FERVE

TECHNICAL SUPPORT

FERVE
THE BATTERY LIFE

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GB

CONTENTS

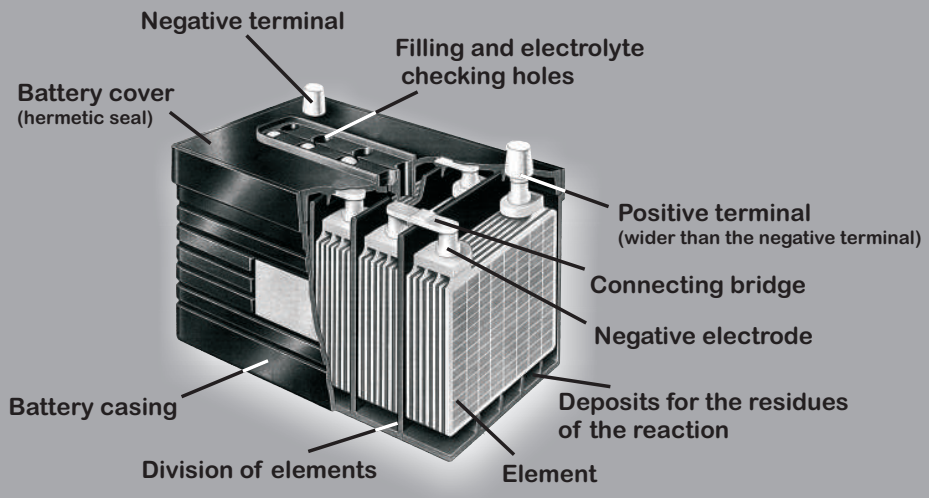
GENERAL INFORMATION ON BATTERIES

WHAT IS A BATTERY?

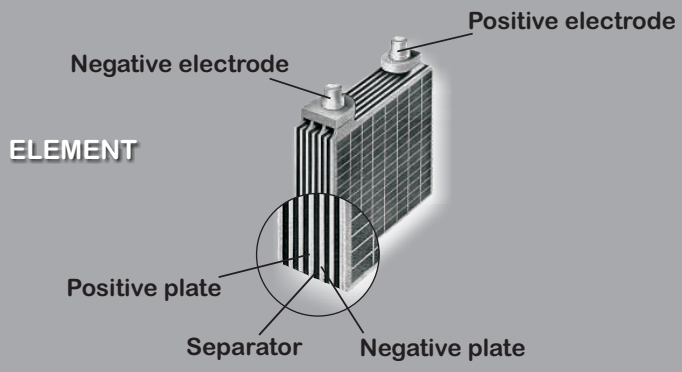
A battery is a chemical accumulator of continuous electrical energy.
If a voltage produced by an alternator or a charger is applied on its terminals, a current is created which modifies the composition of its elements, due to the phenomenon of electrolysis: the battery accumulates energy.
When the direction of the chemical reactions is reverse (i.e. when the energy of the battery is consumed) the battery returns the accumulated energy as a generator of DC current.

HOW DO THEY WORK?

A 12 V battery consists of 6 elements of 2 V, each one connected in series and individually situated in the cells of a suitable container.

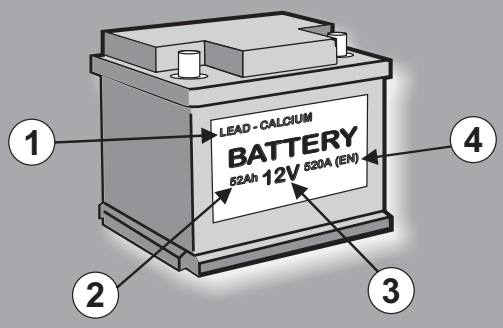


An element is formed by several lead plates covered externally with a positive active substance (lead oxide, PbO_2) and several with a negative active substance (porous lead, Pb), separated from each other by separators to prevent short-circuits.



The element is situated in a cell of the connector, immersed in an electrolyte solution composed of sulphuric acid and distilled water. Each element generates a potential difference of 2 V. The charge and discharge process consists of the migration of electrical charges between plates through the electrolyte solution. Due to normal use of the battery, the plates become worn and generate a small residue (lead sulphate, $PbSO_4$), which accumulates at the bottom of the cells.

TECHNICAL DESCRIPTION OF THE BATTERY



1 Battery tipe
Lead-liquid, lead-gel, lead-antimony (PbSb),lead-calcium (PbCa), AGM etc.

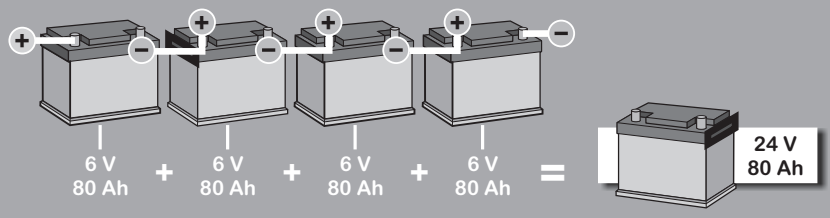
2 Capacity of the battery
Amount of electricity the battery can deliver,expressed in amperes per hour (Ah).

3 Voltage
Potential difference between the terminals of the battery.

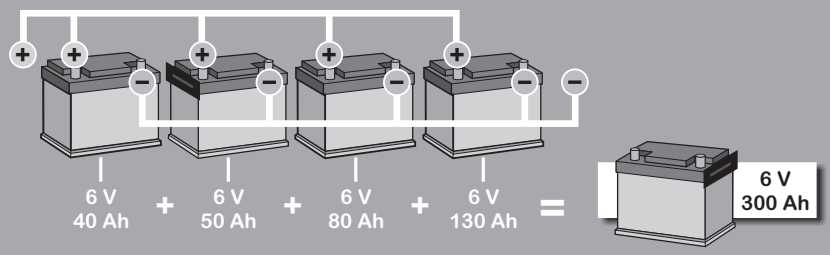
4 Current
Amount of current, measured in amperes (A), that the battery can deliver instantaneously. Depending on the country and the manufacturer, this current is governed by the EN, IEC, SAE or DIN regulations.

WIRING BETWEEN BATTERIES

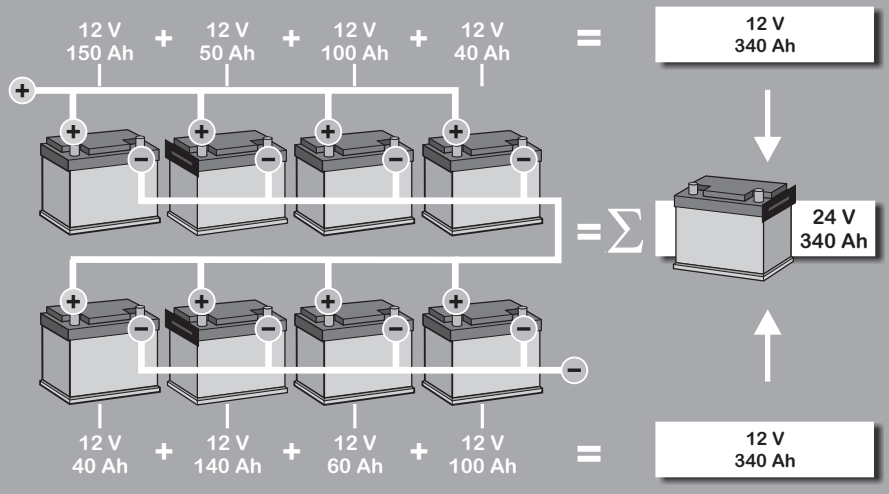
CONNECTION IN SERIES



CONNECTION IN PARALLEL



CONNECTION IN PARALLEL AND SERIES



CLASSIFICATION OF BATTERIES ACCORDING TO THEIR USE

STARTER BATTERIES:

These are normally used in automobiles (they are inexpensive). They can produce high currents for short periods of time (from 100 to 1000 amps). These batteries cannot withstand deep discharges.

STATIONARY BATTERIES:

These can discharge up to 80% of their capacity and withstand a great number of discharges. For example, they are used in photovoltaic solar energy installations.

DRIVE BATTERIES:

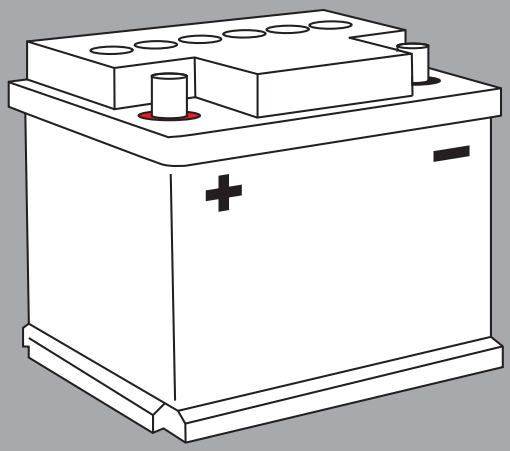
These withstand strong discharges of current and long periods of time with low levels of charge. For example, they are used in forklift trucks and stackers of materials.

CLASSIFICATION OF BATTERIES ACCORDING TO THEIR CONSTRUCTION

There are many types of batteries, depending on the materials used, the construction techniques or the polices of each manufacturer. However, they can all be classified into two large groups:

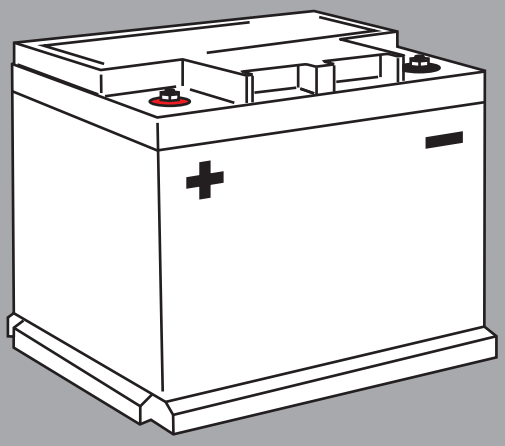
BATTERIES WITH LIQUID ELECTROLYTE (LIQUID)

These are generally known as open batteries. They lose electrolyte liquid over time, so that they require maintenance (adding of distilled water). Today there are liquid batteries which require no maintenance, thanks to the addition of electrolyte liquid loss-limiters.
This type is considered to include lead-liquid, lead-antimony (PbSb), calcium-silver etc. batteries.



BATTERIES WITH SOLID ELECTROLYTE (GEL)

The liquid electrolyte is fixed in a gel. They do not require maintenance and can be fitted in any position with no loss of liquids. They are currently more expensive than liquid batteries.
Lead-gel, AGM (Absorptive Glass Matt), © Optima etc. batteries are of this type.



MEASUREMENTS ON BATTERIES

MEASUREMENT OF THE CHARGE LEVEL BY MEANS OF THE VOLTAGE IN BATTERY TERMINALS

This is the most common type of measurement due to its simplicity. To be reliable, this must be carried out using especially sensitive equipment, since a small variation in the reading can cause great deviations in the result. It has the disadvantage that measurement has to be performed on the total of cells in the battery.
It works on the principle that the potential difference of each cell increases as the battery is charged. This variation in a liquid battery goes from a value of 1.98 V to 2.11 V. In a 12 V (6-cell) battery, this variation of 0.13 V represents a total variation of: 0.13 x 6 = 0.78 V.
The table of ratios for batteries of 12 and 24 volts, both liquid and gel is:

ESTADO DE CARGA	LIQUID	GEL	LIQUID	GEL
STATE OF CHARGE	12 V	12 V	24 V	24 V
<20%	< 11.9	< 12.1	< 23.8	< 24.2
25%	12.1	12.3	24.3	24.5
50%	12.3	12.5	24.6	25
75%	12.5	12.8	25	25.5
100%	12.7	13	25.4	26

Related FERVE products: Battery analysers, start and charge, multimeters and measurement modules, F-814 battery and alternator tester, electronic range and F-616 voltmeter-ammeter.

MEASUREMNTS OF THE CHARGE LEVEL BY MEANS OF THE ELECTROLYTIC LIQUID

The level of reliability is higher using this system than with the previous one. However, it has the disadvantage of having to test the battery cell by cell, as it is necessary to work directly with the electrolytic liquid. Gel batteries do not admit this type of measurement.
It works on the principle that, as the battery is charging, the proportion of water decreases (density = 1 g/cm3) and the proportion of sulphuric acid increases (density 1.8 g/cm3), thus obtaining an increase in the density of the electrolyte (from 1.10 to 1.30 g/cm3).The measurement of the density of the electrolyte gives us an idea of the battery's degree of charge.
The existing ratio is:

Related FERVE products: F-423, F-425 and F-425C density meters.

MEASUREMENT OF THE COLD START CURRENT CAPACITY (CSCC)

This indicates the starting capacity in amperes of the battery, according to its capacity in amperes per hour. There is a variation on this test which does not give direct results, but rather a pass/fail result.
There are two ways of carrying out this measurement. One consists of performing a discharge on the battery and observing its voltage drop. The other, more complex way, is to perform a discharge, measure the conductance and voltage of the battery, and by applying Ohm's Law, obtain the cold start current.
Related FERVE products: Battery analysers, start and charge, F-814 battery and alternator tester.

CHARGERS: CHARACTERISTICS AND OPTIONS

VOLTAGE OF THE BATTERY CHARGER

The voltage value of the battery charger must be equal to the voltage of the battery to be charged. The unit used to express this is the volt.
There are models of battery charger with one or two output voltages.
Chargers with two output voltages are more versatile than those with one as they can charge a greater variety of batteries, but have the disadvantage of being rather more expensive than those with a single output voltage.

CHARGE VOLTAGE

The voltage while the battery is charging is greater than the voltage in open circuit. This is due to the fact that the voltage drop produced by the battery's internal resistance must be added, meaning that:

Voltage in charge = Voltage in open circuit + (Charge current x Internal resistance)

At the beginning of the charge, the internal resistance increases gradually, and then increases quickly at the end. Care must be taken, since when this parameter is increased quickly, bubbling may be produced in the batteries. In W-curve chargers, this problem is compensated since, although the internal resistance increases, the charge current decreases.
The recommended end-of-charge voltage values are 15.3 V for liquid batteries and 14.7 V for gel batteries.

RECOMMENDED RANGE OF BATTERY CAPACITIES

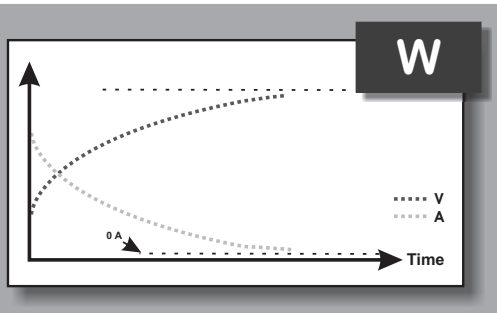
There is quite high tolerance between the ideal charge current and the range of battery capacities in which a battery charger may be used with no contra-indication.
Taking as an example the FERVE F-905 model, which delivers 5 amperes, it can thus be said that it is the ideal charger for batteries of 50 amperes per hour. However it is recommended for a range of batteries of between 32 and 60 amperes per hour.

CHARGE CURRENT

The value of the charge current must be expressed in arithmetical amperes. This is the only value officially accepted under the EN 60335-2-29 European regulations.
Nevertheless, many battery charger manufacturers express the charge current of their products in efficient amperes, thus not complying with these European regulations. The reason is that 1 arithmetic ampere is equal to 1.4142 effective amperes. So a battery charger of 8 effective amperes must actually be considered as one of 5.66 amperes. Therefore, to avoid deception, it is necessary to know whether the battery charger manufacturer uses arithmetic or effective amperes when stating the charge current.
FERVE always expresses charge current values in arithmetic amperes.
The ideal charge current is 1/10 of the battery's capacity (e.g.: 8 A for a battery of 80 Ah).
As occurs with the voltage, there are chargers with several output currents. FERVE chargers have from a single output current to four different ones.

BATTERY CHARGER CHARGE CURVES

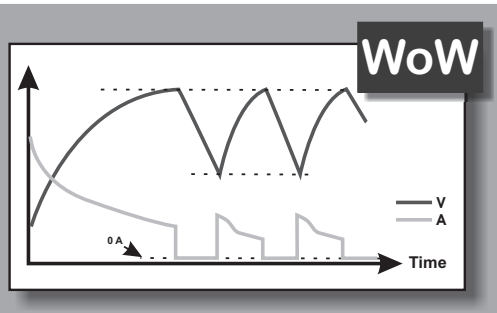
The charge curve of a battery charger expresses the way in which the battery charger delivers the energy to the battery over a period of time.
The charge curves used by FERVE are:



Traditional charge (1 step)

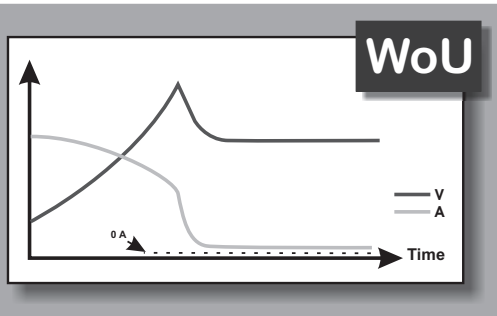
Step 1: The current decreases and the voltage increases. The charger must be disconnected manually to prevent overloads. It has the advantage of being able to restore deeply discharged batteries.

FERVE chargers: all the non-automatic ones; Dual range (manual mode) Tetra range (manual mode).



Traditional automatic charging (2 steps)

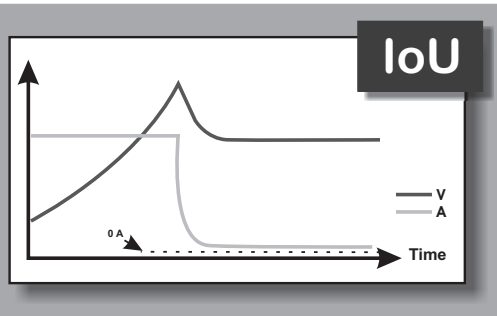
Step 1: The current decreases and the voltage increases to 15.3 V (12 V liquid) or 14.7 V (12 V gel).
Step 2: The charger goes to monitoring mode, and disconnects the charge of electrical current until the battery voltage drops to12.5 V (12 V liquid) or 12.9 V (12 V gel). With WoW charging, the maximum useful life of the batteries is ensured and any risk is avoided.
FERVE chargers: Automatic range, Dual range (automatic mode), Tetra range (automatic mode), F-990RF.



Automatic charge with flotation maintenance (2 steps)

Step 1: The current decreases and the voltage increases to14.7 V.
Step 2: The charger goes to flotation charge and a constant voltage (13.6 V), in order to maintain the level of the battery and prevent overloads.

FERVE chargers: F-2201, F-2106.



Automatic charging at constant current and floatation maintenance (2 steps)

Step 1: The current is maintained constant and the voltage increases to14.4 V (12 V liquid) or 14.7 V (12 V gel).
Step 2: The charger goes to flotation charge and a constant voltage (13.6 V) to maintain the level of the battery and prevent overloads.

FERVE chargers: F-2912.

CHARGE TYPES

MANUAL CHARGE

This is the most common type. The user must disconnect the charger from the battery when charging is complete. In the case of very powerful battery chargers compared to the batteries to be charged, there may be a risk of overloads. Manual chargers have the advantage of being able to restore deeply discharged batteries, since they do not require a reference voltage in order to be connected.
Associated charge curve: W

AUTOMATIC CHARGE FOR LIQUID BATTERIES

The charger monitors the charge completely and may be left connected for long periods of time. When the maximum level of the battery is reached, the charger stops the charge automatically, thus eliminating the risk of overload. It needs a reference voltage to start itself up.
Associated charge curves: WoW, IoU and WoU

AUTOMATIC CHARGE FOR GEL BATTERIES

The same as the above charge, but with stoppage and connection levels adapted to these types of battery.
Associated charge curves: WoW, IoU and WoU

FAST CHARGE

Fast charge consists of delivering a high charge current over a short period. To avoid risks of overloads or overheating, this type of charge is limited by a timer.
This type of charge could be interesting in deeply discharged batteries which need to be used immediately, for example, before a start (*see Booster*).
FERVE has a wide range of chargers with fast charge function.

RIPPLE FREE

In the majority of today's automobiles, most of the system controls are electronic. This means that sometimes, and especially in the most sensitive systems, traditional charging could damage them. The reason for this is that traditional charging is of a pulsing type (beneficial for the battery), but the charge returned by the battery is purely continuous. This is why it is recommended to disconnect the battery from the vehicle for charging.
Ripple Free chargers have powerful electronic filters, thanks to which any possible interference with the systems of the automobile is avoided. It is not necessary to disconnect the battery from the vehicle with this type of charger.

BOOSTER

On many occasions, and especially in specialist workshops, it is necessary to start vehicles with discharged batteries.
The Booster system consists of delivering a very high current for a short period of time, which is able to start the vehicle.
Depending on the Booster power and on the condition of the vehicle's battery, before starting it is advisable to make a fast charge for 10 minutes.
FERVE has chargers with Booster systems capable of delivering from150 A to 600 A.

DISPLAYS

Battery chargers have displays to inform the user of the status of the charge. Below is a brief summary of the most widely-used ones.

ANALOGUE VOLTMETER (VA)

Commonly known as a needle voltmeter. It measures the voltage in terminals of the battery and can be used to check the charge status of the battery. In W-curve chargers, the needle increases the value as the end of the charge is approaching.
The charge percentages are shown in the section above. It can also be used to check batteries.

DIGITAL VOLTMETER (VD)

This shows the voltage measurement digitally and is more exact than its analogue equivalent. It also has the advantage of being able to be used with few variations as an ammeter. In chargers W-curve chargers, the voltage increases as the end of the charge is approaching. It can also be used to check batteries and alternators.

ANALOGUE AMMETER (AA)

Commonly known as a needle ammeter. It measures the current the charger delivers to the battery. In W-curve chargers, the needle reduces the value as the end of the charge is approaching.

DIGITAL AMMETER (AD)

This shows the measurement of current digitally and is more exact than its analogue equivalent. It also has the advantage of being able to be used with few variations as a voltmeter. In W-curve chargers, the charge current is reduced as the end of the charge is approaching.

ELECTRONIC DISPLAY (VE)

This shows the information in LED form. Those used by FERVE show the connection of the clamps to the battery, the charging process and the end of the charge.

FERVE RANGE OF CHARGERS

Model	Voltage, V	Charge current, A	Range of capacities, Ah	Display	Charge curves	Liquid batteries: Standard	Maintenance-free	Calcium silver	AGM	SLA, VRLA
DOMESTIC BATTERY CHARGERS										
F-204	12	3	24-50	VA	W	•	•	•		
F-705	6-12	1,5-3	10-50	AA	W	•	•	•		
F-903	12	3	24-50	VA	W	•	•	•		
F-905	12	5	32-60	VA	W	•	•	•		
F-805	12	5	32-60	VA	W	•	•	•		
F-886	12	4-8	24-120	AA	W	•	•	•		
F-806	12	4-8	24-120	VA	W	•	•	•		
F-807	12-24	4-8	24-120	AA	W	•	•	•		
BATTERY CHARGERS-TESTERS										
F-811	12	6-12	45-180	VD-AD	W	•	•	•		
F-812	12-24	6-12	45-180	VD-AD	W	•	•	•		
F-812RF	12-24	6-12	45-180	VD-AD	W	•	•	•	•	
F-915	12-24	8-16	60-205	VD-AD	W	•	•	•		
F-915RF	12-24	8-16	60-205	VD-AD	W	•	•	•	•	
F-918	12-24	10-20	92-250	VD-AD	W	•	•	•		
F-918RF	12-24	10-20	92-250	VD-AD	W	•	•	•	•	
F-930	12-24	15-30	120-360	VD-AD	W	•	•	•		

Model	Voltage, V	Charge current, A	Range of capacities, Ah	Display	Charge curves	Liquid batteries: Standard	Maintenance-free	Calcium silver	AGM	SLA, VRLA
AUTOMATIC CHARGERS										
F-2912	12	2-6-12	10-200	VE	IoU	•	•	•	•	•
F-2106	6	0,75	4-45	VE	WoU	•	•	•	•	•
F-2201	12	0,75	4-45	VE	WoU	•	•	•	•	•
F-66	12	3	24-50	AA	WoW	•	•	•		
F-2603	12	1,5-3	10-50	VE	WoW	•	•	•	•	•
F-968	6-12	4-8	24-120	AA	WoW	•	•	•		
F-909	12-24	4-8	24-120	VE	WoW	•	•	•		
F-911	12	6-12	45-180	VD-AD	WoW	•	•	•		
F-77	12	5-10	32-140	VE	WoW	•	•	•	•	•
DUAL AUTOMATIC CHARGERS										
F-2305	12	5	32-60	AA	WoW	•	•	•		
F-908	12	4-8	24-120	AA	WoW	•	•	•		
F-2310	12	5-10	32-140	VE	WoW	•	•	•		
F-2312	12-24	6-12	45-180	VD	WoW	•	•	•		
F-2316	12-24	8-16	60-205	VD	WoW	•	•	•		
F-2320	12-24	10-20	92-250	VD	WoW	•	•	•		
F-2330	12-24	15-30	120-360	VD	WoW	•	•	•		

Model	Voltage, V	Charge current, A	Range of capacities, Ah	Display	Charge curves	Liquid batteries: Standard	Maintenance-free	Calcium silver	AGM	SLA, VRLA
TETRA AUTOMATIC CHARGERS										
F-2908	12-24	8	60-120	AA	WoW	•	•	•	•	•
F-2914	12-24	12	90-140	VD	WoW	•	•	•	•	•
F-2916	12-24	15	140-180	VD	WoW	•	•	•	•	•
F-2920	12-24	20	180-250	VD	WoW	•	•	•	•	•
F-2930	12-24	30	220-360	VD	WoW	•	•	•	•	•

Model	Voltage, V	Normal charge current, A	Fast charge current, A (maximum 1 hour)	Range of capacities, Ah	Display	Charge curves	Liquid batteries: Standard	Maintenance-free	Calcium silver	AGM	SLA, VRLA	Booster, A
FAST CHARGERS												
F-923	12 24	8 6	20-40 10-20	35-150 20-120	VD-AD	W	•	•	•	•		150
F-925	12 24	10 8	35-55 25-35	45-200 35-150	VD-AD	W	•	•	•	•		250
F-925RF	12 24	10 8	35-55 25-35	45-200 35-150	VD-AD	W	•	•	•	•		250
F-970	12 24	12 10	50-70 35-55	55-250 45-200	VD-AD	W	•	•	•	•		450
F-970RF	12 24	12 10	50-70 35-55	55-250 45-200	VD-AD	W	•	•	•	•		450
F-99RF	12 24	12-25-50-100 10-20-35-70		45-1000 45-700	VD-AD	WoW	•	•	•	•		600