

 **corpuls®**



corpuls cpr 

THE STRONG ARM THAT SAVES LIVES

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The **corpuls cpr** is possibly the most modern and innovative player in the field of mechanical chest compression devices. It combines revolutionary and extremely intuitive user guidance, designed to optimally support users in Emergency Medical Services as well as medical professionals in hospitals when working on patients.

The system consists of the **corpuls cpr** arm with an inserted compression stamp and – depending on requirements – one of three different resuscitation boards available: Recboard, Quadboard and Scoopboard. These were specially developed for the different requirements in EMS, air rescue and clinical settings and are made of radiolucent material.

corpuls cpr meets the significantly more stringent EU Medical Device Regulation requirements and is MDR certified.

FEATURES

- The **corpuls cpr** offers professional users **anytime easy access** to the patient's thorax. **Diagnosis and treatment can thus be performed while resuscitation is in progress.**
- With only a few steps, the **corpuls cpr** is ready for operation. **Minimal hands-off-time** leads to an optimal outcome.
- The **intuitive operability** of the **corpuls cpr** allows to adapt the therapy to the individual patient.
- Therapy parameters can be adjusted during therapy.
- The **operating temperature** of the **corpuls cpr** ranges from -20°C to $+45^{\circ}\text{C}$.
- The system is certified according to **IP54**.
- Certified according to **MDR**





DEPLOYMENT IN EMS






HIGH-PERFORMANCE AND FLEXIBILITY

In emergency situations, every minute counts. An efficient therapy is therefore decisive. By supplying fully automated chest compressions, the **corpuls cpr** ensures less strain on rescue service personnel and allows precise and continuous therapy, even in the most difficult conditions. After the stamp is positioned, there is more time for important procedures such as airway management or administering drugs.

MINIMAL HANDS-OFF TIME

- The **quick and easy setup** helps to save precious seconds.
- The simple and still safe adjustment of the **corpuls cpr** allows to switch from manual CPR to mechanical thorax compressions with minimal interruption.
- The **corpuls cpr** is continually recording the mission data. These can be evaluated with the software **corpuls.manager REVIEW** in debriefing.

POSITION CHECK

LED START/ STOP Button	Display Symbol	Description
		<ul style="list-style-type: none">• corpuls cpr arm too low• Release of the thorax not ensured• Therapy not possible
		<ul style="list-style-type: none">• corpuls cpr arm too high• Stamp has no contact with the thorax• Therapy possible, but not recommended
		<ul style="list-style-type: none">• corpuls cpr arm adjusted optimally• Full release and configured compression depth can be achieved



DEPLOYMENT IN AIR RESCUE

THERAPY UNDER EXTREME CONDITIONS

Almost every primary mission in air rescue makes extremely high demands on the team and equipment. The patient often is in a critical condition, the space conditions are confined and time is of the essence.

Transporting the patient and continuing a high-quality manual CPR seems almost impossible in these conditions. Here, the **corpuls cpr** enables fully automated thorax compressions and life-saving therapy also during transport.

FEATURES

- **Transport is possible while resuscitation is being performed.**
- The design of the **corpuls cpr** arm allows even in confined spaces **easy access to the entire upper body** for diagnosis and treatment.
- By means of the recboard, the **corpuls cpr** is fixed safely **on the stretcher**.
- The **long battery running time** and connection to the on-board power supply guarantee a reliable and uninterrupted therapy.



▲ In air rescue, patient access is extremely limited. A resuscitation without intermediate landing is rarely possible or not effective in this environment. The **corpuls cpr** helps to stay calm in the cabin and to perform high-quality thorax compressions.



DEPLOYMENT IN HOSPITAL

COMPACT AND RADIOLUCENT

The compact and very light-weight quadboard of the **corpuls cpr** is made from radiolucent carbon. Coronary angiographies can be performed even during resuscitation without interfering artefacts. The hands-off time is thus limited to a minimum.

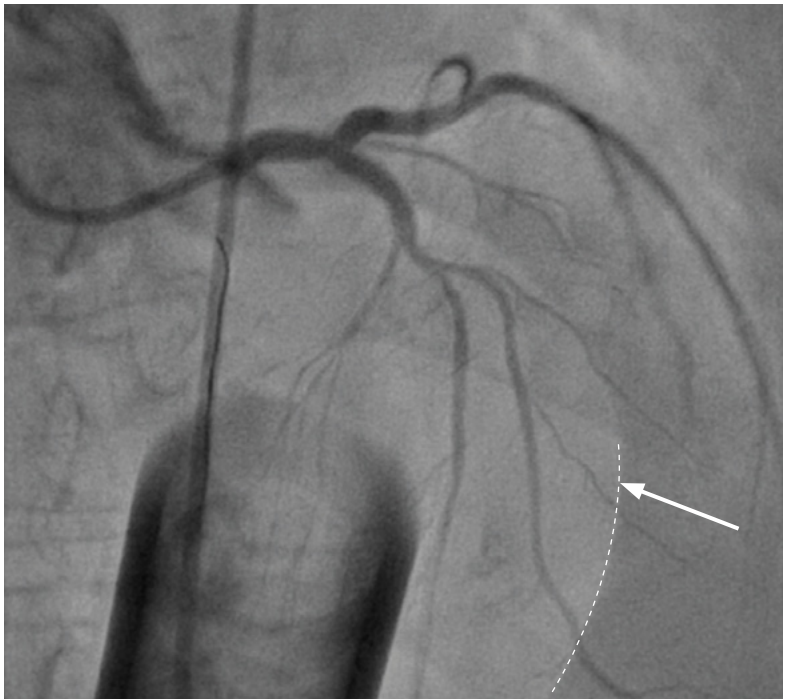


◀ Quadboard of the **corpuls cpr**

INTERFERENCE-FREE DIAGNOSTICS DURING ONGOING TREATMENT

The flexible positioning of the **corpuls cpr** on the patient allows optimal access for interventions in the upper body and head area.

Therapy modes and parameters can be adjusted individually even during therapy – anytime, whatever adjustment is necessary.

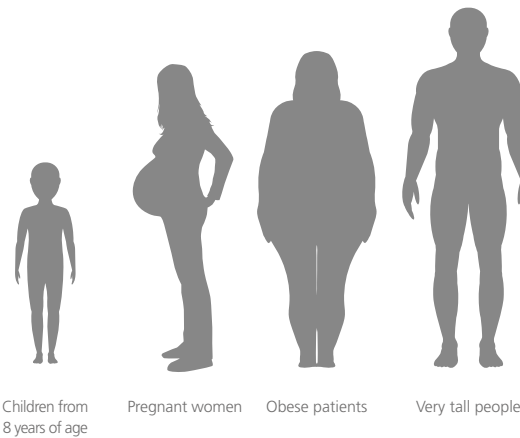


▲ In the cardiac catheter lab, the artefact-free view on the coronary vessels is of decisive importance. The **corpuls cpr** stamp only gives a minimal shadow, otherwise there is an unimpeded view on the coronary vessels.



INDIVIDUALISED THERAPY

With only one lever, the **corpuls cpr** arm is adjusted and fixed above the patient. The compression depth, freely adjustable between 2 and 6 cm and the compression rate, adjustable between 80 and 120 compressions per minute, allow an individualised therapy, even on children. The **corpuls cpr** with its intuitive operating concept is approved for the treatment of children from the age of 8 years and older.



FEATURES

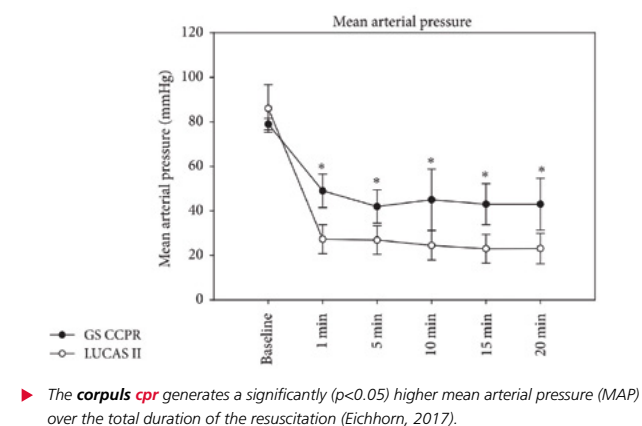
- Treatment of children from 8 years of age, **pregnant women, very tall people and obese patients possible.**
- Stress reduction due to safe application in an often chaotic situation – **more time** for other life-saving therapy measures.
- **Re-usable stamps in two sizes.**
- **No limitations in regard to weight or size of treatable patients.**
- Resuscitation according to currently valid guidelines.

*Possible thorax heights depend on the board used
Quadboard 13.3-34.2cm, Recboard 12.8-33.5cm, Scoopboard 12.6-33.0cm)



EFFECTIVE – SCIENTIFICALLY CONSIDERED

Studies have confirmed that the **corpuls cpr** meets the high standards of the **corpuls** brand. We conducted tests on both the mechanical thorax and animal models. We were able to show that the **corpuls cpr** generates a significantly higher mean arterial pressure, a higher blood flow and thus a higher coronary perfusion pressure in direct comparison to a competitor device. We are also currently evaluating the performance of the device in practice with a follow-up study.



Sources

Eichhorn S, Spindler J, Polski M, Mendoza Garcia A, Schreiber U, Heller M, et al. Development and validation of an improved mechanical thorax for simulating cardiopulmonary resuscitation with adjustable chest stiffness and simulated blood flow. *Med Eng Phys.* 2017 May;43:64-70. *Med Eng Phys.* 2017;43:64-70. doi: 10.1016/j.medengphys.2017.02.005. PubMed PMID: 28242180.

Eichhorn S, Mendoza Garcia A, Polski M, Spindler J, Stroh A, Heller M, et al. corpuls cpr resuscitation device generates superior emulated flows and pressures than LUCAS II in a mechanical thorax model. *Australas Phys Eng Sci Med.* 2017. doi: 10.1007/s13246-017-0537-3. PubMed PMID: 28258484.

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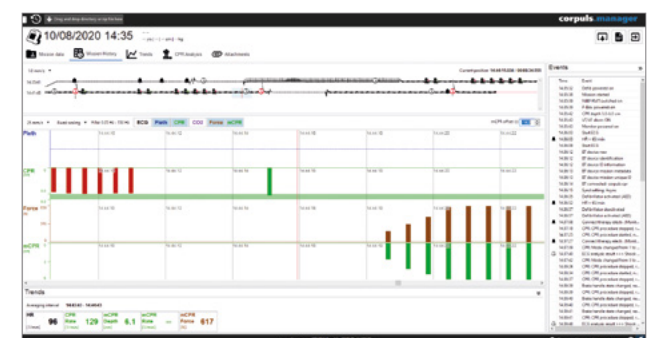
EVALUATION OF MISSIONS WITH CORPULS.MANAGER ANALYSE

The **corpuls cpr** continually saves all relevant settings and sensor data during the mission.

This includes compression depths and rates as selected by the user at each point in time, as well as movement and force feedback values during each individual compression. The software tool **corpuls.manager ANALYSE** provides the ability to gain insights into this data. The entire mission is displayed as a scrollable timeline, showing compressions, settings, pauses and events.

Debriefings and CPR trainings among other things can be significantly improved by consulting the recorded real-time data – also PDF reports can be created from the mission. These can be added to the patient file for documentation purposes and archiving.

Additional insights on a larger scale can be obtained via the companion server software **corpuls.manager ANALYSE**. Important questions about CPR quality and device usage can be quickly answered using the entire set of recorded missions. It is also possible to represent key performance indicators on data analytics dashboards. This solution can help to improve the treatment quality for the entire organisation.



▲ Evaluation in **corpuls.manager ANALYSE**

Due to the synchronised therapy the application data of **corpuls3** and **corpuls cpr** can be combined comfortably. These are displayed together on a timeline, so that a debriefing or evaluation becomes even easier.

TEAMWORK TO PERFECTION

SYNCHRONISATION OF CORPULS3 AND CORPULS CPR

We have had this vision for a long time: The perfect interaction between our defibrillator/monitor **corpuls3** and our mechanical chest compression device **corpuls cpr** during resuscitation. Raising the resuscitation processes to the next level of quality was our goal.

With its revolutionary modular design, the **corpuls3** stands out from other compact devices. It can be separated into the Monitoring Unit, Patient Box and Defibrillator/Pacer. Thanks to the synchronised therapy, stress amongst the

team can be significantly reduced. **corpuls3** and **corpuls cpr** become one and when integrated into the team, this duo makes resuscitation even more efficient.

Hands-off time is significantly reduced* and the patient's chance of survival is increased – even under the most difficult conditions where space is extremely limited.

Even after the mission, synchronisation still continues. In **corpuls.manager ANALYSE**, all mission data from the **corpuls3** and **corpuls cpr** are represented together as one mission.



ADVANTAGES OF SYNCHRONISED THERAPY

- No additional cables
- Intuitive control of the therapy via the **corpuls3**
- Less tension and stress within the team
- Reduced hands-off time during rhythm analysis and defibrillation
- More time for important procedures
- Also in confined spaces
- At one glance all data on the display
- Merging of missions in **corpuls.manager ANALYSE**

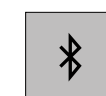
* See also „Scientific Evaluation“ on page 17

CONNECTION IN 3 CLICKS

During synchronised therapy, the **corpuls3** is not just the remote control for the **corpuls cpr** – although that is also possible. The **corpuls cpr** has been perfectly integrated into the AED and manual mode of the **corpuls3**. Therefore giving the rescue team the ability to treat the patient in accordance with the current guideline recommendations. The **corpuls3** shows all the required information on its display.



Connect softkey to connect with the **corpuls cpr** via Bluetooth



Bluetooth icon symbolises a Bluetooth connection to the **corpuls cpr**



Pie chart with **corpuls cpr** symbol indicates a connection with the **corpuls cpr** and shows the 2 minute resuscitation cycle



Start/Stop softkey to start and stop the mechanical chest compressions by the **corpuls cpr**



Reset the time in the pie chart, if not defibrillated

FULL CONTROL – AT ANY TIME

Once connected to each other, it is no longer necessary to operate the **corpuls cpr** during a resuscitation.

The **corpuls cpr** is completely automatically controlled by the **corpuls3**, regardless of whether it is in AED or manual mode. All therapy parameters of the **corpuls cpr** are displayed on the monitor of the **corpuls3**.

If you want to change the settings manually or stop or start the **corpuls cpr**, this is also possible.

corpuls cpr

INTELLIGENT CONTROL WITH THE CORPULS3

The intelligent control of the **corpuls cpr** by the **corpuls3** during a resuscitation follows the current guideline recommendations – depending on the mode (AED, Manual-ERC, Manual-AHA). In each of the modes, the entire rhythm analysis is controlled via

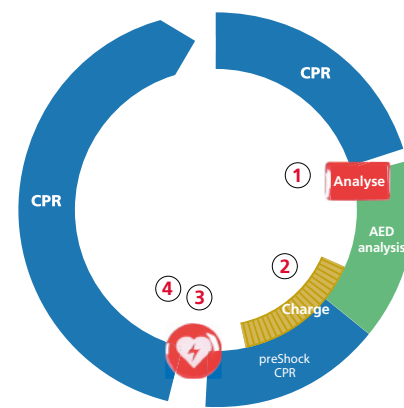
the **corpuls3** as the central operating unit. The user only needs to monitor the stamp of **corpuls cpr** is correctly positioned. All control commands for the user take place wirelessly between **corpuls3** and **corpuls cpr**.

INITIAL SITUATION:

The **corpuls cpr** is positioned on the patient and is performing chest compressions. There is a Bluetooth connection to a **corpuls3**.

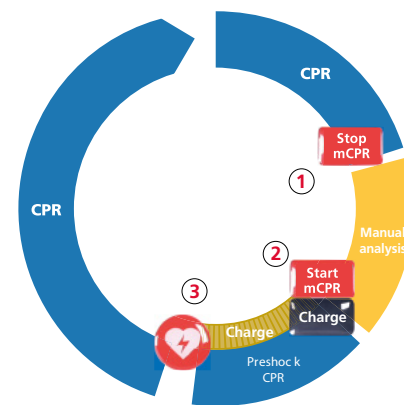
AED MODE

1. **Analyse key** interrupts the **corpuls cpr** for the **AED analysis** and then automatically continues the therapy by **corpuls cpr**.
2. If the **rhythm is shockable**, the defibrillator is charged and automatic preShock CPR is performed.
3. The **Shock key** interrupts the **corpuls cpr** for shock delivery.
4. If the **rhythm is not shockable**, the **corpuls cpr** therapy is automatically continued.



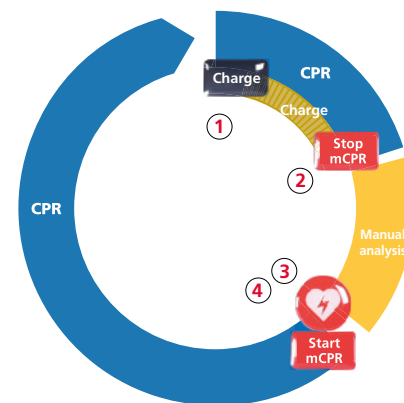
MANUAL 1 (procedure according to ERC)

1. The **stop mCPR key** on the **corpuls3** interrupts the **corpuls cpr** for manual rhythm control.
2. The **Start mCPR key** resumes chest compressions/preShock CPR.
3. If the **rhythm is shockable**, the **Shock key** interrupts the **corpuls cpr** for shock delivery. If the **rhythm is not shockable**, the **Start mCPR softkey** continues the therapy by the **corpuls cpr**.



MANUAL 2 (procedure according to AHA)

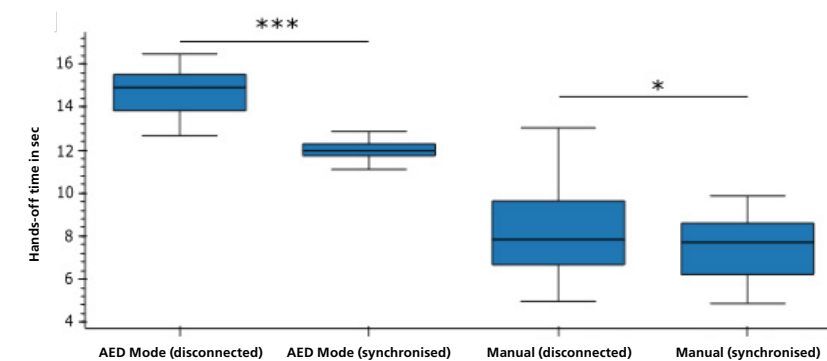
1. **Charge softkey** charges the defibrillator.
2. The **Stop mCPR softkey** on **corpuls3** interrupts the **corpuls cpr** for manual rhythm analysis.
3. If the **rhythm is shockable**, the **Shock key** interrupts the **corpuls cpr** for shock delivery.
4. **Start mCPR softkey** resumes the therapy by the **corpuls cpr**.



SCIENTIFIC EVALUATION

The ERC guidelines recommend the shortest possible compression interruptions during cardiopulmonary resuscitation. Before and after the shock delivery, chest compressions should be interrupted for a maximum of 10 seconds. A peri-shock pause (the compression break before and after defibrillation) of a maximum of 10 seconds has been scientifically proven to be associated with a higher survival rate (Cheskes et al. 2014; Sell et al. 2010). According to the ERC guidelines, the entire

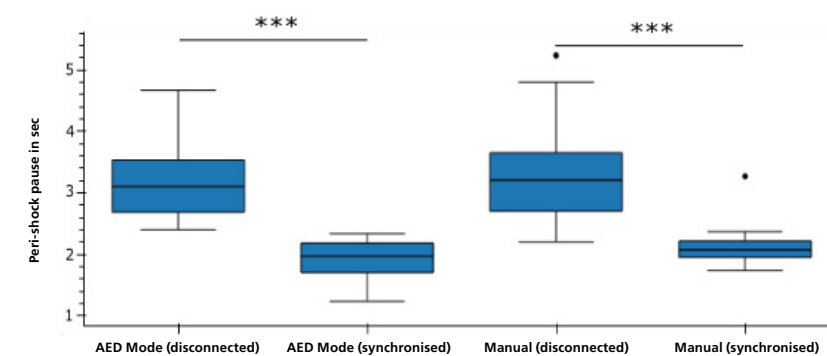
manual defibrillation process should be possible with a compression break of less than 5 seconds (Monsieurs et al. 2015). When using the **corpuls3** in combination with the **corpuls cpr** in an in-house study, these recommendations could be noticeably undercut. With the synchronisation of the **corpuls3** and the **corpuls cpr**, this endeavour could be further increased. With synchronised device operation, the hands-off time was reduced by 16.08%.



► Illustration 1:
Representation of the hands-off time of our study comparing synchronised and disconnected device operation of the **corpuls3** and **corpuls cpr**. (Significance $P < 0.001$: ***; $P < 0.05$: *)

The reduction in the compression pause is particularly evident during the peri-Shock pause. On average, the perishock pause in synchronised mode of 2.00 ± 0.32 s is 38.23% shorter than

the peri-Shock pause in disconnected mode of 3.24 ± 0.71 s. This saving can be a valuable gain in time with the desired break being a maximum of 5 seconds.



► Illustration 2:
When comparing the peri-Shock pauses, the significant minimisation of the pause duration with synchronisation compared to disconnected device operation of **corpuls3** and **corpuls cpr** becomes particularly clear. (Significance $P < 0.001$: ***)

Sources

- Cheskes, Sheldon; Schmicker, Robert H.; Verbeek, P. Richard; Salcido, David D.; Brown, Siobhan P.; Brooks, Steven et al. (2014): The impact of peri-shock pause on survival from out-of-hospital shockable cardiac arrest during the Resuscitation Outcomes Consortium PRIMED trial. In: Resuscitation 85, S. 336–342. DOI: 10.1016/j.resuscitation.2013.10.014.
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- Sell, Rebecca E.; Sarno, Renee; Lawrence, Brenna; Castillo, Edward M.; Fisher, Roger; Brainard, Cris et al. (2010): Minimizing pre- and post-defibrillation pauses increases the likelihood of return of spontaneous circulation (ROSC). In: Resuscitation 81 (7), S. 822–825. DOI: 10.1016/j.resuscitation.2010.03.013.

INTUITIVE AND SIMPLE HANDLING

With these four simple steps, the **corpuls cpr** can be adapted to the patient in a very short amount of time and with only a minimal interruption of thorax compressions.

1. PREPARATION



▲ First, a team member mounts the **corpuls cpr** arm on the board and switches the **corpuls cpr** on. Then, the locking lever has to be opened to be able to move the **corpuls cpr** arm. The user checks the displayed therapy settings and positions the board under the patient's head.



2. ATTACH



▲ The team lifts the upper body of the patient and positions the board completely beneath the patient within a few seconds. For this, the thorax compressions must only be interrupted minimally.

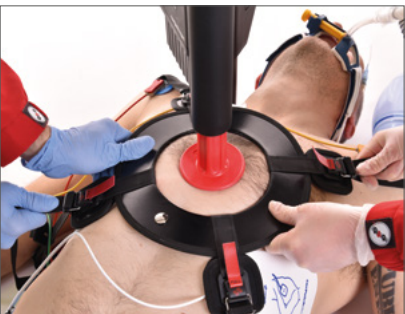
3. ADJUSTING & STARTING



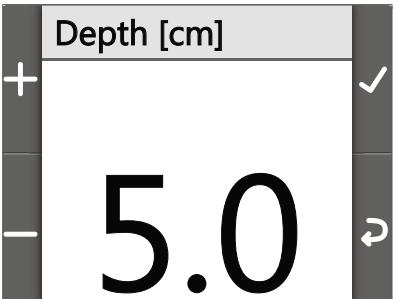
▲ Then, the **corpuls cpr** arm is positioned over the thorax. The **corpuls cpr** arm is adjusted in height and angle and a team member adjusts the stamp position on the thorax. Immediately after positioning, the **corpuls cpr** arm is locked by closing the locking lever and the mechanical thorax compression started by pressing the START/STOP key.



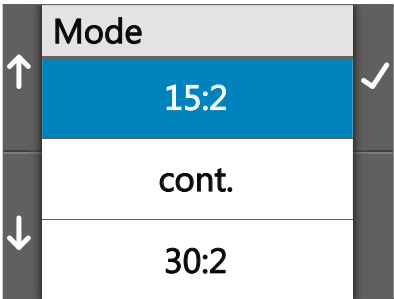
4. TRANSPORT PREPARATION



▲ The rescue team positions the fixation ring and prepares the patient for transport.

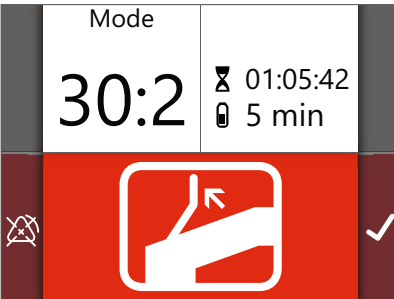


Via the softkeys, settings such as compression depth or compression rate are configured.



You can select three different therapy modes:

- 15:2
- continuous
- 30:2



The integrated alarm management indicates possible errors, e. g. when the locking lever is not closed.

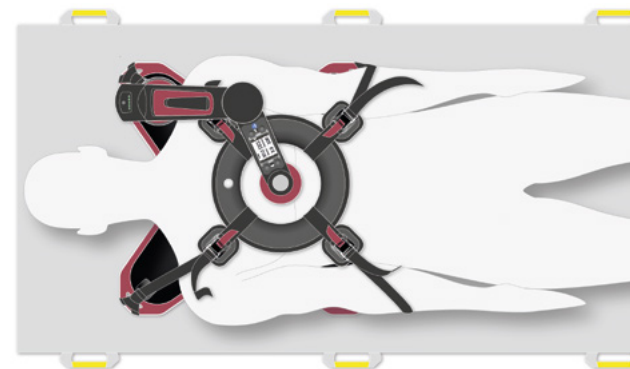


The main menu of the user interface shows the configured therapy mode (30:2, 15:2, continuous), the compression depth and compression rate as well as the remaining running time and therapy duration.

ACCESS FROM ALL SIDES

Free access to the thorax is essential for treatment of a patient during resuscitation. The Recboard or the Quad-board can be placed in multiple positions beneath the patient. The lever is opened for alignment on the thorax. The user determines the position of the stamp. That is exactly the position at which manual compression is applied, i.e. the lower half of the sternum. The stamp position check helps the user find the proper neutral position to avoid generating unwanted leaning. When the light is green, the lever can be closed and the therapy started. During therapy the **corpuls cpr** monitors the position of the stamp at every ventilation pause or after 100 compressions in continuous mode. If the thorax has collapsed due to the preceding compressions, the **corpuls cpr** automatically corrects the distance between the stamp and the thorax. Thus ensuring that the set compression depth is always achieved.

The patient can be transported with the **corpuls cpr** on different transport systems, if the patient is secured with a corresponding securing system. Make sure to leave the therapy zone uncovered.



► Use with Recboard Ring



HIGH SAFETY FOR PATIENT AND RESCUE SERVICE PERSONNEL

The **corpuls cpr** contributes greatly to the safety of ambulance service staff. They can remain seated with safety belts during therapy, which reduces the danger in case of an accident. To demonstrate this safety, several standardised test procedures were implemented.

- IEC 60529:1989 + A2:2013
Degrees of protection provided by enclosures (IP-Code)
- IEC 60601-1-12:2014, AMD1:2020
Medical electrical equipment – Part 1-12: General requirements for basic safety & essential performance
- EN 13718-1:2014+A1:2020
Medical vehicles and their equipment – Air ambulances – Part 1: Requirements for medical devices used in air ambulances;
- DO160G:2016 Section 7, Category A; Section 8, Category U/U2 Environmental Conditions and Test procedures for Airborne Equipment
- EN 60068-2-27:2008 Shock testing
- EN 60068-2-64:2008 Vibration testing
- EN 1789:2020 Medical vehicles and their equipment – Road ambulances

ENERGY MANAGEMENT

The **corpuls cpr** can be operated with a battery as well as via mains connector. The long running time of the battery (typical: 90 min.) guarantees optimal operational readiness. The display shows the remaining running time in minutes.

The battery can be exchanged quick and easy with one operation. When using the device in a rescue vehicle, the power can also be supplied via the magnetic clip directly from the on-board power supply.



► **corpuls cpr** arm on mains operation with magnetic RoPD connector



► The LEDs of the charging status display give a quick overview of the remaining capacity of the battery.



► By pressing both release buttons, the battery can be exchanged quick and easy. The operation parameters are retained for 30 seconds.

THE RIGHT BOARD FOR EVERY CASE

All boards are made of carbon and are therefore mostly **radiolucent**. They are also very **easy to clean** thanks to their smooth surface.



QUADBOARD

- Specifically developed for **hospital application**
- Large handle for easy positioning under patients



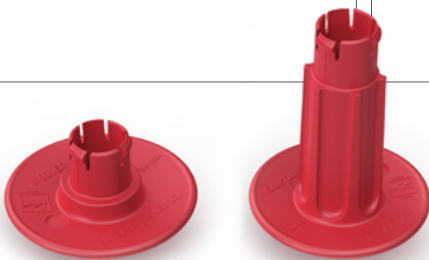
RECBOARD

- Specifically developed for use in **emergency services and preclinical setting**
- Compatible with all common stretcher systems
- Fastening straps with magnetic clasp and fixation ring for secure fixation of the patient



SCOOPBOARD

- Ideal for **technically demanding operations with a scoop stretcher**
- Compatible with most common scoop stretchers
- Fastening straps with magnetic clasp and fixation ring for secure fixation of the patient



STAMP

- Two sizes available
- Re-usable
- Easy to clean



BAG & BACKPACK FROM PAX®

- Custom-made for the **corpuls cpr**
- Room for all accessories (stamp, reserve battery, external mains converter)
- Storage compartment for a board
- Charging status indicator and possibility of charging the arm in the bag

WALL MOUNTING FOR HOSPITAL

- Optimal storage of the **corpuls cpr** and charger
- Accessible anytime
- Mounting also possible in crash cart



SPECIFICATIONS

COMPRESSION PARAMETERS

- Compression rate:
80 – 120 compressions per minute
(adjustable in increments of 1 compression per minute)
- Compression depth: 2 – 6 cm
(adjustable in increments of 0.1 cm)
- Therapy mode: 30:2 / 15:2 / continuous (secure airway)

PATIENT PARAMETERS:

- Thorax height: 14 – 34 cm
- No restrictions on the thorax width
- No restrictions on the weight of the patient
- 8 years and older

OPERATING PARAMETERS:

- Power source: electric
- Battery: Lithium Polymer (LiPo)
- Power supply:
12-33V DC (on-board power),
110-240V AC (Mains 50-60 Hz)
- Battery with 300 charging cycles
- Operating time: typical 90 min.
- Displays the remaining running time in minutes
- LED indication of battery charge level in 20% increments
- Battery charging time (via magnetic clip):
105 min. 0-80%
30 min. 80-100%
- Intuitive user interface:
Therapy start/stop button with LED display and 4 softkeys

GENERAL SPECIFICATIONS:

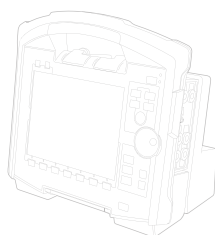
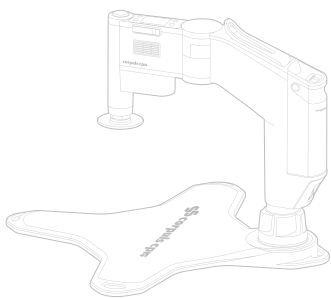
- Color display 2.4" with LED backlight
- Operating temperature:
-20 °C to +45 °C
- Dust and splash proof (IP54)
- Operating noise: 70 dB
- Data interface: SD card
- Integrated alarm management
- RTCA DO 160 G (EMC tested)
- Simultaneous display of mode, compression depth and rate, time/therapy duration and remaining running time of the battery in minutes and percentage

DIMENSION AND WEIGHT:

- **corpuls cpr** arm including stamp and battery:
45 x 43 x 9 cm / 5.5 kg
- Recboard:
47 x 47 x 3.5 cm / 2.2 kg
- Quadboard:
46 x 46 x 13 cm / 1.7 kg
- Scoopboard:
45 x 35 x 83 cm / 1.6 kg

More at www.corpuls.world

*Possible thorax heights depend on the board used (Quadboard 13.3-34.2cm, Recboard 12.8-33.5cm, Scoopboard 12.6-33.0cm)



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