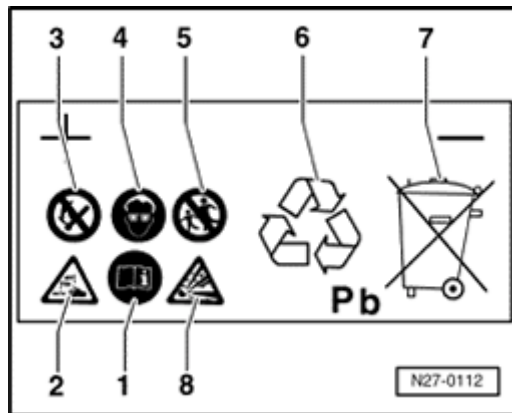


Battery

The battery is one of the most important electrical components in the vehicle. If it functions properly, the battery will make a significant contribution to customer satisfaction. To ensure a long service life, the battery must be checked, serviced and maintained as described in this section.

In addition to starting the engine, the battery has additional functions as a buffer and supplier of electrical power for the entire vehicle electrical system.



⚠ Warnings and safety precautions for lead-acid batteries

1 - Follow the recommendations on the battery, in this Repair Manual and in the Owners Manual.

2 - Danger of acid burns:

Battery acid is extremely caustic, therefore wear protective gloves and eye protection.

Do not tip battery. Acid may escape from battery vents.

3 - Keep open flame, sparks, unenclosed light bulbs and lit smoking materials away from battery.

Guard against creating sparks when working with cables and electrical equipment.

- Avoid short-circuits.

4 - Wear eye protection

5 - Keep children away from acid and batteries.

6 - Proper disposal:

Waste batteries must be brought to appropriate waste disposal site. Dispose of old batteries in compliance with applicable Federal, State and local laws regarding hazardous waste disposal.

7 - Never discard old batteries in the household trash!

8 - Explosive hazard:

Highly explosive gas is produced when batteries are charged.

Battery handling instructions

Notes:

- ◆ *Battery terminals should no longer be coated with grease.*
- ◆ *To avoid damage to the battery case, place the cable clamps on the terminals by hand without using force.*
- ◆ *The battery terminal clamp tightening torque is 6 Nm (53 in. lb).*
- ◆ *Once the battery is reconnected, check and activate the vehicle's electrical equipment (radio, clock, comfort and convenience features, etc.) as described in the Repair Manual or the Owner's Manual.*

Battery, removing and installing

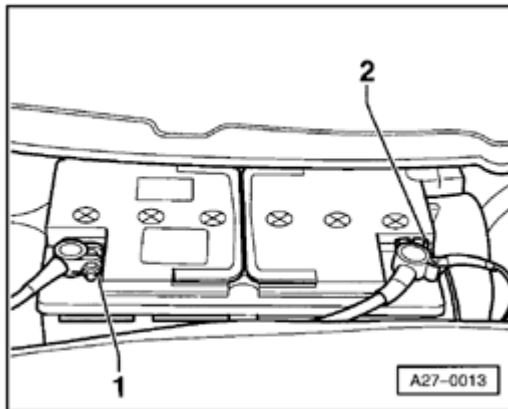
CAUTION!

Disconnect the battery Ground (GND) strap before working on the electrical system.

Notes:

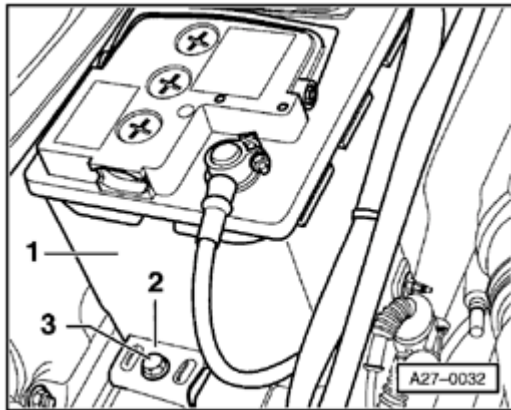
- ◆ Before disconnecting the battery, determine the correct coding for the anti-theft radio.
- ◆ Once the battery is reconnected, check and activate the vehicle's electrical equipment (radio, clock, comfort and convenience features, etc.) as described in the Repair Manual or the Owner's Manual.

Removing



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- Disconnect battery Ground (GND) strap from negative terminal by loosening nut -1-.
Tightening torque: 6 Nm (53 in. lb)
- Disconnect battery positive cable from positive terminal by loosening nut -2-.
Tightening torque: 6 Nm (53 in. lb)



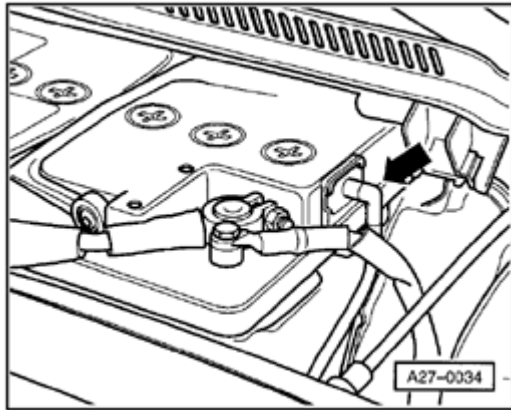
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- Remove bolt -3- and remove hold-down clamp -2-.
- Tightening torque: 15 Nm (11 ft lb)
- Lift battery -1- out of battery tray.

Installing

Notes:

- ◆ *The newest generation of batteries is equipped with a central gas vent and flame trap by means of a "baffle."*
- ◆ *Function: the gas produced during charging escapes at one place through an opening in the top of the cover. The flame trap (which prevents the flammable gas located in the battery from igniting) is also integrated in this unit.*
- ◆ *For proper venting of the battery via the diffuser and the hose, it is important that the hose attached to the central gas vent does not become pinched off during installation.*
- ◆ *The diffuser consists of a small round glass fiber mat having a diameter of approximately 15 mm and a thickness of 2 mm. It functions similar to a valve, i.e., it allows the gas formed in the battery to flow out.*

**Note:**

- ▲ *When installing the battery (if the battery has a central gas vent), make absolutely certain that the hose is not pinched off. This allows the battery be freely vented via the diffuser and the hose. If the battery does not have a hose, make sure that the opening on the top of the battery's cover is not plugged.*

- Install in reverse order of removal.

Make sure battery is securely mounted

If the battery is not secured properly, there is a risk that the following might occur:

- ◆ Shortened service life due to damage caused by vibration
- ◆ Battery cell and plate damage
- ◆ Damage to battery case by the hold-down clamp (possible release of electrolyte resulting in costly damage).
- ◆ Poor collision safety

Visual inspection

WARNING!

When charging, measuring the voltage or load testing a battery, the cell caps must always be screwed in tightly.

Before performing tests such as no-load voltage, specific gravity or the battery load tests, a visual check should be made of the battery.

The purpose of this check is to determine

- ◆ If the case of the battery has been damaged. Damage to the case can cause acid to leak.

- ◆ If the terminals have been damaged. Damaged terminals make it impossible to assure a good contact at the terminal. This can lead to a cable fire and damage to the electrical system.

Electrolyte level, checking

CAUTION!

To ensure that the various battery cover systems do not leak, the original cell caps that come with the battery must always be screwed in. If they are lost or damaged, use only genuine cell caps for the same model battery. The cell caps must be equipped with an O-ring seal.

Notes:

- ◆ *Maintaining the correct electrolyte level is important for long battery life.*
- ◆ *If the battery has visible minimum and maximum lines on the case, the electrolyte level can be checked from outside the battery.*
- ◆ *The electrolyte level must be between the minimum and maximum lines.*
- ◆ *If the external minimum and maximum lines are hard to see or if it is difficult to see the electrolyte level due to opacity of the battery case, the cell caps will have to be removed. After that it will be possible to visually check the electrolyte level from the interior of the battery.*

- ◆ *The electrolyte level must reach the internal electrolyte level indicator (lip of plastic flange). This corresponds to the external maximum line on the battery case.*

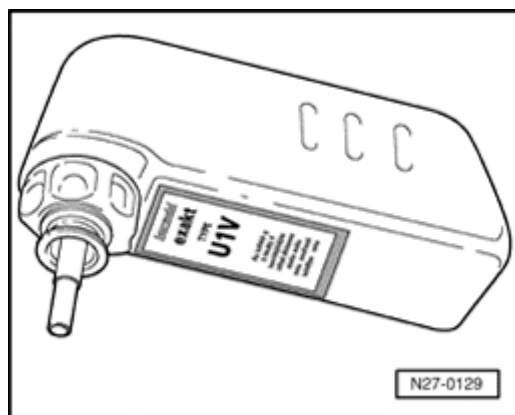
Electrolyte level too low

Special tools, test equipment and auxiliary items

VAS5045 battery cell filler

Note:

If the electrolyte level is too low, the plates will dry out causing a loss of capacity (power loss) in the battery. If the plates are not surrounded by electrolyte (sulfuric acid), the plates, plate straps and the cell connectors will corrode. The result of this corrosion is that battery function can no longer be assured. The battery is made useless.



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- If electrolyte level is too low, add distilled water up to maximum mark using VAS5045 battery cell filler.

Notes:

- ◆ *The design of the filler nozzle of the VAS5045 battery cell filler prevents overfilling the battery cell and loss of battery acid. When the maximum fill level is reached, the flow of distilled water into the battery cell is stopped.*
- ◆ *To avoid contaminating the electrolyte, add only distilled water to the battery (contaminated water will lead to increased self-discharge).*

Electrolyte level too high

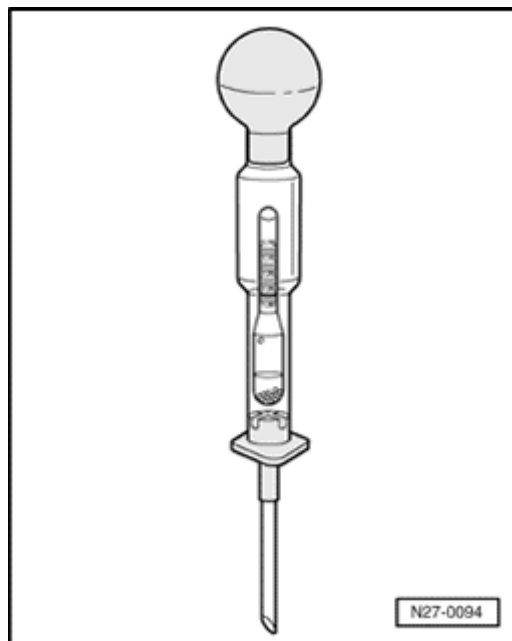
Special tools, test equipment and auxiliary items

- ◀ Commercially available hydrometer

Note:

If the electrolyte level is too high, the sulfuric acid/water mixture will leak to the outside of the battery and damage functional components in the engine compartment.

- If electrolyte level is too high (overfilling), i.e., it is above internal electrolyte level mark (lip of plastic flange) or external maximum line, draw off excess electrolyte using commercially available hydrometer.
- Draw off electrolyte using hydrometer until electrolyte level has reached lip of plastic flange or maximum line.



Batteries with central gas vent

CAUTION!

- ◆ ***Make absolutely certain that only batteries of the most recent design with central gas vents are installed.***
- ◆ ***Always use the original cell caps. The caps must be equipped with an O-ring seal.***

There are two types of batteries with central gas vents:

- ◆ Batteries with a hose on the central gas vent
- ◆ Batteries without a hose on the central gas vent

No-load voltage, checking

CAUTION!

- ◆ *Battery cell caps must be screwed in tightly when charging, measuring voltage or performing load tests.*
- ◆ *Always comply with the following instructions otherwise a correct measurement cannot be assured.*

Special tools, test equipment and auxiliary items

- ◆ VAG1715 multimeter or
- ◆ VAG1362 minitester or
- ◆ Multimeter (Fluke 83 or equivalent)

Notes:

- ◆ *When testing the no-load voltage of a battery installed in a vehicle, make sure the battery Ground (GND) strap is disconnected.*
- ◆ *The battery must not have been under a load*

for at least two hours before the test.

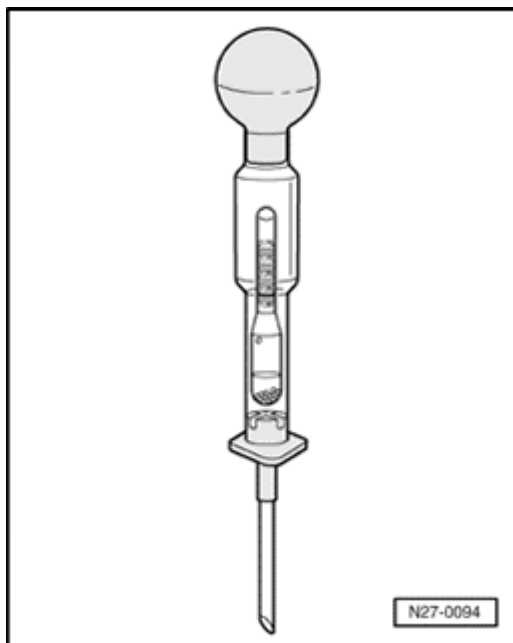
- ◆ *The battery must not have been charged at least two hours before the test.*

Use the following procedure for testing the voltage of a battery which is not under load:

- Switch ignition off.
- Disconnect battery Ground strap.
- Measure voltage between battery terminals.
 - ◆ 12.5 volts or higher: battery OK
 - ◆ Below 12.5 volts: recharge battery immediately ⇒ [Page 27-21](#)

Specific gravity, checking

Special tools, test equipment and auxiliary items



- ◆ Commercially available hydrometer
- ◆ Shop towel

CAUTION!

- ◆ ***When working with battery acid, make sure to follow all "Warnings and safety precautions for lead-acid batteries." Wear suitable protective clothing and eye protection.***
- ◆ ***When disposing of batteries, always comply with applicable Federal, State and local laws regarding the disposal of batteries and sulfuric acid.***

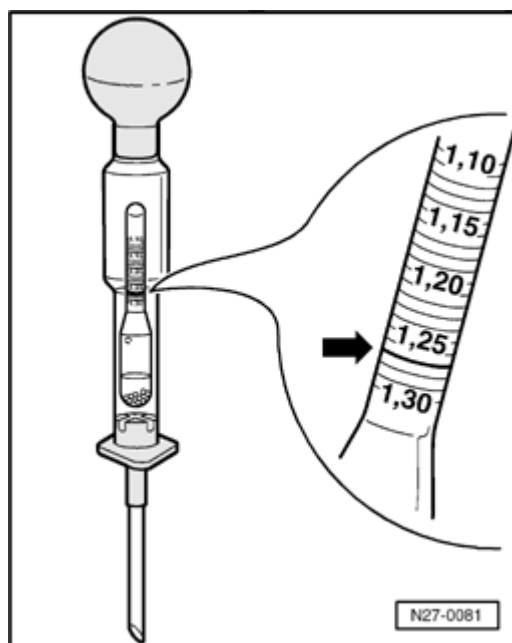
Notes:

- ◆ *In order to better determine the overall condition of a battery, always perform a specific gravity test in conjunction with the load test.*
- ◆ *The temperature of the electrolyte must be at least 10° C (50° F).*

The specific gravity can be tested immediately after charging the battery.

Use the following procedure to test the specific gravity in all of the battery cells:

- Switch ignition off.
- Remove all cell caps.
- Immerse tip of hydrometer into battery cell and draw out enough electrolyte to allow indicator to float freely.



The higher the specific gravity of the drawn electrolyte, the higher the indicator will float.

The specific gravity of the electrolyte can be read in kg/dm³ on the hydrometer scale.

- Compare measured value indicated on hydrometer to values indicated in table below:

State of charge in normal climate zones	Specific gravity in kg/dm ³
Discharged	1.12
Half charged	1.20
Good charge	1.28

In normal climate zones, the specific gravity must be at least 1.24 kg/dm³.

- If specific gravity is too low: charge battery.
- After charging battery, repeat specific gravity test.

Note:

The measured values for the specific gravity of the individual battery cells must not vary by more than 0.03 kg/dm³.

Examples of unacceptable variations in specific gravity:

Battery cell:	1	2	3	4	5	6
	Specific gravity per cell in kg/dm ³					
Example 1:	1.24	1.25	1.25	1.10	1.24	1.25
Example 2:	1.26	1.26	1.25	1.14	1.18	1.24

Example 1:

The specific gravity in cell 4 is too low.

Example 2:

The specific gravity in cells 4 and 5 is too low (the difference in specific gravity between the cells is greater than 0.03 kg/dm³).

- If values are not met, replace battery.
- If values are met, reinstall cell caps.

The original cell caps that came with the battery must be reinstalled to help prevent leakage.

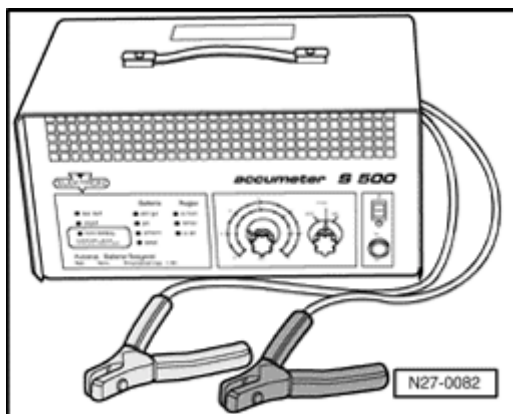
If the cell caps are lost or damaged, use replacement cell caps of the same manufacture.

The cell caps must be equipped with an O-ring seal.

Load testing

In order to better determine the overall condition of a battery, always perform a load test in conjunction with the specific gravity test.

Special tools, test equipment and auxiliary items



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- ◆ VAS1979 or VAS5033 battery tester

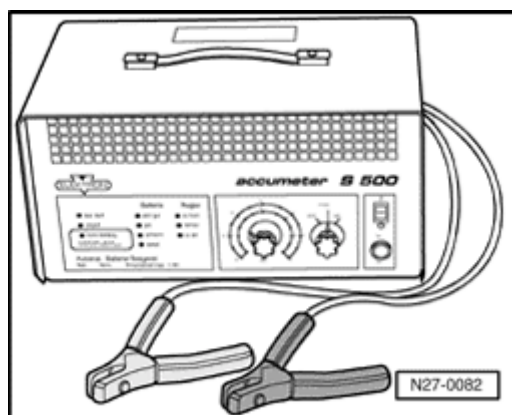
Note:

When using the VAS1979 or VAS5033 battery tester, it is not necessary to remove the battery or disconnect the battery cables.

- Follow warnings and safety precautions for lead-acid batteries. Wear protective clothing such as face shield and leather gloves.

Load test procedure

- Switch ignition off.
- Read battery tester operating instructions.



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- Observe carefully:
Connect the clamps to the battery terminals as required by the tester instruction manual. The clamps must make good contact with the battery terminals.
- Load current varies depending on battery capacity, set load current on tester appropriately.

⇒ *Battery tester operating instructions*

- Obtain load current from table below.
 - ◆ The minimum voltage (the voltage which must be exceeded) varies and can be obtained from the table below.
 - ◆ The load current and minimum voltage vary depending on the capacity of the battery.

Table

Battery capacity	Cold cranking amps	Load current	Minimum voltage (limit)
70 Ah	340 A	200 A	9.5 V

Load test results

- ◆ The severe load (ohmic resistance) during this test (high current draw) causes the battery voltage to drop. If the battery is in good condition, the voltage value will only drop to the minimum voltage. The minimum voltage varies and depends on battery capacity and cold cranking amps. Cold cranking amps is understood to be the capacity of the battery in cold weather. Batteries with high cold cranking amps are especially important in vehicles with high compression engines.

- ◆ If the battery is faulty or has only a weak charge, the battery voltage will drop off very quickly "voltage collapse" (voltage below 9.0 V). After the test is completed, this low voltage will last for a longer period of time and the voltage will increase only very slowly. Such a battery will no longer reach a usable voltage (no-load voltage) ⇒ [Page 27-12](#) .

- ◆ A battery with the faults described above does not have the power reserve of an undamaged battery and must be discarded.

Battery, charging

CAUTION!

- ◆ *Battery cell caps must be screwed in tightly when charging, measuring voltage or performing load tests.*
- ◆ *Do not enter the room in which batteries are being charged with unenclosed light bulbs or when smoking. The reason for this is that an explosive gas is formed in the battery by the charging process.*

Special tools, test equipment and auxiliary items

- ◆ Battery charger
- ◆ Batteries should be charged using a VAG battery charger such as VAG1471, VAG1648 or VAS1974.

Notes:

- ◆ *The temperature of the battery must not be less than 10° C (50° F).*
- ◆ *Batteries should not be fast-charged; fast-*

charging damages batteries.

- ◆ *If totally discharged batteries are fast-charged, either they will not accept any charging current or they will appear to be fully charged too early due to a "surface charge" and will only appear to be OK.*

Battery charging procedure

- Switch off battery charger.

- Switch ignition off.

- First disconnect battery Ground (GND) strap; then disconnect positive cable from battery.

- Connect positive cable of battery charger to positive terminal of battery.

- Connect negative cable of battery charger to negative terminal of battery.

- Adjust charging current on battery charger to battery capacity. It should be equivalent to approximately 10% of battery capacity or about 6 A for 60 Ah battery.

- Switch on battery charger.

Charging totally discharged batteries

Batteries out of operation for extended periods of time, such as in stored vehicles, lose their charge.

A battery is totally discharge if its no-load voltage has dropped to less than 11.6 V. To measure no-load voltage ⇒ [Page 27-12](#)

In totally discharged batteries, the electrolyte (sulfuric acid/water mixture) consists almost entirely of water, since the sulfuric acid component has been strongly reduced. At freezing temperatures, the battery can freeze and the case may burst.

Totally discharged batteries sulfate, i.e., the plate surfaces of the batteries harden and the electrolyte is not clear and has a slightly whitish coloration.

If totally discharged batteries are charged again immediately after the deep discharge, the sulfating forms again.

If these batteries are not recharged, the plates harden further and the charging capacity is diminished resulting is a loss of battery power.

Procedure for charging totally discharged, sulfated batteries

Totally discharged, sulfated batteries must be charged with a low charging current as follows:

- Set charging current to approximately 5% of battery capacity, (e.g., for 60 Ah battery, charging current should be about 3 amps).

To charge the battery ⇒ [Page 27-22](#) . The charging voltage must not exceed 14.4 volts.

Never fast-charge totally discharged batteries.

Note:

Once the battery is reconnected, check and activate the vehicle's electrical equipment (radio, clock, comfort and convenience features, etc.) as described in this Repair Manual or the Owners Manual.

Fast-charging/boost starting

Notes:

- ◆ *Batteries should be fast-charged (charging current approximately 20% of battery capacity and higher) only under exceptional circumstances.*
- ◆ *Batteries are damaged by fast-charging.*
- ◆ *Boost starting is also possible using the VAG1472 starter/charger.*
- ◆ *The VAS1992 battery-starter provides boost starting for vehicles with totally discharged/weak batteries without connection to line voltage. Depending on the outside temperature and battery capacity, 15-30 starting operations can be completed.*