



Operating Instructions

Translation of original operating instructions

Installation Machine VM-301-KJ-GREENLINE

VM-301-KJ-GREENLINE



Bitte beachten Sie, dass das Produkt ohne vorliegende Betriebsanleitung in Landessprache nicht eingesetzt / in Betrieb gesetzt werden darf. Sollten Sie mit der Lieferung des Produkts keine Betriebsanleitung in Ihrer Landessprache erhalten haben, kontaktieren Sie uns bitte. In Länder der EU / EFTA senden wir Ihnen diese kostenlos nach. Für Länder außerhalb der EU / EFTA erstellen wir Ihnen gerne ein Angebot für eine Betriebsanleitung in Landessprache, falls die Übersetzung nicht durch den Händler/Importeur organisiert werden kann.

Please note that the product may not be used / put into operation without these operating instructions in the national language. If you did not receive operating instructions in your national language with the delivery of the product, please contact us. In countries of the EU / EFTA we will send them to you free of charge. For countries outside the EU / EFTA, we will be pleased to provide you with an offer for an operating manual in the national language if the translation cannot be organised by the dealer/importer.

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1 EC-Declaration of Conformity

Description: **Installation Machine VM-301-KJ-GREENLINE**
Type: **VM-301-KJ-GREENLINE**
Order number: **51500024**
Manufacturer: Probst GmbH
Gottlieb-Daimler-Straße 6
71729 Erdmannhausen, Germany
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www.probst-handling.com



The machine described above complies with the relevant requirements of the following EU directives:

EC-machinery directive 2006/42/EC

2014/30/EU (Electromagnetic compatibility)

The following standards and technical specifications were used:

DIN EN ISO 12100

Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)

DIN EN ISO 13857

Safety of machinery - safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)

DIN EN 60204-1 (IEC 60204-1)

Safety of machinery, electrical equipment of industrial machines. Part 1: General requirements.

Authorized person for EC-documentation:

Name: J. Holderied

Address: Probst GmbH; Gottlieb-Daimler-Straße 6; 71729 Erdmannhausen, Germany

Signature, information to the subscriber:

A handwritten signature in black ink, appearing to read "Eric Wilhelm", written over a dotted line.

Erdmannhausen, 07.01.2020.....

(Eric Wilhelm, Managing director)

EC-Declaration of Conformity / UKCA-Declaration of Conformity

Manufacturer: Probst GmbH
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71729 Erdmannhausen, Germany
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Importer: Probst Ltd
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Stafford Park 17
Telford Shropshire TF3 3DG, United Kingdom
www.probst-handling.co.uk
sales@probst-handling.co.uk



The machine described above complies with the relevant requirements of the following EU directives:
The object of the declaration described above is in conformity with the relevant UK-Regulations and UK-Guidelines:

EC-machinery directive 2006/42/EC (Reference: OJ L 157, 09.06.2006)

UK-Regulation: Supply of Machinery (Safety) Regulations 2008 (SI 2008 No. 1597)

2014/30/EU (Electromagnetic compatibility) / (Reference: OJ L 96, 29.03.2014)

UK-Regulation: Electromagnetic Compatibility Regulations 2016 (SI 2016 No. 1091)

The following standards and technical specifications were used:

DIN EN ISO 12100

Safety of machinery - General principles for design - Risk assessment and risk reduction

UK-Regulation: BS EN ISO 12100-1:2003+A1:2009

DIN EN ISO 13857

Safety of machinery - safety distances to prevent hazard zones being reached by upper and lower limbs.

UK-Regulation: BS EN ISO 13857:2019

2014/30/EU (Electromagnetic compatibility) / (Reference: OJ L 96, 29.03.2014)

UK-Regulation: Electromagnetic Compatibility Regulations 2016 (SI 2016 No. 1091)

DIN EN 60204-1 (IEC 60204-1)

Safety of machinery, electrical equipment of industrial machines. Part 1: General requirements.

UK-Regulation: BS EN 60204-1:2018

Authorized person for EC-documentation:

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Signature, information to the subscriber:



Erdmannhausen, 02.08.2021.....

(Eric Wilhelm, Managing director)

2 Safety

2.1 Safety symbols



Danger to life!

Identifies imminent hazard. If you do not avoid the hazard, death or severe injury will result.



Hazardous situation!

Identifies a potentially hazardous situation. If you do not avoid the situation, injury or damage to property can result.



Prohibition!

Identifies imminent a prohibition. If you do not avoid the prohibition, death and severe injury, or damage to property will result.



Important informations or useful tips for use.

2.2 Definition skilled worker / specialist

Only skilled workers or specialists is it allowed to carry out the installation,- maintenance, - and repair work on these device!

Skilled workers or specialists must have for the following points (if it applies for these device), the necessary professional knowledge.

- for mechanic
- for hydraulics
- for pneumatics
- for electricians

2.3 Safety Marking

PROHIBITION SIGN

| Symbol | Meaning | Order-No. | Size |
|--------|--|-------------------------------------|-------------------------------|
| | It is not allowed to stand under hanging loads. Danger to life! | 2904.0210 2904.0209 2904.0204 | Ø 30 mm Ø 50 mm Ø 80 mm |
| | It is forbidden to ride on the installation machine!° | 2904.0762 | Ø 80 mm |
| | Do not open the tool cover while the engine/system is running! | 2904.0259 | 70 x 115 mm |



Cleaning with a high pressure cleaner or water in the area of the cover is prohibited. Danger of short-circuit/electric shock to electronic components.

29040839

70x55 mm

WARNING SIGN

| Symbol | Meaning | Order-No. | Size |
|--------|---------|-----------|------|
|--------|---------|-----------|------|



Danger of squeezing the hands.

2904.0221

30 x 30 mm

2904.0220

50 x 50 mm

2904.0107

80 x 80 mm



Do not reach into the fan with your hands - Risk of injury to the hands

29040838

60 x30 mm



Warning of electric voltage

2904.0397

31 x 27 mm



Warning of battery acid.

2904.0551

31 x 27 mm



Danger: Keep distance to the machine..

2904.0756

64 x 103 mm

REGULATORY SIGN

| Symbol | Meaning | Order-No. | Size |
|--------|---------|-----------|------|
|--------|---------|-----------|------|



Each operator must have read and understood the operating instructions (and all safety instructions).

2904.0665

Ø 30 mm

2904.0666

Ø 50 mm



Seat belt duty

On every drive with the machine the seat belt must always be worn.

2904.0450

Ø 52 mm



Pull hand brake in idle machine time. To drive release handbrake.

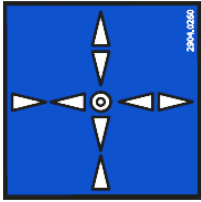
2904.0267

45 x 80 mm

| | | | |
|--|--|------------------|-------------------|
| | <p>Drive forward and backward with the right foot pedal. The pedal must not only be operated with the tips of the shoes! To be able to react quickly in dangerous situations, the shoe must be fully positioned on the control pedal.</p> | <p>2904.0760</p> | <p>68 x 43 mm</p> |
| | <p>Lifting and lowering boom arm with left foot pedal.</p> | <p>2904.0759</p> | <p>48 x 43 mm</p> |
| | <p>Suspension point for transport goods for lifting (recovering) the laying machine</p> | <p>2904.0370</p> | <p>23 x 60 mm</p> |
| | <p>Lashing eyelet for securing the laying machine to the transport vehicle by means of chains or tension belts</p> | <p>2904.0755</p> | <p>Ø 60 mm</p> |
| | <p>The steering of the machine must be locked before transport!</p> | <p>2904.0818</p> | <p>90 x 55 mm</p> |

OPERATING INFORMATION

| Symbol | Meaning | Order-No. | Size |
|--------|---|------------------|--------------------|
| | <p>Max. 600 kg (1,320 lbs) → VM-301 Maximum weight paver load 320 kg (710 lbs) with counterbalance 380 kg (840 lbs)</p> | <p>2904.0616</p> | <p>40 x 160 mm</p> |
| | <p>Max. 650 kg (1,430 lbs) → VM-301-K Maximum weight paver load 380 kg (840 lbs) (837,8 lbs) with counterbalance 440 kg (970 lbs)</p> | <p>2904.0623</p> | <p>40 x 160 mm</p> |
| | <p>Button for horn / reset button: Press reset button each time for the driving, when the machine will be started and when the driving was stopped caused by the standing up of the driver from the driver's seat (triggered by the seat switch). The reset button only works (and the driving of the machine), when the driver is sitting in the seat.</p> | <p>2904.0716</p> | <p>90 x 23 mm</p> |
| | <p>Open cover hood</p> | <p>2904.0253</p> | <p>28 x 85 mm</p> |
| | <p>After approx. 40 days of machine idle the 12 V battery for operating voltage (radio, lighting etc.) must be charged, otherwise no system start is possible.</p> | <p>2904.0837</p> | <p>45x45 mm</p> |



Joystick / control lever:

Movement directions for the Control / operation of attachments (e.g. for opening and closing the main and side clamping at a HVZ)

2904.0260

50 x 50 mm

Electronic joystick with function controls as well as activations of additional functions.

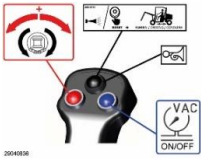
Function controls: for controlling of a hydraulic installation clamp (HVZ) → opening and closing of the main and side clamping.

Additional functions:

- Rotating movement of a hydraulic rotator
- Vacuum operation (suction and release of load)
- Horn/reset button (reset button for releasing the seat switch)

29040836

70x55 mm



Reset button for driving must be pressed each time the laying machine is started, or the driving was stopped due to the driver getting up from the driver's seat (triggered by the seat switch).

The reset button (and driving the machine) only works when the driver is in the driver's seat.

Start (2 sek.)

29040835

Press and hold the button (in the driver's cabin next to the ignition switch) for at least 2 seconds to start the system.

29040835

50 x12 mm



Release the parking brake when the LED (in the driver's cab next to the fuses) lights up red.

29040834

40 x33 mm



Fuses (symbols and ampere rating) in driver's cabin.

29040808

125 x45 mm

2.4 Personal safety requirements



Each operator must have read and understood the operating instructions (and all safety instructions). Only qualified, authorized personal is allowed to operate the device and all devices which are connected (lifting device/carrier).



The manual guiding is only allowed for devices with handles.



IMPORTANT INFORMATION REGARDING SAFETY, STORAGE, HANDLING AND THE LIKE MUST BE OBSERVED AND CAN BE FOUND IN THE ENCLOSED PRODUCT DATA SHEET OF THE LITHIUM-ION BATTERIES.

2.5 Protective equipment

The protective equipment must consist, according to the safety regulations of the following parts:

- Protective clothing
- Safety gloves
- Safety shoes

2.6 Accident prevention



- The workplace has to be covered for unauthorized persons, especially children.
- Take care in case of thunderstorm!



- The workplace must be sufficiently illuminated.
- Take care with handling wet, dirty and not solidified components.



- The working with the device in case of atmospheric editions under 3° C (37,5° F) is forbidden! Because the goods could be fall down caused by dampness or freezing.



Caution during operation, dismantling and maintenance work on the laying machine!
There is a risk of electric shock, etching and burns from battery acid and various engine fluids. Appropriate protective measures must be taken and protective equipment worn in order to avoid serious injuries or even death!

2.7 Function Control

2.7.1 General



- Before every usage of the device check the functions and the working condition.
- Maintenance and lubrication are only permitted when device is shut down!



- Do not use the device, until all faults which can cause safety hazards are removed.
- If there are any cracks, splits or damaged parts on any parts of the device, **immediately** stop using it.



- The operating instructions must be available at the workplace every time.
- Do not remove the type plate of the machine.
- Unrecognisable information signs (such as regulatory or prohibition signs) must be replaced.

2.7.2 Hydraulic



Check all hydraulic hoses and connection for tightness before every operation. Only experts are allowed to replace faulty parts (depressurized).



Ensure a clean working environment before opening the hydraulic connection.



The hydraulic hoses must be free of breaks and abrasion. Take care that there are no outstanding edges, where the hoses could hook in.



The operator of the device is responsible for a constant line pressure, which is necessary for the working with this device.

Only under these conditions is a safety gripping, lifting and transporting of the gripping goods with this device ensured.

2.8 Safety procedures

2.8.1 Equipment attachments



During all adjustments on equipment attachments (e.g. HVZ-UNI) it must be ensured that the attachment cannot close unintentionally. **Risk of injury!**

All adjustments may only be made when the laying machine is shut down (**pull handbrake**) and the engine is **switched off!**

2.8.2 Installation machine

- The installation machine has to be in good, safe working condition.
- **Never exceed the maximum capacity/working load limit (WLL) of the installation machine!**
- Only authorized and qualified persons are allowed to operate the installation machine.
- The operator must have all the necessary qualifications.

2.8.3 Safety in the operation of the laying machine



- The entry and exit may only be done from the left side (in the direction of travel) in order to avoid unintentional activation of the controls.
- The operation of the laying machine is generally only permitted under optimum visibility conditions and enough lighting (e.g. daylight)!
- By retrofitting appropriate headlamps (light package VM-301), work is also permitted in the dark.
- Always lower the load to approx. 20 cm above the ground when moving!
- The **maximum load** of the laying machine, its attachments (e.g. HVZ-UNI) and the loads attached to them **must not be exceeded!**
- When leaving the laying machine, the driver must pull the handbrake and ensure that the laying machine is on a horizontal surface. If necessary, use wheel chocks or the like to prevent the laying machine from rolling away unintentionally.
- **Unattended parking of the laying machine on inclined and sloping surfaces is not permitted!**
- During operation of the machine, the operator must always ensure that the machine is in a safe operating condition.



- **Always disconnect the battery when working on the electrical system. Risk of electrical shock!**



It is forbidden for persons to ride on the laying machine (by hanging on from the outside)!
Accident/life hazard!



- **It is generally forbidden for persons to stand in the working and travel area of the installation machine during installation work.**
A minimum safety distance of 1.5 m between the person and the machine must be observed!
Exception: It is essential due to the type of use of the implement, e.g. by manually guiding a implement at the handles.
- **It is generally forbidden to stand under a suspended load!**
- **It is strictly forbidden to stand in the steering area/kink area of the machine! Risk of crushing the feet/legs between the front wheels and the chassis.**
- **The driver must not leave the control position if the attachments of the laying machine are loaded with laying material and the system is in operation.**
- **Never let the control lever valve (joystick) for operating the attachments, the control pedal for forward and reverse travel or the control pedal for up and down movement of the boom **spring back**.**
Otherwise there will be pressure surges in the forward and return lines! The laying material may fall down and the hydraulic motors may be **damaged!**

2.8.4 Stability

Danger of overturning!

Only drive at walking speed and with the boom lowered (with and without load) if the following applies:



- No attachment equipment (e.g. HVZ-UNI) mounted on boom
- **Driving curves**
- Driving in **unpaved and uneven terrain**
- Terrain with **slope**
- Machine **slope** of more than 10° (~ 18 %)



Driving faster than step speed allowed if the following applies:

- Drive straight ahead (with and without attachment equipment and stone position)
- Driving in paved and level terrain
- Check terrain in advance for **sufficient surface condition** (such as large holes or broken ground).
- When using the laying machine on roofs, parking decks or other soft ground, the **load capacity of the ground** must be checked in advance.
- In the event of accidents or when the laying machine tilts over, load-bearing parts must be inspected by a specialist workshop before the machine is put back into operation.



3 General

3.1 Authorized use



- The machine is only designed for the use specified in this documentation.
- Every other use is not authorized and is forbidden!
- All relevant safety regulations, especially regulations of the declaration of conformity, and additional local health and safety regulations have to be observed.



Prior to every operation the user must ensure that:

- the machine is suited to the intended operation, the functioning and the working condition of the equipment is examined and the loads are suitable to be handled.

Any doubts about instructions should be raised with the manufacturer prior to use.

- The installation machine VM-301-KJ-GREENLINE in connection with the hydraulic installation clamp HVZ/HVZ-UNI is used for laying interlocking paving stones in connection with the kerb stone laying clamp VZ-H-UNI (for laying kerb stones).
- **Only attachment equipment from Probst** may be attached to the installation machine VM-301-KJ-GREENLINE, such as:
 - VZ-H-UNI, HVZ-STANDARD, HVZ-UNI, HVZ-UNI-II, HVZ-LIGHT.
 - On request also Probst vacuum attachment equipment like SH-1000-MINI-H.



When using third-party attachment equipment on the Probst installation machine, the relevant safety regulations and the technically necessary prerequisites (performance data) of the respective attachment must be observed. In addition, all technical requirements of the Probst installation machine must correspond to those of the third-party attachment equipment. The responsibility for this lies solely with the operator of the installation machine!

- The installation machine is **no lifting equipment!**
- All instructions in the instructions handed over with the installation machine must be observed.



It is not allowed to use the installation machine in public traffic – only construction sites or private ground!



NOT ALLOWED ACTIVITIES:

Unauthorized alterations of the device and the use of any self-made additional equipment could cause danger and are therefore **forbidden!**

Use of the machine after substantial modification, as well as after improper troubleshooting/maintenance

Never exceed the **carrying capacity/working load limit (WLL)** and the **nominal width/nominal size** of the device.

All unauthorized transportations with the device are not allowed:

- Transportation of people and animals.
- Transportation of other loads and materials than described in this manual.
- Never suspend any goods with ropes, chains or similar at the device.

3.1.1 Optional Accessories



| Type | Description |
|---------------------------|---|
| LED light package: | combination headlights (close/distance), 1 rear spotlight |
| LED- rotating beacon: | with fold-down stand incl. mounting material |
| VM-RFW: | reversing alarm VM-301 |
| Exterior mirror: | retrofit kit |
| Mounting: | for light and/or mirror (only needed once |
| Additional weight: | for increasing the load capacity by 60 kg ¹⁾ |
| Windscreen washer system: | without wiping interval. Retrofit kit for VM-301-K |
| Additional battery: | for 50% more battery lifetime |

¹⁾ with adjusted forward speed and lowered load. Max. Weight of the stone layer see technical data.

3.2 Survey and construction



3.3 Technical data

| | | | |
|---|--|------|------------------------|
| Traction drive: | 8 kW | | |
| Hydraulic drive: | 5 kW | | |
| Effective value of the acceleration to which the body is exposed: | | | < 0.5 m/s ² |
| Landing gear: | Double articulated steering | | |
| Driving speeds: | Drivingstage I: approx. 11 km/h  | | |
| | Speed stage II: approx. 6 km/h  | | |
| Dimensions and weights: | | | |
| Total height / total width / total length: | 1,980 mm / 1,220 mm / 3,610 mm | | |
| Total weight: | 1,565 kg ① | | |
| Load capacity: | 650 kg * | | |
| Max. Weight of attachments with attached loads: | 320 kg (with additional weight 380 kg) * | | |
| | 380 kg (with additional weight 440 kg) * | | |
| maximum height of acceptance: | 1.600 mm | | |
| Turning radius on the front inner wheel / outer wheel: | 700 mm / 1,900 mm | | |
| Turning radius (above all): | 2.450 mm | | |
| Ground clearance: | 180 mm | | |
| Operating voltage (travel drive / working hydraulics): | 48 V | | |
| Operating voltage (lighting, radio etc.): | 12 V | | |
| Battery technology (basic version): | 2x lithium-ion battery, 48 V each, 105 Ah, (total 210 Ah) | | |
| - Charging technology: | 2x on-board chargers, à 48V, 50 A (total 100 A) | | |
| - Charging time at 230 V mains: | 0% → 100% = approx. 4.6 h | | |
| - Charging time at 400 V mains: | 0% → 100% = approx. 2.3 h | | |
| - Battery life (100 % → 0 %): | approx. 6 h (depending on operating mode) | | |
| - starter battery | 12 V | | |
| Battery technology (optional additional battery): | 3x lithium-ion battery, 48 V each, 105 Ah, (total 315 Ah) | | |
| - charging technology | 2x on-board chargers, à 48V, 50 A (total 100 A) | | |
| - Charging time at 230 V mains: | 0% → 100% = approx. 7 h | | |
| - Charging time at 400 V mains: | 0% → 100% = approx. 3.5 h | | |
| Battery life (100 % → 0 %): | approx. 9 h (depending on operating mode) | | |
| Working hydraulics: | 180 bar, 20 l/min | | |
| fill quantities | hydraulic oil | 18 l | HLP 46 |
| Sit: | height adjustable in 3 steps or infinitely variable, back and forth, backrest adjustable, spring strength adjustable | | |

* With adapted travel speed and lowered load.

① Total weight increases e.g. by retrofitting the optional (third) battery.

4 Operation

4.1 Charging the Lithium Ion Batteries



Before the daily use of the machine, it is recommended to charge the lithium-ion batteries completely!

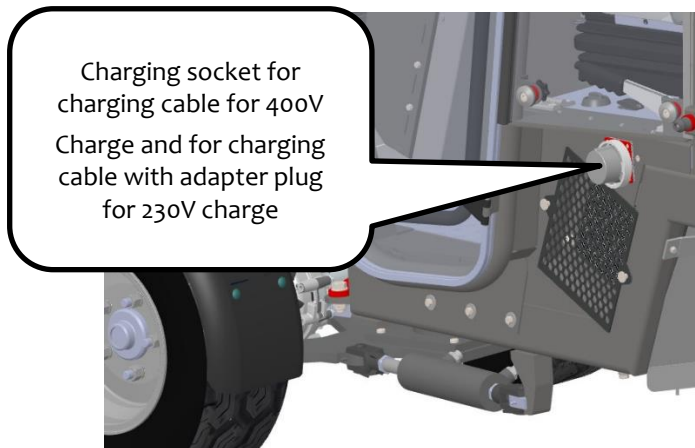


The lithium-ion batteries may only be recharged by suitably qualified persons. Due to electrical voltage (230 v /400V) there is a danger to life if used improperly.

- Check the battery charging capacity in the display (in the driver's cab) → see the following chapter "Operation" or "Display - Function overview".
- Open cover (see following chapter "Opening the cover")

There are two ways to charge the two lithium-ion batteries:

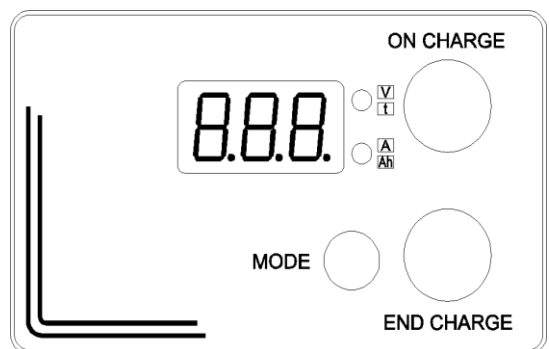
- with 230 V → Charging time approx. 4.6 h (from 0 to 100% charging capacity)
- with 440 V → Charging time approx. 2.3 h (from 0 to 100% charging capacity)



After the start, the digital instrument displays the string of the following parameters:

- **BATTERY VOLTAGE** (two-colour red upper LED).
- **Current** supplied by the charger (two-colour red lower LED).
- **TIME** in hours missing until the end of charging (two-colour green upper LED).
- **Ah** (two-colour green lower LED).

By pressing the MODE key, the sequence of the parameters is locked and the last displayed value is retained. Press the MODE button again to restart the parameter sequence.



| Color: | Description |
|---|---|
| red | Constant or maximum current phase (IU1a). |
| Flashing red (4s ON - 1s OFF) | Voltage regulation phase (IU1a). |
| Red and flashing green (4s ON - 1s OFF) | Overloading phase (IU1a). |
| Flashing green (4s ON - 1s OFF) | Waiting phase (for equalization) (IU1a). |
| green | Loading finished (with CU1 BA2) |
| Flashing green (4s ON - 1s OFF) | Equalizing pulse and floating |
| Green and red flash together. | Connection with CanConsolle or S/S HW-SW. |



Before putting the installation machine into operation, the safety regulations must be observed and the maintenance work carried out.

To ensure safe and trouble-free operation of the installation machine, the following daily checks must be carried out in particular.

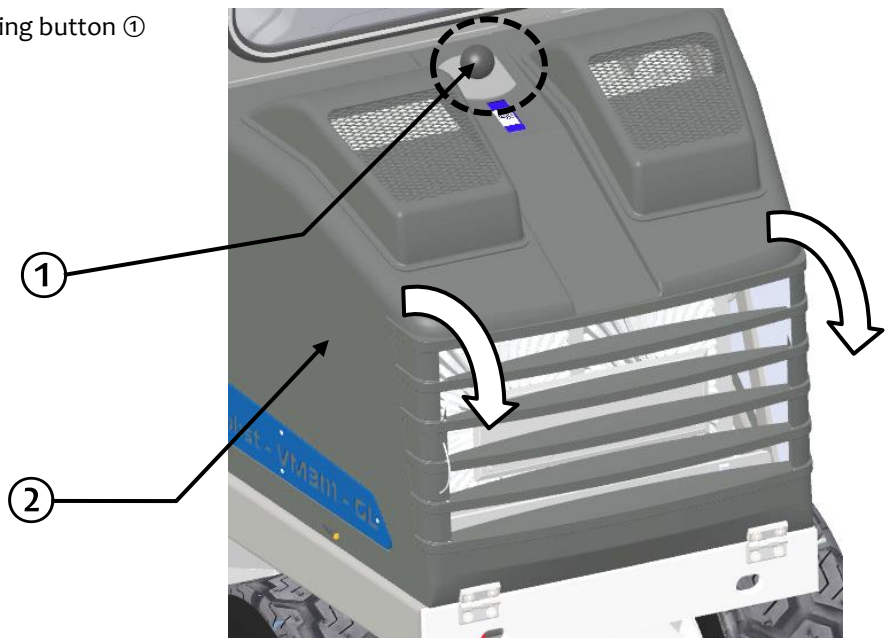
4.2 Daily checks



Before the initial start-up and generally before each start-up, all liquid levels (hydraulic oil, wiping water (optional)) must be checked and refilled if necessary!

4.2.1 Open cover

- In order to open the cover ②, the unlocking button ① on the cover ② must first be actuated.

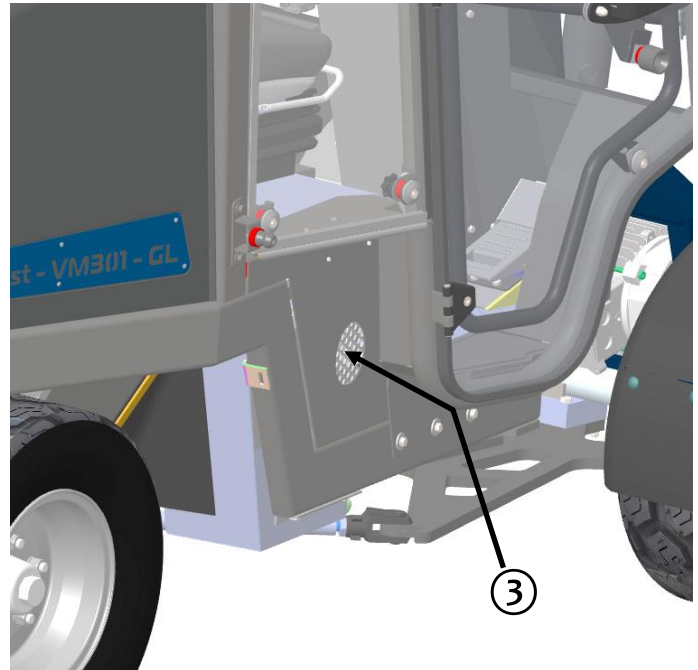


4.2.2 hydraulic oil check

- The installation machine **must** stand on absolutely **level ground**.
- **To check the hydraulic oil, the hydraulic ram of the boom must be fully retracted and the boom at the bottom of the ground.**
- The oil level must be in the middle to the upper third of the sight glass ③. If this is not the case, the corresponding hydraulic oil must be refilled!



As soon as the boom is moved all the way up, the oil level drops to the lower part of the sight glass.



4.2.2.1 Refill hydraulic oil

The installation machine **must be placed** on an absolutely **level surface**.



To top up the hydraulic oil, the hydraulic ram of the boom must be completely retracted or the boom must be at the bottom of the ground.

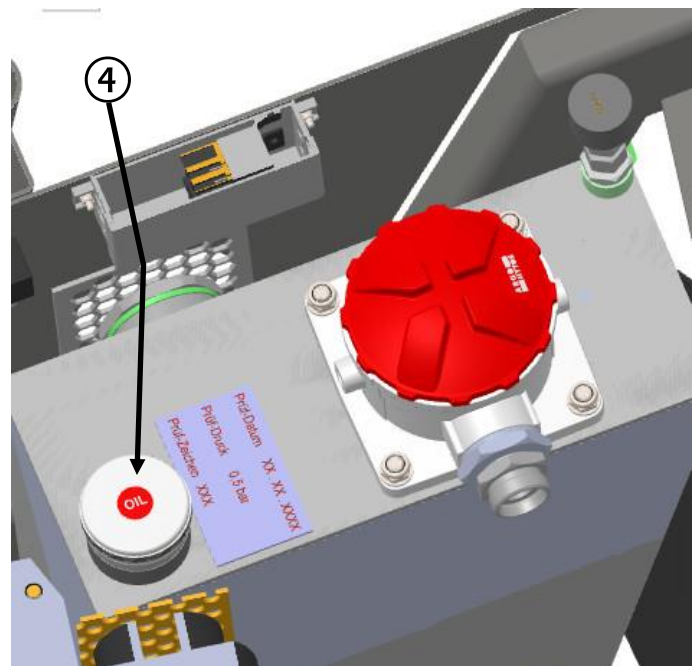
Otherwise the wrong oil level will be displayed.

Switch off traction drive (ignition to 0)

The oil filler neck ④ is located under the driver's seat. For this the driver's seat must be folded down (see following chapter "Folding the driver's seat down").

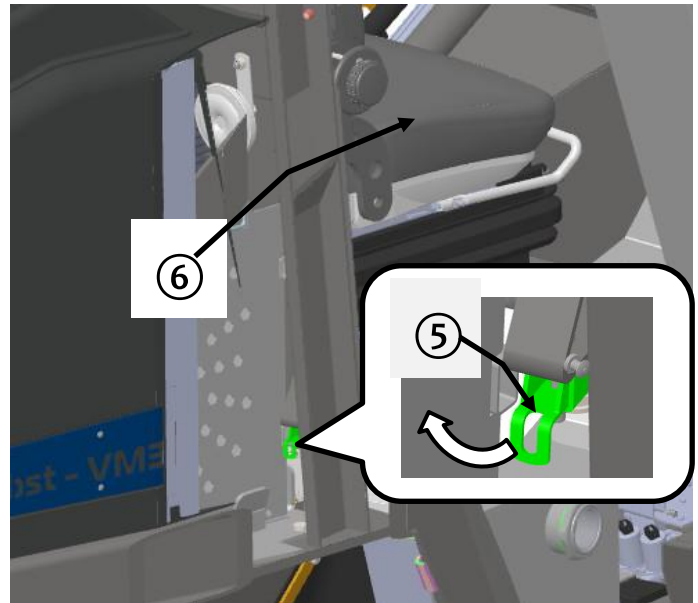
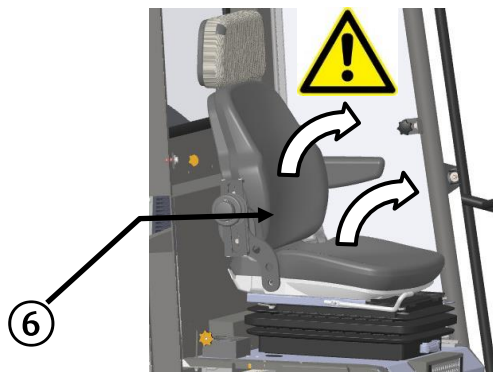
Open oil cap ④ and first fill in only a small amount of hydraulic oil (HLP 46).
Observe oil level in sight glass ③!

Fill in hydraulic oil until the oil level is in the upper third of the sight glass ③. Then close oil filler neck ④ again.



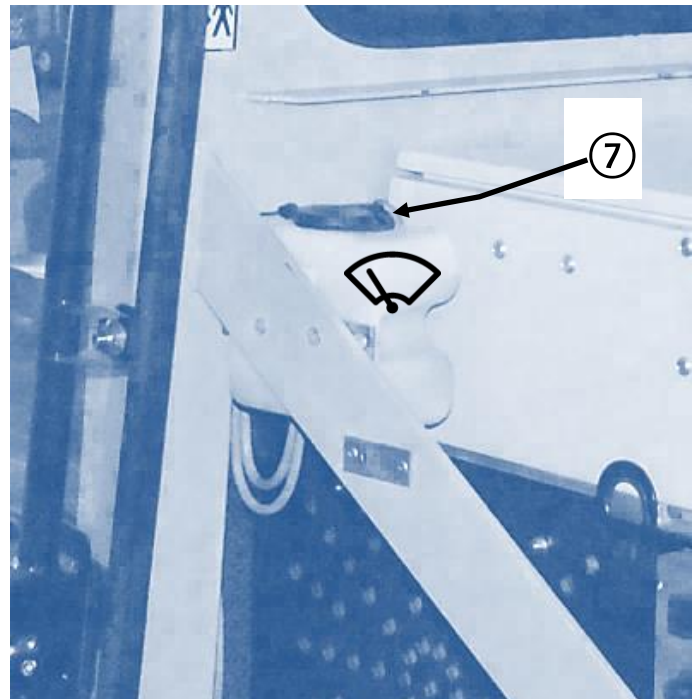
4.2.2.1.1 Folding the driver's seat down

- Open cover ② .
- To fold down the driver's seat ④, the unlocking lever ⑤ (under the cover on the right below the switch cabinet) must first be actuated.
- Press the driver's seat ⑥ upwards with both hands and slowly fold it to the left (in the direction of travel).



4.2.3 Windscreen wiper water control (windscreen washer system - optional)

- Open the cover as described in chapter "Opening the cover".
- Open the lid ⑦ on the water container and top up the windscreen wiper water if necessary.
- At temperatures **below 3° C**, commercially available **antifreeze** should be added to prevent freezing of the wiper water in the tank and the hoses!



4.2.4 Control displays / Function checks

display control

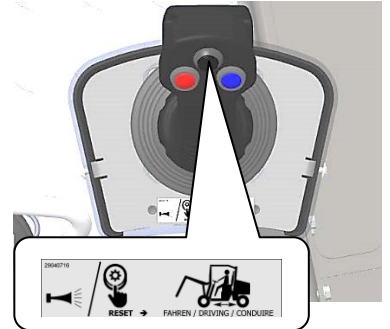
The display must switch on when the key position is set to position I and the start button has been pressed **Start** (2 Sek.)



Horn/reset driving (seat switch)

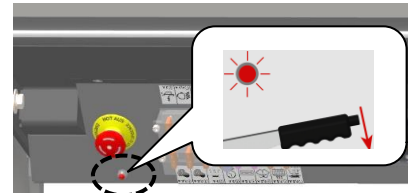
Horn button / Reset button: the driving reset button must be pressed every time the machine is started or the driving is stopped due to the driver getting up from the driver's seat (triggered by the seat switch).

The reset button (and driving the machine) only works when the driver is seated in the driver's seat.



Signal lamp handbrake

When the handbrake is applied, the red LED on the upper left of the valve lights up as soon as the start system is switched on.



battery capacity

Indication (in the display) of the current battery capacity in %.



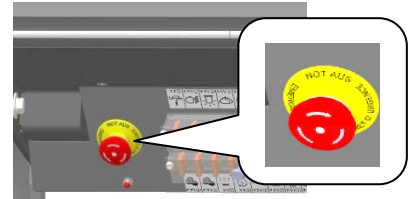
horn

Function test of the horn by pressing the black button on the joystick.



emergency stop

Check emergency stop switch once a day. To do this, activate the system start with the start key, then actuate the emergency stop switch. The drive and all functions of the machine must then be deactivated.

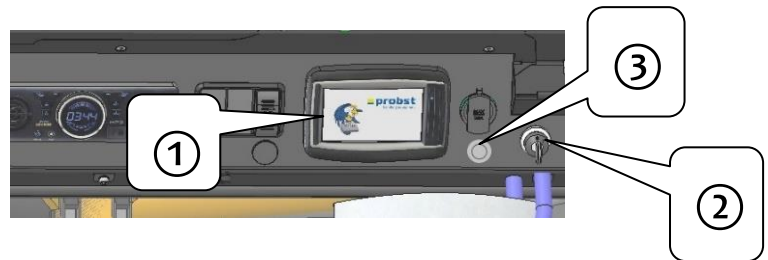


4.3 Display - Overview of functions

The display in the driver's cab has the following basic functions:

- Driving speed (km/h)
- Operating hours counter (h)
- Distance travelled (km)
- Battery capacity (%)
- Average consumption (kWh)
- Remaining battery life up to 20% Battery capacity (h:mm)

- Insert the start key into the key switch ② (upper right dashboard - next to the display).
- Turn the start key position to position I and hold down the start button ③ for at least 2 seconds (display ① starts).



Driving speed in km/h: 8.3 km/h

distance travelled in km (total): 176.4 km

Operating hours (time from ignition ON to ignition OFF): 95.2 h

Display: Date and time (Format: YYYY.MM.TT - HH.MM.SS): 2019.07.31 09:45:53

Battery capacity in: 93.1 %

average consumption in kWh: 2.1 kWh

Display of the remaining running time in h:mm. (Depending on the average consumption, until a residual battery capacity of ≤ 20% is reached): 3.52 h:mm

Menu Settings

Driving speed in km/h: 6.8 km/h

distance travelled in km (total): 180.7 km

Operating hours (time from ignition ON to ignition OFF): 99.2 h

Display: Date and time (Format: YYYY.MM.TT - HH.MM.SS): 2019.07.31 09:48:44

Battery capacity in: 16.7 %

average consumption in kWh: 1.7 kWh


Display of the remaining running time in h:mm. (Depending on the average consumption, until a residual battery capacity of ≤ 20% is reached): h:mm

If a battery capacity of < 20%, the remaining time display changes to a plug symbol. Note for users that the batteries must be recharged promptly.

Additional hint:

From a battery capacity <30%, individual functions of the machine such as radio, 12V socket and heating are deactivated and are only available again when the batteries are charged (to a battery capacity >30%)!

From a battery capacity of <20%, the machine then additionally only runs at a maximum of 6.0 km/h (creep speed).

Settings menu: Pressing  the icon on the main screen takes you to the settings.

Settings and display of the average consumption:
Here additionally the display for which **period of time** the consumption was calculated and the **power added to it**.



Press the back key to return to the main screen (applies to any further display in the settings menu).

With the RESET button all data can be set to zero (0) and the calculation restarts from this point in time.

Date setting



Year and month setting

Setting Day

The setting must be confirmed via **SET DATE**.

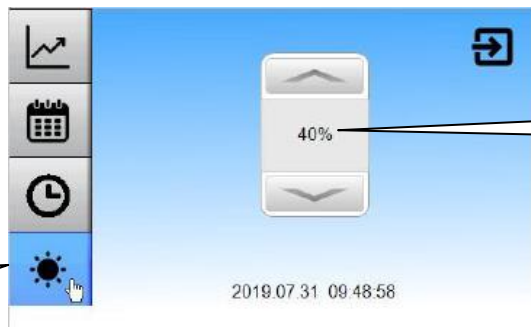
Time setting



Time setting (HH.MM.SS)

The setting must be confirmed via **SET DATE**.

Setting display brightness



Display of the brightness in %.

4.4 System start

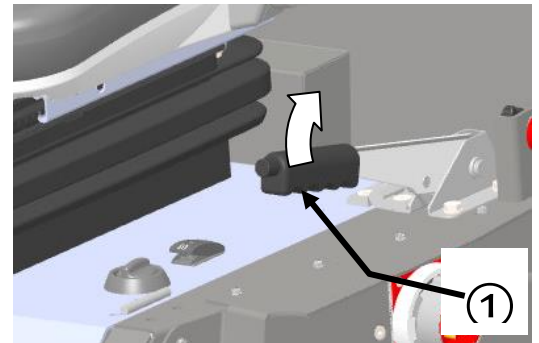


Before the daily use, all daily checks must be done (see chapter "Daily checks").

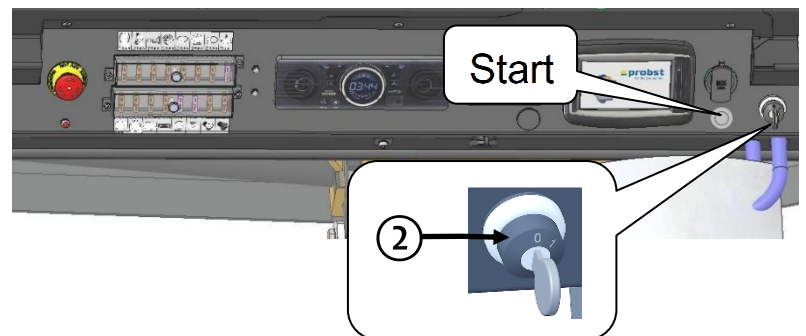


The driver must sit in the driver's seat and the seat belt must be fastened.

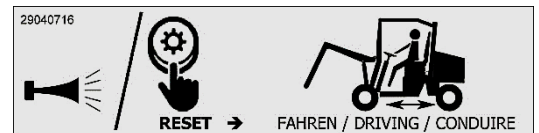
- Before the system (drive) is started, the **handbrake ① must be applied!**
- Insert the start key into the key switch ② (upper right dashboard - next to the display).
- Turn start key to position I. To start the system, press and hold the "Start" button next to the ignition lock ② for at least 2 seconds.
- To stop the system, simply turn the start key to position 0.



- The system switches off after approx. 10 minutes (power saving mode) if no machine movements are performed within this time. The start key can only be removed in position 0.



- **Press the reset button (button for horn).** The horn sounds once to warn people in the vicinity that the machine is about to start driving.



Do not release the handbrake ① until the driver has taken a seat in the driver's seat. Press the handbrake button to release the handbrake.

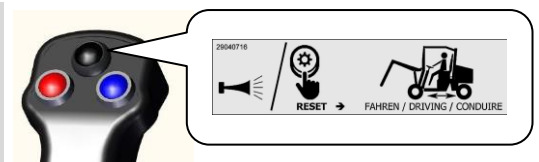
**If the driver leaves the driver's seat, the parking brake must be applied again!
No travel movement can be carried out with the handbrake applied!**

- To stop the system, always set the start key to position 0!



The Reset button for travel and **must be pressed each time** the installation machine is started or the travel has been stopped due to the driver getting up from the driver's seat (triggered by the seat switch).

The reset button (and driving the machine) only works when the driver is in the driver's seat.



4.5 Driving with the installation machine

When reversing with the installation machine, the "**blind spot**" of the machine must always be observed! Otherwise there is a risk of accident and death!

When leaving the installation machine, the attachment (e.g. HVZ) must be placed on the ground, the parking brake pulled (and the system switched off) !

When driving on **terrain with an incline**, the following must be observed:

- Lower the boom arm with attachment (e.g. HVZ) both with and without load (e.g. brick layer) as far as possible.
- extremely careful and slow (slow walking pace) driving style is required
- abrupt braking (by changing the direction of travel with the foot pedals) is prohibited!

Otherwise there is a risk of tipping over, →accidents and death!

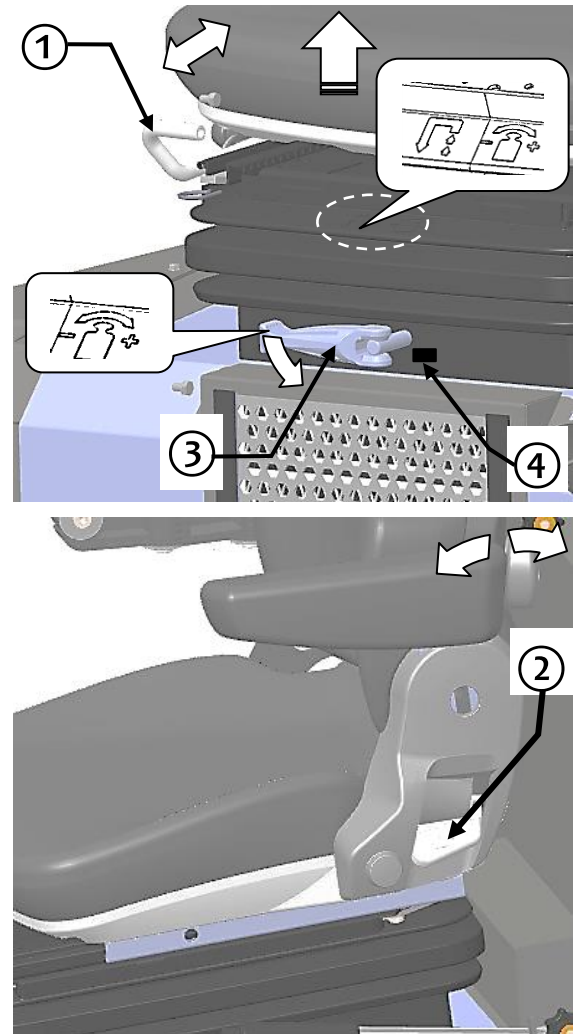
Emergency situation: the installation machine threatens to **tip over**, boom arm with attachment (e.g. HVZ) immediately lowered!



4.6 Driver seat adjustment

Adjust the adjustable driver's seat according to body height and weight:

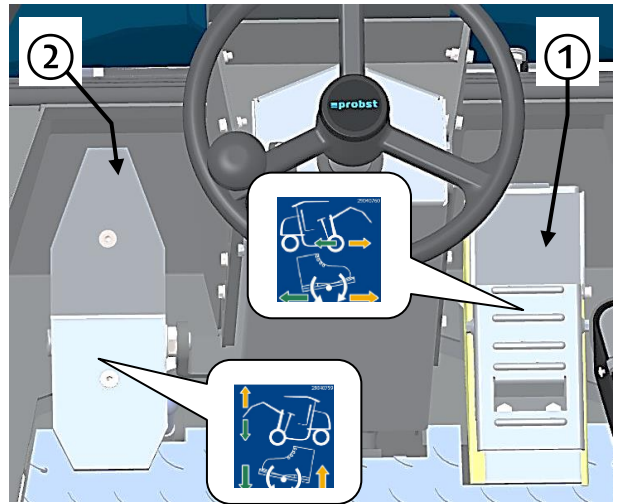
- Lever ① (bottom right) for seat back and forth
- 3-fold height adjustment: Pull the seat all the way up. ↑
- Lever ② (rear left) for backrest forwards and backwards
- For twill weight adjustment (scale ④), turn the rotary handle ③ (centre front down) to the left or right.



4.7 Operating elements

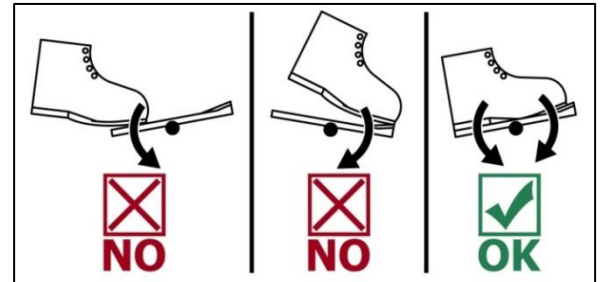
4.7.1 System start / foot pedals (driving brakes)

- Activating the system startup
- Do not release the handbrake until the driver has taken a seat in the driver's seat. As soon as the driver leaves the driver's seat, the parking brake must be applied!
- The accelerator pedal ① enables stepless forward and reverse driving.
The accelerator pedal must under no circumstances be confused with the accelerator pedal of a motor vehicle (passenger car)!
- Tilting the accelerator pedal forwards:
→ Machine moves forward
- Tilt the accelerator pedal backwards:
→ Machine reverses



Forward-reverse travel with the accelerator pedal ①.
The accelerator pedal must not only be operated with the tips of the shoes!

In order to be able to react quickly in **dangerous situations**, the shoe **must** be positioned completely on the accelerator pedal.



- Braking is achieved by slowly bringing the Fahrpedal① into the 0 position. A strong deceleration is achieved by counteracting the stroke pedal.
- The lifting pedal ② is for raising and lowering the boom.
- Tilting the lift pedal ② forwards:
→ Lower the boom.
- Tilting the Hubpedals② backwards:
→ Lift the boom.





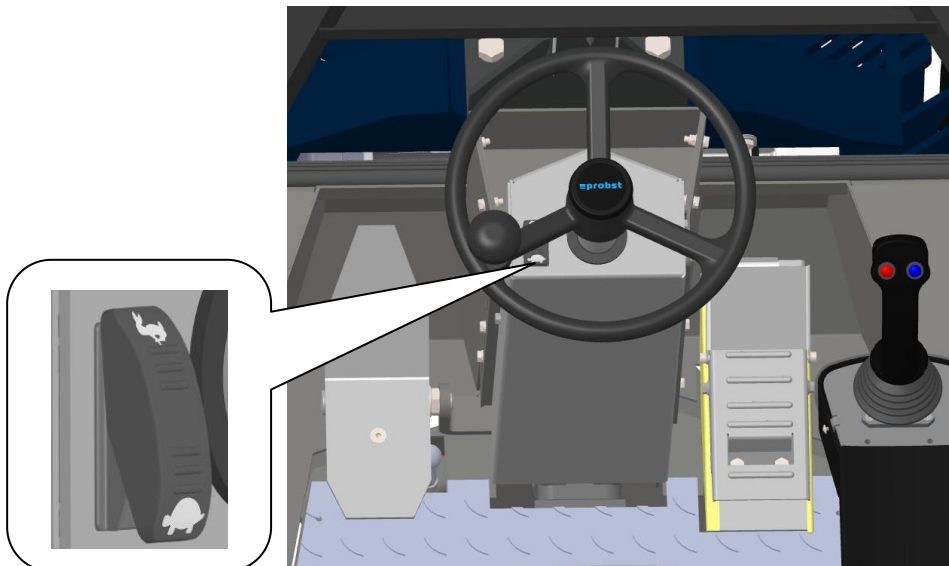
NEVER operate the pedals with a jerk or let them jump back, otherwise you will get jerky movements!

4.7.2 Driving speeds



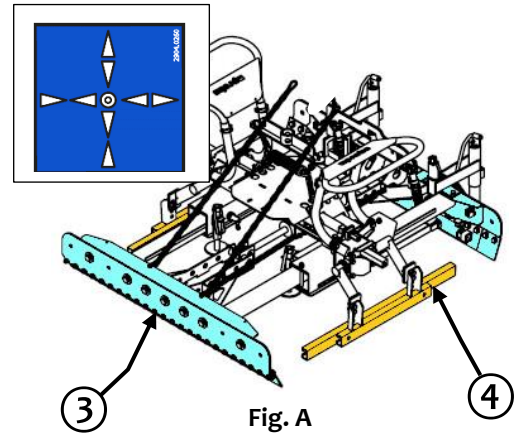
The machine has two travel speeds:

- In general, driving is only permitted on level, firm and horizontal surfaces. When driving on uneven surfaces as well as on surfaces with gradients, there is a **risk of tipping over / accidents!**
- **Speed stage I**  **approx. 15 km/h**
Driving in the fast driving mode is only recommended on level, firm and horizontal ground, as well as for longer distances and straight rides (**without load**).
In addition, the longer braking distance at this speed level and the faster reduction of battery capacity (compared to speed level II) must also be taken into account.
There is a **risk of overturning / accidents** when **cornering** abruptly or braking abruptly on surfaces with a gradient!
- **Speed stage II**  **approx. 6 km/h**
In general, the more energy-efficient speed stage II is recommended for all paving work on level, firm and horizontal surfaces, as well as for cornering (with and without load).



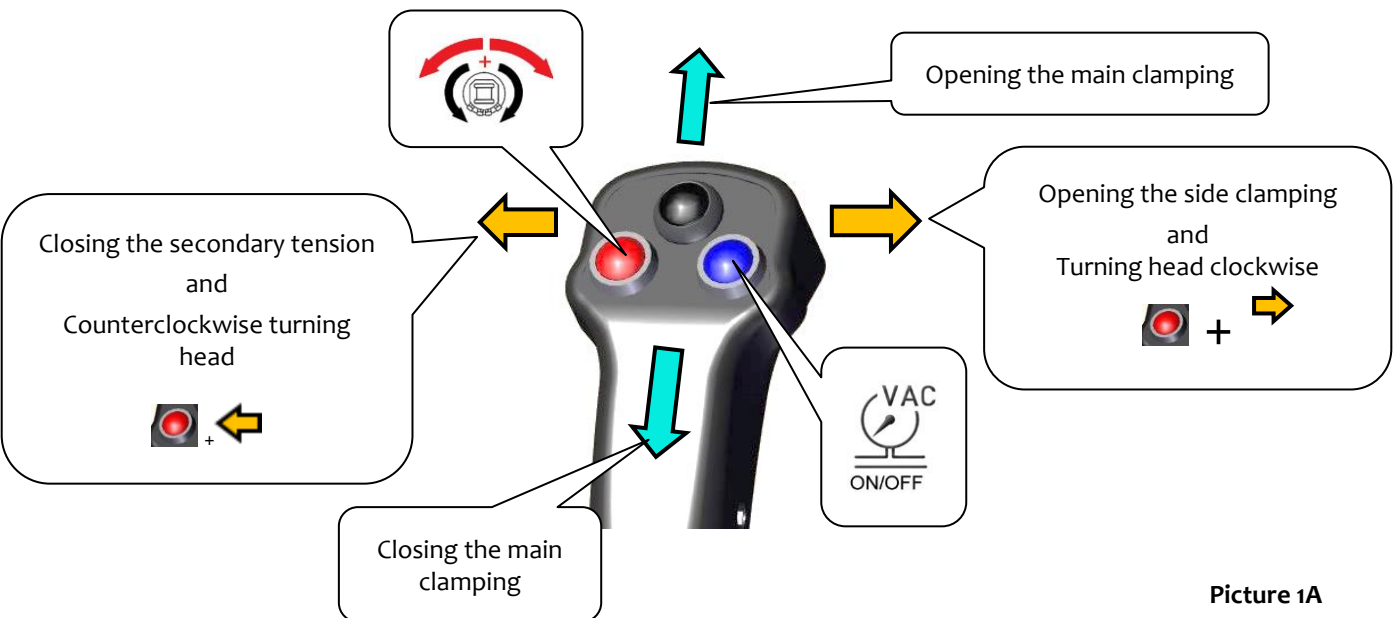
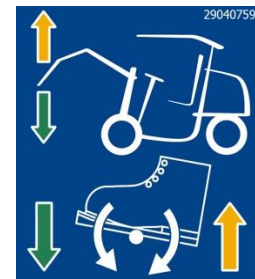
4.7.3 Electronic Joystick

- The electronic joystick (Fig. 1A) controls the operation of the attachments). For example the opening and closing of the main clamping ③ and secondary tension ④ of a hydraulic laying clamp HVZ (→picture A).
- As well as turning the hydraulic turning head (pressing the red knob on the joystick - see Fig. 1A)



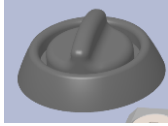
Vacuum operation:

- Switch on vacuum → Press the blue button on the joystick (see Fig. 1A)
- Lower the boom arm downwards (with lifting pedal (Fig. B)).
- Place the vacuum suction plate on the load (stone plate).
- Move the boom arm upwards with the left foot pedal (Fig. B).
- Move the load (stone slab) carefully to its destination.
- Lower the load (stone slab) (with lifting pedal (Fig. B)).
- Place the load on the floor and move the joystick forward (vacuum is interrupted).
- Immediately** move the boom arm upwards again (Fig. B), otherwise the joystick will be released (in the middle position) and the boom operation will be active again immediately!
- Switch off vacuum → Press the blue button on the joystick.

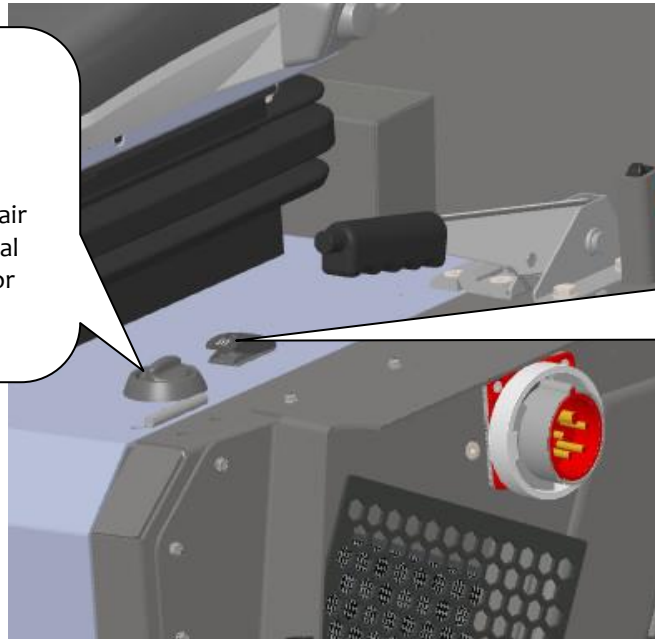


Picture 1A

4.7.4 Ventilation / Heating



Ventilation (3-stage): cold air and warm air (by additional actuation of the switch for heating)

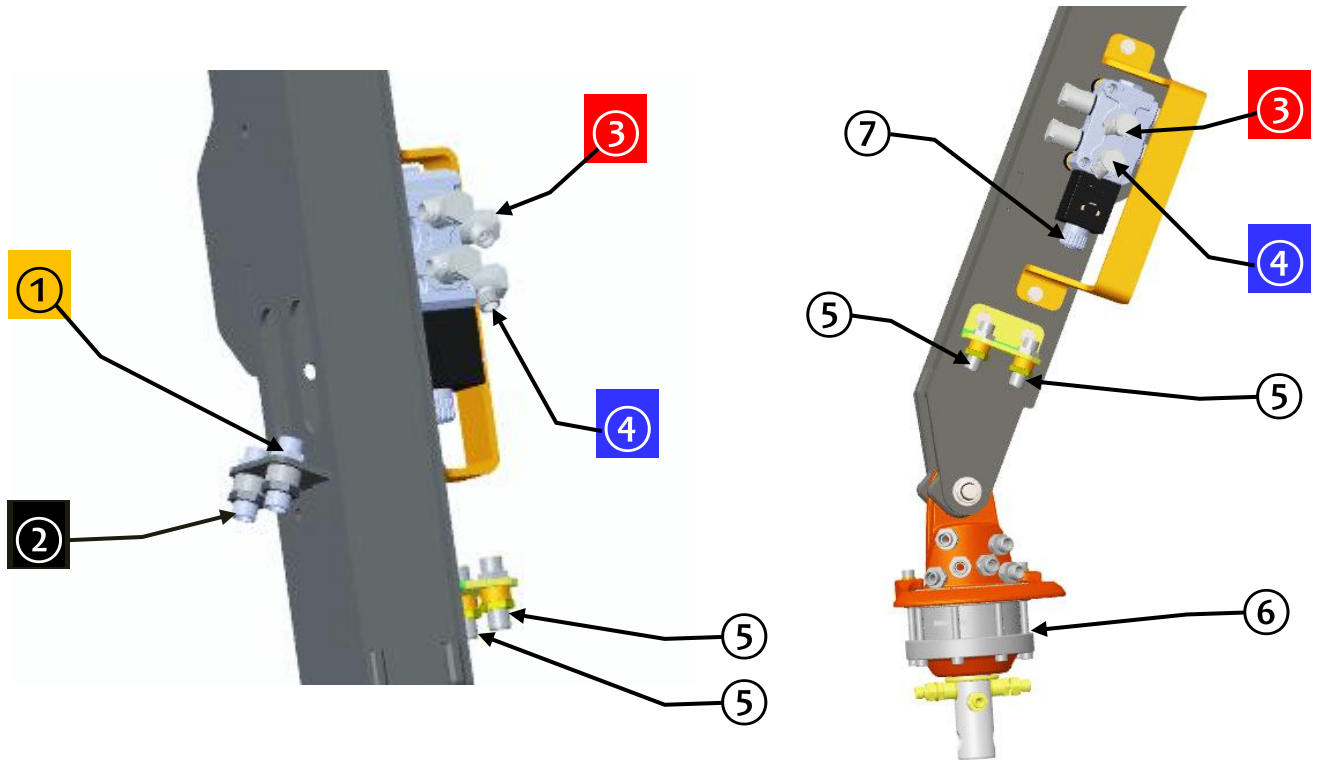


Switch for heating

4.8 Mounting additional equipment



Various attachments (e.g. HVZ) can be mounted on the bracket.
Two separate oil circuits are available for the hydraulic supply.



| | | | | | |
|----------|---|----------|---|---|--|
| 1 | HVZ main clamping connection (yellow marking) | 3 | HVZ side clamping connection (red marking) | 5 | Connections for hydraulic rotary head |
| 2 | HVZ main clamping connection (black marking) | 4 | HVZ side clamping connection (blue marking) | 6 | Hydraulic rotary head |
| | | | | 7 | Setting the rotation speed for the hydraulic rotating head |

5 Transport

5.1 Transport of the installation machine



No lifting equipment is required to move the installation machine onto the trailer or onto the platform of a truck.

The machine can be driven onto the loading area.



Safe and sufficiently dimensioned ramps must be used - in consideration of the maximum width and the maximum weight of the installation machine!

The different track widths of the laying machine (front and rear) must always be observed!

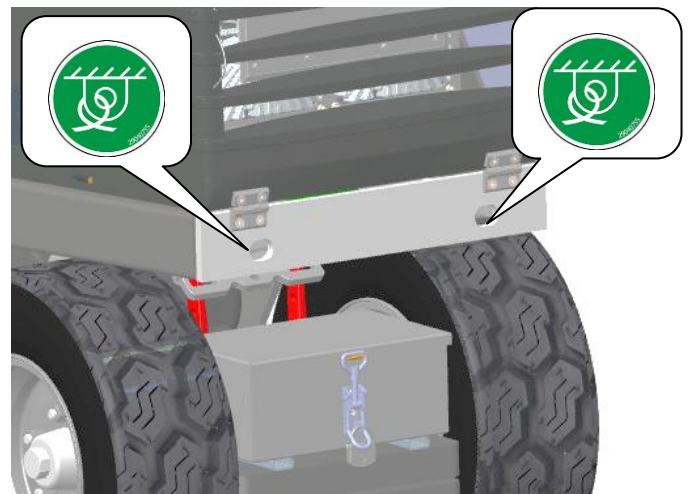


The maximum angle of the ramps of <math>< 18^\circ</math> (32%) must NOT be exceeded!

The parking brake must be pulled in and the installation machine must be secured against rolling and shifting in accordance with the regulations of the employers' liability insurance association.



Two lashing lugs are attached to the front and rear of the installation machine for securing purposes:



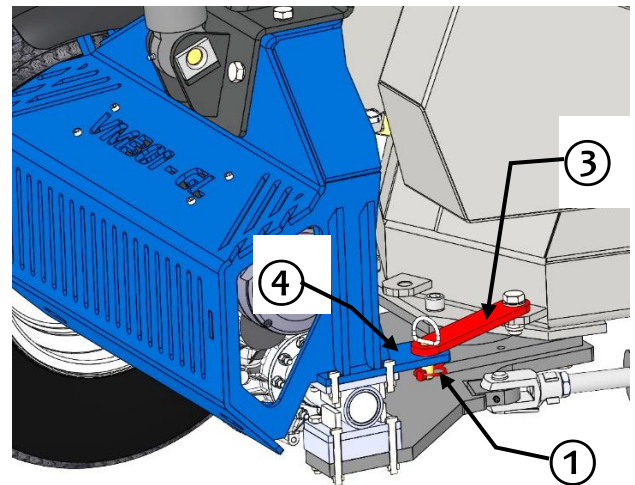
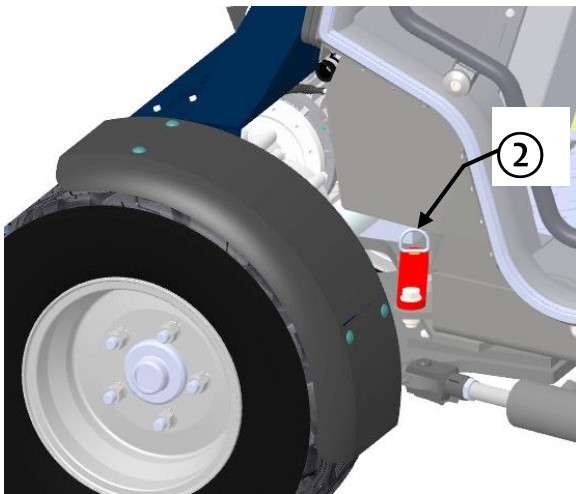


The steering of the installation machine must be locked before transport!

Locking the steering during transport: two lashing lugs are fitted to the front and rear of the installation machine for securing:



- Remove the safety splint (1).
- Remove bolt (2).
- Turn the tension rod (3) onto the plate (4) so that the holes are aligned.
- Insert bolt (2).
- Insert safety splint (1)



The steering lock must be removed before the installation machine is unloaded!

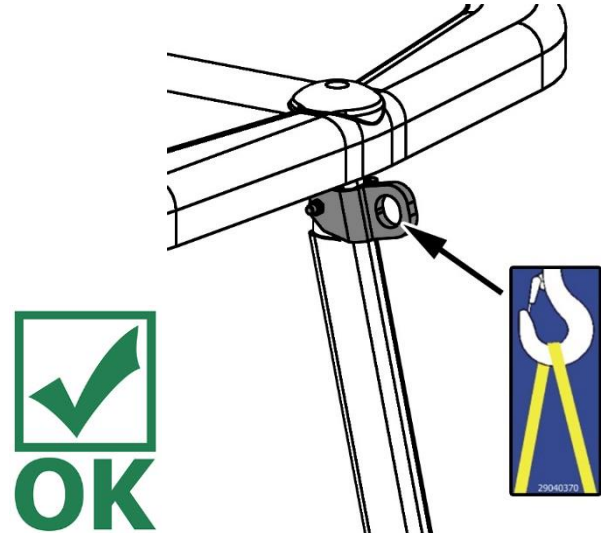
5.2 Lifting the machine with a crane



The lashing rings must never be used as attachment points when lifting the machine!



Only the suspension eye may be used to lift the machine with a crane.



When the machine is suspended from the crane, all movements on the crane must be done with the utmost care!



- There must be no persons in the danger area!
- Let the machine swing as little as possible!
- Do not allow the machine or parts of the suspension system to collide with other objects!
- All safety regulations for working with lifting equipment must be strictly observed.

5.3 Towing the installation machine



Do not tow or wheel the installation machine without traction drive!

As this will cause damage to the drive.

- For towing the installation machine (e.g. with empty batteries or a gearbox damage or similar) the front axle must be raised accordingly (so that the front wheels do not touch the ground anymore).
- As soon as the parking brake has been released, the installation machine can be towed away on the rear wheels.

6 Storage



When the laying machine is stored for a longer time:

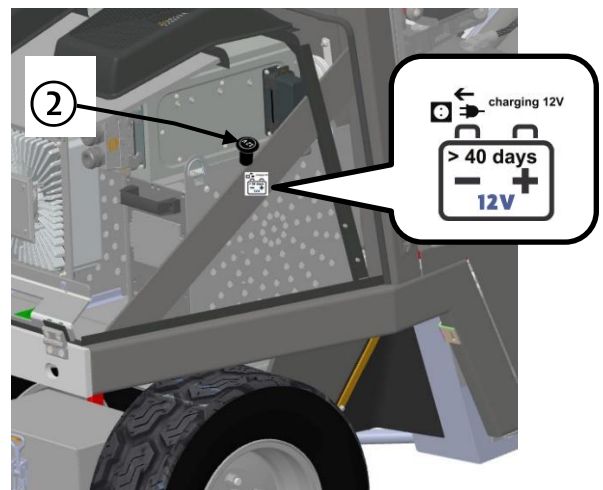
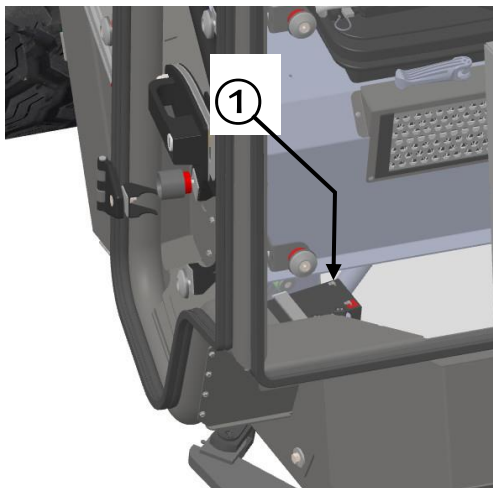
- Store the machine in a level and dry place in a hall.
- In order not to damage the lithium-ion batteries at cold outside temperatures (below 3° C), it is not advisable to store the laying machine outdoors.
- **Pull the handbrake!**
- Use wheel chocks or similar which prevent the laying machine from rolling away unintentionally.
- Protect machine from direct sea air (danger of corrosion!)
- Retract the lifting cylinder.
- Completely clean and lubricate all components (joints) according to the lubrication plan.
- **Cleaning with a high pressure cleaner or water in the area of the cover is prohibited.** Danger of short-circuit/electric shock to the electronic components in the switch box and lithium-ion batteries.
- **Further details regarding storage can be found in the enclosed product data sheet for lithium-ion batteries.**



- In the winter months, pour sufficient antifreeze into the windscreen wiper water.
- Place the attached laying clamp (HVZ) on the floor, place the wooden beam under the grab cheeks.
- Close main voltage to laying clamp (HVZ).
- Open the secondary tension on the installation clamp (HVZ).



The **12 V battery** ① for operating voltage (radio, lighting etc.) **must be completely charged** with a suitable 12 V charger via the 12 V socket ② under the cover after approx. 40-50 days at the latest. **Since otherwise NO system start is possible** (even if all available lithium ion batteries are fully charged).



7 Maintenance and care

7.1 maintenance



In order to guarantee perfect function, operational safety and service life of the laying machine, the maintenance work listed in the table below must be carried out after the specified intervals.

Only original spare parts may be used, otherwise the warranty expires.



All work may only be carried out with the laying machine stopped (apply handbrake) and the engine switched off! It must also be on a horizontal surface.

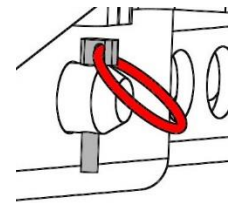
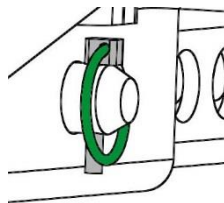
Unattended parking of the laying machine on inclined surfaces is not permitted.

When carrying out any work on attachments (e.g. HVZ-UNI), it must be ensured that the unit cannot close unintentionally. **Risk of injury!!!**

7.1.1 Mechanical

| SERVICE INTERVAL | Maintenance work |
|---|--|
| First inspection after 25 operating hours | <ul style="list-style-type: none"> Control and tighten all screws and connections. (The implementation is only allowed by an expert). |
| All 50 operating hours | <ul style="list-style-type: none"> Tighten all screws and connections (take care that the tightening torques according to the property class of the screws are observed). Check all existing safety elements (such as linchpins) for perfect function and replace defective safety elements. → 1) Check all joints, bolts, guidance's and gears for correct function, if necessary adjust or replace it. Check all grippers (if available) for signs of wear. Grease all slidings (if available) when the device is in opened position with a spatula. Grease all grease nipples (if available) with a grease gun. |
| Minimum 1x per year (at rough conditions shorten the interval) | <ul style="list-style-type: none"> Check of all the suspension parts, bolts and straps. Check for corrosion and safety by an expert. |

1)



7.1.2 Electrics

| Service interval | Maintenance work |
|--------------------------|--|
| After 25 operating hours | <ul style="list-style-type: none"> Control all electrical connections and/or retighten (the implementation is only allowed by an expert) |
| All 50 operating hours | <ul style="list-style-type: none"> Check all fuses (if existing) Check the electric cabling for breaks and abrasion, if necessary replace it (only qualified personal) |



Opening the control cabinet and replacing the fuses (48 V) must **ONLY** be carried out by an authorised electrician.

Likewise, all work on the electrical system (rechargeable batteries, batteries, cables, components, etc.), especially on the 400V power socket, must **ONLY** be carried out by an authorised electrician! **I'M GONNA KILL YOU!!!**

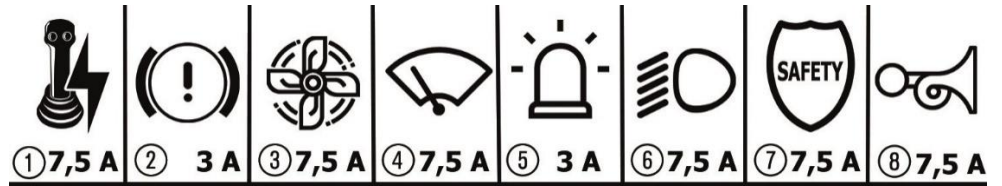
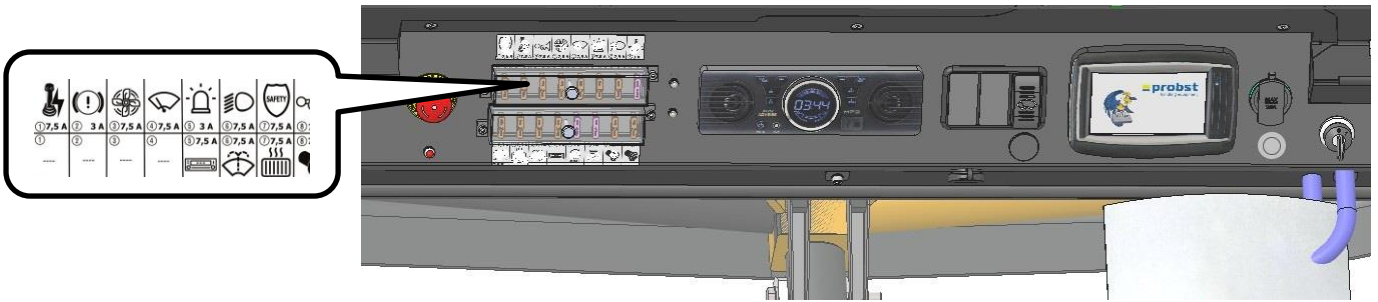











The fuses in the switch cabinet are (partly) **NOT** conventional fuses from the passenger car sector, but special 48 V fuses.









This must be observed when replacing fuses!



7.1.3 Fuse assignment (dash panel)



| | |
|---|--|
|  | Working hydraulics |
|  | LED signal lamp (handbrake locked) |
|  | Electric fan (hydraulic oil cooling) |
|  | Windscreen wiper |
|  | Rotating beacon |
|  | Headlights |
|  | Relay box Safety package - Seat switch / Reset button - Driving mode  |
|  | Alarm horn |

| | | | | | | | |
|---|----------|----------|----------|---|--|--|--|
| ① --- 29040808  | ② --- | ③ --- | ④ --- | ⑤ 7,5 A  | ⑥ 7,5 A  | ⑦ 7,5 A  | ⑧ 7,5 A  |
| | | | | Radio | | | |
| | | | |  | | | |
| | | | | Windscreen washer system | | | |
| | | | |  | | | |
| | | | | Heating | | | |
| | | | |  | | | |
| | | | | 12 V socket outlet | | | |

7.1.4 Hydraulic

| Service interval | Maintenance work |
|---|--|
| First inspection after 25 operating hours | <ul style="list-style-type: none"> Control and tighten all hydraulic thread joints and connection. (The implementation is only allowed by an expert). |
| All 50 operating hours | <ul style="list-style-type: none"> Tighten all hydraulic connections. Check the hydraulic system for leaks. Check the hydraulic oil filter, clean it if necessary (if available). Check the hydraulic oil and replace it in accordance to the manufacturer information (recommended hydraulic oil: HLP 46 according to DIN 51524 – 51535). Check the hydraulic hoses for breaks and abrasion. |
| Only specified types of oil may be used! | |

Regular maintenance

In order to maintain the machine functions and to ensure a long operating life of the engine, the regular checks must be carried out according to the table below.

Warranty claim for this device only exists if the prescribed maintenance work is carried out (by an authorised specialist workshop)! After each maintenance interval has been carried out, this proof of maintenance (with signature and stamp) must be sent to us immediately (by e-mail to service@probst-handling.de / by fax or post).

| No. | Maintenance work (① Order number see enclosed maintenance record booklet) | Before each commissioning | After first 50 hrs. | Every 100 hours | Every 200 hours | Every 1000 hours | Every year | Every 2 years |
|-----|---|---------------------------|---------------------|-----------------|-----------------|------------------|------------|---------------|
| 4 | Changing the hydraulic oil (RANDO HLP 46 ~ 25 l) | | ● | | | ● | ● | |
| 5 | Check hydraulic oil level top up if necessary (RANDO HLP 46 ~ 25 l) | ● | | | | | | |
| 6 | Replacing the hydraulic oil filter ① | | ● | | | ● | ● | |
| 17 | Checking the electrical wiring for loose connections | | ● | | ● | ● | ● | |
| 19 | Recharge the 12V battery ⑤ | | | | | | | |
| 21 | Replacement of windscreen wiper water including antifreeze | | | | | | | ● |
| 22 | Check the antifreeze in the windscreen wiper water (before each frost period). | | | | | | ● | |
| 26 | Check the hydraulic hoses for leaks (tighten connections) | | ● ② | | | | | |
| 27 | Check the function of the instruments and controls. | | ● | | ● | ● | | |
| 28 | Check the machine for damaged, deformed components and abnormal noises. | | ● | | ● | ● | | |
| 29 | Tighten all screws and nuts, replace missing screw connections. | | ● | | ● | ● | | |
| 30 | Checking the tyre pressure (front 2.5 bar/36 psi, rear 2.2 bar/32 psi) | | ● | | ● | ● | | |
| 31 | Lubrication according to lubrication schedule | | ● | | ● | ● | | |
| 32 | Check ball joint for strength (135 Nm) | | ● | | ● | ● | | |
| 33 | Check load-bearing components for cracks (axles, chassis, swivel legs), steering linkage) | | | | ● | ● | ● | |
| 34 | Tighten all wheel nuts (130 Nm) | | ● | | ● | ● | | |
| 35 | Check the handbrake (readjust 3-4 teeth if necessary) | | ● | | ● | ● | | |
| 36 | Check the wheel bearing and adjust the axle pivot bearing if necessary. | | | | | ● | | |
| 37 | Check steering play | | | | | ● | | |
| 38 | Checking the alternator | | | | | ● | | |
| 39 | Adjusting the valve clearance of the toggle lever (0.15 mm) | | | | | ● | | |

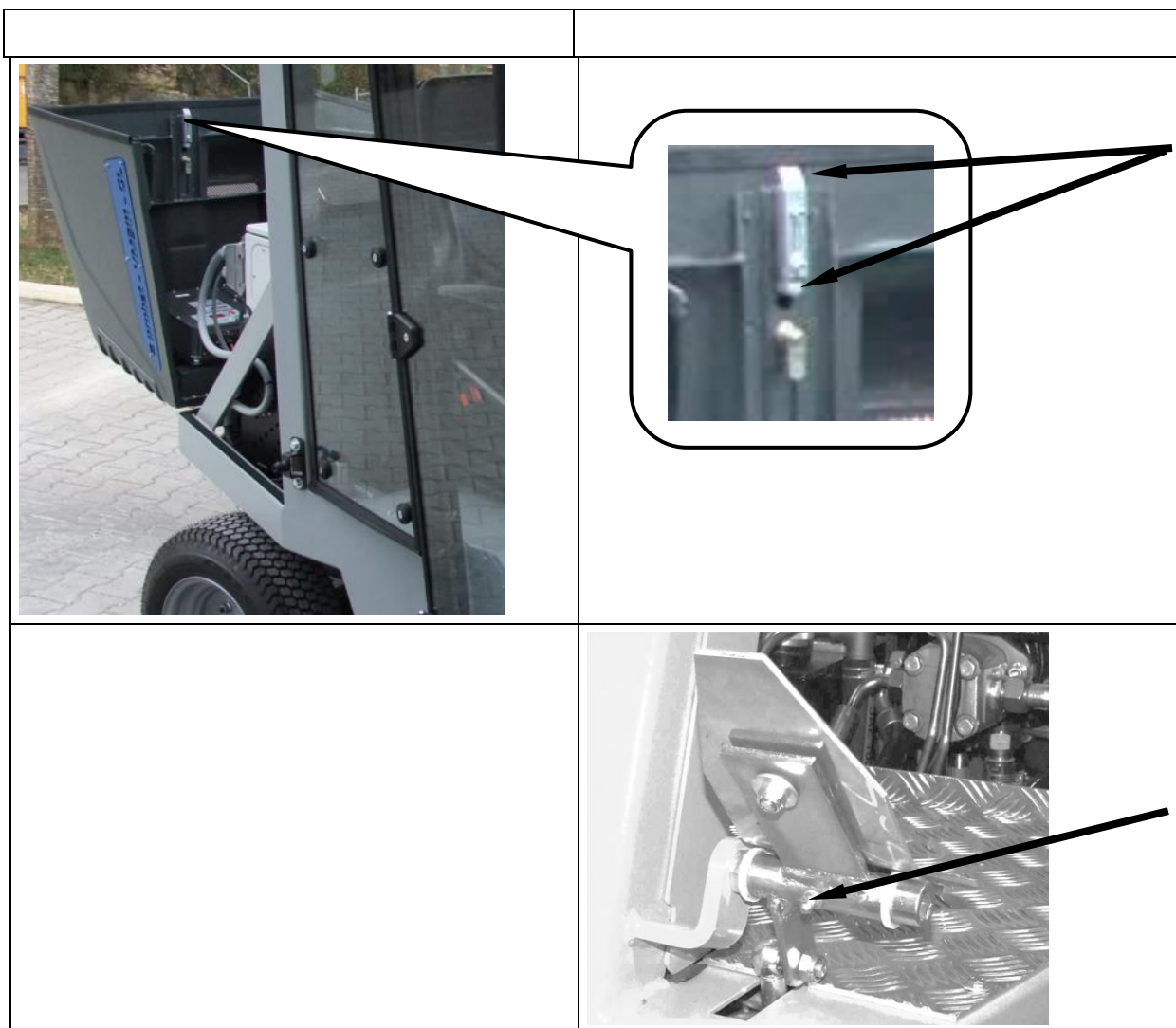
During welding work, the plug connection to the batteries must generally be disconnected, as otherwise damage to the electronics can occur!

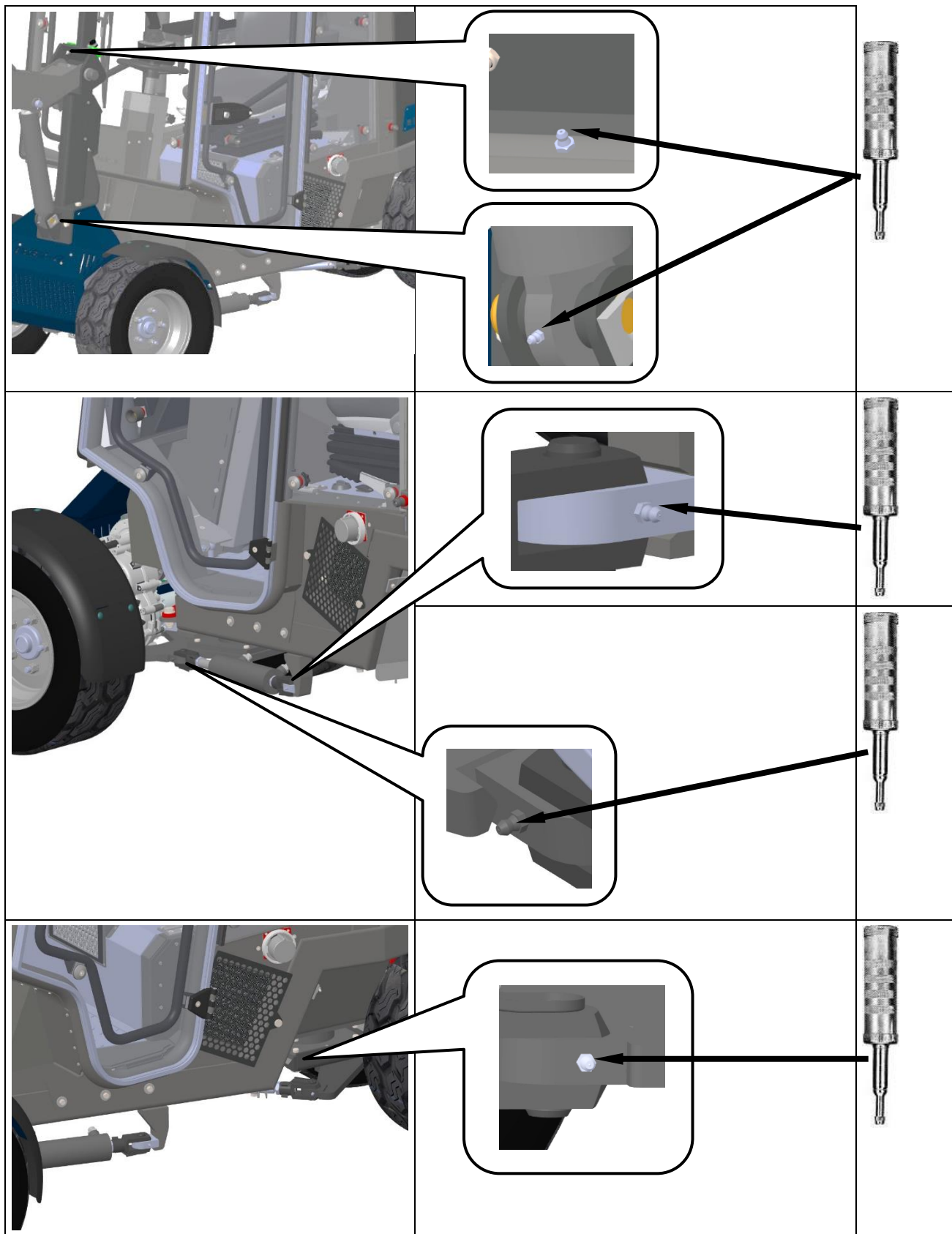
Visual inspection before each start-up: Hydraulic oil

② and additionally every 50 hours / ③ replace every 400 hours / ④ replace every 500 hours


⑤ at the latest after approx. 40-50 days idle state of the machine

7.2 Lubrication plan





7.3 Trouble shooting

| DISTURBANCE | CAUSE | LIFTING |
|--|---------------------------------|--|
| System does not start | Lithium-ion batteries are empty | Charging Lithium-Ion Batteries |
| System does not start (when lithium-ion batteries are fully charged) | 12V battery is discharged | Charge 12V battery for operating voltage |
| The system is running, but the machine is not running. | Seat switch is active | Press reset button (horn) 1 x  |
| The handbrake does not work | Brake pads worn out | Replace brake pads |
| | Handbrake cable loose | Adjust handbrake cable |
| Machine does not start | Fuse blown | Check fuses |
| | Battery defective | Check battery |
| Outrigger cannot be lifted | Hydraulic system has leakage | Repair leakage |
| | Too little hydraulic pressure | Check oil level |
| System is running, but machine is not running | Handbrake is applied | Releasing the handbrake |

7.4 Repairs



Only persons with the appropriate knowledge and ability are allowed to repair the device. Before the device is used again, it has to be checked by an expert.

7.5 Safety procedures

- It is the contractor's responsibility to ensure that the device is checked by an expert in periods of max. 1 year and all recognized errors are removed (→ see DGUV regulation 1-54 and DGUV norm 100-500).
- The corresponding legal regulations and the regulations of the declaration of conformity must be observed!
- The expert inspection can also be done by the manufacturer Probst GmbH. Contact us at: service@probst-handling.com
- We recommend affixing the inspection sticker "„Sachkundigenprüfung / Expert inspection" in a clearly visible place (order no.: 2904.0056+Tüv sticker with year number) after the inspection has been done.





The check by an expert must be proved!

| Device | Year | Date | Expert | Company |
|--------|------|------|--------|---------|
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7.6 Hints to the type plate



Type, serial-number and production year are very important for the identification of your device. If you need information to spare-parts, warranty or other specific details please refer to this information's.

The maximum carrying capacity/working load limit (WLL) is the maximum load which can be handled with the device. **Do not exceed** this carrying capacity/working load limit (WLL).

If you use the device in combination with other lifting equipment (Crane, chain hoist, forklift truck, excavator) consider the deadweight of the device.

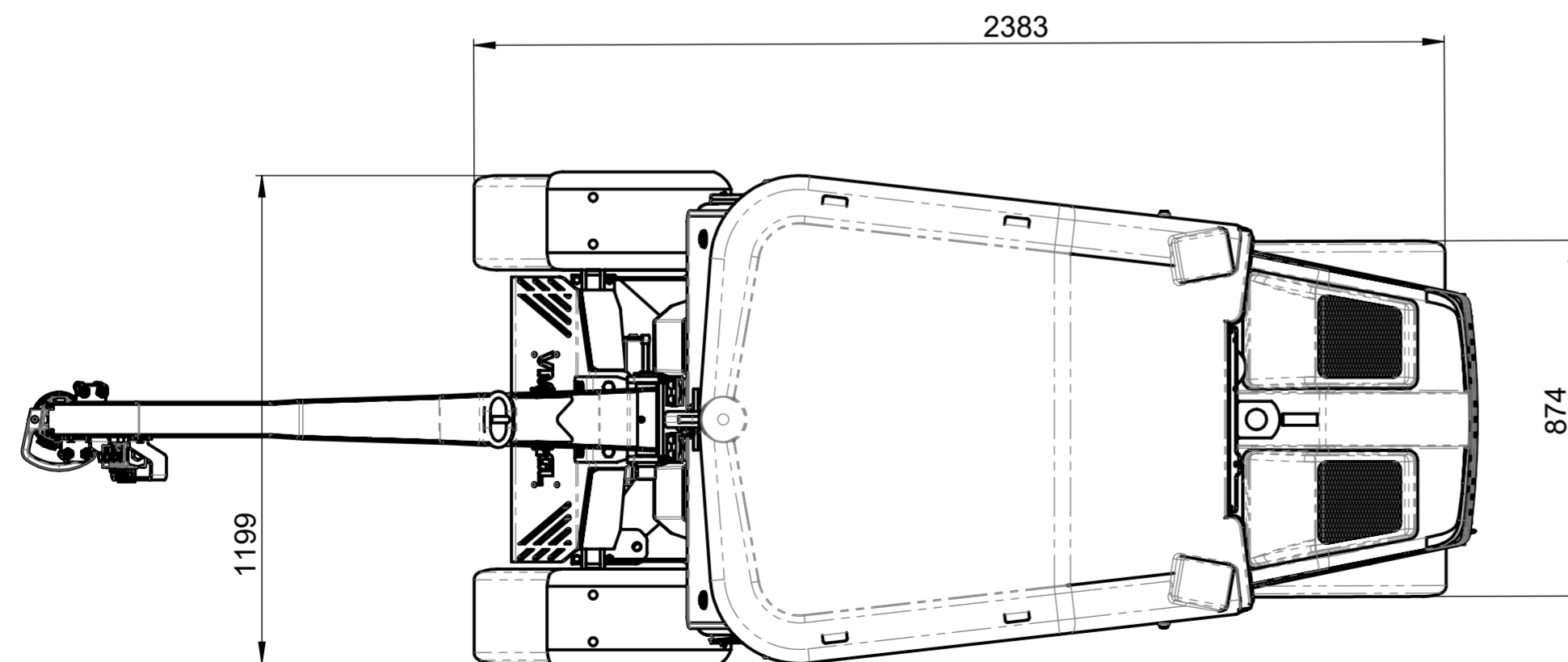
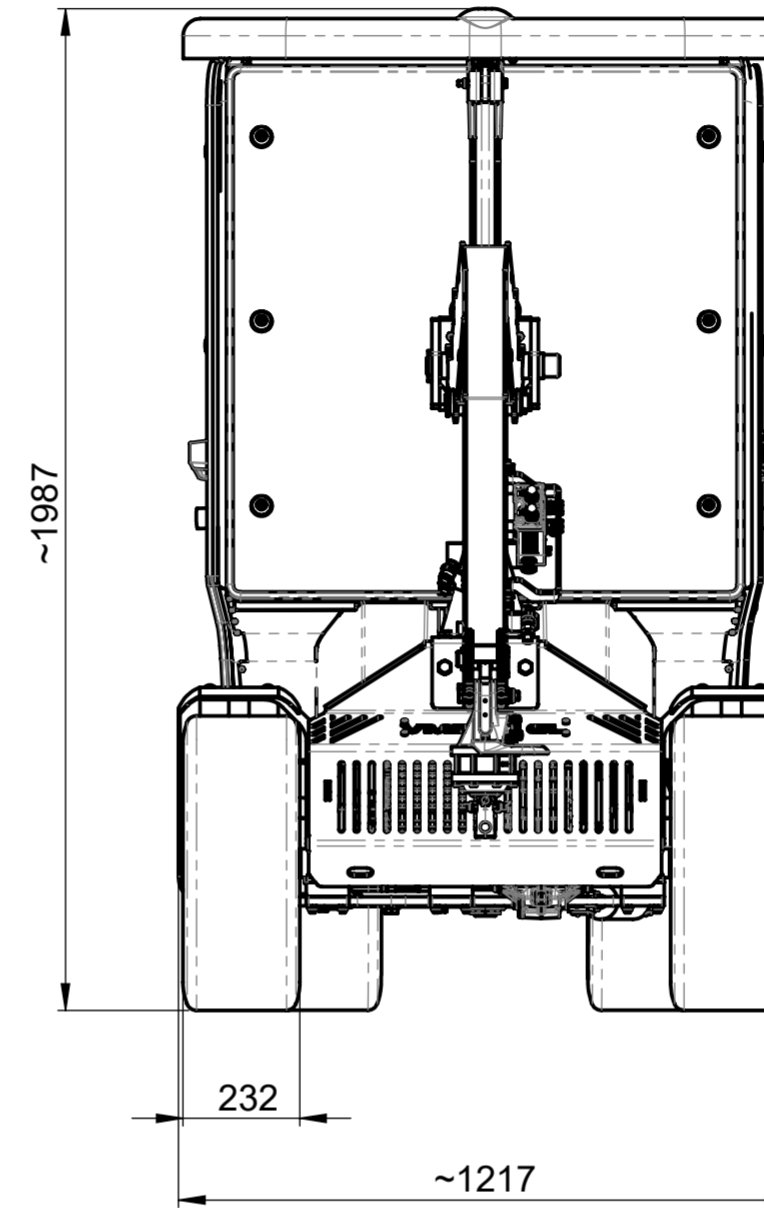
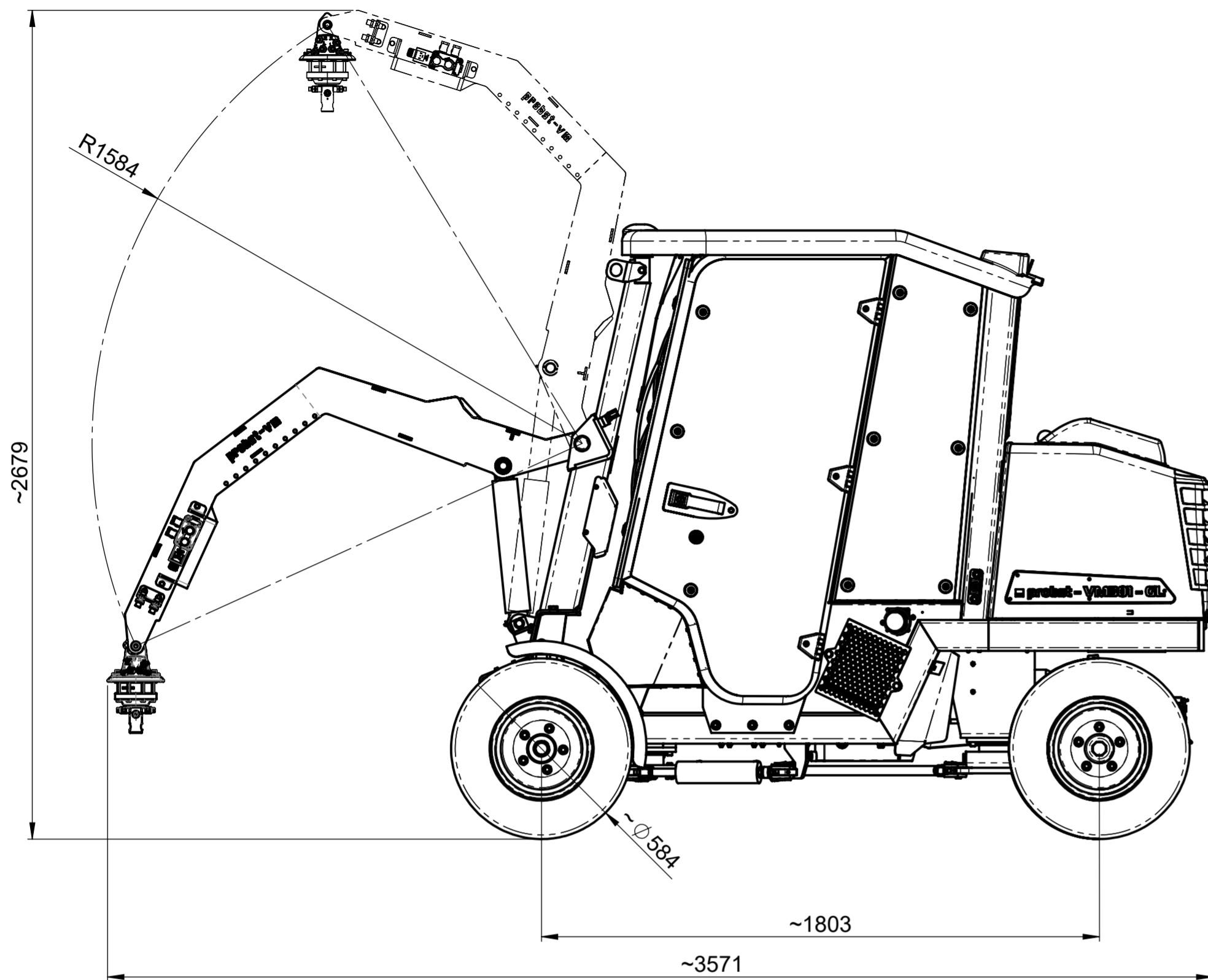


Example:

7.7 Hints to the renting/leasing of PROBST devices



With every renting/leasing of PROBST devices the original operating instructions must be included unconditionally (in deviation of the user's country's language, the respective translations of the original operating instructions must be delivered additionally)!



Technische Daten / Technical specifications

Batteriesystem / Battery system

| | | |
|-----------|------------|-------------|
| Typ | Type | Lithium-Ion |
| Spannung | Voltage | 48 V |
| Kapazität | Capacity | 105 Ah |
| Leistung | Output | 4 kW |
| Gewicht | Mass | 39 kg |
| Schutzart | Protection | IP 54 |

Ladegerät / Battery charger

| | | |
|------------------|------------------|---------------|
| Ladespannung | Charging voltage | 230 V / 400 V |
| Ausgangsstrom | Output current | 50 A / 100 A |
| Ausgangsspannung | Output voltage | 48 V |
| Schutzart | Protection | IP 54 / IP 65 |

Differentialachse / Differential axle

| | | |
|---------------|---------------------|----------------------|
| Leistung | Output | 8 kW |
| Spannung | Voltage | 48 V |
| Stromaufnahme | Current consumption | 200 A |
| Schutzart | Protection | IP 54 / IP 65 |
| max. Drehzahl | max. revolutions | 4000 $\frac{1}{min}$ |

Pumpenmotor / Pump motor

| | | |
|---------------|---------------------|----------------------|
| Leistung | Output | 5 kW |
| Spannung | Voltage | 48 V |
| Stromaufnahme | Current consumption | 165 A |
| Schutzart | Protection | IP 54 / IP 65 |
| max. Drehzahl | max. revolutions | 2500 $\frac{1}{min}$ |

Tragfähigkeit / Working Load Limit:

650 kg / 1433 lbs

Eigengewicht / Dead Weight:

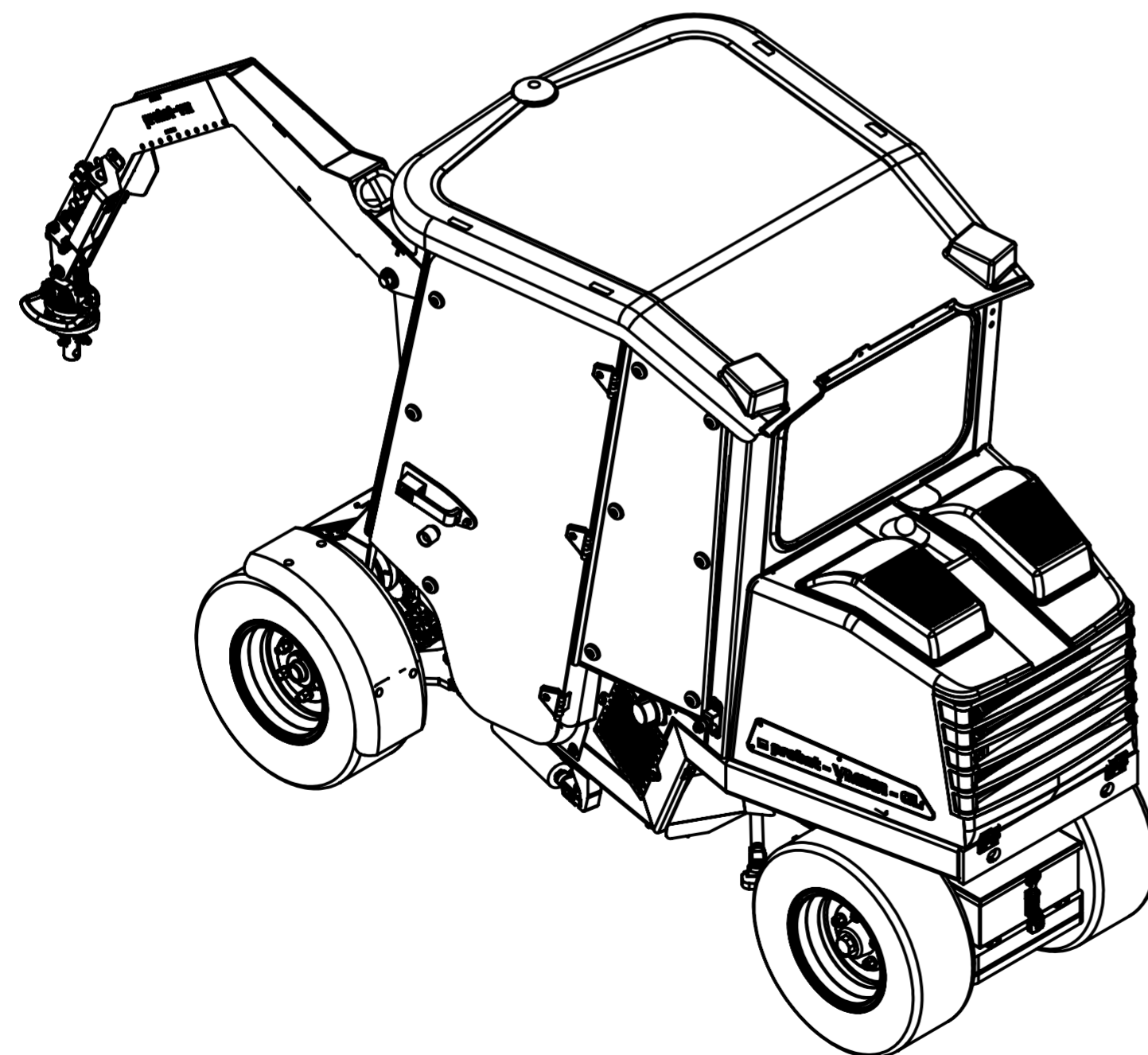
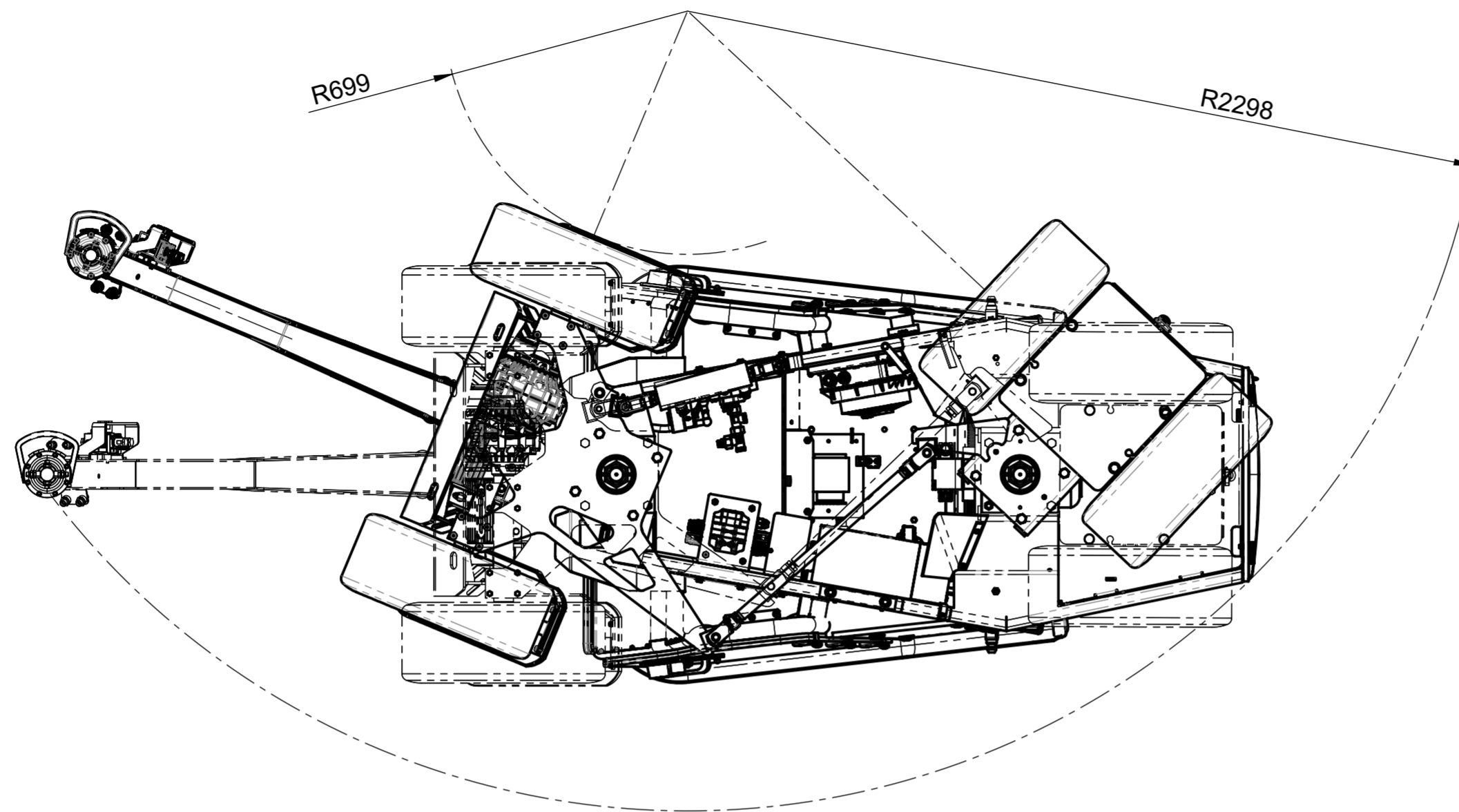
1570 kg / 3461 lbs

Product Name:
Installation machine VM301-GREENLINE



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| | | | | | |
|--------------------------------|-----------|---------|-------|--------------------|--|
| Datum | | Name | | Benennung | |
| Erst. | 15.7.2019 | R. | Wolff | Verlegemaschine | |
| Gepr. | | | | VM301-KJ-GREENLINE | |
| Artikelnummer/Zeichnungsnummer | | | | Blatt | |
| D51500024 | | | | 1 | |
| | | | | von 2 | |
| Zust. | Urspr. | Ers. f. | | Ers. d. | |



Technische Daten / Technical specifications

Fahreigenschaften / Driving Performance

| Typ | Type | |
|----------------------------|------------------------|--------------------|
| Fahrgeschwindigkeit | Driving speed | |
| Vorwärts - Gang 1 / 2 | Forward - Gear 1 / 2 | 11,2 km/h / 6 km/h |
| Rückwärts - Gang 1 / 2 | Backwards / Gear 1 / 2 | 8,2 km/h / 6 km/h |
| Max. Steigfähigkeit | Max. Gradability | <18° (<32%) |

Hydraulik / Hydraulic

| | | |
|-------------------|----------------|----------|
| Max. Druck | Max. Preassure | 180 bar |
| Max. Volumenstrom | Max. Flow Rate | 20 l/min |
| Zahnradpumpe | Gear Pump | 8 cm³/U |

Bordelektrik / On-Board Electronic

| | | |
|----------------|------------------|------------------------|
| Bordspannung | On-Board Voltage | 12V |
| Max. Strom | Max. Current | 45 A |
| Heizung | Heater | 48V / 12V P= 1,3 kW |
| Pufferbatterie | Buffer Battery | 12V / 7,2Ah |



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| Datum | Name | Benennung |
|-----------------|---------|---------------------------------------|
| Erst. 15.7.2019 | R.Wolff | Verlegemaschine VM301-KJ-GREENLINE |
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Artikelnummer/Zeichnungsnummer
D51500024

Blatt
2
von 2

Product data sheet

Lithium-ion batteries

Part number **AA006302**

Product name **Double module system 14s36p**

CHANGE TRACKING

| Version | Modified on / from | Responsibility | Change description/scope |
|---------|-----------------------|----------------|--------------------------|
| 1V0 | 03.08.2018 | HAM | Release |
| 1V1 | 23.08.2018 | ADE | AA006302 |

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I GENERAL INFORMATION

I.1 GENERAL PRODUCT DESCRIPTION

Energy storage systems are based on high-quality, durable and high-performance Li-ion cells (18650) from renowned manufacturers, which are characterized by their very high specific energy and performance as well as good cycle stability without memory effect. Due to the integral design and compact arrangement of the battery cells, battery modules have an outstanding energy density. The patented technology enables a vibration-resistant, durable cell contact (frictional connection) as well as a unique cooling via pole contacts, which guarantees a homogeneous module temperature and a long service life. The use of aluminium core circuit boards also ensures a robust design of the battery modules. Battery modules are available with different active materials as well as in different sizes and shapes, so that overall the performance characteristics, capacity, cycle stability and thermal behaviour can be individually adapted to customer requirements.

The Battery Management System (BMS) is based on a dual safety structure with two separate systems, thus enabling redundant operation. Due to complex algorithms that adapt exactly to the cell behavior, the BMS provides an extremely precise determination of the state of charge or a high degree of precision with regard to range prediction. The exact recognition of the current cell losses and capacities allows a cell-individual aging determination and a precise, gentle load regulation. By means of data recording and on-board black box functionality.

2 SAFETY, STORAGE AND USAGE INSTRUCTIONS

NOTE

With regard to the detailed safety and storage instructions, the information in the storage and safety instructions (separate document) must be observed.

The battery system may only be used by persons who have sufficient knowledge of Li-ion battery systems. A proper use within the boundary conditions specified by Probst GmbH must be guaranteed. The battery system may only be charged with chargers provided or approved in writing by Probst GmbH.

DANGER

Do not touch metal contacts or electronic components, as they may be live. Do not connect power or communication signals unless clearly stated in the operating instructions. Take special care that the systems do not come into contact with water or are not exposed to a humid environment. Do not touch the battery cells with metal parts or other hard objects, as damage can lead to short circuits, overheating and exothermic chemical reactions.

For the use of this product, the following additional instructions must be observed:

- Only use the charger approved by Probst GmbH to charge the system
- Do not load the system above the currently permitted current values
- Do not disconnect or shut down the system under load
- Do not disconnect the power plug under load
- Only switch off the system when it is at standstill
- Do not switch off the system in a discharged state for long periods of time, but connect it promptly to the appropriate, active charger (principle: "charging")
- Switch off the system if the signal tone is continuous
- Only use the system under the specified tightness classes

3 SCOPE OF SERVICES

The battery storage system includes the following components:

- lithium-ion modules
 - Number2 Modules
 - System interconnection 7s36p
- Number of temperature sensors 4
- Electrical heating functionYes
- Separating device Relay (mechanical isolator) EV200
- Fuse ANL Bolt-down 355 A
- Power interfaceSB175 Connector
- BMS (Battery Management System) & EMS (Energy Management System)
- Acoustic signaler
- Deep discharge protection
- 4Gb microSD card for data logging
- Pressure compensation diaphragm & outgassing valve
- Communication cable with stand-alone termination and mating connector
- Digital enable signal

The system is complete on the part of Probst GmbH when delivered. The customer is responsible for the final assembly and the correct installation of missing components as well as the power and communication cabling in the vehicle.

In case of questions or ambiguities, please always contact Probst GmbH.

4 MECHANICAL PROPERTIES

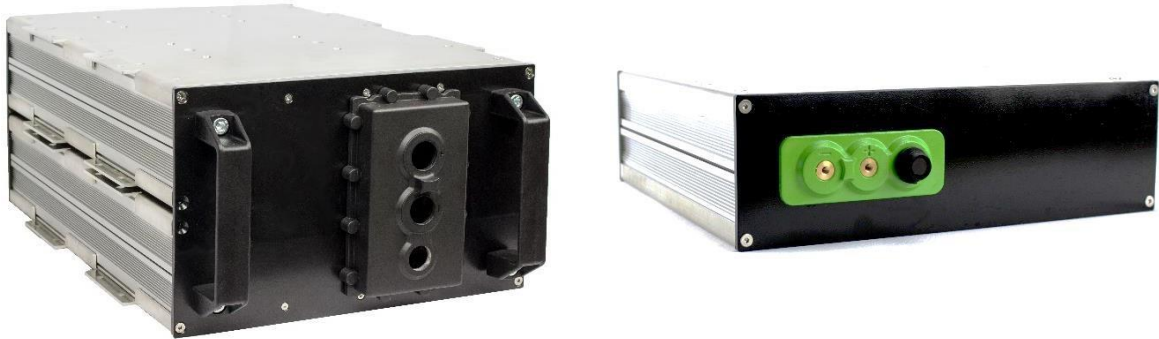


Figure 1: Double module energy storage system (left) and single module energy storage system (right)

4.1 MECHANICAL KEY DATA

| Designation | Value |
|--|---|
| Weight | 36kg7s72p 14s36p |
| Dimensions | 480 x 325 x 185 mm7s72p 14s36p |
| Maximum torque at M6 battery power contact (minus, plus) | 5 Nm |
| Protection class | IP 54 |

Table 1: Mechanical maximum values.

Further mechanical data and detailed geometric views can be found in Appendix 1_Design drawings.

4.2 ENVIRONMENTAL CONDITIONS

| Designation | Value |
|---|-----------------------------|
| Ambient temperature Storage | -20 °C to 50 °C |
| Ambient temperature Operating ¹ | -20 °C to 50 °C |
| Discharge temperature range (battery module) ¹ | -20 °C to 59 °C |
| Charging temperature range (battery module) ¹ | 0 °C to 45 °C |
| Air humidity | max. 60 % (non-condensing) |
| Elevation gain | Up to 2000m above sea level |

Table 2: Thermal characteristics

¹At system temperatures below 10°C the performance is severely limited. The heating function heats the battery to over 10°C to allow full performance from the start.

4.3 FASTENING

The system can be attached to the mounting plates on the lower side on a floor plate or on a wall. When orienting, make sure that the cables are not pointing downwards. The system must not be mounted horizontally on the top, one side or front or back.

5 ELECTRICAL PROPERTIES

5.1 ELECTRICAL CHARACTERISTICS

WARNING

Loads above the electrical parameters can cause permanent damage. Permanent loading of the system with absolute maximum values can influence the reliability and lifetime of the system.

It is therefore recommended to operate the system only within the range of the nominal specification.

The system may only be connected to chargers approved by Probst GmbH that comply with the performance data of the product.

The following tables show the electrical specifications of the battery system. Table 3 shows the performance-related characteristics of the system.

| Designation | Stand-Alone | Increase in performance |
|---|---|-----------------------------|
| Number of systems | 1 | 2 |
| Voltage range of the battery system | 37.8 V - 58.8 V | |
| Nominal voltage | 25,2 V | |
| Capacity | 104 Ah 5,200 Wh | 208 Ah 10,400 Wh |
| Recommended discharge depth | 15 % to 90 % of nominal capacity | |
| Discharge current Continuous | 75 A | 135 A |
| Discharge current 10 s Peak load ¹ | 250 A | 450 A |
| Charge current/recuperation Continuous ¹ | 50 A | 90 A |
| Recuperation current 10 s Peak load ¹ | 100 A | 145 A |

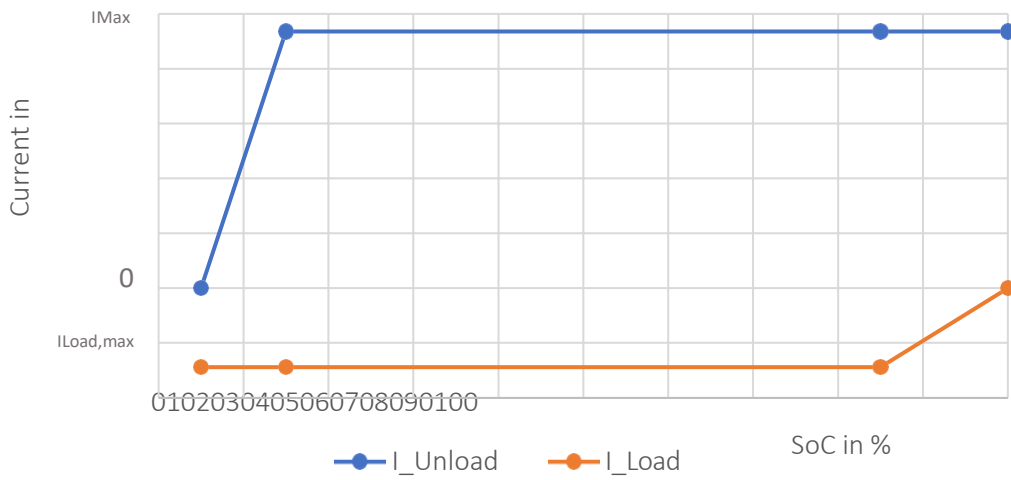
Table 3: Electrical properties (single system) under normal conditions

¹Power reduction depending on temperature and state of charge. Information on this in the parameter list

The maximum number of parallel connections is 4 systems.

The following table shows the maximum permissible current values set by the factory as a function of the state of charge and temperature. The term *charging* stands for both charging and recuperation.

Maximum permissible current depending on the state of charge



Maximum permissible current as a function of temperature

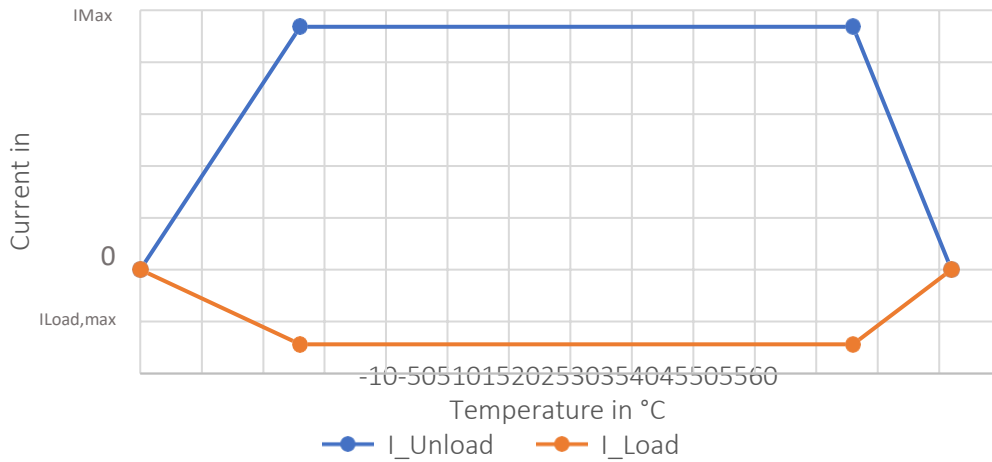


Table 4 shows the electrical characteristics of the battery electronics.

| Designation | Value |
|--------------------------------------|--|
| BMS Supply voltage | Battery voltage U_{Bat} |
| BMS supply current (Pin 1 and 2) | < 100 mA |
| Quiescent current | < 2.0 mA |
| Voltage level CAN bus (CAN-H, CAN-L) | 1,5 – 3,5 V |
| Impedance AUX-NO output | 2.2 kΩ |
| Voltage AUX-NO output | 3 – 60 V |
| Current AUX-NO output | < 1 mA |

Table 4: Electrical properties of battery electronics

5.2 CAN-MATRIX

For detailed information see attached CAN parameter list. Optional CAN configurations are listed below

- CAN protocol CAN 2.0 A
- Baud rate of the CAN interface 250k
- 120 Ohm termination resistor integrated in termination

For smooth CAN communication, another 120 Ω Terminating resistor required. Star taps should be avoided.

5.3 PIN ASSIGNMENT

DANGER

- Separation of power under load must be avoided to protect persons and components. When changing the power cabling or pulling a plug, make sure that the system is switched off.

WARNING

- The power must always be connected before communication.
- The communication plug must be disconnected before the power connection
- If changes are made to the power cabling, the system must be switched off.

5.3.1 Power connector

| Designation | Manufacturer | Battery page | Opposite side |
|----------------------------------|--------------|------------------------------|----------------------------|
| Peculiarity | | Connector | |
| | APP | 940-BK, SB175A, grey | 940-BK, SB175A, grey |
| Service contact | APP | 1383-BK, PP180, AWG2 | 1383-BK, PP180, AWG2 |
| Waterproof rubber protection cap | APP | 3-6036P1, Boot, Cover Source | 3-6037P1, boat, cover load |

Table 5: Power connectors and accessories

5.3.2 Communication plug

| Designation | Manufacturer | Connector Battery side | Connector opposite side |
|--|--------------|------------------------|-------------------------|
| Drive communication connector | Delphi | 15326660 - f | 15326661 - m |
| Communication connector termination/parallel operation | Delphi | 15326661 - m | 15326660 - f |
| Communication connector <i>Battery</i> | Bulgin | PX0413/12S/PC | PX0410/12P |

Table 6: List of communication plugs

The power and communication plugs for the vehicle side are not included in the scope of delivery. For additionally required contacts, the following table lists the manufacturer numbers for the contacts.

| Designation | Manufacturer number | Additional information |
|-------------|---------------------|---|
| Bulgin | SA3180/1 | Pin contacts 18-22AWG for PX0410/12P (solder contact) |
| Delphi | 15304718-L | Socket contact |
| Delphi | 15304730-L | Pin contact |
| Delphi | 12191221 | Cable seals orange |
| Delphi | 15305170 | Blanking plug white |
| Delphi | 15317832 | Closure bracket grey |

Table 7: Components for the connectors

The battery system can be extended by up to 3 further systems in parallel, provided that this was provided by Probst GmbH at delivery. The modular design of the cable set allows the end user to operate the system in stand-alone or parallel mode with other battery systems by simply connecting the communication cables. A wiring proposal is enclosed in the data sheet.

5.3.2.1 Drive communication connector

The pin assignment of the Molex communication connector for the vehicle is shown in Table 8. This plug serves as an interface to the vehicle and the charger.

| ID | Signal | Description |
|----|---------------|---|
| A | system-on-out | System supply output for system activation. Must not be used for any other purpose and must be switched potential-free with Pin-B System-On In to activate the system. potential corresponds to the positive battery system potential. |
| B | System-On In | System supply input for the electronics. To activate the system, this must be switched potential-free with Pin-A System-On Out . |
| C | n.c. | |
| D | CAN Shield | Connection for CAN shielding. |
| E | CAN High | Connection to vehicle/charger CAN Bus High. |
| F | AUX-COM | Input of the polarized isolated NO switch. Auxiliary contact closes when the battery grants a driving licence and opens before the circuit breakers open in case of a fault. |
| G | AUX-NO | Output of the polarized potential-free NO switch. Auxiliary contact closes when the battery grants and opens a driving licence before open the circuit breakers in the event of a fault. |
| H | n.c. | |
| J | n.c. | |
| K | CAN-Low | Connection to vehicle/charger CAN Bus Low. |

Table 8: Pin Assignment Communication Connector 15326660 (according to numbering on connector)

5.3.2.2 Communication connector termination/parallel operation

This communication plug is used for termination or parallel operation. In parallel operation, this connector is connected to the drive connector of the next system, and so on. In the last system in the parallel group, this connection is connected to a termination.

5.3.2.3 Termination

The system is also delivered with a scheduling function. This can be either a scheduling for stand-alone, i.e. one system per vehicle, or a scheduling of a parallel connection of several systems. The structure of the circuitry is described in the next section. Scheduling includes

- Option 1 - Stand alone
 - Signal routing for stand-alone of a single battery system
 - 120 Ohm terminating resistor for CAN
- Option 2 - Parallel operation:
 - Signal routing for parallel operation of maximum 4 battery systems
 - 120 Ohm terminating resistor for CAN

5.3.2.4 Connection

The following two figures show the two possible interconnection options of the battery systems. The circuitry for the stand-alone is shown in Figure 2. If several battery systems are to be connected in parallel, the communication must be wired according to Figure 3. In the parallel operation variant, the first battery system supplies the electronics of all systems.

- Option 1 - Stand alone system:
 - The entire system consists of a battery system.
 - The drive plug is connected to the vehicle/charger.
 - The connector for termination is connected to the termination for stand-alone.
 - Figure 2 shows the cabling of the system in single mode.

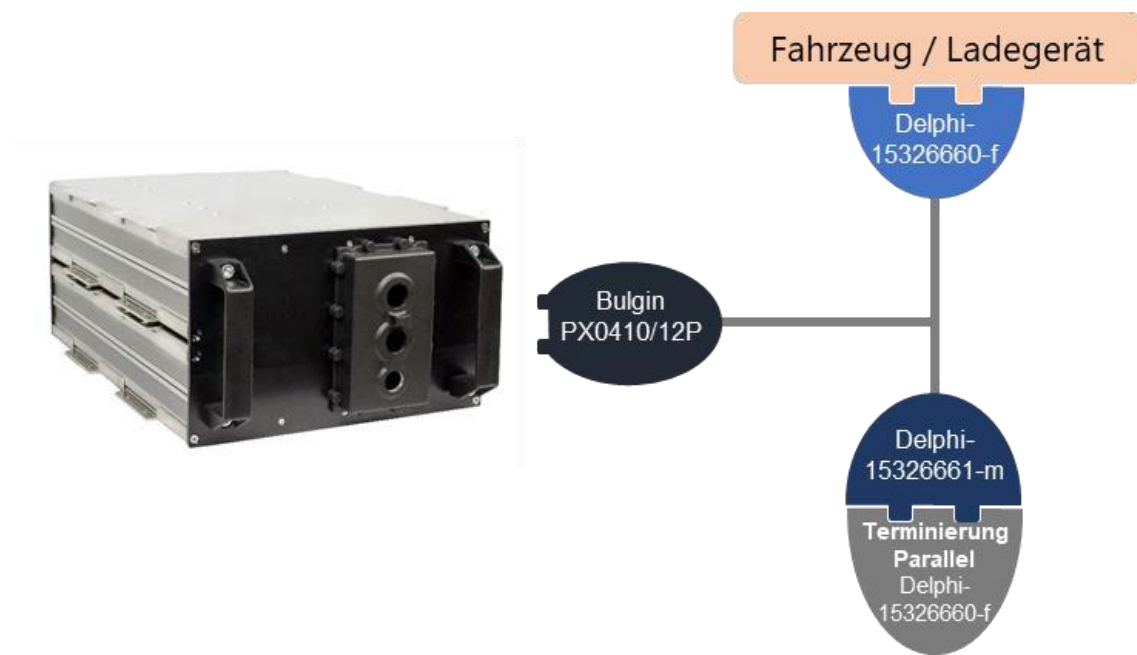


Figure 2: Communication cabling in stand-alone of a single battery system

- Option 2 - Parallel operation:
 - The entire system consists of a minimum of two and a maximum of four parallel battery systems.
 - The drive connector of the first battery system is connected to the vehicle/charger as in Figure 3.
 - The connector for termination of the first battery system is connected to the drive connector of the second parallel battery system. The connector for the termination of the second parallel battery system again with the drive connector of the third parallel battery system and so on.
 - The termination plug of the last parallel battery system (**maximum 4**) is connected to the supplied termination for parallel operation.
 - Figure 3 shows the wiring of the entire system with n individual battery systems in parallel operation.

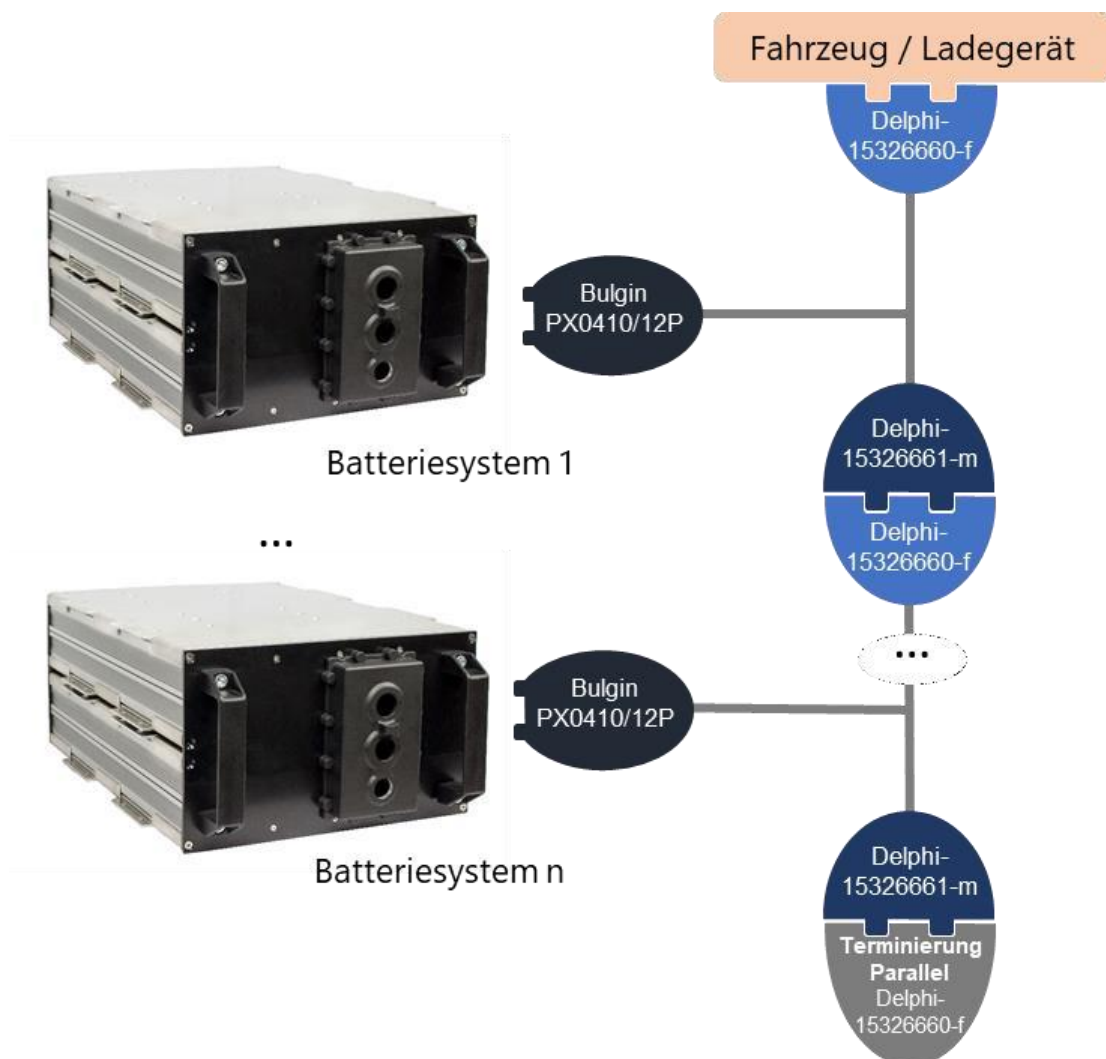


Figure 3: Communication cabling in parallel operation of n battery systems, where $2 \leq n \leq 4$.

5.4 GROUNDING CONCEPT

The ground of the battery electronics is internally referenced to the battery negative potential. The customer must ensure that the housing is externally grounded to the same potential (battery minus potential) by means of a potential equalization cable.

WARNING

- Care must be taken that no short circuits occur between CAN communication and the positive or negative battery potential. This can lead to the destruction of the CAN electronics.
- Other CAN devices installed in the application must be referenced to the same potential as the battery CAN or be galvanically isolated via an opto-decoupled module.

6 PROGRAM BEHAVIOR

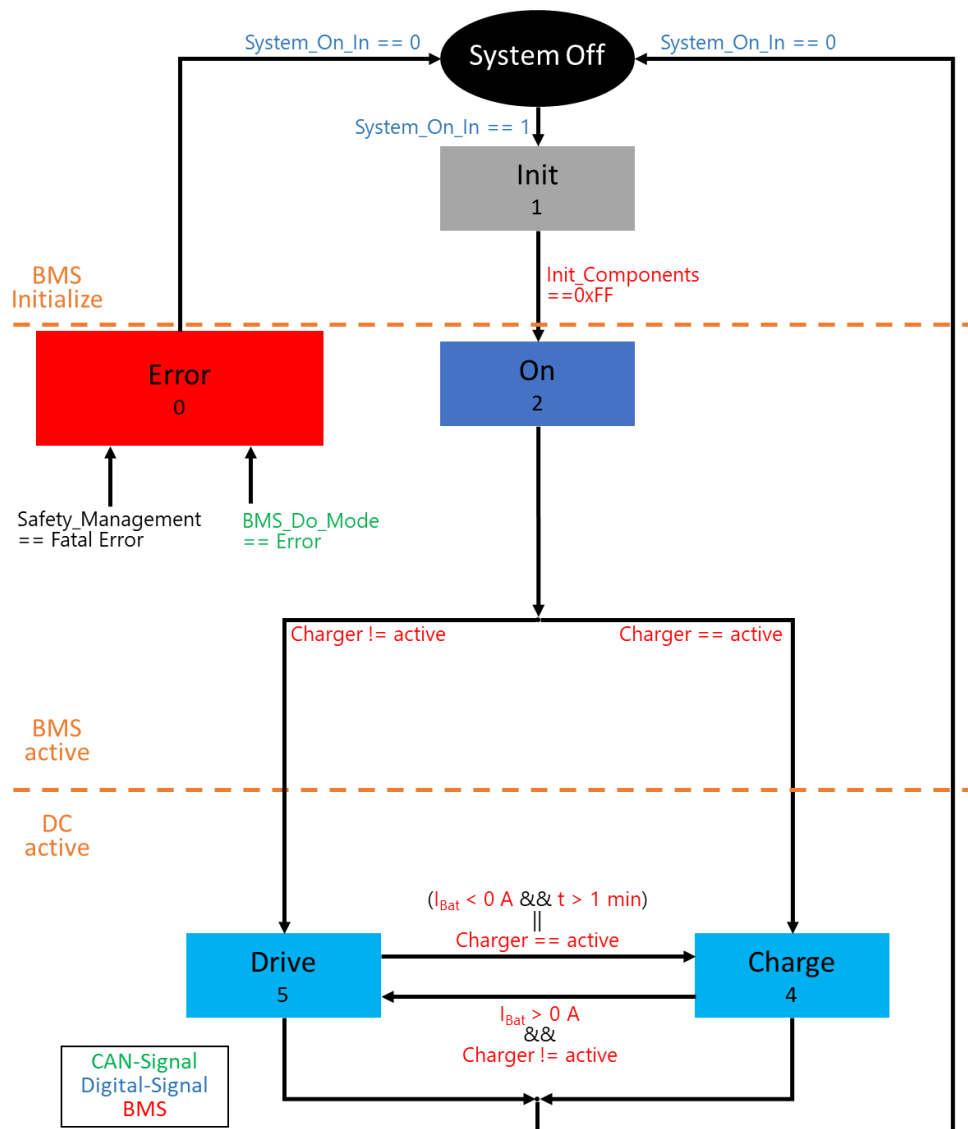


Figure 4: State machine

The individual states of the individual system are described below:

6.1.1 0_ERROR

Error mode of the system. Open all circuit breakers and remove all driving and charging releases. The system can only be restarted by rebooting the system. The corresponding error message is communicated via CAN.

6.1.2 1_INIT

Initialization of all battery components. As soon as all components are initialized, the BMS automatically switches to the ON mode

6.1.3 2_ON

Battery is in active state

- Balancing is not active
- Service specification is not active

When the charger is connected, the system automatically switches to CHARGE mode. If no charger is active, the system automatically switches to DRIVE mode.

6.1.4 3_SHUTDOWN

shutting down the system

- Battery is not active

6.1.5 4_CHARGE

Condition for charging the battery

- Charge control of the system with charger via the BMS, if a CAN-compatible charger is used
- Balancing is controlled according to the charging algorithm
- Power input active
- Circuit breaker closed
- Acoustic signal transmitter not active

Via the corresponding CAN control signals it is possible to switch to ON, ERROR or DRIVE mode as soon as the charger is disconnected.

In the event of a fatal fault, the system switches to ERROR mode and the circuit-breaker is opened.

6.1.6 5_DRIVE

Driving status of the battery

- Balancing active during longer periods of rest
- Power input active
- Circuit breaker closed
- Acoustic signal generator active based on current performance

Via the corresponding CAN control signals it is possible to switch to ON, ERROR or CHARGE mode. If the charger is connected and recognized by the BMS, the charger automatically switches to CHARGE mode.

In the event of a fatal fault, the system switches to ERROR mode and the circuit-breaker is opened.

6.2 DETAILED DESCRIPTION PROPERTIES

6.2.1 Charging behavior with CAN-compatible charger

Controlled charging is only possible with a CAN-compatible charger approved by Probst GmbH.

As soon as the charger plug is connected to the vehicle, the battery system goes into charging mode and automatically starts the charging process, provided that the wiring of the charger

with the battery system has been properly observed. The BMS automatically controls the corresponding charger.

If the system was previously in drive mode, it automatically switches to charge mode as soon as the charger plug is connected and the charger is active. The driving mode is no longer active.

The system does not leave the charging mode even after the charging process has been successfully completed. The charger is controlled via the CAN interface. If a battery cell reaches the maximum charging end voltage or the maximum SoC is reached, the charging process is interrupted and the balancing function is activated. If the voltage of the battery cell drops again by more than 50 mV, although the charging process was completed, the charging process is reactivated.

The maximum end-of-charge voltage is set at the factory in such a way that sufficient recuperation capacity is also possible at the beginning of the subsequent driving operation and the ageing of the battery system is minimised. The value of the maximum charge end SoC can be found in the parameter list.

The circuit-breaker is only opened in the event of a fault. The charge control is only done via the CAN signal. The charge current in the charge mode is controlled based on the battery temperature and the SoC and is calculated using a stored linear function.

6.2.2 Charging behavior with non CAN-capable charger

If no CAN-capable charger is used, the BMS automatically switches to charging mode if the BMS detects a charging current for at least one minute.

The maximum end-of-charge voltage must be set by the customer on the charger. Probst GmbH recommends to limit the maximum charge cut-off voltage to 95 % of the maximum system voltage.

DANGER

- Overloading to over 100% must be prevented by the customer. This can lead to unsafe conditions and increased aging.

The balancing function is only active during longer periods of rest.

The circuit breaker is only opened in the event of a fault (e.g. excessive charging current). Charging is controlled exclusively via the acoustic signal generator.

6.2.3 Driving behaviour

As soon as the ignition switch is activated, the battery system starts up and automatically goes into DRIVE mode - if the charger is not connected.

The circuit-breaker is only opened in the event of a fault. The power control of the system in driving mode is done via the CAN signals and acoustically via the signal generator. Based on the states of charge, temperatures and voltages of the battery cells, the current performance of the system is transmitted via the CAN interface.

6.2.4 Balancing function

The balancing function is only activated when the battery system is fully charged in charging mode or if the battery system is inactive for more than one minute. During charging and

The battery voltages may vary slightly during the discharging process. This is not yet an indication that the state of charge of the cells varies greatly.

6.2.5 Preheat function

Optional function.

The preheat function is only active when the DRIVE or CHARGE mode is active and the battery temperature is below a certain temperature threshold. The temperature thresholds (start & end preheating) can be taken from the parameter list.

6.2.6 Deep discharge protection

Since the electronics are supplied by the battery in the active state, undercharging of the system must be prevented during prolonged activation and when the state of charge is low.

A monitoring electronics on the EMS switches off the system supply in case of low battery voltage. The deep discharge protection can be bridged either by the integrated button or by a separate termination plug, provided that the individual cell voltages are above the minimum cell voltage.

WARNING

- It is therefore recommended to recharge the system as soon as possible when the deep discharge protection is active.
- The charger must be connected and active before the deep discharge protection is bridged.
- If charging is not possible when the deep discharge protection is active and/or a permanent acoustic warning signal sounds, the system must be switched off and returned to the manufacturer.

As soon as the system has been recharged above a certain threshold, the system is able to supply itself independently again.

6.2.7 Enable signal

- The system has an insulated NO-closer which gives the vehicle/charger a drive/charge permit.
- The contact closes as soon as the battery system allows a power drain
- The contact opens when the system is switched off, in the initialization phase or when the system detects a fatal error.
- In the event of a fatal fault, the release signal is removed about three seconds before the circuit-breakers open.
- Technical data from the upper sections must be observed.

6.3 SYSTEM BEHAVIOUR IN CASE OF ERROR

Each detectable fault in the system is divided into three fault thresholds:

- Warning,
- Standard errors and
- Fatal mistake.

As soon as one of the errors is present, the corresponding message is transmitted via the CAN interface. The three error thresholds cause the battery to react as follows:

- **Warning:** Only transmission of the message via the CAN interface.
- **Standard error:** Removal of the service specification. Transmission of the error message via the CAN interface.
- **Fatal error:** opening of the battery circuit breaker, removal of the driving and charging releases, transmission of the error message via the CAN interface. Audible, continuous signal.

If the error is corrected at the first two error thresholds (warning and standard error), the error is deleted and not transmitted further. If there is a fatal error, the system can only be restarted by rebooting the system.

6.4 POWER REDUCTION AND BEHAVIOUR OF THE ACOUSTIC SIGNALING DEVICE

6.4.1 Power reduction via the CAN interface

The battery system transmits the current capacity via the Limit_Data CAN message. The following parameters influence the performance of the battery:

- **Battery temperature:** A distinction is made between charge and discharge operation. Due to the lithium-ion cells, the temperature window is more limited during charging.
- **State of charge:** If the system is highly charged, the charging or recuperation capacity is limited to prevent overcharging. At low charge levels the discharge power is reduced to counteract undercharging.
- **Temperature of the circuit breakers:** The circuit breakers in the system are designed for a certain continuous current. If this continuous load is exceeded, the temperature of the circuit-breaker rises sharply. Above a certain limit temperature, the performance of the system is reduced.

The power reduction in relation to the respective characteristic variable is linear between the warning threshold and the threshold of the standard error. The maximum of the respective restriction then determines the actual performance of the battery. The respective parameters and limit values can be taken from the parameter list in the appendix.

During the charging process the battery automatically regulates the charging current of the charger via the CAN interface - if this option is available. Thus the battery always remains within the current capacity.

In the discharging process this specification must be implemented via the inverter. If this is not possible, the battery warns the user of a critical situation via a signal generator and the user has the possibility to leave this state by reducing the power.

As soon as a fatal error limit is reached, the battery disconnects from the application via the circuit breaker to protect itself.

6.4.2 Acoustic signaler

This signal generator warns the user of critical situations. A distinction is made between an interrupted and a continuous signal tone. If the signal tone is interrupted, the user must reduce the load. If the signal tone is continuous, no further load is allowed.

The possible sources of error are listed below:

- Interrupted signal
 - Permissible discharge capacity is less than 20% due to the power reduction.
 - The discharge current or recuperation current is above the allowed set point of the battery.
 - The temperature is too low. The system must first heat up.
- Permanent signal
 - Battery system does not allow discharge current. The setpoint has reached the value 0.
 - A fatal error has occurred (battery additionally switches off the output).

7 PARALLEL OPERATION OF SYSTEMS / HOT-SWAPPING

The battery system can be extended to up to 4 systems of the same type in parallel. Here the systems control each other. If there are differences in the SoC of the respective battery systems, the system regulates itself independently.

With parallel enhancement, a distinction is made between two options that can be set via the configuration:

1. **Operating time optimization:** The entire system is normally operated together, but should individual systems fail, the remaining functional systems remain active, only the capacity of the entire system is reduced. However, the permissible currents must not exceed those of a single system, since in the worst case a system alone must deliver the required power.
2. **Performance optimization:** The overall system is always operated together with all individual systems. As soon as one system has an error and shuts down, the remaining systems also shut down. The permissible total power is here the addition of the respective individual powers, taking into account the maximum switching capacity of an individual system. The permissible values are listed in this document.

The parallel connection offers the following features:

- Extension of the system to up to 4 parallel systems
- Hotswapping: The individual systems can be connected in parallel even if they have different charge states.
- High failure safety: If individual systems in the network show a fault or have to disconnect from the network, the remaining, active systems can still be used (in optimising the operating time).

7.1 HOTSWAPPING OF SYSTEMS

To extend systems in parallel, the following settings must be made in the overall system:

- Setting the number of parallel systems via the CAN interface.
- Use the appropriate termination in the communication cabling.
- Ensuring that a single system can deliver the required performance. The performance of the overall system is not increased by a parallel expansion, since each individual system must deliver full performance in the event of a fault in the other systems.

The system will not activate until all the items have been set correctly and the system then initializes correctly.

7.1.1 Parallelism in charging mode

If individual systems with different SoC are connected together and the loading process is then started, the systems are parallelized as follows:

1. The single system or a combination with the lowest SoC is activated first and fully charged to the required charge end SoC.
2. As soon as the first system is fully charged, the next individual system or group is activated and is fully charged again.
3. As soon as all systems are fully loaded, they are all activated together and the parallelization of these systems is completed

7.1.2 Parallelisation in discharge mode

If single systems with different SoC are connected together and the unloading process is started, the parallelization of the systems is carried out as follows:

1. The single system or a compound with the highest SoC is activated and discharged first.
2. As soon as the first system is discharged, this system is disconnected and the single system or the compound with the next higher charge level is activated.
3. As soon as this system is unloaded again, the next single system or compound is activated and unloaded.
4. The systems that accept the same SoC and voltage are connected in parallel if there is no load on the system at that time.
5. If parallelization does not yet work completely in discharge mode, because the individual states of charge still differ, parallelization is performed in the subsequent charging process at the defined discharge SoC.

7.2 FAULTS AND THEIR RECTIFICATION

7.2.1 Parallel system cannot be activated:

If the parallel system can no longer be activated, you must ensure that

- The correct cabling of the parallel systems including the appropriate termination is used
- If one system is not wired correctly, the other systems will not start
- The correct hardware number was set for each system. Otherwise, the systems cannot distinguish between each other and do not initialize
- The correct number of parallel systems has been set. The systems are only activated when the number of systems actively communicating via CAN corresponds to the set number of parallel systems.
- The systems are sufficiently charged and the first system supplies the activation voltage via the AUX output to start up the system.

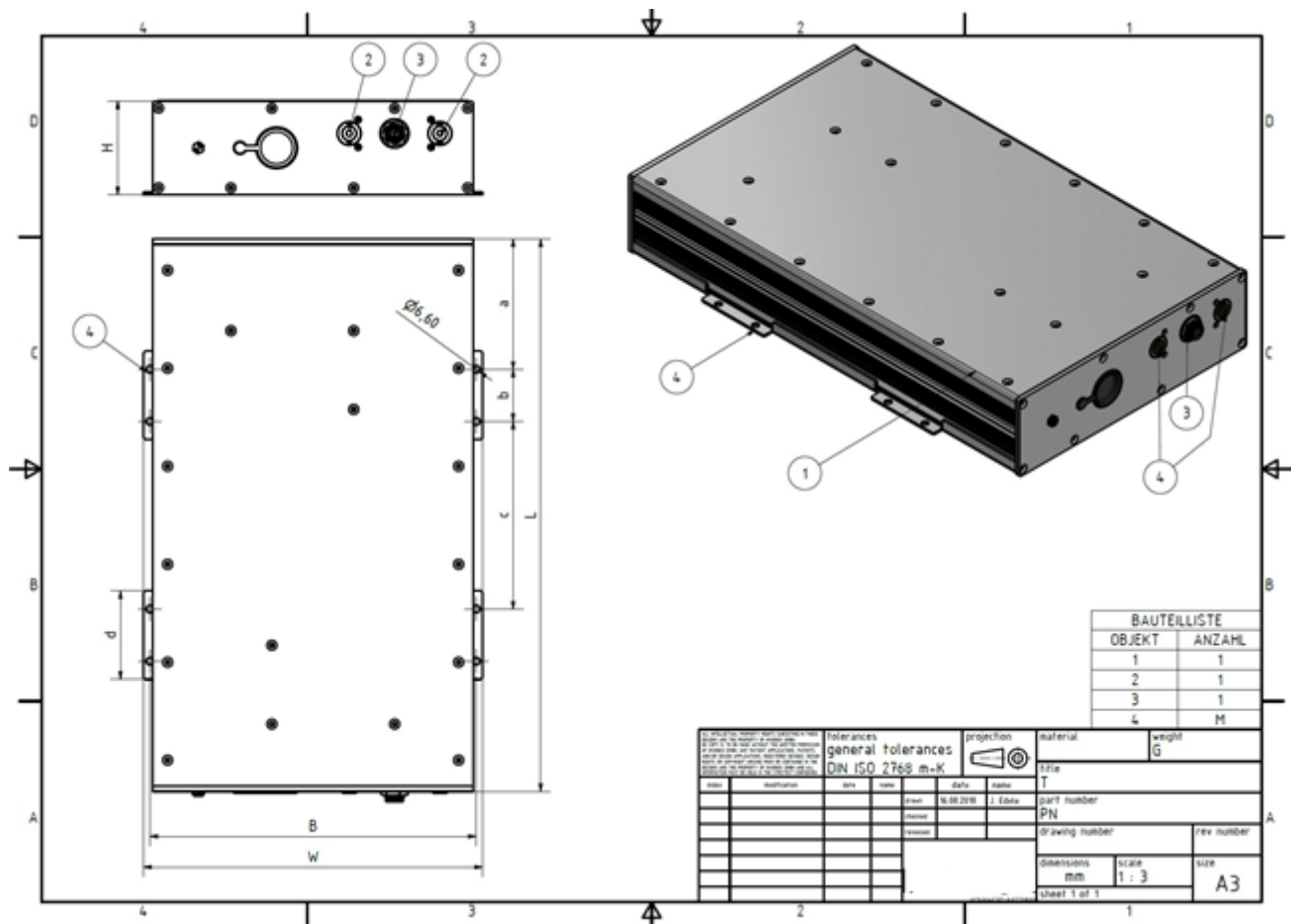
7.2.2 System cannot be parallelized:

If the parallel connection is not carried out, this can have several reasons:

- Parallelisation in discharge mode is not always possible, as it is difficult to start up the same charge states. - It is best to carry out parallelization via the charging mode.
- Parallelisation in charging mode is not possible because the final charge SoC is below the maximum charge SoC of one or more modules. Here, the system should simply be discharged a little bit so that the SoC of the systems sinks.

8 ANNEX

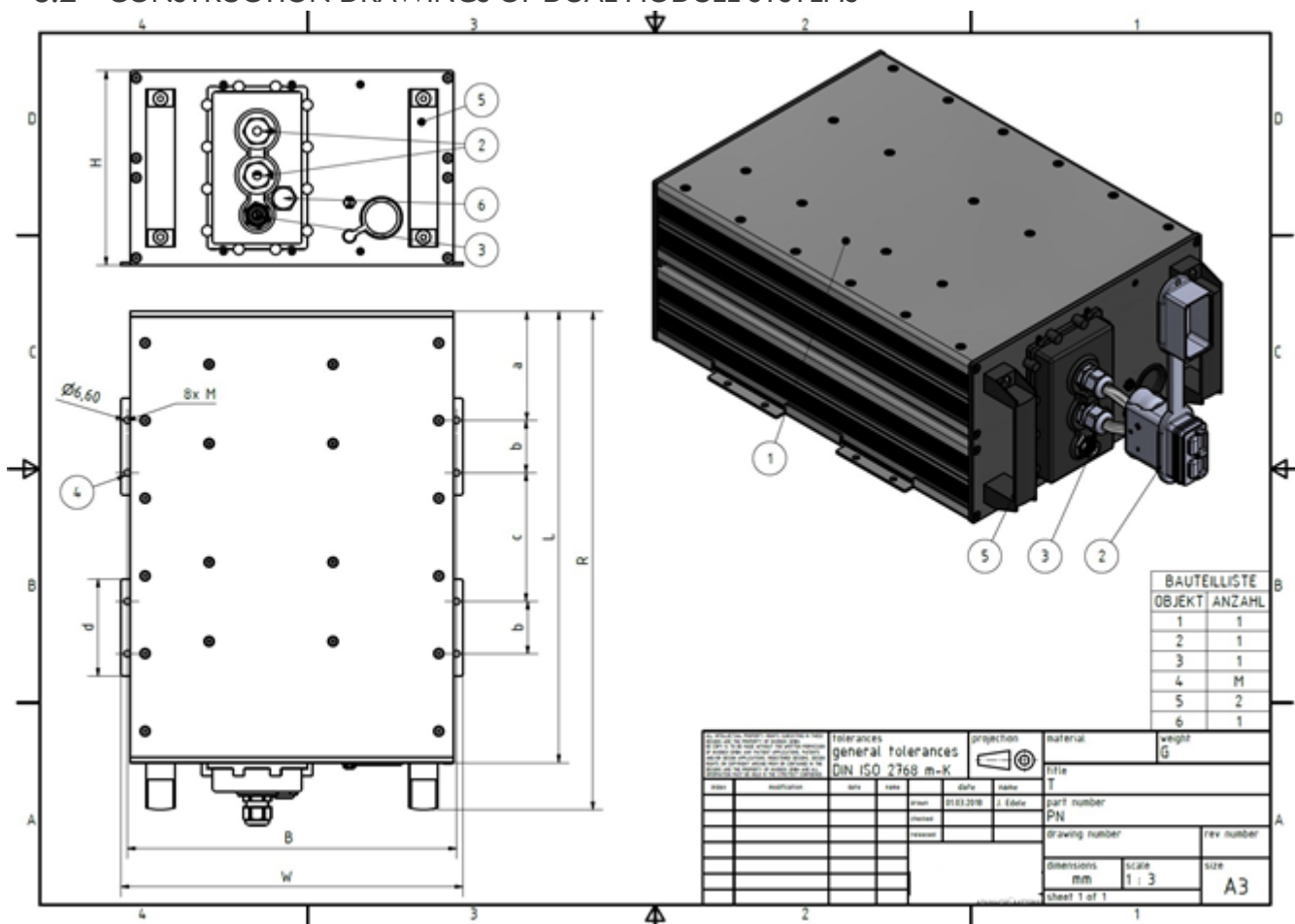
8.1 CONSTRUCTION DRAWINGS OF SINGLE MODULE SYSTEMS



| Abbreviation | Meaning | 7s24p | 7s36p | 14s12p | 14s18p | 14s24p |
|--------------|--------------------------------------|-------|--------|--------|--------|--------|
| H | Height | 90 | 90 | 90 | 90 | 90 |
| B | Distance between screw-on points | 313 | 313 | 313 | 313 | 313 |
| W | Total width | 325 | 325 | 325 | 325 | 325 |
| a | Distance rear - first screw-on point | 135 | 103,75 | 125 | 115 | 125 |
| b | Distance between screw-on points | 50 | 50 | 50 | 65 | 50 |
| c | Distance between screw-on surfaces | - | 122,5 | - | 86,8 | 180 |
| d | Width screw-on surface | 105 | 92,5 | 85 | 85 | 85 |
| L | Housing length | 320 | 430 | 300 | 418 | 531 |
| R | Length of housing with handles | - | - | - | - | - |
| M | Number of screw-on points | 4 | 8 | 4 | 8 | 8 |

Dimensions in mm

8.2 CONSTRUCTION DRAWINGS OF DUAL MODULE SYSTEMS



| Abbreviation | Meaning | 14s24p 7s48p | 14s36p 7s72p |
|--------------|---|-----------------|-----------------|
| H | Height | 185 | 185 |
| B | Distance between screw-on points in width | 313 | 313 |
| W | Total width | 325 | 325 |
| a | Distance rear - first screw-on point | 135 | 103,75 |
| b | Distance between screw-on points | 50 | 50 |
| c | Distance between screw-on surfaces | - | 122,5 |
| d | Width screw-on surface | 105 | 92,5 |
| L | Housing length | 320 | 430 |
| R | Length of housing with handles | 370 | 480 |
| M | Number of screw-on points | 4 | 8 |

Product data sheet in dependence on EC-Safety Data Sheet

and adapted by EC-Regulation 1907/2006 (REACH) and Reg (EC) 1272/2008

INVENOX GmbH product data sheet

Version: 2018/04

Valid from: 01.04.2018
 replaces version from: -
 print date: 07.05.2018
 trade name: Various battery module models by INVENOX GmbH

1. Product and producer identification:

| | |
|--------------------------|--|
| Product | Lithium-Ion battery modules or systems with Li-Ion battery cells type 18650 (various producer) |
| Brand | INVENOX GmbH (Li-Ion-cells: diverse) |
| Capacity [Ah Wh] | 130 6.530 |
| Voltage [V] | 50,4 |
| Siez (L/W/H) [mm] | 515 x 375 x 175 |
| Package Unit | 1 |
| Producer | INVENOX GmbH |
| Address | Schleißheimer Straße 104 a, 85748 Garching |
| Phone | +49 89 4117 9149 |
| Date | 15.11.2019 |

2. Composition and substance

2.1 Usage of LI-Ion Zellen from SANYO / Panasonic / LG *

safety data sheet in the attachment

| Description | Substance | Concentration |
|-----------------------------|--|---------------|
| Positive Electrode | Lithium transition metal oxidate (Li[M]m[O]n** | 20-60 |
| Positive Electrode divertor | Aluminum | 1-10 |
| Negative Electrode | Carbon | 10-30 |
| Negative Electrode divertor | Copper | 1-15 |
| Electrolyt | Organic electrolyte principally involves ester carbonate | 5-25 |
| casing | Aluminum, iron, aluminum lamiated plastic | 1-30 |

*: not all products contain all mentioned substances

**.: The letter M means transition metal and stands for either Co, Mn, Ni or Al. A mixture contains one or more than one of these metals and a product contains one or more than one of these mixtures. Letters m and n stand for the number of atoms

2.2 Usage of LI-Ion Cells from SANYO

safety data sheet in the attachment

| Description | Substance | Concentration | Classification and hazard |
|---|------------|---------------|---------------------------------------|
| Lithium Cobaltate (LiCoO ₂) | 12190-79-3 | 25-40% | |
| Iron | 7439-89-6 | 15-25% | |
| Aluminum foil | 7429-90-5 | 2-6% | |
| Graphite (natural) | 7782-42-5 | 10-20% | |
| Graphite (Artificial) | 7740-44-0 | | |
| Copper foil | 7440-50-8 | 5-15% | Sensitization of the skin group No. 2 |
| Organic electrolyte | | 10-20 % | Inflammable liquid |

2.3 Usage of LI-Ion Cells from SAMSUNG

| Substance | CAS-Nr. | Concentration |
|----------------------------|------------|----------------|
| Litium Cobalt Dioxide | 12190-79-3 | 25-40 % |
| Equivalent Lithium Content | 7439-93-2 | max. 0,95g/pcs |
| Aluminium foil | 7429-90-5 | 2-6 % |
| Graphite (various Carbons) | 7782-42-5 | 11-21 % |
| Copper foil | 7440-50-8 | 6-16 % |
| Organic elctrolyte | - | 8-18 % |
| Lithium hexafluorophoshate | 21324-40-3 | 1-4 % |
| Steel and inert components | 7439-89-6 | balance |

2.4 Usage of Li-Ion Cell from LG MJ1

| Substance | CAS-Nr. | Concentration |
|-----------------------------------|------------|---------------|
| Aluminum Foil | 7429-90-5 | 2-10 % |
| Nickel compound(proprietary) | 1313-99-1 | 0-80 % |
| Manganese compound(proprietary) | 1313-13-9 | 0-15 % |
| Cobalt compound(proprietary) | 1307-96-6 | 0-15 % |
| Styrene-Butadiene-Rubber | 9003-55-3 | <1 % |
| Polyvinylidene Fluoride (PVDF) | 24937-79-9 | <5 % |
| Copper Foil | 7440-50-8 | 2-10 % |
| Carbon (proprietary) | 7440-44-0 | 10-30 % |
| Electrolyte (proprietary) | 96-49-1 | 10-20 % |
| Steel, Nickel and inert materials | N/A | Remainder |

2.5 Usage of Li-Ion Cell from LG HE4

| Substance | CAS-Nr. | Concentration |
|--------------------------------------|------------|---------------|
| Aluminum Foil | 7429-90-5 | 2-10 % |
| Metal Oxide (proprietary) | | 20-50% |
| Polyvinylidene Fluoride (PVDF) | 24937-79-9 | < 5 % |
| Copper Foil | 7440-50-8 | 2-10 % |
| Carbon (proprietary) | 7440-44-0 | 10-30 % |
| Electrolyte (proprietary) | | 10-20 % |
| Stainless steel, Nickel and inert ma | N/A | Remainder |

3. Cell test series for determination of transport according to UN3480:

| No | Test Item | Criteria | Result | Remark |
|----|------------------------|---|--------|--------|
| T1 | Altitude Simulation | No mass loss, leakage, venting, disassembly, rupture, an fire. OCV should not be less than 90% before testing. | Passed | - |
| T2 | Thermal Test | No mass loss, leakage, venting, disassembly, rupture, an fire. OCV should not be less than 90% before testing. | Passed | - |
| T3 | Vibration | No mass loss, leakage, venting, disassembly, rupture, an fire. OCV should not be less than 90% before testing. | Passed | - |
| T4 | Shock | No mass loss, leakage, venting, disassembly, rupture, an fire. OCV should not be less than 91% before testing. | Passed | - |
| T5 | External Short Circuit | External temperature should not exceed 170 degC. No disassembly, rupture, and fire within six hours of this test. | Passed | - |
| T6 | Impact | External temperature should not exceed 170 degC. No disassembly, and fire within six hours of this test. | Passed | - |
| T7 | Overcharge | No disassembly, and fire within seven days of this test. | Passed | - |
| T8 | Forced Discharge | No disassembly, and fire within seven days of this test. | Passed | - |

the conducted test are in accordance with ADR 2011 section 38.3 and were performed by the cell manufacturer

4. Potential hazards from Li-Ion cells and modules

The danger of battery systems is determined significantly through the danger of the single Li-Ion cell, therefore the following focuses on the danger of single cells.

The chemical materials of Lithium Ion cells are in an airtight,

round metal casing to resist the inner and external pressure and temperatures in proper use.

When carefully handled, according to the specifications, no danger of combustion,

explosion or leakage of hazardous liquids persists. Improper handling however could lead to the hazard of combustion, explosion or leakage of hazardous liquids as electrolyte. Contact with fire, damaging the casing through shocks or improper charging or discharging could develop a inflammable gas in the inner Li-Ion cell

which in contact with fire or hot construction elements could catch fire or lead to an explosion.

Security measures within the cell could prevent this reaction through safe outgassing, if no other load applies.

Potential health risks at improper use:

The active material Cobalt and Cobalt combines are known as carcinogenic.

Escaping steams could lead to excitation of eyes, skin, throat, nose and respiratory system.

Inhalation of evaporations could lead to excitation in throat and lung.

Escaping liquids on direct contact could lead to burnings on skin and eyes.

Swallowing could lead to chemical burn of the oral cavity, the gullet and the gastrointestinal tract.

Through circuitry of cells to cell circuits, modules and systems could increment

the danger caused by reaction intensity.

The mechanical integrity is augmented through the aluminium circuit board and reinforcement structure.

The implemented outgassing cavities should prevent the accumulation of gases and consequently prevent

a increased concentration of inflammable gases.

5. First-aid measure

- **Eyes** Wash with water for min. 15 minutes.
At prolonged discomfort go to see a doctor
- **Skin contact** take off affected clothes and wash the part of the body with soap and water.
At prolonged discomfort go to see a doctor
- **Inhalation** Get fresh air as quick as possible. At prolonged discomfort go to
see a doctor. In case of suspended respiration start life saving measures
and call an emergency doctor

6. Fire fighting measures

- In case of fire hazardous evaproations as carbon monoxide, carbon bioxide and fluorine can develop.
- Extinguishing agent Water, CO2-extinguisher, dry powder or fire extinguishing foam.
- Protective equip- self-contained breathing apparatus, wear sealed protective clothing.
ment Avoid contact with skinn and eyes.
- Note for fire fighters

The material does not provide particular fire or explosion risks.
flash point: 65 degrees Celsius
spontaneous ignition n. a.
imflammability threshold in air: low, % Volume: 1.4
imflammability threshold in air: above, % Volume: 11

7. Environmental satey measures and cleaning

- Collect contaminated water for fire fighting separately, water shall not get into sewerage.
- Sweep remainings and depollute them in seperate containers.

8. Handling and storage

□ Handling

Protect from heat, water, fire, sparks, shorts and long direct solar radiation.
Do not throw or open the product by force nor connect the poles of the batteries.
Keep away from water and other corrosive products.
Keep away from children.
Use the product only for the foreseen purpose.
Do not charge the product above 40°C or below 0°C.

□ Storage

Do not store next to sources of heat or direct solar radiation.
Store battery modules firmly and safely in a enclosed, dry, cool (~25°C) and defined room
Reposit in a dry and cool environment.
Storage temperature 0 to 30 °C.
Humidity 45-85 %.
Storage of modules at ca. 50% ± 10%
Inappropriate storage can lead to premature defects or fading capacity

9. Restriction and surveillance of exposure / personal protective equipment

- With appropriate use no particular safty measures or protective equipment is necessary.
- Under surveillance of general notes no potential hazards need to be expected.
- Battery modules need to be used with the proper electronic surveillance (BMS).

10. Specifications of basic physical and chemical properties

| | |
|------------------------|--|
| appearance | different forms |
| physical condition | solid |
| colour | various |
| odour | inodorous |
| odour detection | |
| treshold | n. a. |
| pH-value | n. a. |
| melting point/ | n. a. |
| freezing point | n. a. |
| start boiling and | n. a. |
| boiling range | n. a. |
| flash point | n. a. |
| material reinforcement | aluminum, plastic, ABS |
| material AI-PCB | aluminum (>95%, copper < 5 %, residual: Isolator (PP), electric components |
| material screws | steel |

11. Stability and reactivity

- Observing all aspects from point 8 at no time a dangerous or unforeseen reaction should occure.

12. Toxicologic specifications

- No effects at proper use.

13. Note for disposal

Waste classification according to waste classification decree (AVV): 200133
Recommendation: Depollute battery modules according to national provisions
or hand disused energy storage systems back to INVENOX GmbH

Since October 1st 1998 mandatory redemption for batteries exist.
To depollute properly the **STIFTUNG GEMEINSAMES RÜCKNAHMESYSTEM BATTERIEN**,
GRS, was installed.

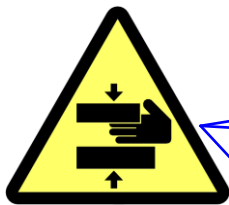
Modules of each kind cannot be discharged in consumer waste

Please return any used batteries and battery packs to us,
or to a local battery collecting facility
(Schadstoffsammelstellen, etc.) ab.

We are member of GRS

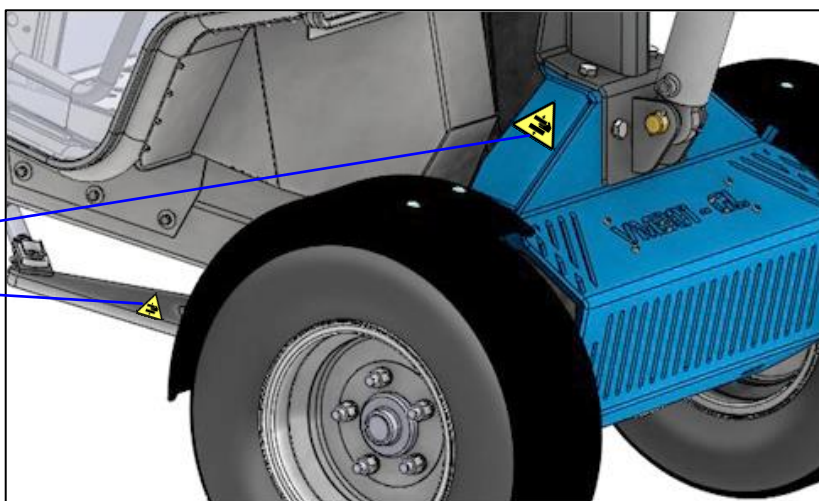
For more information: www.grs-batterien.de



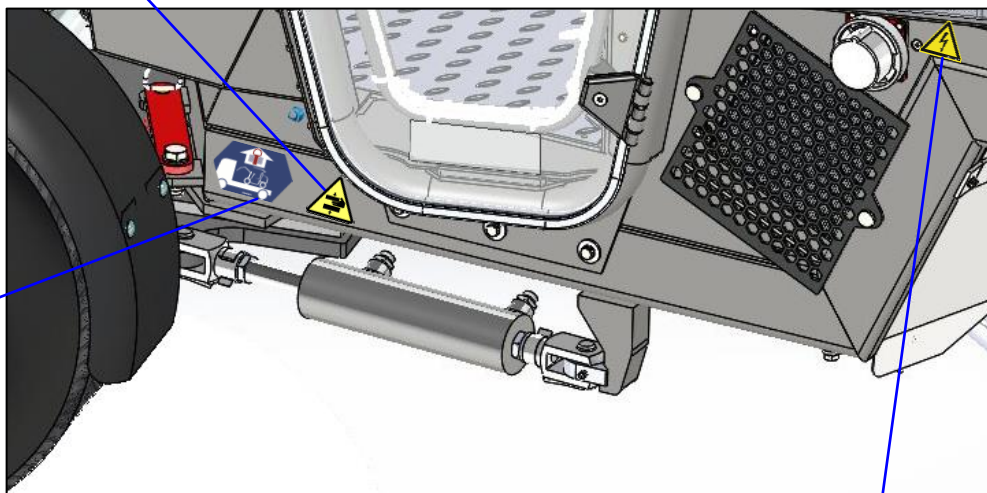


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Bedseitig /
On both sides



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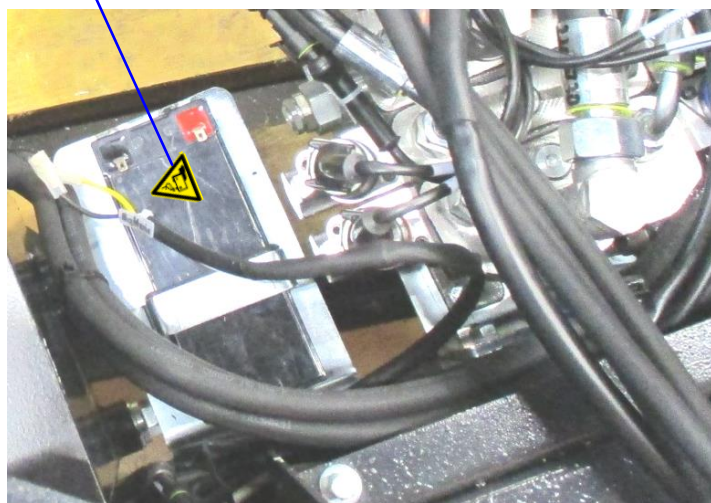
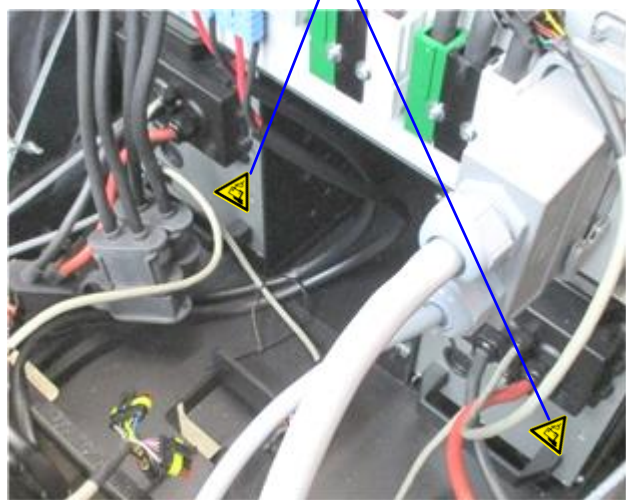
Auf jeden Akku einen Aufkleber /
On each battery one Sticker

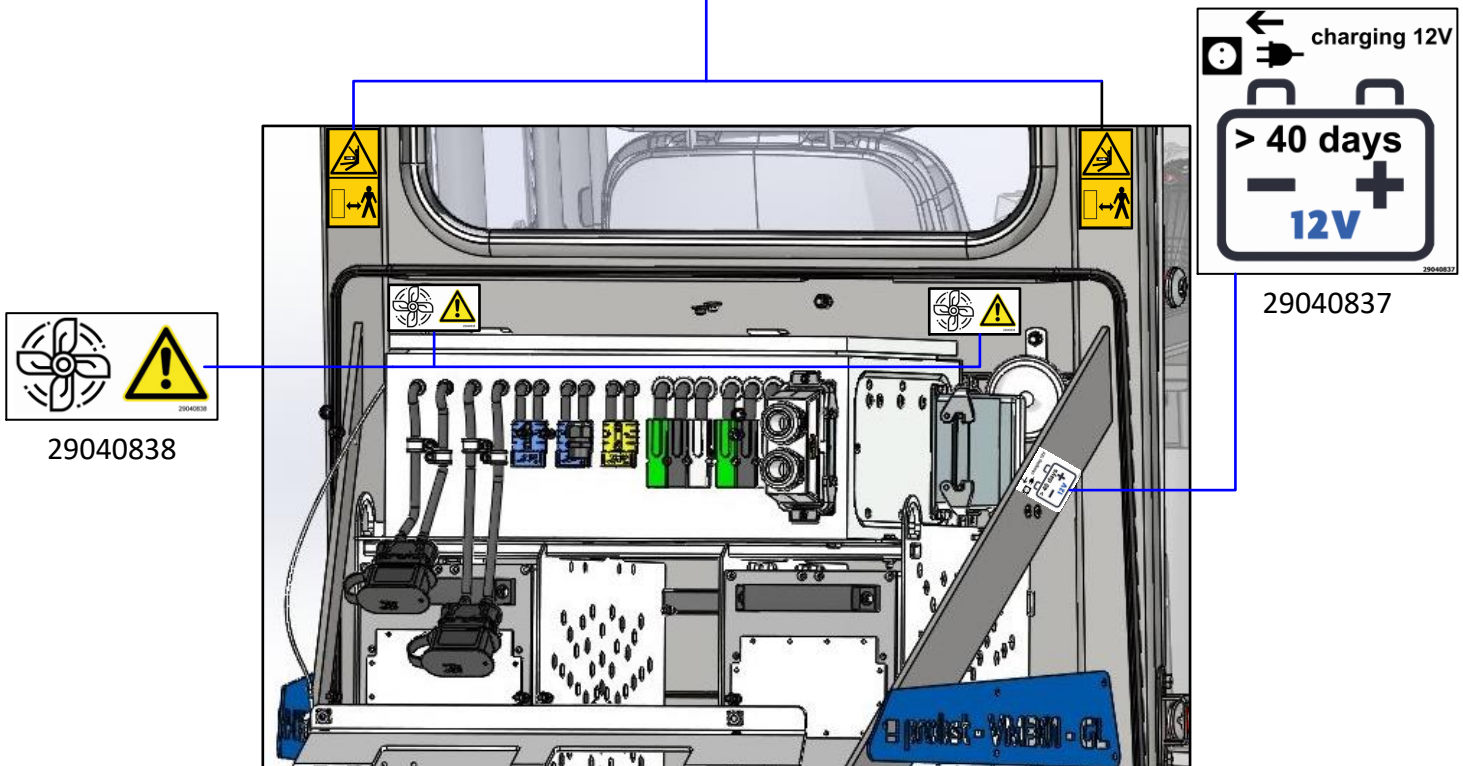
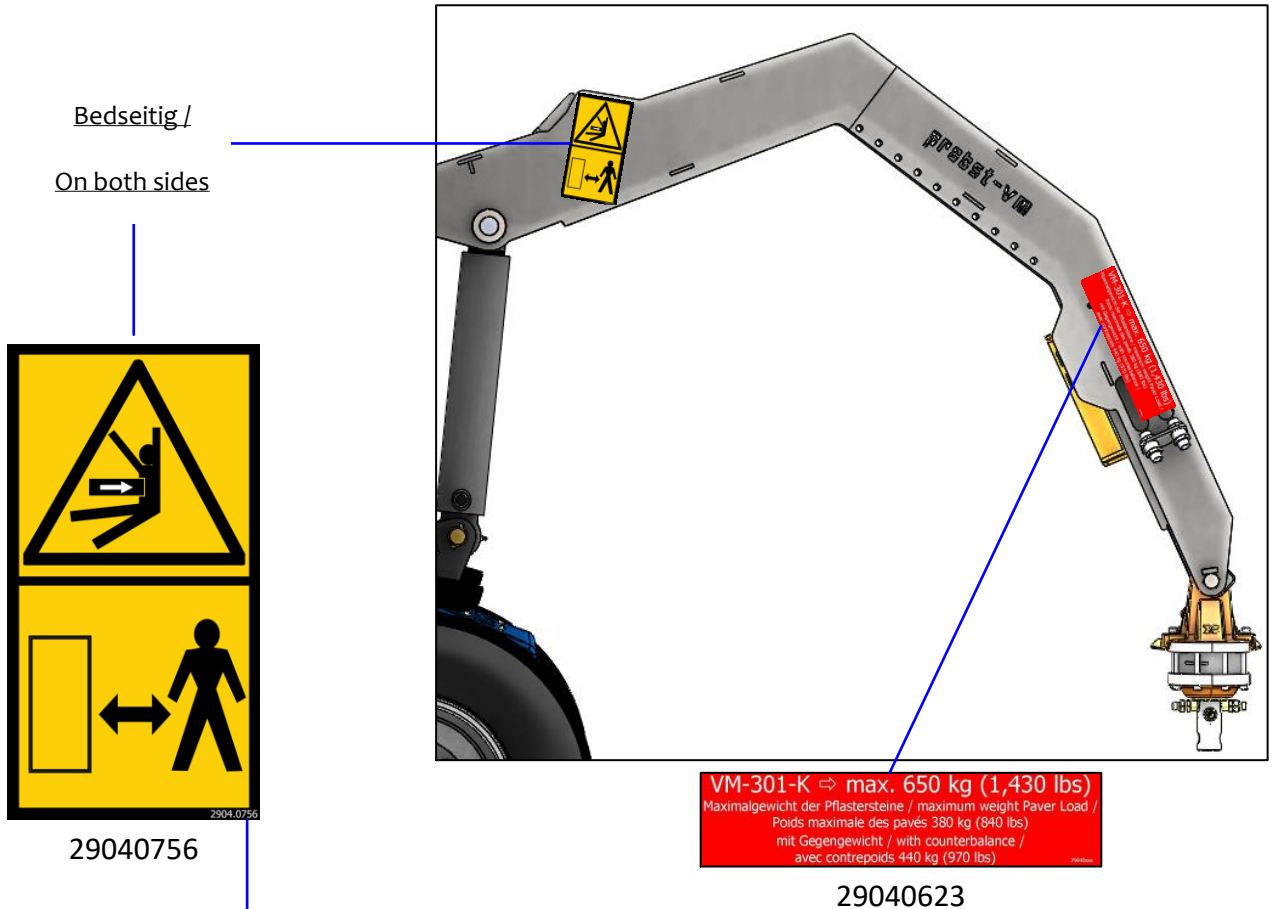


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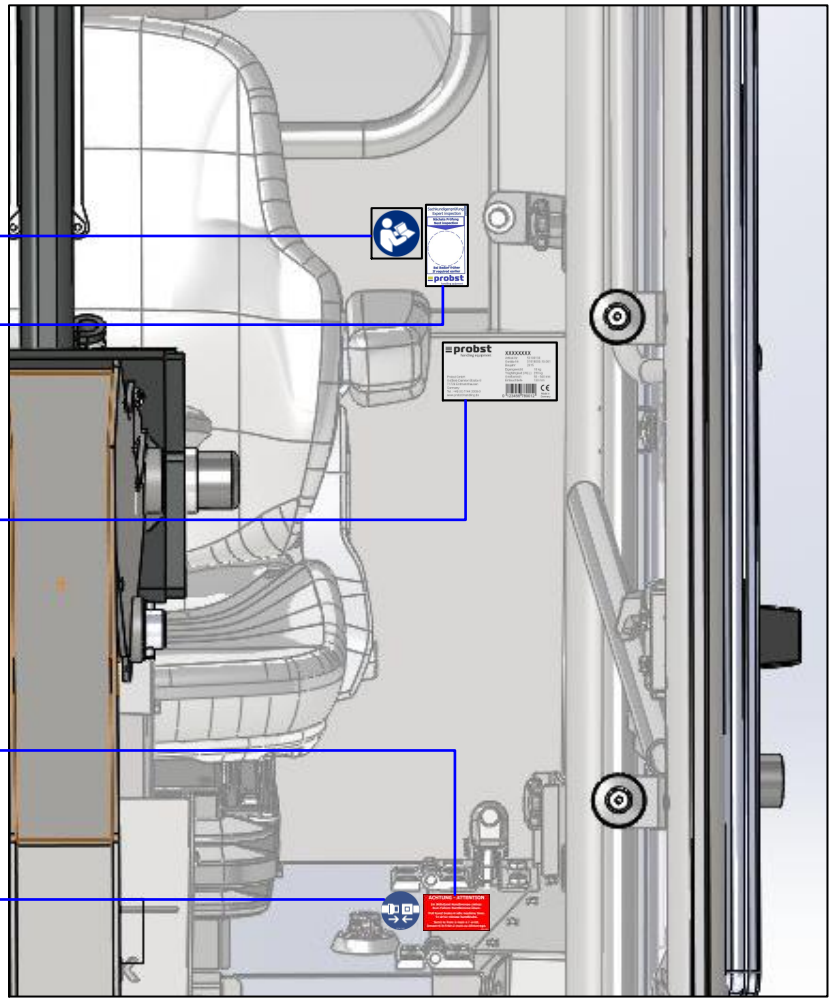
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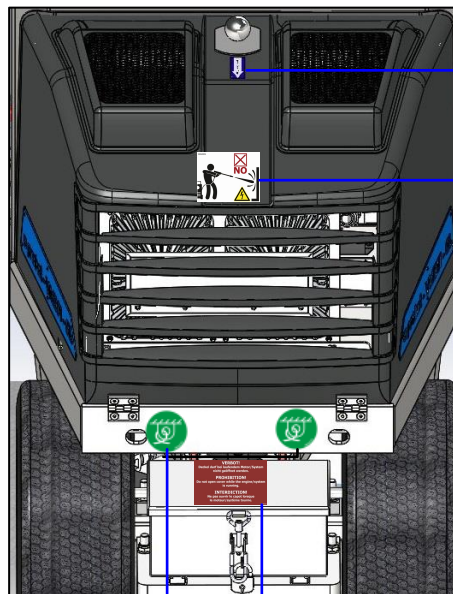
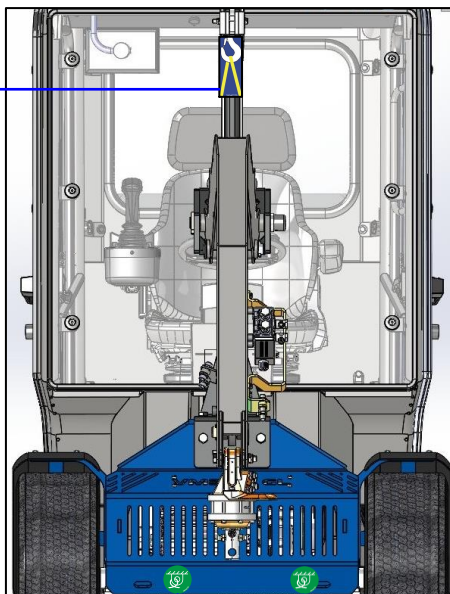


Vorderansicht / Front view

Rückansicht / Rear view



29040370



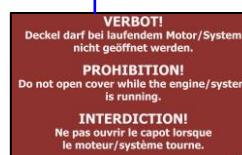
29040253



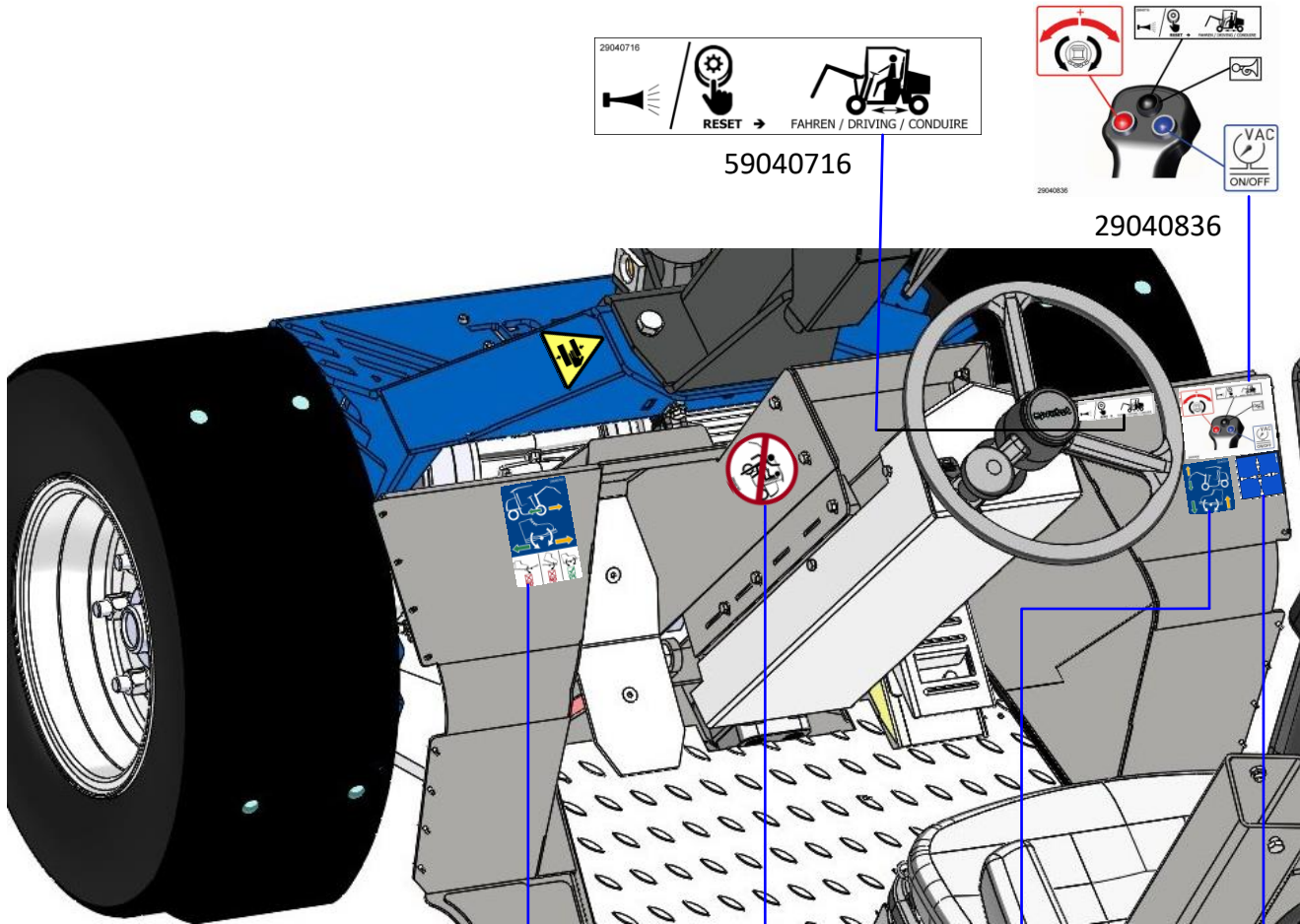
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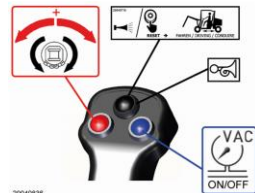
29040755



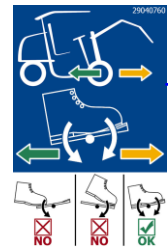
29040259



59040716



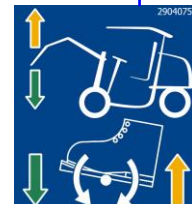
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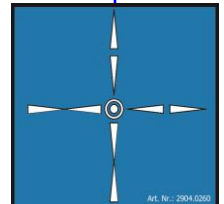
29040760



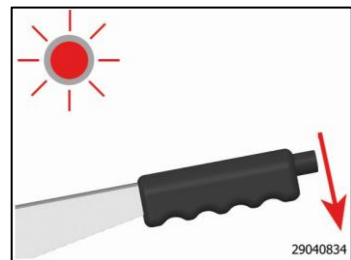
Beidseitig /
On both
sides
29040762



59040759



29040260



29040834

| | | | | | | | |
|---------|-------|---------|---------|---------|---------|---------|---------|
| | | | | | | | |
| ① 7,5 A | ② 3 A | ③ 7,5 A | ④ 7,5 A | ⑤ 3 A | ⑥ 7,5 A | ⑦ 7,5 A | ⑧ 7,5 A |
| ① | ② | ③ | ④ | ⑤ 7,5 A | ⑥ 7,5 A | ⑦ 7,5 A | ⑧ 7,5 A |
| --- | --- | --- | --- | | | | |

29040808

Start (2 Sek.)
29040835

29040835



