized only when CTIS is in inflate, deflate, or test cycles.

Inspect CTIS power manifold and controller to see that all connectors are fully plugged in.
n4. TIRES DO NOT DEFLATE TO LOWER PRESSURE SETTING (CONT)

3.

**WARNING**
Read WARNING on following page.

**Is there continuity to chassis ground in deflation valve ground wire?**

- **NO**
  - Replace power manifold (para 7–64).

- **YES**

4.

**Is the resistance of the deflation valve solenoid coil 23–28 ohms?**

- **NO**
  - Replace deflation valve solenoid (para 7–68).

- **YES**

5.

**Is the deflation valve operating properly?**

- **NO**
  - Replace deflation valve (para 7–68).

- **YES**

**Fault not corrected. Notify supervisor.**
WARNING

Wear safety goggles when performing leakage tests on valves and air hoses. Failure to comply may cause serious eye injury due to high air pressure.

WARNING

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

POWER MANIFOLD GROUND CIRCUIT CONTINUITY TEST

1. Disconnect deflation valve connector from power manifold.
2. Place positive (+) probe of multimeter in deflation valve connector, position 1.
3. Place negative (-) probe of multimeter on known good ground and check multimeter for continuity.
4. Connect deflation valve connector to power manifold.

DEFLATION VALVE SOLENOID COIL TEST

1. Remove connector from deflation valve solenoid.
2. Place positive (+) probe of multimeter on deflation valve solenoid position 1.
3. Place negative (-) probe of multimeter on deflation valve solenoid position 2 and check multimeter for continuity.
4. Install connector on deflation valve solenoid.

1. Remove deflation valve (para 7–68).
2. Inspect valve assembly for broken springs, damaged diaphragm, sticking, or any other physical damage.
3. Install deflation valve (para 7–68).
n4. TIRES DO NOT DEFLATE TO LOWER PRESSURE SETTING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- CTIS inflates tires OK
- CTIS wire harness connection OK
- CTIS power manifold OK
- Deflation valve solenoid coil OK
- Deflation valve OK

**POSSIBLE PROBLEMS**
- Faulty CTIS wire harness
- Faulty CTIS controller

**TEST OPTIONS**
- CTIS Wire Harness Continuity Test
  
  or
  
  STE/ICE-R Test #89

**REASON FOR QUESTION**
Deflation valve is operated by the controller. If wiring is faulty between controller and power manifold, deflation valve may not operate.

6. **WARNING**
Read WARNING on following page.

**Is there continuity in the wire harness between controller and power manifold? Are terminals and connectors OK?**

- **NO**
  - Replace CTIS wire harness (para 7-66).

- **YES**
  - Replace CTIS controller (para 7-63).

**TEST OPTIONS**
- Wire No. 1058 Voltage Test

  or

  STE/ICE-R Test #89

**REASON FOR QUESTION**
Any voltage above 20 volts on wire no. 1058 indicates controller has failed internally. If voltage is under 20 volts, power manifold is faulty.

7. **Is there voltage present on position 3, wire no. 1058 (red), from controller to power manifold?**

- **NO**
  - Replace power manifold (para 7-64).

- **YES**
  - Replace CTIS controller (para 7-63).
NOTE
CTIS wiring harness must remain installed to controller and power manifold when performing this test.

Tire pressure should be over 60 psi to perform this test.

(1) Turn engine switch to ON position and/or press start button (TM 9–2320–360–10).
(2) Set CTIS controller selector to EMERGENCY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position (TM 9–2320–360–10).

NOTE
Wait for power manifold to stop clicking before continuing with test.

(4) Place positive (+) probe of multimeter on position 3, wire no. 1058 (red), of CTIS wire harness connector at power manifold.
(5) Place negative (−) probe of multimeter on known good ground.
(6) Press CTIS START button and look for voltage on multimeter.
(7) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9–2320–360–10).

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CTIS WIRE HARNESS CONTINUITY TEST

1. Disconnect CTIS wire harness connector from power manifold.
2. Disconnect CTIS wire harness connector from controller.
   • CTIS wiring harness must remain installed to controller and power manifold when performing this test.
   • Tire pressure should be over 60 psi to perform this test.
3. Place positive (+) probe of multimeter on position 1 of connector at controller end.
4. Place negative (−) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
5. Repeat steps (3) and (4) for remaining positions 2 thru 10.
6. Install CTIS wire harness connectors back on power manifold and controller.

WIRE NO. 1058 VOLTAGE TEST

1. Disconnect CTIS wire harness connector from power manifold.
2. Disconnect CTIS wire harness connector from controller.
3. Place positive (+) probe of multimeter on position 1 of connector at controller end.
4. Place negative (−) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
5. Repeat steps (3) and (4) for remaining positions 2 thru 10.
6. Install CTIS wire harness connectors back on power manifold and controller.
n5. TIRE PRESSURES DO NOT AGREE WITH CTIS SETTINGS

INITIAL SETUP

Equipment Conditions
- Wheels chocked.

Tools and Special Tools
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (Item 47, Appendix F)

\[ \text{START} \]

1. Are all CTIS connectors fully connected?

   - **NO**: Secure loose connections.
   - **YES**: Proceed.

2. Are 5 volts present at transducer connector?

   - **NO**: Replace power manifold (para 7–64).
   - **YES**: Proceed.

\[ \text{WARNING} \]

Read WARNING on following page.

\[ \text{TEST OPTIONS} \]

- Visual inspection
- Power Manifold Voltage Test
  or
  STE/ICE–R Test #89

\[ \text{REASON FOR QUESTION} \]

- CTIS may act erratic if all connectors are not fully connected.
- CTIS will not inflate or deflate to correct pressures if transducer does not receive 5 volts from power manifold.

\[ \text{KNOWN INFO} \]

- Circuit breaker not tripped
- CTIS operational except for tire pressure

\[ \text{POSSIBLE PROBLEMS} \]

- Faulty CTIS connections
- Faulty CTIS power manifold
- Faulty transducer
- Faulty CTIS wire harness
- Faulty CTIS controller

\[ \text{KNOWN INFO} \]

- Circuit breaker not tripped
- CTIS operational except for tire pressure
- CTIS connections OK

\[ \text{POSSIBLE PROBLEMS} \]

- Faulty CTIS power manifold
- Faulty transducer
- Faulty CTIS wire harness
- Faulty CTIS controller
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Inspect CTIS power manifold and controller to see that all connectors are fully plugged in.

NOTE
Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.

POWER MANIFOLD VOLTAGE TEST

(1) Disconnect transducer connector.
(2) Turn engine switch to ON position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position and/or press start button (TM 9-2320-360-10).
(4) Place positive (+) probe of multimeter on position b (black) transducer wire.
(5) Place negative (−) probe of multimeter on known good ground and look for 5 volts on multimeter.
(6) Connect transducer connector.
n5. TIRE PRESSURES DO NOT AGREE WITH CTIS SETTINGS (CONT)

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- CTIS operational except for tire pressure
- CTIS connections OK
- 5 volts to transducer

**POSSIBLE PROBLEMS**
- Faulty transducer
- Faulty power manifold
- Faulty CTIS wire harness
- Faulty CTIS controller

**TEST OPTIONS**
- Transducer Voltage Test
- STE/ICE-R Test #89
- STE/ICE-R Test #50

**REASON FOR QUESTION**
- CTIS uses transducer to monitor CTI/tire pressure. If transducer voltage is incorrect, tire pressure will be incorrect.

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- CTIS operational except for tire pressure
- CTIS connections OK
- 5 volts to transducer
- Transducer OK

**POSSIBLE PROBLEMS**
- Faulty power manifold
- Faulty CTIS wire harness
- Faulty CTIS controller

**TEST OPTIONS**
- Power Manifold Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Different voltage from power manifold indicates power manifold has failed internally.

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- CTIS operational except for tire pressure
- CTIS connections OK
- 5 volts to transducer
- Transducer OK
- Power manifold OK

**POSSIBLE PROBLEMS**
- Faulty CTIS wire harness
- Faulty CTIS controller

**TEST OPTIONS**
- Wire Harness Continuity Test
- STE/ICE Test #91

**REASON FOR QUESTION**
- Wire harness is faulty if there is no continuity. If there is continuity controller is faulty.

**3.**
**Does measured voltage at transducer agree with voltage and pressures specified in table 2-11?**

- **YES**
  - Replace transducer (para 7-67).
- **NO**
  - Replace power manifold (para 7-64).

**4.**
**Are there 3.5 volts present at pin 7, wire no. 1062 (white), at power manifold?**

- **YES**
  - Replace CTIS controller (para 7-63).
- **NO**
  - Replace power manifold (para 7-64).

**5.**
**Is there continuity in the wire harness between controller and power manifold? Are terminals and connectors OK?**

- **YES**
  - Replace CTIS wire harness (para 7-66).
- **NO**
  - Replace CTIS controller (para 7-63).
**TRANSDUCER VOLTAGE TEST**

**NOTE**
- Tire pressures must be between 20–30 psi (138–207 kPa) before beginning test to measure complete range of transducer voltage output.
- STE/ICE Test #50 is used to monitor pressures at porting block.

1. Remove hose no. 2102 and elbow from porting block.
2. Install STE/ICE adapter and 0–1000 psi (0–6895 kPa) pressure transducer on porting block.
3. Place positive (+) probe of multimeter on position 7, wire no. 1062 (white), at controller.
4. Place negative (–) probe of multimeter on known good ground.
8. Record transducer voltage when porting block pressure reaches values shown in Table 2–11.
10. Remove STE/ICE pressure transducer and adapter from porting block.
11. Install elbow and air hose no. 2102 on porting block.

**POWER MANIFOLD VOLTAGE TEST**

**NOTE**
- Tire pressures must be 75 psi (517 kPa) before beginning test to measure correct transducer voltage output.
- CTIS wiring harness must remain installed to controller and power manifold when performing this test.

1. Place positive (+) probe of multimeter on position 7, wire no. 1062 (white), at controller.
2. Place negative (–) probe of multimeter on known good ground.
5. Press CTIS START button (TM 9–2320–360–10) and look for 3.5 ± 0.2 volts on multimeter.

**CTIS WIRE HARNESS CONTINUITY TEST**

1. Disconnect CTIS wire harness connector from power manifold.
2. Disconnect CTIS wire harness connector from controller.

**NOTE**
- Pay special attention to pin 7.
3. Place positive (+) probe of multimeter on position 1 of connector at controller end.
4. Place negative (–) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
5. Repeat steps (3) and (4) for remaining positions 2 thru 10.
6. Install CTIS wire harness connectors back on power manifold and controller.

---

**Table 2-11**

<table>
<thead>
<tr>
<th>PSI</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>3.5</td>
</tr>
<tr>
<td>70</td>
<td>3.3</td>
</tr>
<tr>
<td>60</td>
<td>2.9</td>
</tr>
<tr>
<td>50</td>
<td>2.5</td>
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<tr>
<td>40</td>
<td>2.0</td>
</tr>
<tr>
<td>30</td>
<td>1.7</td>
</tr>
<tr>
<td>20</td>
<td>1.3</td>
</tr>
</tbody>
</table>
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)
- STE/ICE–R (Item 47, Appendix F)

---

**KNOWN INFO**

**POSSIBLE PROBLEMS**
- CTIS harness connector(s) loose
- Release valve faulty
- Inflation/deflation valve faulty
- Axle manifolds faulty
- Air lines or fittings faulty
- CTIS hoses or tubes faulty
- CTIS wheel valve faulty
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

---

**WARNING**

Read WARNING on following page.

**TEST OPTIONS**

Visual inspection

---

**REASON FOR QUESTION**

CTIS may act erratic if all connectors are not fully connected.

---

**KNOWN INFO**

**POSSIBLE PROBLEMS**
- Release valve faulty
- Inflation/deflation valve faulty
- Axle manifolds faulty
- Air lines or fittings faulty
- CTIS hoses or tubes faulty
- CTIS wheel valve faulty
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

---

**TEST OPTIONS**

Visual inspection

---

**REASON FOR QUESTION**

If there is no air to the supply port, CTIS will shut down and the low air light will begin to flash.
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**NOTE**
Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.

Inspect CTIS power manifold and controller to see that all connectors are fully plugged in.

**WARNING**
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.
- Loosen but do not remove air line. Failure to comply may result in air line blowing off, causing injury to personnel.

1. Loosen air line no. 2100 at porting block to check for air pressure.
2. Check air lines and fittings from air reservoir no. 1 to porting block for leakage or damage.
3. **Is exhaust port (hose no. 2120) quiet (no air leaking)?**

   - **NO**
     - Air leaking from hose no. 2120, go to step 20.

   - **YES**
     - Visual inspection

4. **Is air pressure present at transducer?**

   - **NO**
     - Go to step 27.

   - **YES**
     - Power Manifold Pressure Test

5. **Are the air lines from the porting block to the axle manifolds OK?**

   - **NO**
     - Repair air lines and fittings (para 11-40).

   - **YES**
     - Visual inspection.

---

**WARNING**

Read WARNING on following page.

- Air pressure leaking from exhaust port will cause CTIS to shut down and low air light to begin to flash.

- Air pressure leaking from air lines or fittings will cause CTIS to shut down and LOW AIR light to begin to flash.

---

**Known Info**

- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port

**Possible Problems**

- Release valve faulty
- Inflation/deflation valve faulty
- Axle manifolds faulty
- Air lines or fittings faulty
- CTIS hoses or tubes faulty
- CTIS wheel valve faulty
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

---

**Reason for Question**

- Air pressure leaking from exhaust port will cause CTIS to shut down and low air light to begin to flash.

---

**Test Options**

- Visual inspection

---

**Reason for Question**

- If no pressure is at transducer, CTIS will think there is an air leak and not turn on. Inflation valve, solenoid, or wiring may be faulty.

---

**Test Options**

- Power Manifold Pressure Test

---

**Reason for Question**

- Air pressure leaking from air lines or fittings will cause CTIS to shut down and LOW AIR light to begin to flash.
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE

- The CTI system initially and periodically checks for system air leaks. The CTIS will display a flashing LOW AIR light and shut off if 6 psi cannot be maintained by the CTI system. The manifold will click during this test for approximately 1.5 minutes.
- Excessive inflation times (without low air light) are caused by minor leaks in CTI system.
- CTIS air lines are pressurized only when CTIS is in inflate, deflate, or test cycles.
- Tests 1 thru 5 can be made consecutively while the CTI system is in the inflate cycle.
- Normal inflation time from EMERGENCY to HIGHWAY setting is approximately 12 minutes at high idle.
- Excess inflation times, sometimes accompanied by a LOW AIR light is normal if engine is at idle RPM and/or air operated accessories are being used.
- Soap solution may be used to detect air leaks.

With engine shut OFF, listen for air leaking from exhaust port (hose no. 2120).

POWER MANIFOLD PRESSURE TEST

(1) Remove transducer from power manifold (para 7–67).
(2) Set CTIS to HIGHWAY setting (TM 9–2320–360–10).
(3) Start engine (TM 9–2320–360–10).
(4) Move CTIS switch to ON position and/or press START button (TM 9–2320–360–10).
(5) Check for any air pressure at transducer port on power manifold.
(7) Install transducer in power manifold (para 7–67).

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check air lines from the porting block to the axle manifolds for air leaks.
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWLEDGE INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Air pressure at transducer

**POSSIBLE PROBLEMS**
- Axle manifolds faulty
- Air lines or fittings faulty
- CTIS hoses or tubes faulty
- CTIS wheel valve faulty
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Air pressure leaking from axle manifolds will cause CTIS to shut down and LOW AIR light to begin to flash.

---

**6.** Are the axle manifolds OK (not leaking or damaged)?

- **YES**
  - Replace axle manifold (para 12-2).
- **NO**
  - Replace axle manifolds (para 12-2).

---

**7.** Are air lines, fittings, and bulkhead connectors from axle manifolds OK?

- **YES**
  - Repair air lines and fittings (para 11-40).
- **NO**
  - Repair air lines and fittings (para 11-40).

---

**8.** Are CTIS hoses from wheel hub to CTIS wheel valve OK?

- **YES**
  - Replace CTIS hose (para 12-4).
- **NO**
  - Replace CTIS hose (para 12-4).
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

**NOTE**
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check axle manifolds for air leaks.

**NOTE**
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position (TM 9–2320–360–10).
(4) Check air lines, fittings and bulkhead connections from axle manifold to axle spindle for air leaks, damage, or crimps.

**NOTE**
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Remove four nuts and wheel cover.
(2) Start engine (TM 9–2320–360–10).
(3) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(4) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(5) Check CTIS hoses from wheel hub to CTIS wheel valve for air leaks, damage, or crimps.
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Air pressure at transducer
- Axle manifolds OK
- Air lines and fittings OK

**POSSIBLE PROBLEMS**
- CTIS tubes faulty
- CTIS wheel valve faulty
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Air pressure leaking from tire tubes will cause CTIS to shut down and LOW AIR light to begin to flash.

**WARNING**
Read WARNING on following page.

**9.** Are CTIS tubes from wheel valve to tire OK?

- **YES**
  - Repair CTIS tube(s) (para 12-4).
- **NO**

**10.** Are the CTIS wheel valves OK (not damaged or leaking air)?

- **YES**
  - Replace CTIS wheel valve (para 12-3).
- **NO**

**11.** Is power manifold free from any external air leaks?

- **YES**
  - Repair power manifold (para 7-64).
- **NO**

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Air pressure at transducer
- Axle manifolds OK
- Air lines and fittings OK
- CTIS hoses and tubes OK

**POSSIBLE PROBLEMS**
- CTIS wheel valve faulty
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- High volume of air leaking from CTIS wheel valve will cause CTIS to shut down and LOW AIR light to begin to flash.
**WARNING**

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

**NOTE**

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9-2320-360-10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position and/or push start button (TM 9-2320-360-10).
(4) Check CTIS tubes from wheel valve to tire for air leaks, damage, or crimps.
(5) Shut off engine (TM 9-2320-360-10).

**NOTE**

- Tire must be deflated to 60 psi (414 kPa) or less to perform this test.
- Some air leakage may occur at breather during inflation/deflation cycles.

(1) Start engine (TM 9-2320-360-10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position and/or push start button (TM 9-2320-360-10).
(4) Check CTIS wheel valves for air leaks or damage.
(5) Shut off engine (TM 9-2320-360-10).

**NOTE**

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9-2320-360-10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position (TM 9-2320-360-10).
(4) Check CTIS power manifold casting and mounting base area for air leaks.
(5) Shut off engine (TM 9-2320-360-10).
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Axle manifolds OK
- Air lines and fittings OK
- CTIS hoses and tubes OK
- CTIS wheel valves OK

**POSSIBLE PROBLEMS**
- Relief valve faulty
- Wheel hub seals faulty
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Pressure relief valve which is damaged or leaking will cause excess inflation times.

---

**12. Is the pressure relief valve closed?**

- **YES**
  - Replace relief valve (para 7-71).

- **NO**
  - Wheel hub seals faulty. Notify supervisor.

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- If the inside CTIS wheel seal is leaking, the CTI system will consider this a major leak. CTIS will automatically shut down and the low air light will begin to flash.

---

**13. Are the inside CTIS wheel seals OK?**

- **YES**
  - Wheel hub seals faulty. Notify supervisor.

- **NO**
  - Wheel hub seals faulty. Notify supervisor.

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- If the outside CTIS wheel seal is leaking, the CTI system will consider this a major leak. CTIS will automatically shut down and the low air light will begin to flash.

---

**14. Are outside CTIS wheel seals OK?**

- **YES**
  - Wheel hub seals faulty. Notify supervisor.

- **NO**
  - Wheel hub seals faulty. Notify supervisor.

---

**WARNING**

Read WARNING on following page.
WARNING

- Exercise extreme caution when working around wheels or under truck while engine is running. Movement of truck may cause severe injury or death.
- Wear safety goggles when performing leakage tests on valves air hoses. Failure to comply may cause serious eye injury due to high air pressure.

NOTE

- Tire must be deflated to 60 psi (414 kPa) or less to perform this test.
- Pressure relief valve remains closed unless pressure to tires exceeds 85 psi (586 kPa).

(1) Start engine (TM 9-2320-360-10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position and/or push start button (TM 9-2320-360-10).
(4) Check pressure relief valve for air leaks.
(5) Shut off engine (TM 9-2320-360-10).

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9-2320-360-10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position and/or push start button (TM 9-2320-360-10).
(4) Check inside wheel seals for air leaks.
(5) Shut off engine (TM 9-2320-360-10).

NOTE

Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9-2320-360-10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position and/or push start button (TM 9-2320-360-10).
(4) Check axle breathers for escaping air.
(5) Shut off engine (TM 9-2320-360-10).
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Air pressure at transducer
- Axle manifolds OK
- Air lines and fittings OK
- CTIS hoses and tubes OK
- CTIS wheel valves OK
- Relief valve OK

**POSSIBLE PROBLEMS**
- CTIS wire harness faulty
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

---

**TEST OPTIONS**
- CTIS Wire Harness Continuity Test
  - or
  - STE/ICE Test #91

**REASON FOR QUESTION**
An open in the CTIS wire harness will prevent proper information from reaching controller.

---

**WARNING**
Read WARNING on following page.

---

**TEST OPTIONS**
- Power Manifold Voltage Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
If the CTIS pressure transducer does not receive source voltage from the power manifold, the CTI system will sense that there is no pressure in the system. The CTIS will automatically shut down and the low air light will begin to flash.

---

**TEST OPTIONS**
- Power Manifold Ground Circuit Continuity Test
  - or
  - STE/ICE-R Test #91

**REASON FOR QUESTION**
If the pressure transducer does not have a good ground circuit, the CTI system will sense that there is no air pressure in the system. The CTIS will automatically shut down and the low air light will begin to flash.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CTIS WIRE HARNESS CONTINUITY TEST
(1) Disconnect CTIS wire harness connector from power manifold.
(2) Disconnect CTIS wire harness connector from controller.

NOTE
Pay special attention to position 7 and position 1.
(3) Place positive (+) probe of multimeter on position 1 of connector at controller end.
(4) Place negative (−) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
(5) Repeat steps (3) and (4) for remaining positions 2 thru 10.
(6) Install CTIS wire harness connectors back on power manifold and controller.

POWER MANIFOLD VOLTAGE TEST
(1) Disconnect transducer connector.
(2) Turn engine switch to ON position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position (TM 9–2320–360–10).
(4) Place positive (+) probe of multimeter on position b (black) transducer wire.
(5) Place negative (−) probe of multimeter on known good ground and look for 5 volts on multimeter.
(6) Connect transducer connector.

POWER MANIFOLD GROUND CIRCUIT CONTINUITY TEST
(1) Disconnect transducer connector from power manifold.
(2) Place positive (+) probe of multimeter on position a (green wire) of transducer connector to power manifold.
(3) Place negative (−) probe of multimeter on known good ground and check multimeter for continuity.
(4) Connect CTIS wire harness connector on power manifold.
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Axle manifolds OK
- Air lines and fittings OK
- CTIS hoses and tubes OK
- CTIS wheel valves OK
- Relief valve OK
- CTIS wire harness OK

**POSSIBLE PROBLEMS**
- Pressure transducer faulty
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Transducer Voltage Test

**REASON FOR QUESTION**
- If there is no transducer output to power manifold the CTI system will automatically shut down and low air light will flash.

---

**Known Info**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- Axle manifolds OK
- Air lines and fittings OK
- CTIS hoses and tubes OK
- CTIS wheel valves OK
- Relief valve OK
- CTIS wire harness OK

**Possible Problems**
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Power Manifold Voltage Test
  - or
  - STE/ICE-R Test #89

**Reason for Question**
- No voltage from power manifold indicates power manifold has failed internally. Controller is faulty if wire harness and power manifold are OK.

---

**Known Info**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- No air exhausted from exhaust port

**Possible Problems**
- CTIS wire harness faulty
- Release valve or solenoid faulty
- Deflation valve faulty
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- CTIS Wire Harness Continuity Test
  - or
  - STE/ICE-R Test #91

**Reason for Question**
- An open in the CTIS wire harness will prevent proper information from reaching controller.
**WARNING**

Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

---

**TRANSDUCER VOLTAGE TEST**

1. Turn engine switch to ON position (TM 9–2320–360–10).
3. Place positive (+) probe of multimeter at positions C (white) of transducer.
4. Place negative (−) probe of multimeter on known good ground and check multimeter for voltage.
5. Turn engine switch to OFF position (TM 9–2320–360–10).

---

**POWER MANIFOLD VOLTAGE TEST**

**NOTE**

- Tire pressures must be 75 psi (517 kPa) before beginning test to measure correct transducer voltage output.
- CTIS wiring harness must remain installed to controller and power manifold when performing this test.

1. Place positive (+) probe of multimeter on position 7, wire no. 1062 (white), at controller.
2. Place negative (−) probe of multimeter on known good ground.
5. Press CTIS START button (TM 9–2320–360–10) and check for voltage on multimeter.

---

**CTIS WIRE HARNESS CONTINUITY TEST**

1. Disconnect CTIS wire harness connector from power manifold.
2. Disconnect CTIS wire harness connector from controller.

**NOTE**

Pay special attention to positions 1,3,4, and 7.

3. Place positive (+) probe of multimeter on position 1 of connector at controller end.
4. Place negative (−) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
5. Repeat steps (3) and (4) for remaining positions 2 thru 10.
6. Install CTIS wire harness connectors back on power manifold and controller.
**Release Valve Voltage Test**

- **Known Info**
  - Circuit breaker not tripped
  - Vehicle air pressure is 110 psi (759 kPa) or more
  - CTIS connectors secure
  - No air exhausted from exhaust port
  - CTIS wire harness OK

- **Possible Problems**
  - Release valve or solenoid faulty
  - Deflation valve faulty
  - CTIS controller faulty
  - Power manifold faulty

- **Reason for Question**
  - Release valve will not operate if power manifold does not supply required voltage.

- **Test Options**
  - Release Valve Voltage Test
  - STE/ICE-R Test #89

---

**Solenoid Coil Test**

- **Known Info**
  - Circuit breaker not tripped
  - Vehicle air pressure is 110 psi (759 kPa) or more
  - CTIS connectors secure
  - No air exhausted from exhaust port
  - CTIS wire harness OK
  - 22-28 volts at release valve

- **Possible Problems**
  - Release valve or solenoid faulty
  - Deflation valve faulty
  - CTIS controller faulty
  - Power manifold faulty

- **Reason for Question**
  - Release valve will not operate properly if valve solenoid coil is faulty.

- **Test Options**
  - Solenoid Coil Test
  - STE/ICE-R Test #89

---

**Power Manifold Ground Circuit Continuity Test**

- **Known Info**
  - Circuit breaker not tripped
  - Vehicle air pressure is 110 psi (759 kPa) or more
  - CTIS connectors secure
  - No air exhausted from exhaust port
  - CTIS wire harness OK
  - 22-28 volts at release valve
  - Release valve solenoid OK

- **Possible Problems**
  - Release valve faulty
  - Deflation valve faulty
  - CTIS controller faulty
  - Power manifold faulty

- **Reason for Question**
  - Release valve is grounded thru power manifold. An open indicates the power manifold has failed internally which would prevent release valve operation.

- **Test Options**
  - Power Manifold Ground Circuit Continuity Test
  - STE/ICE-R Test #89
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

---

**RELEASE VALVE VOLTAGE TEST**

1. Disconnect release valve connector from power manifold.
2. Place positive (+) probe of multimeter on release valve connector, position 2.
3. Place negative (−) probe of multimeter on known good ground.
4. Turn engine switch to ON position (TM 9-2320-360-10).
5. Move CTIS switch to ON position (TM 9-2320-360-10).
7. Turn engine switch to OFF position (TM 9-2320-360-10).
8. Connect release valve connector to power manifold.

---

**SOLENOID COIL TEST**

1. Remove connector from release valve solenoid.
2. Place positive probe (+) of multimeter on release valve solenoid position 1.
3. Place negative probe (−) of multimeter on release valve solenoid position 2 and look for 50–60 ohms on multimeter.
4. Install connector on release valve solenoid.

---

**POWER MANIFOLD GROUND CIRCUIT CONTINUITY TEST**

1. Disconnect release valve connector from power manifold.
2. Place positive (+) probe of multimeter in release valve connector, position 1.
3. Place negative (−) probe of multimeter on known good ground and check multimeter for continuity.
4. Connect release valve connector to power manifold.
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

24. Are there zero (0) volts present at the deflation valve position 2?

- **NO**: Go to step 33.
- **YES**: Power manifold is faulty if voltage is being supplied to deflation valve during inflate cycle.

25. Is the release valve operating properly?

- **NO**: Replace release valve (para 7-71).
- **YES**: Release valve which remains open or leaks will cause the CTIS to shut down and the low air light to begin to flash.

26. Is the deflation valve operating properly?

- **NO**: Replace deflation valve (para 7-68).
- **YES**: Deflation valve which remains open or leaks will cause the CTIS to shut down and the low air light to begin to flash.

**Known Info**

- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- No air exhausted from exhaust port
- CTIS wire harness OK
- 22-28 volts at release valve
- Release valve solenoid OK
- Release valve ground circuit OK
- Power manifold faulty

**Possible Problems**

- Release valve faulty
- Deflation valve faulty
- CTIS controller faulty

**Test Options**

- Deflation Valve Voltage Test or STE/ICE-R Test #89

**Reason for Question**

- Power manifold is faulty if voltage is being supplied to deflation valve during inflate cycle.

**Known Info**

- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- No air exhausted from exhaust port
- CTIS wire harness OK
- 22-28 volts at release valve
- Release valve solenoid OK
- Release valve ground circuit OK
- 0 volts at deflation valve

**Possible Problems**

- Release valve faulty
- Deflation valve faulty

**Test Options**

- Visual inspection

**Reason for Question**

- Release valve which remains open or leaks will cause the CTIS to shut down and the low air light to begin to flash.

**Known Info**

- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- No air exhausted from exhaust port
- CTIS wire harness OK
- 22-28 volts at release valve
- Release valve solenoid OK
- Release valve ground circuit OK
- 0 volts at deflation valve
- Release valve OK

**Possible Problems**

- Deflation valve faulty

**Test Options**

- Visual inspection

**Reason for Question**

- Deflation valve which remains open or leaks will cause the CTIS to shut down and the low air light to begin to flash.

Fault not corrected. Notify supervisor.
**WARNING**
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

<table>
<thead>
<tr>
<th>DEFLATION VALVE VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Disconnect deflation valve connector from power manifold.</td>
</tr>
<tr>
<td>(2) Place positive (+) probe of multimeter on deflation valve connector, pin 2.</td>
</tr>
<tr>
<td>(3) Place negative (−) probe of multimeter on known good ground.</td>
</tr>
<tr>
<td>(4) Turn engine switch to ON position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(5) Move CTIS switch to ON position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(6) Press START button and look for 0 volts on multimeter.</td>
</tr>
<tr>
<td>(7) Turn engine switch to OFF position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(8) Connect deflation valve connector to power manifold.</td>
</tr>
</tbody>
</table>

(1) Remove release valve (para 7–70).

(2) Inspect valve assembly for a broken spring, damaged diaphragm, sticking, or any other physical damage.

(3) Install release valve (para 7–70).

(1) Remove deflation valve (para 7–68).

(2) Inspect valve assembly for a broken spring, damaged diaphragm, sticking, or any other physical damage.

(3) Install deflation valve (para 7–68).
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- No air pressure at transducer

**POSSIBLE PROBLEMS**
- CTIS wire harness faulty
- Power manifold faulty
- Inflation valve faulty or solenoid
- CTIS controller faulty

---

**TEST OPTIONS**
- CTIS Wire Harness Continuity Test
  - or
  - STE/ICE-R Test #91

**REASON FOR QUESTION**
An open in the CTIS wire harness will prevent proper information from reaching controller.

---

27. **Is there continuity in the wire harness between controller and power manifold? Are terminals and connectors OK?**

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Inflation Valve Voltage Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
Inflation valve will not open if power manifold does not supply required voltage.

---

28. **Is voltage fluctuating between 0 and 22–28 volts at inflation valve position 2?**

**TEST OPTIONS**
- Inflation Valve Solenoid Coil Test
  - or
  - STE/ICE-R Test #91

**REASON FOR QUESTION**
Inflation valve which remains in the closed position will increase inflation time or prevent inflation.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

CTIS WIRE HARNESS CONTINUITY TEST
(1) Disconnect CTIS wire harness connector from power manifold.
(2) Disconnect CTIS wire harness connector from controller.

NOTE
Pay special attention to position 7 and position 1.
(3) Place positive (+) probe of multimeter on position 1 of connector at controller end.
(4) Place negative (-) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
(5) Repeat steps (3) and (4) for remaining positions 2 thru 10.
(6) Install CTIS wire harness connectors back on power manifold and controller.

INFLATION VALVE VOLTAGE TEST
(1) Disconnect inflation valve connector from power manifold.
(2) Place positive (+) probe of multimeter on inflation valve connector, position 2.
(3) Place negative (-) probe of multimeter on known good ground.
(4) Turn engine switch to ON position (TM 9-2320-360-10).
(5) Move CTIS switch to ON position (TM 9-2320-360-10).

NOTE
It is normal for voltage to fluctuate.
(6) Press START button and look for 22–28 volts on multimeter.
(7) Turn engine switch to OFF position (TM 9-2320-360-10).
(8) Connect inflation valve connector to power manifold.

INFLATION VALVE SOLENOID COIL TEST
(1) Remove connector from inflation valve solenoid.
(2) Place positive probe (+) of multimeter on inflation valve solenoid pin 1.
(3) Place negative probe (-) of multimeter on inflation valve solenoid pin 2 and look for 23–28 ohms on multimeter.
(4) Install connector on inflation valve solenoid.
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

### KNOWN INFO
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- No air pressure at transducer
- CTIS wire harness OK
- 22-28 volts at inflation valve
- Inflation valve solenoid OK

### POSSIBLE PROBLEMS
- Power manifold faulty
- Inflation valve faulty

---

### KNOWN INFO
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- No air pressure at transducer
- CTIS wire harness OK
- 22-28 volts at inflation valve
- Inflation valve solenoid OK

### POSSIBLE PROBLEMS
- Inflation valve faulty

---

### KNOWN INFO
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- No air exhausted from exhaust port
- 22-28 volts not present at release valve

### POSSIBLE PROBLEMS
- CTIS controller faulty
- Power manifold faulty

---

### TEST OPTIONS
- Power Manifold Ground Circuit Continuity Test
  - or
  - STE/ICE-R Test #91

### REASON FOR QUESTION
- Inflation valve is grounded thru pressure switch. If low air indicator is not solid and there is continuity at position 1, then power manifold has failed.

---

### TEST OPTIONS
- Visual inspection

### REASON FOR QUESTION
- Inflation valve which remains in the closed position will increase inflation time or prevent inflation.

---

### TEST OPTIONS
- Wire No. 1059 Voltage Test
  - or
  - STE/ICE-R Test #89

### REASON FOR QUESTION
- Any voltage above 20 volts on wire no. 1059 indicates controller is faulty. If voltage is under 20 volts, power manifold is faulty.
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

POWER MANIFOLD GROUND CIRCUIT CONTINUITY TEST
(1) Disconnect inflation valve connector from power manifold.
(2) Place positive (+) probe of multimeter in inflation valve connector, position 1.
(3) Place negative (--) probe of multimeter on known good ground and check multimeter for continuity.
(4) Connect inflation valve connector to power manifold.

(1) Remove inflation valve (para 7–69).
(2) Inspect valve assembly for a broken spring, damaged diaphragm, sticking, or any other physical damage.
(3) Install inflation valve (para 7–69).

WIRE NO. 1059 VOLTAGE TEST
NOTE
CTIS wiring harness must remain installed to controller and power manifold when performing this test.
(1) Turn engine switch to ON position (TM 9–2320–360–10).
(2) Move CTIS switch to ON position (TM 9–2320–360–10).
(3) Place positive (+) probe of multimeter on position 4, wire no. 1059 (green), of CTIS wire harness connector at power manifold.
(4) Place negative (--) probe of multimeter on known good ground.
(5) Press CTIS START button and look for voltage on multimeter.
(6) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9–2320–360–10).
n6. POWER MANIFOLD CLICKS CONTINUALLY/LOW AIR LIGHT FLASHING (CONT)

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- No air exhausted from exhaust port
- CTIS wire harness OK
- 22-28 volts at release valve
- Release valve solenoid OK
- Release valve ground circuit OK
- Voltage supplied to deflation valve

**POSSIBLE PROBLEMS**
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Wire No. 1058 Voltage Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
- If voltage is under 20 volts, controller is faulty. Any voltage above 20 volts on wire no. 1058 indicates power manifold is faulty.

### 33.
**Is there less than 20 volts present on position 3, wire no. 1058 (red), from controller to power manifold?**

**WARNING**
Read **WARNING** on following page.

**YES**
Replace CTIS controller (para 7-64).

**NO**
Replace power manifold (para 7-64).

### 34.
**Is there above 20 volts present at position 2, wire no. 1057 (brown) from controller to power manifold?**

**YES**
Replace CTIS controller (para 7-63).

**NO**
Replace power manifold (para 7-64).

**KNOWN INFO**
- Circuit breaker not tripped
- Vehicle air pressure is 110 psi (759 kPa) or more
- CTIS connectors secure
- Air exhausted from exhaust port
- No air pressure at transducer
- CTIS wire harness OK
- 22-28 volts not supplied to inflation valve

**POSSIBLE PROBLEMS**
- CTIS controller faulty
- Power manifold faulty

**TEST OPTIONS**
- Wire No. 1057 Voltage Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
- Any voltage above 20 volts on wire no. 1057 indicates controller is faulty. If voltage is under 20 volts, power manifold is faulty.
NOTE
CTIS wiring harness must remain installed to controller and power manifold when performing this test.
Tire pressure should be over 60 psi to perform this test.

(1) Turn engine switch to ON position (TM 9-2320-360-10).
(2) Set CTIS controller selector to EMERGENCY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position (TM 9-2320-360-10).
(4) Place positive (+) probe of multimeter on position 3, wire no. 1058 (red), of CTIS wire harness connector at power manifold.
(5) Place negative (−) probe of multimeter on known good ground.
(6) Press CTIS START button and look for voltage on multimeter.
(7) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9-2320-360-10).

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE
CTIS wiring harness must remain installed to controller and power manifold when performing this test.
Tire pressure should be over 60 psi to perform this test.

(1) Turn engine switch to ON position (TM 9-2320-360-10).
(2) Set CTIS controller selector to EMERGENCY position (TM 9-2320-360-10).
(3) Move CTIS switch to ON position (TM 9-2320-360-10).
(4) Place positive (+) probe of multimeter on position 3, wire no. 1057 (brown), of CTIS wire harness connector at power manifold.
(5) Place negative (−) probe of multimeter on known good ground.

NOTE
It is normal for voltage to fluctuate.

(6) Press CTIS START button and look for voltage on multimeter.
(7) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9-2320-360-10).
**n8. TIRES DEFLATE UPON COMPLETION OF ADJUSTMENT CYCLE**

**INITIAL SETUP**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- Multimeter (Item 20, Appendix F)

---

**START**

1. **KNOWN INFO**
- Circuit breaker not tripped
- Inflates/deflates OK during adjustment cycle

**POSSIBLE PROBLEMS**
- Faulty release valve
- Faulty wheel valve
- Faulty CTIS hoses or tubes

**TEST OPTIONS**
- Check Tire Pressures

**REASON FOR QUESTION**
- If one tire is deflating there is a problem with the wheel valve.
- If all tires are deflating there is a problem with the release valve.

2. **KNOWN INFO**
- Circuit breaker not tripped
- Inflates/deflates OK during adjustment cycle
- All tires loose pressure

**POSSIBLE PROBLEMS**
- Faulty release valve

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Release valve quickly releases delivery pressure which causes wheel valves to close. If release valve is faulty, wheel valve will remain open and deflate.

---

**YES**

3. **KNOWN INFO**
- Circuit breaker not tripped
- Inflates/deflates OK during adjustment cycle

**POSSIBLE PROBLEMS**
- Faulty release valve

**TEST OPTIONS**
- Replace release valve (para 7-70).

**REASON FOR QUESTION**
- Faults not corrected. Notify supervisor.
NOTE

- Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.

- CTIS air lines are pressurized only when CTIS is in inflate, deflate, or test cycles.

Refer to Servicing Tires, (TM 9-2320-360-10).

(1) Remove release valve (para 7-70).
(2) Inspect valve assembly for broken springs, damaged diaphragm, sticking, or any other physical damage.
(3) Install release valve (para 7-70).
n8. TIRES DEFLATE UPON COMPLETION OF ADJUSTMENT CYCLE (CONT)

3. Are hoses from wheel hub to wheel valve free from air pressure?

   - **NO**
     - Replace wheel valve (para 12-3).

   - **YES**

4. Are tubes and valve stems from tire to wheel valve free from leaks?

   - **NO**
     - Repair CTIS tube(s) (para 12-4).

   - **YES**
     - Fault not corrected. Notify supervisor

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- If there is pressure in the supply lines when CTIS is not adjusting tire pressures the wheel valve is faulty.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- These tubes and valve stem are pressurized at all times. If they are leaking the tire will deflate.
(1) Remove four nuts and wheel cover.
(2) Start engine (TM 9–2320–360–10).
(3) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(4) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(5) Check CTIS hoses from wheel hub to CTIS wheel valve for air leaks, damage, or crimps.

**NOTE**
Tire must be deflated to 60 psi (414 kPa) or less to perform this test.

(1) Start engine (TM 9–2320–360–10).
(2) Set CTIS controller selector to HIGHWAY position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position and/or push start button (TM 9–2320–360–10).
(4) Check CTIS tubes from wheel valve to tire for air leaks, damage, or crimps.
n9. CTIS LOW AIR INDICATOR STAYS ON OVER 110 PSI (758 KPA)

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)

---

START

1. Is the LOW AIR light on and not flashing?

   YES

   2. Does the low air indicator stay on with pressure switch wire grounded?

   NO

   Refer to n6, Power manifold clicks continually/low air light flashing.

   YES

   Light out—replace pressure switch (para 7–72).

   NO

---

WARNING

Read WARNING on following page.

---

TEST OPTIONS

Visual inspection

Pressure Switch Test

---

REASON FOR QUESTION

If LOW AIR light is on constantly, there is no system air pressure above 82–90 psi (565–621 kPa) available. If the LOW AIR light is flashing there is a leak in the CTIS air system which does not allow adequate air pressure.

---

Faulty pressure switch
Faulty CTIS wire harness
Faulty CTIS controller
Faulty CTIS power manifold

---

Faulty pressure switch
Faulty CTIS wire harness
Faulty CTIS controller
Faulty CTIS power manifold

---

Circuit breaker not tripped
Air pressure over 110 psi (758 kPa)
Solid LOW AIR light

---

Circuit breaker not tripped
Air pressure over 110 psi (758 kPa)
WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE

- The CTI system initially and periodically checks for system air leaks. The CTIS will display a flashing LOW AIR light and shut off if 6 PSI cannot be maintained by the CTI system. The manifold will click during this check for approximately 1.5 minutes.
- Air system pressure must be 120 psi (827 kPa) before beginning troubleshooting. If air pressure gage does not indicate 120 psi (827 kPa), wait for system air pressure to build before beginning troubleshooting.
- CTIS air lines are pressurized only when CTIS is in inflate, deflate, or test cycles.
- Tests 1 thru 5 can be made consecutively while the CTI system is in the inflate cycle.
- Normal inflation time from EMERGENCY to HIGHWAY setting is approximately 12 minutes at high idle.
- Excess inflation times, sometimes accompanied by a flashing LOW AIR light is normal if engine is at idle RPM and/or air operated accessories are being used.

### PRESSURE SWITCH TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Disconnect single wire connector to low pressure switch.</td>
</tr>
<tr>
<td>(2)</td>
<td>Turn engine switch to ON position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(3)</td>
<td>Move CTIS switch to ON position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(4)</td>
<td>Touch the power manifold end of the connector to known good ground and observe low air indicator light.</td>
</tr>
<tr>
<td>(5)</td>
<td>Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(6)</td>
<td>Connect single wire connector for low pressure switch.</td>
</tr>
</tbody>
</table>
n9. CTIS LOW AIR INDICATOR STAYS ON OVER 110 PSI (758 KPA) (CONT)

### Known Info
- Controller provides signal voltage for pressure switch.
- If no voltage is present on wire no. 1061, controller is faulty.

### Possible Problems
- Faulty CTIS wire harness
- Faulty CTIS controller
- Faulty CTIS power manifold

### Test Options
- Wire Harness Continuity Test
- STE/ICE Test #91

### Reason for Question
Controller provides voltage to power manifold for pressure switch via the wire harness. Damaged harness may affect indicator operation.

#### 3. Is there continuity in the wire harness between controller and power manifold? Are terminals and connectors OK?

- **YES**: Replace CTIS wire harness (para 7–66).
- **NO**: Replace CTIS controller (para 7–63).

### Known Info
- Circuit breaker not tripped
- Air pressure over 110 psi (758 kPa)
- Solid LOW AIR light
- Pressure switch OK
- CTIS wire harness OK

### Possible Problems
- Faulty CTIS controller
- Faulty CTIS power manifold

### Test Options
- Wire No. 1061 Voltage Test
- STE/ICE–R Test #89

### Reason for Question
Controller provides signal voltage for pressure switch. If no voltage is present on wire no. 1061, controller is faulty.

#### 4. Are there 5 volts measured on position 6 (wire no. 1061) from controller to power manifold?

- **YES**: Replace CTIS controller (para 7–63).
- **NO**: Replace CTIS controller (para 7–63).

### Known Info
- Circuit breaker not tripped
- Air pressure over 110 psi (758 kPa)
- Solid LOW AIR light
- Pressure switch OK
- CTIS wire harness OK
- CTIS controller OK

### Possible Problems
- Faulty CTIS power manifold

### Test Options
- Power Manifold Voltage Test
- STE/ICE Test #91

### Reason for Question
Pressure switch receives voltage from power manifold. If no voltage is present on pressure switch wire, power manifold is defective.

#### 5. Are there 5 volts measured on wire to pressure switch?

- **YES**: Replace power manifold (para 7–64).
- **NO**: Replace power manifold (para 7–64).

Fault not corrected. Notify supervisor.
CTIS WIRE HARNESS CONTINUITY TEST
(1) Disconnect CTIS wire harness connector from power manifold.
(2) Disconnect CTIS wire harness connector from controller.

NOTE
Pay special attention to position 6.

(3) Place positive (+) probe of multimeter on position 1 of connector at controller end.
(4) Place negative (-) probe of multimeter on position 1 of connector at power manifold end and check multimeter for continuity.
(5) Repeat steps (3) and (4) for remaining positions 2 thru 10.
(6) Install CTIS wire harness connectors back on power manifold and controller.

WIRE NO. 1061 VOLTAGE TEST
NOTE
CTIS wiring harness must remain installed to controller and power manifold when performing this test.

(1) Turn engine switch to ON position (TM 9–2320–360–10).
(2) Move CTIS switch to ON position (TM 9–2320–360–10).
(3) Place positive (+) probe of multimeter on position 6, wire no. 1061 (blue), of CTIS wire harness connector at power manifold.
(4) Place negative (-) probe of multimeter on known good ground.
(5) Press CTIS START button (TM 9–2320–360–10) and look for 5 volts on multimeter.
(6) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9–2320–360–10).

POWER MANIFOLD VOLTAGE TEST
(1) Disconnect single wire connector to low pressure switch.
(2) Turn engine switch to ON position (TM 9–2320–360–10).
(3) Move CTIS switch to ON position (TM 9–2320–360–10).
(4) Place positive (+) probe of multimeter on power manifold end of low pressure switch connector.
(5) Place negative (-) probe of multimeter on known good ground and look for 5 volts on multimeter.
(6) Turn engine switch to OFF position and move CTIS controller switch to OFF position (TM 9–2320–360–10).
(7) Connect single wire connector for low pressure switch.
n10. OVER SPEED LIGHT DOES NOT FUNCTION

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
Multimeter (Item 20, Appendix F)

---

WARNING
Read WARNING on following page.

1. Is there 178.5–241.5 ohms across terminals of speed sending unit?

   NO
   Replace CTIS signal generator (para 20–8).

   YES

   CAUTION
   Read CAUTION on following page.

2. Is there 178.5–241.5 ohms resistance across positions 1 and 2 wires no. 1519, of controller wire harness?

   NO
   Secure loose connections. Notify supervisor if damaged wiring is found.

   YES
   Replace CTIS controller (para 7–63).

---

TEST OPTIONS

Sending Unit Circuit Test (Ohms)
or
STE/ICE–R Test #91

REASON FOR QUESTION
If resistance other than 178.5–241.5 ohms is measured across the terminals of speed sending unit, the unit is faulty.

---

TEST OPTIONS

Speed Sending Unit Wiring Harness Test (Ohms)
or
STE/ICE–R Test #91

REASON FOR QUESTION
If 178.5–241.5 ohms resistance is present, CTIS signal generator and wiring is OK. Fault is with CTIS Controller.
(1) Disconnect cab wire harness connector from rear of controller.

CAUTION
Probe only terminals indicates in step (2).
Failure to comply may result in damage to
CTIS components, wiring or test equipment.

(2) Connect negative (−) and positive (+) probes of multimeter between positions 1 and 2 and look for 178.5–241.5 ohms on multimeter.

(3) Connect cab wire harness connector to controller.

WARNING
Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

SPEED SENDING UNIT TEST
(1) Disconnect Controller wire harness from speed sending unit on transfer case.

(2) Connect negative (−) and positive (+) probes of multimeter across terminals of sending unit and look for 178.5–241.5 ohms on multimeter.

(3) Connect Controller wiring harness to speed sending unit on transfer case.

SPEED SENDING UNIT CIRCUIT TEST
(1) Disconnect cab wire harness connector from rear of controller.

CAUTION
Probe only terminals indicates in step (2).
Failure to comply may result in damage to
CTIS components, wiring or test equipment.

(2) Connect negative (−) and positive (+) probes of multimeter between positions 1 and 2 and look for 178.5–241.5 ohms on multimeter.

(3) Connect cab wire harness connector to controller.
### AXLES

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<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
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<td>2–876</td>
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<tr>
<td>p2. Interaxle lockup does not engage</td>
<td>2–882</td>
</tr>
</tbody>
</table>
p1. AXLE UNUSUALLY NOISY WHEN OPERATING

INITIAL SETUP

<table>
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<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
<th>Personnel Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine shut off (TM 9–2320–360–10).</td>
<td>Tool Kit, Genl Mech (Item 54, Appendix F)</td>
<td>Two</td>
</tr>
<tr>
<td>Wheels chocked.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KNOWN INFO**

Nothing

**POSSIBLE PROBLEMS**

- Low axle differential oil level
- Axle differentials leaking or damaged
- Planetary wheel ends
- Low planetary wheel end oil level
- Drive pinion yoke
- Wheel bearings

**KNOWN INFO**

Axle differential oil level OK

**POSSIBLE PROBLEMS**

- Axle differentials leaking or damaged.
- Planetary wheel ends
- Low planetary wheel end oil level
- Drive pinion yoke
- Wheel bearings

**TEST OPTIONS**

- Is the axle differential oil at proper level?
  - **YES**: Add oil (LO 9–2320–360–12).
  - **NO**: Notify supervisor.

- Are the axle differentials free from leaks or damage?
  - **YES**: Visual inspection
  - **NO**: Axle differential(s) may be unusually noisy when operating if damaged.
Check axle for loose, missing, or damaged hardware. Check input and output shafts for leaks and damage.

Refer to LO 9-2320-360-12 to check axle differential oil level.
p1. AXLE UNUSUALLY NOISY WHEN OPERATING (CONT)

**KNOWLEDGE INFO**
- Axle differential oil level OK
- Axle differential(s) OK

**POSSIBLE PROBLEMS**
- Planetary wheel ends
- Low planetary wheel end oil level
- Drive pinion yoke
- Wheel bearings

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Axle differential(s) may be unusually noisy when operating if planetary wheel ends are damaged.

---

**KNOWLEDGE INFO**
- Axle differential oil level OK
- Axle differential(s) OK
- Planetary wheel ends OK

**POSSIBLE PROBLEMS**
- Low planetary wheel end oil level
- Drive pinion yoke
- Wheel bearings

**TEST OPTIONS**
- Check oil level according to LO 9-2320-360-12

**REASON FOR QUESTION**
- Low oil level will cause axle differential(s) to make unusual noises and lead to damage.

---

**KNOWLEDGE INFO**
- Axle differential oil level OK
- Axle differential(s) OK
- Planetary wheel ends OK
- Planetary wheel end oil level OK

**POSSIBLE PROBLEMS**
- Drive pinion yoke
- Wheel bearings

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Loose drive pinion yoke will cause axle differential(s) to make unusual noises and lead to damage.
Check planetary wheel ends for leaks and for loose, missing, or damaged hardware.

Refer to LO 9-2320-360-12 to check planetary wheel end oil level.

Check drive pinion yoke for looseness, and for missing or damaged hardware.
p1. AXLE UNUSUALLY NOISY WHEN OPERATING (CONT)

**KNOWN INFO**
- Axle differential oil level OK
- Axle differential(s) OK
- Planetary wheel ends OK
- Planetary wheel end oil level OK
- Drive pinion yoke OK

**POSSIBLE PROBLEMS**
- Wheel bearings

**TEST OPTIONS**
- Wheel Bearing Check

**REASON FOR QUESTION**
- Loose, worn, or damaged wheel bearings will cause axle differential(s) to make unusual noises and lead to damage.

---

**WARNING**
Read WARNING on following page.

**6. Are the wheel bearings secure, and not worn or damaged?**

- **NO** Notify supervisor.
- **YES**
  - Fault not corrected. Notify supervisor.
<table>
<thead>
<tr>
<th>WHEEL BEARING CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARNING</strong></td>
</tr>
<tr>
<td>HET Tractor must be on level ground and wheels must be chocked before parking brake is released. Otherwise, HET Tractor may roll and cause personnel injury.</td>
</tr>
<tr>
<td>(1) Remove tire (TM 9-2320-360-10) from axle that is unusually noisy when operating.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
</tr>
<tr>
<td>* Wheel bearings are loose, worn, or damaged if hub is loose, or rotates roughly.</td>
</tr>
<tr>
<td>* Perform step (2) only if working on rear three axles.</td>
</tr>
<tr>
<td>(2) Chock wheels and release parking brake (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>(3) Rotate hub and check for looseness or roughness.</td>
</tr>
<tr>
<td>(4) Install tire (TM 9-2320-360-10) on axle.</td>
</tr>
<tr>
<td>(5) Repeat steps (1) through (4) for other tire an axle.</td>
</tr>
</tbody>
</table>
p2. INTERAXLE LOCKUP DOES NOT ENGAGE

INITIAL SETUP

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine shut off (TM 9–2320–360–10).</td>
<td>Tool Kit, Genl Mech (Item 54, Appendix F)</td>
</tr>
<tr>
<td>Wheels chocked.</td>
<td></td>
</tr>
</tbody>
</table>

**KNOWN INFO**

- Transfer case in LOW
- ALL WHEEL DRIVE indicator is ON
- Green needle on air pressure gage over 65 psi (448 kPa)

**POSSIBLE PROBLEMS**

- Leaking air lines or fittings
- Faulty driveline lockup valve
- Faulty interaxle lockup pilot valve
- Leaking air lines at interaxle lockup valve

**TEST OPTIONS**

- Visual inspection

**REASON FOR QUESTION**

- Interaxle lockup will not operate if interaxle lockup air lines or fittings are leaking or damaged.

**KNOWLEDGE**

- Does air flow from driveline lockup valve?

**POSSIBLE PROBLEMS**

- Faulty driveline lockup valve
- Faulty interaxle lockup pilot valve
- Leaking air lines at interaxle lockup valve

**TEST OPTIONS**

- Driveline Lockup Valve Test

**REASON FOR QUESTION**

- Driveline lockup valve is defective if no air flows thru valve with DRIVELINE control positioned in LOCK.
Check the following air lines and fittings for leakage and damage.

- Air line no. 2074 from no. 2 air reservoir to air manifold
- Air line no. 2785 from air manifold to air manifold
- Air line no. 2765 from air manifold to driveline lockup valve
- Air line no. 2766 from driveline lockup valve to interaxle lockup pilot
- Air line no. 2761 from air manifold to push valve
- Air line no. 2762 from push valve to interaxle lockup pilot valve
- Air line no. 2767 from interaxle lockup pilot valve to air manifold
- Air line no. 2339 from air manifold to interaxle lockup valve on no. 2 axle
- Air line no. 2422 from air manifold to interaxle lockup valve on no. 3 axle

**NOTE**

- Interaxle lockup will not operate until AIR PRESS gage reads greater than 65 psi (448 kPa).
- Interaxle lockup will only operate with TRANSFER CASE shift lever in LOW position and DRIVELINE control in LOCK position.
- Refer to air hose diagrams in front of this system troubleshooting section for air line locations.

Check the following air lines and fittings for leakage and damage.

<table>
<thead>
<tr>
<th>DRIVELINE LOCKUP VALVE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Start engine (TM 9–2320–360–10) and allow air pressure to build greater than 65 psi (448 kPa).</td>
</tr>
<tr>
<td>(2) Shut off engine (TM 9–2320–360–10).</td>
</tr>
<tr>
<td>(3) Position DRIVELINE control to LOCK.</td>
</tr>
<tr>
<td>(4) Loosen air line no. 2766 on driveline lockup valve and check for air flow from driveline lockup valve.</td>
</tr>
<tr>
<td>(5) Tighten air line no. 2766 on driveline lockup valve.</td>
</tr>
</tbody>
</table>
### Known Info
- Transfer case in LOW
- ALL WHEEL DRIVE indicator is ON
- Green needle on air pressure gage over 65 psi (448 kPa)
- Interaxle lockup air lines OK
- Driveline lockup valve OK

### Possible Problems
- Faulty interaxle lockup pilot valve
- Leaking air lines at interaxle lockup valve

#### Known Info
- Transfer case in LOW
- ALL WHEEL DRIVE indicator is ON
- Green needle on air pressure gage over 65 psi (448 kPa)
- Interaxle lockup air lines OK
- Driveline lockup valve OK
- Interaxle lockup pilot valve OK

#### Possible Problems
- Leaking air lines at interaxle lockup valve

### Test Options
- Interaxle Lockup Pilot Valve Test

#### Reason for Question
- Interaxle lockup pilot valve is defective if no air flows thru valve with TRANSFER CASE shift lever positioned in LOW and DRIVELINE control positioned in LOCK.

### Diagram

#### 3. Does air flow from interaxle lockup pilot valve?
- **Yes**: Replace interaxle lockup pilot valve (para 11–37).
- **No**: Replace damaged air lines or fittings (para 11–40).

#### 4. Is air present at interaxle lockup valve on no. 2 and no. 3 axle and air line connections not damaged?
- **Yes**: Fault not corrected. Notify supervisor.
- **No**: Replace damaged air lines or fittings (para 11–40).
### INTERAXLE LOCKUP PILOT VALVE TEST

1. Start engine (TM 9–2320–360–10) and allow air pressure to build greater than 65 psi (448 kPa).
3. Position DRIVELINE control to LOCK and TRANSFER CASE shift lever to LOW.
4. Loosen air line no. 2767 on interaxle lockup pilot valve and check for air flow from interaxle lockup pilot valve.
5. Tighten air line no. 2767 on interaxle lockup pilot valve.

### INTERAXLE LOCKUP VALVE TEST

1. Start engine (TM 9–2320–360–10) and allow air pressure to build greater than 65 psi (448 kPa).
3. Position DRIVELINE control to LOCK and TRANSFER CASE shift lever to LOW.
4. Loosen air line no. 2339 on axle no. 2 interaxle lockup valve and check for air flow to interaxle lockup valve. Inspect air line no. 2339 for damaged connections.
5. Tighten air line no. 2339 on interaxle lockup valve.
6. Loosen air line no. 2422 on axle no. 3 interaxle lockup valve and check for air flow to interaxle lockup valve. Inspect air line no. 2422 for damaged connections.
7. Tighten air line no. 2422 on interaxle lockup valve.
8. Check air lines no. 2339 and no. 2422 at axles no. 2 and no. 3 for loose or damaged connections.
Steering Hydraulic Hose Diagram

- Rear Steering Gear
- 0.75 OD Tube (164 in.)
- 0.5 OD Tube Tee
- 0.75 OD Tube (60 in.)
- Double Steering Pump
- Steering Reservoir
- Front Steering Gear

Components labeled:
- 2275
- 2276
- 2274
- 2883
- 2278
- 2701
- 2726
- 2301
- 2302
### q. STEERING SYSTEM

<table>
<thead>
<tr>
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<th>Troubleshooting Procedure (Page)</th>
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<tbody>
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<tr>
<td>q2. Wanders, pulls to one side, or shimmies</td>
<td>2–896</td>
</tr>
<tr>
<td>q3. Excessive play when turning steering wheel</td>
<td>2–902</td>
</tr>
<tr>
<td>q4. No response when turning steering wheel</td>
<td>2–906</td>
</tr>
<tr>
<td>q5. No response at no. 1 axle when turning steering wheel</td>
<td>2–908</td>
</tr>
<tr>
<td>q6. No response at no. 4 axle when turning steering wheel</td>
<td>2–912</td>
</tr>
<tr>
<td>q7. Steering binds, does not return to straight ahead after turns</td>
<td>2–916</td>
</tr>
</tbody>
</table>
q1. HARD TO STEER

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

**Materials/Parts**
- Locknuts (2), (Item 56, Appendix G)

---

**KNOWLEDGE INFO**

- Power steering oil level OK

**POSSIBLE PROBLEMS**
- Faulty power steering pump

---

**TEST OPTIONS**

**Road Test**

**REASON FOR QUESTION**

- In the event of failure of the main steering pump, the transfer case driven auxiliary steering pump provides steering pressure to the front steering gear. This assist is most evident at road speeds above 15–20 MPH (24–32 KPH). Hard steering below this speed indicates that the main steering pump is faulty.

---

**KNOWLEDGE INFO**

- Hard to steer at all speeds

**POSSIBLE PROBLEMS**
- Faulty steering shafts and/or tie rods
- Faulty pitman arms and/or drag links
- Faulty front steering gear
- Faulty rear steering gear
- Faulty tee box

---

**TEST OPTIONS**

- Visual inspection

**REASON FOR QUESTION**

- HET Tractor may be hard to steer if shafts or tie rods are loose, damaged, or require lubrication.

---

1. **Does the vehicle steer easier at speeds above 15–20 MPH (24–32 KPH) and harder at speeds less than 15–20 MPH (24–32 KPH)?**

   - **YES**
   - **NO**
     - Go to step 2.

2. **Are steering shafts and tie rods properly lubricated, secure, and free from damage?**

   - **YES**
     - Lubricate steering shaft(s) (LO 9–2320–360–12), Repair steering shaft (para 13–7) or repair tie rod (para 13–4).
   - **NO**
     - Go to step 2.
Check steering shafts and tie rods for damage, and loose or missing mounting hardware. Refer to LO 9-2320-360-12 to lubricate steering linkage.
q1. HARD TO STEER (CONT)

3. Are pitman arms and drag links properly lubricated, secure, and free from damage?

   - **Known Info**
     - Hard to steer at all speeds
     - Steering shafts and/or tie rods OK

   - **Possible Problems**
     - Faulty pitman arms and/or drag links
     - Faulty front steering gear
     - Faulty rear steering gear
     - Faulty tee box

   - **Test Options**
     - Visual inspection

   - **Reason for Question**
     - HET Tractor may be hard to steer if pitman arms or drag links are loose, damaged or require lubrication.

   - **Yes**

   - **No**
     - Lubricate (LO 9-2320-360-12). Notify supervisor of loose or damaged pitman arm or drag links. If mounting is damaged.

4. Is the vehicle hard to steer with the front steering gear disconnected?

   - **Known Info**
     - Hard to steer at all speeds
     - Steering shafts and tie rods OK
     - Pitman arms and drag links OK

   - **Possible Problems**
     - Faulty front steering gear
     - Faulty rear steering gear
     - Faulty tee box

   - **Test Options**
     - Front Steering Gear Test

   - **Reason for Question**
     - The front steering gear or related parts are faulty if the hard steering problem disappears with the front steering shaft disconnected.

   - **Yes**

   - **No**
     - Go to step 7.

5. Is the vehicle hard to steer with the rear steering gear disconnected?

   - **Known Info**
     - Hard to steer at all speeds
     - Steering shafts and tie rods OK
     - Pitman arms and drag links OK
     - Disconnecting front gear does not make steering easier

   - **Possible Problems**
     - Faulty rear steering gear
     - Faulty tee box

   - **Test Options**
     - Rear Steering Gear Test

   - **Reason for Question**
     - The rear steering gear or related parts are faulty if the hard steering problem disappears with the rear steering shaft disconnected.

   - **Yes**

   - **No**
     - Go to step 9.
Check pitman arm and drag links for damage, and loose or missing mounting hardware. Refer to LO 9-2320-360-12 to lubricate steering linkage.

**FRONT STEERING GEAR TEST**

1. Remove locknut, screw and front steering shaft yoke from tee box. Discard locknut.
2. Start engine (TM 9-2320-360-10).
3. Detect steering effort while turning steering wheel from straight ahead to full left and full right positions.
4. Return steering wheel to straight ahead position.
5. Shut off engine (TM 9-2320-360-10).
6. Align slot on yoke with key on tee box shaft.
7. Install front steering shaft yoke on tee box with screw and new locknut.

**REAR STEERING GEAR TEST**

1. Remove locknut, screw and rear steering shaft yoke from tee box. Discard locknut.
2. Start engine (TM 9-2320-360-10).
3. Detect steering effort while turning steering wheel from straight ahead to full left and full right positions.
4. Return steering wheel to straight ahead position.
5. Shut off engine (TM 9-2320-360-10).
6. Align slot on yoke with key on tee box shaft.
7. Install rear steering shaft yoke on tee box with screw and new locknut.
q1. HARD TO STEER (CONT)

**KNOWN INFO**
- Hard to steer at all speeds
- Steering shafts and tie rods OK
- Pitman arms and drag links OK
- Disconnecting front gear does not help
- Disconnecting rear gear does not make steering easier

**POSSIBLE PROBLEMS**
- Faulty tee box

6. Do tee box output shafts turn freely when top shaft is turned?
   - **NO**
     - Replace tee box (para 13-8).
   - **YES**

**TEST OPTIONS**
- Tee Box Test

**REASON FOR QUESTION**
- HET tractor may steer hard if tee box output shafts are binding.

**KNOWN INFO**
- Steering is easier with the front steering gear disconnected

**POSSIBLE PROBLEMS**
- Damaged front steering gear hoses and/or fittings
- Damaged front steering gear mounting

7. Are front steering gear hoses and fittings free from leaks or damage?
   - **NO**
     - Replace damaged hose(s) and fitting(s) (para 13-9).
   - **YES**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- HET Tractor may be hard to steer if front steering gear hoses or fittings are leaking or damaged.

**KNOWN INFO**
- Steering is easier with the front steering gear disconnected
- Front steering gear hoses and fittings OK

**POSSIBLE PROBLEMS**
- Damaged front steering gear mounting

8. Is front steering gear mounting secure and free from damage?
   - **NO**
     - Notify supervisor if mounting is damaged.
   - **YES**

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- HET Tractor may be hard to steer if front steering gear mounting is loose or damaged.
Check front steering gear, steering hoses, and fittings for leaks or damage.

Check front steering gear mounting for damage.

### TEE BOX TEST

1. Remove screw and locknut from lower yoke of top steering shaft. Discard locknut.
2. Remove yoke from top tee box shaft.
3. Remove screw and locknut from yoke on front steering shaft. Discard locknut.
4. Remove yoke from front tee box shaft.
5. Remove screw and locknut from yoke on rear steering shaft. Discard locknut.
6. Remove yoke from rear tee box shaft.
7. Turn top tee box shaft to check for binding. Replace tee box (para 13–8) if it fails to turn smoothly or if it binds when top shaft is turned.
8. Align key on rear tee box shaft with slot in steering shaft yoke.
9. Install yoke on rear tee box shaft with screw and new locknut.
10. Align key on front tee box shaft with slot in steering shaft yoke.
11. Install yoke on front tee box shaft with screw and new locknut.
12. Align key on top tee box shaft with slot in steering shaft yoke.
13. Install yoke on top tee box shaft with screw and new locknut.

### NOTE

Refer to steering hydraulic hose diagram in front of this troubleshooting section for steering hose locations.

Check front steering gear, steering hoses, and fittings for leaks or damage.
q1. HARD TO STEER (CONT)

**9. Are rear steering gear hoses and fittings free from leaks or damage?**

**KNOWN INFO**
Steering is easier with the rear steering gear disconnected

**POSSIBLE PROBLEMS**
- Damaged rear steering gear hoses and/or fittings
- Damaged rear steering gear mounting

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Replace damaged hoses and fittings (para 13-9). Notify supervisor if mounting is damaged.
- A damaged rear steering gear or leaking hoses or fittings may cause HET tractor steer hard.

**10. Is rear steering gear mounting secure and free from damage?**

**KNOWN INFO**
Steering is easier with the rear steering gear disconnected
Rear steering gear hoses and fittings OK

**POSSIBLE PROBLEMS**
- Damaged rear steering gear mounting

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Replace damaged hoses and fittings (para 13-9). Notify supervisor if mounting is damaged.
- If rear steering gear is damaged or if steering gear hoses or fittings are leaking, HET Tractor may steer hard.

No faults found. Notify supervisor.
Check rear steering gear, steering hoses, and fittings for leaks or damage.

Check rear steering gear mounting for missing, loose, or damaged parts.

NOTE
Refer to steering hydraulic hose diagram in front of this troubleshooting section for steering hose locations.
q2. WANDERS, PULLS TO ONE SIDE, OR SHIMMIES

**INITIAL SETUP**

**Equipment Conditions**
Wheels chocked.

**Tools and Special Tools**
Tool Kit, Genl Mech (Item 54, Appendix F)
Wrench, Torque 0–600 LB–FT (Item 74, Appendix F)

---

**KNOWN INFO**

- Tire pressure OK
- Front springs and shocks OK
- Ride height is level

**POSSIBLE PROBLEMS**
- Loose or damaged lugnuts
- Faulty steering shafts and tie rods
- Faulty pitman arms and drag links
- Brakes out of adjustment
- Faulty tee box
- Faulty front steering gear
- Faulty rear steering gear
- Steering out of adjustment

**WARNINGS**

**TEST OPTIONS**

Lug Nut Check

**REASON FOR QUESTION**

Loose, missing, or damaged lugnuts may cause HET tractor to wander, pull to one side, or shimmy.

---

**KNOWN INFO**

- Tire pressure OK
- Front springs and shocks OK
- Ride height is level
- Lugnuts OK

**POSSIBLE PROBLEMS**
- Faulty steering shafts and tie rods
- Faulty pitman arms and drag links
- Brakes out of adjustment
- Faulty tee box
- Faulty front steering gear
- Faulty rear steering gear
- Steering out of adjustment

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Steering shafts or tie rods that are loose, damaged, or require lubrication may cause HET tractor to wander, pull to one side, or shimmy.
LUG NUT CHECK

(1) Remove four nuts and wheel cover from tire assembly.

**WARNING**

After removing the wheel cover, if any bolts are found loose or broken, deflate the tire completely before attempting to loosen lugnuts. Failure to comply may result in injury to personnel.

(2) Check if any lugnuts are loose, missing, or damaged.

(3) Tighten loose lugnuts 450–550 lb ft (610–746 N·m). Replace missing or damaged lugnuts.

(4) Install wheel cover on tire assembly with four nuts.

Check steering shafts and tie rods for damage, and loose or missing mounting hardware. Refer to LO 9–2320–360–12 to lubricate steering linkage.
q2. WANDERS, PULLS TO ONE SIDE, OR SHIMMIES (CONT)

**KNOW INFO**
Tire pressure OK
Front springs and shocks OK
Ride height is level
Lugnuts OK
Steering shafts and tie rods OK

**POSSIBLE PROBLEMS**
Faulty pitman arms and drag links
Brakes out of adjustment
Faulty tee box
Faulty front steering gear
Faulty rear steering gear
Steering out of adjustment

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
Pitman arms or drag links which are loose, damaged, or require lubrication may cause HET tractor to wander, pull to one side, or shimmy.

**3. Are pitman arms and drag links properly lubricated, secure, and free from damage?**

- **NO**
  - Lubricate (LO 9-2320-360-12). Notify supervisor of loose or damaged pitman arms or drag links.

- **YES**

**KNOW INFO**
Tire pressure OK
Front springs and shocks OK
Ride height is level
Lugnuts OK
Steering shafts and tie rods OK
Pitman arms and drag links OK

**POSSIBLE PROBLEMS**
Brakes out of adjustment
Faulty tee box
Faulty front steering gear
Faulty rear steering gear
Steering out of adjustment

**TEST OPTIONS**
Refer to brake adjustment procedure (para 11-2)

**REASON FOR QUESTION**
HET tractor may wander, pull to one side, or shimmy if brakes are not adjusted properly.

**4. Are brakes properly adjusted?**

- **NO**
  - Adjust brakes (para 11-2).

- **YES**

**KNOW INFO**
Tire pressure OK
Front springs and shocks OK
Ride height is level
Lugnuts OK
Steering shafts and tie rods OK
Pitman arms and drag links OK
Brakes OK

**POSSIBLE PROBLEMS**
Faulty tee box
Faulty front steering gear
Faulty rear steering gear
Steering out of adjustment

**TEST OPTIONS**
Visual inspection or Tee Box Test

**REASON FOR QUESTION**
Damaged tee box or tee box mounting may cause HET tractor to wander, pull to one side, or shimmy.

**5. Is tee box free from damage, and is tee box mounting secure and free from damage?**

- **NO**
  - Tighten loose mounting. Replace damaged tee box (para 13-8).

- **YES**
Check pitman arms and drag links for damage, and loose or missing mounting hardware. Refer to (LO 9-2320-360-12) to lubricate steering linkage.

Check tee box for damage, and for loose or missing mounting hardware.

Refer to para 11-2 to adjust brakes.

<table>
<thead>
<tr>
<th>TEE BOX TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove screw and locknut from lower yoke of top steering shaft. Discard locknut.</td>
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<td>(2) Remove yoke from top tee box shaft.</td>
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<td>(3) Remove screw and locknut from yoke on front steering shaft. Discard locknut.</td>
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<tr>
<td>(4) Remove yoke from front tee box shaft.</td>
</tr>
<tr>
<td>(5) Remove screw and locknut from yoke on rear steering shaft. Discard locknut.</td>
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<tr>
<td>(6) Remove yoke from rear tee box shaft.</td>
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<tr>
<td>(7) Turn top tee box shaft to check for binding. Replace tee box (para 13–8) if it fails to turn smoothly or if it binds when top shaft is turned.</td>
</tr>
<tr>
<td>(8) Align key on rear tee box shaft with slot in steering shaft yoke.</td>
</tr>
<tr>
<td>(9) Install yoke on rear tee box shaft with screw and new locknut.</td>
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<td>(10) Align key on front tee box shaft with slot in steering shaft yoke.</td>
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<td>(12) Align key on top tee box shaft with slot in steering shaft yoke.</td>
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<tr>
<td>(13) Install yoke on top tee box shaft with screw and new locknut.</td>
</tr>
</tbody>
</table>
q2. WANDERS, PULLS TO ONE SIDE, OR SHIMMIES (CONT)

**KNOWN INFO**
- Tire pressure OK
- Front springs and shocks OK
- Ride height is level
- Lugnuts OK
- Steering shafts and tie rods OK
- Pitman arms and drag links OK
- Brakes OK
- Tee box OK
- Front steering gear OK

**POSSIBLE PROBLEMS**
- Faulty front steering gear
- Faulty rear steering gear
- Steering out of adjustment

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damaged front steering gear or steering gear mounting may cause HET tractor to wander, pull to one side, or shimmy.

**6.**
Is front steering gear free from damage, and is steering gear mounting secure and free from damage?

- **NO**
  - Notify supervisor if steering gear is damaged or mounting loose.
- **YES**

**7.**
Is rear steering gear free from damage, and is steering gear mounting secure and free from damage?

- **NO**
  - Notify supervisor if steering gear is damaged or mounting is loose.
- **YES**

**8.**
Do rear wheels appear to track directly behind front wheels?

- **NO**
  - Notify supervisor.
- **YES**

Fault not corrected. Refer to Suspension System Troubleshooting (s1, Wanders, pulls to one side, or shimmies).

**KNOWN INFO**
- Tire pressure OK
- Front springs and shocks OK
- Ride height is level
- Lugnuts OK
- Steering shafts and tie rods OK
- Pitman arms and drag links OK
- Brakes OK
- Tee box OK
- Front steering gear OK

**POSSIBLE PROBLEMS**
- Steering out of adjustment

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- If the steering system is not adjusted properly, HET tractor may wander, pull to one side, or shimmy.
Check front steering gear for damage, and for loose or missing mounting hardware.

Check rear steering gear for damage, and for loose or missing mounting hardware.

**NOTE**

- This test is only for diagnostic purposes. Any adjustment must be performed by DS maintenance.
- Other surfaces where tire tracking can be observed can also be used. These include surfaces such as snow, mud, or sand.

(1) Drive HET tractor, straight ahead, thru water covered surface and on to dry pavement.

(2) Observe where the tires on axle no. 4 pass over the tracks left by axle no. 1. The tires should overlap equally, on both sides, the tracks left by axle no. 1.
q3. EXCESSIVE PLAY WHEN TURNING STEERING WHEEL

START

1. Are steering shafts and tie rods properly lubricated, secure, and free from damage?

- **NO**

- **YES**

2. Are pitman arms and drag links properly lubricated, secure, and free from damage?

- **NO**
  - Lubricate (LO 9–2320–360–12). Notify supervisor of loose or damaged pitman arms or drag links.

- **YES**

**KNOWN INFO**
- Power steering oil level OK
- Power steering lines OK

**POSSIBLE PROBLEMS**
- Faulty steering shafts and tie rods
- Faulty pitman arms and drag links
- Faulty front or rear steering gears
- Faulty tee box

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Steering shafts or tie rods that are loose, damaged, or require lubrication may cause HET tractor to have excessive play when turning steering wheel.

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

**Personnel Required**
- Two
Check steering shafts and tie rods for damage and loose or missing mounting hardware. Refer to LO 9-2320-360-12 to lubricate steering linkage.

Check pitman arms and drag links for damage and loose or missing mounting hardware. Refer to (LO 9-2320-360-12) to lubricate steering linkage.
q3. EXCESSIVE PLAY WHEN TURNING STEERING WHEEL (CONT)

### Known Info
- Power steering oil level OK
- Power steering lines OK
- Steering linkage OK

### Possible Problems
- Faulty front or rear steering gears
- Faulty tee box

### Test Options
- Steering Gear Preload Test

### Reason for Question
If steering gear input shaft turns before pitman arm begins to move, front and/or rear steering gear has excessive play.

### Known Info
- Power steering oil level OK
- Power steering lines OK
- Steering linkage OK
- Front and rear steering gears OK

### Possible Problems
- Faulty tee box

### Test Options
- Tee Box Test

### Reason for Question
If there is play in top tee box shaft before output shafts begin to move, it may cause excessive play when steering wheel is turned.

### Questions
3. Does steering gear pitman arm move immediately when turning input shaft?
   - **Yes**
     - Notify supervisor.
   - **No**
     - Fault not corrected. Notify supervisor.

4. Is top tee box shaft free from play before output shafts begin to move?
   - **Yes**
     - Replace tee box (para 13–8).
   - **No**
     - Notify supervisor.
### STEERING GEAR PRELOAD TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Start engine (TM 9-2320-360-10).</td>
</tr>
<tr>
<td>(2)</td>
<td>Turn steering wheel while assistant observes front steering gear input shaft and pitman arm.</td>
</tr>
<tr>
<td>(3)</td>
<td>Notify supervisor if there is any play in steering gear input shaft before pitman arm begins to move.</td>
</tr>
<tr>
<td>(4)</td>
<td>Repeat step (2) and (3) for rear steering gear.</td>
</tr>
<tr>
<td>(5)</td>
<td>Shut off engine (TM 9-2320-360-10).</td>
</tr>
</tbody>
</table>

### TEE BOX TEST

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Remove screw and locknut from lower yoke of top steering shaft. Discard locknut.</td>
</tr>
<tr>
<td>(2)</td>
<td>Remove yoke from top tee box shaft.</td>
</tr>
<tr>
<td>(3)</td>
<td>Remove screw and locknut from yoke on front steering shaft. Discard locknut.</td>
</tr>
<tr>
<td>(4)</td>
<td>Remove yoke from front tee box shaft.</td>
</tr>
<tr>
<td>(5)</td>
<td>Remove screw and locknut from yoke on rear steering shaft. Discard locknut.</td>
</tr>
<tr>
<td>(6)</td>
<td>Remove yoke from rear tee box shaft.</td>
</tr>
<tr>
<td>(7)</td>
<td>Turn top tee box shaft to check for binding. Replace tee box (para 13-8) if it fails to turn smoothly or if it binds when top shaft is turned.</td>
</tr>
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<td>(8)</td>
<td>Align key on rear tee box shaft with slot in steering shaft yoke.</td>
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<td>Install yoke on rear tee box shaft with screw and new locknut.</td>
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</tr>
<tr>
<td>(13)</td>
<td>Install yoke on top tee box shaft with screw and new locknut.</td>
</tr>
</tbody>
</table>
q4. NO RESPONSE WHEN TURNING STEERING WHEEL

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

1. Are top steering shafts secure and free from damage?
   - **NO**
     - Tighten loose top steering shafts. Repair damaged shafts (para 13–7).
   - **YES**

2. Do tee box output shafts turn freely when input shaft is turned?
   - **NO**
     - Replace tee box (para 13–8).
   - **YES**
     - Fault not corrected. Notify supervisor.

KNOWN INFO

Power steering reservoir level OK

POSSIBLE PROBLEMS

Faulty top steering shafts
Faulty tee box

TEST OPTIONS

Visual inspection

REASON FOR QUESTION

Loose or damaged top steering shafts may cause no response when steering wheel is turned.

KNOWN INFO

Power steering reservoir level OK
Top steering shafts OK

POSSIBLE PROBLEMS

Faulty tee box

TEST OPTIONS

Tee Box Test

REASON FOR QUESTION

Faulty tee box may cause no response when steering wheel is turned.
Check top steering shafts for looseness and damage.

<table>
<thead>
<tr>
<th>TEE BOX TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Remove screw and locknut from lower yoke of top steering shaft. Discard locknut.</td>
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<td>(5) Remove screw and locknut from yoke on rear steering shaft. Discard locknut.</td>
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<td>(6) Remove yoke from rear tee box shaft.</td>
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<td>(7) Turn top tee box shaft to check for binding. Replace tee box (para 13-8) if it fails to turn smoothly or if it binds when top shaft is turned.</td>
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<tr>
<td>(13) Install yoke on top tee box shaft with screw and new locknut.</td>
</tr>
</tbody>
</table>
q5. NO RESPONSE AT NO. 1 AXLE WHEN TURNING STEERING WHEEL

**INITIAL SETUP**

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine shut off (TM 9–2320–360–10).</td>
<td>Tool Kit, Genl Mech (Item 54, Appendix F)</td>
</tr>
<tr>
<td>Wheels chocked.</td>
<td></td>
</tr>
</tbody>
</table>

**KNOWN INFO**

- Rear steering is OK

**POSSIBLE PROBLEMS**

- Faulty front steering shaft
- Faulty tee box
- Faulty front steering gear
- Faulty pitman arm or drag link

**TEST OPTIONS**

**REASON FOR QUESTION**

- Loose or damaged top steering shafts may cause no response at axle no. 1 when steering wheel is turned.

1. **Is front steering shaft secure and free from damage?**

   - **NO**
     - Tighten loose top steering shaft(s). Replace damaged shaft(s) (para 13–7).
   - **YES**

2. **Is tee box free from damage, and is tee box mounting secure and free from damage?**

   - **NO**
     - Replace tee box (para 13–8).
   - **YES**

**INITIAL SETUP**

**KNOWN INFO**

- Rear steering is OK
- Front steering shaft OK

**POSSIBLE PROBLEMS**

- Faulty tee box
- Faulty front steering gear
- Faulty pitman arm or drag link

**TEST OPTIONS**

**REASON FOR QUESTION**

- Faulty tee box may cause no response at axle no. 1 when steering wheel is turned. Axle no. 4 may steer normally.
Check front steering shaft for looseness and damage.

TEE BOX TEST

(1) Remove screw and locknut from lower yoke of top steering shaft. Discard locknut.

(2) Remove yoke from top tee box shaft.

(3) Remove screw and locknut from yoke on front steering shaft. Discard locknut.

(4) Remove yoke from front tee box shaft.

(5) Remove screw and locknut from yoke on rear steering shaft. Discard locknut.

(6) Remove yoke from rear tee box shaft.

(7) Turn top tee box shaft to check for binding. Replace tee box (para 13–8) if it fails to turn smoothly or if it binds when top shaft is turned.

(8) Align key on rear tee box shaft with slot in steering shaft yoke.

(9) Install yoke on rear tee box shaft with screw and new locknut.

(10) Align key on front tee box shaft with slot in steering shaft yoke.

(11) Install yoke on front tee box shaft with screw and new locknut.

(12) Align key on top tee box shaft with slot in steering shaft yoke.

(13) Install yoke on top tee box shaft with screw and new locknut.
q5. NO RESPONSE AT NO. 1 AXLE WHEN TURNING STEERING WHEEL (CONT)

**KNOWN INFO**

<table>
<thead>
<tr>
<th>Rear steering is OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front steering shaft OK</td>
</tr>
<tr>
<td>Tee box OK</td>
</tr>
</tbody>
</table>

**POSSIBLE PROBLEMS**

<table>
<thead>
<tr>
<th>Faulty front steering gear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty pitman arm or drag link</td>
</tr>
</tbody>
</table>

**TEST OPTIONS**

- Visual inspection

**REASON FOR QUESTION**

- Damaged front steering gear or steering gear mounting may cause no response at axle no. 1 when steering wheel is turned.

---

3. **Is front steering gear free from damage, and is steering gear mounting secure and free from damage?**
   
   **YES**
   
   **NO**
   
   - Tighten loose mounting(s).
   
   - Notify supervisor if steering gear is damaged.

---

4. **Are pitman arm and drag link at axle no. 1 secure and free from damage?**
   
   **YES**
   
   - Notify supervisor.
   
   **NO**
   
   - Fault not corrected.
   
   - Notify supervisor.

---

Rear steering is OK  
Front steering shaft OK  
Tee box OK  
Front steering gear OK

**POSSIBLE PROBLEMS**

| Faulty pitman arm or drag link |

---

Fault not corrected.  
Notify supervisor.
Check front steering gear for damage, and for loose or missing mounting hardware.

Check pitman arm and drag link at no. 1 axle for damage and for loose or missing mounting hardware.
### q6. NO RESPONSE AT NO. 4 AXLE WHEN TURNING STEERING WHEEL

#### INITIAL SETUP

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
<th>Personnel Required</th>
</tr>
</thead>
</table>

#### KNOWN INFO

<table>
<thead>
<tr>
<th>Does the rear output shaft on the tee box rotate when the top input shaft is turned?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front steering is OK</td>
</tr>
</tbody>
</table>

#### POSSIBLE PROBLEMS

<table>
<thead>
<tr>
<th>Faulty tee box</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty rear steering shafts</td>
</tr>
<tr>
<td>Faulty steering reduction gear</td>
</tr>
<tr>
<td>Faulty rear steering gear</td>
</tr>
<tr>
<td>Faulty pitman arm or drag link</td>
</tr>
</tbody>
</table>

#### TEST OPTIONS

<table>
<thead>
<tr>
<th>Does the rear output shaft on the tee box rotate when the top input shaft is turned?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

#### REASON FOR QUESTION

Faulty tee box may cause no response at axle no. 4 when steering wheel is turned. Axle no. 1 may steer normally.

#### KNOWN INFO

<table>
<thead>
<tr>
<th>Are rear steering shafts secure and free from damage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front steering is OK</td>
</tr>
<tr>
<td>Tee box OK</td>
</tr>
</tbody>
</table>

#### POSSIBLE PROBLEMS

<table>
<thead>
<tr>
<th>Faulty rear steering shafts</th>
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</thead>
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<tr>
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</tr>
<tr>
<td>Faulty rear steering gear</td>
</tr>
<tr>
<td>Faulty pitman arm or drag link</td>
</tr>
</tbody>
</table>

#### TEST OPTIONS

<table>
<thead>
<tr>
<th>Are rear steering shafts secure and free from damage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

#### REASON FOR QUESTION

Loose or damaged rear steering shafts may cause no response at axle no. 4 when steering wheel is turned.
Check rear steering shafts for looseness and damage.

TEE BOX TEST

(14) Support axle no. 1 and axle no. 4 on jackstands (para 12-5).
(15) Observe rear output shaft of tee box while assistant turns the steering wheel left and right.
q6. NO RESPONSE AT NO. 4 AXLE WHEN TURNING STEERING WHEEL (CONT)

**KNOWN INFO**
- Front steering is OK
- Tee box OK
- Rear steering shafts OK
- Steering reduction gear OK

**POSSIBLE PROBLEMS**
- Faulty steering reduction gear
- Faulty rear steering gear
- Faulty pitman arm or drag link

**TEST OPTIONS**
- Steering Reduction Gear Test

**REASON FOR QUESTION**
- If the steering reduction gear has failed, the rotation of the steering shafts will stop at the reduction gear. No response will be present at axle no. 4 when steering wheel is turned.

---

**KNOWN INFO**
- Front steering is OK
- Tee box OK
- Rear steering shafts OK
- Steering reduction gear OK

**POSSIBLE PROBLEMS**
- Faulty rear steering gear
- Faulty pitman arm or drag link

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damaged rear steering gear or steering gear mounting may cause no response at axle no. 4 when steering wheel is turned.

---

**KNOWN INFO**
- Front steering is OK
- Tee box OK
- Rear steering shafts OK
- Steering reduction gear OK
- Rear steering gear OK

**POSSIBLE PROBLEMS**
- Faulty pitman arm or drag link

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Damaged pitman arm or drag link at axle no. 4 may cause no response at axle no. 4 when steering wheel is turned.

---

3. **Does the output shaft on the steering reduction gear turn when the input shaft is turned?**

**TEST OPTIONS**
- Replace steering reduction gear (para 13-12).

**REASON FOR QUESTION**
- Notify supervisor.

---

4. **Is rear steering gear free from damage and is steering gear mounting secure and free from damage?**

**TEST OPTIONS**
- Tighten loose mounting(s). Notify supervisor if steering gear is damaged.

**REASON FOR QUESTION**
- Notify supervisor.

---

5. **Are pitman arm and drag link at axle no. 4 secure and free from damage?**

**TEST OPTIONS**
- Notify supervisor.

**REASON FOR QUESTION**
- Notify supervisor.

---

Fault not corrected. Notify supervisor.
Check pitman arm and drag link at no. 4 axle for damage and for loose or missing mounting hardware.

(1) Observe output shaft of steering reduction gear while assistant turns the steering wheel left and right.

(2) Remove jackstands from axle no. 1 and axle no. 4 (para 12-5).

Check rear steering gear for damage, and for loose or missing mounting hardware.
q7. **STEERING BINDS, DOES NOT RETURN TO STRAIGHT AHEAD AFTER TURNS**

**INITIAL SETUP**

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheels chocked.</td>
<td></td>
</tr>
<tr>
<td>Tool Kit, Genl Mech (Item 54, Appendix F)</td>
<td></td>
</tr>
</tbody>
</table>

**KNOWN INFO**

1. Does the input shaft on the tee box turn easily and do both output shafts rotate?

   - **NO** Replace tee box (para 13–8).
   - **YES**

2. Does the input shaft on the steering reduction gear box turn easily and does the output shaft rotate?

   - **NO** Replace steering reduction gear (para 13–12).
   - **YES** Fault not corrected. Notify supervisor.

**POSSIBLE PROBLEMS**

- Faulty tee box
- Faulty steering reduction gear
- Faulty steering reduction gear

**TEST OPTIONS**

- **Tee Box Test**
- **Steering Reduction Gear Test**

**REASON FOR QUESTION**

- Faulty tee box may cause steering to bind.
- Faulty steering reduction gear may cause steering to bind.
(1) Remove screw and locknut from lower yoke of top steering shaft. Discard locknut.
(2) Remove yoke from top tee box shaft.
(3) Remove screw and locknut from yoke on front steering shaft. Discard locknut.
(4) Remove yoke from front tee box shaft.
(5) Remove screw and locknut from yoke on rear steering shaft. Discard locknut.
(6) Remove yoke from rear tee box shaft.
(7) Turn top tee box shaft to check for binding. Replace tee box (para 13–8) if it fails to turn smoothly or if it binds when top shaft is turned.
(8) Align key on rear tee box shaft with slot in steering shaft yoke.
(9) Install yoke on rear tee box shaft with screw and new locknut.
(10) Align key on front tee box shaft with slot in steering shaft yoke.
(11) Install yoke on front tee box shaft with screw and new locknut.
(12) Align key on top tee box shaft with slot in steering shaft yoke.
(13) Install yoke on top tee box shaft with screw and new locknut.

STEERING REDUCTION GEAR TEST

(1) Remove screw and locknut from yoke of input shaft. Discard locknut.
(2) Remove yoke from input shaft.
(3) Remove screw and locknut from yoke on output shaft. Discard locknut.
(4) Remove yoke from output shaft.
(5) Turn input shaft to check for binding. Replace steering reduction gear (para 13–12) if it fails to turn smoothly or if it binds when input shaft is turned.
(6) Align key on output shaft with slot in steering shaft yoke.
(7) Install yoke on output shaft with screw and new locknut.
(8) Align key on input shaft with slot in steering shaft yoke.
(9) Install yoke on input shaft with screw and new locknut.
r. FIFTH WHEEL

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
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<tbody>
<tr>
<td>r1. Fifth wheel will not lock when coupling trailer to HET Tractor</td>
<td>2–918</td>
</tr>
<tr>
<td>r2. Excessive movement of trailer king pin in fifth wheel</td>
<td>2–922</td>
</tr>
<tr>
<td>r3. Fifth wheel will not unlock when disconnecting trailer from HET Tractor</td>
<td>2–924</td>
</tr>
</tbody>
</table>
## Initial Setup

<table>
<thead>
<tr>
<th>Equipment Conditions</th>
<th>Tools and Special Tools</th>
</tr>
</thead>
</table>

## Known Info

1. **Fifth wheel will not lock when coupling trailer to HET tractor**

### Known Info
- Fifth wheel is clean (no dirt, ice, snow, or other debris)
- Primary and secondary release handles in lock position

### Possible Problems
- Fifth wheel lubrication
- Fifth wheel adjustment
- Loose, broken, or missing king pin jaws

## Test Options

<table>
<thead>
<tr>
<th>Reason for Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fifth wheel may not lock if it requires lubrication.</td>
</tr>
</tbody>
</table>

## Flowchart

1. **Is fifth wheel properly lubricated?**
   - **Yes**: Fifth wheel is adequately lubricated.
   - **No**: Lubricate fifth wheel (LO 9–2320–360–12).

2. **Is fifth wheel properly adjusted?**
   - **Yes**: Primary and secondary release handles in lock position
   - **No**: Adjust fifth wheel. (para 14–3).

## Known Info

### Test Options
- Refer to fifth wheel adjustment procedure (para 14–3).

### Reason for Question
- Fifth wheel may not lock if improperly adjusted.
Refer to LO 9-2320-360-12 to lubricate fifth wheel.

Refer to para 14-3 to check for proper fifth wheel adjustment.
r1. **FIFTH WHEEL WILL NOT LOCK WHEN COUPLING TRAILER TO HET TRACTOR (CONT)**

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fifth wheel is clean (no dirt, ice, snow, or other debris)</td>
<td></td>
</tr>
<tr>
<td>Primary and secondary release handles in lock position</td>
<td></td>
</tr>
<tr>
<td>Fifth wheel is adequately lubricated</td>
<td></td>
</tr>
<tr>
<td>Fifth wheel is properly adjusted</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose, broken, or missing king pin jaws</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fifth wheel may not lock if king pin jaws are loose, broken, or missing.</td>
<td></td>
</tr>
</tbody>
</table>

3. **Are king pin jaws secure and free from damage or missing parts?**

- **NO**
  - Notify supervisor.

- **YES**
  - Fault not corrected. Notify supervisor.
Check for loose, damaged, or missing kingpin jaws. Check that kingpin jaws stay open when primary lock release handle is in locked position (TM 9-2320-360-10).
r2. EXCESSIVE MOVEMENT OF TRAILER KING PIN IN FIFTH WHEEL

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**

Nothing

**POSSIBLE PROBLEMS**

- Fifth wheel mounting hardware loose, missing, or broken.
- Fifth wheel adjustment
- King pin jaws loose or broken

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

There may be excessive movement of trailer king pin in fifth wheel if mounting hardware is loose, missing, or broken.

---

**KNOWN INFO**

Fifth wheel mounting hardware OK

**POSSIBLE PROBLEMS**

- Fifth wheel adjustment
- Fifth wheel king pin jaws loose or broken

**TEST OPTIONS**

Refer to fifth wheel adjustment procedure (para 14–3).

**REASON FOR QUESTION**

There will be excessive movement of trailer king pin in fifth wheel if fifth wheel is improperly adjusted.

---

1. Is fifth wheel mounting hardware secure and free from loose or missing parts?

   **YES**
   - Fifth wheel mounting hardware OK
   - Adjust fifth wheel. (para 14–3).

   **NO**
   - Replace fifth wheel mounting hardware (para 14–6).

2. Is fifth wheel properly adjusted?

   **YES**
   - Fault not corrected. Notify supervisor.

   **NO**
   - Adjust fifth wheel. (para 14–3).
Check fifth wheel for missing or broken hardware. Locknuts should be tightened to 325 lb-ft (509 N-m). Replace any loose locknuts.

Refer to para 14-3 to check for proper fifth wheel adjustment.
r3. FIFTH WHEEL WILL NOT UNLOCK WHEN DISCONNECTING TRAILER FROM HET TRACTOR

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWLEDGE INFO**
- Fifth wheel is clean (no dirt, ice, snow, or other debris)
- Primary and secondary release handles in lock position

**POSSIBLE PROBLEMS**
- Fifth wheel lubrication
- Release handles broken or disconnected

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Fifth wheel may not unlock if it requires lubrication.

---

**START**

1. **Is fifth wheel properly lubricated?**
   - **NO**
   - **YES**

2. **Do primary or secondary lock release handles operate freely?**
   - **NO**
     - Notify supervisor (fifth wheel needs replacement).
   - **YES**

---

No faults found. Notify supervisor.
Refer to LO 9–2320–360–12 to lubricate fifth wheel.

### s. SUSPENSION SYSTEM

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Troubleshooting Procedure (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>s1. Wanders, pulls to one side, or shimmies</td>
<td>2–928</td>
</tr>
<tr>
<td>s2. Leans to one side, or rear of vehicle sags</td>
<td>2–934</td>
</tr>
</tbody>
</table>
s1. WANDERS, PULLS TO ONE SIDE, OR SHIMMIES

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

**KNOWN INFO**

- Lugnuts OK
- Steering shafts and components OK
- Brake adjustment OK

**POSSIBLE PROBLEMS**

- Faulty or damaged front shock absorbers
- Faulty or damaged front leaf spring assemblies
- Faulty or damaged rear shock absorbers
- Faulty or damaged rear air bag assemblies
- Faulty or damaged longitudinal torque rods
- Faulty or damaged lateral torque rods
- Faulty or damaged rear suspension arm

**REASON FOR QUESTION**

**TEST OPTIONS**

**Visual inspection**

**CHECK**

1. Are front shock absorbers secure and free from damage?
   - **YES**
   - **NO** Replace damaged shock absorbers (para 15–3).

2. Are front leaf spring assemblies secure and free from damage?
   - **YES**
   - **NO** Notify supervisor if leaf spring is damaged.

**REASON FOR QUESTION**

HET tractor may wander, pull to one side, or shimmy if shock absorbers are loose or damaged.

HET tractor may wander, pull to one side, or shimmy if leaf spring assemblies are loose or damaged.
Check shock absorbers for damage or leaks, and for missing mounting hardware.

Check leaf springs for cracked or broken leaves or missing spring clips.

NOTE
Perform Steering System Troubleshooting - (w2, Wanders, Pulls to One Side, or Shimmies) before starting the steps given below.
s1. WANDERS, PULLS TO ONE SIDE, OR SHIMMIES (CONT)

**KNOWN INFO**
- Lugnuts OK
- Steering shafts and components OK
- Brake adjustment OK
- Front shock absorbers OK
- Front leaf spring assemblies OK

**POSSIBLE PROBLEMS**
- Faulty or damaged rear shock absorbers
- Faulty or damaged rear spring assemblies
- Faulty or damaged longitudinal torque rods
- Faulty or damaged lateral torque rods
- Faulty or damaged rear suspension arm

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- HET tractor may wander, pull to one side, or shimmy if shock absorber is loose or damaged.

---

3. Are rear shock absorbers secure and free from damage?

   - NO: Replace damaged shock absorber(s) (para 15-3).
   - YES

---

4. Are air springs secure and free from damage?

   - NO: Notify supervisor if air bag is damaged.
   - YES

---

5. Are lateral torque rods secure and free from damage?

   - NO: Notify supervisor if lateral torque rod(s) is damaged.
   - YES

---
Check springs for damage or leaks, and for missing mounting hardware.

Check shock absorbers for damage or leaks, and for missing mounting hardware.

Check lateral torque rods at the three rear axles for damage, and for loose or missing mounting hardware.
s1. WANDERS, PULLS TO ONE SIDE, OR SHIMMIES (CONT)

**KNOWLEDGE INFO**
- Lugnuts OK
- Steering shafts and components OK
- Brake adjustment OK
- Front shock absorbers OK
- Front leaf spring assemblies OK
- Rear shock absorbers OK
- Rear air spring assemblies OK
- Lateral torque rods OK

**POSSIBLE PROBLEMS**
- Faulty or damaged lateral torque rods
- Faulty or damaged rear suspension arm

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- HET Tractor may wander, pull to one side, or shimmy if longitudinal torque rods are loose or damaged.

**KNOWLEDGE INFO**
- Lugnuts OK
- Steering shafts and components OK
- Brake adjustment OK
- Front shock absorbers OK
- Front leaf spring assemblies OK
- Rear shock absorbers OK
- Rear air spring assemblies OK
- Longitudinal torque rods OK
- Lateral torque rods OK

**POSSIBLE PROBLEMS**
- Faulty or damaged rear suspension arm

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- HET Tractor may wander, pull to one side, or shimmy if longitudinal torque rods are loose or damaged.
Check rear suspension arm for loose or damaged mounting hardware. Inspect suspension arm bushing for damage.

NOTE
Make sure torque of mounting screws is 212 lb-ft (287 N-m)

Check longitudinal torque rods for damage, and for loose or missing mounting hardware.
s2. LEANS TO ONE SIDE, OR REAR OF VEHICLE SAGS

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**START**

1. **Is vehicle ride height correct?**
   - **NO**
     - Go to step 4.
   - **YES**
     - **TEST OPTIONS**
       - Visual inspection

**REASON FOR QUESTION**
- HET Tractor will sag if ride height adjustment is not correct.

---

2. **Are front leaf spring assemblies secure and free from damage?**
   - **NO**
     - Notify supervisor if leaf spring(s) is damaged.
   - **YES**
     - **TEST OPTIONS**
       - Visual inspection

**REASON FOR QUESTION**
- HET Tractor may lean to one side if leaf spring assembly is loose or damaged.
Check leaf springs for cracked or broken leaves or missing spring clips. Check shock absorbers for damage or leaks, and for missing mounting hardware.

Measure distance from top of no. 3 axle housing to bottom of frame rail on left and right sides. Distance should be 9 in (22.9 cm) on both sides.
s2. LEANS TO ONE SIDE, OR REAR OF VEHICLE SAGS (CONT)

**KNOWN INFO**
Vehicle ride height OK
Front leaf spring assemblies OK

**POSSIBLE PROBLEMS**
Faulty or damaged air spring or air lines
Ride height control valve out of adjustment
Faulty ride height control valve

**TEST OPTIONS**
Visual inspection

**REASON FOR QUESTION**
HET Tractor may lean to one side if air line or air spring assembly is leaking or damaged.

**KNOWLEDGE OPTIONS**
Vehicle ride height OK
Front leaf spring assemblies OK
Air spring and air lines OK
Ride height control valve correctly adjusted

**POSSIBLE PROBLEMS**
Ride height control valve out of adjustment
Faulty ride height control valve

**TEST OPTIONS**
Ride Height Adjustment Procedure (para 15-4)

**REASON FOR QUESTION**
If ride height cannot be adjusted, ride height control valve may be faulty.

**KNOWLEDGE OPTIONS**
Vehicle ride height OK
Front leaf spring assemblies OK
Air spring and air lines OK
Ride height control valve correctly adjusted

**POSSIBLE PROBLEMS**
Faulty ride height control valve

**TEST OPTIONS**
Ride Height Control Valve Test

**REASON FOR QUESTION**
HET Tractor may lean to one side, or rear of vehicle may sag if ride height control valve does not operate properly.

3. Are air spring assemblies or air lines going to and from air bag assemblies free from leaks or damage?

- **YES**
  - Replace faulty air spring (para 15-2).

- **NO**
  - Visual inspection
    - Replace damaged air lines (para 11-40).

4. Can vehicle ride height be adjusted?

- **YES**
  - Adjust ride height (para 15-4).

- **NO**
  - Go to step 5.

5. Does ride height control valve operate properly?

- **YES**
  - Fault not corrected.
    - Notify supervisor.

- **NO**
  - Replace ride height control valve (para 15-5).
WARNING
Wear safety goggles when performing leakage tests on valves and air hoses. Failure to comply may cause serious eye injury due to high air pressure.

Check air springs for leaks, and for missing mounting hardware. Inspect no. 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, and 2050 air lines going to and from air spring assemblies for loose connections and damage.

Refer to para 15–4 to adjust ride height.

RIDE HEIGHT CONTROL VALVE TEST

(1) Start engine (TM 9–2320–360–10) and allow air pressure to build up in air reservoirs. Shut off engine (TM 9–2320–360–10) when air pressure has built up to at least 65 psi (450 kPa).

(2) Remove screw, washer, and locknut from valve lever arm. Discard locknut.

   NOTE
   Moving height control valve more than 1 inch in either direction will shut off air supply.

(3) Pull up on height control valve. Air should flow into air springs.

(4) Push down on height control valve. Air should exhaust from air springs.

(5) Return height control valve to neutral position. Air should not flow into or out of air springs.

(6) Replace height control valve (para 15–5) if it does not operate properly. Install valve lever arm to height control valve with screw, washer, and new locknut if height control valve operates properly.
### t. WINCH SYSTEM

<table>
<thead>
<tr>
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<tbody>
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<td>t1. Both main winches and auxiliary winch do not operate</td>
<td>2–940</td>
</tr>
<tr>
<td>t2. One main winch does not operate in either direction</td>
<td>2–944</td>
</tr>
<tr>
<td>t3. Both main winches do not operate</td>
<td>2–948</td>
</tr>
<tr>
<td>t4. Auxiliary winch does not operate</td>
<td>2–950</td>
</tr>
<tr>
<td>t5. Cable hold down does not operate</td>
<td>2–954</td>
</tr>
<tr>
<td>t6. Main winch high speed will not work</td>
<td>2–958</td>
</tr>
<tr>
<td>t7. Engine does not operate at high idle when engine speed control switches are properly positioned</td>
<td>2–962</td>
</tr>
<tr>
<td>t8. Main winch or auxiliary winch makes excessive or unusual noise operates slowly, or jerks</td>
<td>2–970</td>
</tr>
<tr>
<td>t9. One main winch will not pull load</td>
<td>2–974</td>
</tr>
<tr>
<td>t10. One main winch will not pay out (using control valve)</td>
<td>2–976</td>
</tr>
</tbody>
</table>
t1. BOTH MAIN WINCHES AND AUXILIARY WINCH DO NOT OPERATE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**
- Hydraulic oil level OK
- Circuit breakers OK

**POSSIBLE PROBLEMS**
- PTO inoperative
- Damaged hydraulic hoses or fittings
- Damaged hydraulic pump

---

**TEST OPTIONS**
- Propeller Shaft Check

**REASON FOR QUESTION**
- There is no malfunction in winch system if PTO propeller shaft is not turning. Malfunction is with propeller shaft.

---

**KNOWN INFO**
- Hydraulic oil level OK
- Circuit breakers OK
- PTO OK

**POSSIBLE PROBLEMS**
- Damaged hydraulic hoses or fittings
- Damaged hydraulic pump

---

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Leaking or damaged hoses may cause insufficient oil supply to reach winch hydraulic motors.

---

1. **Does PTO propeller shaft turn properly?**
   - **YES**
     - Replace damaged oil hose(s) and fitting(s) para 17–11).
   - **NO**
     - Refer to PTO Troubleshooting- (i1, PTO does not engage).

2. **Are hydraulic hoses and fittings free from leaks or damage?**
   - **YES**
   - **NO**
(1) Remove control console panels (para 17-8).
(2) Check hydraulic hoses and fittings for leakage or damage.

**PTO PROPELLER SHAFT CHECK**

(1) Start engine and engage PTO (TM 9-2320-360-10).
(2) Check if PTO propeller shaft is turning.

**WARNING**

Wear safety goggles when performing leakage tests on valves and hydraulic hoses. Failure to comply may cause serious eye injury due to high hydraulic pressure.

(1) Remove control console panels (para 17-8).
(2) Check hydraulic hoses and fittings for leakage or damage.
t1. BOTH MAIN WINCHES AND AUXILIARY WINCH DO NOT OPERATE (CONT)

**KNOWN INFO**
- Hydraulic oil level OK
- Circuit breakers OK
- PTO OK
- Hydraulic hoses or fittings OK

**POSSIBLE PROBLEMS**
- Damaged hydraulic pump

**3.**

**Is hydraulic pump free from leaks or damage?**

- **NO**
  - Notify supervisor

- **YES**
  - Fault not corrected. Notify supervisor.

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Winches will not operate if hydraulic pump is damaged.

**NOTES**
Check hydraulic pump for leakage or damage, and for loose or missing mounting hardware.
## T2. ONE MAIN WINCH DOES NOT OPERATE IN EITHER DIRECTION

### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.
- Control Console Panels Removed (para 17–8).

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

**Personnel Required**
- Two

### KNOWN INFO

- Hydraulic oil level OK
- Circuit breakers OK

### POSSIBLE PROBLEMS

- Damaged hydraulic hoses or fittings
- Faulty kickout control valve
- Damaged winch kickout air lines
- Leaking winch drive motor

### TEST OPTIONS

**Visual inspection**

**Kickout Control Valve Test**

### REASON FOR QUESTION

- Oil quantity may be insufficient to operate winch if hydraulic hoses are leaking or damaged.
- Winch may not operate if kickout control valve does not operate properly or air lines are reversed on winch kickout.

---

### TEST OPTIONS

#### 1.

Are hydraulic hoses and fittings free from leaks or damage?

- **YES**
  - Replace damaged oil hose(s) and fitting(s) para 17–11.

- **NO**
  - Replace damaged oil hose(s) and fitting(s) para 17–11.

#### 2.

Does air escape from outside air line when winch kickout is engaged and from inside air line when winch kickout is disengaged?

- **YES**
  - Replace kickout control valve (para 17–2).

- **NO**
  - Replace kickout control valve (para 17–2).
NOTE

AIR PRESS gage must read at least 65 psi (448 kPa) before winch kickouts will operate.

(1) Start engine (TM 9-2320-360-10) and run until AIR PRESS gage indicates at least 65 psi (448 kPa).

(2) Remove two air lines from winch kickout.

(3) Engage winch kickout control. Air should escape from outside air line.

(4) Disengage winch kickout control. Air should escape from inside air line.

(5) Replace kickout control valve (para 17-2) if it does not operate properly.

(6) Install two air lines on winch kickout if kickout control valve operates properly.

WARNING

Wear safety goggles when performing leakage tests on valves and hoses. Failure to comply may cause serious eye injury due to high pressures.

Check hydraulic hoses and fittings for leakage or damage.

KICKOUT CONTROL VALVE TEST

NOTE

AIR PRESS gage must read at least 65 psi (448 kPa) before winch kickouts will operate.

(1) Start engine (TM 9-2320-360-10) and run until AIR PRESS gage indicates at least 65 psi (448 kPa).

(2) Remove two air lines from winch kickout.

(3) Engage winch kickout control. Air should escape from outside air line.

(4) Disengage winch kickout control. Air should escape from inside air line.

(5) Replace kickout control valve (para 17-2) if it does not operate properly.

(6) Install two air lines on winch kickout if kickout control valve operates properly.
t2. ONE MAIN WINCH DOES NOT OPERATE IN EITHER DIRECTION (CONT)

3. Are winch kickout air lines free from leaks or damage?

   | KNOWN INFO |
   | Hydraulic oil level OK |
   | Circuit breakers OK |
   | Hydraulic hoses and fittings OK |
   | Kickout control valve OK |

   | POSSIBLE PROBLEMS |
   | Damaged winch kickout air lines |
   | Leaking winch drive motor |

   YES

   NO

   Replace winch kickout air line(s) (para 11–40).

4. Is main winch drive motor free from leaks?

   | KNOWN INFO |
   | Hydraulic oil level OK |
   | Circuit breakers OK |
   | Hydraulic hoses and fittings OK |
   | Kickout control valve OK |
   | Winch kickout air lines OK |

   | POSSIBLE PROBLEMS |
   | Leaking winch drive motor |

   YES

   NO

   Notify supervisor

   Fault not corrected. Notify supervisor.

   YES

   NO

   Notify supervisor

   Winch may not operate if winch drive motor is leaking or damaged.

   Winch may not operate if winch kickout air line is leaking or damaged.
WARNING

Wear safety goggles when performing leakage tests on valves and hoses. Failure to comply may cause serious eye injury due to high air pressure.

Check winch kickout air lines for leakage or damage.

Check main winch drive motor for leakage and damage, and for loose or missing mounting hardware.
### t3. BOTH MAIN WINCHES DO NOT OPERATE

#### INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.
- Control console panel removed (rear only)
  (para 17–8)

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic oil level OK</td>
<td>Damaged air lines</td>
</tr>
<tr>
<td>Circuit breakers OK</td>
<td>Damaged hydraulic oil hoses or fittings</td>
</tr>
</tbody>
</table>

---

#### KNOWN INFO

Hydraulic oil level OK
Circuit breakers OK
Winch holddowns OK

#### POSSIBLE PROBLEMS

Damaged hydraulic oil hoses or fittings
Damaged air lines

---

#### TEST OPTIONS

**1. Do the winch cable holddowns operate properly?**

- **YES**
- **NO**

  Replace air line no. 2771 (para 11–40).

---

#### TEST OPTIONS

**2. Are hydraulic hoses and fittings free from leaks or damage?**

- **YES**
- **NO**

  Replace damaged oil hose(s) and fitting(s) (para 17–11).

---

**REASON FOR QUESTION**

- Winch platform air supply is faulty if cable holddowns are faulty.
- Leaking or damaged hoses may cause insufficient oil supply to reach winch hydraulic motors.
Check hydraulic hoses and fittings for leakage or damage.

**WARNING**

Wear safety goggles when performing leakage tests on valves and hydraulic hoses. Failure to comply may cause serious eye injury due to high hydraulic pressure.

Check air line no. 2771 from air manifold for leakage and damage.

Check hydraulic hoses and fittings for leakage or damage.
t3. BOTH MAIN WINCHES DO NOT OPERATE (CONT)

**KNOWN INFO**
- Hydraulic oil level OK
- Circuit breakers OK
- Winch holddowns OK
- Hydraulic oil hoses and fittings OK

**POSSIBLE PROBLEMS**
- Damaged air lines

**TEST OPTIONS**
- Visual inspection

**REASON FOR QUESTION**
- Kickouts may not engage winch if winch kickout air line is leaking or damaged.

---

3. Are winch kickout air lines free from leaks or damage?

- **NO**: Replace winch kickout air line(s) (para 11–40).
- **YES**: Fault not corrected. Notify supervisor.
Check winch kickout air lines for leakage or damage.
t4. AUXILIARY WINCH DOES NOT OPERATE

**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.
- Control console panel removed (rear only) (para 17–8)

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)

---

**KNOWN INFO**

Hydraulic oil level OK
Circuit breakers OK

**POSSIBLE PROBLEMS**

Damaged hydraulic hoses or fittings
Winch drive motor damaged or leaking
Auxiliary winch damaged or leaking

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Oil quantity may be insufficient to operate winch if hydraulic hoses are leaking or damaged.

---

**KNOWN INFO**

Hydraulic oil level OK
Circuit breakers OK
Hydraulic oil hoses and fittings OK

**POSSIBLE PROBLEMS**

Winch drive motor damaged or leaking
Auxiliary winch damaged or leaking

**TEST OPTIONS**

Visual inspection

**REASON FOR QUESTION**

Winch may not operate if winch drive motor is leaking or damaged.
Check hydraulic hoses and fittings for leakage or damage.

WARNING
Wear safety goggles when performing leakage tests on valves and hydraulic hoses. Failure to comply may cause serious eye injury due to high hydraulic pressure.

Check auxiliary winch drive motor for leakage or damage, and for loose or missing mounting hardware.
t4. AUXILIARY WINCH DOES NOT OPERATE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>3. Is auxiliary winch free from damage or leaks?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic oil level OK</td>
<td></td>
</tr>
<tr>
<td>Circuit breakers OK</td>
<td></td>
</tr>
<tr>
<td>Hydraulic oil hoses and fittings OK</td>
<td></td>
</tr>
<tr>
<td>Auxiliary winch drive motor OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary winch damaged or leaking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REASON FOR QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary winch will not operate if damaged.</td>
</tr>
</tbody>
</table>

Fault not corrected. Notify supervisor.
Check auxiliary winch for damage, and for loose or missing mounting hardware.
t5. CABLE HOLD DOWN DOES NOT OPERATE

INITIAL SETUP

**Equipment Conditions**
- Wheels chocked.
- Control console panel removed (rear only) (para 17–8).

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)

---

**KNOWN INFO**

| Air pressure needle on green, over 70 psi (483 kPa) |
| Air supplied to winch |

**POSSIBLE PROBLEMS**

- Air supply lines leaking or damaged
- Cable hold down spring cushions leaking
- Air lines damaged or leaking
- Pressure regulator valve faulty or out of adjustment
- Faulty cable hold down control valve

---

**TEST OPTIONS**

**REASON FOR QUESTION**

Both hold down and kickout will not operate if air supply lines to winch are leaking or damaged.

---

1. Do winch kick-outs operate?

   - **NO**
     - Repair air supply lines to winch platform (para 11–40).
   - **YES**

2. Are cable hold down spring cushions free from leaks or damage?

   - **NO**
     - Replace cable hold down spring cushion(s) (para 17–7).
   - **YES**

---

**KNOWN INFO**

| Air pressure needle on green, over 70 psi (483 kPa) |
| Air supplied to winch |

**POSSIBLE PROBLEMS**

- Cable hold down spring cushions leaking
- Air lines damaged or leaking
- Pressure regulator valve faulty or out of adjustment
- Faulty cable hold down control valve

---

**TEST OPTIONS**

**REASON FOR QUESTION**

Cable hold down will not operate if cable hold down spring cushions are leaking or damaged.
Check cable hold down spring cushions for leakage or damage.

NOTE
AIR PRESS gage must read at least 70 psi (483 kPa) for cable hold down to operate.

Check cable hold down spring cushions for leakage or damage.

WARNING
Wear safety goggles when performing leakage tests on valves and air hoses. Failure to comply may cause serious eye injury due to high air pressure.

Operate winch kickouts (TM 9-2320-360-10). If kickouts do not function, check air line no. 2771 from winch holddowns to air manifold for leakage and damage.

Winch Air System
t5. CABLE HOLD DOWN DOES NOT OPERATE (CONT)

3. Are cable hold down air lines or air line no. 2771 from cable hold down control valve to chassis air manifold free from leaks or damage?

- **NO**
  - Replace cable hold down air lines or air line no. 2771 (para 11-40).

- **YES**
  - Visual inspection

4. Does pressure gage measure 70 psi (483 kPa) at pressure regulator valve?

- **NO**
  - Adjust pressure regulator valve (para 17-3). Replace damaged pressure regulator valve (para 17-3).

- **YES**
  - Refer to pressure regulator valve adjustment procedure (para 17-3).
  - or
  - STE/ICE-R Test #50

5. Does pressure gage measure 70 psi (483 kPa) at cable hold down control valve outlet port?

- **NO**
  - Replace cable hold down control valve (para 17-7).

- **YES**
  - Fault not corrected. Notify supervisor
Refer to para 17-3 to adjust pressure regulator valve.

WARNING
Wear safety goggles when performing leakage tests on valves and air hoses. Failure to comply may cause serious eye injury due to high air pressure.

Check cable hold down air lines and air line no. 2771 from cable hold down to air manifold for leakage or damage.

CONTROL VALVE TEST

1. Start engine (TM 9-2320-360-10) and run until AIR PRESS gage indicates at least 70 psi (483 kPa).
2. Remove air line from cable hold down control valve outlet port.
3. Connect pressure gage to cable hold down control valve outlet port.
4. Position CABLE HOLD DOWN control to ON (TM 9-2320-360-10) and check reading on pressure gage. Pressure gage should read 70 psi (483 kPa).
5. Replace cable hold down control valve (para 17-7) if pressure gage does not read 70 psi (483 kPa).
6. Install air line on cable hold down control valve outlet port if it operates properly.
**t6. MAIN WINCHES WILL ONLY OPERATE IN ONE SPEED**

**INITIAL SETUP**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)
- Multimeter (Item 20, Appendix F)

---

**KNOWN INFO**
- Circuit breakers OK
- Engine high idle OK
- Hydraulic oil level OK

**POSSIBLE PROBLEMS**
- WINCH SPEED CONTROL switch
- Loose or damaged wire connections

---

**TEST OPTIONS**
- Wire no. 1929 Voltage Test
  - or
  - STE/ICE-R Test #89

---

**REASON FOR QUESTION**
- Main winches will not operate if low voltage is measured on wire no. 1930 at WINCH SPEED CONTROL switch.
  - (WINCH SPEED CONTROL switch defective.)

---

**WARNING**
Read WARNING on following page.

---

**TEST OPTIONS**
- Winch Speed Control Switch Test
  - or
  - STE/ICE-R Test #89

---

**REASON FOR QUESTION**
Main winches will not operate if wire no. 1929 from PTO control switch to WINCH SPEED CONTROL switch is loose or damaged.

---

**KNOWN INFO**
- Circuit breakers OK
- Engine high idle OK
- Hydraulic oil level OK
- Voltage present at WINCH SPEED CONTROL switch

**POSSIBLE PROBLEMS**
- WINCH SPEED CONTROL switch
- Loose or damaged wire connections

---

**TEST OPTIONS**
- Wire no. 1930 Voltage Test
  - or
  - STE/ICE-R Test #89

---

**REASON FOR QUESTION**
Main winches will not operate if low voltage is measured on wire no. 1930 at WINCH SPEED CONTROL switch.
  - (WINCH SPEED CONTROL switch defective.)
WARNING

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE

Engine must be running and PTO control switch placed in the on position to perform this step.

---

### WIRE NO. 1929 VOLTAGE TEST

1. Place positive (+) probe of multimeter on wire no. 1929 at WINCH SPEED CONTROL switch.
2. Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.

### WINCH SPEED CONTROL SWITCH TEST

1. Position WINCH SPEED CONTROL switch to HIGH.
2. Place positive (+) probe of multimeter on wire no. 1930 at WINCH SPEED CONTROL switch.
3. Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.
4. Replace WINCH SPEED CONTROL switch (para 7–92) if no voltage is measured.
t6. MAIN WINCHES WILL ONLY OPERATE IN ONE SPEED (CONT)

**KNOWN INFO**
- Circuit breakers OK
- Engine high idle OK
- Hydraulic oil level OK
- Voltage present at WINCH SPEED CONTROL switch
- WINCH SPEED CONTROL switch OK

**POSSIBLE PROBLEMS**
- Loose or damaged wire connections

---

**3.**

**WARNING**
Read WARNING on following page.

**TEST OPTIONS**
- Wire no. 1930 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Main winches will not operate if wire no. 1930 from WINCH SPEED CONTROL switch to counterbalance valve is loose or damaged.

**TEST OPTIONS**
- Visual inspection
- Continuity Test
- STE/ICE-R Test #91

---

**4.**

**Are 22-28 volts measured on wire no. 1930 at counter balance valve?**

**TEST OPTIONS**
- Wire no. 1930 Voltage Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
Main winches will not operate if wire no. 1930 from WINCH SPEED CONTROL switch to counterbalance valve is loose or damaged.

**KNOWN INFO**
- Circuit breakers OK
- Engine high idle OK
- Hydraulic oil level OK
- Voltage present at WINCH SPEED CONTROL switch
- WINCH SPEED CONTROL switch OK

**POSSIBLE PROBLEMS**
- Loose or damaged wire connections

---

**Are ground wire no. 1435C from counterbalance valve secure and free from damage?**

**TEST OPTIONS**
- Visual inspection
- Continuity Test
- STE/ICE-R Test #91

**REASON FOR QUESTION**
Main winches will not operate if ground wire no. 1435C from counterbalance valve is loose or damaged. Counterbalance valve is faulty if ground wire no. 1435 is secure.

---

**Fault not corrected. Notify supervisor.**
WARNING

* Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.

* Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

WIRE NO. 1930 VOLTAGE TEST

1. Place positive (+) probe of multimeter on wire no. 1930 at counterbalance valve.
2. Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.

Check ground wire no. 1435 from counterbalance valve for loose connections, damage, and continuity.

CONTINUITY TEST

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

3. Connect multimeter leads to each end of wire and check multimeter for continuity.

**NOTE**
A reading of other than infinity indicates a grounded wire.

4. Remove multimeter lead from one end of wire and connect to chassis ground.
17. ENGINE DOES NOT OPERATE AT HIGH IDLE WHEN ENGINE SPEED CONTROL SWITCHES ARE PROPERLY POSITIONED

**INITIAL SETUP**

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

**Tools and Special Tools**
- Tool Kit, Genl Mech (Item 54, Appendix F)
- STE/ICE-R (optional) (Item 47, Appendix F)
- Multimeter (Item 20, Appendix F)

---

**KNOWN INFO**

- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK

**POSSIBLE PROBLEMS**

- Engine DDEC system
- Wire no. 1154 damaged or loose
- Faulty left ENGINE SPEED CONTROL switch
- Wire no. 1154A damaged or loose
- Wire no. 1154B damaged or loose
- Faulty right ENGINE SPEED CONTROL switch
- Faulty Hi IDLE SWITCH relay
- Wire no. 1590 damaged or loose
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

---

**TEST OPTIONS**

- DDEC HE/IDLE Relay Test
- or
- STE/ICE-R Test #89

**REASON FOR QUESTION**

If 2.2–2.7 volts are present at wire no. 510 at DDEC relay, chassis wiring and relays are OK. Problem is with engine DDEC system. Less than 2.2 volts or greater than 2.7 volts indicates problem with chassis electrical system.

---

**KNOWN INFO**

- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK
- Problem is not with engine DDEC system

**POSSIBLE PROBLEMS**

- Wire no. 1154 damaged or loose
- Faulty left ENGINE SPEED CONTROL switch
- Wire no. 1154A damaged or loose
- Wire no. 1154B damaged or loose
- Faulty right ENGINE SPEED CONTROL switch
- Faulty Hi IDLE SWITCH relay
- Wire no. 1590 damaged or loose
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

---

**TEST OPTIONS**

- Visual inspection

**REASON FOR QUESTION**

Engine will not operate at high idle if wire no. 1154 from P.T.O. HI IDLE relay to ENGINE SPEED CONTROL switches is loose or damaged.
WARNING

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

NOTE

If voltage on wire no. 510 exceeds 4.7 volts for more than 2 seconds, DDEC will log Code 12.

DDEC HI/IDLE RELAY TEST

NOTE

Engine must be running, PTO control switch placed in the on position, and engine speed control switches in the HIGH position to perform this test.

(1) Place positive (+) probe of multimeter on wire no. 510 at DDEC HI IDLE relay.

(2) Place negative (−) probe of multimeter on ground and look for voltage on multimeter.

CONTINUITY TEST

(1) Disconnect wiring from components at each end of wire.

(2) Set multimeter to ohms position.

NOTE

A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire and check multimeter for continuity.

NOTE

A reading of other than infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.
17. ENGINE DOES NOT OPERATE AT HIGH IDLE WHEN ENGINE SPEED CONTROL SWITCHES ARE PROPERLY POSITIONED (CONT)

### KNOWN INFO
- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK
- Problem is not with engine
- DDEC system
- Wire no. 1154 OK

### POSSIBLE PROBLEMS
- Faulty left ENGINE SPEED CONTROL switch
- Wire no. 1154A damaged or loose
- Wire no. 1154B damaged or loose
- Faulty right ENGINE SPEED CONTROL switch
- Faulty HI IDLE SWITCH relay
- Wire no. 1590 damaged or loose
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

### WARNING
Read WARNING on following page.

### TEST OPTIONS
- Engine Speed Control Switch Test
- or
- STE/ICE-R Test #89

---

**Are 22–28 volts measured on wire no. 1154A at left ENGINE SPEED CONTROL switch?**

- **YES**
  - Replace left ENGINE SPEED CONTROL switch (para 7–92).

- **NO**
  - Test OPTIONS

### TEST OPTIONS
- Visual inspection
  - or
- Continuity Test
  - or
- STE/ICE-R #91

### REASON FOR QUESTION
Engine will not operate at high idle if low voltage is measured on wire no. 1154A at left ENGINE SPEED CONTROL switch. (Left ENGINE SPEED CONTROL switch damaged.)

---

**Is wire no. 1154A from left ENGINE SPEED CONTROL switch to HI IDLE SWITCH relay secure and free from damage?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wiring is found.

- **NO**
  - Test OPTIONS

### TEST OPTIONS
- Visual inspection
  - or
- Continuity Test
  - or
- STE/ICE-R #91

### REASON FOR QUESTION
Engine will not operate at high idle if wire no. 1154A from left ENGINE SPEED CONTROL switch to HI IDLE SWITCH relay is loose or damaged.

---

**Is wire no. 1154B from right ENGINE SPEED CONTROL switch to HI IDLE SWITCH relay secure and free from damage?**

- **YES**
  - Secure loose connections. Notify supervisor if damaged wiring is found.

- **NO**
  - Test OPTIONS

### TEST OPTIONS
- Visual inspection
  - or
- Continuity Test
  - or
- STE/ICE-R #91

### REASON FOR QUESTION
Engine will not operate at high idle if wire no. 1154B from right ENGINE SPEED CONTROL switch to HI IDLE SWITCH relay is loose or damaged.
WARNING

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

**ENGINE SPEED CONTROL SWITCH TEST**

**NOTE**
Engine must be running, PTO control switch placed in the on position, and engine speed control switches in the HIGH position to perform this test.

(1) Place positive (+) probe of multimeter on wire no. 1154A at left ENGINE SPEED CONTROL switch.

(2) Place negative (−) probe of multimeter on ground and look for 22–28 volts on multimeter.

(3) Replace left ENGINE SPEED CONTROL switch (para 7–92) if no voltage is measured.

---

Check wire no. 1154A from left ENGINE SPEED CONTROL switch to HI IDLE SWITCH relay for loose connections, damage, and continuity test.

---

Check wire no. 1154B from right ENGINE SPEED CONTROL switch to HI IDLE SWITCH relay for loose connections, damage, and continuity.

---

**CONTINUITY TEST**

(1) Disconnect wiring from components at each end of wire.

(2) Set multimeter to ohms position.

**NOTE**
A reading of infinity indicates an open circuit.

(3) Connect multimeter leads to each end of wire.

**NOTE**
A reading of other than infinity indicates a grounded wire.

(4) Remove multimeter lead from one end of wire and connect to chassis ground.
17. ENGINE DOES NOT OPERATE AT HIGH IDLE WHEN ENGINE SPEED CONTROL SWITCHES ARE PROPERLY POSITIONED (CONT)

**KNOWN INFO**
- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK
- Problem is not with engine
- DDEC system
- Wire no. 1154 OK
- Left ENGINE SPEED CONTROL switch OK
- Wire no. 1154A OK
- Wire no. 1154B OK

**POSSIBLE PROBLEMS**
- Faulty right ENGINE SPEED CONTROL switch
- Faulty HI IDLE SWITCH relay
- Wire no. 1590 damaged or loose
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

---

**KNOWN INFO**
- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK
- Problem is not with engine
- DDEC system
- Wire no. 1154 OK
- Left ENGINE SPEED CONTROL switch OK
- Wire no. 1154A OK
- Wire no. 1154B OK
- Right ENGINE SPEED CONTROL switch OK

**POSSIBLE PROBLEMS**
- Faulty HI IDLE SWITCH relay
- Wire no. 1590 damaged or loose
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

---

**KNOWN INFO**
- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK
- Problem is not with engine
- DDEC system
- Wire no. 1154 OK
- Left ENGINE SPEED CONTROL switch OK
- Wire no. 1154A OK
- Wire no. 1154B OK
- Right ENGINE SPEED CONTROL switch OK
- HI IDLE SWITCH relay OK

**POSSIBLE PROBLEMS**
- Wire no. 1590 damaged or loose
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

---

**TEST OPTIONS**
- Engine Speed Control Switch Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
- Engine will not operate at high idle if low voltage is measured on wire no. 1154B at right ENGINE SPEED CONTROL switch. (Right ENGINE SPEED CONTROL switch damaged.)

---

**TEST OPTIONS**
- HIGH/IDLE Switch Relay Test
  - or
  - STE/ICE-R Test #89

**REASON FOR QUESTION**
- Engine will not operate at high idle if low voltage is measured on wires no. 1590 at HI IDLE SWITCH relay (HI IDLE SWITCH relay damaged).

---

**TEST OPTIONS**
- Visual inspection
  - or
  - Continuity Test
  - or
  - STE/ICE-R #91

**REASON FOR QUESTION**
- Engine will not operate at high idle if no. 1590 wire from HI IDLE SWITCH relay to DDEC HI IDLE relay is loose or damaged.
**WARNING**

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

### ENGINE SPEED CONTROL SWITCH TEST

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine must be running, PTO control switch placed in the on position, and engine speed control switches placed in the HIGH position to perform this test.</td>
</tr>
</tbody>
</table>

1. Place positive (+) probe of multimeter on wire no. 1154B at right ENGINE SPEED CONTROL switch.
2. Place negative (--) probe of multimeter on ground and look for 22–28 volts on multimeter.
3. Replace right ENGINE SPEED CONTROL switch (para 7–92) if no voltage is measured.

### HIGH IDLE SWITCH RELAY TEST

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine must be running, PTO control switch placed in the on position, and engine speed control switches placed in the HIGH position to perform this test.</td>
</tr>
</tbody>
</table>

1. Place positive (+) probe of multimeter on wire no. 1590 at HI IDLE SWITCH relay.
2. Place negative (--) probe of multimeter on ground and look for 22–28 volts on multimeter.
3. Replace HI IDLE SWITCH relay (para 7–27) if no voltage is measured.

### CONTINUITY TEST

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A reading of infinity indicates an open circuit..</td>
</tr>
</tbody>
</table>
3. Connect multimeter leads to each end of wire and check multimeter for continuity.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A reading of other than infinity indicates a grounded wire.</td>
</tr>
</tbody>
</table>
4. Remove multimeter lead from one end of wire and connect to chassis ground.
t7. ENGINE DOES NOT OPERATE AT HIGH IDLE WHEN ENGINE SPEED
CONTROL SWITCHES ARE PROPERLY POSITIONED (CONT)

**KNOWLEDGE**
- Circuit breakers OK
- Backup lights OK
- Engine starts in neutral
- Transmission cable is adjusted properly
- PTO operation OK
- Problem is not with engine
- DDEC system
- Wire no. 1154 OK
- Left ENGINE SPEED
  - CONTROL switch OK
- Wire no. 1154A OK
- Wire no. 1154B OK
- Right ENGINE SPEED
  - CONTROL switch OK
- HI IDLE SWITCH relay OK
- Wire no. 1950 OK

**POSSIBLE PROBLEMS**
- Wire no. 1435 damaged or loose
- Faulty DDEC HI IDLE relay

---

9. Is ground wire no. 1435 from DDEC HI IDLE relay secure and free from damage?

- **YES**
  - Secure loose connections. Notify supervisor if damaged wiring is found

- **NO**
  - Engine will not operate at high idle if ground wire no. 1435 from DDEC HI IDLE relay is loose or damaged.

**TEST OPTIONS**
- Visual inspection
- Continuity Test
- STE/ICE-R #91

**REASON FOR QUESTION**
- Engine will not operate at high idle if ground wire no. 1435 from DDEC HI IDLE relay is loose or damaged.

---

10. Is voltage measured on wires no. 510 at DDEC HI IDLE relay?

- **NO**
  - Replace DDEC HI IDLE relay (para 7-27)

- **YES**
  - Engine will not operate at high idle if no voltage is measured on wires no. 510 at DDEC HI IDLE relay.

**TEST OPTIONS**
- DDEC HE/IDLE Relay Test
- STE/ICE-R Test #89

**REASON FOR QUESTION**
- Engine will not operate at high idle if no voltage is measured on wires no. 510 at DDEC HI IDLE relay.
Check ground wire no. 1435 from DDEC HI IDLE relay for loose connections, damage, and continuity.

**CONTINUITY TEST**

1. Disconnect wiring from components at each end of wire.
2. Set multimeter to ohms position.
   
   **NOTE**
   
   A reading of infinity indicates an open circuit.
3. Connect multimeter leads to each end of wire and check multimeter for continuity.
   
   **NOTE**
   
   A reading of other than infinity indicates a grounded wire.
4. Remove multimeter lead from one end of wire and connect to chassis ground.

**WARNING**

- Batteries must be disconnected before tightening any connections. Failure to comply may result in injury to personnel.
- Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor.

Check ground wire no. 1435 from DDEC HI IDLE relay for loose connections, damage, and continuity.

**DDEC HI/IDLE RELAY TEST**

**NOTE**

Engine must be running, PTO control switch placed in the on position, and engine speed control switches in the HIGH position to perform this test.

1. Place positive (+) probe of multimeter on wire no. 510 at DDEC HI IDLE relay.
2. Place negative (-) probe of multimeter on ground and look for voltage on multimeter.
3. Replace DDEC HI IDLE relay (para 7-27) if no voltage is measured on wire no. 510.
t8. MAIN WINCHES OR AUXILIARY WINCH MAKE EXCESSIVE OR UNUSUAL NOISE DURING OPERATION

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)

KNOWN INFO
Hydraulic oil at proper level
Winch drum free
Winch cable not tangled

POSSIBLE PROBLEMS
Damaged hydraulic hoses or fittings
Damaged or leaking hydraulic pump
Damaged or leaking winch drive motor

Are hydraulic hoses and fittings free from leaks or damage?

YES

Replace damaged oil hose(s) and fitting(s) (para 17–11).

NO

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Leaking hydraulic hoses may lead to insufficient oil supplied to winches causing winches to operate with excessive or unusual noise.

Is hydraulic pump free from leaks or damage?

YES

Notify supervisor

NO

TEST OPTIONS
Visual inspection

REASON FOR QUESTION
Hydraulic pump may operate with excessive or unusual noise if damaged.
Check hydraulic hoses and fittings for leakage or damage.

**WARNING**
Wear safety goggles when performing leakage tests on valves and hydraulic hoses. Failure to comply may cause serious eye injury due to high hydraulic pressure.

Check hydraulic pump for leakage or damage, and for loose or missing mounting hardware.
**t8. MAIN WINCHES OR AUXILIARY WINCH MAKE EXCESSIVE OR UNUSUAL NOISE DURING OPERATION (CONT)**

**KNOWN INFO**
- Hydraulic oil at proper level
- Winch drum free
- Winch cable not tangled
- Hydraulic hoses and fittings OK
- Hydraulic pump OK

**POSSIBLE PROBLEMS**
- Damaged or leaking winch drive motor

---

**TEST OPTIONS**
- Visual inspection

---

**REASON FOR QUESTION**
- Winch drive motor may operate with excessive or unusual noise if damaged.

---

**3. Is winch drive motor free from leaks or damage?**

- **YES**
  - Fault not corrected.
  - Notify supervisor.

- **NO**
  - Notify supervisor.
Check winch drive motor for leakage, and for loose or missing mounting hardware.
### t9. ONE MAIN WINCH WILL NOT PULL LOAD

#### INITIAL SETUP

**Equipment Conditions**
- Engine shut off (TM 9-2320-360-10).
- Parking brake on (TM 9-2320-360-10).
- Wheels chocked.

---

#### KNOWN INFO

<table>
<thead>
<tr>
<th>Test Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic oil level OK</td>
</tr>
<tr>
<td>Circuit breakers OK</td>
</tr>
</tbody>
</table>

#### TEST OPTIONS

<table>
<thead>
<tr>
<th>Test Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM 9-2320-360-34</td>
</tr>
</tbody>
</table>

---

1. Refer to direct support maintenance for troubleshooting of this fault.
**INITIAL SETUP**

**Equipment Conditions**
- Wheels chocked.

---

1. **KNOWN INFO**
   - Hydraulic oil level OK
   - Circuit breakers OK

2. **TEST OPTIONS**
   - TM 9–2320–360–34

---

Refer to direct support maintenance for troubleshooting of this fault.
u. ARCTIC KIT

Malfunction

u.1 Arctic kit coolant pump does not operate .......................... 2-978
u1. ARCTIC KIT COOLANT PUMP DOES NOT OPERATE

INITIAL SETUP

Equipment Conditions
Wheels chocked.

Tools and Special Tools
Tool Kit, Genl Mech (Item 54, Appendix F)
STE/ICE–R (optional) (Item 47, Appendix F)
Multimeter (Item 20, Appendix F)

---

START

1. Are 22–28 volts measured across arctic kit batteries?

   YES
   - Service or replace arctic kit batterie(s) (para 19–3).
   NO

   WARNING
   Read WARNING on following page.

   TEST OPTIONS
   Arctic Kit Battery Voltage Test or
   STE/ICE–R Test #89

   REASON FOR QUESTION
   Low battery voltage will not provide enough power to operate coolant pump.

2. Are 22–28 volts measured across arctic kit coolant pump fuse?

   YES
   - Arctic Kit Fuse Test or
     STE/ICE–R Test #89
   NO
   - Go to step 7.

   TEST OPTIONS
   Faulty arctic kit coolant pump fuse
   Loose or damaged wires
   Faulty arctic kit coolant pump
   Faulty coolant pump switch

   REASON FOR QUESTION
   Coolant pump fuse or wire from battery to fuse is faulty if low voltage is measured.
(1) Place positive (+) probe of multimeter on positive (+) battery post.
(2) Place negative (--) probe of multimeter on negative (--) battery post and look for 22–28 volts on multimeter.
(3) Service or replace arctic kit batteries (para 19–3) if less than 24 volts is measured.

**WARNINGS**

Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes.

### ARCTIC KIT BATTERY VOLTAGE TEST

- Place positive (+) probe of multimeter on positive (+) battery post.
- Place negative (--) probe of multimeter on negative (--) battery post and look for 22–28 volts on multimeter.
- Service or replace arctic kit batteries (para 19–3) if less than 24 volts is measured.

### ARCTIC KIT FUSE TEST

**NOTE**

Arctic Kit pump switch must be positioned to on to perform this test.

- Place positive (+) probe of multimeter on no. 1373 wire just after coolant pump fuse.
- Place negative (--) probe of multimeter on ground and look for 22–28 volts on multimeter.
u1. ARCTIC KIT COOLANT PUMP DOES NOT OPERATE (CONT)

**KNOWN INFO**
- Arctic kit batteries OK
- Wire no. 1373 from batteries to fuse OK
- Arctic kit coolant pump fuse OK

**POSSIBLE PROBLEMS**
- Loose or damaged wires
- Faulty arctic kit coolant pump
- Faulty coolant pump switch

**TEST OPTIONS**
- Wire No. 1373 Voltage Test
  - or
  - STE/ICE-R Test # 89

**REASON FOR QUESTION**
- Wire no. 1373 is loose or damaged or coolant pump switch is faulty if low voltage is measured.

3. **WARNING**
Read WARNING on following page.

**Are 22–28 volts measured on wire no. 1373 at coolant pump?**

- **NO**
  - Go to step 5.

- **YES**
  - Replace arctic kit coolant pump (para 19–6).

4. **Is ground wire no. 1435 from coolant pump to batteries secure and free from damage?**

- **NO**
  - Secure loose connections. Replaced damaged wire harness (para 19–7).

- **YES**

5. **Are 22–28 volts measured at coolant pump switch on wire no. 1373 from coolant pump fuse?**

- **NO**
  - Secure loose connections. Replaced damaged wire harness (para 19–7).

- **YES**

**KNOWN INFO**
- Arctic kit batteries OK
- Wire no. 1373 from batteries to fuse OK
- Arctic kit coolant pump fuse OK

**POSSIBLE PROBLEMS**
- Wire no. 1373 loose or damaged
- Arctic kit coolant pump switch

**TEST OPTIONS**
- Continuity Test
  - or
  - STE/ICE-R Test # 91

**REASON FOR QUESTION**
- Coolant pump is faulty if wire no. 1435 is OK and there is power to coolant pump.

**KNOWN INFO**
- Arctic kit batteries OK
- Wire no. 1373 from batteries to fuse OK
- Arctic kit coolant pump fuse OK

**TEST OPTIONS**
- Wire No. 1373 Voltage Test
  - or
  - STE/ICE-R Test # 89

**REASON FOR QUESTION**
- Wire no. 1373 from coolant pump fuse to coolant switch is loose or damaged if low voltage is measured.
WARNING
Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes.

<table>
<thead>
<tr>
<th>WIRE NO. 1373 VOLTAGE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE</td>
</tr>
<tr>
<td>Arctic Kit pump switch must be positioned to on to perform this test.</td>
</tr>
<tr>
<td>(1) Place positive (+) probe of multimeter on wire no. 1373 at coolant pump.</td>
</tr>
<tr>
<td>(2) Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.</td>
</tr>
</tbody>
</table>

Check no. 1435 ground wire from coolant pump to batteries for loose connections or damage.

<table>
<thead>
<tr>
<th>CONTINUITY TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Disconnect wiring from components at each end of wire.</td>
</tr>
<tr>
<td>(2) Set multimeter to ohms position.</td>
</tr>
<tr>
<td>NOTE</td>
</tr>
<tr>
<td>A reading of infinity indicates an open circuit.</td>
</tr>
<tr>
<td>(3) Connect multimeter leads to each end of wire and check multimeter for continuity.</td>
</tr>
<tr>
<td>NOTE</td>
</tr>
<tr>
<td>A reading of other than infinity indicates a grounded wire.</td>
</tr>
<tr>
<td>(4) Remove multimeter lead from one end of wire and connect to chassis ground.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE NO. 1373 TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE</td>
</tr>
<tr>
<td>• Arctic Kit pump switch must be positioned to on to perform this test.</td>
</tr>
<tr>
<td>• Test is made on terminal of switch with wire that goes to coolant pump fuse.</td>
</tr>
<tr>
<td>(1) Place positive (+) probe of multimeter on no. 1373 wire at coolant pump switch.</td>
</tr>
<tr>
<td>(2) Place negative (-) probe of multimeter on ground and look for 22–28 volts on multimeter.</td>
</tr>
</tbody>
</table>
u1. ARCTIC KIT COOLANT PUMP DOES NOT OPERATE (CONT)

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
</table>
| Arctic kit batteries OK  
Wire no. 1373 from batteries to fuse OK  
Arctic kit coolant pump fuse OK  
Wire no. 1373 from fuse to switch OK | Faulty coolant pump switch  
Wire no. 1373 loose or damaged |

<table>
<thead>
<tr>
<th>KNOWN INFO</th>
<th>POSSIBLE PROBLEMS</th>
</tr>
</thead>
</table>
| Arctic kit batteries OK  
No voltage from coolant pump fuse | Wire no. 1373 loose or damaged  
Faulty arctic kit coolant pump fuse |

**TEST OPTIONS**

- Arctic Kit Coolant Pump Switch Test  
  or  
  STE/ICE-R Test #89

**REASON FOR QUESTION**

Coolant pump switch is faulty if low voltage is measured on wire no. 1373 at coolant pump switch. Wire no. 1373 from coolant pump switch to coolant pump is faulty if 22–28 volts are measured.

**TEST OPTIONS**

- Wire No. 1373 Voltage Test  
  or  
  STE/ICE-R Test #89

**REASON FOR QUESTION**

Wire no. 1373 from batteries to fuse is loose or damaged if low voltage is measured.

---

**6.**

Are 22–28 volts measured at coolant pump switch on wire no. 1373 to coolant pump?

- YES
  - Secure loose connections. Replaced damaged wire harness (para 19–7).
  - Replace coolant pump switch (para 19–8).
- NO
  - Replace coolant pump fuse (para 19–6).

**7.**

Are 22–28 volts measured at fuse on wire no. 1373 from batteries?

- YES
  - Secure loose connections. Replace damaged wire harness (para 19–7).
- NO
  - Replace coolant pump fuse (para 19–6).
**WARNING**

Remove rings, bracelets, watches, necklaces, and any other jewelry before working around HET Tractor. Jewelry can catch on equipment and cause injury or short across electrical circuit and cause severe burns or electrical shock. Batteries can explode from a spark. Battery acid is harmful to skin and eyes.

### ARCTIC KIT COOLANT PUMP SWITCH TEST

**NOTE**

- Arctic Kit pump switch must be positioned to on to perform this test.
- Test is made on terminal of switch with wire that goes to coolant pump.

1. Place positive (+) probe of multimeter on no. 1373 wire at coolant pump switch.
2. Place negative (--) probe of multimeter on ground and look for 22–28 volts on multimeter.

Check no. 1373 wire from positive (+) post on arctic kit battery to coolant pump fuse for loose connections or damage.

### WIRE NO. 1373 VOLTAGE TEST

**NOTE**

Arctic Kit pump switch must be positioned to on to perform this test.

1. Place positive (+) probe of multimeter on no. 1373 wire just before coolant pump fuse.
2. Place negative (--) probe of multimeter on ground and look for 22–28 volts on multimeter.
Section V. MAINTENANCE PROCEDURES

2-14. MAINTENANCE INTRODUCTION

This section provides general procedures for equipment maintenance at the organizational level. If a special procedure is needed for maintenance of a component, the detailed procedure will be located in the chapter covering maintenance of that component.

2-15. GENERAL REMOVAL INSTRUCTIONS

a. Work Required. Remove only those parts needing repair or replacement. Do not disassemble a component any further than needed.

b. Preparation.

WARNING

Vehicle may move unexpectedly when working on it. Unless otherwise noted, parking brake must be applied and wheels chocked before performing maintenance. Failure to comply may result in injury or death to personnel.

(1) Before removing any part of the electrical, winch hydraulic, or air systems, ensure system is not energized or pressurized. Disconnect battery cables. Relieve all pressure from air system. Ensure parking brake is applied and that all controls are in OFF position before starting a removal procedure.

(2) Chock wheels: Wheel chocks should be positioned directly in front of and behind one of the rear wheels to keep vehicle from rolling.

c. Lifting. Always use a lifting device when lifting heavy parts. Ensure that load limit of lifting device exceeds weight being lifted. Position lifting device and sling before disconnecting part for removal.

d. Identification. Tag and mark all similar parts, such as electrical leads and hoses, before disconnecting and removing them. This will make proper assembly easier. Identify mating ends of electric, hydraulic, and air lines before they are disconnected.

e. Hoses. Hose numbers are identified in detailed procedures by a four-digit number. This corresponds with the numbers used on the air and hydraulic schematic.

f. Electrical Wires. Wire numbers are identified in detailed procedures by a four-digit number. This number corresponds with the numbers used on the electrical schematic.

2-16. GENERAL DISASSEMBLY INSTRUCTIONS

a. Cleanliness. Work area must be kept as clean as possible. This will prevent contamination of internal parts. This is true for valves, cylinders, and other hydraulic or air system parts.

b. Expendable Parts. Gaskets, packings, and seals removed during repair must be discarded and replaced with new parts. These items are usually damaged during removal. In the same way, lockwires, lockwashers, cotter pins, and like items must be replaced at time of assembly. Self-locking fasteners that loosen up must be replaced, not tightened.

c. Removing Seals. When removing gaskets, packings, or seals, do not use any tool that will scratch the surfaces next to these items.

d. Parts Protection. To prevent moisture and dirt from entering open housings, lines, and other openings, apply protective caps and plugs as soon as possible after disassembly. Wrap all removed parts in clean paper.
2-17. GENERAL CLEANING INSTRUCTIONS

**WARNING**

Solvent cleaning compound MIL-PRF-680 Type II and III may be irritating to the eyes and skin. Use protective gloves and goggles. Use in well-ventilated areas. Use respirator as needed. Accidental ingestion can cause irritation of digestive tract and respiratory tract, may cause lung and central nervous system damage. Can be fatal if swallowed. Inhalation of high/massive concentrations can cause coma or be fatal. First aid for ingestion: do not induce vomiting. Seek immediate medical attention. First aid for skin contact: remove contaminated clothing. Wash skin thoroughly with soap and water. If symptoms persist, seek medical attention. First aid for eye contact: flush with water for 15 minutes or until irritation subsides. If symptoms persist, seek medical attention. First aid for inhalation: move to fresh air. If not breathing, provide artificial respiration. If symptoms persist, seek medical attention. Keep away from open flames and other sources of ignition. Failure to follow this warning may result in injury or death to personnel.

- The flashpoint for type II solvent cleaning compound is 141-198°F (61-92C) and type III is 200-241°F (93-116C).
- Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment.
- Fire extinguishers should be placed nearby when using solvent cleaning compound. Failure to follow this warning may result in injury or death.
- Cloths or rags saturated with solvent cleaning compound must be disposed of IAW authorized facilities’ procedures. Failure to follow this warning may result in injury.
- Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury.

**CAUTION**

- Never use fuel to clean parts. Fuel is highly flammable. Serious personal injury could result if fuel ignites during cleaning.
- Petroleum solvents may damage parts that are in contact with hydraulic fluids.
- Do not clean tires, lubricant seals, rubber hoses, or electrical components with solvent mixture.

a. **Cleaning Solvents.** Use only approved cleaning solvents to clean parts. Solvent cleaning compound MIL-PRF-680 Type II and III is commonly used. Always work in a well-ventilated area.

**WARNING**

Compressed air used for cleaning and drying purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury to personnel.

b. **Removing Deposits.** After soaking parts in solvent, wash away deposits by flushing or spraying. Where necessary, brush with a soft bristle brush moistened in solvent. Use compressed air to dry all parts, except bearings. Bearings must be allowed to air dry.

c. **Tools.** Do not use abrasive wheels or compounds for cleaning parts unless called for in detailed instructions. These procedures may weaken a highly stressed parts.

d. **Ball and Roller Bearings.** When cleaning ball or roller bearings, place them in a basket and suspend them in a container of solvent cleaning compound. If needed, use a brush to remove caked grease, chips, etc. Avoid rotating bearing before solid particles are removed to prevent damaging races and balls. When bearings have been cleaned, coat them lightly with lubricating oil to remove solvent.

e. **Rubber Parts.** Do not clean preformed packings or other rubber parts in solvent cleaning compound. These parts should be wiped clean with a clean, dry, lint-free cloth.

**WARNING**

Steam cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection is required. Failure to comply may result in injury to personnel.

f. **Exterior Parts.** Steam clean all exterior parts thoroughly before removing. This will make inspection and disassembly easier.
2-17. GENERAL CLEANING INSTRUCTIONS (CONT)

**WARNING**

Face shield must be used by personnel operating spray gun. Failure to comply may result in injury to personnel.

g. **Engine, Cab, and Body.** Use a spray gun and solvent mixture for cleaning exterior of engine, cab, and body. Allow mixture to remain on item surface for about 10 minutes before rinsing. Rinse with hot water under 80 to 120 psi (550 to 830 kPa), if available. An ordinary garden hose with nozzle may be used if other equipment is not available. Rinse thoroughly.

h. **Passages.** Check all oil passages and cavities for dirt or blockage. A thin, flexible wire should be run through oil passages to ensure they are not clogged. Individual passages that are dirty may be cleaned using a pressure spray gun and solvent cleaning compound.

i. **Electrical Parts.** Electrical parts, such as coils, junction blocks, switches, and igniters, which use insulating materials, should not be soaked or sprayed with cleaning solutions. Clean these parts with a clean, lint-free cloth.

j. **Fuel Tanks.** Pay special attention to all warnings and cautions when working on fuel tanks.

**WARNING**

Battery acid (electrolyte) is extremely harmful. Always wear safety goggles and rubber gloves and do not smoke when performing maintenance on batteries. Injury will result if acid contacts skin or eyes. Wear rubber apron to prevent clothing being damaged.

k. **Battery.** Exterior surfaces of the electrical system and battery should be cleaned with a solution of baking soda and water. Apply solution with a bristle brush to remove any corrosion.

2-18. GENERAL INSPECTION INSTRUCTIONS

a. **Inspection.** Inspection consists of checking for defects such as distortion, wear, cracks, and pitting. Clean all parts before inspection.

b. **Sealing Surfaces.** Inspect all surfaces in contact with gaskets, packings, or seals. Ensure there are no nicks, burrs, or scratches. If any defect is found, remove or repair it as outlined in para 2-19.

c. **Bearings.** Check bearings for rusted or pitted balls, races, or separators. Check balls and races for brinelling, abrasion, and serious discoloration. Following are causes for bearing rejection:

   (1) Cuts or grooves parallel to ball or roller rotation.

   (2) Pits

   (3) Cracks.

d. **Drain Plugs.** When removing drain plugs from transmission, engine, or hydraulic system components, inspect sediment adhering to plug. A few fine particles are normal. A build-up of grit or fine metal particles may indicate part failure. This inspection is effective in determining defective parts prior to internal inspection of parts.

e. **Splines.** Inspect shaft splines for wear, pitting, rolling, peening, and fatigue cracks.
CAUTION
Hoses and nylon tubing that are kinked or chafed must be replaced. Hoses must be secured and routed properly. Failure to comply may result in sudden, unexpected hose failure.

f. Tubing and Hose. Check all hose surfaces for broken or frayed fabric. Check for breaks caused by sharp kinks or rubbing against other parts of the truck. Inspect hoses and lines for kinking. Inspect the fitting threads for damage.

g. Electrical Parts. Inspect all wiring harnesses for chafed or burned insulation. Inspect all terminal connectors for loose connections and broken parts.

CAUTION
Do not attempt to weld on HET Tractor without disconnecting all battery cables, DDEC electronic control module, alternators, and CTIS system. Failure to comply will damage electrical system.

h. Metal Parts. Visually inspect all castings and weldments for cracks.

2-19. GENERAL REPAIR INSTRUCTIONS

a. Nicks, Burrs, and Scratches. Remove nicks, burrs, and scratches from surfaces with crocus cloth.

b. Exterior Parts. Chassis and exterior painted parts may be resurfaced where paint is damaged or where parts have been repaired.

NOTE
Polished and machined steel parts not protected by cadmium, tin, copper, or other plating or surface treatment must be free of moisture when protective coating is applied.

c. Protective Parts. Protect bare metal surfaces from rusting when not actually undergoing repair work. Dip parts in, or spray them with, corrosion preventive compound. Aluminum parts may require protection in atmospheres having a high salt content.

d. Stud Installation. When installing studs in engine block and axle housings, use a driver designed for the stud to be installed. A worn stud driver may damage the end thread and make it necessary to use a die before a nut can be installed. This procedure will remove cadmium plating and allow corrosion, which will make future disassembly difficult and cause stud to be backed out with nut. Before installing a stud, inspect hole for chips and liquid. Blow out any foreign matter. Start stud by hand.

e. Electrical Parts. Replace all broken, worn, or burned electrical wiring. Wires with several broken strands must be replaced. Broken strands will increase the resistance of the wire and impair efficiency of electrical components, especially the ignition system. Wire numbers must be permanently identified on any new wiring.

f. Hoses. Replace all broken, frayed, crimped, or soft flexible lines and hoses. Replace stripped or damaged fittings. Replace entire flexible hose if fittings are damaged. Hose clamps should not crimp hoses. Hose numbers must be permanently identified on any new hoses.

g. Fasteners. Replace any bolt, screw, nut, or fitting with damaged threads. Inspect tapped holes for thread damage.

h. Dents. Straighten minor body dents by tapping with a soft-faced hammer while using a wooden block for backing.

i. Sheet Metal Repair. Repair minor sheet metal cracks by installing patches.
2–20. GENERAL ASSEMBLY INSTRUCTIONS

a. Preparation. Remove protective coating from new parts before installation.

b. Preformed Packing Installation. Lubricate all preformed packings with a thin coating of light mineral oil before installation. Uniformly press the preformed packing into position.

**WARNING**

Pipe thread sealing compound may burn or give off harmful vapors. It is harmful to skin and clothing. To avoid injury or death, keep away from open flame and use in well-ventilated area. If pipe thread sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**

Use pipe thread sealing compound sparingly only on pipe threads. Do not apply compound to hose connections. Failure to comply may result in component failure.


d. Gaskets. Remove all traces of previous gasket and sealant before installing new gasket.

**WARNING**

On direct contact, uncured silicone sealant irritates eyes. In case of contact, flush eyes with water and seek medical attention. In case of skin contact, wipe off and flush with water.

e. Silicone Sealant. Silicone sealant is often used instead of a gasket to seal mating parts. The mating parts must be clean, dry, and free of oil or grease for proper adhesion. After silicone sealant has been applied, the mating parts must be assembled immediately. Excess silicone sealant should be wiped off after assembling the mating parts.

f. Seal Rings. Coat seal rings with oil and carefully install into their bores. If seal rings must be installed over threaded parts, temporarily wrap the threads with tape to protect the seal ring.

g. Bearing Lubrication. Lubricate bearings before reassembly with the type of lubricant normally used in the related housing or container. This will provide lubrication during the first run–in until lubricant from system can reach the bearings.

2–21. GENERAL INSTALLATION INSTRUCTIONS

a. Put hoses, tubes, lines, and electrical wiring in place by matching identification tags, markings on equipment, identification numbers given in task and schematic presented at the end of this manual.

b. Use sealing compounds as required in each maintenance task.

c. Screws and nuts must be tightened to values given in appendix E, Torque Limits, or values given in maintenance task.
Section VI. PREPARATION FOR STORAGE OR SHIPMENT

2-22. PREPARATION FOR STORAGE OR SHIPMENT

a. Instructions in this section apply to the vehicle to make it available for use upon receipt after shipment. The storage instructions apply to vehicle being taken out of service for a period up to one year with vehicle exercise. If vehicles are inactive for more than one year they will use extended storage procedures.

b. Refer to (AR 750–1) for detailed administrative storage instructions.

c. Refer to (TB 9–2300–422–20) for security procedures.

d. Perform Preventive Maintenance Checks and Services (PMCS) listed in table 2–1.

e. Correct all deficiencies noted during the inspection if facilities are available. If repairs required are beyond the scope of unit maintenance, refer the deficiencies to direct and general support maintenance.

f. Instructions pertaining to Basic Issue Items (BII) and Components of End Items (COEI) stowage locations are covered in appendix B and F of (TM 9–2320–360–10).

g. Remove rust and corrosion, and scrape any flaked and peeling paint. Dry all surfaces to be painted and coated with preservatives. Refer to (TM 9–247), Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Material and Related Materials including Chemicals.

h. Repaint surface, as required, to prevent against deterioration. Refer to (TM 43–0209) for painting instructions for Field Use, Color, Marking, and Camouflage Painting of Military Vehicles.

CAUTION

During storage tachograph will wear out paper charts. Teflon chart must be installed when in storage. Failure to comply may damage tachograph.

i. Replace tachograph paper chart with teflon chart (para 7–15).

2-23. STORAGE MAINTENANCE PROCEDURES

a. Before placing a vehicle in storage, perform the following tasks:

   (1) Clean the exterior, interior of cab, engine, and undercarriage. Wash any oil, grease, or mud from tires.

   (2) Conduct a visual inspection of the vehicle. Check lubricant levels and tire pressures (CTIS highway setting). Correct any discrepancies.

   (3) Completely lubricate the chassis and all ancillary equipment in accordance with (LO 9–2320–360–12).

   (4) Check the coolant level. Test the coolant to ensure that the cooling system is protected against corrosion and temperatures down to −30°F (−34°C). Add antifreeze or corrosion inhibitors compatible with ethylene glycol base antifreeze if cooling system is not adequately protected (TB 750–651).

   (5) Ensure the fuel tank contains at least 20 gallons (75.7 L) of treated fuel. The fuel should be treated with Biobor J.F. (MIL–S–53021 (or equivalent) as a fungus inhibitor. The addition of 3 teaspoons of Biobor to 20 gallons of fuel will provide adequate protection against fungus growth. When storing a vehicle in freezing conditions, the addition of 3 ounces (88.7 ml) of isopropyl alcohol (MIL–A–10–428) to 20 gallons of diesel fuel will help prevent fuel line freeze up.

   (6) All fuel that is added to the vehicle during storage must be treated. While in storage, there must always be at least 20 (75.7 L) gallons of treated fuel in the vehicle’s fuel tank.

   (7) Check condition of engine air cleaner. Replace if necessary (para 4–2).

   (8) Coat all exposed unpainted surfaces such as spools, drive shafts, and shift cables with grease.

CAUTION

Do not allow the baking soda solution to enter the batteries or damage to batteries will result.

(9) Clean batteries and battery cables with a baking soda solution and rinse with fresh water. Add water to battery electrolyte if necessary. Check the specific gravity of the batteries regularly. Keep the batteries fully charged and clean (TM 9–6150–200–14).
2-23. STORAGE MAINTENANCE PROCEDURES (CONT)

(10) Protect spare tire from direct sunlight.

(11) If possible, store vehicles close together, out of direct sunlight, and away from electrical or generating equipment.

(12) Park vehicle to allow access for inspection, maintenance, and exercising.

**CAUTION**

Ensure tires are not resting on surface containing grease or oil. Failure to comply may result in damage to tires.

(13) Park vehicle so tires are not resting on surfaces containing grease or oil.

**CAUTION**

The DDEC system, tachograph, and turn signal flasher drain on batteries at all times. Batteries will discharge during storage if not disconnected.

(14) Disconnect batteries (TM 9--2320--360--20).

b. While vehicle is in storage, perform the following tasks monthly:

(1) Connect batteries (TM 9--2320--360--20).

(2) If engine is run every 30 days or less, use lubricating oil (OE/HDO MIL--L--2104). If engine is not run every 30 days or less, use preservative lubricating oil (MIL--L--21260C) grade 2 and change oil filter, or warranty will not be maintained.

(3) Conduct visual inspection of the vehicle. Check for oil leaks, lubricant levels, battery electrolyte, coolant level, and tire pressures (CTIS highway setting). Correct any discrepancies.

(4) Inspect oil can points. Lubricate if necessary (LO 9--2320--360--12).

(5) Shift transfer case to neutral, start engine, and idle for 10 minutes. After 10 minutes of engine idle, operate engine for 5 minutes at 1500 rpm or until the engine water temperature reaches 180°F (82°C). Shift the transmission slowly through all gear selector positions. Return the transmission to neutral and the transfer case to high range.

(6) Move vehicle 30 feet (9 m) forward and reverse.

(7) Idle engine 10 minutes before shutdown.

(8) Check grease coating on all chromium plated and unpainted surfaces. If grease was wiped from chromium plated or unpainted surfaces when vehicle was moved, recoat these surfaces.

(9) Disconnect batteries (para 7--61). If batteries are not going to be charged for over 30 days, remove from vehicle (para 7--57) and keep fully charged (TM--9--6150--200--14).

c. While vehicle is in storage, perform the following tasks quarterly:

(1) Perform all monthly tasks.

(2) Exercise all ancillary equipment (TM 9--2320--360--10). While operating winches, lubricate wire rope.

(3) Drive vehicle at least 1/4 mile (.4 km). While driving, shift transmission through all gear ranges.

d. While vehicle is in storage, perform the following tasks yearly:

(1) Perform all quarterly tasks.

(2) Clean the exterior, interior of cab, engine, and undercarriage. Wash any oil and grease from tires.

**CAUTION**

Do not allow the baking soda solution to enter the batteries or damage to batteries will result.

(3) Clean batteries and battery cables with a baking soda solution and rinse with fresh water. Add water to battery electrolyte if necessary. Check the specific gravity of the batteries regularly. Keep the batteries fully charged and clean (TM 9--6150--200--14).
(4) Completely lubricate the chassis and all ancillary equipment in accordance with (LO 9–2320–360–12).

(5) Check the coolant level. Test the coolant to ensure that the cooling system is protected against corrosion and temperatures down to \(-30^\circ F\)\((-34^\circ C)\). Add antifreeze or corrosion inhibitors compatible with ethylene glycol base antifreeze if cooling system is not adequately protected (TB 750–651).


e. Extended storage (vehicle inactive).

**CAUTION**

When vehicle is to remain inactive for more than 12 months, extended storage procedures must be performed to prevent damage due to rust, corrosion or organic growth in the fluids.

**NOTE**

When vehicle is to remain inactive for more than 12 months, extended storage procedures must be performed to maintain the vehicle warranty.

(1) Completely lubricate the chassis and all ancillary equipment in accordance with (LO 9–2320–360–12).

(2) Engine extended storage.

(a) Change oil and filter (paras 3–3 and 3–4). Add preservative lubricating oil (MIL–L–21260C), Grade 2.

(b) Seal off turbocharger inlet and outlet connections with moisture resistant tape.

(3) Transmission extended storage.

(a) Drain oil (LO 9–2320–360–12).

(b) Add two qt (1.9 L) of VCI–329 vapor corrosion inhibitor (MIL–L–46002B) or equivalent and then fill transmission to operating level with transmission fluid. Add 1 teaspoon of Biobor JF (MIL–S–53021) anti–fungicide (or equivalent) to the transmission fluid.

(c) Run the engine for approximately five minutes at 1500 rpm with the transmission in neutral (N).

(d) Drive the vehicle. Make sure the transmission shifts thru all ranges.

(e) Continue running the engine at 1500 rpm with the transmission in neutral until normal operating temperature is reached.

**CAUTION**

Do not allow transmission oil temperature to exceed 225\(^{\circ} F\) (107\(^{\circ} C\)) or damage to transmission may result.

(f) If normal operating temperature is less than 225\(^{\circ} F\) (107\(^{\circ} C\)), shift the transmission to forward range and stall the converter. Do not exceed 225\(^{\circ} F\) (107\(^{\circ} C\)). Idle engine for approximately five minutes with transmission in neutral (N).

**WARNING**

Ensure transmission is cool before proceeding. Failure to comply may result in injury to personnel.

(g) When transmission is cool enough to touch, seal all openings and the breather with moisture–proof tape.

(h) Coat all exposed, unpainted surfaces with preservative grease such as petrolatum (MIL–C–11796), Class 2.

(i) If additional storage time is required, repeat steps (b) thru (h) at yearly intervals: except, it is not necessary to drain the transmission each year. Just add VCI–329 (MIL–L–46002) vapor corrosion inhibitor (or equivalent) and Biobor JF (MIL–S–53021) anti–fungicide (or equivalent).
2-23. STORAGE MAINTENANCE PROCEDURES (CONT)

(4) Axle extended storage.

**CAUTION**
To avoid overfilling, drain oil before installing additive. Failure to comply may cause damage to equipment.

(a) Drain amount of oil from axle that is equal to quantity of additive being added.

(b) Add 1.7 pt (0.8 L) VCI–326 vapor corrosion inhibitor (MIL–P–46002B) (or equivalent) to axles no. 1, 2, 3, and 4.

(c) Add 2.6 oz (76 ml) VCI–326 vapor corrosion inhibitor (MIL–P–46002B) (or equivalent) to planetary wheel ends of axles no 1, 2, 3, and 4.

(d) Drive vehicle approximately 1 mile (1.6 km) to mix additive with the axle oil.

(e) If additional storage time is required, repeat steps (a) thru (c) at yearly intervals.

(5) Winch extended storage.

None required.

(6) Transfer Case extended storage.

**CAUTION**
To avoid overfilling, drain oil before installing additives. Failure to comply may cause damage to equipment.

(a) Drain amount of oil from transfer case that is equal to quantity of additive being added.

(b) Add .5 pt (0.25 L) VCI–326 vapor corrosion inhibitor (MIL–P–46002B) or equivalent to transfer case.

(c) If vehicle can be driven, drive vehicle approximately 1 mile (1.6 km) to mix additive. If vehicle cannot be driven, shift transfer case to neutral, start engine (TM 9–2320–360–10), with parking brake applied shift transmission thru all gear selections.

**WARNING**
Ensure transfer case is cool before proceeding. Failure to comply may result in injury to personnel.

(d) When transfer case is cool enough to touch, seal breather with moisture proof tape.

(e) Coat all exposed, unpainted surfaces with preservative grease such as petrolatum (MIL–C–11796 grade 2) or equivalent.

(f) If additional storage time is required, repeat step (b) at yearly intervals.

(7) Winch hydraulic system extended storage.

**CAUTION**
To avoid overfilling, drain oil before installing additives. Failure to comply may cause damage to equipment.

(a) Drain amount of oil from winch hydraulic reservoir that is equal to the quantity of additive being added.

(b) Add 8.5 qt (8 L) VCI–326 vapor corrosion inhibitor (MIL–P–46002B) or equivalent to winch hydraulic reservoir.

(c) Operate all winches.

(1) Pay out and then pay in passenger side and drivers side main winches approximately 10 ft (3 m). Repeat this procedure two times.

(2) Pay out and then pay in auxiliary winch approximately 10 ft (3 m). Repeat this procedure two times.

(d) If additional storage time is required, repeat steps (a) and (b) at yearly intervals.
(8) Steering hydraulic system extended storage.

**CAUTION**

To avoid overfilling, drain oil before installing additives. Failure to comply may cause damage to equipment.

(a) Drain amount of oil from steering hydraulic reservoir that is equal to the quantity of additive being added.

(b) Add 1.6 pt (0.75 L) VCI–326 vapor corrosion inhibitor (MIL–P–46002B) or equivalent to steering hydraulic reservoir.

(c) Operate steering system to mix additive. Turn steering wheel to full right and then full left positions. Repeat this cycle three times.

(d) If additional storage time is required, repeat steps (a) and (b) at yearly intervals.

(9) Steering reduction gear box 2.21 to 1 extended storage.

None required.

(10) Fuel system extended storage.

(a) Drain fuel tank.

(b) Change all fuel filters (paras 4–11 and 4–13).

(c) Ensure the fuel tank contains at least 20 gallons (75.7 L) of treated fuel. The fuel should be treated with Biobor J F, (MIL–S–53021) or equivalent. The addition of 3 teaspoons of biobor to 20 gallons of fuel will provide adequate protection against fungus growth. When storing a vehicle in freezing conditions, the addition of 3 ounces (88.7 ml) of isopropyl alcohol (MIL–A–10–428) to 20 gallons of fuel will help prevent fuel line freeze up.

(d) Run engine 5 minute to circulate clean treated fuel throughout the fuel system.

(e) All fuel that is added to the vehicle during storage must be treated. While in storage, there must always be at least 20 gallons (75.7 L) of treated fuel in the vehicle’s fuel tank.

(f) Cap off fuel system.

(11) Battery extended storage.

Remove batteries from vehicle (para 7–57) and keep fully charged (TM 9–6150–200–14).

(12) Check the coolant level. Test the coolant to ensure that the cooling system is protected against corrosion and temperatures down to –30°F (–34°C). Add antifreeze or corrosion inhibitors compatible with ethylene glycol base antifreeze if cooling system is not adequately protected (TB 750–651).

f. When removing vehicle from storage, perform the following tasks:

(4) Install batteries (paras 7–57 and 7–61).

(5) Conduct a visual inspection to the vehicle and remove moisture proof tape from engine, transmission, transfer case, and fuel system. Check lubricant levels and tire pressures. Correct any discrepancies.

(6) Lubricate the chassis, ancillary equipment, and oil can points (LO 9–2320–360–12).
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By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the Secretary of the Army
0702303

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 380754. requirements for TM 9-2320-360-20-1.
**RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS**

For use of this form, see AR 25-30; the proponent agency is ODSC4.

Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).

**DATE**
Date you filled out this form.

**TO:** (Forward to proponent of publication or form) (Include ZIP Code)
AMSTA-LC-LPIT / TECH PUBS, TACOM-RI
1 Rock Island Arsenal
Rock Island, IL 61299-7630

**FROM:** (Activity and location) (Include ZIP Code)
Your mailing address

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**TYPED NAME, GRADE OR TITLE**
Your Name

**TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION**

**SIGNATURE**
Your Signature

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**DA FORM 2028, FEB 74**
REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED.

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USAPPC V3.00
RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

For use of this form, see AR 25-30; the proponent agency is ODISC4.

Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).

DATE

TO: (Forward to proponent of publication or form) (Include ZIP Code)
AMSTA-LC-LPIT / TECH PUBS, TACOM-RI
1 Rock Island Arsenal
Rock Island, IL 61299-7630

FROM: (Activity and location) (Include ZIP Code)

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DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00
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# RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

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<th>PAGE NO.</th>
<th>PARAG NO.</th>
<th>LINE NO.</th>
<th>FIGURE NO.</th>
<th>TABLE NO.</th>
<th>RECOMMENDED CHANGES AND REASON</th>
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<td>31 May 2007</td>
<td>Heavy Equipment Transporter, M1070, Unit Maintenance</td>
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</table>

*Reference to line numbers within the paragraph or subparagraph.

**Typed Name, Grade or Title**

**Telephone Exchange/AutoVon, Plus Extension**

**Signature**

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*DA FORM 2028, FEB 74* REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00
# PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

<table>
<thead>
<tr>
<th>PAGE NO.</th>
<th>COLM NO.</th>
<th>LINE NO.</th>
<th>NATIONAL STOCK NUMBER</th>
<th>REFERENCE NO.</th>
<th>FIGURE NO.</th>
<th>ITEM NO.</th>
<th>TOTAL NO. OF MAJOR ITEMS SUPPORTED</th>
<th>RECOMMENDED ACTION</th>
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</table>

# PART III – REMARKS
(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)

<table>
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<tr>
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<th>TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION</th>
<th>SIGNATURE</th>
</tr>
</thead>
</table>

USAPPC V3.00
# The Metric System and Equivalents

## Linear Measure

| 1 Centimeter | 10 Millimeters | 0.01 Meters | 0.3937 Inches |
| 1 Meter      | 100 Centimeters | 1000 Millimeters | 39.37 Inches |
| 1 Kilometer  | 1000 Meters      | 0.621 Miles       |

## Square Measure

| 1 Square Centimeter | 100 Square Millimeters | 0.155 Square Inches |
| 1 Square Meter      | 10,000 Square Centimeters | 10.76 Square Feet |
| 1 Square Kilometer  | 1,000,000 Square Meters | 0.386 Square Miles |

## Weights

| 1 Gram          | 0.001 Kilograms | 1000 Milligrams | 0.035 Ounces |
| 1 Kilogram      | 1000 Grams      | 2.2 Lb           |
| 1 Metric Ton    | 1000 Kilograms  | 1 Megagram       |
|                 |                  | 1.1 Short Tons   |

## Cubic Measure

| 1 Cub Centimeter | 1000 Cub Millimeters | 0.06 Cub Inches |
| 1 Cub Meter      | 1,000,000 Cub Centimeters | 35.31 Cub Feet |

## Liquid Measure

| 1 Milliliter     | 0.001 Liters | 0.0338 Fluid Ounces |
| 1 Liter          | 1000 Milliliters | 33.82 Fluid Ounces |

## Temperature

| 5/9 (°F - 32) = °C |
| 212°F Fahrenheit = 100°C Celsius |
| 90°F Fahrenheit = 32.2°C Celsius |
| 32°F Fahrenheit = 0°C Celsius |

### Approximate Conversion Factors

#### To Change

<table>
<thead>
<tr>
<th>Inches</th>
<th>Centimeters</th>
<th>Multiply By</th>
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<tbody>
<tr>
<td>Feet</td>
<td>Meters</td>
<td>0.305</td>
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<tr>
<td>Yards</td>
<td>Meters</td>
<td>0.914</td>
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<tr>
<td>Miles</td>
<td>Kilometers</td>
<td>1.609</td>
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<tr>
<td>Square Inches</td>
<td>Square Centimeters</td>
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<td>Square Yards</td>
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<tr>
<td>Square Miles</td>
<td>Square Kilometers</td>
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<tr>
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<td>Gallons</td>
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<tr>
<td>Pounds</td>
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<td>Short Tons</td>
<td>Metric Tons</td>
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<td>Pound-Feet</td>
<td>Newton-Meters</td>
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<tr>
<td>Pound per Square Inch</td>
<td>Kilopascals</td>
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<tr>
<td>Miles per Gallon</td>
<td>Kilometers per Liter</td>
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</tr>
<tr>
<td>Miles per Hour</td>
<td>Kilometers per Hour</td>
<td>1.609</td>
</tr>
</tbody>
</table>

#### To Multiply By

| Centimeters   | Inches  | 0.394       |
| Meters        | Feet    | 3.280       |
| Meters        | Yards   | 1.094       |
| Kilometers    | Miles   | 0.621       |
| Square Centimeters | Square Inches | 0.155 |
| Square Meters | Square Feet | 10.764       |
| Square Meters | Square Yards | 1.196       |
| Square Kilometers | Square Miles | 0.386     |
| Square Hectometers | Acres | 2.471     |
| Cubic Meters  | Cubic Feet | 35.315     |
| Cubic Meters  | Cubic Yards | 1.308       |
| Milliliters   | Fluid Ounces | 0.034       |
| Liters        | Pints   | 2.113       |
| Liters        | Quarts  | 1.057       |
| Liters        | Gallons | 0.264       |
| Grams         | Ounces  | 0.035       |
| Kilograms     | Pounds  | 2.205       |
| Metric Tons   | Short Tons | 1.102       |
| Newton-Meters | Pound-Feet | 0.738       |
| Kilopascals   | Pound per Square Inch | 0.145 |
| Kilometers per Liter | Miles per Gallon | 2.354 |
| Kilometers per Hour | Miles per Hour | 0.621 |
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