INSTALLATION – OPERATING AND ENGINEERING MANUAL

MONOLITE

RANGE UMTB

Valve Regulated Recombination Batteries

FIAMM

Table of Contents

1. INTRODUCTION

Wherever a stationary battery is required, UMTB can offer considerable advantages such as: ready for installation as delivered; no topping-up necessity during life; virtually sealed; it can be installed where people work and is office compatible.
UMTB utilises the most advanced technology and rigorous quality control which guarantees the utmost reliability and quality of the battery.

2. FEATURES

No topping-up
UMTB batteries require no topping-up throughout their life.

Compatibility
UMTB was specially designed to meet the requirements of modern electronic equipment and is compatible with normally available recharging systems without special modifications.

High energy density
The compact construction and excellent performance at high rates of discharge provide big savings in volume and weight as compared to conventional flooded, vented batteries.

Office compatibility
FIAMM UMTB batteries, which are valve regulated and virtually sealed, under normal operating conditions, do not give off perceptible amounts of gas; thus they can be installed with complete confidence in the same environment where people live and work.

Savings
UMTB offers substantial savings over the installation and maintenance costs of conventional vented batteries. In fact, no special rooms and virtually no maintenance operations are required during the battery life.

Long life
Rigorous laboratory tests and extensive field experience have enabled FIAMM to manufacture a highly reliable product with a very long life.

Installation
UMTB is very easy to position by hand because it's designed with handles moulded into the case.
Smaller, more compact and lighter than normal batteries, UMTB is supplied filled and charged, i.e. it can be immediately installed directly into the equipment, in cabinets or on easily assembled racks of simple design.

Reliability
UMTB batteries have been tested in the field for a number of years and fully comply with established international standards.
UMTB has been fully tested with respect to charge and discharge characteristics, cyclic life, recombination efficiency, mechanical strength, vibration life and flame retardancy.

3. OPERATING PRINCIPLE OF THE RECOMBINATION TECHNOLOGY

Recombination

During cycling of conventional lead acid cells, water is lost from the cell due to electrolysis and results in the venting of hydrogen, oxygen and droplets of sulphuric acid entrained in the gas stream.

This action results in the need for regular battery checks and periodic topping-up operations to maintain the electrolyte at the proper level. The sealed, valve regulated lead acid battery design, eliminates these problems through continuous recombination of the oxygen during overcharge.

The oxygen recombination process occurs if the separators are not completely filled with electrolyte. This allows some pores to be free for the oxygen diffusion from the positive plates (where it is generated) directly to the negative plates where it reacts to reform water.

During overcharge the following reactions occur:

1)Oxygen is evolved at the positive plate by the reaction;

$H_2O \rightarrow \frac{1}{2} O_2 + 2H^+ + 2e^-$

and diffuses through the unfilled pores of the separator to the surface of the negative plate.

2)At the negative plate oxygen combines with Pb and sulphuric acid;

$Pb + H_2SO_4 + \frac{1}{2} O_2 \rightarrow Pb SO_4 + H_2O$

3)The charging process electrochemically regenerates the lead in the negative plate, completing the cycle.

$Pb SO_4 + 2H^+ + 2e^- \rightarrow Pb + H_2SO_4$

As a result (see also fig. 1), the recombination process with an efficiency higher than 98% completes and reverses the water oxidation.

At the end of the process, the recombination has replaced the water, the electrolyte and the lead in the negative plates without having modified the state of charge of the plates.

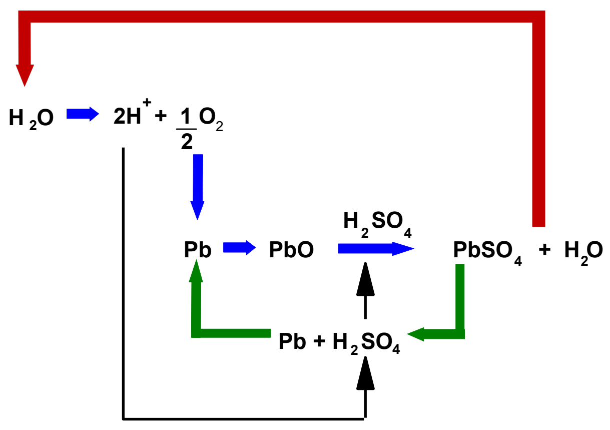


Fig. 1Recombination process

Special separators with high porosity and very small pore diameter are required to facilitate the oxygen recombination cycle; in addition a carefully controlled quantity of electrolyte must be inserted into every single cell in order to maintain sufficient electrolyte to satisfy the discharge reactions while maintaining a sufficient quantity of pores free of electrolyte to maintain the gas diffusion. These unique requirements also result in the fact that all of the electrolyte is retained in the separator and plates and there is no free electrolyte. The gas pressure within the cells during operation is normally above atmospheric pressure and consists of oxygen, hydrogen, nitrogen and carbon dioxide. It is thus necessary that each cell has an outlet for the release of non recombined gases to avoid excessive internal pressure. Safety valves are used for this purpose. The carbon dioxide is present because of the use of organic compounds used as "expanders" in the negative plate. These organic compounds are slowly oxidised to carbon dioxide.The hydrogen in the cell is the result of this oxidation as well as the very slow corrosion of the positive plate grids. It is also very important that the valves in the cell construction are in proper working conditions to prevent air from entering the cell since the internal pressure can be less than the external atmosphere, particularly during periods of open circuit; air leakage would allow the oxygen in the air to be in contact with the Pb lead of the negative plates and would chemically oxidise the lead. To meet these needs, each cell of the monobloc has a one way relief valve which permits the release of gases when necessary, while assuring that no air enters the cells. For this reason these accumulators cannot be described as fully sealed, but virtually sealed, valve regulated accumulators.

4. CONSTRUCTION FEATURES

Table 1 lists the types of batteries now available with UMTB construction and the principal characteristics.

BATTERY TYPE	Nominal Voltage (V)	NOMINAL CAPACITY in Ah at 20°C				DIMENSIONS (mm)			WEIGHT (kg)
		10 hrs to 1.80 VPC	5 hrs to 1.80 VPC	3 hrs to 1.75 VPC	1 hr to 1.67 VPC	Length L	Width W	Height H	
12 UMTB 60	12	60.0	53	47.1	36.1	105	280	260	20
12 UMTB 92	12	92.0	79.5	73.2	60.6	108	395	275	34
12UMTB100S	12	100	88.0	80.0	64.6	108	395	575	36
12 UMTB 105	12	105	92.5	85.2	71.7	126	558	230	41
12 UMTB 130	12	130	114	105	88.8	126	558	270	50
12 UMTB 160	12	160	141	129	109	126	558	320	60

Table 1

Plates
Both positive and negative plates are of the flat pasted type. The active material is made of a paste of lead oxide, water, sulphuric acid and other materials needed to obtain the performances and stability required throughout the battery life. The grids are made of a high quality lead alloy with calcium and tin which assures good resistance against corrosion; the grids are sized to ensure a design life of 10 or more years at normal ambient temperature.

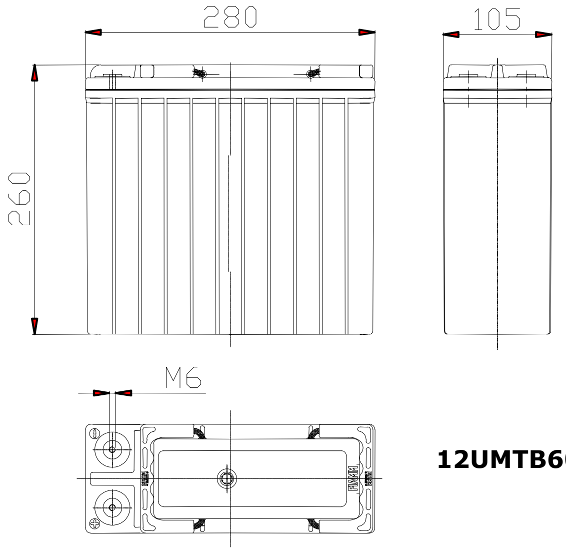
Containers
Battery cases and lids are made of a type of ABS which complies with American Standards UL 94, class V-0 and with IEC 707, method FV0. This material is shock resistant, self extinguishing and flame retardant. They are also designed to fully withstand the internal pressure variations during battery operation. This is further ensured by reinforced container walls and lids. Handles have been designed into the lids to facilitate handling.

Separators
The special separators, which ensure reliable operation of the oxygen recombination cycle, are one of the most important and basic components of the UMTB batteries. These separators are made of microfibre glass sheets by a special process which results in a high porosity with very small pore diameters to ensure maximum oxygen diffusion while maintaining high plate utilisation and low internal impedance. Thanks to the chemical nature of the separator material (silica), it is fully inert to the sulphuric acid and the lead dioxide, and remains unchanged during the life of the battery. The excellent electrical and mechanical characteristics remain constant over a very wide temperature range. The very low internal resistance of the separator material combined with the special plates designed for the UMTB batteries results in excellent utilisation of the active materials in the plates over a wide range of high and low discharge rates. The plates are completely wrapped by the separator and the electrolyte is completely absorbed in the separator and plates. By this method, the shedding of active material which during the battery life causes shorting with flooded battery construction is avoided.

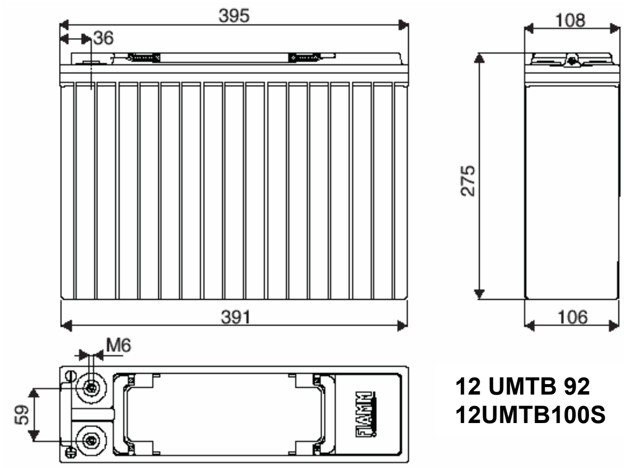
Electrolyte
The electrolyte is sulphuric acid of 1.3 sp. gr. at 20°C with same purity characteristics as other types of high quality lead acid batteries.

Valves
Each cell has a one way valve to permit the release of gases from the cell whenever the internal pressure exceeds the fixed safety value. The valve is rated at approximately 0.3 atmospheres (30 kPa).

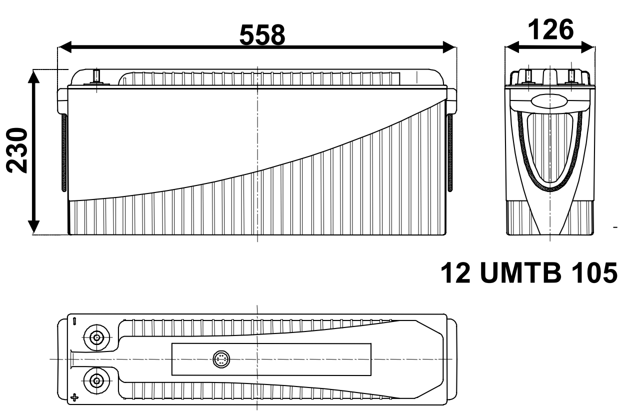
Terminal posts
Suitable threaded pillars with solid or flexible connectors are provided to ensure low ohmic losses. Post to lid seals are designed to prevent leakage (see fig. 2) over a wide range of internal pressures and conditions of thermal cycling. Intercell connections in the UMTB design are electrically welded through the cell walls to minimise the internal impedance while maintaining complete separation of the individual cells.



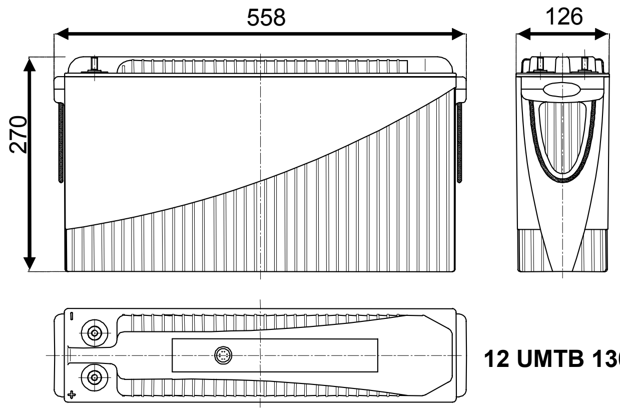
12UMTB60



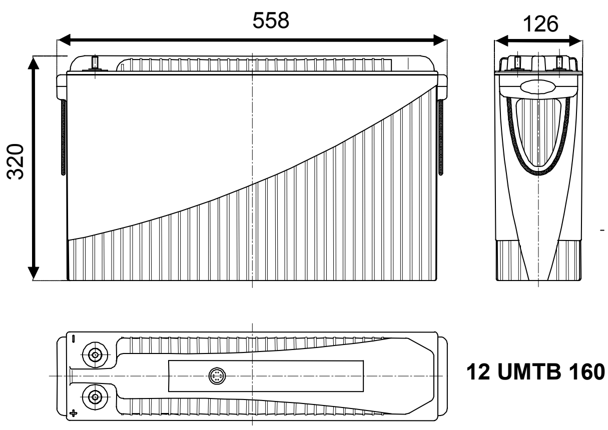
12 UMTB 92
12UMTB100S



12 UMTB 105



12 UMTB 130



12 UMTB 160

5. OPERATING FEATURES

Capacity

The battery capacity is rated in ampere hours (Ah) and is the quantity of electricity which it can supply during discharge. The capacity depends on the quantity of the active materials contained in the battery (thus on dimensions and weight) as well as the discharge rate and temperature. The nominal capacity (C_{10}) of UMTB batteries refers to the 10 hr discharge rate with constant current at 20° C.

Cell Voltage

The voltage of lead acid cells is due to the electrochemical potential differences between the active electrode materials (PbO_2 and Pb) in the presence of electrolyte (sulphuric acid). Its value depends on the electrolyte concentration in contact with these electrodes, but is approximately 2 Volts under most open circuit conditions. More precisely, it is a function of the state of charge of the battery; the open circuit voltage of a UMTB cell at ambient temperature can be represented by the figure 3.

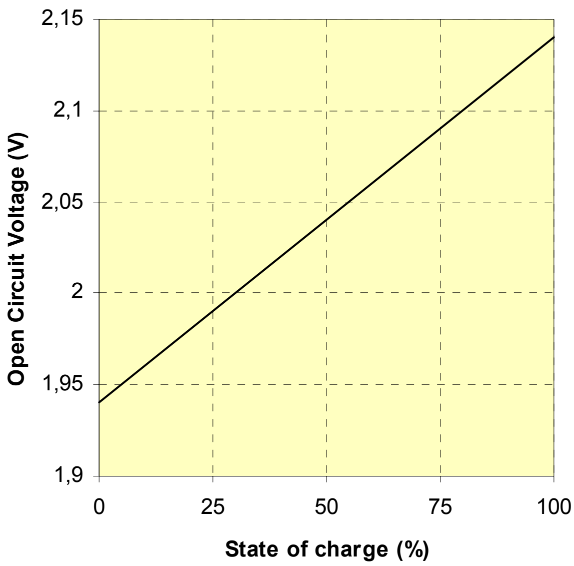


Fig. 3 **Open circuit voltage in relation to the state of charge of the cell**

Internal impedance and short circuit current

The internal impedance of a lead acid battery is a direct result of the type of internal construction, plate thickness, number of plates, separator material, electrolyte sp. gr., temperature and state of charge. UMTB batteries are designed to withstand a short circuit current for 1 minute without damaging. The internal resistance and the short circuit current of UMTB batteries at 100% state of charge and 20° C is given in the following table 2:

CELL TYPE	Capacity (Ah)	Internal Resistance (mΩ)	Short circuit current (Amps.)
12 UMTB 60	60	13	1200
12 UMTB 92	92	6	1600
12UMTB100S	100	5.6	2200
12 UMTB 105	105	5.5	2800
12 UMTB 130	130	4.6	3000
12 UMTB 160	160	3.9	3200

Table 2

Capacity in relation to the discharge rate

The capacity available from a battery, depends on the rate of discharge. For UMTB batteries at 20°C please refer to table 3.

DISCHARGE RATE (hours) to 1.80 VPC	CAPACITY (% of C_{10} Ah)
10	100
5	87
3	78
1	59.8

Table 3

Capacity in relation to the temperature

The capacity available from a battery, at any particular discharge rate, varies with temperature. The following graph (see fig.4) shows the capacity depreciation at different temperatures and discharge rates.

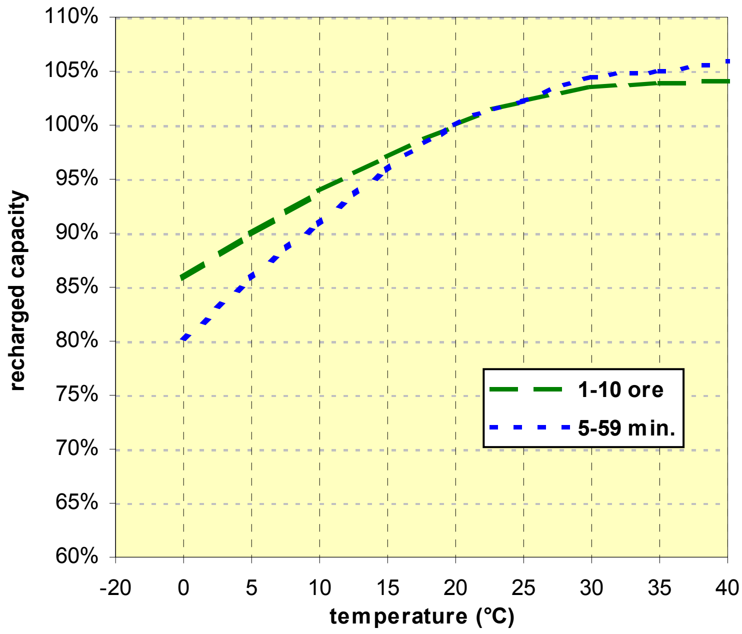


Fig. 4 Available capacity versus temperature

Open circuit

The state of charge of lead acid batteries slowly decreases on open circuit stand due to self discharge. In UMTB batteries, the rate of self discharge in respect to time is about 2% per month at 20° C. During prolonged storage it is necessary to float charge the battery every 6 months according to the instructions in paragraph 7 to maintain a fully charged condition of the battery; excessive open circuit storage of any lead acid battery without recharge will result in some permanent loss of capacity.

Cycling

UMTB batteries have passed successfully the cycle life test as described in the standards BS 6290.

Gassing

As previously stated, UMTB batteries have a high recombination efficiency (>98%) and for cells operated at 20°C under normal operating conditions venting is virtually negligible. Laboratory test measurements show the following gassing rates:

- 2 ml/Ah/cell/month at a float voltage of 2.27 V/cell
- 10 ml/Ah/cell/month at a recharge voltage of 2.40 V/cell.

The quantity of gas given off in the air (it basically consists of 80-90% hydrogen) is very low and thus it is clear that UMTB recombination batteries can be installed in rooms containing electric equipment with no explosion danger or corrosion problems under normal conditions. The only requirements is that these rooms or cabinets must have a natural ventilation and not be fully sealed.

Operation of batteries in parallel

When the required capacity is greater than the maximum available from our range, it is possible to connect batteries in parallel to obtain the desired capacity. Certain guidelines should be followed, summarised as follows:

- use only batteries of the same type, i.e. same capacity and same number of cells per battery;
- make all electrical connection of parallels as equal as possible and symmetrical between the batteries (e.g., length and type of connector) to minimise possible impedance variations;
- limit the number of string in parallel(usually up to 4 battery strings are connected in parallel).

6. CHARGING

Introduction

After installation, batteries are an energy source ready to be used whenever necessary. It is very important that batteries are:

- Float charged in order to be maintained in a fully charged condition during the standby period.
- Completely recharged after a discharge. Recharged as soon as possible to ensure maximum protection against subsequent power outages. Early recharge also ensures the maximum battery life.

Recharge can be done in many ways, depending on the needs of recharge time or life of the batteries. In general, charging is performed as follows:

- at recharge voltages equal to the float voltage and low currents (long recharge time);
- at recharge voltage not higher than 2.4 V/cell and high currents (faster recharge).

The IU recharge method, also known as modified constant potential, has been used for many years and in a variety of applications, as it combines the need of having the battery quickly recharged while ensuring maximum battery life. With this method, recharge starts at a constant current rate. The voltage increases up to a pre-set value. The pre-set voltage is maintained and the current then decreases to a minimum defined value. Finally, the recharge is completed at a final constant voltage value equal to or less than that defined for float charge with the current decreasing to the value used in float.

Recommended procedure for charging and floating of UMTB batteries

It is important to recharge valve regulated recombination batteries using methods which do not cause excessive gassing. Such methods would cause excessive water consumption and a loss of battery life in addition to the venting of gases. The only charging methods which should be used are those which operate automatically with a preset constant voltage value supplying a charging current whose maximum value cannot be exceeded; i.e., constant voltage charging with current limit and automatic crossover.

Float charge

The voltage recommended for float charge, which will ensure the maximum life of the UMTB batteries is 2.27 V at 20°C. These batteries can operate over a temperature range of –20 to +60°C, as performance and life are greatly reduced outside of this temperature range. The recommended float voltages to maximise the battery life over the range of temperatures between -20 and +60°C are shown in the figure 5.

The normal float current observed in fully charged UMTB batteries at 2.27 VPC and a temperature of 20°C is approximately 0.3 mA/Ah. Because of the nature of recombination phenomena, the float current observed in the case of the UMTB batteries is normally higher than that of vented batteries and is not an indication of the state of charge of batteries

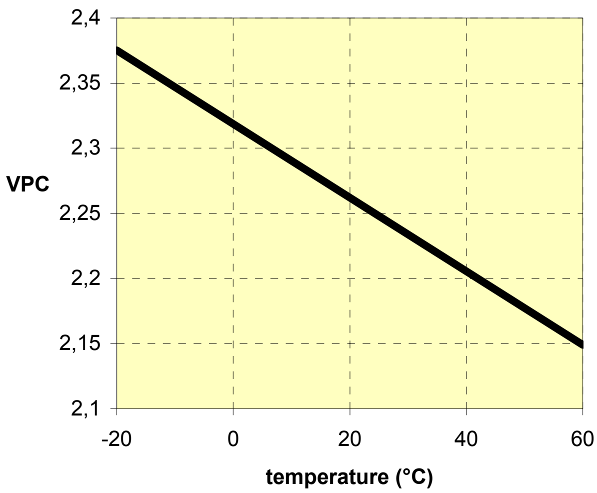


Fig. 5 Float Voltage vs. temperature

Recharge following discharge

The recommended recharge method of UMTB batteries to maximise the battery life is to use a constant voltage equal to the float charge voltage (2.27 VPC at 20°C) with a maximum charge current of 0.25 C_{10} amperes. Using this procedure, the recharge times at different values of maximum current, for a fully discharged cell (100%) are shown on the following figure 6.
If it is necessary to reduce the recharge time, the IU recharge method previously explained can be used with a maximum voltage of 2.4 V/cell at 20°C with a maximum current of 0.25 C_{10}. However this recharge should be limited to no more than once per month to ensure the maximum service life of the battery.

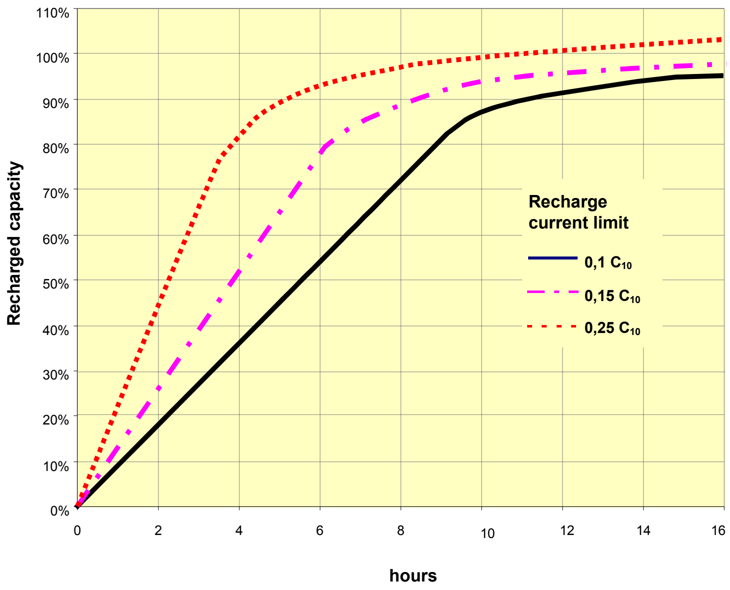


Fig. 6 Recharge curves

7. APPLICABLE STANDARDS

UMTB batteries fully comply with:
•British Standards N° 6290 Part 4 "Specification for lead acid batteries"
•IEC 60896-Part 21 Stationary lead-acid battery - Valve Regulated Type – Methods of tests; Part 22 Stationary lead-acid battery - Valve Regulated Type - Requirements
•Norme CEI 21.6 fascicolo 1434 Batterie di accumulatori stazionari al piombo
•Eurobat Guide to the specification of valve regulated Lead acid stationary cells and batteries: Group I: 1 12 years and longer "long life"
•Australian Standard AS 4029.2 - 1992 Stationary batteries - Lead-acid - Part 2: Valve - regulated sealed type.

8. STORAGE

•Batteries are delivered filled, charged and ready for installation.
•No operation such as filling, commissioning or other type is required. They need only to be connected in series and/or in parallel as required by the particular application.
•If they cannot be installed immediately, batteries are to be kept in fresh, clean dry rooms. Furthermore, considering that on open circuit batteries lose part of their capacity due to self discharge (2% per month at 20°C), a float recharge is recommended at least every 6 months.
Float recharge consists in applying a voltage of 2.27 V/cell for approx. 48 hours.

9. INSTALLATION

UMTB valve regulated recombination batteries can be fitted on stands or into cabinets. FIAMM offers a wide selection of stands, from one tier/one row to six tiers/three rows, to suit most applications. Cabinets are available with or without circuit breaker and its relevant compartment.

1)Upon installation of UMTB blocs into a cabinet or on a stand, first place the single units at their correct position according to the electrical layout. Start with the lowest shelf to ensure stability. Carefully preserve the sequence: positive, negative, positive, negative throughout the whole battery. Flexible cable connectors for connecting from one shelf to the one below, will be applied once that all the blocs have been connected (we would suggest to connect such inter-shelf or inter-row cable connectors at the final User's premises only).

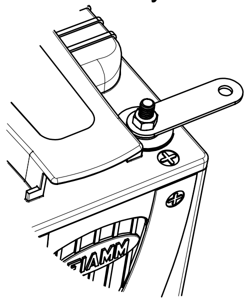
2)To ensure a good electrical contact between the bottom of each terminal and the connecting strap and, at the same time, to ensure that the threaded terminals are not damaged by excessive torque, use a torque spanner set on the value of:

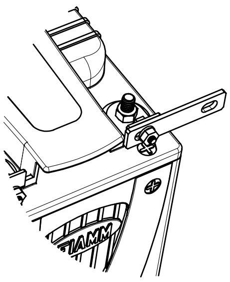
- 5-7 Nm / 44-62 in. lb
- 7-8 Nm / 65-70 in. lb

3)For safety reasons, we would recommend not to pre-assemble the blocs into the cabinets before shipment to the final Customer. However, if this is normal practice for some system makers, we would strongly recommend to pay special attention to protect the battery system from mechanical stress and vibrations occurring during transport. For this purpose, we would require to properly fasten all the blocs to the relevant cabinet shelves by means of plastic band and/or other adequate methods. Furthermore, the cabinet should be protected, in the outside, with shock-absorbing packaging material, in order to prevent any transmission of vibrations to the internal components such as the battery blocs. Special precautions must be taken to avoid accidental short circuits.

There are three possibilities to apply connectors to the battery terminals:

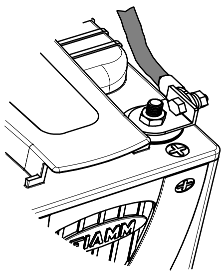
On the top of the bloc by solid connectors



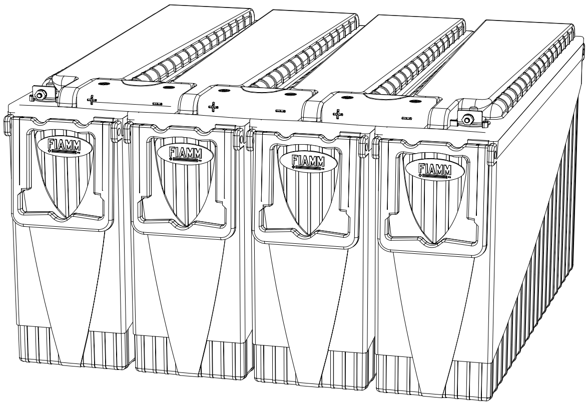


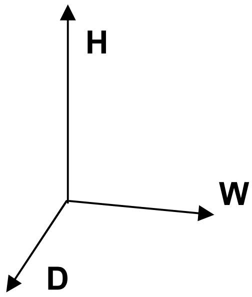
On the front by a special "L " clamp

There is also the possibility to turn the special clamp of 90° to connect end cable on the longer side of the battery.



- 48 Volt System with 4 blocs each 12 Volt





	C_{10} (Ah)	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
4 x 12UMTB60	60	435	285	285	80
4 x 12UMTB92	92	450	400	300	136
4 x 12UMTB100S	100	450	400	300	144
4 x 12UMTB105	105	520	600	250	164
4 x 12UMTB130	130	520	600	290	200
4 x 12UMTB160	160	520	600	340	240

INSTALLATION – OPERATING AND ENGINEERING MANUAL

MONOLITE

RANGE UMTB

Austria:
BÄREN BATTERIE Gmbh
Dr. Leopold Jungfer Str.
9181 Feistriz
Tel : +43 4228 2036 99
Fax : +43 4228 2036 68
info.standby.austria@fiamm.com

China:
FIAMM Enertech Co., Ltd.
Building A, Zhuankou Industrial Park,
Wuhan Econ. & Tech. Development Zone
Wuhan City, Hubei Province, PR China 430057
Tel: +86 27 84297900
Fax : +86 27 84231256
www.fiammenertech.com

Czech Republic:
AKUMA - prumyslove baterie s.r.o.
Parizske komuny 96, Debr nad Jizerou
293 07 Mlada Boleslav
Tel : +420/326/748344
Fax : +420/326/748370
info.standby.czech@fiamm.com

France:
FIAMM FRANCE
1, rue du Clos Reine Z.I.
78410 Aubergenville
Tel : +33 1 30905484
Fax : +33 130903369
info.standby.france@fiamm.com

Germany:
FIAMM GmbH
Hansestrasse 101
51149 Köln
Tel : +49 (0)2203-92578-0
Fax : +49 (0)2203-92578-49
info.standby.germany@fiamm.com

Italy:
FIAMM S.P.A.
Viale Europa, 63
36075 Montecchio Maggiore (VI)
Tel : +39 0444 709311
Fax : +39 0444 694178
info.standby.italy@fiamm.com

Singapore :
FIAMM ASIA PACIFIC Pte Ltd
36 Tuas Crescent
638724 Singapore
Tel : +65 68653276-8
Fax : +65 68626550
info.standby.asiapacific@fiamm.com

Spain:
FIAMM IBERICA S.A.
Calle Nubes, 7 - P.I. San José de Valderas
28918 Leganes - Madrid
Tel : +34 91 4880247
Fax : +34 91 6105618
info.standby.spain@fiamm.com

Fiamm UK Ltd:
Unit 9 Zone 4
Burntwood Business Park
WS7 3XD Burntwood Staffordshire
UNITED KINDOM
Tel : +44 1543 677170
Fax : +44 1543 685837

USA:
FIAMM Technologies, Inc.
One FIAMM Way
Waynesboro, GA 30830
Tel : +1 (678) 746-5640
Fax : +1 (770) 360-1240
www.fiammamerica.com

FIAMM

www.fiamm.com