BATTERY CARE MANUAL

Publication Part No. JLR 13 65 10_1E (Edition 1)

INTRODUCTION

This publication sets out, for the benefit of importers and dealers / retailers worldwide, requirements for the care and maintenance of batteries, from the vehicle's dispatch from the factory to its hand-over to the customer.

The clearly laid out and illustrated sections guide importers and dealers / retailers through each stage of the vehicle's receipt, storage, pre-delivery and customer hand-over. This publication can be used as a guide to the handling and care of batteries in service. It is vital to appreciate that unless each process is rigorously applied on all vehicles, the customer will receive a vehicle with a battery which will not provide a satisfactory service life.

It is very important that open circuit voltage and all other test results quoted throughout this publication are adhered to. If they are applied incorrectly batteries could be scrapped unnecessarily. Refer to the battery testing section for detailed information.

It is equally important therefore to note the following key points:

- All new vehicles leave the factory with either a transit relay installed and/or, on certain models, have a transit mode programmed into the vehicle control modules. The transit relay must be removed and the transit mode disabled (where applicable) using an approved diagnostic system, **NOT MORE THAN 24 HOURS** before the customer takes delivery.

- The battery will be damaged if it is allowed to discharge over a number of weeks / months, or is left in a discharged state for a lengthy time period. For this reason the battery must be tested / re-charged if necessary every month, and **MUST BE** re-charged after every three month period of storage. Refer to the vehicle storage manual and update the vehicle history sheet.

- Under no circumstances should the battery be disconnected with the engine running because under these conditions the alternator can give a very high output voltage. This high transient voltage will damage the electronic components in the vehicle. Loose or incomplete battery connections may also cause high transient voltage.

- On vehicles with conventional ignition keys, these must not be left in the ignition lock barrel when the transit relay has been removed, otherwise quiescent current will increase and the battery will discharge more rapidly.

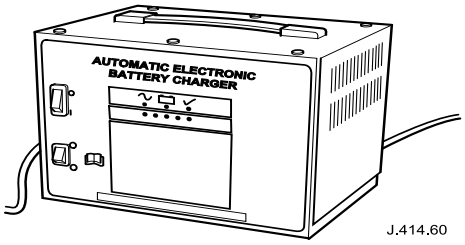
  On vehicles with Smart Keys, ensure these are not left in the vehicle once the transit relay has been removed or the transit mode disabled.

Both importers and dealers have a responsibility to ensure that only vehicles having a fully satisfactory battery may be processed further through the distribution selling chain.

EQUIPMENT (MINIMUM STANDARD)

Existing minimum standards requirements are presently specified as follows:

Traction Battery Charger



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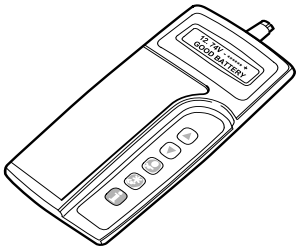
Midtronics Tester 3.5 Digit



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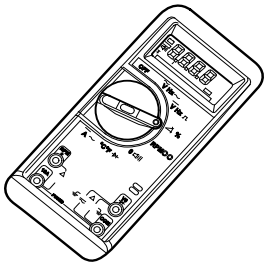
Digital Multi-Meter or Digital Volt-Ohm Meter (DVOM)



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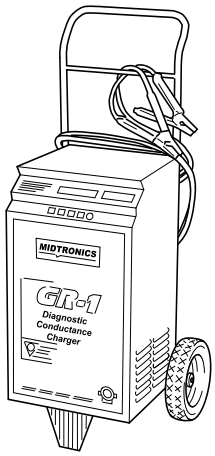
Midtronics Diagnostic Charger



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HEALTH AND SAFETY PRECAUTIONS

WARNING: BATTERY CELLS CONTAIN SULPHURIC ACID AND EXPLOSIVE MIXTURES OF HYDROGEN AND OXYGEN GASES. IT IS THEREFORE ESSENTIAL THAT THE FOLLOWING SAFETY PRECAUTIONS ARE OBSERVED.

WARNING: Batteries emit highly explosive hydrogen at all times, particularly during charging. To prevent any potential form of ignition occurring when working in the vicinity of a battery:

- ***Do not smoke when working near batteries.***
- ***Avoid sparks, short circuits or other sources of ignition in the battery vicinity.***
- ***Switch off current before making or breaking electrical connections.***
- ***Ensure battery charging area is well ventilated.***
- ***Ensure the charger is switched off when: a) connecting to a battery; b) disconnecting from the battery.***
- ***Always disconnect the ground cable from the battery terminal first and reconnect it last.***

WARNING: Batteries contain poisonous and highly corrosive acid. To prevent personal injury, or damage to clothing or the vehicle, the following working practices should be followed when topping up, checking electrolyte specific gravity, removal, refitting or carrying batteries:

- ***Always wear suitable protective clothing (an apron or similar), safety glasses, a face mask and suitable gloves.***
- ***If acid is spilled or splashed onto clothing or the body, it must be neutralized immediately and then rinsed with clean water. A solution of baking soda or household ammonia and water may be used as a neutralizer.***
- ***In the event of contact with the skin, drench the affected area with water. In the case of contact with the eyes, bathe the affected area with cool clean water for approximately 15 minutes and seek urgent medical attention.***
- ***If battery acid is spilled or splashed on any surface of a vehicle, it should be neutralized and rinsed with clean water.***
- ***Heat is generated when acid is mixed with water. If it becomes necessary to prepare electrolyte of a desired specific gravity, SLOWLY pour the concentrated acid into water (not water into acid), adding small amounts of acid while stirring. Allow the electrolyte to cool if noticeable heat develops. With the exception of lead or lead-lined containers, always use non-metallic receptacles or funnels. Do not store acid in excessively warm locations or in direct sunlight.***

WARNING: Due to their hazardous contents, the disposal of batteries is strictly controlled.

- ***When a battery is scrapped, ensure it is disposed of safely, complying with local environmental regulations. If in doubt, contact your local authority for advice on disposal facilities.***

DETERMINING BATTERY CONDITION

The tools used for determining the condition of the vehicle battery will depend upon whether the vehicle is new or a customer vehicle undergoing service or investigation.

NOTE: The term 'New Vehicle' refers to a vehicle arriving at a port of entry, dealership, retailer or a vehicle being stored prior to sale at dealership / retailer.

NEW VEHICLES

In the case of batteries fitted to a new vehicle, the battery open-circuit voltage (OCV) is the only reliable measure to determine the battery condition. OCV should be measured using a Digital Multi-Meter (DVOM) set to 0 - 20V DC range. Alternatively, a hand-held Midtronics tester set to measure voltage may be used. No other indication shown on the Midtronics tester should be used to assess the condition of the battery for new vehicles. The test results should be recorded on the New Battery Report form (See page 12).

Scenario 1 - Port of Entry

1 Immediately following receipt of a vehicle at the port of entry, proceed as follows:
- Perform an open-circuit voltage test (See Appendix A).
- Carry out the recommended actions accordingly.

Scenario 2 - Arrival at Dealership / Retailer

1 On arrival at the dealer / retailer proceed as follows:
- Perform an open-circuit voltage test (See Appendix A.)
- Carry out the recommended actions accordingly.

Scenario 3 - New Vehicles in Storage

1 For vehicles in storage at the dealer / retailer proceed as follows:
- Perform an open-circuit voltage test (See Appendix A).
- Carry out the recommended actions accordingly.

2 If the battery open-circuit voltage is 12.55 volts or above, the vehicle may be stored. The transit relay MUST be fitted, or the battery negative cable DISCONNECTED from the battery for all new vehicles in storage.

3 The battery must be tested and/or re-charged every month and MUST be re-charged after every three month period.

4 Record your test results on the Storage History Sheet (see New Vehicle Storage manual) to indicate when a re-charge will be necessary.

Scenario 4 - Delivery to the Customer

NOTE: It is essential that the following actions are conducted in the 24 hours prior to the agreed hand over time:

1 Perform an open-circuit voltage test (See Appendix A).

2 Carry out the recommended actions accordingly.

VEHICLES IN SERVICE

The Midtronics hand-held tester or the Midtronics GR-1 Diagnostic Charger are the preferred tools to assess battery condition for vehicles in service. The test results should be recorded on the In-Service Battery Report Form (See page 13).

Midtronics Testing - In-Service Testing Only

NOTE: The battery surface charge must be removed before this test in accordance with the procedure in Appendix A. Ensure that the battery terminal.connectors are clean. When connecting the Midtronics testing equipment, connect the RED clip to the positive (+) battery terminal first, and then connect the BLACK clip to the negative (-) battery terminal. Rock the clips backward and forward to ensure a good connection to the battery.

1 Remove the battery surface charge (See Appendix A).

CAUTION: DO NOT connect the tester to any other circuit or chassis point.

2 Attach the Midtronics tester to the battery.

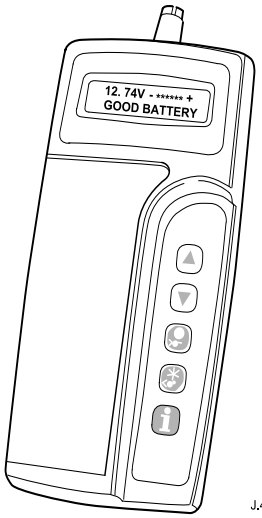
3 Use the 'arrow' buttons to scroll to the battery's labelled Cold Cranking Amps (CCA) rating.

4 Press the 'Test' button that corresponds to the correct battery temperature. For example:

- If the temperature is above 0°C (32°F) press the 'Sun' button.
- If the battery temperature is below 0°C (32°F) press the 'Ice crystal' button. Perform the action based on the tester results (see table below).

5 Press the 'Information' button to view the test code.

- Enter the readings and test code obtained on the In Service Battery Report Form.



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TESTER RESULTS

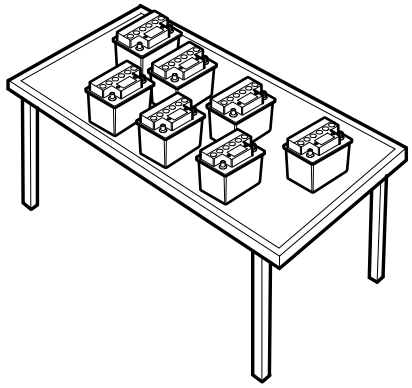
TESTER RESULTS	ACTION
GOOD BATTERY	Return to service.
GOOD RE-CHARGE	Fully charge battery and return to service.
CHARGE AND RE-TEST	Fully charge battery. Remove surface charge. Re-test battery. If same result replace battery.
REPLACE BATTERY OR BAD CELL BATTERY	Verify surface charge removed. Disconnect battery from vehicle and re-test. If result repeats after surface charge removal, replace battery. **DO NOT RECHARGE**.
UNABLE TO DO TEST	Disconnect battery from vehicle and re-test.

BATTERY CHARGING AND MAINTENANCE

BATTERY CHARGING

It is essential that a suitably ventilated defined area exists in each dealership / retailer for battery charging and post-charge checking. Likewise, an area should be allotted for scrap batteries, and clearly indicated as such. It is recommended that dealers / retailers always have fully charged batteries ready for use. However the battery MUST BE tested and charged if necessary every month, and charged after three months irrespective of any test.

CAUTION: Batteries must be re-charged after a maximum of 3 months storage (see Storage History sheet in the New Vehicle Storage Manual).



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CAUTION: Vehicles from 2007MY only use one type of battery; Lead Calcium. It is very important that when charging batteries using the traction charger that the switch selector on the charger is selected for the correct type of battery. If the wrong switch is selected the result would be a battery that is not charged fully and / or overheating can occur.

NOTE: Use of the Midtronics GR-1 Diagnostic Charger (USA) or Traction Charger (all other markets if Midtronics GR-1 is not available) is required.

1 To bring a serviceable but discharged battery back to a fully charged condition proceed as follows:

- Check and if necessary top-up the battery electrolyte level (see page 8)
- Charge the battery using the Midtronics GR-1 Diagnostic Charger (USA) or Traction Charger (all other markets).
- Carry out a post-charge test (see page 7).

POST-CHARGE TEST METHODS

New Batteries and Batteries in Storage

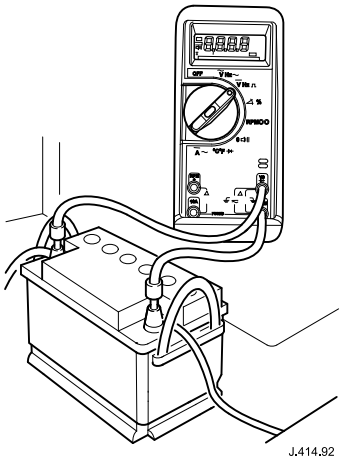
NOTE: The purpose of this test is to ensure that the charging process has fully charged the battery and should always follow dry charge commissioning or new battery storage or charging.

NOTE: AT LEAST 24 HOURS AFTER THE CHARGE CYCLE IS COMPLETED or if the time restraint is unacceptable due to circumstances, then:

1 Remove the battery surface charge (See Appendix A)

2 Perform an open-circuit voltage test (See Appendix A).

- If the voltage is 12.69 volts or less the battery should be scrapped.
- If the voltage is 12.70 volts or greater the battery is good to use or store.



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In-Service Batteries

NOTE: AT LEAST 24 HOURS AFTER THE CHARGE CYCLE IS COMPLETED or if this time constraint is unacceptable due to circumstances, then:

1 Remove the battery surface charge (See Appendix A)

CAUTION: DO NOT connect the tester to any other circuit or chassis point.

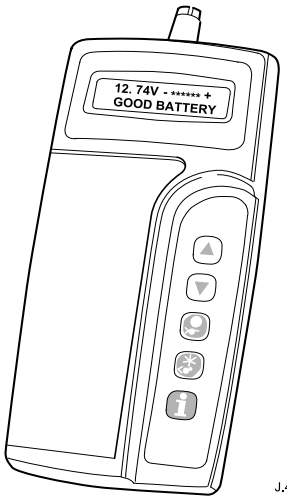
2 Attach the Midtronics Tester to the battery.

3 Use the 'Arrow' buttons to scroll to the battery's labelled Cold Cranking Amps (CCA) rating.

4 Press the 'Test' button that corresponds to the correct battery temperature. For example:

- If the temperature is above 0°C (32°F) press the 'Sun' button.
- If the temperature is below 0°C (32°F) press the 'Ice Crystal' button. Perform the action based on the testers results.

5 Press the 'Information' button to view the test code and refer to the tester results chart on page 5 for the appropriate action.



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BATTERY REPLACEMENT

If it is determined that a battery requires replacement, always refer to the appropriate section of the workshop manual for instructions on removing the battery from the vehicle.

On vehicles fitted with a Battery Monitoring System (BMS), the BMS module must be reset following the installation of a new battery. The BMS module reset procedure must be performed using an approved diagnostic system.

CHECK/TOP-UP BATTERY ELECTROLYTE

WARNING: BEFORE CHECKING AND TOPPING-UP THE BATTERY ELECTROLYTE, REFER TO THE HEALTH AND SAFETY PRECAUTIONS ON PAGE 3.

Check to ensure the battery is of a type suitable for topping up. These type of batteries will have cell plugs visible on the top face of the battery or a removable access panel to allow access to the cells.

On batteries with a clear or opaque case and level marks, check the electrolyte level by visual inspection of the maximum level indicator mark on the battery casing indicating adequate level above the battery separators.

On batteries with black cases, remove the cell plugs or access panel and ensure the electrolyte level is level with the indicator in the cell hole. A flashlight may be required to see the electrolyte level on this type of battery.

CAUTION: DO NOT overfill.

If the electrolyte level is low, top-up using distilled water

Maintenance free batteries are sealed and therefore cannot be topped up.

CHARGING SYSTEM TEST AND DIAGNOSIS

NOTE: On vehicles fitted with a Battery Monitoring System (BMS) (except Freelander 2/LR2), the 'Voltage Reading Under Load' test below is not applicable and may give misleading results.

On vehicles with a BMS, run the automated diagnostic routine using an approved Land Rover diagnostic system to test the power supply components.

For Freelander 2/LR2 vehicles, use the procedure detailed below.

VOLTAGE READING UNDER LOAD @ 2000 RPM

1. Set a Digital Multi-Meter (DVOM) to 0 - 20 DCV range.
2. Connect the RED positive (+) meter lead to the battery positive (+) terminal post.
3. Connect the BLACK negative (-) meter lead to the battery negative (-) terminal post.
4. Start the vehicle's engine and leave to idle for 3 minutes.
5. Switch on electrical loads:
   - Heated front and rear screens.
   - Headlamps on high beam.
   - Climate control fan on full speed.
6. Increase the engine speed to 2000 RPM.
7. When the RPM has remained stable for a few minutes, read the voltage on the DVOM.
8. Enter the reading obtained on the applicable Battery Report Form.

VEHICLE QUIESCENT CURRENT TESTING

NOTE: On vehicles fitted with a Battery Monitoring System (BMS), the diagnostic routine for quiescent drain testing in the approved Land Rover diagnostic system should be utilized.

NOTE: If an open-circuit voltage test gives a result between 12.45 and 12.49 volts, it is recommended to verify the battery is not being slowly discharged by an electrical consumer that is remaining on after the vehicles shutdown period (See Appendix B for typical shutdown periods).

NOTE: If a customer complains of a vehicle battery that discharges continuously or when left for a prolonged period of time, it is recommended that a quiescent drain test is performed as described below.

NOTE: The battery drain should be measured using the approved Land Rover diagnostic system or a Digital Multi-Meter (DVOM). A procedure for quiescent drain measurement using the diagnostic system is available in the Diagnosis and Testing section of the Workshop Manual. The vehicle should be in the locked/armed state (for example vehicle alarm fully armed), all doors, engine and luggage compartment lids are closed or latched (so as to appear closed from an electrical point of view). The test should take place after the vehicle has entered shutdown mode. The time taken for this to occur after the ignition is switched off varies according to model (Refer to Appendix B).

NOTE: When the vehicle is armed, the effect of the security system Light Emitting Diode (LED) flashing is to cause a pulsation in the measured current drain. In this case, either the average current should be taken (using a Digital Multi-Meter (DVOM) with an averaging system) or the current reading taken, ignoring the brief high current peaks.

EQUIPMENT

- Approved Land Rover diagnostic system with current probe

OR

- Digital Multi-Meter (DVOM) with current probe.

METHOD OF MEASUREMENT

Using an Approved Land Rover Diagnostic System

1. Switch off all electrical loads and ensure that the ignition is off.
2. Connect the current probe to the approved Land Rover diagnostic system.
3. Calibrate the probe.
4. Install a clamp around the battery lead/junction box lead.
5. Go to the Quiescent Current Testing section.

Using a Digital Multi-Meter (DVOM)

NOTE: Do not use an in-line DVOM to measure the quiescent drain on vehicles fitted with an electronic throttle (for example Range Rover 2002MY onwards). The current exceeds the maximum amount the fuse in the DVOM is capable of handling.

1. Switch off all electrical loads and ensure that the ignition is off.
2. Connect the current probe to the DVOM.
3. Calibrate the probe.
4. Install a clamp around the battery lead/junction box lead.
5. Go to the following Quiescent Current Testing section.

QUIESCENT CURRENT TESTING

1. Switch ignition to ‘on’ or select ignition mode in keyless vehicles and switch to ‘off’ (do not crank).
2. Remove key from ignition switch (where applicable).
3. Close or latch all doors, hood and luggage compartment lid.
4. Lock the vehicle using the remote function on the remote handset.
5. Remove any other potential electrical consumers.
6. Record the amperage readings after the shutdown period referenced in Appendix B.
7. Record the final reading on the applicable battery report form.

NOTE: The preferred method of testing following an excessive current consumption figure is to use a current probe around individual junction box leads to the various suspected circuits to identify a potential cause. This is in preference to the old method of removing fuses for the following reasons:

- *Many modules take a considerable time to power down. Each time a fuse is removed and re-fitted, the quiescent drain current may take an extended period of time to return to normal (typically up to 45 minutes).*
- *The drain may be caused by a module remaining active and preventing the quiescent drain from reducing to normal levels.*
- *The drain may be caused by a relay winding that is activated. Pulling the fuse can allow this to ‘reset’ and the drain will be lost and go un-diagnosed.*

NEW BATTERY REPORT FORM

- Port of entry
- Dealer/retailer new vehicles
- New vehicles in storage
- New stored batteries

GENERAL INFORMATION (Note: Mandatory fields are shown as shaded and must be filled in)			
		Dealer/Retailer Code:	
Repair Order Number:		Customer Signature:	
Date:		Dealer/Retailer Name:	
Technicians Name:		Battery Date Code:	
Model:		Technicians Name:	
VIN: (last 6/8 digit)		Technicians Signature:	

Give a detailed description of the symptoms experienced by the customer (attach a separate sheet if necessary)

DIAGNOSTICS (Battery Testing)

1. Loose battery clamps	YES			NO		10. Voltage reading under load @ 2000 rpm HFS/HRW on- High beam on, - Heater fan on full speed (See page 9)					V	
2. Loose hold down clamps	YES			NO		11. Temperature after 15 mins:			°C		°F	
3. Corroded terminal/posts	YES			NO		12. Vent tube fitted correctly?	YES			NO		
4. Physical damage/leaks	YES			NO								
5. Low electrolyte	YES			NO								
6. FEAD- belt tension	OK			NOT OK								
7. Surface charge removed	YES			NO								
8.Open-circuit voltage after 10 mins (See page 14)			-		V							
9. Quiescent drain (See page 10)					mA							

Comments:

BATTERY REPORT FORM - IN SERVICE BATTERIES ONLY

GENERAL INFORMATION (Note: Mandatory fields are shown as shaded and must be filled in)								
Customer's Name:							Dealer/Retailer Code:	
Repair Order Number:							Customer Signature:	
Repair Order Date:							Battery Date Code:	
Technician's Name:							No. of Battery Charges:	
Vehicle Model:							Technicians Name:	
VIN (last 6/8 digits):							Technicians Signature:	
Give a detailed description of the symptoms experienced by the customer (attach a separate sheet if necessary)								

DIAGNOSTICS (Battery Testing)								
1. Loose battery clamps	YES			NO		10. Quiescent drain (page 10)		mA
2. Loose hold down clamps	YES			NO		11. Voltage reading under load @ 2000 rpm HFS/HRW on, - High beam on, - Heater fan on full speed (See page 9)		V
3. Corroded terminal/posts	YES			NO				
4. Physical damage/leaks	YES			NO				
5. Low electrolyte	YES			NO		12. Vent tube fitted correctly:	YES	NO
6. FEAD belt tension	OK			NOT OK		**Comments:**		
7. Surface charge removed	YES			NO				
8. Open-Circuit Voltage after 10 minutes: (page 14)			-					
9. Midtronics Test								
Code before charge								
- If initial open circuit voltage is below 12.5 volts, charge battery for 24 hours.								
Code after charge								
Result after charge								
- If 'good & re-charge', charge for an additional 24 hours and re-test								
- If 'charge & re-test' for both before and after 24 hour charge, replace battery								
- Replace battery only if 'replace battery', 'bad cell' or 'charge & re-test' has been displayed twice.								

APPENDIX A

BATTERY OPEN CIRCUIT VOLTAGE TEST

Part 1 - Surface Charge Removal

NOTE: Before carrying out an open-circuit voltage check you must ensure that there is no battery surface charge present.

NOTE: The battery may be tested either on a bench or on the vehicle.

- *In the case of on-vehicle testing, the battery must be isolated from the vehicle by removal of the battery negative (-) cable from the battery terminal before the measurement is taken unless the vehicle has a transit relay fitted or is in transit mode.*

A vehicle which has had its battery charged or been driven in a 24 hour period before the test, must have its surface charge removed using one of the following methods:

1. If 24 hours have passed since the last time the engine was run, proceed to 'Part 2 - Open-Circuit Voltage Test'.
2. Turn on the ignition. Switch on the headlamps on high beam for 5 minutes.
3. Switch off the headlamps. For vehicles without a transit relay fitted or after the transit relay has been removed, disconnect the battery by removal of the negative (-) cable.
4. Wait a further 10 minutes before recording test results for any battery measurements.

Part 2 - Open-Circuit Voltage Test

NOTE: Battery open-circuit voltage should be measured after 10 minutes has elapsed following surface charge removal, with the ignition off and the battery negative (-) cable removed, unless the vehicle has a transit relay fitted or is in transit mode. If the vehicle is fitted with a transit relay or is in transit mode, it is not necessary to disconnect the battery negative (-) cable from the battery.

1. Use a Digital Multi-Meter (DVOM) set to 0 - 20 volt range to measure the open-circuit voltage.
2. Connect the RED positive (+) lead of the DVOM to the battery positive (+) terminal post and the BLACK negative (-) meter lead to the negative (-) battery terminal post.
3. Enter the readings on the appropriate Battery Report Form.
4. If open-circuit voltage is less than 12.49 volts, replace the battery. Perform full charging system diagnosis (see page 9).
5. If open-circuit voltage is between 12.49 and 12.54 volts:
   - Re-charge the battery.
   - Perform a post charge test (see page 7).
   - If the result after charging the battery is 12.69 volts or less, replace the battery.
6. If open-circuit voltage is greater than 12.55 volts:
   - Port of entry - deliver vehicle to dealership / retailer.
   - Dealership / Retailer - deliver vehicle to customer or place into storage.

At the end of the test, the battery negative (-) cable should be re-attached to the battery terminal and any necessary re-calibration routines performed, for example electric parking brake, seat position, windows, radio code, etc..

APPENDIX B

QUIESCENT DRAIN - TYPICAL VALUES

NOTE: The quiescent drain after the initial shutdown period should not exceed the value shown in the table.

Land Rover Values

Model	Shutdown Period (minutes)	Typical Values Battery Drain (mA)
Range Rover (LM)	30	16.0 - 18.0
Range Rover Sport (LS) - from 2007MY	30	<25.0
Range Rover Sport (LS) up to 2007MY	20	<22
Discovery 3/LR3 (LA) - from 2007MY	30	<25.0
Discovery 3/LR3 (LA) - up to 2007MY	20	<22
Freelander 2/LR2 (LF) - from 2007MY	35 (single locked or unlocked)	<23.6
	12 (double locked)	<23.6
Freelander (LN) - up to 2007MY	10	24-25 - without Becker Navigation system 27-28 with Becker Navigation system
Defender - 1998 onwards	30	<21.0
Discovery Series 2 (LT)	30	<30.0

The total current drain will be higher if certain approved accessories are fitted (for example tracker, trailer towing module etc.).