



# **JAGUAR - LAND ROVER**

## **BATTERY CARE MANUAL**

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## INTRODUCTION

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This publication sets out, for the benefit of importers and dealers worldwide, requirements for the care and maintenance of batteries, from the vehicles despatch from the factory to its hand-over to the customer.

The clearly laid out and illustrated sections guide importers and dealers through each stage of the vehicles 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 Land Rover/Jaguar 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 will appreciate their responsibility to ensure that only vehicles having a fully satisfactory battery may be processed further through the distribution selling chain.

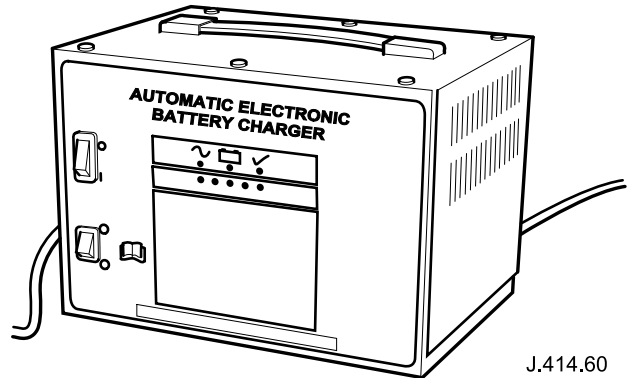
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## EQUIPMENT (MINIMUM STANDARD)

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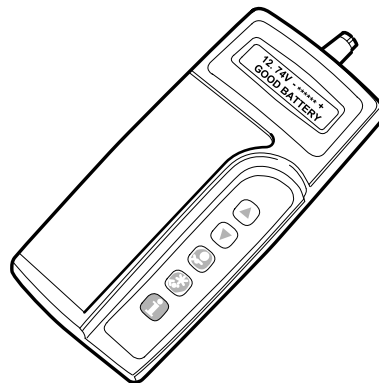
Existing minimum standards requirements are presently specified as follows:

### Traction Battery Charger



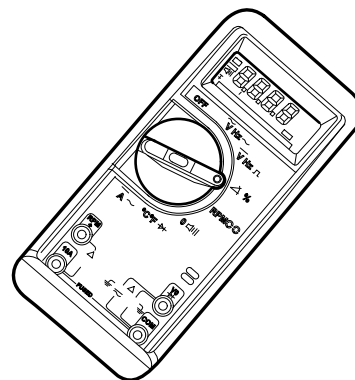
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### Midtronics Tester



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### Digital Multi-meter: 3.5 digit.



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## HEALTH AND SAFETY PRECAUTIONS

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**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:**

- 1 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 the 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.
  
- 2 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 the 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 neutralised immediately, then rinsed with clean water. A solution of baking soda, or household ammonia and water may be used as a neutraliser.
  - 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 areas 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 neutralised 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 and / or funnels. Do not store acid in excessively warm locations or in direct sunlight.
  
- 3 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 the local authority for advice on disposal facilities.

## SCENARIOS

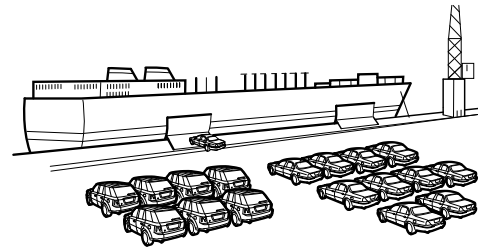
A digital multi-meter (set to 0 - 20 voltage range) should be used to determine the battery condition in the scenarios below. If no digital multi-meter is available, a Midtronics tester may be used (in voltage mode only) to determine the open circuit battery voltage. No other indication on the Midtronics tester should be used to determine battery condition.

### PORT OF ENTRY

Immediately following the receipt of a vehicle at the port of entry, proceed as follows:

Carry out an open circuit voltage test (see page 12).

Compare your results with those on page 13 - carry out the recommended actions accordingly.

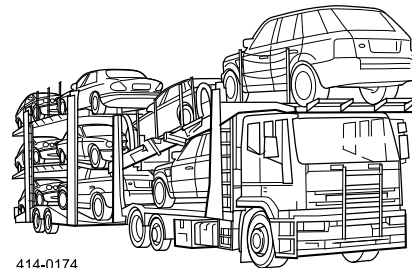


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### ARRIVAL AT THE DEALERSHIP

On arrival at the dealer a battery open circuit voltage test (see page 12) must be carried out to ensure the vehicle's battery is in a satisfactory condition to put into storage.

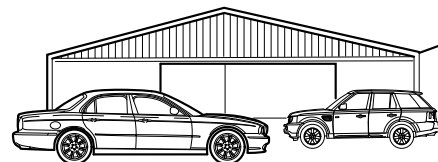
Compare your results with those on page 13 - carry out the recommended actions accordingly.



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### VEHICLES IN STORAGE

Perform an open circuit voltage test (see page 12). Compare your results with those on page 13 - carry out the recommended actions accordingly. Providing the battery open circuit voltage is 12.55 volts or above, the transit relay in place, or the battery disconnected, the vehicle may be stored. The battery must be tested and / or re-charged every month, and **MUST BE** re-charged after every three-month period irrespective of any test. Record your test results on the Storage History Sheet (see New Vehicle Storage Manual) to indicate when a re-charge will be necessary.



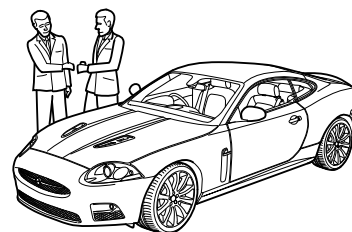
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### DELIVERY TO THE CUSTOMER

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

Perform an open circuit voltage test (see page 12) then set clock, set radio etc.

Compare your results with those on page 13 - carry out the recommended actions accordingly.



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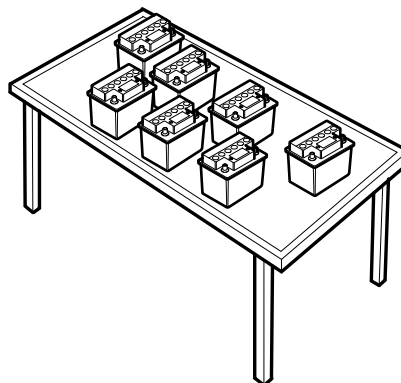
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## NEW BATTERY STORAGE AND CHARGING

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It is essential that a suitably ventilated defined area exists in each dealership 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 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: Battery 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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To bring a serviceable but discharged battery back to a fully charged condition proceed as follows:

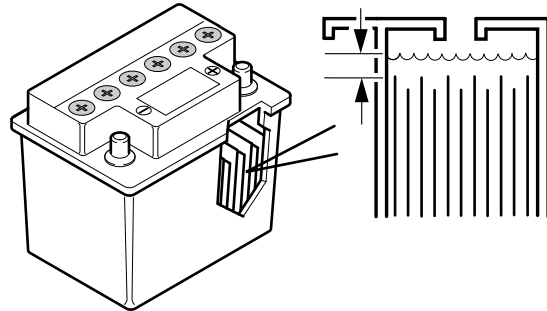
- Check and if necessary top-up the battery electrolyte level (see page 6)
- Charge the battery by following the instructions given with the charger in use (see note below).
- Carry out a post-charge test (see page 7).

**CAUTION: Jaguar and Land Rover 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.**

## CHECK/TOP-UP BATTERY ELECTROLYTE

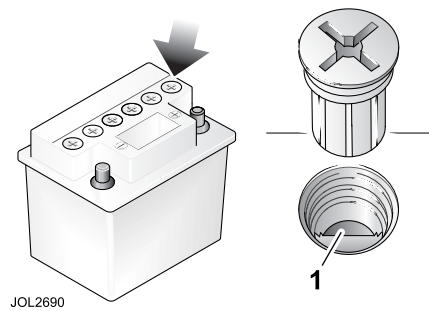
Before checking and topping-up the battery electrolyte, refer to the Health and Safety Precautions on Page 3.

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



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On batteries with black cases, remove the cell plugs or access panel and ensure electrolyte is level with indicator in the cell hole (1). A flashlight may be required to see the electrolyte level on this type of battery.

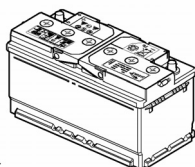


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If electrolyte level is low, top up using distilled water. Do not overfill

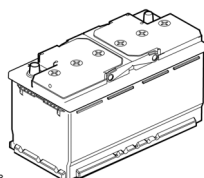
The following illustrations show the different types of batteries which can be topped up.

Varta



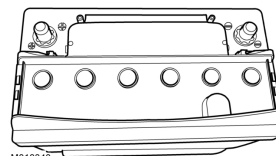
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Varta



M010338

Exide



M010340

**NOTE:** Delphi batteries are maintenance free and cannot be topped up.

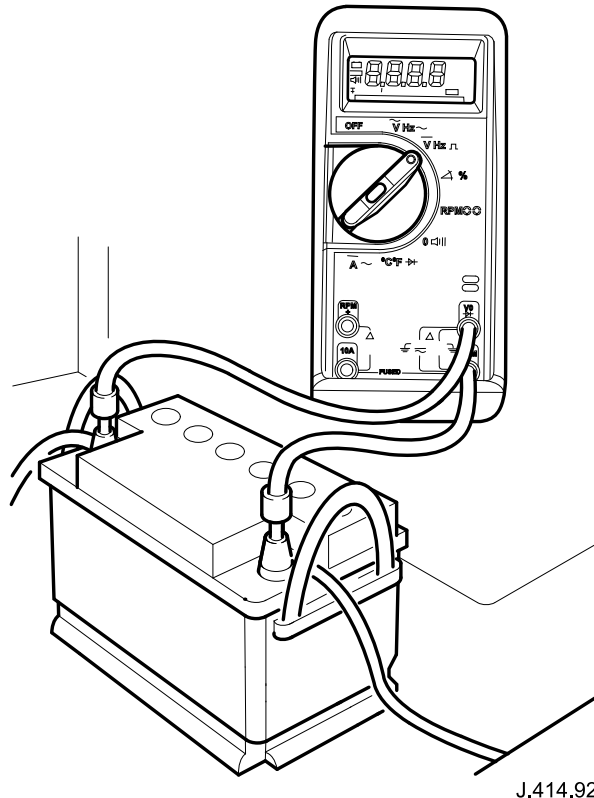
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## POST-CHARGE TEST

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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 and charging.

**NOTE:** The figures quoted below only apply to new batteries. The post-charge test needs to show the battery has recovered to the higher voltage before putting it into storage.



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

- Remove the battery surface charge (see page 12)
- Perform an open circuit voltage test (see page 12)

Then compare your results with those below if the battery is new and perform the recommended actions accordingly (or refer to the Midtronics Test Results Table (see page 11) for in service batteries).

Open Circuit Voltage ~ **12.69 or less: Scrap battery and / or submit for warranty.**

Open Circuit Voltage ~ **12.7 or above: Okay to use or store.**

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## CHARGING IN-SERVICE BATTERIES

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Charging equipment must be used as follows:

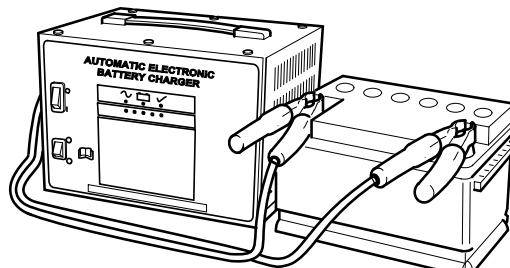
- 1 Do not boost charge the battery.
- 2 Do not charge at more than 16 volts.
- 3 Do not charge at more than 40 amps.
- 4 During charging, do not let the battery exceed a temperature of 50°C.
- 5 Do not charge more than one battery per charger.
- 6 Do not leave a battery in a discharged condition, but promptly recharge.
- 7 Use chargers with the following specification:
  - Automatic controls, no manual boost charge.
  - Automatic switch off at charge termination.

*NOTE: The use of such chargers will minimise potential battery damage caused by overcharging.*

- 8 Always check the electrolyte levels before and after charging, top-up with distilled water if necessary.

*NOTE: Some batteries are sealed and cannot be topped up. All batteries from 2007MY will be able to be topped up by removal of either screw caps or covers from the top face of the battery.*

- 9 After charging is complete, perform a post-charge test (see page 7) and perform the recommended actions accordingly.



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## BATTERY TESTING

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The following section gives a detailed description of how to accurately diagnose a battery condition.

The first two pages are Battery Report Forms which must be used in conjunction with the test pages. Use the appropriate Report Form for the type of test being performed. Mandatory fields on the Report Form are shaded and they must be filled in. Likewise, we actively encourage all other fields to be filled in with as much information and detail as possible.

To accurately determine the battery condition, you **MUST** carry out battery testing as indicated on the battery report. Following the tests in the order shown on the Report Form will encourage a logical and methodical approach to accurately diagnosing battery faults. Failure to follow this routine rigorously and the result will be incorrectly diagnosed battery conditions.

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## BATTERY REPLACEMENT

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On vehicles fitted with a Battery Monitoring System, the battery monitoring system module must be reset following the fitment of a new or replacement battery. The module reset procedure must be performed using a Land Rover or Jaguar approved diagnostic system.

**BATTERY REPORT FORM - NEW BATTERIES ONLY - Port of entry, Dealer (new vehicles only), stored batteries**

<b>GENERAL INFORMATION</b> (Note: Mandatory fields are shown as shaded and must be filled in)										
Customer's Name:				Dealer Code (Export)						
Job Number:				Corporate I.D. (UK)						
Date:				Battery Date Code:						
Technician's Name:				No. of Battery Changes						
Vehicle Make/Model:				Customer's Signature:						
VIN:				Technicians Signature:						
Give a detailed description of the symptoms experienced by the customer (attach a separate sheet if necessary)										

<b>DIAGNOSTICS</b> (Battery Testing)									
1. Loose battery clamps	YES			NO					
2. Loose hold down clamps	YES			NO		11. Voltage reading under load @ 2000 rpm (page 19)			
3. Corroded terminal/posts	YES			NO		HFS/HRW - Headlamps - Heater			
4. Physical damage/leaks	YES			NO		12. High rate discharge test (Page 19)			
5. Low electrolyte	YES			NO		Temperature			
6. Alternator - belt tension	OK			NOT OK		Reading after 15 seconds			
7. Surface charge removed	YES			NO				°C	°F
8. Wait 10 min. Open Circuit V (page 12)			-						
9. Quiescent drain (page 15)					mA				
10. Specific gravity									
No. 1 Cell			-						
No. 2 Cell			-						
No. 3 Cell			-						
No. 4 Cell			-						
No. 5 Cell			-						
No. 6 Cell			-						
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 Code (Export)						
Job Number:				Corporate I.D. (UK)						
Date:				Battery Date Code:						
Technician's Name:				No. of Battery Changes						
Vehicle Make/Model:				Customer's Signature:						
VIN:				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		9. Quiescent drain (page 15)				mA
2. Loose hold down clamps	YES			NO		10. Voltage reading under load @ 2000 rpm (page 18)				
3. Corroded terminal/posts	YES			NO		HFS/HRW - Headlamps - Heater			-	
4. Physical damage/leaks	YES			NO						
5. Low electrolyte	YES			NO		Jaguar				
6. Alternator - belt tension	OK			NOT OK		Land Rover				Tick one Box only
7. Surface charge removed	YES			NO						
8. Wait 10 min. Open circuit V (page 12)				-		Comments:				
<b>Midtronics Test</b>										
Code before charge										
If initial open circuit voltage is below 12.5 volts, charge battery for 24 hours. Then remove surface charge.										
Code after charge										
Result after charge										
If 'charge and re-test' is the result before and after charge, then replace the battery										
If the test after charging gives a result 'good & re-charge', charge for a further 24 hours, then re-test.										
Replace battery only if 'replace battery', 'bad cell' or 'charge & re-test' has been displayed twice.										

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## OPEN CIRCUIT VOLTAGE TEST - NEW VEHICLES ONLY PRIOR TO CUSTOMER HANDOVER

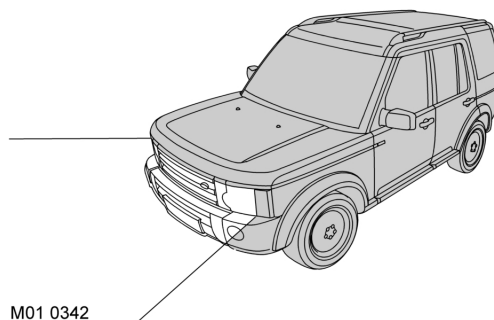
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### Surface Charge Removal

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

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 removing the negative battery cable from the battery terminal before the measurement is taken.

A vehicle which has had its battery charged or been driven within 24 hours prior to the test must have its surface charge removed using one of the following methods:

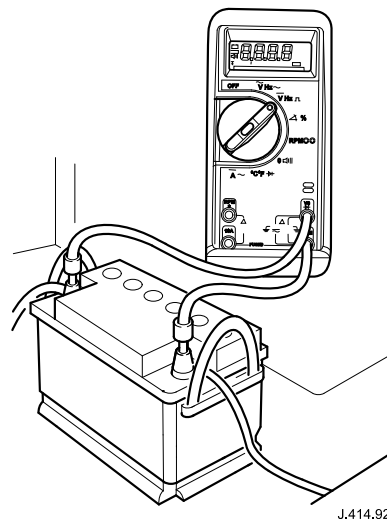


- Wait 24 hours before the test is performed
- Or switch on the headlights on main-beam for 5 minutes for all models except Jaguar 'X' Type which should be for 2 minutes only.

At the end of the test, the negative cable should be re-attached to the battery terminal and any necessary re-calibration routines performed, for example; electric park brake, seat position, windows.

### Open Circuit Voltage Test (Multimeter connections)

Battery open circuit voltage should be measured after 10 minutes has elapsed following surface charge removal, with the ignition off and battery negative cable removed. Measure the open circuit voltage of the battery by using a 3.5 digit multi-meter set to 0 - 20 voltage range. Connect the red positive lead of the digital multimeter to the battery positive terminal post and the black negative meter lead to the negative battery terminal post, as shown below.





## (With battery open circuit & engine stationary)

- Compare your results and carry out the recommended actions accordingly, as follows:

**NOTE:** *If preliminary findings give unsatisfactory results (i.e. 12.49 volts or less) then enter the readings obtained on to the battery report form and proceed with a full battery diagnosis.*

### **Results Obtained**

#### **Open circuit voltage ~ less than 12.49 volts**

- Fit replacement battery
- Scrap or return removed battery

**Unsatisfactory result:** See note above and carry out a full diagnostic routine.

#### **Open circuit Voltage ~ 12.49 to 12.54 volts**

- Remove and re-charge battery
- Charge the battery by following the instructions given with the charger in use (see note on charging on page 8)
- Perform a post-charge check (see page 7)
- If the result after charging the battery is 12.54 volts or less, then fit a replacement battery
- Scrap or return the removed battery.

#### **Open circuit voltage ~ 12.55 volts or above**

Carry out one of the following:

- At Port of entry - deliver to the dealership
- At Dealership - deliver to the customer or put into storage. Note that batteries in storage should be subject to an open circuit voltage check every month, and re-charge if necessary. Batteries must be re-charged after a maximum of 3 months in storage.

## MIDTRONICS TESTING - IN SERVICE TESTING ONLY (suitable for 12 volts batteries only)

**NOTE:** The battery surface charge must be removed before this test (see page 12).

- Ensure that the battery terminal / connectors are clean.
- Connect the red clip to the positive (+) battery terminal.
- Connect the black clip to the negative (-) battery terminal.
- Rock clips backward and forward to ensure a good connection to the battery.

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

### TEST PROCEDURE

#### Step 1

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

#### Step 2

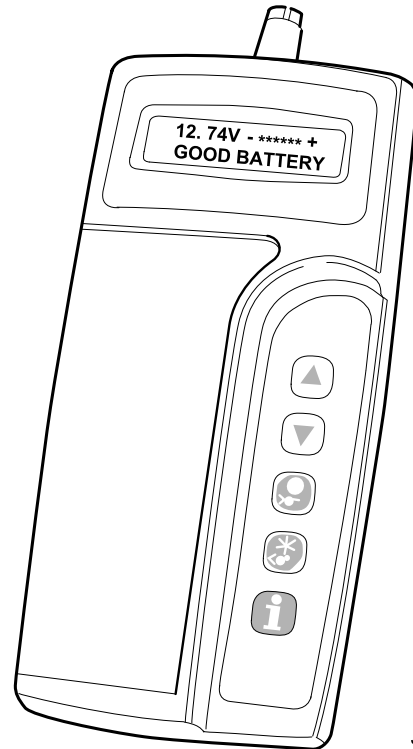
Press the 'Test' button that corresponds to the correct battery temperature. For example, if the temperature is above 0°C press the 'Sun' button. If the battery temperature is below 0°C press the 'Ice Crystal' button. Perform the action based on the tester results (see table below).

#### Step 3

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

#### Step 4

Enter the readings obtained on the Battery Report Form (see page 11).



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Tester Results	Actions
GOOD BATTERY	Return to service.
GOOD RE-CHARGE	Fully charge the battery and return to service
CHARGE & RE-TEST	Fully charge the battery. Before re-testing, remove the surface charge. If this result remains after the surface charge removal - replace the battery.
REPLACE BATTERY or BAD CELL BATTERY	Ensure that the surface charge was removed. If so, disconnect the battery from the vehicle and re-test. If this result remains after the surface charge removal - replace the battery. <b>WARNING: Do not charge.</b>
UNABLE TO DO TEST	Disconnect the battery from the vehicle and re-test.

Press the 'Information' button and carefully note the 6-digit 'test code' on the battery job card and the Battery Report Form. The battery tester will always generate a 'test code' on completion of every test.

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## VEHICLE QUIESCENT CURRENT TESTING

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**NOTE:** On vehicles fitted with a Battery Monitoring System (except Freelander 2/LR2 (LF)), run the power-supply diagnostic routine using a Land Rover or Jaguar approved diagnostic system for quiescent current testing and measurement. For Freelander 2/LR2 vehicles and other Land Rover and Jaguar vehicles without a battery monitoring system, use the procedure detailed below for quiescent current testing.

If an open circuit voltage test gives a result in the region of 12.45 to 12.49 volts, it is recommended that you ensure the battery isn't slowly being discharged by an electrical consumer that is remaining on after the vehicle's shutdown period (see page 16 for typical shutdown periods). Likewise if a customer complains of a vehicle battery that discharges continuously or when left for a prolonged period of time it is recommended that you perform a quiescent drain test as described below:

### **Method of Measurement**

In order to correctly measure quiescent drain, it is preferable to use a Land Rover or Jaguar approved diagnostic system with the current probe attachment. A procedure for quiescent drain measurement using the diagnostic system is available in the Diagnosis and Testing section of the Workshop Manual.

If this is not possible, then an ammeter may be used. Whichever method is used, technicians MUST adhere to the following procedure.

**CAUTION: DO NOT use a multi-meter to check the battery drain on vehicles with an electronic throttle (for example XK8 1997 on or Range Rover 2002 on) as the current drawn by the throttle is in excess of the fuse rating in most multi-meters, and damage to your multi-meter may result.**

### **Using a Land Rover or Jaguar Approved Diagnostic System with Current Probe**

- Switch off all electrical loads and ensure that the ignition is off.
- Connect the current probe to the approved diagnostic system.
- Calibrate the probe.
- Clamp around the battery lead / junction box lead. **Go to Test Results below.**

### **Using a Multi-meter**

- Disconnect the battery negative lead.
- Connect the ammeter between the battery negative post and the negative lead using clips.
- Select high meter range (i.e. equal or more than 10 amps) then switch the multi-meter on. **Go to Test Results below.**

### **Test Results (both methods)**

- Switch the ignition 'on' (ignition mode on keyless vehicles) and then to 'off' (DO NOT CRANK) and remove the key (where applicable).
- Close or latch all doors and remove any other potential electrical consumers.
- Observe / compare the readings obtained over the time scales identified (see page 16)
- Enter the reading obtained on to the applicable Battery Report form (see page 10 or 11)

**NOTE:** The preferred method of testing following an excessive current consumption figure is to use the clamp of the ammeter around individual junction box leads to the various suspected circuits to identify a potential cause. Rather than the old method of pulling fuses out, in a one after another fashion.

The main reasons for using the current probe to determine which junction box/ circuit the drain is going through are:

- 1 Many modules take a considerable time to power down, every time a fuse is removed and re-fitted, the quiescent drain figures will need 45 minutes to reset.
- 2 Sometimes the drain is caused by a module 'holding on' to something that has been switched off. sometimes it is only a relay winding that is activated. Pulling the fuse can allow this to 'reset' and the drain will be lost and go undiagnosed. Similarly for example, the headlights of a Jaguar S-Type are switched on, removing the switch input will not turn them off. Therefore, the reading obtained would be incorrect and misleading.

## BATTERY CURRENT DRAIN - TYPICAL VALUES

The battery drain should be measured (see page 15) using a Land Rover or Jaguar approved diagnostic system (where available) or an ammeter, with the vehicle in the double-locked armed state (i.e. vehicle alarm fully armed), with all doors and other body apertures either 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 key-off varies according to model. (Refer to the table below.)

**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 meter with an averaging function) or the current reading should be taken, ignoring the brief high current peaks.

## JAGUAR VALUES

The current drain after the initial shutdown period should not exceed the value shown in the table.

Model	Shutdown Period (minutes)	Typical Values Battery Drain (mA)
XJS 3.2	60	<30.0
Sovereign 3.2	60	<37.3
XJ6 4.0	60	<38.6
XJS	60	<43.9
XJ6 (X300)(95 MY)	60	<43.0 <sup>1</sup>
XJ8 (X300)	60	<30.0
XK8 (X100)	60	<30.0
S-Type (X200)	60	<30.0
X-Type (X400)	30	<30.0
XJ6 (X350)	40	<30.0
XJ8 (X350)I	40	<30.0
XK (X150)	3 (after lock/arm condition)	<30.0 <sup>2</sup>
	33 (unlocked)	<30.0
XF(X250)	2 (after lock/arm condition)	<24.0 <sup>2</sup>
	30 (unlocked)	<24.0

**NOTE:**

<sup>1</sup> Further drop after 72 hours to 30.0 mA, but this would not be part of the standard test.

<sup>2</sup> Applies to vehicles without TPMS. Vehicle shutdown period with TPMS fitted is approximately 15 minutes.

The total current drain will be higher if certain Jaguar approved accessories (for example, tracker, cool bag, trailer tow module) are fitted.

## 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

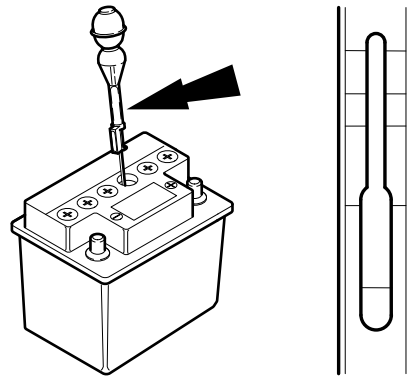
## SPECIFIC GRAVITY TESTING (Dealers without Midtronics)

Before checking the specific gravity, refer to the Health and Safety Precautions on Page 3.

The SI (System International) measures the strength of the battery electrolyte as density in grams per cubic metre ( $\text{g/M}^3$ ) @ 25°C.

This can be measured by means of a battery hydrometer which measures the battery electrolyte specific gravity (density).

Temperature correction is necessary if readings are taken at anything other than 25°C.



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**NOTE:** *Not all batteries have access caps or a plate and therefore cannot be specific gravity tested. All batteries fitted to vehicles from 2007MY are able to have cell caps or plates removed and a specific gravity test performed*

## TEST PROCEDURE

- Remove all battery cell covers or caps and visually inspect to ensure sufficient electrolyte is present. Do not top-up any of the cells before testing. If topping up is necessary then you must charge the battery fully then remove any surface charge before continuing with this test.
- Squeeze the bulb of the battery hydrometer and insert the tube into the first cell (No. 1 cell) and draw the battery electrolyte out of the cell and into the hydrometer.
- Allow for any air bubbles to disappear and the float level to stabilise before reading the value displayed by the level of the fluid on the float. Then enter this figure onto the applicable Battery Report Form for cell No. 1.
- Repeat the above operation for the remaining cells and enter the readings on the applicable Battery Report Form (see page 10 or 11).

## Results

Compare the cells for consistent readings, regardless of what the readings are, they should all be similar. A significantly lower or higher reading in one cell indicates a bad cell and the battery must be replaced.

Readings Obtained	Condition	Actions Necessary
1:110 - 1:130	Discharged	Re-charge battery fully - Remove surface charge and then re-test.
1:230 - 1:250	Approx. 70% charged	Re-charge battery fully - Remove surface charge and then re-test.
1:270 - 1:290	Charged	Battery serviceable - Carry out the remaining tests and the Battery Report form.

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## VOLTAGE READING UNDER LOAD

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**NOTE:** *On vehicles fitted with a Battery Monitoring System (except Freelander 2/LR2 (LF)), the 'Voltage Reading Under Load' test below is not applicable and may give misleading results. On vehicles with a battery monitoring system, run the automated diagnostic routine using a Land Rover or Jaguar approved diagnostic system to test the power supply components. For Freelander 2/LR2 vehicles and other Land Rover and Jaguar vehicles without a battery monitoring system, use the procedure detailed below.*

### VOLTAGE READING UNDER LOAD @2000 RPM

Connect the RED positive lead of a 3.5 digit multimeter (set to 0 - 20 voltage range) to the battery positive terminal post and the BLACK negative meter lead to the negative battery terminal post.

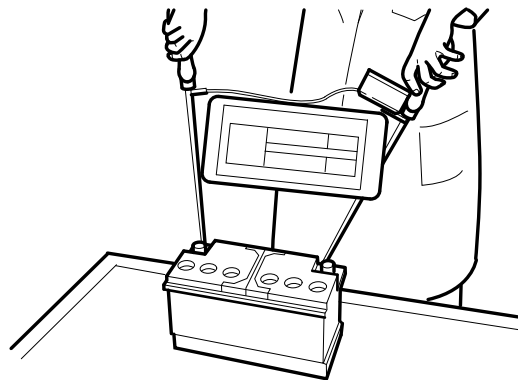
- Start the vehicle's engine and leave to idle for a few minutes.
- Switch on electrical loads: heated front and or rear screens, headlamps on main beam and heater blower on full speed.
- Increase the engine speed to 2000 rpm.
- When the rpm has remained stable for a few minutes, read the voltage on the multimeter.
- Enter the reading obtained on the applicable Battery Report Form (see page 10 or 11).

## **BATTERY HIGH RATE DISCHARGE TEST (Dealers without Midtronics)**

The purpose of this test is to ensure that the battery is in a satisfactory condition for service. (This is a severe test for the battery and generally indicates the ability of the battery to perform under heavy load.)

It will determine if the battery can perform under such loads that it may have to deal with when starting in cold conditions for example.

**NOTE:** The battery should be removed from the vehicle when carrying out a High Rate Discharge Test. It is essential that the battery is fully re-charged (see page 5 or 8) subsequent to performing this test.



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Perform an open circuit voltage test (see page 12).

Open circuit voltage - 12.55 volts or above and with a room temperature of 20°C.

### **Connect the High Rate Discharge Tester as follows:**

- Remove the battery from the vehicle and take off cell tops.
- Connect the testers RED lead to the positive battery lead and the BLACK lead to negative battery lead.
- Set the current at 300 amps for new vehicles and new batteries, for 15 seconds, or 210 amps for in-service vehicles and batteries.
- The voltmeter should read 9.6 volts or above after 15 seconds have elapsed.
- Enter the reading obtained on to the Battery Report Form (see page 10).

**NOTE:** The battery must be charged after this test.

*If the voltage is 9.6 volts or above @ 20°C or above throughout the 15 second test period, then the battery is serviceable.*

With open circuit temperatures that differ from those recommended for testing, refer to the table below:

Degrees ° C	Degrees ° F	Minimum Acceptance Voltage
20	70	9.6
15	60	9.5
10	50	9.4
4	40	9.3

NOTE: Testing below 4°C is not recommended.