Diversey

TASKI®

TASKI® Battery Handbook

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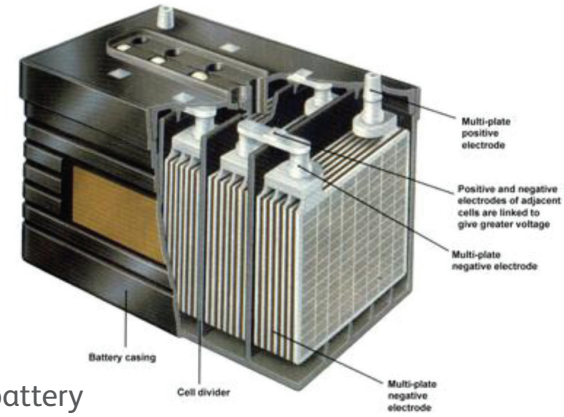
It is VERY IMPORTANT you understand the APPLICATION and recommend the right battery for each USE!

WHAT IS A BATTERY?

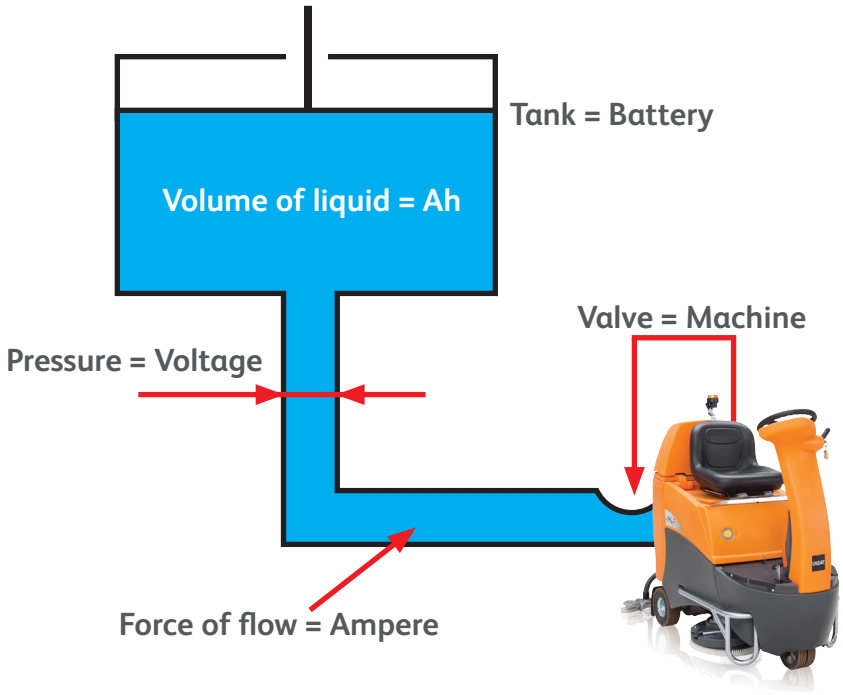
A battery is one or more electro-chemical cells that convert stored chemical energy into direct current (DC) electrical energy.



BASIC TERMINOLOGY

- AC = Alternating current (e.g. wall plug)
- DC = Direct Current (e.g. battery)
- Ah = Ampere hour = Amount of power stored in a battery
- A = Ampere = Force of power flowing at a given time
- V = Voltage = Volume of power flowing at a given time
- Cell = The smallest physical component in a battery

UNDERSTANDING BATTERIES (VISUAL ANALOGY)



NOTE: A battery (tank above) should never be completely emptied.

Types of Batteries
Standard / Starter Batteries:

Built as **("sealed") Wet / AGM / Spiral-wound**

- Designed to deliver high current for a short period of time
  - Thin lead plates enable quick power transfer
  - High current charging
  - High self-discharge
  - No cycle use
- Charging via voltage regulated chargers
- Applications: cars, boats etc.

Deep Cycle:

Built as **Wet / AGM / Spiral-wound / Gel types / Lithium**

- Designed to constantly (or on demand) deliver high to medium current
  - Thicker lead plates still enable relatively quick power transfer
  - High current charging
  - Lower self-discharge - storage up to 6 months
  - Cycle - or Stand-by use
- Charging schemes depend from applications
- Stationary: IU-schemes - Cycling: rather IUIa-schemes
- Applications: electric vehicles (light to medium duty), golf carts, wheel chairs, UPS systems, scrubbers

Traction:

Built as **Wet / AGM / Gel types**

- Designed to constantly deliver medium current
  - Much thicker lead plates only allow "slow" power transfer
  - Lower self-discharge – storage up to 6 months
  - Designed for Multi Cycle use
- Charging schemes always variants of IUIa
- Application areas: electric vehicles / scrubbers and transportation, forklift

NOTE: Spiral-wound batteries cannot be traction-batteries. Lead-plates are thin due to construction.

PRO'S AND CON'S
Wet, Flooded or Lead Acid batteries

Advantages

- Highest cycle life when properly maintained
- Accepts higher recharging voltages
- Lowest initial cost
- Good deep-cycle performance with proper care

Disadvantages

- Requires periodic maintenance by trained personal
- Requires ventilation
- Higher rate of self-discharge
- Corrosive battery acid can be spilled, causing personal and environmental safety risk
- Must be shipped with specialized carriers

GEL batteries

Advantages

- No maintenance
- Shock and vibration resistant
- No gas release
- Longer cycle life than AGM
- Safe and Environmentally friendly

Disadvantages

- High initial cost (lower than Lithium but higher than wet & AGM batteries)
- More weight per Ah than wet batteries
- The acid concentration cannot be checked as in wet batteries

It is VERY IMPORTANT you understand the APPLICATION and recommend the right battery for each USE!

PRO'S AND CON'S *(continue)*
AGM batteries

Advantages

- No Maintenance
- Faster charging than GEL
- Shock and vibration resistant
- No gas release
- Low self-discharge

Disadvantages

- Lowest cycle life
- High initial cost (lower than GEL and lithium but higher than wet batteries)
- Incorrect charging damages the battery
- Most weight per Ah than any batteries
- The acid concentration cannot be checked as in wet batteries
- 70% DOD not practical

Lithium batteries

Advantages

- No maintenance
- Light & Compact
- No gas release
- Longer cycle life than Gel / AGM

Disadvantages

- Highest initial cost
- Less weight per Ah than any battery
- No Acid therefore cannot be checked as in wet batteries

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WHAT IS A CYCLE?

Definition: **Discharging a battery and then recharging the battery back to full.**

This unit of measurement is used to calculate the expected life time of a battery

Average life cycles (group 31)

- Wet / Flooded / Acid = 700 cycles
- GEL = 600 cycles
- AGM = 500 cycles

BATTERY KILLERS

"Batteries don't die ... they get killed"

1st Killer: Temperature of the battery:

- What causes heat in a battery:
  - Charging of the batteries
  - Using of the batteries.

Example 1: Frequent opportunity/intermediate charging, causes the cell to heat-up more often and does not allow a cool down phase before usage.

Example 2: Under sizing your battery pack, forces maximum use and therefore maximizing heat of the pack.

2nd Killer: Deep discharge:

When a battery is used (discharged) below the allowable level specified by the manufacturer of that battery.

- Acid & Gel batteries = Allow for 80% discharge
- AGM = Allow for 70% discharge

Example: Machine "X" with battery pack "Y" can run for 4 hours before the chemical in the battery needs to be recharged / refreshed.

The machine is used for 2 hours and then NOT charged. Next day the machine can be used for 2.5 hours (because cooling allows for Voltage increase). The customer uses the machine until it stops. The battery was in deep discharge for 30 minutes. Deep discharge creates sulfur and kills the cells (sulfation).

REAL WORLD BATTERY EXAMPLE

Example 1

Type	Coverage/Hr.	Run Time	Battery Type	Coverage/Charge
Machine A 20" Auto Scrubber (swingo 855)	2 hrs.	8500 sq.ft/hr.	2 x 12V Batteries	17,100 sq.ft/Charge
Machine B 22" Auto Scrubber (swingo 1255)	4 hrs.	13,500 sq.ft/hr.	4 x 12V Batteries (series parallel)	54,000 sq.ft/Charge

Summary: When comparing two machines, a 20 inch auto scrubber and a 22 in auto scrubber, using the same batteries, we see that by doubling the number of batteries from two batteries in the 20 inch machine to four batteries in the 22 inch machine, we receive double the amount of run time from the machine (now four hours versus two hours). As a result, the amount of coverage from one charge of each machine goes from over 17,000 square feet using the 20 inch machine to 54,000 square feet using the 22 inch machine, over 36,000 more square feet per charge. Put simply, using four batteries in a 22 inch auto scrubber versus two batteries in a 20 inch auto scrubber produces **over 36,000 square feet more cleaning per charge** or **3X more productivity!**

What causes this productivity gain? **BATTERIES!**

BATTERIES = PRODUCTIVITY = $$$
For a small amount of money you can increase productivity!

Example 2

Building X = 45,000ft² to clean

- Machine "Y" can clean 16500 ft²/h (26" working width TASKI SWINGO® 1650)
  - Battery pack "A" = 4x6V each battery with 100Ah = 4h run time = 66,000 ft²
  - Battery pack "B" = 2x12V each battery with 100Ah = 2h run time = 33,000 ft²
- Machine "Z" can clean 12,500 ft²/h (22" working width TASKI SWINGO 1255)
  - Battery pack "A" = 4x12V each battery with 100Ah = 4h run time = 50,000 ft²
  - Battery pack "B" = 2x12V each battery with 100Ah = 2h run time = 25,000 ft

The combination "YA" = most expensive but most productive.

The combination "YB" = NOT possible because you could not complete the task in one charge.

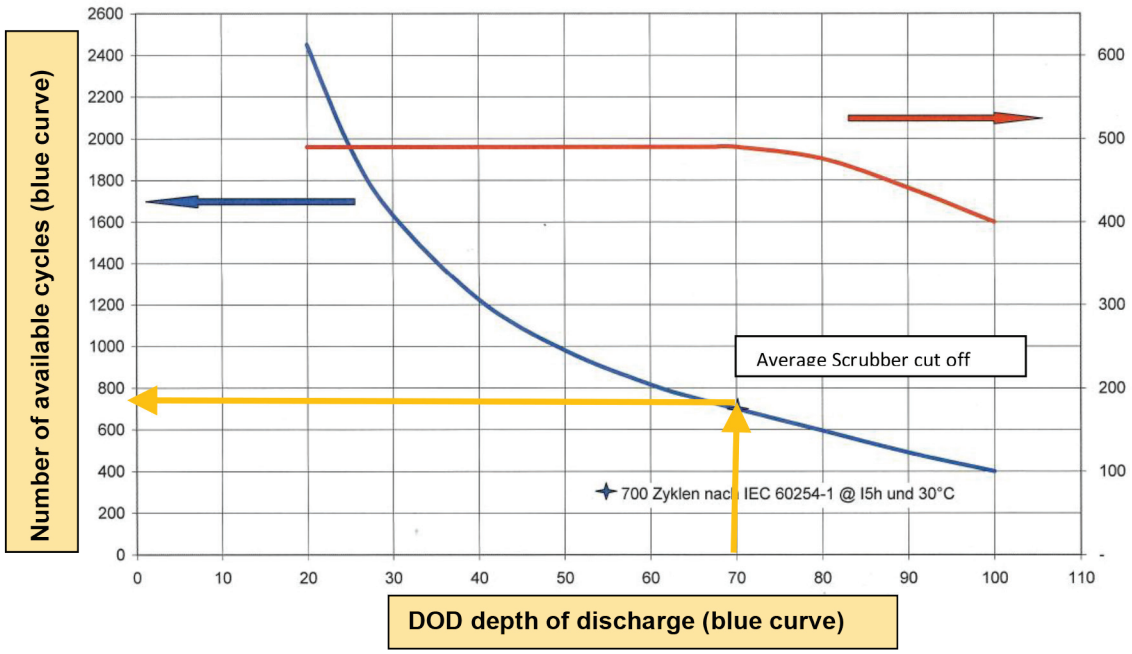
The combination "ZA" = less expensive but also less productive but it can do the job.

The combination "ZB" = NOT possible because you could not complete the task in one charge.

Make sure you understand your customer needs and choose the right machine/battery combination for their needs. Do not forget to consider the time needed for a complete charging of the battery pack.

UNDERSTANDING LIFE EXPECTANCY

Chart below shows the direct collation between Depth of Discharge and Life expectancy.



- Blue curve = Cycle to DOD ratio
- Yellow Arrow = Average Scrubber DOD cut off
- Red Line = AH ou

UNDERSTANDING CHARGING

Correct charging is the most crucial process to achieve expected performance and life-time. Each type of Battery and each make of battery require an EXACT matching profile for charging.

So ... once your Battery is chosen (based on application) you MUST then select your charger and set your charging curve accordingly.

CHARGING CURVES

Each battery (explained earlier in the handbook) needs a way to be charged. The kind of charge can be described as a "Curve". Curves are based on time and the switching between Amps and Voltage (as described earlier).

Two letters are used in Curves:

- I = Ampere (current)
- U = Volt (voltage)

Depending on the way a battery is made it needs the combination of Amps and Volts to be charged fully and properly, without causing damage. Remember our #1 "Killer" is Temperature.

IU CHARGES

Application: **Used for deep-cycle batteries (mostly Gel, lithium and some AGM)**

Combines:
Advantages of an **I-charge (fast power intake)** with advantages of an **U-charge (little over-charging)**

- During the U-phase charging is slowly finalized at low current.
- Charging voltage is determined at a level that prevents battery damage.

This curve is a compromise between short charging time and over-charging.

IUIa CHARGES

Application: **Used for deep-cycle batteries (mostly ACID, AGM and Gel)**

To reduce charging-time compared to a "simple" IU charge

AND

To resolve a graded acid bedding

AND

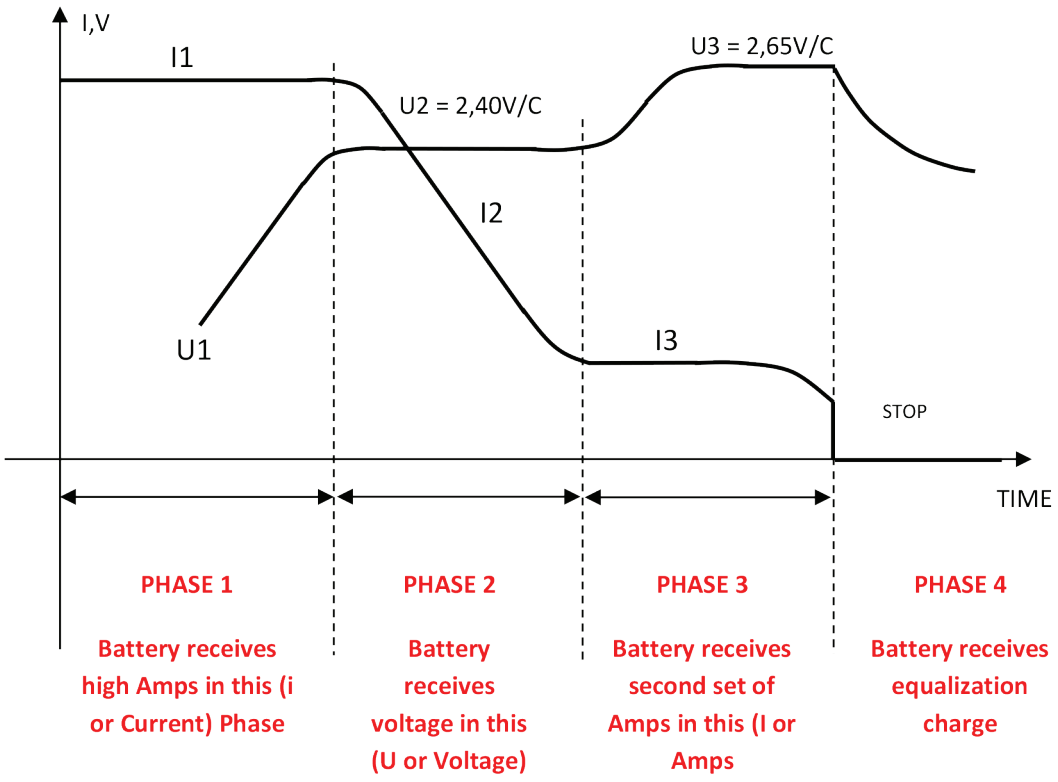
To equalize the cells

AN I–PHASE IS ADDED

(The "a" at the end of the term only tells that there is an automatic switch over). Time and values are determined by or related to battery size.

Remember our "Killers" ... Temperature is the critical factor

EXAMPLE OF IUIa CHARGING CURVE



As you can see each Phase has its own time and purpose.

This is why a complete charge cycle is necessary. It is also why “opportunity charging” kills batteries.

Last Words:

- **Remember batteries are NOT commodities.**
- **Choose the right Battery for your customer’s application.**
- **Make sure your charger is programed correctly for the battery you chose.**

Diversey has been, and always will be, a pioneer and facilitator for life. We constantly deliver revolutionary cleaning and hygiene technologies that provide total confidence to our customers across all of our global sectors. Led by Dr. Ilham Kadri, President & CEO, and headquartered in Charlotte, North Carolina, USA, Diversey employs approximately 9,000 people globally, generating net sales of approximately $2.6 billion in 2017.

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