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TURBO
BATTERY

AKO PRESTIGE

X-FORCE
BATTERY

PRESIDENT DC



AKO BATTERY AFTER SALES MASTER

SERVICE and SALES HANDBOOK



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CONTENTS

1.	Introduction and Purpose	3
2.	AKO AKÜ Policy	4
3.	Mission-Vision	5
4.	What is Battery?	6
4.1.	Definitions	9
5.	Main Functions of Battery	12
6.	Installation of Battery to Vehicle	14
7.	Checking of Battery in Vehicle	14
8.	Storage of Batteries	14
9.	Malfunctions Detection	15
9.1.	Malfunctions due to Factory	15
9.1.1.	Short Circuit	15
9.1.2.	Disconnection	16
9.1.3.	Leakage	19
9.2.	Malfunctions due to Customer	19
9.2.1.	Charge with High Voltage	19
9.2.2.	Sulfation	20
9.2.3.	Wrong Discharge	21
9.2.4.	Deformed Battery	21

1. INTRODUCTION AND PURPOSE

Humankind has benefited from various energy sources in order to meet their needs. After electricity was found and ready for use, it became a great need to store electrical energy in batteries. With the developing technology and industrialization, the need for electrical energy of humankind is increasing day by day. In automotive technology, an electric power source is needed for the first operation of an automobile and for lighting and special receiver equipment on the car to work. In the battery sector, high-quality and high-capacity batteries are developed in parallel with progressing automotive technology.

Lead-acid batteries are in the first place in battery production. The main reasons using lead-acid batteries so much are they have low maintenance costs and they are durable. Batteries, which we encounter in almost all areas of daily life, are mainly used in transportation, industrial facilities, industrial vehicles powered by electrical energy, and in the manufacturing of uninterrupted power supplies in homes and workplaces.

By following the developments in our country and the world in the battery sector, we, as AKO AKÜ, have increased both our capacity and our quality by technological investments in production, and, started to compete with global companies since 2016.

In this manual you will briefly learn what the battery is, which components are exist in the battery and what the fault types of batteries are.

With the help of this manual, you will notice the effects of your battery on your car. You will find that some malfunctions such as headlights do not turning on, windows do not opening and signals do not working can be caused by a simple fuse of the car. You will see the problems you may encounter in case of battery failure.

The purpose of this manual is to identify battery malfunctions and what to do in case of a defective battery.



Prepared by

Mehmet Onur YILDIRIM
Leader of After Sales

2. AKO AKÜ QUALITY POLICY

As AKO AKÜ,

Our Quality Policy is;

- Meeting the expectations of customers, employees, shareholders, suppliers, society and the environment,
- Adopting the principle of "continuous improvement" in production and service.
- Ensuring that laws, regulations and legal legislation are seen and implemented as a responsibility to the customer,
- To be a factory that is agile, challenger, developing with experience, ensuring contributes to all stakeholders,

And,

“

*The best
in the
World.*

3. MISSION - VISION

As AKO AKÜ;

- **MISSION:** Our Mission is to add value to the country and the sector as the World's BEST AND THE MOST COMPETITIVE Turkish company in the sector and to be among the world leading companies in the sector with its automation, technology and cost structure.
- **VISION:** Our Vision is to be the best factory in the world that contributes added value to all stakeholders, to be among the leading companies in the world in terms of benefiting all stakeholders with its applications and added value.

“

To be among the leading companies in the world in terms of benefiting all stakeholders with its applications and added value.

5. WHAT IS BATTERY?

In motor vehicles; it is a generator that stores electrical energy as chemical energy form inside and when a receiver is connected to its circuit, it converts this stored chemical energy back to electrical energy and gives it to the external circuit.



Generator:

The circuit elements that transform any energy (chemical energy, mechanical energy, heat energy, etc.) into electrical energy are called generator. As a simple description, it is a circuit element that produces electrical energy. The generator circuits must have the necessary voltage for suitable electric current. The most used generators are power source, battery, battery and batteries.

While the batteries are charging, they store the electrical energy supplied from outside into to chemical energy with the change of internal structure. When desired, the chemical structure change reverses and electrical energy is started to be taken from the battery.

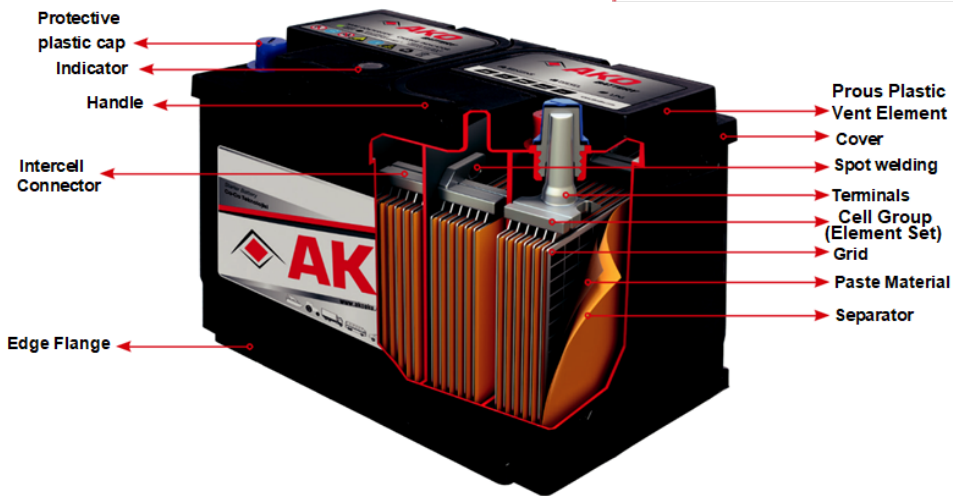
Battery Types and Usage Areas

Battery types and usage areas are as follows:

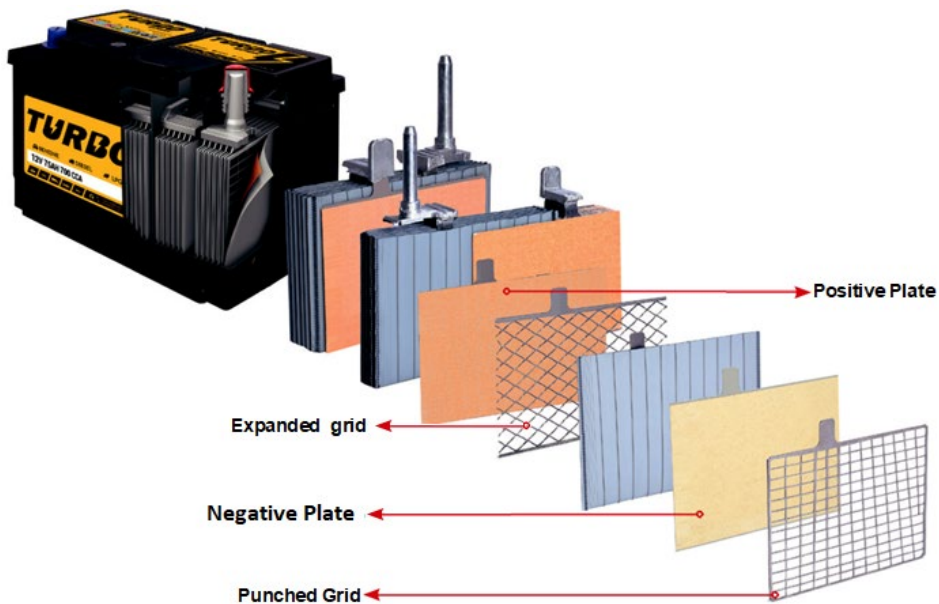
- **Lead-Acid Batteries:** Cars, trucks, tractors etc.
- **AGM (Absorbed Glass Microfiber):** They are batteries in which the sulphuric acid absorbed by fibre separators. Fixed facilities, UPSs, boats, power plants etc.
- **Gel Battery:** These are batteries containing electrolyte in gel form. They are maintenance-free batteries that are resistant to hard environmental conditions, especially temperature and vibration. Marine industry, solar energy systems, etc.

Automotive batteries have 3 main functions:

- To power the starter motor and ignition system in order to engine starts,
- Providing necessary energy in cases when the energy cannot be meet by alternator,
- To work as a voltage regulator in the electrical system. High voltages could damage other components in the electrical system if they were not protected by the battery.



CONSTRUCTION OF BATTERY



BATTERY COMPONENTS

Porous Plastic Vent Element:

Batteries emit small or large amounts of H₂ and O₂ gas during operation. These gases releases from the sealed maintenance-free batteries through a porous plastic vent element to outside. This vent element also prevents vapour of acid and water in the battery to pass outside. Releasing gases ensure pressure in the battery is stable and does not increase more than a certain level. Otherwise, battery may explode due to high pressure. While the porous plastic vent element is contained in the Sealed Maintenance Free (SMF) batteries, does not in the Maintenance Free (MF) batteries.



SMF Battery



MF Battery

Indicator:

A hardened, visual, plastic material that shows the density value of the single cell on which it is mounted. (Indicator shows green above 1.21 g / cm³.)

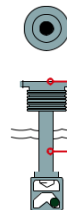
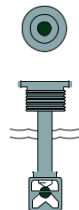
Charged



Green



Black
Needs Charge



Indicator Sight Glass

Indicator Visual Situation

Box and Cover:

AKO AKÜ's uses polypropylene boxes and covers as it is common. The cover and the boxes must ensure sufficient electrical insulation, do not leak and have long life time.

BATTERY COMPONENTS

Terminals:

Each lead-acid cell supplies electrical power around 2.12 Volts. The cells are connected to each other by serial connection. Number of the cells of a battery depends on the desired battery voltage. As a result, end where the positive plates are attached is the positive pole as the end where the negative plates are attached is the negative pole. The poles are defined by some marks on or to the side, and the positive pole is larger. While the outlets for industrial batteries have special connection, the outlets for automotive batteries have some certain size and structures.. It is slightly thicker than the negative pole since the deformation is more at the positive pole. Since the terminals of the batteries are exposed to negative environmental conditions, they will be able to get oxidized. Because oxidation prevents conductivity the vehicle will not run even the battery is full. This problem is easy to solve by rust removers available in the market.

Paste:

Paste material consisting of a mixture of various chemicals determines the capacity and starting power of the battery by a chemical reaction with the acid in the battery.

Grids:

Grid shaped lead plate where the paste material is applied on to it in order to electric current pass through. After the paste applied on the grids they are called as plates. Negative and positive plates have different paste and grid compositions.



Positive Plate



Negative Plate

Separator:

Separators are barriers in the form of sheets or envelopes consisted of PE, PVC, Glass Mat or AGM materials. They prevent contact between negative and positive plates and ensures a short circuit cannot possible while allow the ions move through in which.

4.1 DEFINATIONS

Capacity (Ah):

Capacity is defined as Ampere-Hour (Current-Hour). It indicates the total power that can be drawn from a battery in ampere.

Voltage (V):

Voltage is also called as electric potential difference, electric pressure or electric tension. It is the difference in electric potential between two points. An electrical pressure difference between terminals is necessary for movement of electrons in a circuit. This is called as potential difference or voltage. Its unit is Volt (V).

Current (A):

Electric Current is a flow of electricity through an electric circuit. It's unit is Ampere (A).

Starting Power- Cold Cranking Ampere (CCA):

Starting Power (CCA) is the maximum current value that the battery can supply at one time. CCA (Cold Cranking Ampere) allows vehicles to perform in cold weathers. It is measured at minus 18 degree Celsius.

DEVICES USING ON BATTERY MEASUREMENTS

VOLTMETER:

Voltmeter is a device that measures voltage difference of an electric circuit while it is opened or it is under a constant load by applying an electric load...



**Digital Voltmeter
(Multimeter)**



Shunt Voltmeter



CCA Measurement Device

HYDROMETER:

It is a device to determine the charge status of battery by measuring the electrolyte density and detecting the acid quantity in it. Its other name is "bome".



Hydrometer ("Bome")

REDRESSER:

It is a device to charging a battery which is discharged. There are two types of redressers as Analog and Digital. The digital one is generally preferred. It is an auxiliary device in detecting defective batteries.

**Analog
Redresser**



**Digital
Redresser**



AMMETER:

It shows the current value passing through the cable. The device should be set at "A" position. Main using purpose of the ammeter is to measure electrical leakage current. Also a digital millimetre is available to use for this check. Another purpose of using this device is checking of the current value applied by the redresser during charging. (This is useful for checking the indicator on the redresser and for calibration.)



Ammeter

ELECTROLYTE:

Electrolyte is an electrically conducting liquid that carries ions in which the positive and negative plates are immersed. In lead-acid batteries, the electrolyte is diluted sulphuric acid.

Charge-Discharge Process Stages:

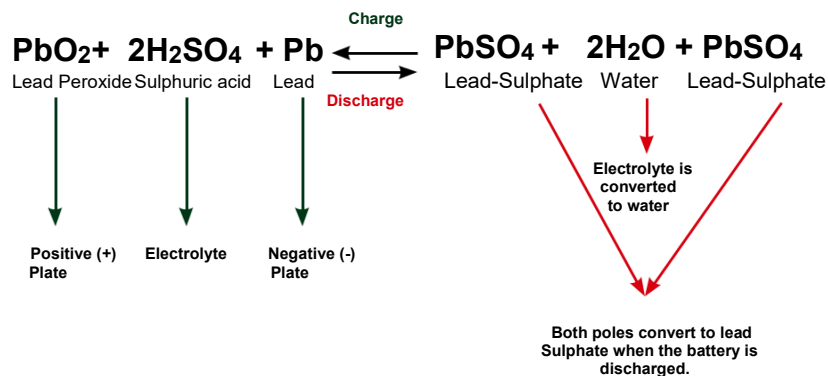
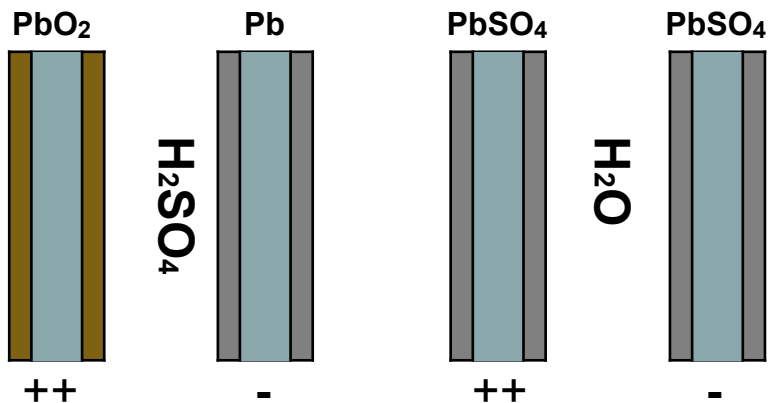
During the battery is charging, sulphate (SO_4) exist on the plates is converted to water (H_2O) and sulphuric acid (H_2SO_4) by electric current. As a result, the density of the electrolyte fluid increases. While lead (Pb) remains in the cathode plate with the sulphate separated from the plates, lead-dioxide (PbO_2) is formed by binding the oxygen in pure water to the anode plate. While discharging, the same reaction works in reverse and provides energy by discharging the battery current.

When Charged (Full)

- PbO_2 (Lead-dioxide), is exist on Anode Plate (+)
- Lead (Pb) is exist in the Cathode Plate (-).
- H_2SO_4 (Sulphuric Acid) is exist in Electrolytic liquid.

While on Discharge (Empty)

- PbO_4 (Lead-sulphate) is exist on Anode (+) Plate.
- There is (-) PbSO_4 (Lead-Sulphate) in the Cathode Plate.
- H_2O (Pure Water) is exist in Electrolytic liquid.



The structure formed by the Pb and PbO₂ plates taking sulphate ions in the electrolyte causes the batteries to become sulphated due to the discharge and waiting of the battery for a long time. If the battery is not charged, the PbSO₄ structure adheres on the positive plate and causes the plate to harden. This can gradually cause to a loss of battery performance and no cranking.

5. BASIC FUNCTIONS OF BATTERY

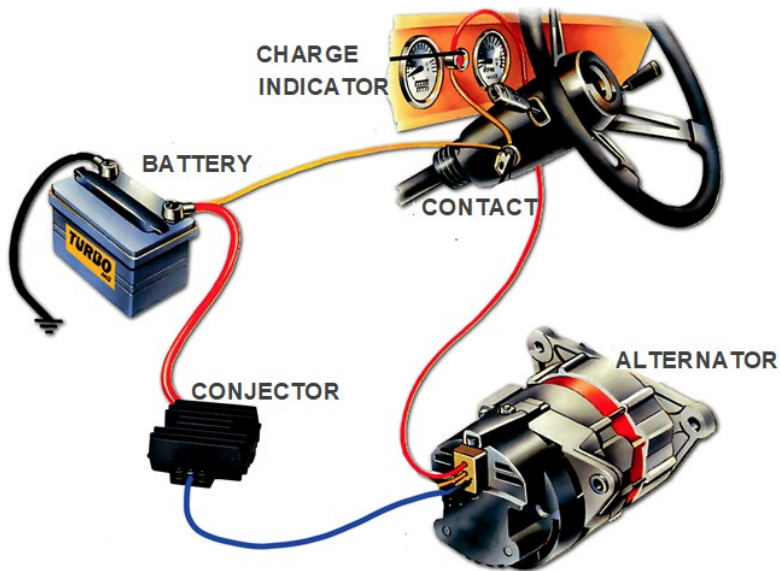
1. To provide power to starter for the first action,
2. To provide power in cases where the alternator is insufficient,
3. Supplying the electric current to the starter
4. Supplying power to receivers to be used when the vehicle engine is not running.
5. To balance the voltage and ampere in the electrical system while the engine is running. Thus, preventing the receivers from being damaged at high speeds. Voltage generated by the alternator may sometimes increase too much. In this case, the battery takes over some of the current created by the alternator and prevents the overvoltage.

Motor: It is a power machine that converts chemical energy into mechanical energy.

Starter Motor: Direct current (DC) motors that convert electrical energy into mechanical energy.

If Starter Motor Does not Work;

- Battery may be discharged.
- Battery terminals may be loose or disconnected.
- Battery terminals may be corroded.
- Chassis connection points may be loose.
- Coal of starter motor may be run out.

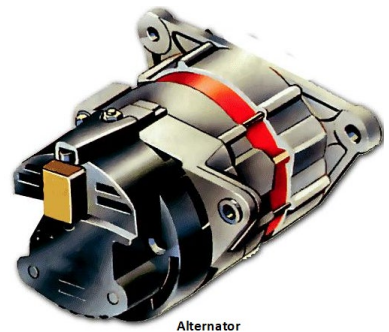


ALTERNATOR:

Its other name is generator. Alternators convert the mechanical energy coming from the engine into electrical energy. It works as a current regulator in the vehicle. When the current is insufficient required power supplied from battery.

Functions of ALTERNATOR;

- Charging Battery
- Supplying electric receivers.
- Balancing charge



CONNECTOR:

Its other name is regulator and defined as voltage adjuster. Function of the "connector" is to keep the voltage generated by the alternator at a constant level. By converting the AC source coming from the alternator to DC, it provides both the necessary energy to the headlights and the spark plugs for the engine to run, and the necessary electricity to charge the battery. When working properly, supplies min.13,80 V max.14,40 V output voltage. Protect the battery from being exposed to overcharging as the engine speed increases; it keeps the alternator output voltage at maximum charge voltage.



CHARGER (CHARGE DYNAMO)

It generates direct current to batteries and other receivers.

DYNAMO:

Direct Current Machine, which converts mechanical energy into electrical energy, called as dynamo or direct current generator.



DYNAMO

6. CONNECTING A NEW BATTERY TO THE VEHICLE

Battery is checked in the vehicle before connection. If the battery has a malfunction it is taken from the vehicle. During disconnection firstly negative connection is detached and then the positive one. The vehicle must be hold levelled in order preventing leakage through the vent element of the battery because of inclination before the new battery mounted in.

First the positive and then the negative terminals of the battery are connected. The battery connections should be neither too loose nor too tight. The loose connections may cause the battery to explode by arcing. The tight connection may cause the terminal to be broken or the terminal cap connection is deformed which may cause acid leakage.

7. CHECKING THE BATTERY IN THE VHECILE

ALTERNATOR (REGULATOR):

While the engine is running the battery's output voltage is checked if it is between minimum 13,8 V and maximum 14,4 V by a digital voltmeter. The digital voltmeter should be calibrated. During this check it is better to hold the high beams, air conditioner, sound system etc. are turned on. The alternator may be faulty if the measured values are outside of this range.

For the trucks have double battery, each battery should be checked separately. It may one battery is good and the other is malfunctioned. One of the causes of malfunction is that the battery is dehydrated due to overcharging.

ELECTRICAL LEAKAGE CONTROL:

The current value is measured by disconnecting one of the battery cables and attaching to the measuring device as ammeter or voltmeter when the vehicle is parked and not running. In clamp-on ammeters, the current value can also be measured by passing the cable coming from the terminal through the ring of the clamp-on ammeters. The measured current value shows the leakage current. This check might also be applied by using a lamp has low watt value in power. The lamp is connected between battery terminal and the cable coming from the circuit of the vehicle. There is leakage current if the lamp is turned on.

STARTER DYNAMO CONTROL:

A voltmeter is connected between the battery terminals. While the starting button of the vehicle on, it is checked and noted how many Volts the device indicator falls. After engine is stopped, engine is turning on for 5-10 seconds while the voltmeter connected to battery (This check can also be applied by using a shunt voltmeter. If a shunt voltmeter is available, the load is applied to battery by using a shunt voltmeter for 5-10 seconds). After than it is checked and noted how many Volts the device indicator falls. It is compared with the previous voltage difference. If there is no big difference between the two voltage values, the starter is working properly. But if the difference is big it means the starter dynamo has malfunction.

8. STORAGE OF BATTERIES

1. Batteries should never to be exposed to direct sunlight during storage.
2. Batteries should be stored at 25 °C.
3. Batteries must not be hold under humid environment.
4. Increase around 10°C in the ambient temperature accelerates the discharge and corrosion of the battery.

5. Since there is acid in the battery, it should never be emptied and should be stored in a way that it will not be spilled.
6. They should not be left in warehouse for too long or in discharging situation due to any reasons.

9. BATTERY TROUBLESHOOTING

VISIAL CHECKS:

It is checked that if there is breakage, defect or deformation on the box, cover, label areas, and, the terminals.

CONTROL WITH SHUNT DEVICE (VOLTMETER):

It is checked Open Circuit Voltage (OCV) and Voltage under load. (After here term of "Volt under load" will be abbreviated as "VUL" in this document.)

CONTROL WITH HYDROMETER:

In MF batteries, the density of the acid in each cell is measured and the acid colour is evaluated.

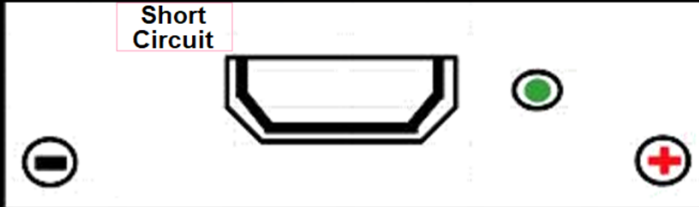
CONNECTING TO THE REDRESSER:

The battery is connected to the redresser and according to the results of the above measurements, it is checked whether it takes charge or not in order to understand the fault of the defective battery.

9.1. MANUFACTURING-CAUSED FAULTS

9.1.1. SHORT CIRCUIT:

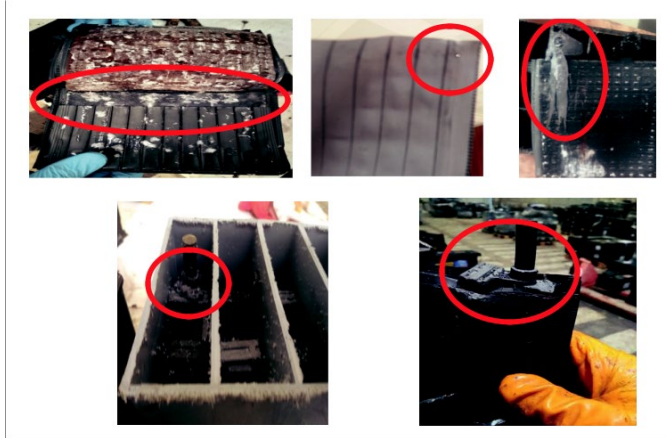
It is a malfunction arising from the positive and negative plates which are contacting each other in the cells. Open Circuit Voltage (OCV) of a battery which has a short-circuited cell shows a value of 10.7 V and below. If the Voltage Under Load (VUL) of a battery which has a short-circuited cell drops to 8V or a certain value and rises again the cell boils. When the measurement is made by an hydrometer ("bome"), the hydrometer value of the cell which has short-circuit problem is lower than the others or the value is zero.

2.12 V 1,24g/cm3 1st Cell	0 V 0 g/cm3 2nd Cell	2.12 V 1.28 g/cm3 3rd Cell	2.12 V 1.28 g/cm3 4th Cell	2.12 V 1.28 g/cm3 5th Cell	2.12 V 1.28 g/cm3 6th Cell
					

SHORT CIRCUIT

Measurements and Findings	Cause of the Fault	Source of the Fault	Symptom in The Vehicle
<p>1. VISUAL CONTROL:</p> <ul style="list-style-type: none"> - If it looks like a new battery and clean - If there is no intervention in the box and cover (fracture, hole, deformation etc.). - If there is no swelling in the box 	Plates are in touch with others	1- Separator is Half	Engine does not start to run
<p>2. SHUNT DEVICE MEASUREMENTS:</p> <ul style="list-style-type: none"> - OCV (Open Circuit Voltage): 10,5 and below - VUL (Voltage Under Load): 8 and below or decreases from any value and then rises again. - In MF batteries, boiling is observed in cell which has short-circuit problem 		2-Punched separator	
<p>3.INDICATOR:</p> <ul style="list-style-type: none"> - If it is Green 		3- Improper spot welding	
<p>4.HYDROMETER MEASUREMENTS:</p> <ul style="list-style-type: none"> - The density of the acid in the short-circuited cell is at least 0.06 g /cm3 lower than the density in other cells. For example, while acid's density in the suitable cells is 1.28g/cm3, density 1.18 or 1.20g /cm3 for the acid in the cells which have short circuit problem. The intensity value measured in short-circuit cells may also be zero 		4- Burr or froing material in the cell group	
<p>5. WHEN CONNECTED TO THE REDRESSER DEVICE:</p> <p>It is seen that there is no boiling in the cell which has short-circuit problem, but the other cells are boiled</p>		5- Plates are in contact with each other	

SHORT CIRCUIT IMAGES

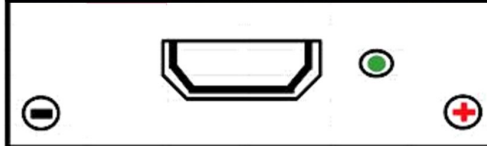


9.1.2. DISCONNECTION:

It is the fault caused by plate disconnection from the spot welding, Inter-cell Connector, Terminal Head and Cell Group (Element Set).

The OCV value is 9V and above and the VUL value is between 0 to 5V. Usually the indicator's colour is green.

2.12 V	2.12 V	2.12 V	2.12 V	2.12 V	2.12 V
1,24g/cm ³	1,24g/cm ³	1.28 g/cm ³	1.28 g/cm ³	1.28 g/cm ³	1.28 g/cm ³
1st Cell	1st Cell	3rd Cell	4th Cell	5th Cell	6th Cell



REPTURE

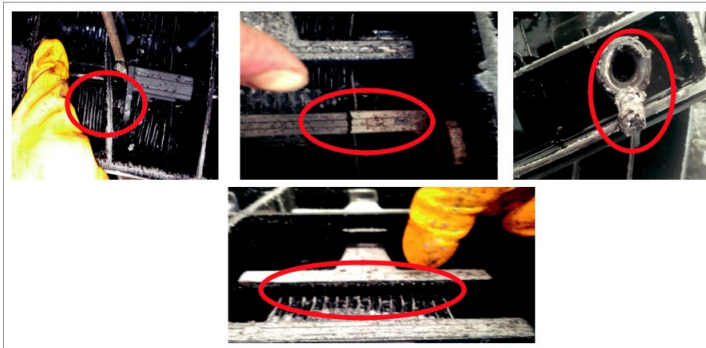
DISCONNECTED SPOT WELDING:

- Density is equal in all cells if there is disconnection between Inter-cell connector and terminals and Cell Groups.
- Shake the terminal well, if it shakes, the terminal may be broken inside.
- Cell Group (element pad) fault is caused by poor welding of the inter-cell connectors of the plate. Smoke can be seen and noise can be heard when battery is under load.

DISCONNECTION

Measurements and Findings	Cause of the Fault	Source of the Fault	Symptom in The Vehicle
1. VISUAL CONTROL: - If it looks like a new battery and clean - If there is no intervention in the box and cover (fracture, hole, deformation etc.).	1- Disconnected welding connection of the cells.	1- Disconnected spot welding	1- VEHICLE DOES NOT RUN
2. SHUNT DEVICE MEASUREMENTS: - OCV (Open Circuit Voltage): 9 and above - VUL (Voltage Under Load): between 0 and 5. - In MF batteries, boiling and smoke is observed in cell whose cell connector is disconnected.	2- The cell group (element set) is cracked or broken	2- Disconnected Cell Connector	2- STARTER CANNOT BE ACTIVATED
3.INDICATOR: - If it is green.	3- Disconnected Terminal	3- Disconnected Terminal	
4.HYDROMETER MEASUREMENTS: -The density in two cells are lower than the other cells (disconnected welding): - Densities are equal in all cells (Cell Connector-Terminal-Cell Group [element pad]).	4- Plate flange is not welded well	4- The Plate is disconnected in Cell Group (Element Set).	3- LOW STARTER POWER
5. WHEN CONNECTED TO THE REDRESSER DEVICE: -No current to the battery. The battery cannot be charged.			

IMAGES



9.1.3. LEAKAGE:

If the battery box leaks acid without any damage and does not have a «XXX» code on it, this is called leakage and it is because of manufacturing fault.

9.2. USER-CAUSED ERRORS

9.2.1. OVER CHARGING:

- OCV: 12.0-13.0V, VUL: 9V and below electrolyte colour brown, acid density is 1.29 g /cm³ and above (if the vehicle can be checked, the vehicle voltage value is expected to be above 14.4V)
- The box is swelling and the battery is heating.

SYMPTOMS OF OVER CHARGING:

- Overcharging more than 14.8 Volts in the vehicle,
- Installing additional wiring to the vehicle electrical system,
- Charging of discharged battery with high voltage which is above than the limit by redresser,
- Adding acidic water to the battery or discharging acidic water,
- Activating the vehicle's start key frequently,
- Using the battery for other purposes not related with the vehicle,
- Overheating where the battery is located,
- There is no converter or which has malfunction in the 24 V vehicle.,
- Music and lighting systems, etc. using while the vehicle is not running,
- All cells may have high electrolyte concentrations.
- Low acidic water levels due to overheating.
- Shedding on the plates
- Acid water colour darkening
- Blackening under the plugs in the battery cover
- Vehicle headlights are blinking when the gas pedal is pressed.



9.2.2. SULFATION:

In the batteries exposed to some bad conditions a white sulphate layer forms on their plates' surfaces. This formation is called as sulfation.

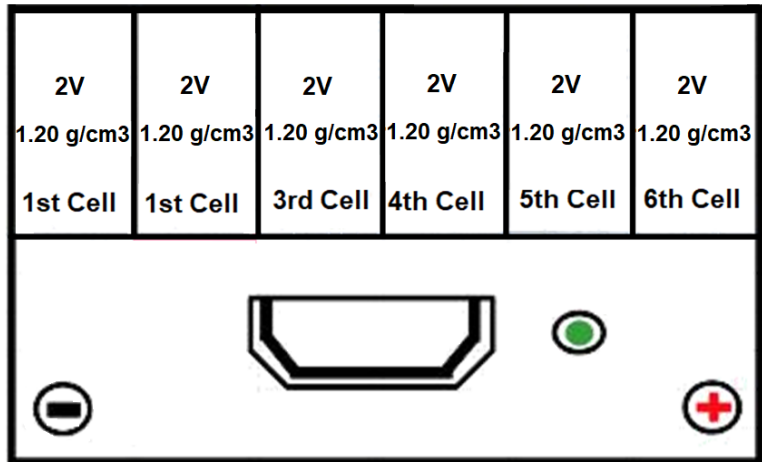
In sulphate batteries, Circuit Voltage (OCV) is below 10V and Voltage Under Load (VUL) is almost zero and density values of cells are 0. Indicator colour is usually black.

CAUSES OF SULFATION:

- Keeping the battery in storage for a long time,
- The vehicle is not operated for a long time,
- Looseness of the alternator belt,
- Battery is not charging due to malfunction in vehicle electrical system
- Vehicle charging voltage is below 13.8 volts.
- Electric leak in the vehicle
- While the vehicle is not run some receivers such as the headlights, trunk lamp, door lamp, electrical equipment added later, etc. goes on to consume electricity.
- Starting to use the discharged battery before being fully charged by redressor,
- No converter is exist or the converter has a malfunction for 24 volt vehicles,
- Unstable usage (long use of receivers while the vehicle is not running).

9.2.3. DISCHARGED BATTERY

If Under Load Voltage (LUV) of a battery does not increase from a certain value even after it is charged, this battery is called as discharged battery. Colour of the indicator is black or green. The discharged battery can be recovered by performing some necessary charging procedures if its OCV is around 12.5V and below VUL is between 8 to 10V.



9.2.4. BROKEN BATTERY:

- It is batteries broken by an outside impact.
- Transportation damages are out of scope.



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N

A series of horizontal dotted lines for writing, spanning the width of the page.



Hit The Road

Harekete Geç!

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