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Cells Manufactured by **EXIDE TECHNOLOGIES S.L.U.**

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Powerhouse Vented cells (hybrid lead+copper)

Powerhouse VRLA cells (hybrid lead+copper VRLA)

Energy solutions for all applications

- The number of transhipment services in Intralogistics is constantly increasing
  - Requires a battery technology supporting longer operation time
- Modern electric trucks are equipped with three-phase motors
  - Requires a battery technology providing high currents
- Heavy trucks with internal combustion engine are converted to electric
  - Requires a battery technology which has superior power.
- Out-door operation of trucks with massive temperature gradients
  - Requires a battery technology which can cope with high and low temperatures.
- The expectations on energy efficiency are very high
  - Requires a battery technology which saves energy costs and CO2 emissions.

Requirements and Benefits

Extended runningtime due to...

... more nominal capacity (= energy plus)

... higher nominal voltage (= energy plus)

... highly efficient energy recovery

... high peak power tolerance

Longer operational life due to...

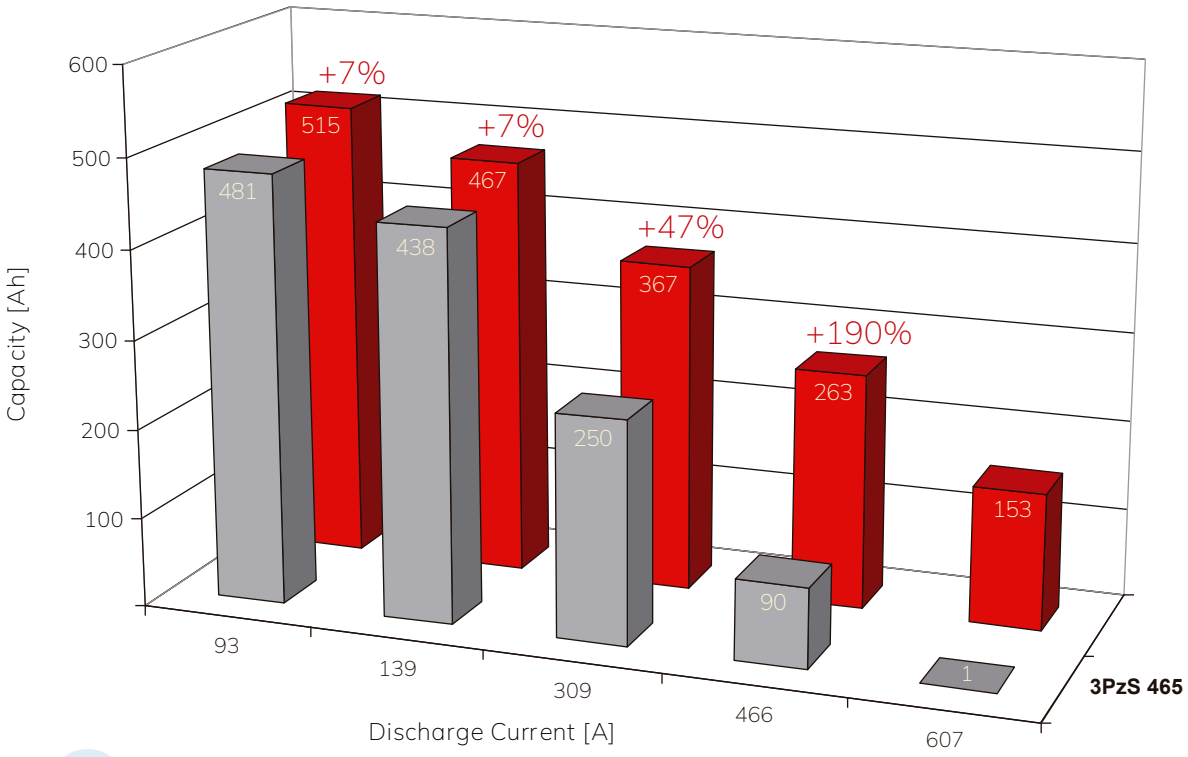
... lower battery temperature profile

... high robustness on high workload

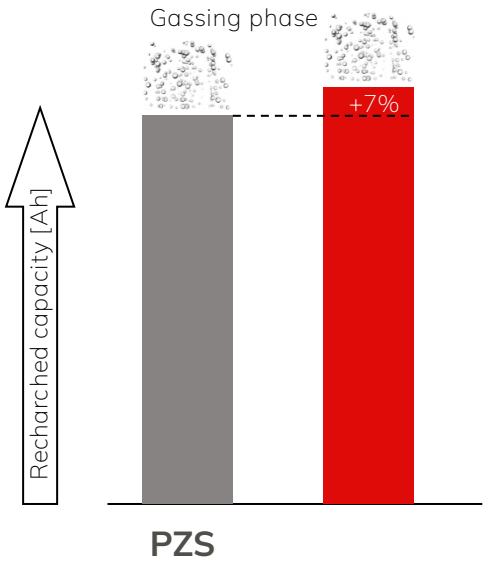
Perfectly suited for fast and opportunity charging

Energy cost savings due to excellent efficiency

Increased Capacity (Ah)

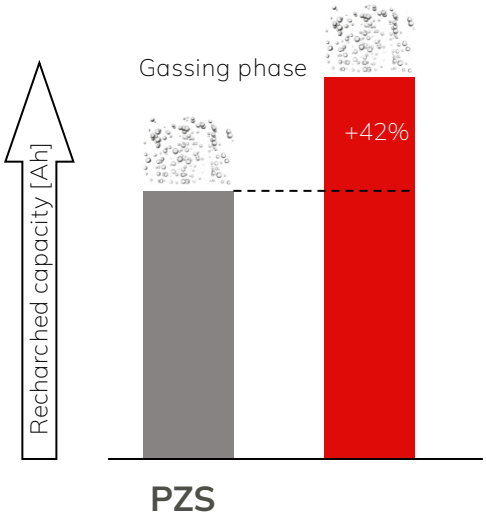


Improved Charge Acceptance



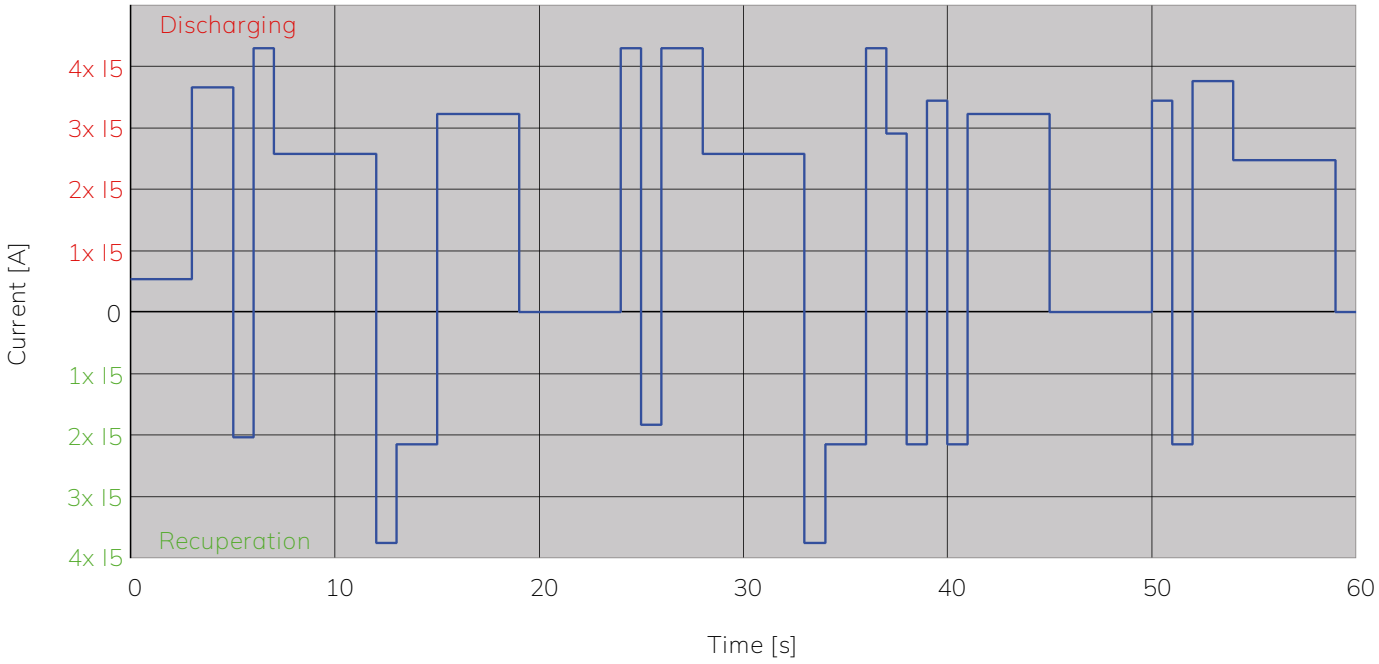
Charging current 1 x I5

(Standard charging current!



Charging current 3 x I5

(Fast / Opportunity charging
Recuperation currents)


Discharging
4x I5
3x I5
2x I5
1x I5
0
1x I5
2x I5
3x I5
4x I5
Recuperation
Current [A]
0
10
20
30
40
50
60
Time [s]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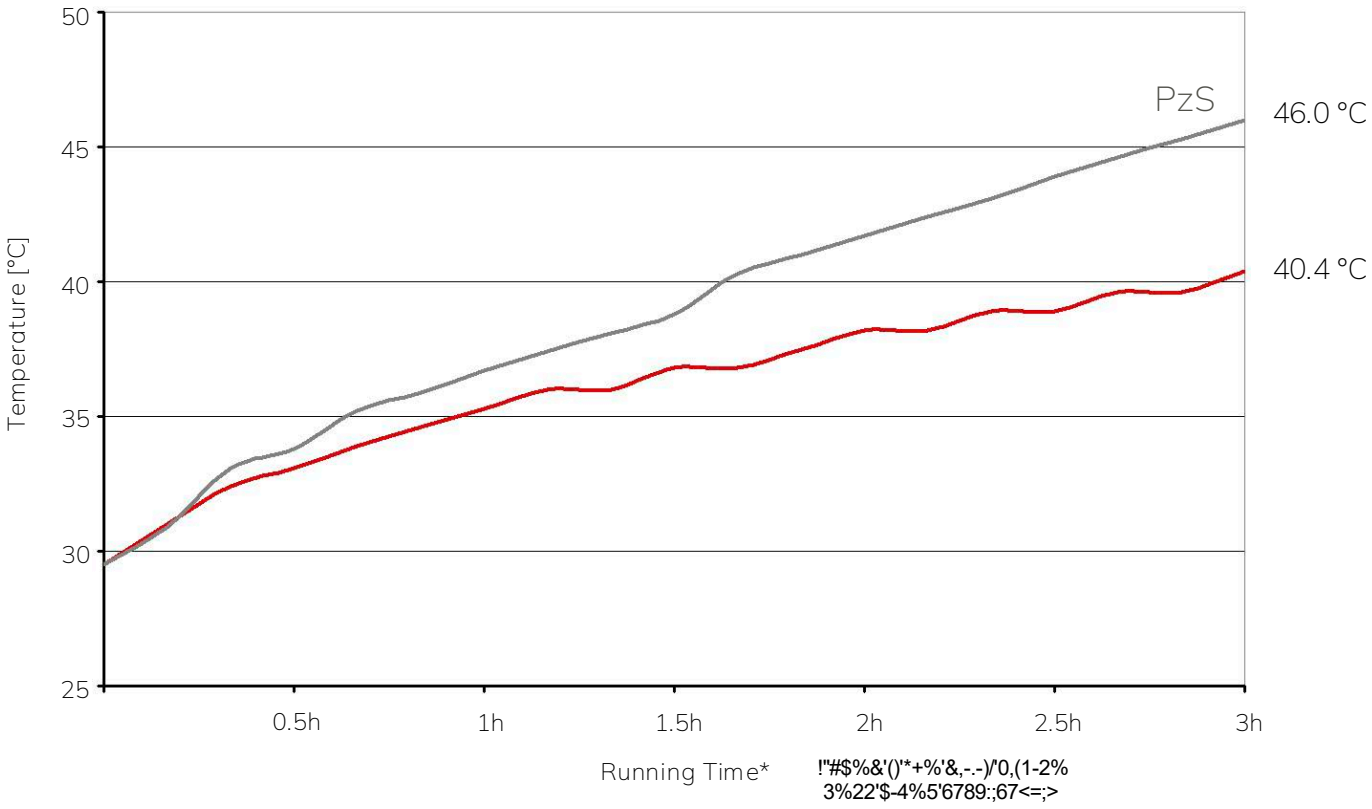
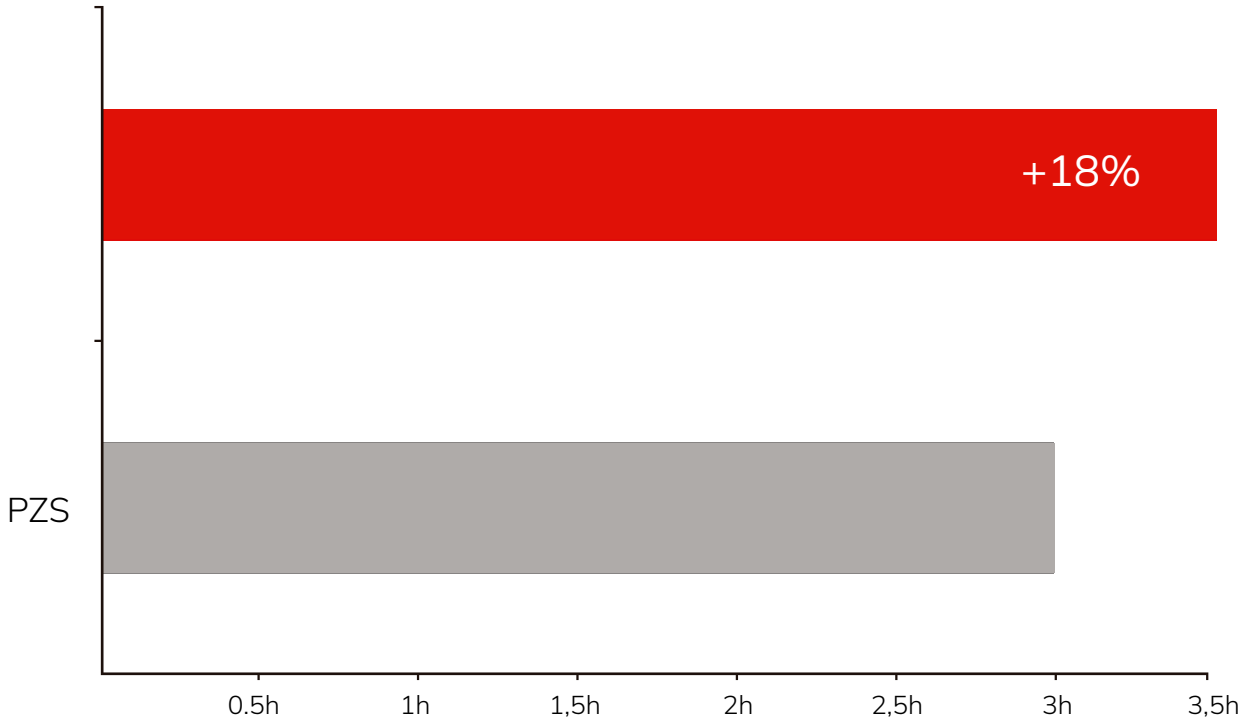
+10% service life

according ZVEI reference sheet:
"Considerations on the Life of Traction Batteries"



!"#$%&'()'*+%'&,-.-)/'0,(1-2%
3%22'$-4%5'6789:;67<=;>

Extended running time at 30°C (86°F)



Running time* *based on the driving profile
05EPZS0775SC vs. 07PCSM0840SC

- POWERHOUSE Vented batteries do not require special chargers for standard charging. (Chargers equipped with charging regimes for flooded batteries can be used)

- POWERHOUSE Vented batteries are also designed for fast & opportunity charging Charging characteristic "Z-Profile" was especially developed for this purpose.

- Z-Profile enables the user to...

  ...fully recharge POWERHOUSE Vented batteries in up to 4-5 hours (80% depth of discharge 100% state of charge)

  ...frequently opportunity charging POWERHOUSE Vented batteries

- Chargers with Z-Profile are equipped with air agitation (to prevent acid stratification) and temperature sensor (for temperature-controlled charging)

High-rack facilities/
Narrow aisle trucks

Cold storage/
Outdoor applications

Accessory equipment/
Additional electrical consumers

Seasonal business /
Activity peaks

Heavy duty applications/
Heavy trucks

24/7 applications/
Multi-shift

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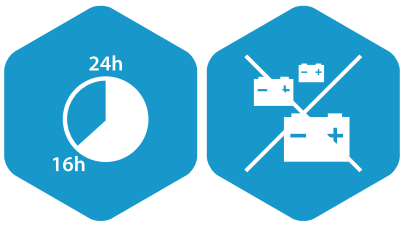
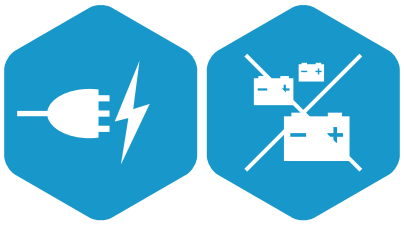
Scenario 1



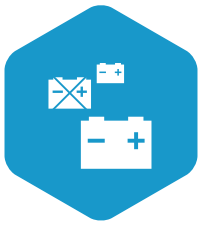
POWERHOUSE Vented fulfils two shifts.
No changing batteries required

Scenario 2



PO WERHOUSE Vented opportunity charging model.
No changing batteries required

Scenario 3



POWERHOUSE Vented works more.
Less changing batteries required

Case Example #1

Villeroy & Boch, Merzig

- POWERHOUSE vented test battery 80V 1285 TCSM (C5: 660 Ah)
- Opponent: Battery from the competition 80V 5 PzS 625 (C5: 625Ah)
- Standard charging profile for flooded batteries
- Industrial truck: Linde E 25 BR 336
- Villeroy & Boch ceramic tiles warehouse
- 6 days a week // 3 shifts

	Competitive Battery 5 PzS 625	POWERHOUSE 1285 TCSM	Advantage
Nominal Capacity (Ah)	625	660	+5,6%
Discharging Time Per Working Day (h)	3,81	4,88	+28,1%
Discharged Capacity (Ah)	15.100	18.789	+24,4%
Cut-off Voltage (V)	1,50	1,79	+19,3%
Operating Temperature (C)	38,8	30,2	-22,1%

Case Example #2

Logistics Service Provider

- POWERHOUSE vented battery 80V 1910 TCSM (C5: 990 Ah)
- Competitive battery 80V 6 PzS 930 (C5: 930 Ah)
- Batteries were being used alternately in the same truck
- Charger with standard charging regime for flooded batteries
- Area of application: Logistics provider
- Test period: 8 weeks

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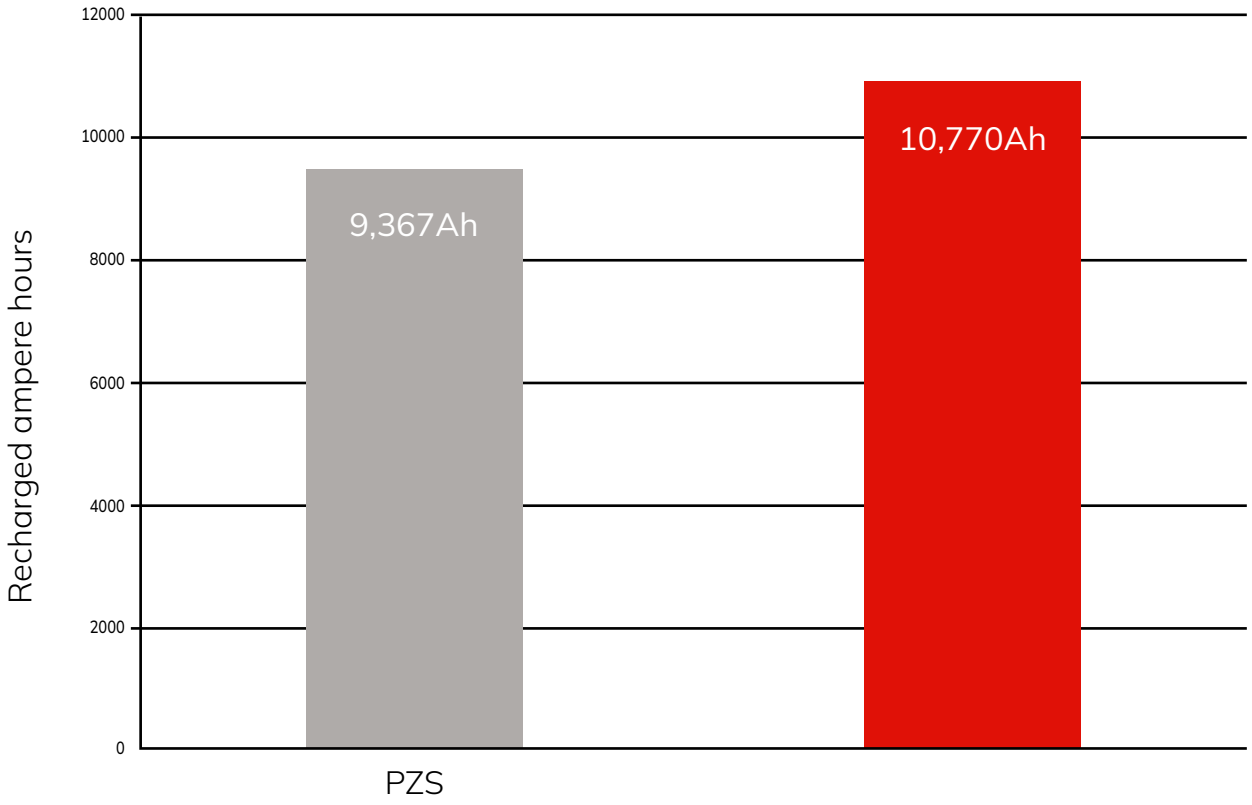
Ampere Hour Turnover



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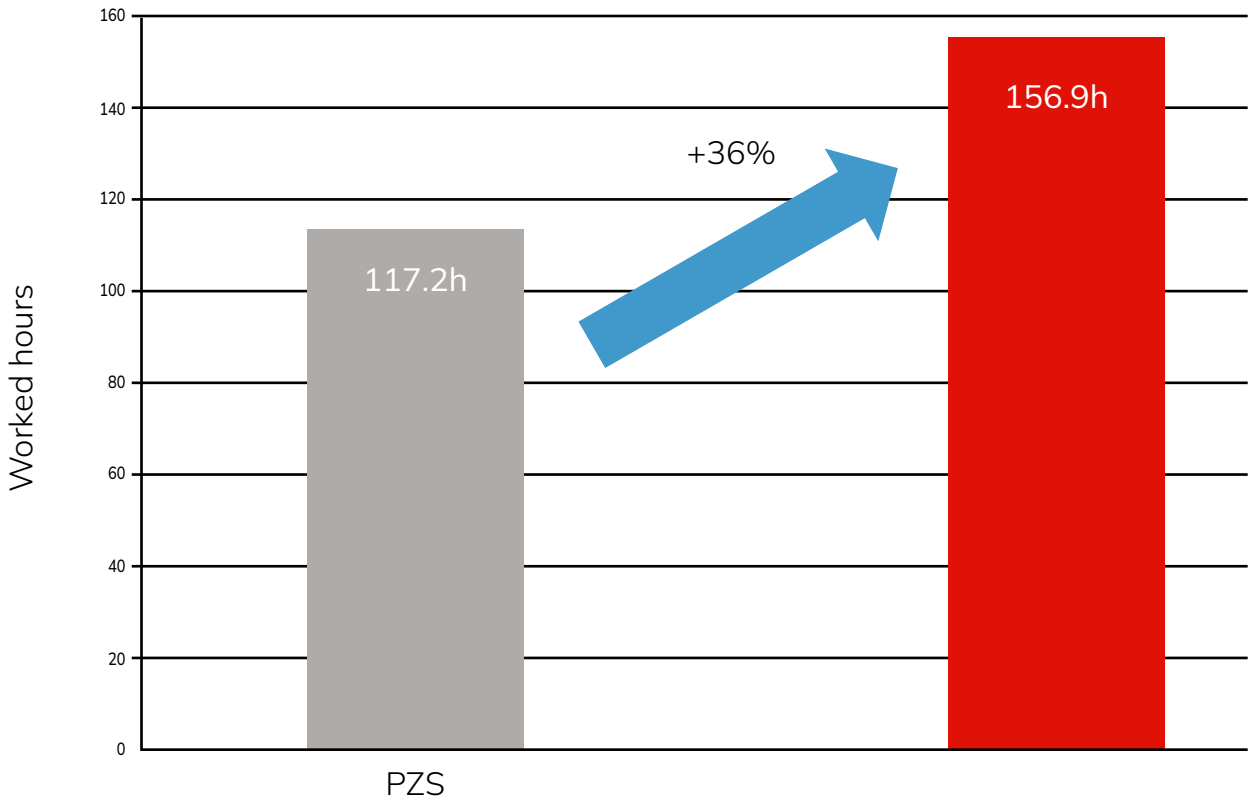

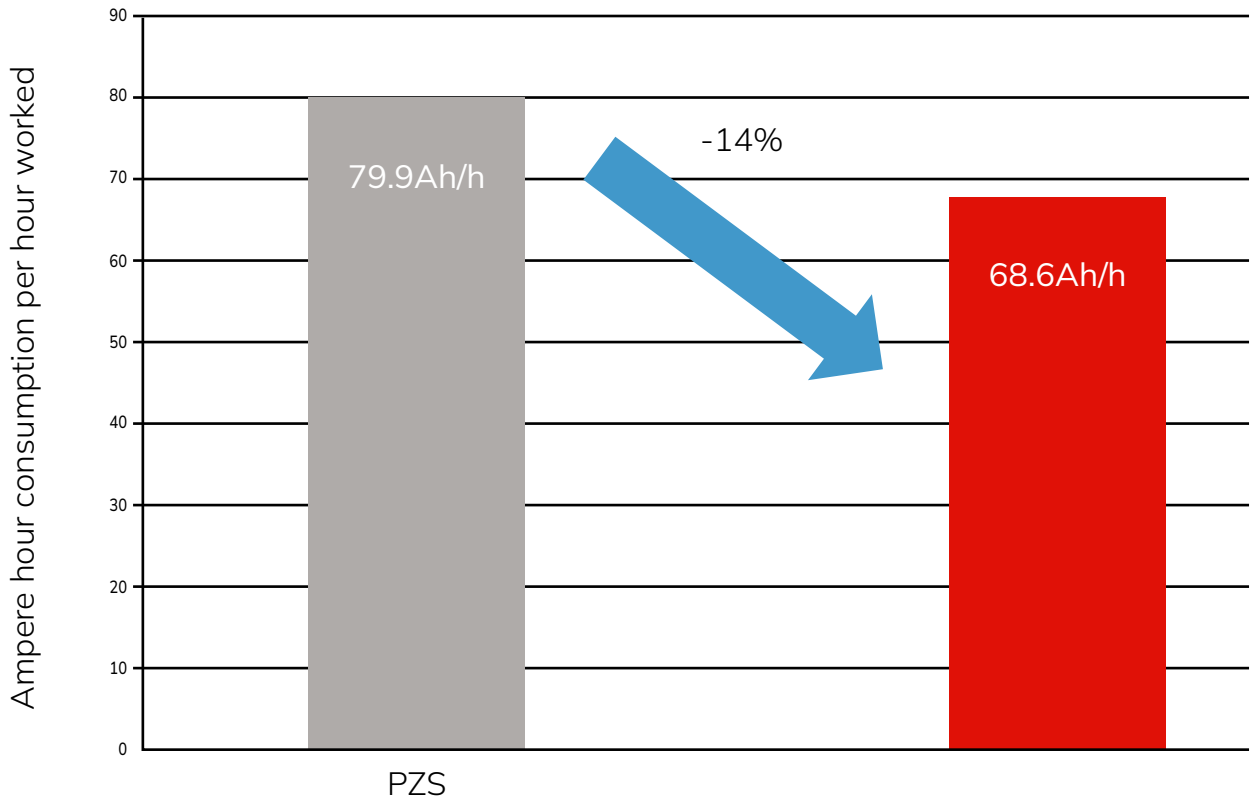
Ampere hour consumption per hour worked
90
80
70
60
50
40
30
20
10
0
79.9Ah/h
-14%
68.6Ah/h
PZS


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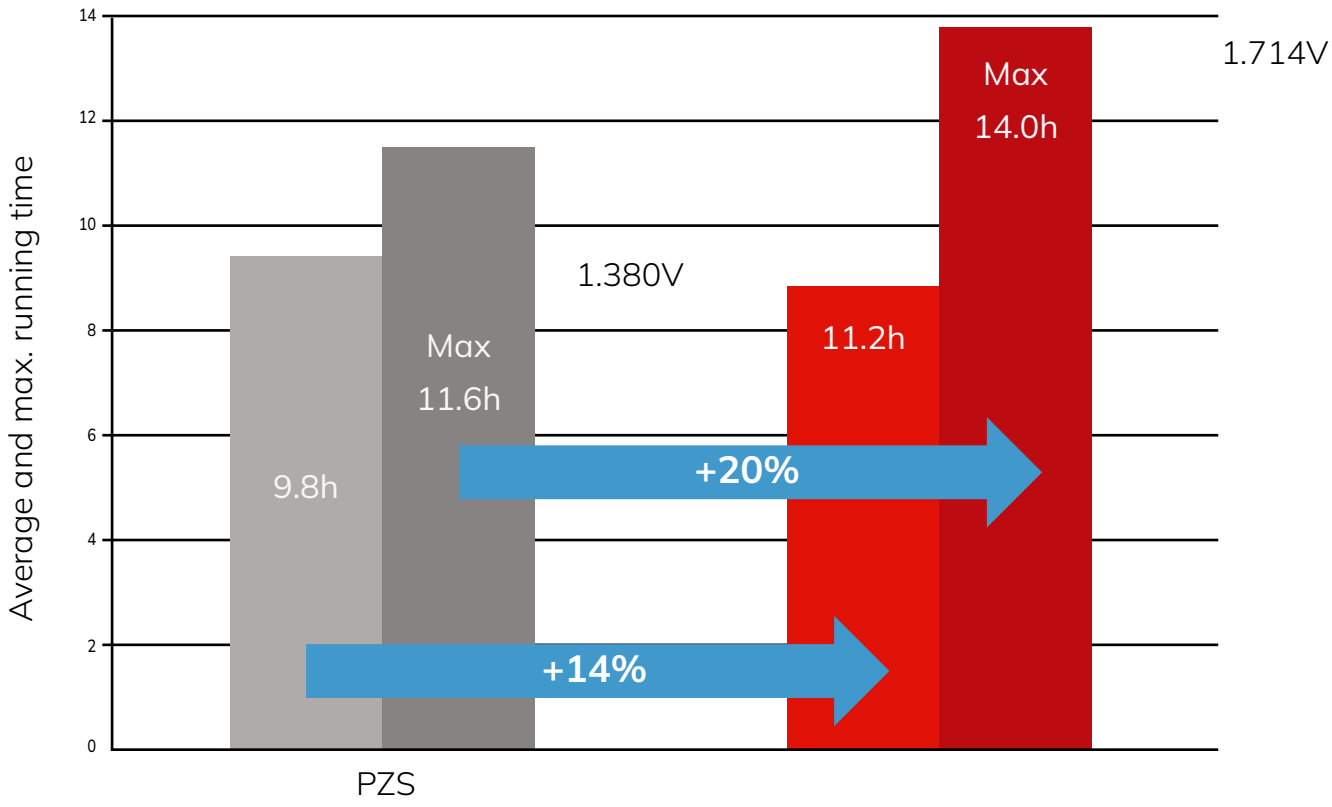

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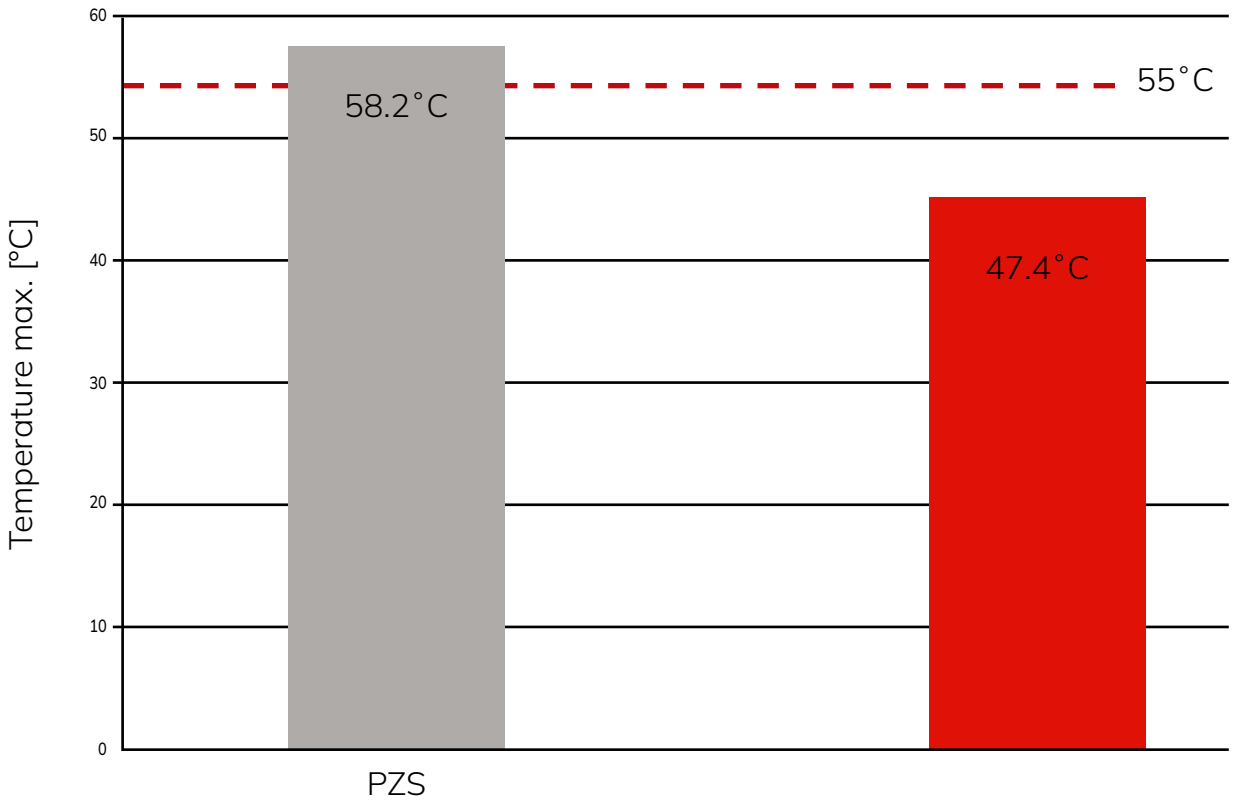

Case Example #3

Cold Storage

- POWERHOUSE vented battery 48V 1620 TCSM (C5: 840Ah)
- Standard battery 48V 5 PzS 775 (C5: 775Ah)
- Area of Application: Cold storage (-25°C) // Fresh fruits area (+5°C)
- Standard charging regime for flooded batteries at low temperatures
- 2 Reach trucks Linde R16
- Battery changing pool (4 batteries)
- Test period: 10 weeks

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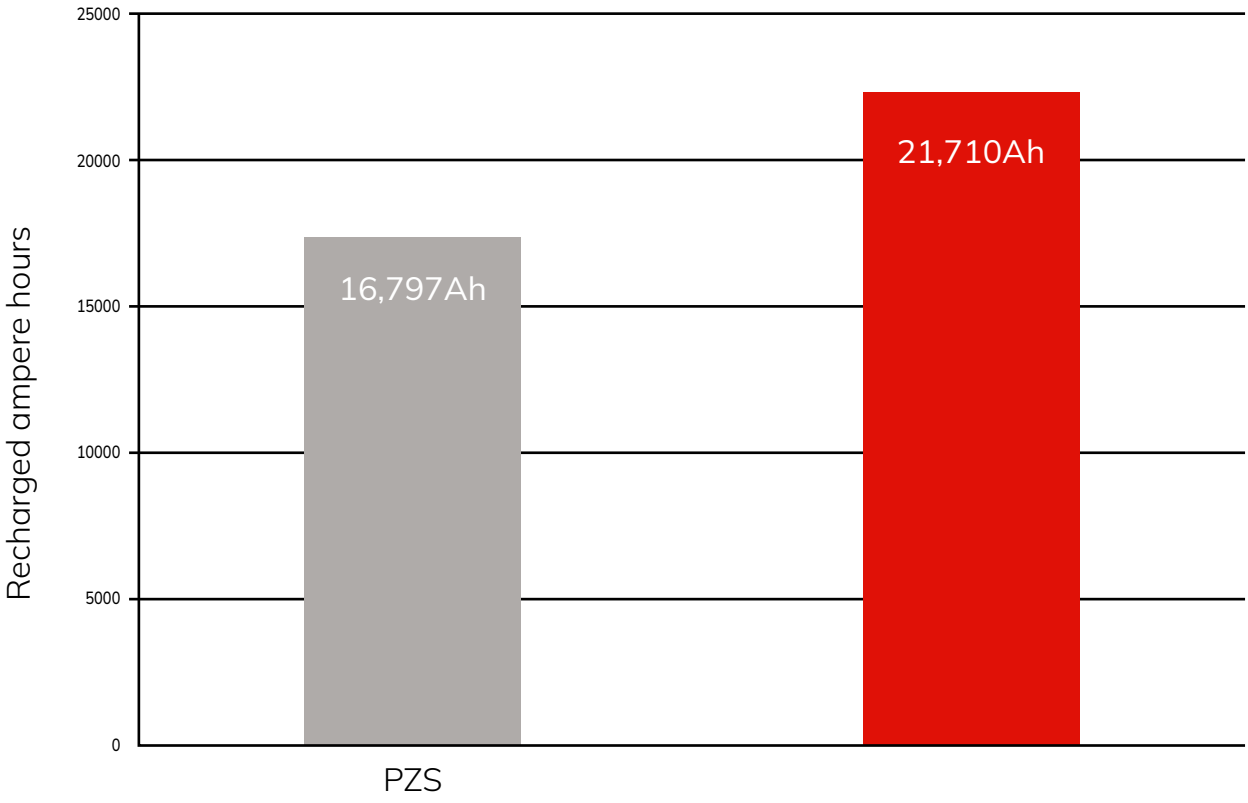

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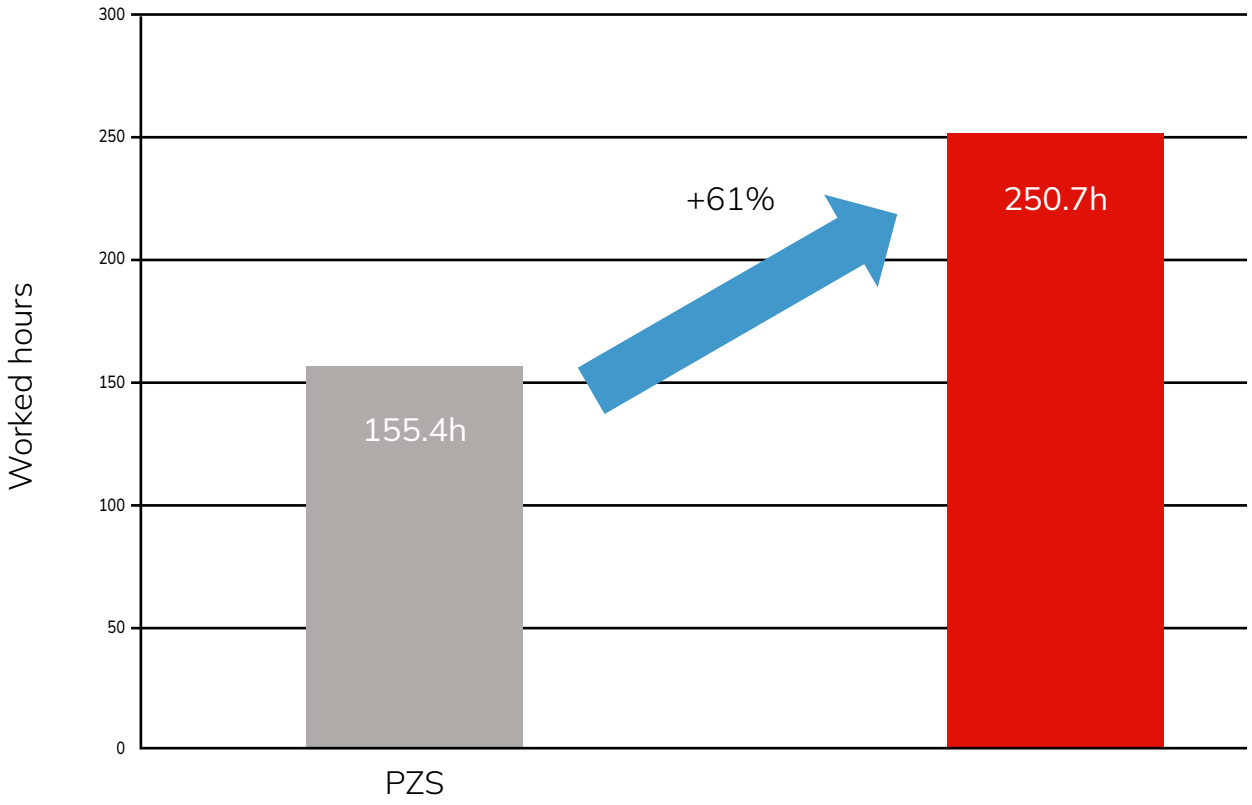

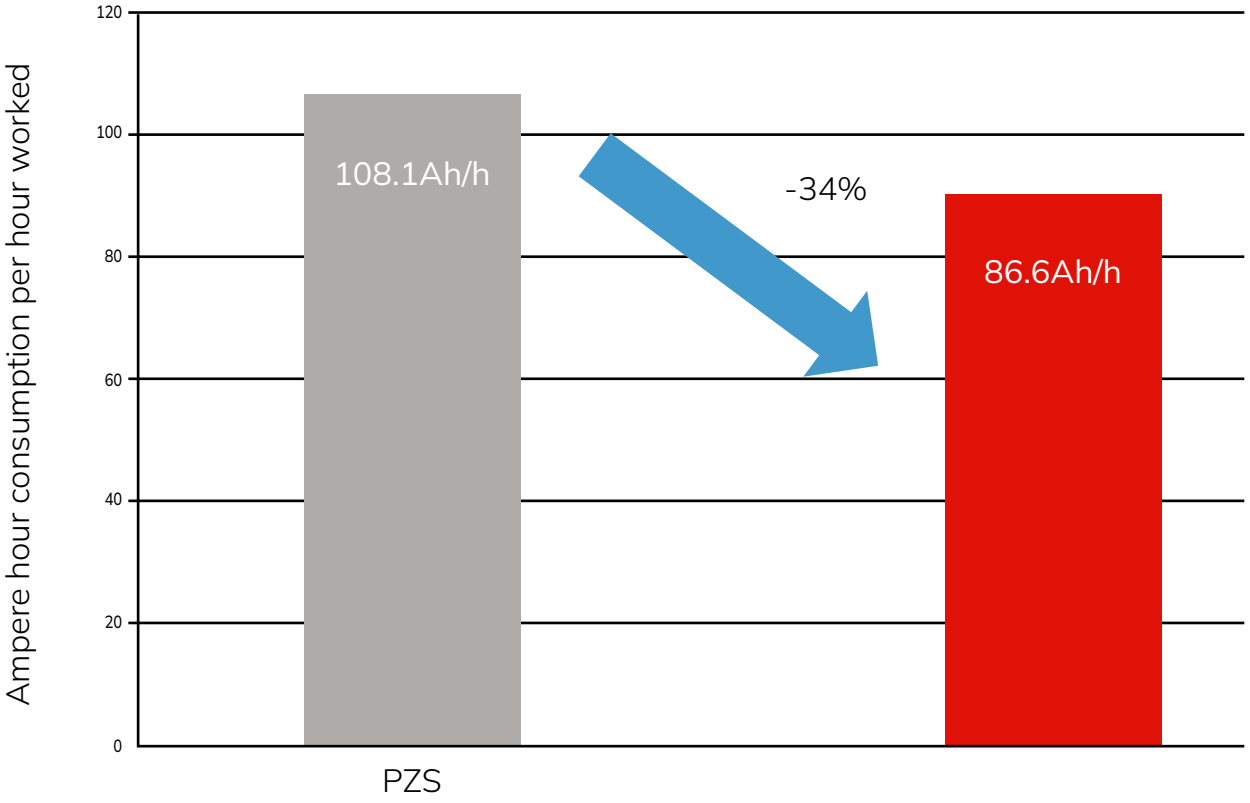
Ampere hour consumption per hour worked
120
100
80
60
40
20
0
108.1Ah/h
-34%
86.6Ah/h
PZS


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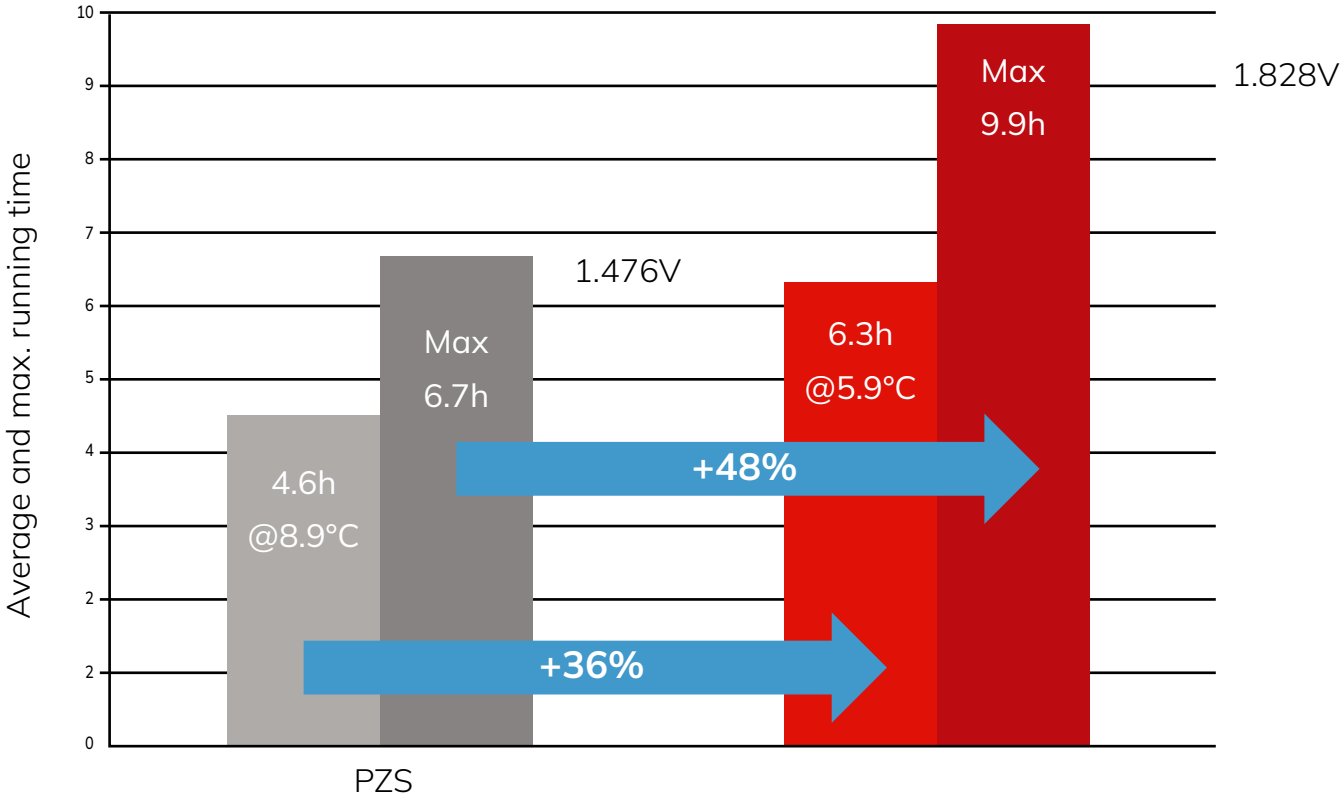
MERCAS


Average and max. running time
10
9
8
7
6
5
4
3
2
2
0
Max
9.9h
1.828V
1.476V
Max
6.7h
6.3h
@5.9°C
4.6h
@8.9°C
+48%
+36%
PZS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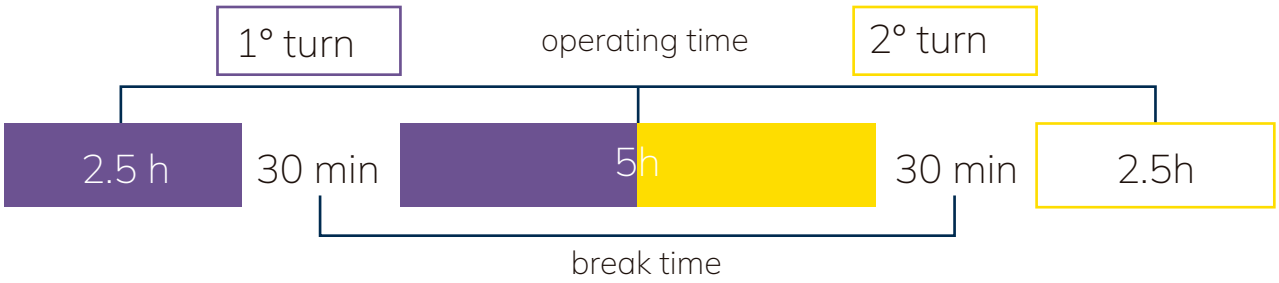
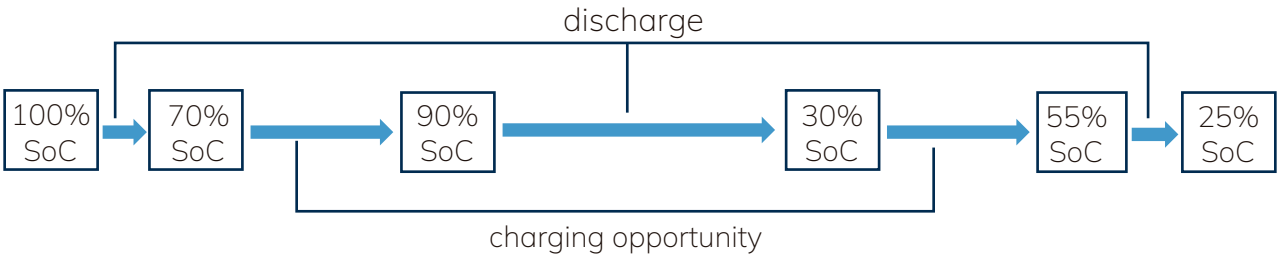
Multi-shift + Fast Opportunity Charging





POWERHOUSE VRLA

New Development

Standard VRLA GEL Batteries usually have:

- Lower capacity Ah (for same cell dimensions)
- Higher charging time (12-14h)

But with POWERHOUSE VRLA:

High availability of industrial trucks due to...

- ... higher capacity and voltage level
- ... significant reduction of the charging time (7 – 8 hrs.)
- .... efficient intermediate and opportunity charging
- Maintenance-free -> 'Install-and-forget'

Product Properties

Expected performance of the POWERHOUSE VRLA product line

- Maintenance-free: No time and infrastructure for water refilling required
- Operational time of POWERHOUSE VRLA similar to standard lead acid at room temperature
- Operational time of POWERHOUSE VRLA exceeds standard lead acid at low temperatures
- Full recharge of POWERHOUSE VRLA from 30% to 100% state of charge in 7 hours
- POWERHOUSE VRLA is capable to opportunity and intermediate charging'

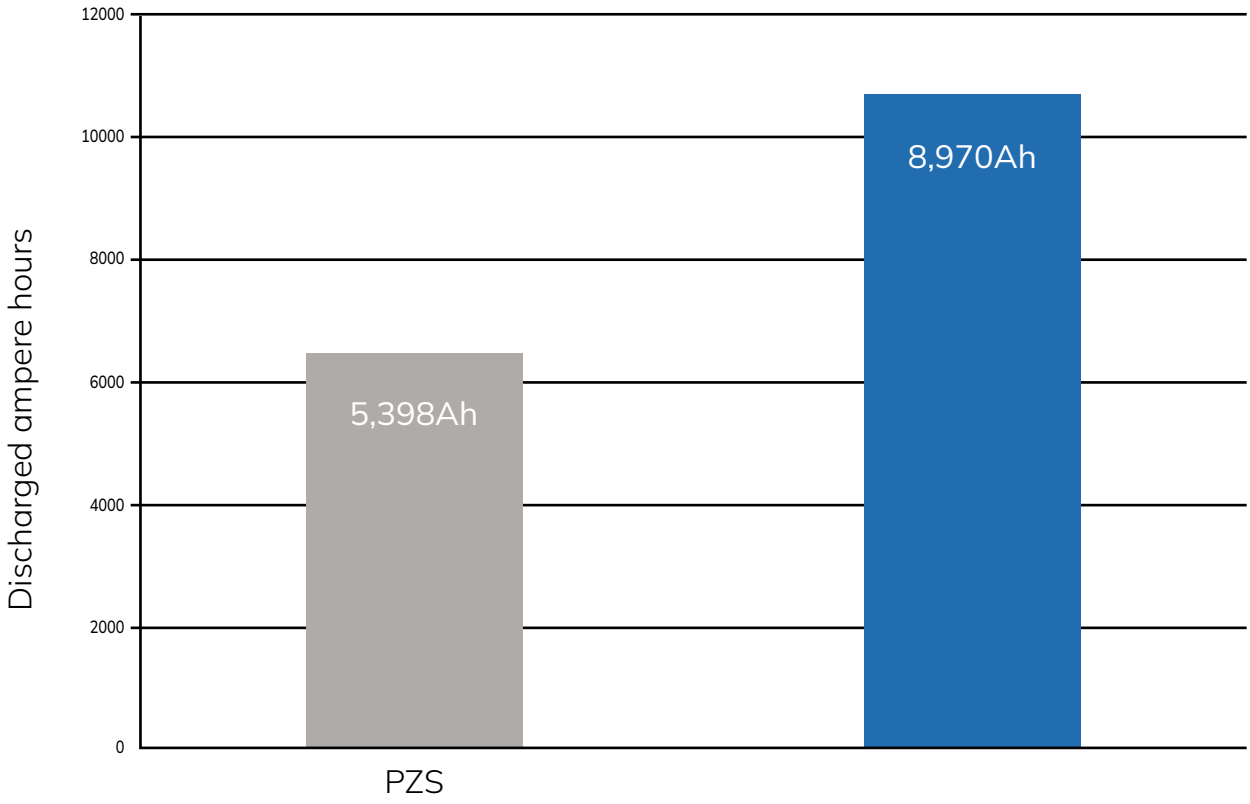
Case Example #1

Automotive Customer

- POWERHOUSE VRLA 80V 3 PCSV 450 (C5: 450 Ah)
- Versus: Standard GEL 80V 3 EPzV 360 (C5: 360 Ah)
- Counterbalanced truck 1.8tn.
- Charger with gel profile
- Automotive customer
- Testing: 5 weeks

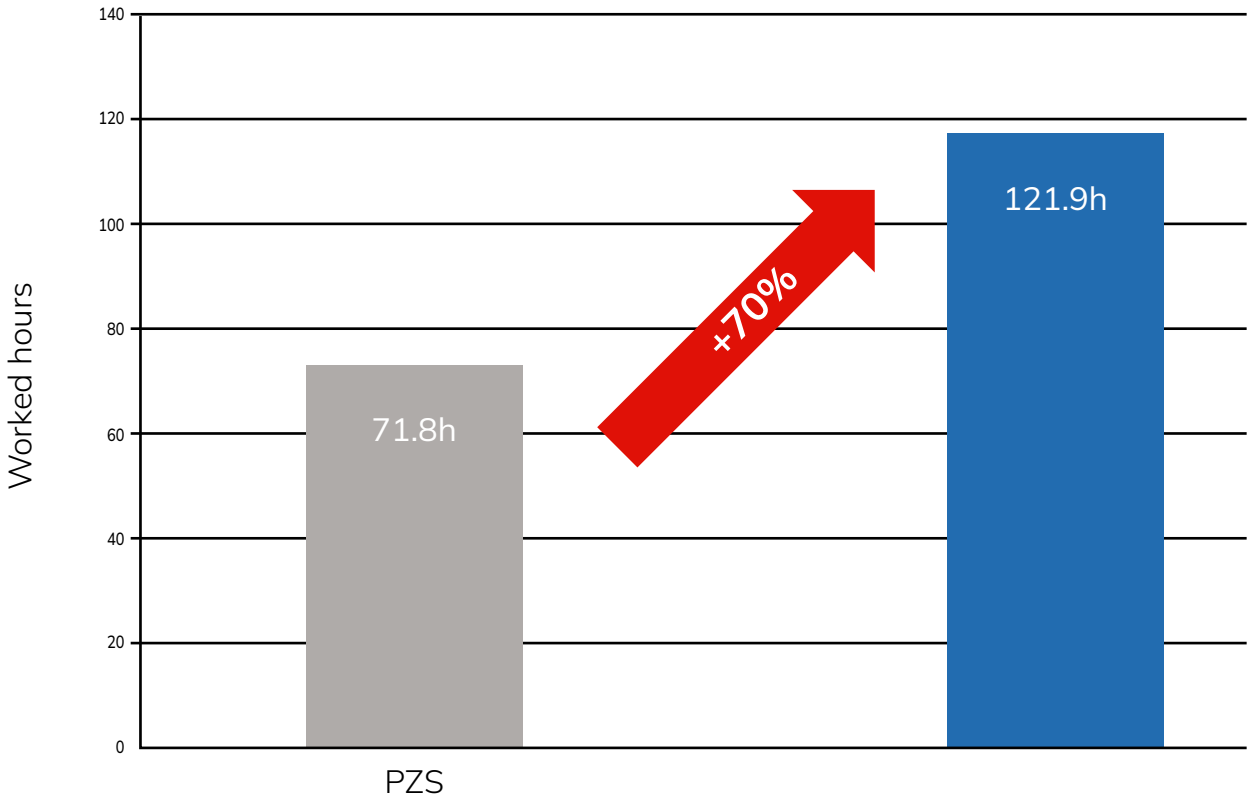
Test Results #1

Discharged Ah



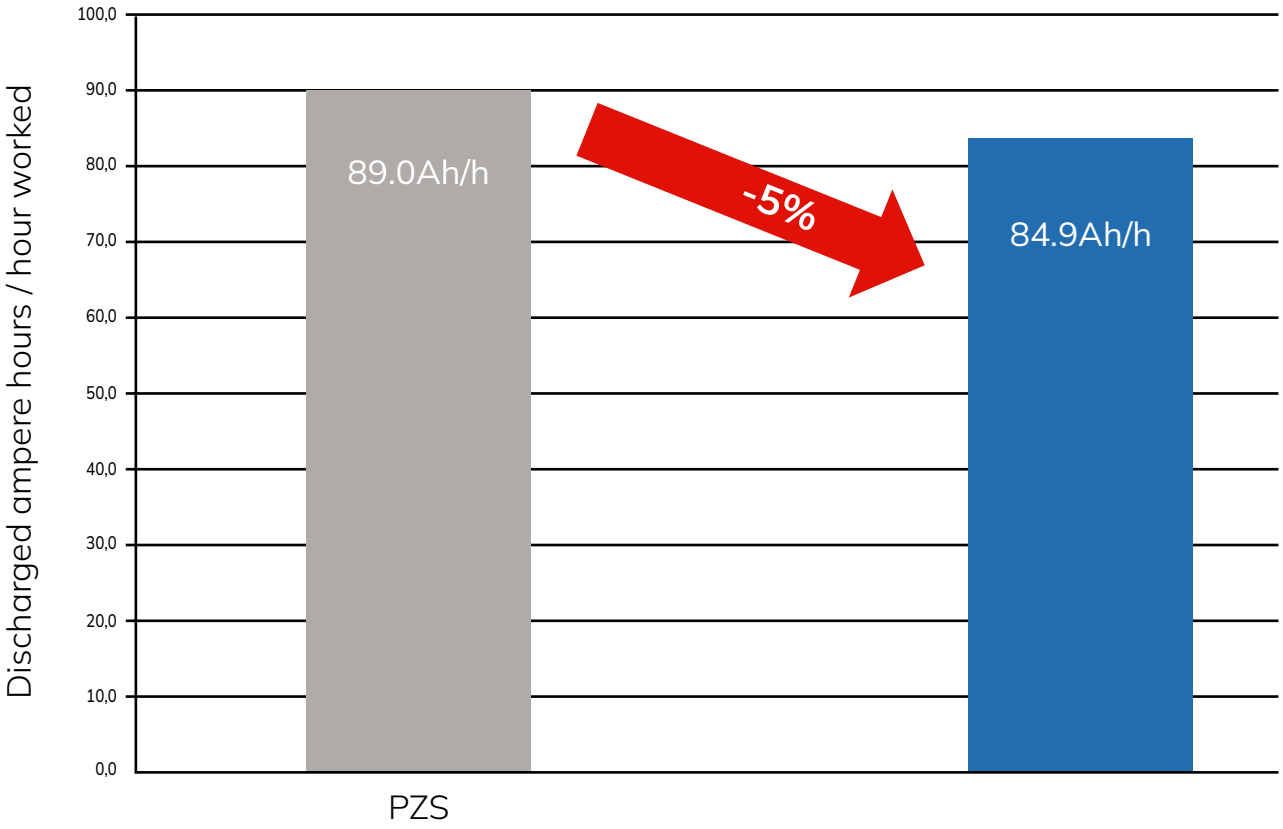
Test Results #1

Operating Hours



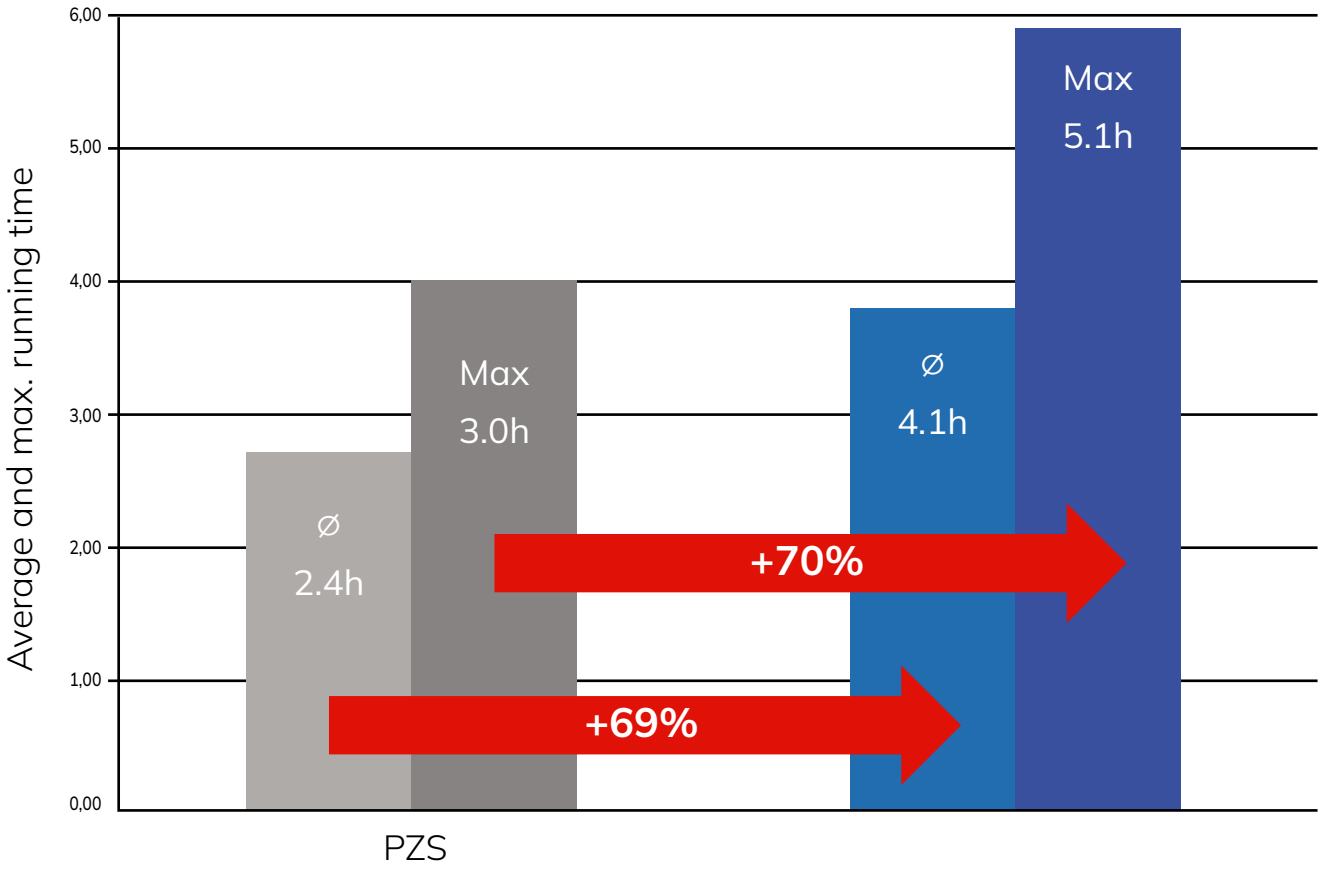
Test Results #1

Energy Consumption Ah/h



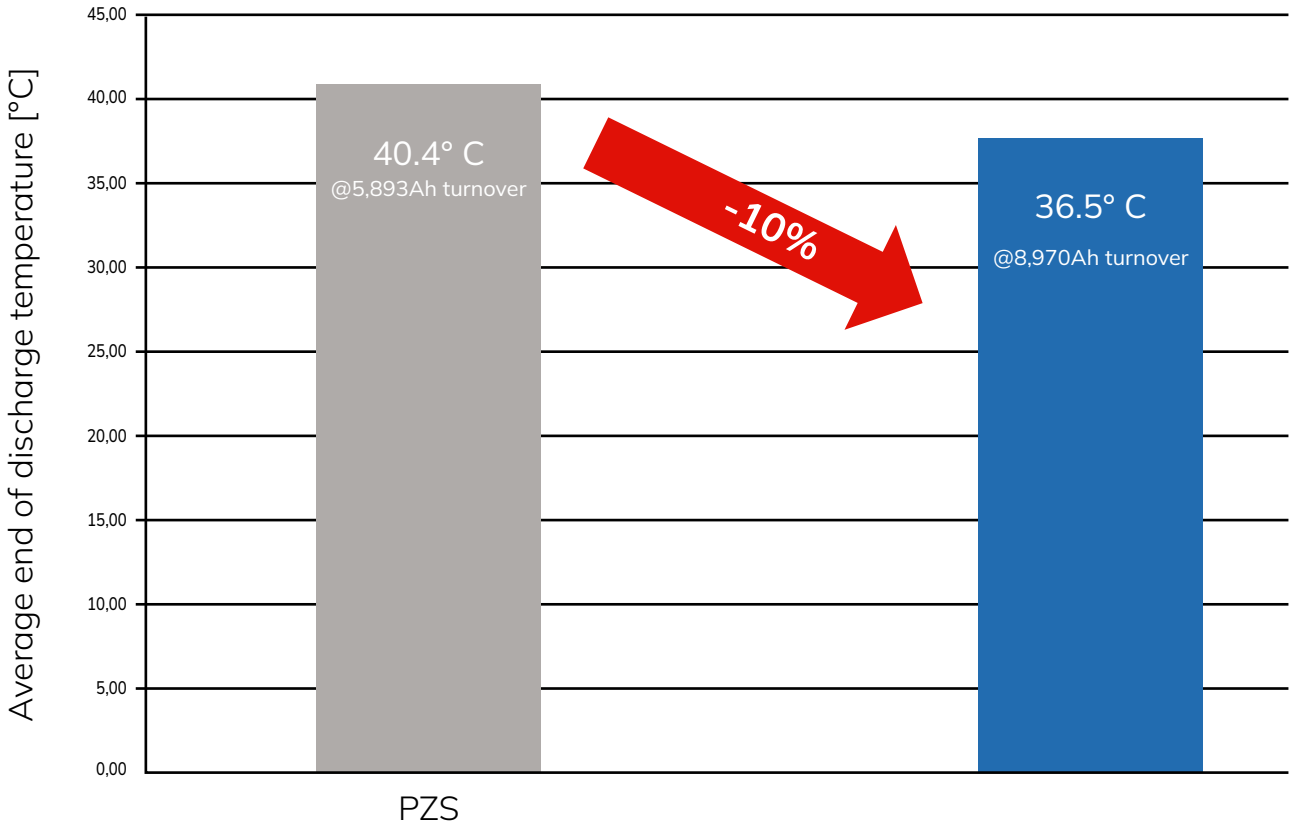
Test Results #1

Running Time



Test Results #1

Temperature



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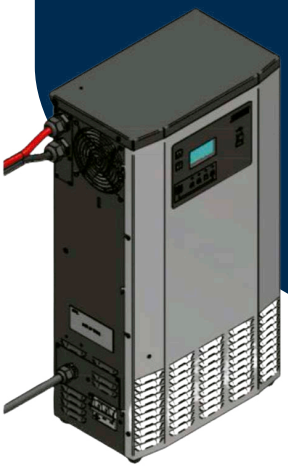

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