E-GATOR®
UTILITY VEHICLE

TECHNICAL MANUAL

John Deere
Worldwide Commercial and Consumer Equipment Division

TM1766 (31Mar00)
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M99964

E-GATOR® UTILITY VEHICLE

This technical manual is written for an experienced technician and contains sections that are specifically for this product. It is a part of a total product support program.

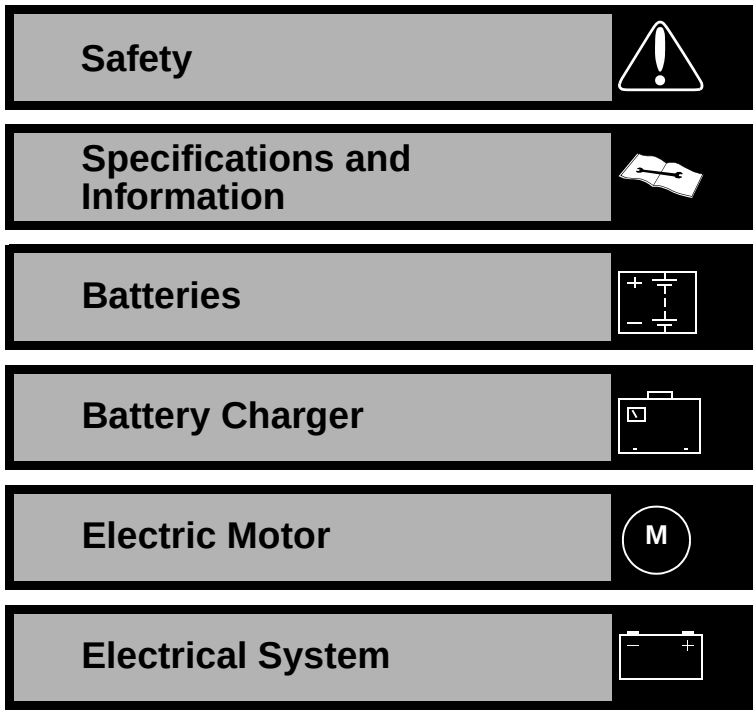
The manual is organized so that all the information on a particular system is kept together. The order of grouping is as follows:

- Table of Contents
- Specifications
- Component Location
- System Schematic
- Theory of Operation
- Troubleshooting Chart
- Diagnostics
- Tests & Adjustments
- Repair

Note: Depending on the particular section or system being covered, not all of the above groups may be used.

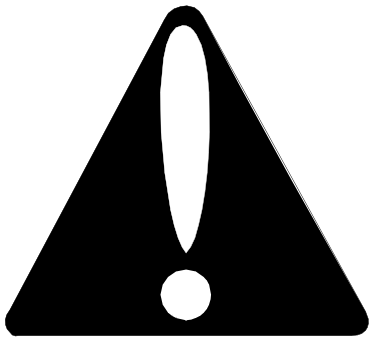
Each section will be identified with a symbol rather than a number. The groups and pages within a section will be consecutively numbered.

We appreciate your input on this manual. To help, there are postage paid post cards included at the back. If you find any errors or want to comment on the layout of the manual please fill out one of the cards and mail it back to us.



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

RECOGNIZE SAFETY INFORMATION



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

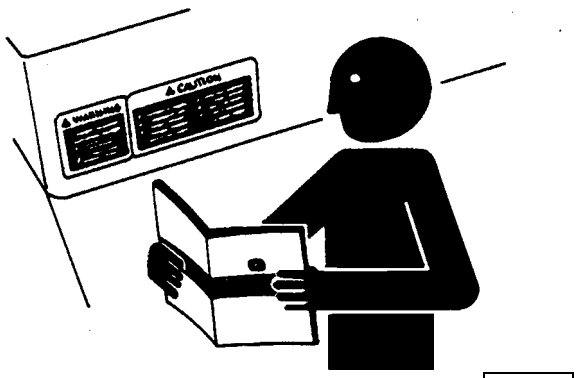
Follow recommended precautions and safe servicing practices.

Understand Signal Words

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

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

REPLACE SAFETY SIGNS



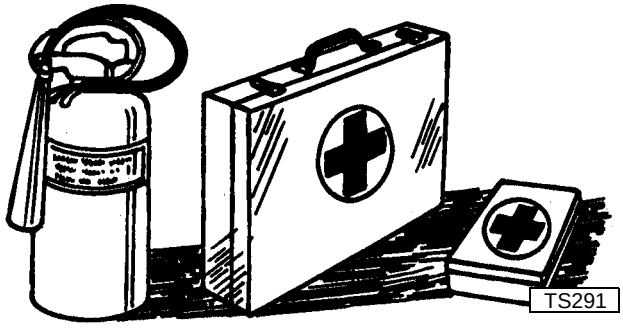
TS201

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

HANDLE FLUIDS SAFELY-AVOID FIRES

Be Prepared For Emergencies

TS227



TS291

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

Charge batteries in a well ventilated area.

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

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

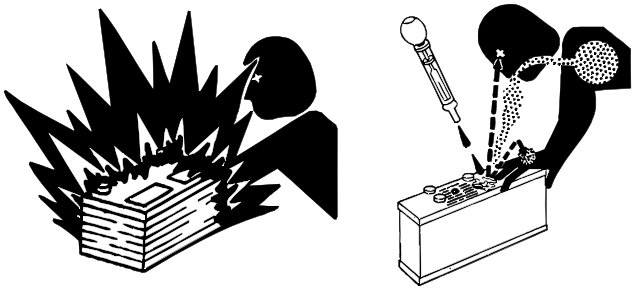
Do not store oily rags; they can ignite and burn spontaneously.

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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

USE CARE IN HANDLING AND SERVICING BATTERIES



Prevent Battery Explosions

Batteries contain sulfuric acid and produce explosive mixtures of hydrogen and oxygen. Because self-discharge action generates hydrogen gas even when the battery is not in operation, make sure batteries are stored and serviced in a well ventilated area.

- Always wear proper eye, face and hand protection.
- Keep sparks, lighted matches, and open flame away from the top of battery.
- Remove all jewelry (watches, rings, bracelets, etc.) before servicing the electrical system or batteries.
- Make sure work area is well ventilated.
- Never lean over battery while testing or charging.
- Keep removable vents tight and level except when servicing electrolyte.
- Exercise caution while working with metallic tools or conductors to prevent short circuits and sparks.
- Never check battery charge by placing a metal object across the posts. Use a battery tester, voltmeter or hydrometer.
- Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

Safe Charging

- Never attempt to charge a battery without first reviewing the instructions for the charger being used.
- Use only the battery charger provided with the utility vehicle. DO NOT use substitutes.
- Always wear proper eye, face and hand protection.
- Keep sparks, lighted matches, and open flame away from the top of battery.
- Make sure work area is well ventilated.
- Never lean over battery while testing or charging.
- Keep removable vents tight and level except when servicing electrolyte.
- To avoid dangerous sparks, Do not disconnect the DC output cord from the battery receptacle when the charger is on. Disconnect the AC power supply cord to turn the charger off before disconnecting the DC output plug.
- Never try to charge a visibly damaged or frozen battery.
- Be sure that the key switch and all electrical accessories are turned off.
- Make sure that the charger leads are not broken, frayed or loose.
- If the battery becomes hot, or if violent gassing or spewing of electrolyte occurs, unplug the charger AC source first before removing the DC plug
- If battery set is on charge, unplug the charger AC plug before disconnecting the charger DC cable plug to avoid dangerous sparks.

Prevent Acid Burns

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

Use extreme caution when handling electrolyte and keep an acid neutralizing solution - such as baking soda or household ammonia mixed with water - readily available.

- **Avoid acid burns by:**
  1. Filling batteries in a well-ventilated area.
  2. Wearing eye and face protection a rubber apron and rubber gloves.
  3. Avoiding breathing fumes when electrolyte is added.
  4. Avoiding spilling or dripping electrolyte.

- **If you spill acid on yourself:**
  1. Flush area of body that has been exposed with clean water for at least 20 minutes.
  2. Remove contaminated clothing.
  3. Flush your eyes with clean, cool water for at least 20 minutes.
  4. Get medical attention immediately.

- **If acid is swallowed:**
  1. Drink large amounts of water or milk. Do not induce vomiting.
  2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
  3. Get medical attention immediately.

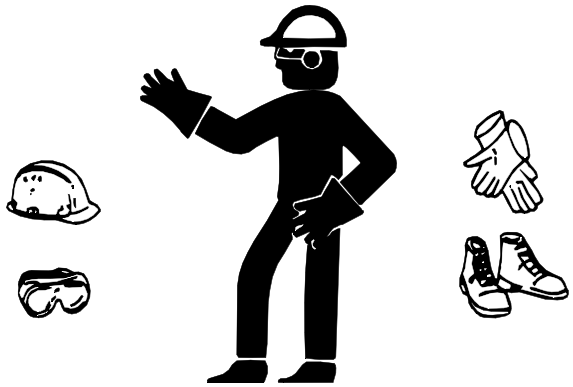
USE SAFE SERVICE PROCEDURES

Wear Protective Clothing

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

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

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



Service Machines Safely

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

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

Use Caution When Servicing Electrical System

Always use extreme caution when servicing this utility vehicle. This utility vehicle is equipped with a 48 volt electrical system capable of passing a high voltage electrical current.

Only persons trained in electrical maintenance should repair or service this utility vehicle.

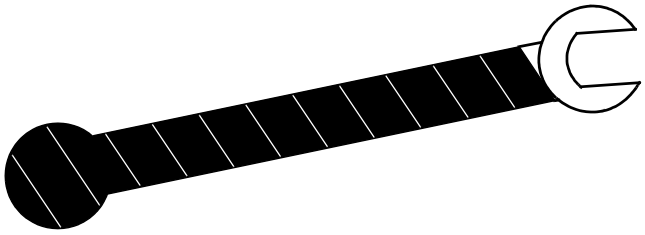
Always move the service/drive switch to the SERVICE position before servicing any part of the electrical system.

Always refer to the battery position/connection diagram when making battery connections to avoid battery explosion. Disconnect the battery set positive (B+) cable before servicing the electrical system.

Use Proper Tools

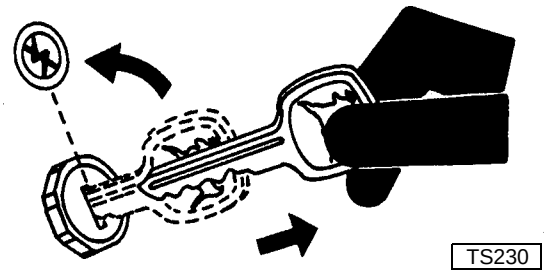
Use tools appropriate to the work.

Use extreme caution when using tools, wires, or metal objects near batteries! A short circuit and/or spark could cause an electrical shock or an explosion. Wrap tools with vinyl tape to prevent shorting out battery(s).



Makeshift tools and procedures can create safety hazards. Use power tools only to loosen threaded parts and fasteners. For loosening and tightening hardware, use the correct size tools. **DO NOT** use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches. Use only service parts meeting John Deere specifications.

Park Machine Safely

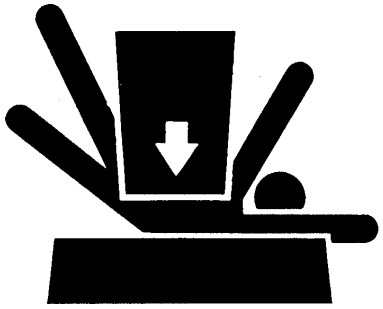


Before working on the machine:

1. Turn key switch to the OFF position and remove the key.
2. Move directional control lever to the NEUTRAL position.
3. Engage the park brake.
4. Raise and tilt operator seat forward. Move the service/drive switch to the SERVICE position.
5. Hang a “DO NOT OPERATE” tag in operator station.

Support Machine Properly And Use Proper Lifting Equipment

TS229



If you must work on a lifted machine or attachment, securely support the machine or attachment.

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

Lifting heavy components incorrectly can cause severe injury or machine damage. Follow recommended procedure for removal and installation of components in the manual.

Work In Clean Area

Before starting a job:

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

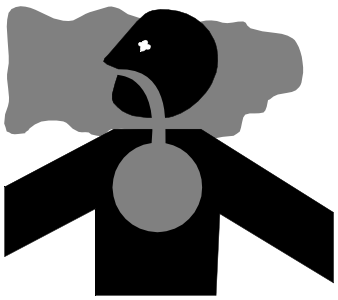
Using High Pressure Washers

Directing pressurized water at electronic/electrical components or connectors, bearings, or other sensitive parts and components may cause product malfunctions. Reduce pressure and spray at a 45 to 90 degree angle.

Illuminate Work Area Safely

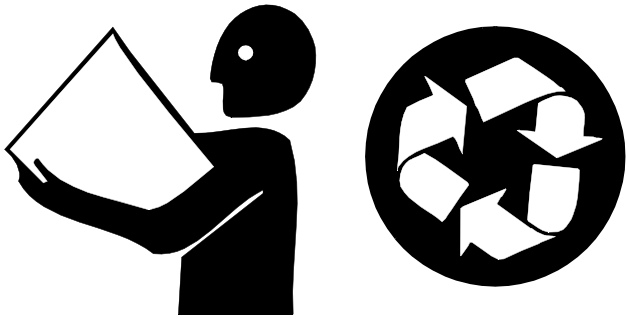
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite hydrogen gases or spilled fuel or oil.

Work In Ventilated Area



Battery fumes can cause sickness or death. Make sure the work area is well ventilated if it is necessary to charge the batteries in an enclosed area.

HANDLE CHEMICAL PRODUCTS SAFELY



Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques. Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

Dispose of Waste Properly

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, greases and batteries. Use leakproof containers when draining fluids.

- Waste products such as batteries, can harm the environment and people.
- Do not use food or beverage containers that may mislead someone into drinking from them.
- Do not pour waste onto the ground, down a drain, or into any water source. Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.
- A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques. The seller of the chemical products used with your vehicle is responsible for providing the MSDS for that product.

LIVE WITH SAFETY

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

CONTENTS

GENERAL VEHICLE SPECIFICATIONS

BATTERIES:

Type. . . . . .Trojan T-105
Voltage (Each Battery) . . . . . 6 VDC
Total Voltage (8 Batteries) . . . . . 48 VDC
Rating
Minutes @ 56 amps 165
Approximate weight. . . . . 28.1 kg (62 lbs)

Optional Type . . . . . .Trojan T-145
Voltage (Each Battery) . . . . . 6 VDC
Total Voltage (8 Batteries) . . . . . 48 VDC
Rating
Minutes @ 56 amps 200
Approximate weight. . . . . 32.2 kg (71 lbs)

MOTOR:

Type. . . . . Separately Excited D.C. Motor
Voltage . . . . . 48 VDC
Insulation Class. . . . . .H 180^{o}C

CONTROLLER:

Type. . . . . Separately Excited Solid State
Nominal Input Voltage . . . . . .36-48 VDC
Electrical Isolation to Heatsink (minimum) . . . . . 500 VAC
Armature Current Limit . . . . . 400 Amps

TRANSAXLE

Nominal Travel Speed-Forward . . . . . .25 km/h (15.5 mph)
Nominal Travel Speed-Reverse. . . . . .14.5 km/h (9 mph)
Transaxle Capacity . . . . . 0.4 L (15 oz)

STEERING and BRAKES

Steering—Type . . . . . Rack and Pinion Ackerman-type
Brake—Type . . . . . .Dual Rear Wheel Mechanical Drum, Auto Adjusting
Suspension
Front . . . . . Independent, Spring Over Shock Single A-Arm Design
Rear. . . . . Fixed Position Axle
Park Brake. . . . . .Three Position, Hand Operated

DIMENSIONS

Overall Length. . . . . 266.5 cm (104.9 in.)
Overall Width. . . . . 152.5 cm (60 in.)
Overall Height . . . . . 113 cm (44.5 in.)
Front tread centers . . . . . 127 cm (50 in.)
Rear tread centers . . . . . 122 cm (48 in.)
Wheelbase . . . . . 194.0 cm (76.4 in.)
Vehicle Weight w/T-105 Batteries . . . . . 634 kg (1395 lb)

GROUND CLEARANCE

Under transaxle . . . . . 196 mm (7.7 in.)
Under foot platform . . . . . 215 mm (8.5 in.)
Turning clearance circle . . . . . 6.7 m (22 ft)

CAPACITY

Seating . . . . . 2 persons
Seat type . . . . . Professional high back
Payload (total)[2] . . . . . 408 kg (900 lb)
Towing . . . . . 272 kg (600 lb)
Cargo Box - Volume . . . . . 0.32 m^3 (11.2 cu ft)
Cargo Box - Weight . . . . . 227 kg (500 lb)

2. Includes 200lb. operator, 200 lb. passenger and maximum box capacity.

TIRES

Size-Front . . . . . 22.5 x 10.00 - 8 2PR Hi-Flotation
Size-Rear . . . . . 25 x 12.00 - 9 2PR Hi-Flotation

ELECTRICAL

Headlights . . . . . Two 48 VDC 27 watt Incandescent (marked SP8)

Charger - N.A.:

Type . . . . . Ferro-Resonant Automatic Taper Charge
Input Voltage . . . . . 120 VAC 60 hz
Input Amperage . . . . . 12 Amps (15 amp breaker max.)
Power Factor 0.87
Output Voltage . . . . . 48 VDC Nominal
Output Amperage . . . . . 21 Amps DC Nominal
AC Power Cord
  Plug . . . . . 125 V 15 amp (NEMA Spec 5-15p)
  Length . . . . . 2.4 m (94 in.)
DC Power Cord
  Length . . . . . 2.8 m (110 in.)

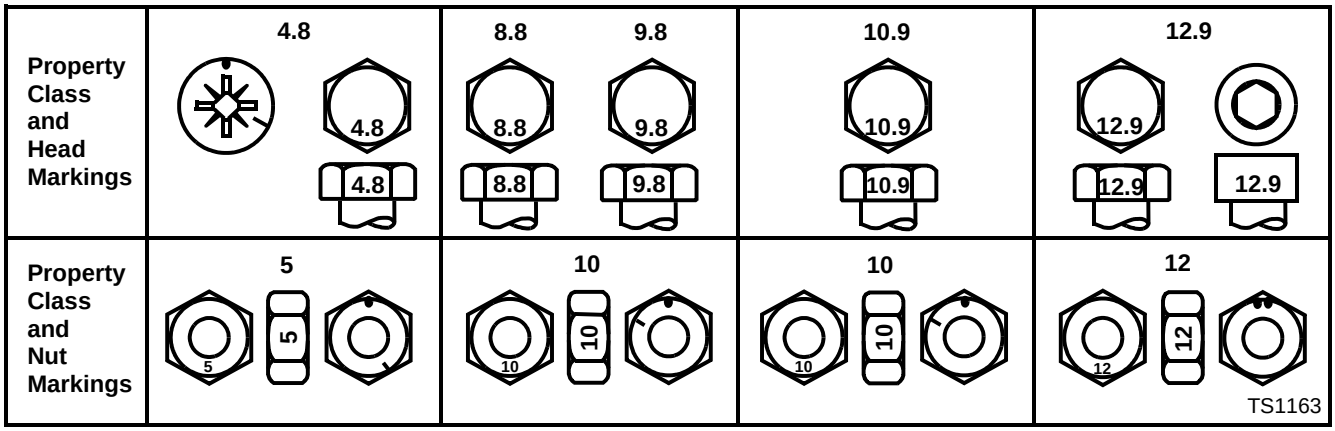
Charger - Export:

Type . . . . . Ferro-Resonant Automatic Taper Charge
Input Voltage . . . . . 230 VAC 50 hz
Input Amperage . . . . . 5.7 Amps (15 amp breaker max.)
Power Factor 0.95
Output Voltage . . . . . 48 VDC Nominal
Output Amperage . . . . . 22 Amps DC Nominal
AC Power Cord (User Supplied)
  Length (Maximum) . . . . . 4 m (13 ft)
DC Power Cord
  Length . . . . . 2.8 m (110 in.)

RECOMMENDED LUBRICANT

Grease
John Deere NON-CLAY HIGH TEMPERATURE EP GREASE®–JDM J13E4, NLGI Grade 2

METRIC FASTENER TORQUE VALUES



	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
SIZE	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	109
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these hand torque values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only and include a ±10% variance factor. Check tightness of fasteners periodically. DO NOT use air powered wrenches.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same class. Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

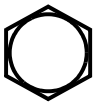
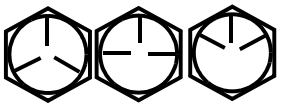
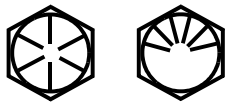
When bolt and nut combination fasteners are used, torque values should be applied to the **NUT** instead of the bolt head.

Tighten toothed or serrated-type lock nuts to the full torque value.

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.*

Reference: JDS—G200.

INCH FASTENER TORQUE VALUES

SAE Grade and Head Markings	**No Marks**  **1 or 2[b]**	 **5 5.1 5.2**	 **8 8.2**
SAE Grade and Nut Markings	**No Marks**  **2**	 **5**	 **8**

TS1162

	Grade 1				Grade 2[b]				Grade 5, 5.1 or 5.2				Grade 8 or 8.2			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
SIZE	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	215	160	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	470	300	510	375	470	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

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When bolt and nut combination fasteners are used, torque values should be applied to the **NUT** instead of the bolt head.

Tighten toothed or serrated-type lock nuts to the full torque value.

a *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.*

b *"Grade 2" applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. "Grade 1" applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.*

Reference: JDS—G200.

TRANSAXLE OIL-NORTH AMERICA

IMPORTANT: DO NOT use engine oil or "Type F" (Red) Automatic Transmission Fluid in this transaxle. DO NOT mix any other oils in this transaxle. DO NOT use BIO-HY-GARD® in this transaxle.

Use recommended oil viscosity based on the expected air temperature range during the service interval.

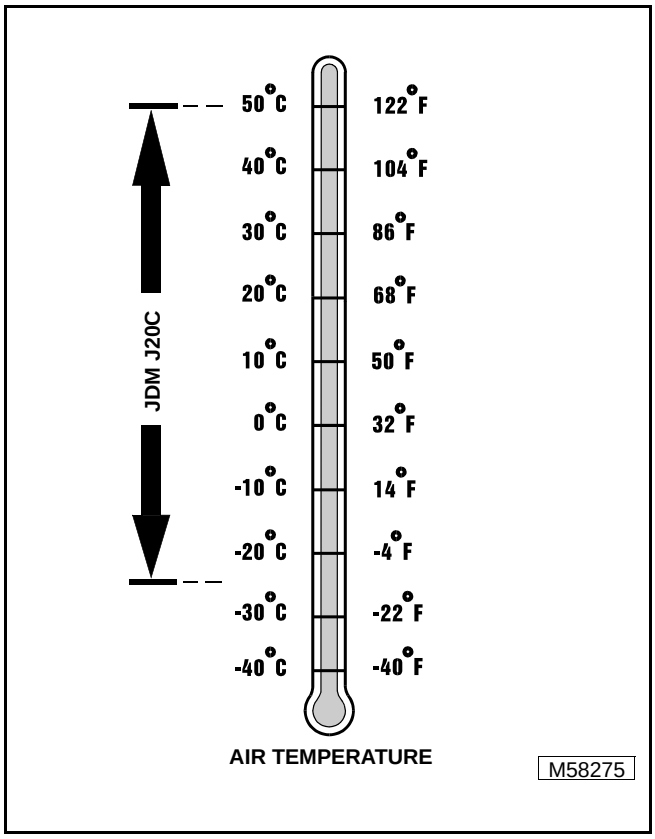
The following John Deere transmission and hydraulic oil is **preferred**:

- **HY-GARD®—JDM J20C.**

Other oils may be used if above recommended John Deere oil is not available, provided the meet the following specification:

- **John Deere Standard JDM J20C.**

IMPORTANT: If minimum air temperature should fall below -25°C (-13°F), the transaxle oil must be heated to at least five degrees above the lower limit before start-up or transaxle may be damaged. For prolonged operation under heavy load in air temperatures above 50°C (122°F) reduce service interval by 50%.



John Deere Dealers: You may want to cross-reference the following publications to recommend the proper grease for your customers:

- Module DX,GREA1 in JDS–G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual PI7032.

NOTE: Disregard the John Deere All Weather Hydrostatic Fluid (JDM J21A) listing - it has been eliminated from the specification.

ANTI-CORROSION GREASE

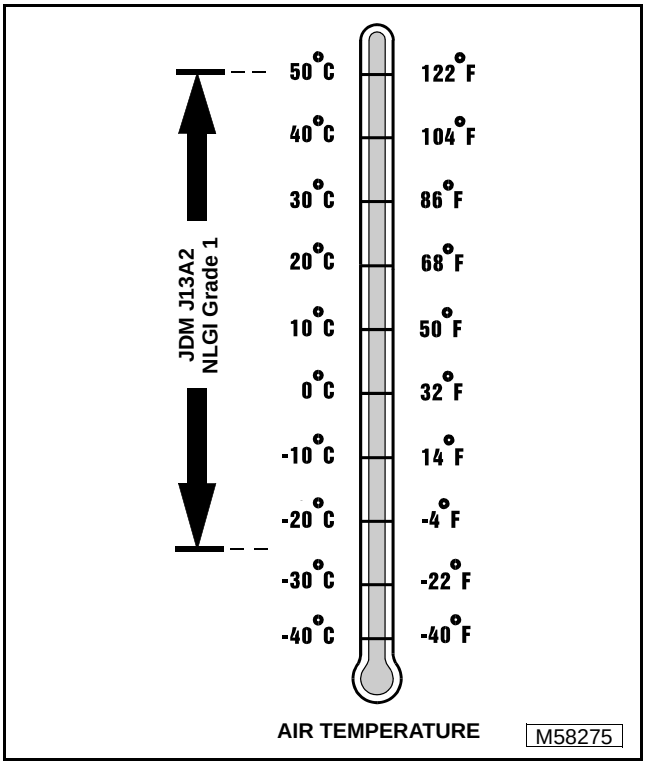
This anti-corrosion grease is formulated to provide the best protection against absorbing moisture, which is one of the major causes of corrosion. This grease is also superior in its resistance to separation and migration.

The following anti-corrosion grease is **PREFERRED**:

- **DuBois MPG-2® Multi-Purpose Polymer Grease—M79292.**

Other greases may be used if they meet or exceed the following specifications:

- John Deere Standard JDM J13A2, NLGI Grade 1.



John Deere Dealers: You may want to cross-reference the following publications to recommend the proper grease for your customers:

- Module DX,GREA1 in JDS–G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual PI7032.

ALTERNATIVE LUBRICANTS

Conditions in certain geographical areas outside the United States and Canada may require different lubricant recommendations than the ones printed in this technical manual or the operator's manual. Consult with your John Deere Dealer, or Sales Branch, to obtain the alternative lubricant recommendations.

IMPORTANT: Use of alternative lubricants could cause reduced life of the component.

If alternative lubricants are to be used, it is recommended that the factory fill be thoroughly removed before switching to any alternative lubricant.

LUBRICANT STORAGE

All machines operate at top efficiency only when clean lubricants are used. Use clean storage containers to handle all lubricants. Store them in an area protected from dust, moisture, and other contamination. Store drums on their sides. Make sure all containers are properly marked as to their contents. Dispose of all old, used containers and their contents properly.

MIXING OF LUBRICANTS

In general, avoid mixing different brands or types of lubricants. Manufacturers blend additives in their lubricants to meet certain specifications and performance requirements. Mixing different lubricants can interfere with the proper functioning of these additives and lubricant properties which will downgrade their intended specified performance.

CHASSIS GREASE—NORTH AMERICA

Use the following grease based on the air temperature range. Operating outside of the recommended grease air temperature range may cause premature failures.

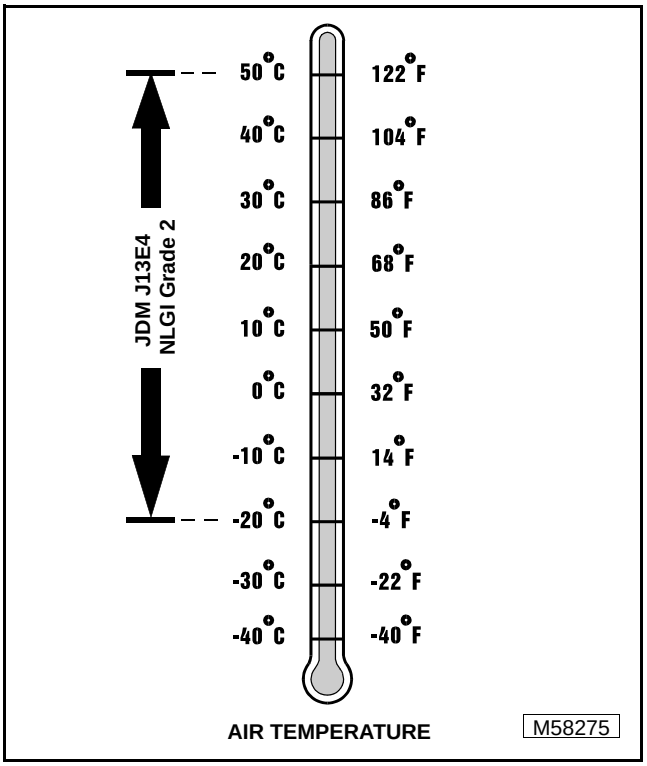
IMPORTANT: ONLY use a quality grease in this application. DO NOT mix any other greases in this application. DO NOT use any BIO–GREASE in this application.

The following John Deere grease is **PREFERRED**:

- **NON-CLAY HIGH-TEMPERATURE EP GREASE®—JDM J13E4, NLGI Grade 2.**

Other greases may be used if above preferred John Deere grease is not available, provided they meet the following specification:

- John Deere Standard JDM J13E4, NLGI Grade 2.



John Deere Dealers: You may want to cross-reference the following publications to recommend the proper grease for your customers:

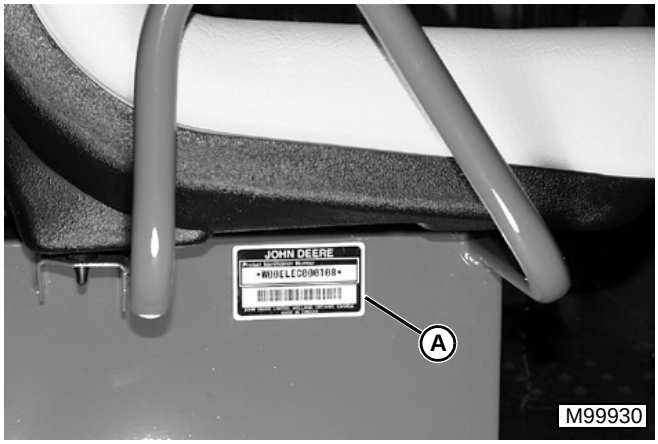
- Module DX,GREA1 in JDS–G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual P17032.

PRODUCT IDENTIFICATION LOCATIONS

When ordering parts or submitting a warranty claim, it is IMPORTANT that you include the product identification number and the component product identification numbers.

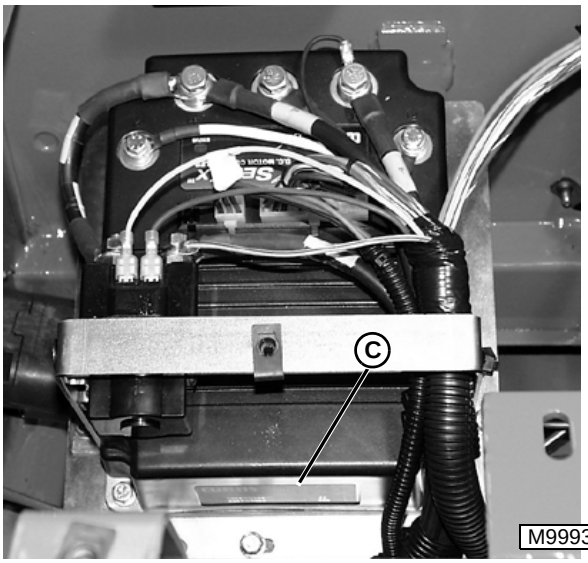
The location of identification numbers and component product identification numbers are shown.

E GATOR® UTILITY VEHICLE IDENTIFICATION NUMBER



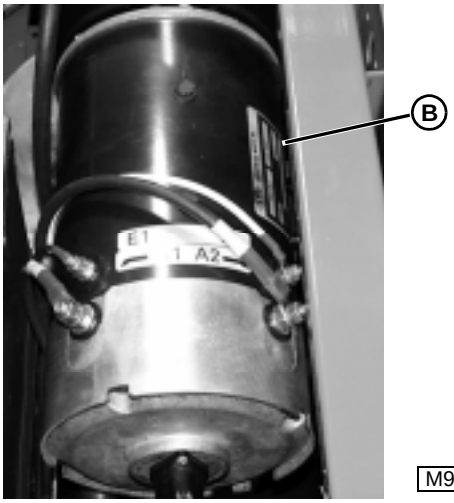
Vehicle identification number plate (A) is located on the frame under the passenger seat.

MOTOR CONTROLLER IDENTIFICATION NUMBER



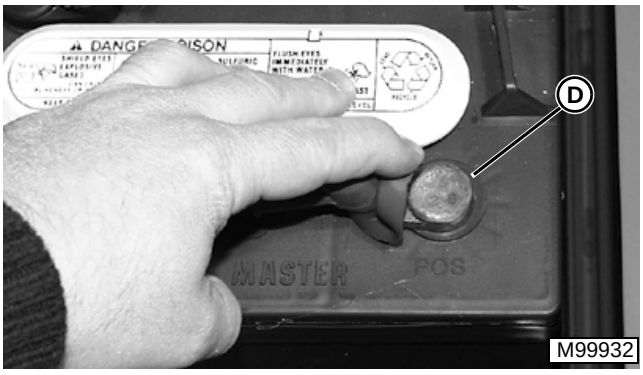
The motor controller serial number (C) is located on a label located on the lower surface of the controller.

ELECTRIC MOTOR IDENTIFICATION NUMBER



The electric motor serial number sticker (B) is located on the motor at the rear of the vehicle.

BATTERY IDENTIFICATION DATE CODE



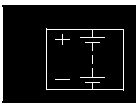
The battery date codes (D) are stamped into the top surface of both the positive and negative terminal of each battery.

BATTERY CHARGER IDENTIFICATION NUMBER

The battery charger serial number (E) is located on the front control panel of the charger.

CONTENTS

Page



SPECIFICATIONS

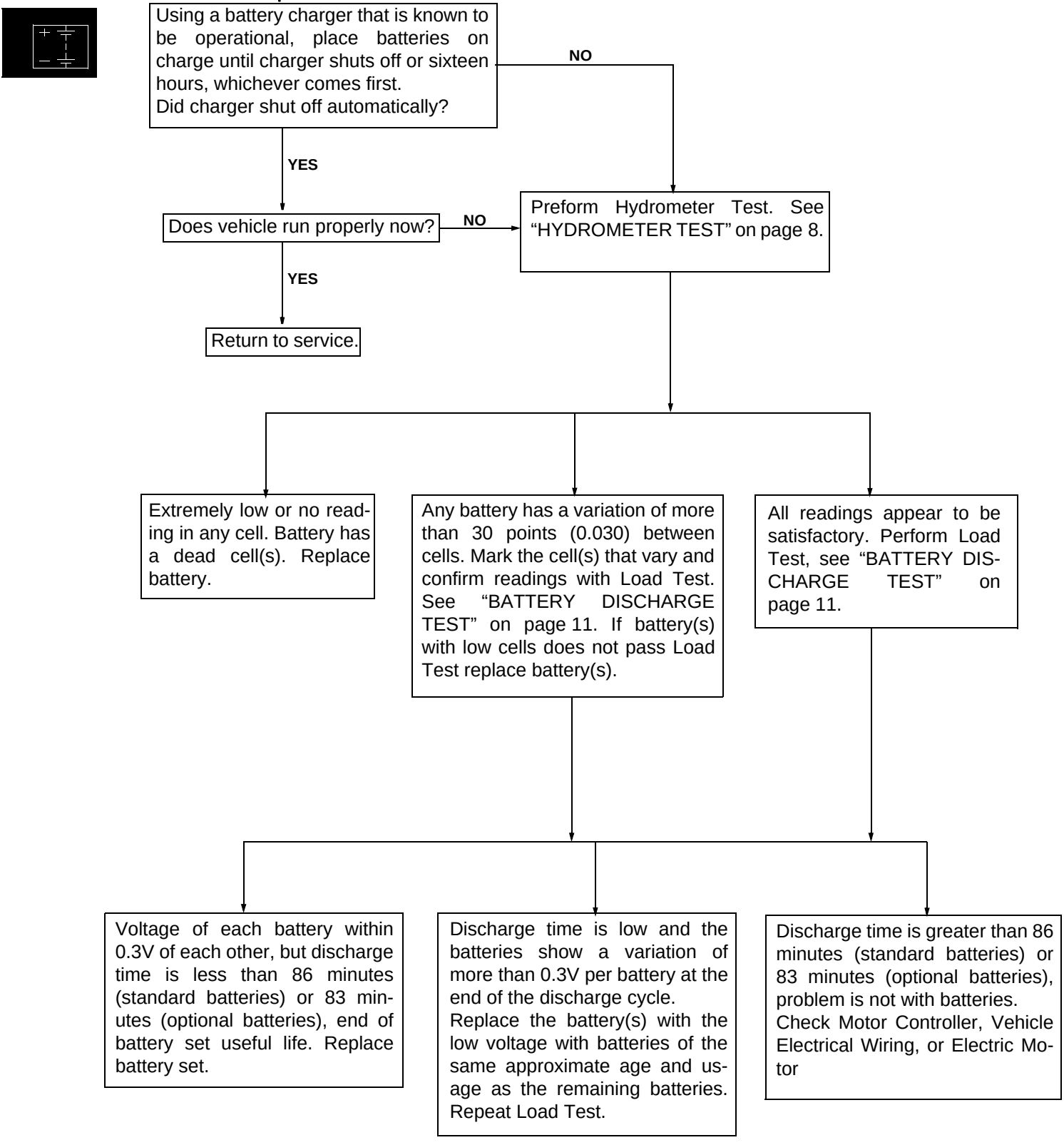
BATTERY SPECIFICATIONS

Type	Trojan T-105
Voltage (Each Battery)	6 VDC
Total Voltage (8 Batteries)	48 VDC
Rating	
Minutes @ 56 amps	165
Approximate weight	28.1 kg (62 lbs)
Optional Type	Trojan T-145
Voltage (Each Battery)	6 VDC
Total Voltage (8 Batteries)	48 VDC
Rating	
Minutes @ 56 amps	200
Approximate weight	32.2 kg (71 lbs)

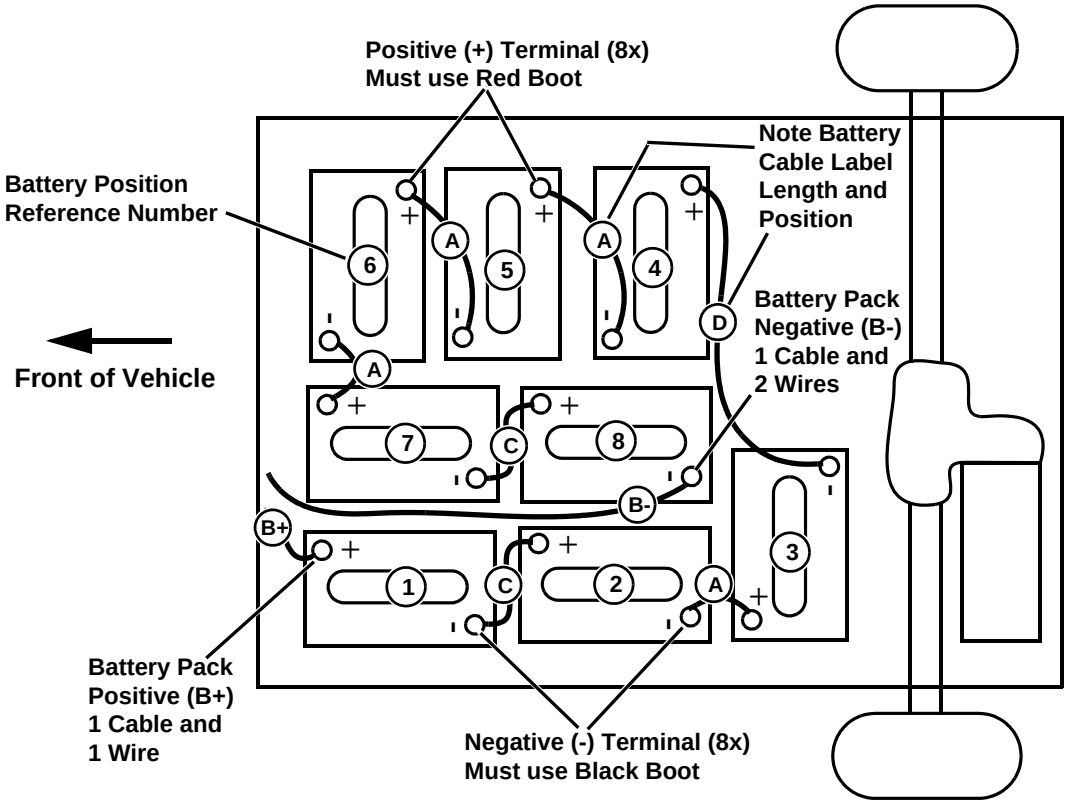
TORQUE SPECIFICATIONS

Battery Hold Downs	7 - 9 N•m (62 - 80 lb-in.)
Battery Post Connectors	14 - 16 N•m (124 - 142 lb-in.)
Battery Support Tray	95 N•m (70 lb-ft)

TROUBLESHOOTING BATTERIES

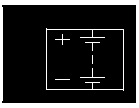


BATTERY POSITION/CONNECTION DIAGRAM



BATTERY THEORY AND OPERATION

DEEP CYCLE BATTERIES



DESCRIPTION:

A cycling battery has a service requirement which is quite different from that of an automotive battery. The automotive battery must deliver high cranking currents at a satisfactory voltage for a few seconds and a portion of the accessory load (10-25 amperes) for a minute or two at a time in city or heavy traffic. Therefore, the automotive battery is designed with maximum plate area and low internal resistance to provide high cranking performance. Power taken from this battery is immediately replaced by the alternator or generator. Therefore, the battery is subjected to shallow discharge cycles (2-3% of the battery capacity). These batteries operate in the 90-100% state of charge.

Cycling batteries supply all the motive power and power for the accessories for the vehicles in which they are used. The rate of discharge varies with the type of service. In electric vehicle service, the battery normally provides a nominal intermittent discharge of 75 amperes, with a typical range of 40-350 amperes. The depth of discharge varies with the length of time it is used before being recharged. Once the battery is discharged, it must be recharged to continue operating the vehicle since it is not maintained by a vehicle generator or alternator. These batteries usually receive “deep” discharge (60-70% or more of their capacity).

NOTE: New cycling batteries do not have their full capacity until they have been cycled several times (usually between 20 and 50 cycles). Therefore, they can be excessively discharged early in their vehicular life, thereby shortening their service life.

Cycling batteries are designed to have good life performance in “deep” cycle service. The major cause of battery failure in “deep” cycle service is poor maintenance:

- Dirt and corrosion on battery tops or terminals
- Water too much or too little
- Excessive discharge (lack of charging)

A battery is a perishable item that requires periodic maintenance. With a reasonable amount of care, the life of a battery can be significantly extended.

The life of a cycling battery is determined not only by the number of cycles (a discharge and a recharge) it receives, but also by the depth of each cycle. Assume a set of batteries is used 4 hours per day; let’s call that one life cycle. If they are used for 8 hours, this is a much deeper discharge and is equivalent to approximately three life cycles. A battery pack used 8 hours per day has a life span approximately one-third that of one used for 4 hours per day.

ELECTROLYTE AND SPECIFIC GRAVITY

The electrolyte in a lead-acid storage battery is a dilute sulfuric acid solution. A battery with a fully charged specific gravity of **1.250** corrected to **26.7°C (80°F)** contains an electrolyte with approximately 33.9% sulfuric acid by weight or 23.5% by volume. The remainder of the electrolyte is water. Pure (concentrated) sulfuric acid has a specific gravity of **1.835**.

The sulfuric acid in the electrolyte is one of the necessary ingredients for the chemical reactions taking place inside the battery. It supplies the sulfate ions (SO4) which combine with the active material in the plates. It is also the carrier for the electric current as it passes from plate to plate. When the battery terminals are connected to an external load, the sulfate combines with the active materials of the positive and negative plates forming lead sulfate (PbSO4) on both and releasing electrical energy.

Specific gravity is a unit of measurement for determining the sulfuric acid content of the electrolyte. The recommended fully charged specific gravity of most batteries today is in the range of **1.250 – 1.280** corrected to **26.7°C (80°F)**. The charts in this service manual assume a fully charged specific gravity of **1.250** or higher.

On the specific gravity scale, water by definition is **1.000**. Therefore, electrolyte with a specific gravity of **1.250** means it is **1.250** times heavier per unit volume than pure water.

TESTS AND ADJUSTMENTS

BATTERY TEST

Reason:

To check battery(s) and determine battery condition. Always follow safety procedures when testing or charging cycling batteries. If a vehicle is not performing satisfactorily, and it is suspected to be battery related, test the battery set for the cause. By following these procedures and recording the data on a copy of the Battery Test Log, see “BATTERY TEST LOG” on page 13, you will be able to verify if the problem is with the battery set or an individual battery within the set. If the battery set tests satisfactorily, then the problem is with the remaining electrical system.

⚠ CAUTION

Battery - Explosive Gases! DO NOT Smoke. Keep Sparks and flames away.

Risk of Electrical Shock. DO NOT touch unisulated battery terminals, connectors, or wires.

Battery - Poison! Batteries contain ACID which is poisonous and causes severe burns. Avoid contact with skin, eyes, or clothing.

ANTIDOTES:

- **EXTERNAL:**
  Flush with clear water for at least 20 minutes. Call a Physician Immediately.
- **INTERNAL:**
  Drink large quantities of milk or water. Follow with Milk of Magnesia or Vegetable Oil. Call a Physician Immediately.
- **EYES:**
  Force eye open and flush with clear water for at least 20 minutes. Call a Physician Immediately.
- **Neutralize all Acid spills with a solution of 1 part baking soda to 5 parts water.**

⚠ CAUTION

Only trained technicians should repair or service this vehicle. Anyone doing even simple repairs or service should have knowledge and experience in general electrical repair.

Always wear approved eye protection while servicing vehicle. Wear a full face shield, rubber gloves and rubber apron when working with batteries.

Remove all jewelry (Watches, rings, braclets, etc.) when working on the batteries or electrical systems.

Turn key switch off and remove key, place shift lever in neutral position, and place service/drive switch to service position prior to servicing.

Use extreme caution when using tools, wires, or metal objects near batteries! A short circuit and/or spark could cause an explosion. Wrap tools with vinyl tape to prevent shorting out a battery(s).

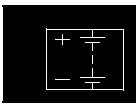
Batteries are heavy. Always use proper lifting techniques when moving them. When lifting batteries, use a commercially available battery lifting device.

Always refer to the battery position diagram when making battery connections. Wrong connections can cause a battery to explode.

HYDROMETER TEST

Purpose:

The state-of-charge of a lead acid battery can be determined by the specific gravity of the electrolyte (its weight compared to water). The specific gravity can be measured directly with a hydrometer.



The lower the float sinks in the electrolyte, the lower its specific gravity and the lower the state of charge.

Temperature Correction

Hydrometer floats are calibrated to give a true reading at one fixed temperature only. A correction factor must be applied for any specific gravity reading made when the electrolyte temperature is not **26.7°C (80°F)**. A temperature correction must be used because the electrolyte will expand and become less dense when heated. The float will sink lower in the less dense solution and give a lower specific gravity reading. The opposite occurs if the electrolyte is cooled. It will shrink in volume, becoming more dense. The float will rise higher and give a false high reading.

A correction factor of **0.004** specific gravity (sometimes referred to as 4 “points of gravity”) is used for each **5.5°C (10°F)** change in temperature. Four “points of gravity” (0.004) are added to the indicated reading each **5.5°C (10°F)** increment above **26.7°C (80°F)** and four points are subtracted for each **5.5°C (10°F)** below. This correction is important at temperature extremes because it can be a substantial value.

The thermometer used should be of the mercury-in-glass type with a scale reading as high as **52°C (125°F)**. The electrolyte should be drawn in and out of the hydrometer barrel a few times to bring the temperature of the hydrometer float and barrel to that of the electrolyte in the cell.

Hydrometer Check

Equipment:

- Hydrometer

Procedure:

1. Park machine safely.
2. Place service/drive switch in service position.
3. Inspect battery terminals, boots and case for breakage, cracks, hot spots or discoloration. Repair as needed.
4. Clean all dirt and moisture from battery top so that none is allowed to get into the battery cell.
5. Carefully remove the battery cap from the battery to be tested.

⚠ CAUTION

DO NOT squeeze the bulb while it is in the electrolyte. This will cause the electrolyte to bubble and spatter possibly causing acid burns.

Use care when squeezing the bulb as there may be electrolyte in the tip that could spray out.

Always wear full face shield, rubber gloves, and rubber apron when working on batteries.

Battery - Poison! Batteries contain ACID which is poisonous and causes severe burns. Avoid contact with skin, eyes, or clothing.

6. Read and note the specific gravity level of each cell by looking across the surface of the electrolyte to the float. The float is calibrated with a scale that ranges from 1.140 to 1.325.

For convenience and accuracy use the “BATTERY TEST LOG” on page 13. Make a copy of the page and record your results. This will also prepare you for additional testing should a problem be indicated by the hydrometer test.

7. Correct the reading for temperature. See “Temperature Correction” on page 8.
8. Repeat this procedure for each cell of each battery.

If the variation between the highest and lowest cell readings in any one battery is **0.030 (30 gravity points)** or more, it probably has a failing cell.

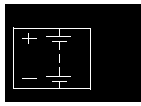
9. Mark the battery(s) and the cell(s) that vary by more than 0.030 points and perform a discharge test.

The following chart illustrates the approximate state of charge based on the specific gravity readings for the battery pack.

Specific Gravity	Percent Charge
1.250 of higher	100%
1.220 - 1.240	75%
1.190 - 1.210	50%
1.160 - 1.180	25%
1.110 - 1.120	Discharged

NOTE: If the cells have been overfilled frequently due to carelessness in adding water, there will be a gradual drop in specific gravity. This could create a 0.030 variation without an internal-mechanical problem. If water has just been added, an additional cycle may be required to mix the electrolyte and ensure a reliable measurement.

The charts on the following page give some examples of possible hydrometer readings. The examples are based on battery sets that are being tested after a full charge.



Example 1

Battery Number	1	2	3	4	5	6	7	8
Uncorrected Hydrometer Reading Before Load Test	1.255	1.250	1.245	1.255	1.250	1.260	1.255	1.250
	1.255	1.255	1.245	1.255	1.250	1.255	1.250	1.250
	1.250	1.250	1.245	1.255	1.255	1.250	1.255	1.250
Cell Temperature	90	90	90	90	90	90	90	90
	90	90	90	90	90	90	90	90
	90	90	90	90	90	90	90	90
Temperature Corrected Hydrometer Reading Before Load Test	1.259	1.254	1.249	1.259	1.254	1.264	1.259	1.254
	1.259	1.259	1.249	1.259	1.254	1.259	1.254	1.254
	1.254	1.254	1.249	1.259	1.259	1.264	1.259	1.254

In example 1 above, the readings indicate a good battery set. Each battery has readings well within 30 points. The battery set is well balanced, and based upon the specific gravity should be at 100% charge. A discharge test will verify the true condition of this batteries.

Example 2

Battery Number	1	2	3	4	5	6	7	8
Uncorrected Hydrometer Reading Before Load Test	1.255	1.250	1.225	1.255	1.250	1.245	1.255	1.250
	1.255	1.255	1.235	1.255	1.250	1.180	1.250	1.250
	1.250	1.250	1.225	1.255	1.255	1.230	1.255	no reading
Cell Temperature	60	60	60	60	60	60	60	60
	60	60	60	60	60	60	60	60
	60	60	60	60	60	60	60	60
Temperature Corrected Hydrometer Reading Before Load Test	1.247	1.242	1.217	1.247	1.242	1.237	1.247	1.242
	1.247	1.247	1.227	1.259	1.242	1.172	1.242	1.242
	1.242	1.242	1.217	1.247	1.247	1.222	1.247	no reading

In example 2 above, the battery set indicates several problems. Battery 1, 2, 4, 5, and 7 appear to be good batteries. Battery 3 does not show signs of having a bad cell but the specific gravity readings are low as compared with the other batteries. This battery may need a few more cycles to equalize with the other batteries. A discharge test will also help determine the condition of this battery. Battery 6 has a variation greater than 30 points. The center cell is 65 points lower than the outer cell. This battery probably has a failing cell. A discharge test should verify the true condition of this battery. Battery 8 has a cell that did not raise the float. This battery has a bad cell. Here again the discharge test will confirm the condition of this battery.

BATTERY DISCHARGE TEST

Reason

This test is designed to simulate the demands imposed on batteries supplying power to electric vehicles.
Fully charged batteries are discharged at the constant rate specified for the type battery being tested to a terminal voltage equivalent to 1.75 volts per cell. Batteries should be tested as indicated above at a rate of **56 amperes**. If the hydrometer check indicates a battery set, or one battery in a set of batteries, is failing, fully charge it and conduct the discharge test. Record the discharge time in minutes for the battery pack to reach 42 volts (5.25 volts per battery for a 6-volt battery). Batteries which deliver less than **86 minutes (83 minutes for optional batteries)** should be replaced.

Equipment:

- JDG1248 Discharger
- JT05791 Voltmeter

Procedure:

1. Park machine on level surface.
2. Turn key switch to OFF position.
3. Move shift lever to NEUTRAL position.
4. Engage park brake.
5. Raise cargo bed and secure.
6. Place service/drive switch in service position.
7. Inspect battery terminals, boots and case for breakage, cracks, hot spots or discoloration. Repair as needed before conducting this test.

⚠ CAUTION

Reduce the risk of fire. DO NOT use discharger near flammable materials or vapors. Batteries generate explosive gasses during operation. Keep sparks and flame away from batteries. NO Smoking.

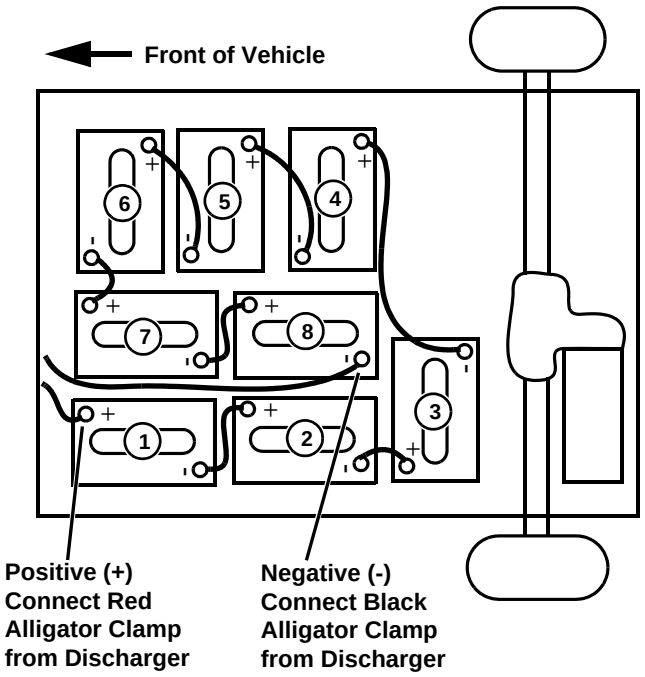
DO NOT touch the back or sides of the case during or just after operation of the discharge unit. A large amount of energy is being dissipated by the unit and the case will be hot.

DO NOT use a discharger other than the one specified by the manufacturer. Using other than specific discharger could result in damage or explosion of batteries.

IMPORTANT:

- **Keep the discharger dry, DO NOT expose to rain, power wash detergents or spray.**
- **Make sure cord, plug, and alligator clamps are in good condition. DO NOT use if cords, plug, or receptacles are damaged, loose, or feel hotter than normal. Replace worn or damaged parts immediately.**
- **To permit free air flow for cooling, allow 45.7 cm (18 in.) minimum between the discharger and any wall or other equipment.**
- **Never disconnect the discharge unit from the batteries while the unit is operating. This will subject the unit to heat stress and may immediately damage or shorten the life of the unit.**

8. Be sure batteries are fully charged and the electrolyte level is correct in all cells.



9. Slide the RED boot on the battery set positive terminal and the black boot on the battery set negative terminal back far enough to expose the terminal.
10. Connect the RED alligator clamp from the discharger, to the POSITIVE terminal of the battery pack.
11. Connect the BLACK alligator clamp from the discharger, to the NEGATIVE terminal of the battery pack.

12. Press the start/stop button. If needed pressing the start/stop button will shut the discharger off during the test cycle.
13. Allow the battery pack to discharge.
14. When the discharger has shut off, note the discharge time.
15. Test the discharged battery load voltage.
16. Press the start/stop button on the discharge unit and wait a few minutes for the discharger to shut OFF. Note the voltage reading on the discharge meter. It should be 42 volts or less.
17. Press the start/stop button again. With the battery set voltage at or below 42 volts, the discharge unit will start and run for 3 minutes. While the discharger is running measure and record the voltage of each battery.

The battery reading should all be within 0.30 volts of each other.

If the discharge time is less than **86 minutes (83 minutes for optional batteries)** and the voltages are within 0.30 volts, the battery pack is at the end of its life cycle and should be replaced.

If the discharge time is low and the voltage between batteries is greater than 0.30 volts, identify the low battery(s), recharge the pack and repeat the test. If the results are similar, replace the low batteries, recharge, and repeat the test.

If the discharge time is at or near the specification, see “SPECIFICATIONS” on page 3, and the voltage variations are less than 0.30 volts the battery pack is good.

Discharge Time	Voltage	Results
124 minutes or higher	within 0.30 volts	Battery Pack OK
124 minutes or higher	vary more than 0.30 volts	Bad battery(s)
83-124 minutes	within 0.30 volts	Batteries aging but still usable.
83-124 minutes	vary more than 0.30 volts	Bad battery(s)
83 minutes or less	within 0.30 volts	Batteries aging. Should be replaced as a set.
83 minutes or less	vary more than 0.30 volts	Bad battery(s) Batteries aging. Replace bad battery and retest. If results still low replace remaining old batteries.

In “Example 1” on page 10, The specific gravity reading of all the batteries were well balanced and have a specific gravity that indicates 100% charge.

In “Example 2” on page 10, batteries 3, 6, and 8 should be specifically watched for poor performance. Because batteries 6 and 8 have specific gravity readings that vary by more than 30 points, it would be expected that these batteries will also have voltages that vary by more than 0.3 volts. If the discharge test confirms this then replace the low batteries.

Battery Test Log

The Battery Test Log should be used whenever testing a battery set because a problem is suspected. Because battery testing is based on both specific data and comparison data the form will allow you to spot and circle specific batteries that may indicate a problem.

The form is designed to group the test result to give quick easy accurate diagnosis of a battery problem. By looking across the rows you can easily compare one battery to the rest of the set. By looking down the columns you can verify the pattern of an individual battery. If a battery set or battery consistently give good results then the battery set is good and any problem that may have initiated the testing is in some other vehicle operating system. If a battery set or battery in a set consistently give poor results then the battery set or battery within the set is bad and should be replaced.