Smart Traction Battery

User Guide

Smart PzS/PzB Lead-Acid Traction Battery with tubular electrode

Rated data

1. Rated capacity C_5 : see type plate
2. Rated voltage : 2.0 V × number of cells
3. Discharge current : $I_5 = C_5 / 5$ (A)
4. Rated electrolyte density **: 1.29 (kg/l)
5. Nominal temperature : 30°C
6. Nominal electrolyte level : for batteries with manual topping up, within the range marked 'min.' and 'max.'
   for batteries with an AQ set, the level is automatically topped up – see the AQ set user manual

** Achieved during the first 10 cycles

	Follow the instructions for use and keep them in a visible place where charging takes place. Only trained personnel are permitted to work with the batteries
	Wear protective equipment (goggles, gloves and an apron) when working with batteries Comply with health and safety regulations and applicable local regulations.
	No smoking. Do not use open flames, hot objects or sources of sparks in the vicinity of the battery. Increased risk of explosion and fire.
	If electrolyte comes into contact with your eyes or skin, rinse thoroughly with plenty of clean water – continue rinsing for at least 15 minutes. Then seek medical attention immediately. Wash clothing soiled with acid in water.
	Risk of explosion and fire. Prevent short circuits in the battery. Warning! The metal parts of the battery cells are always live; therefore, do not place any foreign objects or tools on the battery.
	The electrolyte is highly corrosive.
	Do not tip the battery. Batteries are heavy; ensure they are stored safely. Use only approved lifting and handling equipment. Lifting hooks must not cause damage to the cells, connecting bridges or connecting cables.
	Dangerous electrical voltage. A short circuit in the battery poses a risk of injury. A high short-circuit current can cause burns.

Failure to follow the instructions in the user manual, repairs using non-original spare parts, and unauthorised modifications will void the warranty.

1 
Pb
2 

Battery recycling

16. Used lead-acid batteries are subject to specific waste recycling regulations.
17. Batteries marked with symbol (1) must not be disposed of with industrial or household waste.
18. Batteries marked with symbol (2) are recyclable products and must be handed over for recycling.
19. The method of battery take-back and disposal is laid down in Act No. 106/2005, Section 38, points 3, 4 and 5
20. The obligation to provide information and ensure the take-back of batteries sold lies with the person or organisation that manufactures or places the batteries on the market in the Czech Republic.

If you require lead-acid batteries to be disposed of, please contact us on Tel: +420 315 721 445-7 or email:info@ibg.cz

1. Commissioning of batteries

Check that the battery is in good mechanical condition. The screw connections at the terminals must ensure perfect electrical contact; the battery terminals must be connected with the correct polarity. Failure to do so may result in damage to the battery, the vehicle or the charger.
Tightening torques for terminal screws on the terminal connectors and connecting bridges:

steel M10	brass M10
23 ± 1 Nm	23 ± 1 Nm

Check that the electrolyte level is correct. If the level is below the base
plastic basket or below the upper edge of the separator, top up the battery with demineralised water.
Top up to the 'max' mark or until the bottom of the plastic basket is covered. If the battery is fitted with the AQ SET central topping-up system, follow the AQ SET instructions for use.

Topping up with demineralised water is carried out just before or after charging is complete.
Topping up with demineralised water before charging is permitted only if the electrolyte level in the battery is undetectable.

2. Operation

The operation of traction batteries is governed by standard ČSN EN 50272-3 (DIN/VDE 0510 Part 3) and, in general, by standard ČSN EN 60 254-1.

2.1 Discharging

Ventilation openings must not be closed or covered. Disconnecting or connecting electrical connections (e.g. plugs) may only be carried out when the circuit is de-energised. To achieve optimum service life, operational discharge exceeding 80% of the rated capacity must be avoided. Discharge exceeding 80% of the rated capacity constitutes deep discharge and shortens the overall service life of the battery.

A deep discharge state corresponds to an electrolyte density of less than 1.13 kg/l. Discharged batteries must be recharged immediately and must not be left in a discharged state. This also applies to batteries that are only partially discharged – there is a risk of irreversible damage to the battery.

2.2 Charging

Charging must only be carried out in designated areas that meet the operating conditions set out in the ČSN EN 50 272-3 standard. Batteries may only be recharged using direct current in accordance with the ZVEI technical guideline.
Batteries must only be connected to a suitable charging device that corresponds to the battery's capacity, in order to prevent overloading of electrical circuits and contacts, increased gas formation and electrolyte leakage from the cells caused by an increased volume of electrolyte.
Once gassing occurs, the current limits specified in the ZVEI 10 technical standard 'Dimensioning of Charging Devices' must not be exceeded.

If the charging device was not purchased together with the battery, it is recommended that the battery manufacturer's customer service department check for compatibility.

Before charging begins, ensure that gases are fully vented. Lids or covers of built-in battery compartments must be opened or removed. The battery caps on the cells remain closed – they are fitted with ventilation holes. The battery is connected to the charger using a suitably rated connector, the design of which prevents reverse polarity – the mechanical condition must be checked – as damage to the connector may result in reverse polarity. No current must flow through the battery when the connectors are being connected or disconnected. Charging is started by switching on the power switch or automatically in the case of chargers with an automatic delayed start.
During charging, the temperature inside the battery rises by approximately 10°C. Charging should therefore only be started when the battery temperature is below 45°C. The temperature before charging must be at least +10°C; otherwise, a proper charge will not be achieved. A battery is considered fully charged when the electrolyte density and battery voltage remain constant for a period of 2 hours.

Special precautions for operating batteries in hazardous environments:

These are batteries used in accordance with EN 50014, DIN VDE 0170/0171 Ex I in areas where explosive gases are present, or in accordance with Ex II in areas at risk of explosion. The warning labels on the battery must be observed. During charging and gas generation, the container lids must be lifted or opened so that the resulting explosive gas mixture loses its explosive properties through adequate ventilation.

2.3 Equalisation charging

Equalisation charging serves to ensure a long service life and to maintain a balanced capacity across all battery cells. The recommended interval for regular
equalisation charging is recommended once a week. Equalisation charging is essential following deep discharge of the battery, repeated insufficient charging, and when charging according to the IU characteristic curve. Equalisation charging is carried out following normal charging.
The charging current may be a maximum of 5A per 100Ah of rated capacity; the temperature during equalisation charging must not exceed 55°C.

2.4 Temperature

Observe the specified temperature!
An electrolyte temperature of 30°C is designated as the nominal temperature. Higher temperatures shorten the service life, whilst lower temperatures reduce the available capacity. A temperature of 55°C is the battery's maximum operating temperature; if this is reached, the battery must be taken out of service immediately and the cause investigated.

2.5 Electrolyte

The nominal density of the electrolyte refers to 30°C and the nominal electrolyte level when the battery is fully charged. Higher temperatures reduce the density of the electrolyte, whilst lower temperatures increase it. The relevant correction factor is 0.0007 kg/l per °C (e.g. an electrolyte density of 1.28 kg/l at 45°C corresponds to a density of 1.29 kg/l at 30°C). The purity of the electrolyte must comply with the requirements of DIN 43 530 Part 2.

3. Maintenance

3.1 Daily maintenance

After each discharge, the battery must be recharged immediately until the charger switches off automatically. Before and at the end of charging, a visual inspection must be carried out to check the mechanical condition of the battery, the connector, the battery charging cables and the charger, as well as the correct electrolyte level. If the level is low, the battery must be topped up with demineralised water at the end of charging (see the AQ Set user manual, Chapter 6). After charging, check that the battery surface is clean and that there is no liquid in the tray. If the battery surface is found to be contaminated with electrolyte or if liquid is present in the tray, clean the surface and remove the liquid from the tray – when carrying out these tasks, you must use the prescribed personal protective equipment.

3.2 Weekly maintenance

As part of weekly maintenance, a top-up charge of the batteries is carried out (see Section 2.3).

3.3 Monthly maintenance

With the charger switched on, the voltage of all cells and their specific gravity are measured and recorded on a fully charged battery. If a voltage difference greater than 0.1 V is detected between cells during charging, an equalisation charge must be carried out in accordance with Section 2.3.

3.4 Annual maintenance

In accordance with the ČSN EN 50272-3 (DIN VDE 0117) standard, and at least once a year, a qualified technician must carry out a technical inspection of the battery, including measuring the insulation resistance and cleaning the battery surface.
The battery's insulation resistance must be checked in accordance with the ČSN 332610 standard. The battery's insulation resistance should not be less than 50 ohms per volt of rated voltage. For batteries with a rated voltage of up to 20 V, the minimum value is 1000 ohms.

4. Maintenance

The battery must always be kept clean and dry to prevent the formation of creep currents. Cleaning is carried out in accordance with technical standard ZVEI 6, 'Cleaning of traction batteries for vehicle propulsion'. Any fluid from the battery tray must be drained off and disposed of as waste in accordance with regulations. Any damage to the insulation of the tray must be repaired after cleaning. This ensures that insulation resistance values are maintained and prevents corrosion of the tray. If it is necessary to remove the cells, the manufacturer's service department must be contacted.

5. Storage
If the batteries are out of service for an extended period, they must be fully charged and stored in a dry place at a temperature of 10°C to 30°C. To ensure the battery remains in a ready state, choose one of the following storage maintenance methods:

7. Monthly equalisation charging as per section 2.3.
8. Trickle charging at a charging voltage of 2.23 V × the number of cells.

The storage period shall be taken into account in the overall service life.

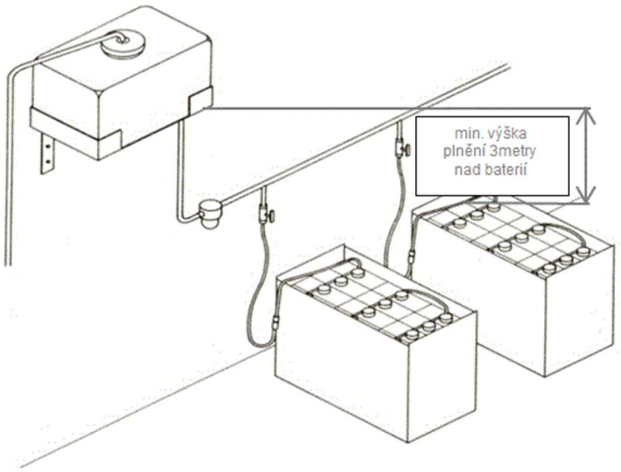
6. Faults
If a fault is detected in the battery or the charger, the manufacturer's customer service must be notified immediately:

servis@ibg.cz **+420 315 721 446**

The measured values specified in section 3.3 facilitate fault diagnosis and troubleshooting.

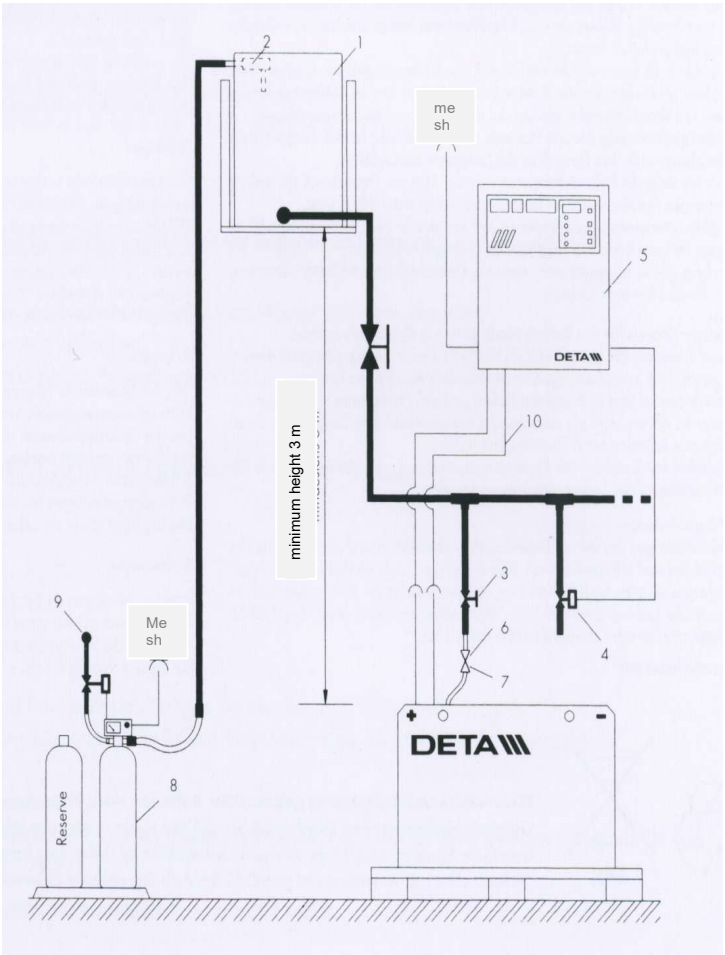
7. Service contract
By entering into a service contract, you ensure the reliable operation of the battery throughout its entire service life.

AQ SET
Central demineralised water top-up system (optional extra)



Refilling unit

1. Storage tank
2. Float switch
3. Top-up station with manual shut-off valve
4. Top-up station with solenoid valve
5. Charging unit
6. Quick-connect coupling (located on the refuelling system)
7. Quick-connect fitting (located on the tap)
8. AQUABATERIE demineralised water production unit
9. Water inlet
10. Charging cables



1. Description

The AQUA SET BFSIII top-up system is designed for the automatic top-up of the electrolyte level. AQ BFSIII plugs are fitted to all battery cells; these automatically shut off the water supply to the cell as soon as the electrolyte level reaches the required level.
AQ plugs for different cell types must not be interchanged.

The AQ plugs are interconnected by a hose (maximum of 20 in a single branch). The AQ set is connected to the topping-up system, which is fitted with a filling connector, via the battery's Aquamatik connector. AQ plugs are fitted with vents to release gases produced during charging, an inspection hole (see section 9.1) and a visual level indicator. The AQ set BFSIII system is an integral part of the battery.

2. Application

The AQUA SET BFSIII system can be fitted to all types of Smart batteries with PzS and PzB traction cells,

3. Function of the AQ plugs

AQ plugs with floats (type BFS III) automatically shut off the water supply to the cell as soon as the electrolyte level reaches the required level. The float controls a valve inside the plug via a lever mechanism.
Once the cap of the AQ SET BFSIII plug has been opened, the inspection port allows the electrolyte density, temperature and correct electrolyte level to be measured.
Once the necessary checks have been carried out, the cap must be closed.

4. Topping up

Batteries must be topped up shortly before the end of a full charge or shortly after charging has finished. Topping up at this point ensures that the correct amount of distilled water is added and that the electrolyte is thoroughly mixed.

To top up the battery, connect the terminal of the battery's AQ set to the terminal of the topping-up device. Once the battery has been topped up (indicated by the flow indicator – see section 10.1), disconnect the terminal of the battery's AQ set. Check that all the visual indicators are in the upper position (white discs at the top).
During normal operation, the top-up interval is generally once a week.
In multi-shift operation, the topping-up interval is once every 5 charging cycles.

Top-up must not be carried out before charging begins, as electrolyte may leak from the battery during gassing (increase in liquid level).

4.1. Manual (by hand) from a storage tank (by gravity)

When topping up by gravity from a storage tank, the correct positioning of the top-up tank must be ensured.
BFS III system (black plugs) filling pressure 0.3–1.8 bar
Any deviations affect the correct functioning of the AQ plugs

4.2. Manual refilling using a mobile refilling trolley

When refilling using a mobile refill trolley, the prescribed filling pressure (0.3–1.8 bar) must be maintained using a water pump.

4.3. Automatic topping up

Battery topping up is automatically controlled by the charging unit's control unit. Topping up takes place shortly before the end of the charging cycle. Topping up at this point ensures that the correct amount of distilled water is added and that the electrolyte is thoroughly mixed. To top up the battery, the battery's quick-connect coupling must be connected to the top-up device's quick-connect coupling; the opening of the solenoid valve is controlled by the charging unit.
Once the battery has been topped up (indicated by the flow indicator – see section 10.1), disconnect the quick-connect coupling and check that all optical indicators are in the upper position (white discs at the top).
During normal operation, the refilling interval is generally once a week (to refill, the refilling quick-connect couplings must be connected)

5. Recharging time

The duration of the refilling process depends on the intensity of the battery's discharge, the operating temperature and the filling pressure. The
takes approximately 0.5–4 minutes.

6. Water quality

The water used to top up the batteries must comply with the requirements of DIN 43530 Part 4: conductivity 30 micro-Siemens/cm. The topping-up equipment (filling tank, pipework, valves, filters) must not be contaminated; the conductivity of the water from the generator must be 10 micro-Siemens/cm. For safety reasons, it is recommended to install a filter in the topping-up system and in the IBG AQUAMATIC BFSIII system fitted to the battery.

7. Connecting the hoses to the battery

The hoses for the individual cells are connected separately alongside the electrical connections – they mirror the electrical circuit. Do not alter the connections – this may damage the battery.

8. Operating temperature

The maximum operating temperature for the battery is set at 55°C. Exceeding this temperature will result in damage to the battery. The AQ set BFSIII may be operated within a temperature range 0 °C to a maximum of 55 °C.

Warning!!!

Batteries with the AQ SET BFSIII system must be stored in areas with a temperature above 0°C (risk of the system freezing).

Using the wrong size float may damage the battery.

9. Cleaning

The AQ SET BFSIII system may only be cleaned with water or steam.
The use of cleaning agents is prohibited

10. Accessories

10.1 Float

The float is part of the AQ plug. The size of the float varies depending on the specific unit.

10.2 Flow indicator

The flow indicator is fitted to the filling device (or the battery) and is used to monitor the filling process (water flow). When the battery is being filled, the flow indicator's propeller rotates due to the flow of water. Once all cells have been filled, the flow indicator's propeller stops, signalling the end of the filling process.

10.3 Filter

For safety reasons, AQ SET battery-powered systems are fitted with filters. The filters are located within the hose system.
The condition of the filter must be checked regularly.

10.4 AQ SET Battery Connector

AQ SET battery connectors and filling units with non-return valves are used to connect the AQ SET BFSIII refill system.
The use of unauthorised connectors is prohibited.

Note: If, after connecting the battery to the top-up device, the indicator propeller does not rotate and the optical indicator (white discs) is at the bottom, it is necessary to check the top-up system for blockages.

11. Maintenance

The AQ SET BFSIII system must be checked regularly for mechanical damage to ensure safe operation; it must be kept clean and the entire system checked for leaks. Furthermore, the openings for the venting of gases produced during charging must be checked and kept clear.

EUW set

forced electrolyte circulation (optional equipment)

19. Application

The EUW set's forced circulation system is suitable for:

- heavy-duty applications with a draw of 80% of the rated capacity and high current draws,
- reducing charging time to as little as 5.5 hours
- extending battery operating time in single- or two-shift operations through interim charging (see Chapter 2)
- operations in high ambient temperatures

20. Description of operation with intermediate charging

In battery operation with intermediate charging, partially discharged batteries are recharged, thereby increasing the usable capacity between two full charging cycles.

During interim charging, the battery is not fully charged.
A full charge must be carried out once every 24 hours.

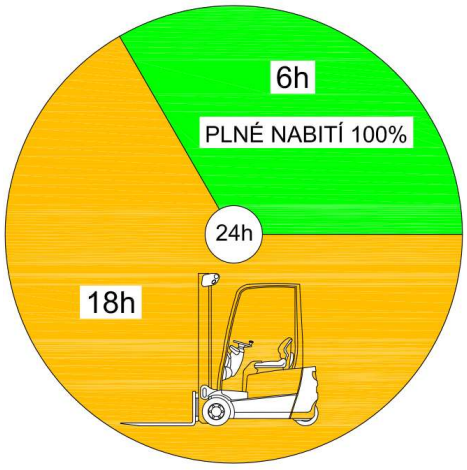


Fig. 1: Illustration of a 24-hour battery cycle
18 hours Battery operation with interim charging
6 hours Full battery charge

Battery operation with interim charging is suitable for single-shift or two-shift operations using a single battery, where daily energy consumption exceeds 80%.

For continuous three-shift operations, battery operation with intermediate charging must be discussed with the battery manufacturer.
Continuous operation of the battery using only top-up charging leads to a reduction in capacity, sulphation and permanent damage to the battery.

21. Function

The forced electrolyte circulation system is based on the principle of forcing air into each battery cell. The EUW system mixes the electrolyte within the cells and ensures its uniform density. The EUW air-forced electrolyte circulation system consists of a network of tubes inserted into the cells. An air diaphragm pump is built into the charger. This diaphragm pump forces air into each cell, causing forced circulation of the electrolyte within the cell. The circulation mode can be continuous or intermittent, depending on the type of charger.
The tubes in the EUW set must be connected in such a way that no creeping currents can flow between adjacent cells (it is recommended to check the electrical connection of the cells). Creep currents can cause sparking, and during charging there is an increased risk of explosion from gases generated during the charging process (ČSN EN 50272-3).

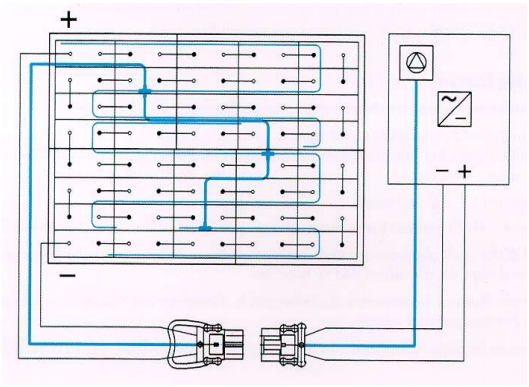


Fig. 2 Schematic diagram of the EUW forced mixing system

22. Connection

4.1 External EUW terminal

The EUW battery terminal is manually connected to the external EUW terminal of the charger.

4.2 Via the battery connector

Once the battery's charging connector has been connected to the charger's connector with integrated EUW adaptors, the EUW set is automatically ready for operation.

23. Maintenance

The air pump filter should be replaced at least once a year, depending on the working environment. In very dusty working environments, the filter must be checked and replaced more frequently.

24. EUW fault

A fault in the EUW system is indicated by the charger.
If the charger detects a pressure loss in the EUW system, it will extend the charging time by 1–2 hours. Operating the battery in trickle-charging mode with a faulty EUW system causes sulphation and permanent damage to the battery.

The technical standard ZVEI Merkblatt 10 (Interim Charging of Lead-Acid Drive Batteries 2009) applies to the operation of batteries in interim charging mode.

Cleaning batteries

Battery cleanliness is very important not only for aesthetic reasons, but above all for operational safety, to prevent accidents and property damage, to extend the battery's service life and to enhance its operational reliability.

Cleaning batteries and battery compartments is important for maintaining the necessary insulation between cells, between the cells and earth, and between the cells and external conductive parts. A clean battery prevents damage caused by the action of the electrolyte and prevents the flow of creep currents.

The insulation resistance of traction batteries must be at least 50 Ω per volt throughout their service life (a 24 V battery = 24 × 50 = 1,200 Ω) in accordance with ČSN EN 50 272-3. For batteries used in electric land vehicles, the insulation resistance must not be lower than 1,000 Ω. Measurement procedure in accordance with ČSN EN 1987-1, clause 6.2: battery insulation resistance.

Warning: Low battery insulation resistance may cause damage to the trolley's electronics, a battery short circuit, a fire and poses a risk of electric shock.

A battery is an electrical device with external battery connectors or terminals, which are protected against contact by insulating covers. Protection by insulating covers is not equivalent to electrical insulation, as there is voltage between the terminals and the connector contacts.

Depending on the location and duration of operation, it is impossible to prevent dust from settling on the battery. Small amounts of electrolyte particles that leak out during battery charging at voltages above the gassing voltage create a more or less conductive layer on the cells or block covers. So-called creep currents then flow through this layer. The result is increased and varying self-discharge of individual cells or battery blocks.

This is one of the reasons why electric forklift drivers complain about insufficient battery capacity after the battery has been left idle over the weekend.

If higher creep currents flow, the formation of electrical sparks cannot be ruled out; these may trigger an explosion of the explosive mixture of hydrogen and oxygen released during battery charging. Therefore, cleaning the batteries is not only necessary to ensure high operational reliability, but is also an essential part of complying with regulations for the safe operation of the battery.

Cleaning of traction cell batteries

- In the operating instructions for traction batteries, attention must be paid to the guidelines highlighting the potential hazards.
- When cleaning, precautions must be taken to ensure that water or steam does not come into contact with the trolley or the charger.
- When cleaning the battery, it must be disconnected from the charger, and it is recommended that the battery be removed from the vehicle.
- The location for cleaning the batteries must be chosen so that any waste water containing electrolyte produced during this activity can be discharged into a suitable waste water treatment facility. When disposing of used electrolytes or the corresponding rinse water, health and safety regulations and legal provisions relating to water and waste materials must be observed.
- Safety goggles and protective clothing must be worn during cleaning.
- Cell caps must not be removed or opened; the cells must remain sealed. The manufacturer's cleaning instructions must be followed.
- Plastic parts of the battery, in particular the cell casings, may only be cleaned with water or with cloths soaked in water, without any additives.
- After cleaning, the battery surface must be dried using suitable means, e.g. compressed air or a dry cloth.
- Any liquid trapped in the battery trays must be extracted and disposed of in accordance with the above-mentioned regulations. (For further details on this, see also the draft DIN EN 50272-3, clauses 10.3 and 14, or the ZVEI guidelines: 'Precautionary measures when handling electrolyte for lead-acid batteries'.)

Traction batteries may be cleaned using high-pressure water or steam cleaning equipment. In this case, particular attention must also be paid to the instructions in the operating manual for the high-pressure cleaning equipment.

To prevent damage to plastic parts such as cell lids, cell connector insulation and plugs during cleaning, please note the following:

- Cell connectors must be firmly tightened or securely plugged in.
- Cell plugs must be fitted, i.e. sealed.
- Cleaning additives must not be used.
- The maximum permissible temperature setting for the cleaning equipment is 140 °C. This generally ensures that the temperature does not exceed 60 °C at a distance of 30 cm from the outlet nozzle.
- The distance between the outlet nozzle of the pressure equipment and the surface of the battery must not be less than 30 cm.
- The maximum operating pressure must not exceed 50 bar.
- The radiators must be sprayed over a large area to prevent overheating.
- The water jet must not be directed at a single point for longer than 3 seconds.
- After cleaning, the surface of the heat exchanger must be dried using suitable methods, e.g. compressed air or dry cloths.
- Hot-air guns with an open flame or heating elements must not be used.
- The surface temperature of the battery must not exceed 60 °C.
- Any liquid that has entered the battery enclosures must be extracted and disposed of in accordance with the regulations set out above. (For further details on this, see also the draft ČSN EN 50272-3, clauses 10.3 and 14, or the ZVEI guidelines: 'Precautionary measures when handling electrolyte for lead-acid batteries'.)

Declaration of Conformity

Manufacturer:	**IBG Česko s.r.o.**
Address:	V Pískovně 2053 278 01 Kralupy nad Vltavou Czech Republic Company registration number: 266 83 229 VAT No.: CZ 266 83 229

We declare, on our sole responsibility, that the product specified below complies with the requirements of the technical regulations, that the product is safe under the conditions of use specified by us, and that we have taken all measures to ensure that all products of the type specified below, placed on the market, comply with the technical documentation and the requirements of the relevant government regulation.

Product:	Lead-acid traction battery with liquid electrolyte
Type:	Smart PzS / Smart PzB comprising sealed traction cells connected in series The traction cells are housed in a steel carrier with protection against the effects of sulphuric acid. The inter-cell connectors and screws are fully insulated in accordance with IBG's technical specifications.
Optional battery accessories	• Flex US battery cable with battery connector • AQ set topping-up system for topping up the battery with demineralised water (BFSIII/Frotek) • EUW set for forced electrolyte mixing • Electronic electrolyte level sensor • Battery operation monitoring system
Intended use:	The product is intended as a source of electrical energy for powering electrical systems
Method of conformity assessment:	in accordance with Act No. 22/1997 Coll., as amended and Government Regulation No. 17/2003 Coll.

The above-mentioned products comply with the requirements of the following European regulations

Number:	20061951 EC (Low Voltage Directive) Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to electrical equipment intended for use
European harmonised standards:	EN 60254-1/EN 60254-2/EN 50272-3 IEC 60245-1/IEC 60254-2 *cell dimensions in accordance with EN/IEC 60245-2
National standards	DIN 43531 / DIN 43535 / DIN 43536 / DIN 43537
CE declaration	issued only for batteries with a nominal voltage > 75V, for batteries with a nominal voltage < 75 V, in accordance with GPSGV dated 18 June 2008, this is not required
Issued by:	IBG Česko s.r.o. V Pískovně 2053 278 01 Kralupy nad Vltavou Czech Republic
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