

Hydraulic locking unit (HLU) series HLU LE25 and HLU LE32

Assembly instructions



Hydraulic locking unit (HLU) for personal restraint systems.



(Translation of the original instructions)

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1 About these instructions

1.1 About these instructions

This manual is part of the product and describes the safe and proper use in all operating phases.

All photos and drawings in this manual show an available product variant. For precise details concerning the variant you have purchased, please refer to the type plate attached to the product.



- ▶ Read instructions before use.
- ▶ Make the manual accessible to operating and maintenance personnel at all times.
- ▶ Keep this manual for the lifetime of the product.
- ▶ Only pass on the product to third parties together with this manual.

1.2 Target audience

The target audience of this manual is trained and qualified personnel who are familiar with the installation, operation and maintenance of machines.






The manual provides relevant information for the machine manufacturer and machine operator as well as for training courses.

To request further information about the product, contact HAWE Micro Fluid GmbH.













1.3 Safety instructions and symbols

Safety indication





In these instructions, the following warning and safety notes are used:

Symbol	Meaning
	Draws your attention to a hazardous situation that can lead directly to serious injury or death if not avoided.
	Draws your attention to a hazardous situation that can indirectly lead to serious injury or death if not avoided.
	Draws your attention to a hazardous situation that can indirectly lead to light to moderate injury if not avoided.
	Notice to prevent environmental and material damage.
	Information to ensure the correct use of the product.


Safety symbols

	General safety symbol Draws your attention to additional safety information.		
	Slipping hazard		Dragging hazard from moving parts
	Harmful substances		Tripping and falling hazard
	Fire accelerants		Falling loads
	Burn hazard		Crushing hazard
	Electrical voltage		Suspended loads
	No access to persons with pacemakers and defibrillators		

Mandatory signs

Protective equipment	
	<p>Safety boots Wear appropriate safety boots to protect your feet against mechanical hazards.</p>
	<p>Work gloves Wear suitable work gloves to protect your hands against chemical and mechanical hazards.</p>
	<p>Safety goggles Wear safety goggles to protect your eyes against chemical and mechanical hazards.</p>
	<p>Protective clothing</p> <ul style="list-style-type: none"> ▶ Wear fitted clothing without protruding parts. ▶ Follow the safety data sheet of the hydraulic fluid.

1.4 Applicable documents

 The locking unit has been designed and manufactured in compliance with engineering practice according to the Pressure Equipment Directive (PED 2014/68/EU Article 4, paragraph 3), and is safe to use. No EU Declaration of Conformity may be issued for pressure equipment and assemblies classified in the Pressure Equipment Directive according to Article 4 (3). No CE mark may be affixed.

Standards	Name
DIN EN 13814	Fairground and amusement park machinery and structure - Safety of amusement rides and amusement devices
ASTM F2291	Standard Practice for Design of Amusement Rides and Devices
ASTM F2974	Standard Practice for Auditing Amusement Rides and Devices
ISO 17842-01	Safety of amusement rides and amusement devices -- Part 1: Design and manufacture
Documents	Designation
D 6052 G,A,E,K,RL,RD	Data sheet: Characteristics and applications for this product
R 2020/16	Information: HAWE load case definition

The product is built according to the state of the art and recognized safety regulations.

Nevertheless, there is a risk of personal injury and damage to property if this chapter and the safety instructions in this manual are not observed.

2.1 Intended use

- The product is a technical work tool and intended for commercial and industrial use only.
- The product may only be operated in accordance with the technical data, operating conditions and performance limits specified in this manual.
- Only use original accessories and original spare parts approved by the manufacturer.
- The product may be used outdoors and indoors.
- The product is used for the infinitely variable locking of passenger restraint systems on seats in amusement rides and flying structures.
- Any rides that are operated as flying structures on the territory of the United States of America are excluded from said use.
- Forces may only be transmitted to the locking unit by way of articulated lugs.
- Use the product only after undergoing training by the seat or ride operator.



Setup, specifically for use at funfairs or amusement parks

The product may only be commissioned by the fairground ride manufacturer if the higher-level system fulfils the requirements of DIN 13814, the Work Equipment Directive 2009/104/EC, the directive 89/391/EEC and the local regulations in the region of use.

The information in this manual must be supplemented by the system manufacturer based on the results of the individual risk assessment. The system manufacturer must decide which of the information included in these assembly instructions is relevant for the system operator and must be passed on.

2.2 Misuse

Unintended use

⚠ WARNING

Hazard from unintended use of the product

Any use of the product that goes beyond the intended use and/or varies from the intended use of the product has the potential of leading to hazardous situations.

- ▶ Only use the product for the stipulated purposes.

- Use in other operating modes than specified in the intended use
- Using the product beyond the specified performance limits
- Do not convert the product or modify it in any way.
- Do not paint over elastic sealing parts, bearings of moving parts and hose lines.
- Do not use this product in potentially explosive atmospheres.

2.3 Residual risks

When handling hydraulic fluid, comply with the safety data sheet of the fluid's manufacturer.

⚠ WARNING



Risk to life due to explosive combustion

Hydraulic fluid, and its associated mists and vapors, is a fire accelerant. Contact with ignition sources will lead to explosive combustion. Risk of serious injury or death.

- ▶ Avoid fire, open flames, and smoking anywhere near the product.
- ▶ Immediately dispose of any flammable materials moistened with hydraulic fluid as hazardous waste.
- ▶ Do not use any flammable or corrosive cleaning agents.

⚠ WARNING



Electrical and magnetic fields

Electrical and magnetic fields impair the functionality of cardiac pacemakers and implanted defibrillators.

- ▶ People with pacemakers or implanted defibrillators must maintain a sufficient distance from magnets.
- ▶ Advise people with pacemakers or implanted defibrillators against approaching magnets.
- ▶ Cordon off the area around the drive system and affix suitable warning signs to the barriers.

⚠ WARNING



Risk of injury through crushing or cutting

Body parts might get trapped or severed between the machine frame and hydraulic system in the event of careless transport, installation and de-installation.

- ▶ Never reach between the hydraulic system and the machine frame.
- ▶ Ensure other people cannot enter the hazardous area.
- ▶ Wear gloves and appropriate footwear.

2.4 Duties of the operator

Observe and comply with regulations:

- ▶ The product must not be commissioned until the complete higher-level machine or system complies with the provisions, safety regulations and standards relevant in that country for the application.
- ▶ Observe and apply regulations for accident prevention and environmental protection.
- ▶ Assess and document any new dangers in the complete system's manual.

Operate product safely:

- ▶ Despite safety devices, the product still poses residual risks. Observe the safety instructions in this manual to reduce health hazards and avoid dangerous situations.
- ▶ The operating company must ensure the operating conditions (see the technical data) are within the limits for use of the product.
- ▶ Keep all instructions/signs on the product in legible condition and observe them.

Instruct personnel:

- ▶ Regularly train personnel in all points of these instructions and ensure they are observed.
- ▶ Ensure the terms of the industrial safety and operating instructions are observed.
- ▶ Only use qualified personnel. Due to their training and experience, qualified personnel must be able to recognize risks and avoid possible hazards.

2.5 Qualification of the personnel

The activities described in these instructions require basic knowledge of mechanics, hydraulics and electrics.

For the transport and handling of heavy loads, additional knowledge in handling hoists and slings is required.

- ▶ The activities may only be carried out by an appropriate specialist or an instructed person under the supervision of a specialist.
- ▶ Activities other than those described in these instructions may only be performed by HAWE or authorized specialist companies.
- ▶ The personnel must have read and understood these instructions.

Trained personnel

Personnel instructed comprehensively, by skilled staff on behalf of the owner, in how to perform their appointed tasks and in how to use the product safely.

Specialist personnel

Due to their technical training, knowledge and experience, specialists are able to assess and carry out the assigned work and can independently recognize possible dangers.

Qualified electrician

A person with appropriate professional training, knowledge and experience, so that he/she can recognize and avoid dangers that can be caused by electricity.

Auditor

Persons of a technical inspection body who are authorized to perform testing and monitoring tasks for pressure equipment and electrical systems.

2.6 Personal protective equipment

Personal protective equipment (PPE) is designed to prevent and reduce hazards.

In the instructions, safety instructions with mandatory symbols indicate the wearing of special protective equipment for special activities.

The supply of PPE, and instruction in its proper use, is carried out by the operator.

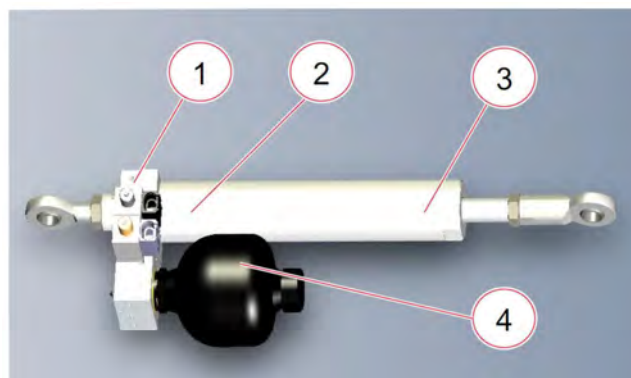
3 About this product

3.1 Markings

(1) Type engraving - 01/05/2015 to 30/04/2024

The type marking is on the valve block of the hydraulic locking unit. The type marking contains the following information:

- Material number (850-XXXX-X)
- 1050 Test passed (T)
- Serial number (ZZZZ)
- Production date (year.month.day)
- Size (LE ..)



(1) Type engraving - from 01/05/2024

- Material number (850-XXXX-X)
- 1050 test passed (T)
- Serial number (ZZZZ)
- Production date (year.month.day)
- Size (LE ..)
- Pressure P2 in bar

(2) Data matrix code

The data matrix code is located on the outer cylinder tube. The following information is encrypted in the data matrix code:

- Material number
- Order number
- Serial number
- Date of production
- Pressure P2 in bar

(3) Type plate - before 01/05/2015

The type plate is fixed to the outer cylinder tube. The type plate shows the following information:

- Material number (850-XXXX-X)
- Production number (4000YYYYY)
- Serial number (ZZZZ)

(4) Diaphragm accumulator

Information on the content and handling of the diaphragm accumulator is provided on the diaphragm accumulator and was mounted by the manufacturer. Additional information:

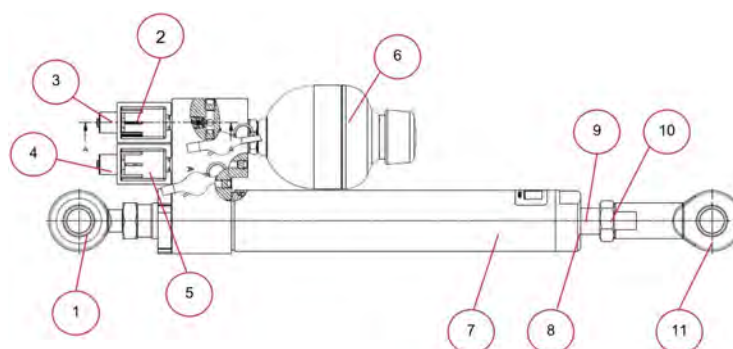
- Pressure data
- Date of manufacture
- Serial number

3.2 Structure

The hydraulic locking unit (HLU) (2) is a closed hydraulic system, including hydraulic fluid, for the infinitely variable locking of passenger restraint systems (1) on seats in amusement rides and flying structures.

- | | | | |
|---|--|----|---|
| 1 | Pivot mount, foot side, with male thread | 8 | Wiper |
| 2 | V2 (only for type K, RL and RD): electro-magnetic 2/2 directional seated valve | 9 | Piston rod |
| 3 | Button for emergency actuation V2 with rubber cap (only for type K and RD) | 10 | Pivot mount lock nut |
| 4 | Emergency override button V1 with rubber cap | 11 | Pivot mount, bar side, with female thread |
| 5 | V1 2/2-way poppet valve with electro-magnetically releasing check valve | 12 | Connection block |
| 6 | Diaphragm accumulator | 13 | Minimes port |
| 7 | Dual-action cylinder | | |

Structure of type RD in the variant RD (E)



3.3 Functions

The inner tube of the screwed double tube cylinder guides the piston rod with piston, the outer tube guides the oil of the rod side to the flanged connection block on the cylinder base. Diaphragm accumulators, electromechanically and manually releasable check valve(s) and two pressure connections are included on the connection block. The diaphragm accumulator precharges the unit to a defined pressure and absorbs the oil volume displaced by the piston rod during retraction. Due to the diaphragm accumulator, the piston rod of the hydraulic locking unit can extend with a different speed and force depending on the pressure ratios.

The seated valve allows the flow of oil only in one direction; it blocks flow in the opposite direction. A flow of oil in both directions is possible through electromechanical actuation (3) and/or (4) in normal operation. In case of emergency, the valve(s) (4) must also be actuated manually. The pressure connections are intended for filling oil at the plant and configuring the pressure of the unit ("[Structure](#)", [page 11](#)).

WARNING

Danger to life if valves V1 and V2 are energized while running

If valves V1 and V2 are energized while the ride is running, the restraint system might release and passengers might suffer fatal injury.

- ▶ Valves V1 and V2 must remain deenergized during operation.
- ▶ Observe the switching logic from [page \(18\)](#).

3.3.1 Type A: Blocking against extension

**Primary function:
Locking the restraint
system**

The hydraulic locking unit is connected via the rod ends (1) and (11) with the restraint system of the fairground ride (e.g. shoulder bar mechanism) and can be released manually/electrically. When closing the restraint system, the piston rod (9) of the hydraulic cylinder (7) is retracted and the hydraulic accumulator (6) is filled. This results in a hydraulic pressure being built up and maintained. The restraint system is closed.

The piston rod (9) is prevented from extending by the check valve (5). The restraint system is thus locked.

**Secondary function:
Opening the restraint
system**

The hydraulic locking unit acts as a bar drive. The piston rod (9) extends by extension force as soon as the 2/2-way valve (5) is energized and thereby opened. The hydraulic pressure is relieved, and the hydraulic locking unit's restraint system (such as the bar) is actively opened.

3.3.2 Type E: Blocking against retraction

**Primary function:
Closing and locking the
restraint system**

The hydraulic locking unit is connected via the pivot mounts (1) and (11) to the ride's restraint system (such as the shoulder bar mechanism), and can be unlocked manually/electrically. When the restraint system is closed, the piston rod (9) of the hydraulic cylinder (7) is extended. The hydraulic pressure in the accumulator (6) is relieved, ensuring correct internal flow of hydraulic fluid. The restraint system is closed. The piston rod (9) is prevented from retracting by the check valve (5). The restraint system is thus locked.

**Secondary function:
None**

The hydraulic locking unit type E generates only low piston extension forces by design. When the 2/2-way valve (5) is energized, and thereby opened, the piston rod (9) of the hydraulic cylinder (7) remains extended. The piston rod can be moved in the retraction and extension directions.

It is not possible to drive the restraint system's opening motion by way of the hydraulic locking unit. The low extension forces produce a force that closes the restraint system. An additional system (such as a gas spring or leg spring) is therefore required to drive the opening motion and keep the restraint system (such as the bar) open.

3.3.3 Type RD (E): Anti-retraction lock with redundancy valve



HLU type RD (E) is only intended for installation in seat classes ≤ 3 (without additional redundancy) according to DIN EN 13814.

The primary and secondary function are the same as HLU type E. The restraint system is primarily closed and locked. Due to the design, the secondary function, opening the restraint system, cannot be achieved by the hydraulic locking unit without an additional opening mechanism. As with type E, an additional system must be used for the secondary function (e.g. gas spring, leg spring).

In addition, type RD (E) has two 2/2-way directional valves connected in series (redundancy). These must be actuated in pairs.

**Opening the restraint
system:**

1. Energize 2/2-way directional valves in pairs
 - ✓ 2/2-way directional valves are opened.
 - ✓ The piston rod can be moved in the retraction and extension direction.
2. Open restraint system with additional system (e.g. gas spring, leg spring).

3.3.4 Type K: Blocking against extension with comfort lock

The hydraulic locking unit is connected via the pivot mounts (1) and (11) to the ride's restraint system (such as the shoulder bar mechanism).

Comfort lock when using type K

When the restraint system is open, blocks on both sides of the valve V2 (2) prevent the hydraulic cylinder (7) from retracting under load. Ride passengers can use the restraint system as a handle when embarking and disembarking. Further constricting closing of the restraint system during ride operation is prevented. Both functions increase passenger comfort.

Closing the restraint system

When valve V2 (2) is energized, the restraint system can be closed. When the restraint system is closed, the piston rod (9) of the hydraulic cylinder (7) is retracted. A hydraulic pressure is built up and maintained in the process. The end position of the piston rod (9) is adjusted hydraulically by inflating the pressure accumulator (6). The restraint system is closed.

The piston rod (9) is prevented from extending by the non-energized check valve V1 (5), and the restraint system cannot be opened.

Primary function: Locking the restraint system

When the restraint system has reached its end position, valve V2 (2) is de-energized. The piston rod (9) can neither retract nor extend. The restraint system is thus locked, and can be neither opened nor closed.

Secondary function: Opening the restraint system

The hydraulic locking unit acts as a bar drive. The piston rod (9) extends by extension force as soon as valves V1 (4) and V2 (2) are energized and thereby opened. The hydraulic pressure is relieved, and the restraint system bar is actively opened. The piston rod can be moved in the both directions.

3.3.5 Type RL: Reverse lock

The hydraulic locking unit is connected via the pivot mounts (1) and (11) to the ride's restraint system (such as the shoulder bar mechanism).

Primary function: Locking the restraint system

When the restraint system is closed, the piston rod (9) of the hydraulic cylinder (7) is extended and locked so it can not be retracted. The hydraulic pressure in the accumulator (6) is relieved and holds the position of the piston rod hydraulically. The restraint system is locked.

The safety lock is active, and the piston rod is locked to stop it retracting by the check valve (V2). The restraint system is thus locked, and cannot be opened.

Comfort lock when using type RL

When the restraint system is open, the double-sided locking of valve V2 (2) prevents the hydraulic cylinder (7) from extending under load. Riders can use the restraint system as a handhold when entering and exiting the ride.


Secondary function: Opening the restraint system

Type RL locking units always generate very low piston extension forces by design. When valves V1 (5) and V2 (2) are energized, and thereby opened, the piston rod (9) of the hydraulic cylinder (7) remains extended, and can only be retracted by an additional system.

It is not possible to drive the restraint system's opening motion by way of the locking unit. The low extension forces produce a force that closes the restraint system. An additional system (such as a gas spring or leg spring) is therefore required to drive the opening motion and keep the restraint system open.

3.4 Control


3.4.1 Instructions for the ride manufacturer

 All of the necessary safety equipment, safety functions and the safety controller should be provided by the machine manufacturer.

The following functions must be assured on the ride/machine, and supplemented with other measures according to your own risk assessment:

Personal safety

- Malfunctions on the ride can be safely remedied, and do not pose a risk to the hydraulic locking unit.
- The ride in which the hydraulic locking unit is installed fully complies with all legal requirements.
- A failure of the electrical power supply to the hydraulic locking unit does not pose any risk.
- A main switch and an emergency stop function are integrated into the ride, or in a higher-level control system.
- It is not possible for persons to reach into the hazard zone of the hydraulic locking unit.
- Persons cannot be endangered by movement of the restraint system.
- Persons cannot randomly or unintentionally open the restraint system/hydraulic locking unit.
- Persons cannot burn themselves on hot surfaces. After the hydraulic locking unit has been installed in the ride, place signs to identify hot surfaces that could endanger persons.

 Maximum loads in drawings and product documentation are calculated according to DIN EN 13814. For locking units on seat classes* 4 and 5 a 70/30 load distribution was applied, and for locking units on seat class* 3 a direct load of 100%. The loads relate to the linear forces acting directly on the piston rod of the hydraulic locking unit.

If the restraint system is not safeguarded by redundancy, the maximum permissible holding forces must be recalculated. Get in touch with HAWE Micro Fluid GmbH.

* Seat classes defined in DIN EN 13814

Construction and control

Installation and control of the hydraulic locking unit is to be implemented by the ride manufacturer. The following supplementary functions and design measures should be added according to your own risk assessment, and must be integrated into the ride control system.

- The hydraulic locking unit must not be used as a mechanical limiter for the bar structure.
- Pay attention to the specific seat kinematics of the ride.
- The limits specified in the technical data sheets (especially the retraction and extension speeds) must not be exceeded.
- Observe the requirements of DIN EN 13814 and the HAWE Load Case Definition.
- Protect the hydraulic locking unit against harmful environmental effects resulting from the construction of the ride or seat, such as very salty water, water containing chemical additives, or other caustic and corrosive liquids.
- Be aware that an opening aid (e.g. gas or leg spring) is required when using type "E" and "RD (E)" in order to drive the opening movement and to hold the restraint system in an open position.
- Consider that if type K is installed the necessary holding forces and leak-proofing for locking in the closure direction (primary function) are assured solely by valve V1. - Do not use hydraulic locking units as blocking against retraction locks pursuant to the primary function.
- Monitor the emergency override button on (V1) and (V2) so that the lock cannot be released unintentionally.
- The control system must ensure that the 2/2-way valve is prevented from being energized, and thereby opening, while the ride is running.

- V2 with type K is only intended for comfort locking. Observe the switching logic on page 18 .
- If more than one hydraulic locking unit is installed per restraint system, the valves of all the relevant locking units must be actuated when the restraint is opened. Similarly, if the emergency override is used, overriding of all relevant locking units must be initiated simultaneously.

Operating modes

- The ride manufacturer must specify the modes for safe operation of the hydraulic locking unit within the ride.

Aids and tools**Provide the following aids, tools and materials:**

- Mobile battery unit to open the hydraulic locking unit without power supply.
- Note the type-specific version of the auxiliary tool for actuating the button/buttons (3 and 4) of the 2/2-way directional valve (= emergency actuation) (page 11).



For hydraulic locking units of the types A, E and RL.



For hydraulic locking units of the types K and RD.

Integrate the following switching logic into the ride control system.

Type		V1	V2
A	Retract piston rod	0	-
	Close and lock restraint system	0	-
	Extend piston rod	1	-
	Open restraint system	1	-
E	Extend piston rod	0	-
	Close and lock restraint system	0	-
	Retract piston rod* *Additional retraction system required (such as a gas spring)	1	-
	Open restraint system	1	-
K	Retract piston rod	0	1
	Restraint system can be closed	0	1
	Extend piston rod, piston rod movable in both directions	1	1
	Open restraint system	1	1
	Restraint system locked - for ride - for entry and exit assist when using the comfort function	0	0
RL	Extend piston rod	0	0
	Restraint system locked for ride	0	0
	Retract piston rod	1	1
	Opening the restraint system	1	1
RD (E)	Extend piston rod	0	0
	Close & lock restraint system	0	0
	Retract piston rod* *additional system required for retraction (e.g. gas spring)	1	1

*For startup and service

NOTICE

Damage due to incorrect valve switching in type RL

If V2 is permanently activated on its own, after a time the temperature in the locking unit will rise, so increasing the pressure at V2. When deactivated, the valve can no longer switch against this pressure; the locking unit remains locked.

- ▶ Always energise valves V1 and V2 in pairs.
- ▶ Deactivate V2 only when no load is acting on the bar. If the comfort lock is under load at the time of deactivation, valve V2 will not be able to switch against the pressure caused by the load.
- ▶ If V2 does not switch despite a switching signal=0, actuate V1 and briefly retract the cylinder piston.
- ▶ Do not use the end positions of the hydraulic locking unit as limiters for the bar movement. This would mean it would not be possible to briefly retract the cylinder piston while simultaneously energizing V1 for unlocking.

4 Transport and storage

In addition to the safety instructions presented in Section 2 "For your safety" follow the safety instructions below.

⚠ WARNING

Danger to life due to negligence when transporting the hydraulic locking unit

Damage to the gas valves on preloaded pressure vessels, or to the pressure vessels themselves, can cause hydraulic fluid or nitrogen to escape at high pressure and penetrate deep into the body via the skin and eyes. This can lead to severe and irreparable injury, or even death.

- ▶ Transport to be carried out only by instructed personnel.
- ▶ Do not subject gas valves to any load.
- ▶ Avoid shock impact on the gas valve.

⚠ CAUTION



Personal injury through tipping or falling load

The product might tip over or fall during transport. This could lead to hands and feet becoming trapped.

- ▶ Adhere to the symbols on the packaging.
- ▶ Use permitted transport aids to carefully transport the product as close to the installation location as possible.
- ▶ Select transport aids that will allow the maximum load to be transported safely.
- ▶ Wear appropriate PPE.

4.1 Transport equipment

Only tested and approved aids may be used.

! NOTICE

Preventing damage in transit

- ▶ Remove the hydraulic locking units individually from the packaging.
- ▶ Do not subject gas valves to any load.
- ▶ Protect gas valves for shipping by padding.

4.2 Scope of delivery

- An assembled hydraulic locking unit filled with hydraulic oil with a double tube cylinder and diaphragm accumulator preloaded with nitrogen (> 2 bar, at 20 °C)
- Separately via e-mail**
- Assembly instructions
 - Product-specific technical data sheet
 - Product-specific technical drawings
- Not included in the scope of delivery**
- Aid for mounting the pivot mounts on the foot side
 - Tool to actuate the emergency release
 - Fastening bolts and bushings
 - Electrical cables

4.3 Checking the delivery

Unpacking

1. Remove every hydraulic locking unit individually from the packaging unit:
 - Hold on the rod ends.
2. Remove the packaging without scratching the piston rods.
3. Check the hydraulic locking unit for completeness and transport damage:
 - If there is any damage, refuse shipment or sign for damage when accepting it.
 - Note any transport damage on the transport documents or on the carrier's delivery note.
4. Dispose of the packaging of your hydraulic locking unit in accordance with local regulations.

**For any defect found, file a complaint immediately with:**

HAWE Micro Fluid GmbH
Borsigstraße 11
93092 Barbing
email: service@hawe-microfluid.com

Claims for damages can only be addressed within the applicable complaint periods. HAWE does not accept any liability for subsequent complaints.

4.4 Storage

NOTICE

Property damage from incorrect storage

Incorrect storage can lead to damage. Refer to the technical data.

Store the locking unit and its individual components as follows:

- In disassembled state: Store only with the piston rod extended by 5 to 10 mm.
- In installed state: Do not lock the restraint system against the locking direction.
- Store in a dry and dust-free place.
- Protect from sunlight (UV radiation) and corrosion (such as very salty water).
- Protect from mechanical damage and damp.
- Do not store near ignition and heat sources.
- Note all additional specifications by the ride manufacturer.

In addition to the safety instructions presented in Section 2 "For your safety" follow the safety instructions below.

 **Startup means initial commissioning and subsequent startups.**

DANGER

Danger to life due to damage to the pressure vessel

Damaged pressure vessels can cause hydraulic fluid or gas to escape at high pressure and penetrate deep into the body via the skin and eyes. This can lead to severe and irreparable injury, or even death.

- ▶ Assembly only by trained specialist personnel.
- ▶ Never weld, solder or drill pressure accumulators.
- ▶ Do not disconnect the pressure accumulator from the hydraulic locking unit.
- ▶ Never modify the hydraulic locking unit with pressure accumulator.
- ▶ Never perform any maintenance on the hydraulic accumulator yourself.

WARNING

Danger of crushing/malfunction from unexpected startup

Body parts may be crushed or shorn off if the system starts up unexpectedly.



- ▶ Wear protective clothing.
- ▶ Take precautions to prevent anyone from entering the danger zone throughout all commissioning or maintenance work.
- ▶ Do not energize solenoid valves while uninstalled.
- ▶ Do not trigger emergency release while uninstalled.

CAUTION

Risk of tripping and falling

Insufficient space for performing the necessary jobs on the hydraulic system increases the risk of accidents due to tripping or falling.



- ▶ Provide a ladder or access platform to make sure the workspace can be reached safely.
- ▶ Ensure there is sufficient space to perform all assembly and installation work.
- ▶ Do not climb onto the hydraulic system.

CAUTION

Risk of falling from leaking hydraulic fluid

Spilled or leaked hydraulic fluid can form a slippery film on the floor.



- ▶ Use suitable aids when filling or bleeding.
- ▶ Check all connecting elements that convey oil for leaks before switching on the motor in the parent system.
- ▶ Wipe up leaked hydraulic fluid with suitable aids.

! NOTICE**Material damage due to mechanical damage**

Protect the product against mechanical damage, e.g. by applying suitable padding.

- ▶ Such as foam, covers, cardboard

5.1 Set-up - Positioning - Attachment**⚠ WARNING****Lethal danger/malfunction from incorrectly installed hydraulic locking unit**

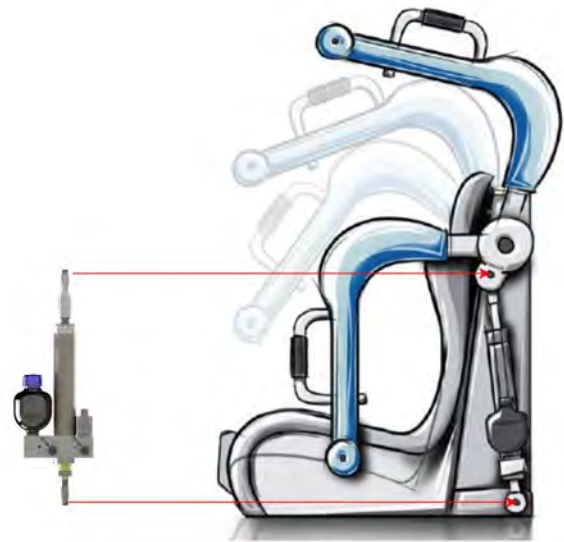
Incorrectly installed hydraulic locking units or use of unsuitable line cross sections and connectors can cause malfunctions, accidents, and irreversible or even fatal injuries.

- ▶ Wear protective clothing.
- ▶ Install the locking unit only in the manner and position specified.
- ▶ Make adjustments to the angle to match the seat's design on the base-side rod end only!
- ▶ Do not adjust the angle as a means to change the length.
- ▶ Keep all drilling chips, screws, and other foreign objects out of the ring gap between piston rod and cylinder head.
- ▶ Protect the piston rod from damage to its surface.
- ▶ Only trained specialist personnel is permitted to assemble the hydraulic locking unit.

! NOTICE**Property damage from incorrectly installed hydraulic system**

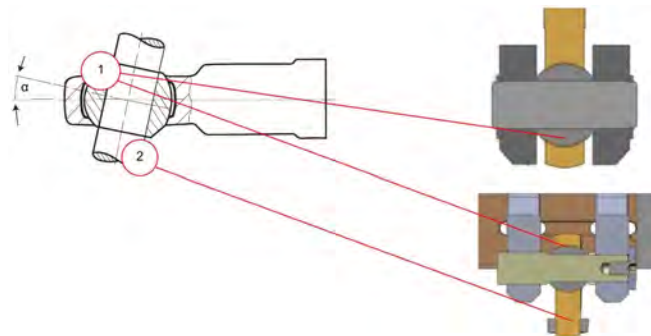
- ▶ Assembly by trained specialists only.
- ▶ Ensure all labels and markings of the hydraulic system are easily visible and legible after assembly.
- ▶ Check installation space/connection points for damage.

1. Space required for assembly, installation and startup:
500x400x500 mm (WxHxD).
2. Transport the hydraulic locking unit safely to the installation location.
3. Ensure that the hydraulic locking unit does not touch the seat construction or other system components in retracted or extended state and in any position during operation.
 - The connection may only be made by the mounting points (ball joint).



	HLU-LE-25	HLU-LE-32
Diameter of articulated lug	Ø 15-0.008mm	Ø 17-0.008mm

4. Take into account the maximum permissible tilt angle α on the ball joint in the selected installation position.
 - Locking unit HLU-LE 25: max. 4.5°
 - Locking unit HLU-LE 32: max. 5.5°
5. Fix the hydraulic locking unit with the restraint system via the ball joint (1) using bolts (2).



6. Only carry out angle adjustments to adjust to the seat geometry on the foot side rod end.
 - ✓ The pivot mount is not rotated more than 179°, starting from the position when shipped.
 - ✓ The angle has not been changed to adjust the length, because that is not permitted.
 - ✓ For specified torques and anti-twist systems (such as threadlocker) refer to the technical drawing.
 - ✓ The hydraulic locking unit cannot be used as a mechanical limiter for the bar structure. If this is not possible, it must be prevented by suitable means (such as a rubber buffer/stop in the seat kinematic unit).
7. Ensure that unintentional triggering of the emergency actuation is prevented at all times if triggering mechanisms are also installed.

5.2 Electrical connection

WARNING



Electrical and magnetic fields

Electrical and magnetic fields impair the functionality of cardiac pacemakers and implanted defibrillators.

- ▶ People with pacemakers or implanted defibrillators must maintain a sufficient distance from magnets.
- ▶ Advise people with pacemakers or implanted defibrillators against approaching magnets.
- ▶ Cordon off the area around the drive system and affix suitable warning signs to the barriers.

WARNING

Danger due to signal interference at check valve

The electromagnetically actuated check valve of the hydraulic locking unit can be subject to interference from electrical, magnetic and electromagnetic fields in the surrounding environment. Signals cannot be transmitted correctly as a result. This can lead to hazardous situations, and danger to life.

- ▶ Lay power and signal cables so that they do not affect the check valve.
- ▶ Use only cables designed for the specific application type (fixed, flexible or highly flexible; outdoor).
- ▶ Follow the cable manufacturer's instructions for selecting the cable type.
- ▶ Include all metal components of the ride in the equipotential bonding plan.

NOTICE

Hazard for electronic components – property damage

Electromagnetic waves lead to malfunctions of electrical or electronic equipment.

- ▶ To prevent electrostatic discharge, do not touch electronic components or contacts.
- ▶ After switching off the electrical power supply, wait at least 15 minutes for the energy stored in the capacitors to dissipate.
- ▶ Do not expose components to moisture or an aggressive environment.
- ▶ To avoid overheating, always keep ventilation openings (if any) open to allow sufficient air circulation.

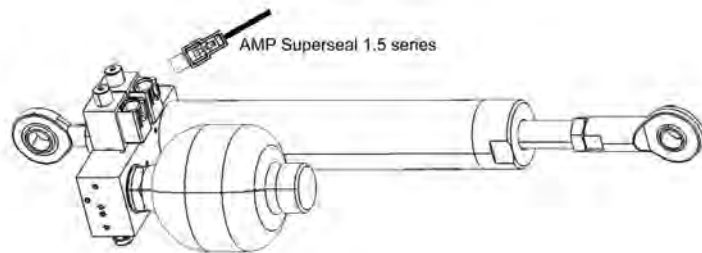
NOTICE

Material damage due to kinks or crushing of the power cable

Kinking or crushing of the power cable can result in cable breaks and cable fires.

- ▶ Do not kink or crush the cable.

1. Secure the unit against being switched on unintentionally.
2. Connect the electromagnetic valve(s) to the control system:
 - ▶ The coil has a socket for 2-pin plugs.
 - ▶ Use the cable with the matching plug in accordance with the technical data sheet.
 - ▶ Any pin assignment
 - ▶ Insert the plug on the cable into the socket of the coil and connect the cable to the electric power supply.
3. Check the electrical connection after a week's operating time.



Example: Electrical connection of the HLU LE 32K

6 Start-up

⚠ CAUTION



Burn hazard from hot surfaces and hydraulic fluid

A burn hazard results from directly or indirectly coming into contact with hot hydraulic fluid and hot components of the hydraulic system.

- ▶ Wear work gloves and protective goggles.
- ▶ Arrange the access to the hydraulic system in such a way that hot surfaces are not accessible to the user.
- ▶ Wait until the hydraulic system has cooled down before servicing or disassembling.

1. Start-up may only be carried out by specialist personnel.
2. Secure the ride against unintentional starting.
3. Check the hydraulic locking unit for damage ([page 36](#)).
4. Check that the hydraulic locking unit has been properly connected as follows:
 - a) **Mechanical:**
 - ✓ Has the hydraulic locking unit been prevented from being used as a mechanical limiter for the bar structure?
 - ✓ Bar opens completely – the “standstill” state must be reliably achieved when the bar is open completely.
 - ✓ Has the hydraulic locking unit been installed free of mechanical stress, and is it protected against the action of lateral forces?
 - ✓ Is the locking unit not touching the seat structure when extended and retracted, and when in any position during operation?
 - ✓ The seat construction must be as free of play as possible.
 - ✓ Are all signs and markings clearly visible?
 - ✓ Check all mechanical connection points as described in the maintenance chapter (“[Mechanism](#)”, [page 39](#)).
 - b) **electrically:**
 - ✓ Check the connection to the central control system and the cable connections on the hydraulic locking unit.
5. Switch on the control system's power supply.
6. Check valve switching and function sequence as per the switching logic of the function sequences (“[Instructions for the ride manufacturer](#)”, [page 16](#)).
7. Check the locking and opening function (“[Functional test](#)”, [page 50](#) onwards)
8. Check bolt connections after one week of operation at the latest.

⚠ DANGER**Danger to life due to faulty or outdated locking unit**

Using a faulty hydraulic locking unit, or one that has been operated beyond its specified service life, can lead to malfunctions in operation, and accidents entailing danger to life.

- ▶ Assembly only by trained specialist personnel.
- ▶ Do not use the hydraulic locking unit if ice has formed on the piston rod, as this will damage the wiper.

Replace the hydraulic locking unit if:

- ▶ the restraint system no longer opens fully.
- ▶ the restraint system can no longer be closed.
- ▶ the restraint system's play exceeds the permissible maximum when closed.
- ▶ the useful life as per the technical data (operating conditions) has expired.

⚠ CAUTION**Burn hazard from hot surfaces and hydraulic fluid**

A burn hazard results from directly or indirectly coming into contact with hot hydraulic fluid and hot components of the hydraulic system.

- ▶ Wear work gloves and protective goggles.
- ▶ Arrange the access to the hydraulic system in such a way that hot surfaces are not accessible to the user.
- ▶ Wait until the hydraulic system has cooled down before servicing or disassembling.

7.1 Switching on and off

The hydraulic locking unit is supplied with power, opened and locked via the ride's control system. When opening the HLU or actuating the valve coil, no external force must act in the locking direction. The coil will otherwise not be able to switch against the hydraulic pressure.

ⓘ NOTICE

Negligent commissioning results in malfunctions and accidents during operation of the hydraulic locking unit.

- ▶ Only trained specialist personnel may carry out commissioning.
- ▶ Secure the unit against being switched on unintentionally.
- ▶ Clean emergency actuation before each commissioning process.
- ▶ Perform commissioning properly.
- ▶ Before each time commissioning, but not before each ride, check all mechanical connections ("[Mechanism](#)", page 39).
- ▶ If the hydraulic locking unit has been removed before re-commissioning, also perform the steps as per chapter "[Start-up](#)", page 27.

Daily before starting rides

1. Check mechanical connections according to the maintenance plan.
2. Check locking, opening and holding function as well as the drift as per "[Functional test](#)", page 50 and maintenance plan.

7.2 Temporary shutdown

NOTICE

Damage due to incorrect piston position during temporary shutdown

If the hydraulic locking unit is shut down temporarily (overnight or longer) with the piston in an incorrect position, temperature fluctuations can damage the unit. Pressure differences cannot be balanced.

During temporary standstills, ensure the following:

- ▶ The locking unit is unlocked.
- ▶ It is possible to move the restraint system at least 10 to 15 mm in the locked direction.
- ▶ The restraint system is not at the mechanical end position of the bar structure.

1. Make sure the piston rod is in the correct position.
2. Switch off the hydraulic locking unit in the ride control system.
3. Secure the unit against use by unauthorized persons.
4. Ensure correct storage, [page 21](#).

7.3 Response in emergency

In the event of emergencies and malfunctions, the ride manufacturer or operator as appropriate must decide between:


- ▶ Opening with power supply connected
- ▶ Opening with power supply disconnected
- ▶ Opening under high static load

WARNING

Risk of injury in event of inadequate qualification

Improper operation of the emergency override can result in severe injury and damage to property.

- ▶ The emergency override may only be operated by trained personnel or instructed persons.
- ▶ After the emergency override has been operated, the locking, opening and holding function, as well as the drift, must be checked as per the functional check procedure.

 The ride operator is responsible for ensuring that passengers are able to disembark, e.g. in the event of evacuation.

7.3.1 Opening with power supply connected

1. Ensure that the persons are secured against falling after release.
2. Ensure that the hydraulic locking unit is supplied with power.
3. Energize the check valve V1 and, for type K and RD hydraulic locking units, also energize valve V2.
 - ✓ The restraint system is open.
4. Ensure that persons can exit safely.
5. Check locking, opening and holding function as per chapter ("[Functional test](#)", [page 50](#)).

7.3.2 Opening with power supply disconnected

NOTICE

Material damage due to incorrect operation of the emergency actuation

Emergency actuation of the hydraulic locking unit can be destroyed due to incorrect operation.

Press button for emergency actuation

- ▶ Only operate the emergency actuation using a suitable auxiliary tool according to the chapter providing notes for the system manufacturer.
- ▶ Avoid sharp-edged and pointed tools.
- ▶ Press emergency actuation button in the centre (no radial or lateral load).
- ▶ Ensure that the mounted actuation mechanisms hit the button in the centre.
- ▶ Only push in the button until the associated check valves open and the piston rod extends. You should sense an end stop resistance.
 - ✓ HLU type A, E, RL: check valve V1
 - ✓ HLU type K and RD: check valves V1 and V2

Open the hydraulic locking unit

1. Ensure that persons are secured against falling after release.
2. Ensure that no persons are located in the opening radius of the retaining bar.
3. Open the hydraulic locking unit:
 - ▶ via mobile battery unit
 - ▶ or with the button for emergency actuation of the associated check valve(s) using a suitable auxiliary tool (page 17). Remove the rubber cap if present.
 - ▶ Or open the hydraulic locking unit as for under high static load.
4. Ensure that persons can exit safely.
5. Check locking, opening and holding function as per chapter ("[Functional test](#)", page 50).
6. Place the rubber cap on the emergency actuation again.

7.3.3 Opening under high static load

Freeing a trapped person

1. Ensure that the persons are secured against falling after release.
2. Ensure that no persons are located in the opening radius of the retaining bar.
3. Carry out the following three measures one after the other to free trapped persons:
 - a) Action 1: Press in closing direction
 - b) Action 2: Drain fluid
 - c) Action 3: Unscrew Minimesse hose connections

Action 1: Press in closing direction


Aids, tools, materials

- Power supply or mobile battery unit
1. Press the bar briefly and forcefully in the closing direction, while energizing the valves to release in accordance with the switching logic from the chapter Energizing function sequences.

or:
 2. If no electric power supply is present, use the emergency actuation and press the bar briefly and forcefully in closing direction at the same time.
 3. Ensure that persons can exit safely.
 4. Check locking, opening and holding function as per chapter ("[Functional test](#)", page 50).
 5. If the restraint system does not open, carry out measure 2.

Action 2: Drain fluid

Draining the hydraulic fluid will depressurize the hydraulic locking unit, and the restraint system can be opened.

 This is an irreversible action. The hydraulic locking unit must then be replaced.

- ▶ Carry out the following actions only if unlocking the hydraulic locking unit is not possible either by connecting power or by pushing the emergency override button or by dismantling the rod-side rod ends.

DANGER

Danger to life from pressurized systems

When lines and components on pressurized systems are disconnected, hydraulic fluid escapes at high pressure and penetrates deep into the body via the skin and eyes. Severe injury or death.



- ▶ Depressurize the hydraulic system including the pressure tank.
- ▶ Secure the hydraulic system against unintentional restart.
- ▶ Check components for correct assembly before pressure is applied.
- ▶ Observe maximum pressure load for fittings and lines.

CAUTION

Risk of falling from leaking hydraulic fluid

Spilled or leaked hydraulic fluid can form a slippery film on the floor.




- ▶ Use suitable aids when filling or bleeding.
- ▶ Check all connecting elements that convey oil for leaks before switching on the motor in the parent system.
- ▶ Wipe up leaked hydraulic fluid with suitable aids.

Aids, tools, materials

- Two Minimesh hoses with plug-in coupling
1. Connect the ends of the two Minimesh hose lines with an oil container (> 0.4 l).
 2. Connect Minimesh hose lines to the hydraulic locking unit:
 - ▶ **HLU type A, E, RL, RD:** Connect Minimesh hose lines with the plug-in connector to the two Minimesh hose connections of the hydraulic locking unit.
 - ▶ **HLU type K:** Connect Minimesh hose lines with the plug-in connector to the two Minimesh hose connections of the hydraulic locking unit and also actuate the spool valve V2 with current feed or emergency actuation.
 - ✓ The hydraulic fluid flows out of the hydraulic locking unit.
 3. Open the restraint system.
 4. If the restraint system does not open, carry out the third measure.
 5. Ensure that persons can exit safely.
 6. Clean the area soiled with hydraulic fluid immediately.
 7. Replace the hydraulic locking unit. Contact HAWE.
 8. Properly dispose of the hydraulic fluid, hydraulic fluid container and any cloths contaminated with hydraulic fluid.

Action 3: Unscrew Minimesh hose connections

Draining the hydraulic fluid will depressurize the hydraulic locking unit, and the restraint system can be opened.

-  This is an irreversible action. The hydraulic locking unit must then be replaced.
- ▶ Carry out the following actions only if unlocking the hydraulic locking unit is not possible either by connecting power or by pushing the emergency override button or by dismantling the rod-side rod ends.

DANGER

Danger to life from pressurized systems

When lines and components on pressurized systems are disconnected, hydraulic fluid escapes at high pressure and penetrates deep into the body via the skin and eyes. Severe injury or death.



- ▶ Depressurize the hydraulic system including the pressure tank.
- ▶ Secure the hydraulic system against unintentional restart.
- ▶ Check components for correct assembly before pressure is applied.
- ▶ Observe maximum pressure load for fittings and lines.

CAUTION

Risk of falling from leaking hydraulic fluid

Spilled or leaked hydraulic fluid can form a slippery film on the floor.



- ▶ Use suitable aids when filling or bleeding.
- ▶ Check all connecting elements that convey oil for leaks before switching on the motor in the parent system.
- ▶ Wipe up leaked hydraulic fluid with suitable aids.

Aids, tools, materials

- Allen key size 12
1. Drain the hydraulic fluid as follows:
 - a) Place an oil container (> 0.4 l) under the drain of the Minimes connections (5).
 - b) Unscrew the Minimes connections from the hydraulic locking unit with a 12 mm Allen key. The hydraulic fluid drains.
 - c) Allow all of the hydraulic fluid to drain.
 2. Open the restraint system.
 3. Ensure that persons can exit safely.
 4. Clean the area soiled with hydraulic fluid immediately.
 5. Replace the hydraulic locking unit. Contact HAWE.
 6. Properly dispose of the hydraulic fluid, hydraulic fluid container and any cloths contaminated with hydraulic fluid.

Maintenance measures consist of inspection, service and repair. Maintenance measures are described here.

- ▶ Maintenance work must only be carried out by qualified personnel.
- ▶ Tasks not described in this chapter may only be carried out by HAWE Service.
- ▶ If faults or damage occur, switch off the hydraulic system immediately.
- ▶ Observe the information in the supplier documentation.
- ▶ Document all activities in a maintenance log.

WARNING

Danger of accident and fatal injury due to lack of maintenance or careless maintenance

Omitted or negligently performed maintenance can cause the hydraulic system to malfunction. Improperly performed maintenance or improperly conducted troubleshooting can pose a danger to personnel.

- ▶ Read and abide by all instructions provided in this section.

In addition to the safety instructions presented in Section 2 "For your safety" follow the safety instructions below.

- Contact HAWE Micro Fluid GmbH immediately if you are in doubt as to whether or not the locking unit can be reused after the maintenance procedure. The locking units should not be used again until clarification has been obtained.
- Only use genuine spare parts.

WARNING

Risk of fatal injury from electric shock

Touching live components directly or indirectly causes injury or death.



- ▶ Electrical and electronic components must only be replaced and connected by trained specialist personnel.
- ▶ Obey all applicable electrical safety rules.
- ▶ Only connect electric lines to the hydraulic system while the system is de-energized.

DANGER

Danger to life from pressurized systems

When lines and components on pressurized systems are disconnected, hydraulic fluid escapes at high pressure and penetrates deep into the body via the skin and eyes. Severe injury or death.



- ▶ Depressurize the hydraulic system including the pressure tank.
- ▶ Secure the hydraulic system against unintentional restart.
- ▶ Check components for correct assembly before pressure is applied.
- ▶ Observe maximum pressure load for fittings and lines.

⚠ WARNING**Danger of accident and fatal injury due to lack of maintenance or careless maintenance**

Omitted or negligently performed maintenance can cause the hydraulic system to malfunction. Improperly performed maintenance or improperly conducted troubleshooting can pose a danger to personnel.

- ▶ Read and abide by all instructions provided in this section.
- ▶ After troubleshooting, follow the instructions in the assembly instructions for (initial) and (re)commissioning.

⚠ WARNING**Danger of crushing/malfunction from unexpected startup**

Body parts may be crushed or shorn off if the system starts up unexpectedly.



- ▶ Wear protective clothing.
- ▶ Take precautions to prevent anyone from entering the danger zone throughout all commissioning or maintenance work.
- ▶ Do not energize solenoid valves while uninstalled.
- ▶ Do not trigger emergency release while uninstalled.

⚠ CAUTION**Burn hazard from hot surfaces and hydraulic fluid**

A burn hazard results from directly or indirectly coming into contact with hot hydraulic fluid and hot components of the hydraulic system.



- ▶ Wear work gloves and protective goggles.
- ▶ Arrange the access to the hydraulic system in such a way that hot surfaces are not accessible to the user.
- ▶ Wait until the hydraulic system has cooled down before servicing or disassembling.

⚠ CAUTION**Risk of falling from leaking hydraulic fluid**

Spilled or leaked hydraulic fluid can form a slippery film on the floor.



- ▶ Use suitable aids when filling or bleeding.
- ▶ Check all connecting elements that convey oil for leaks before switching on the motor in the parent system.
- ▶ Wipe up leaked hydraulic fluid with suitable aids.

8.1 Maintenance plan

i Failure of hydraulic systems

Hydraulic system failures are often caused by an incorrect choice of hydraulic fluid or excessive solid contamination in the hydraulic fluid. High solid contamination is due to lack of maintenance of the hydraulic system.

- ▶ Select hydraulic fluid according to specifications.
- ▶ Carry out the activities described in this section carefully and in due time.

	HAWE check interval	System manufacturer check interval
Cleaning and visual inspection for damage		
Locking unit		✓
Emergency override		✓
Piston rod		✓
Diaphragm accumulator		✓
Minimess ports (dripping)		✓

Mechanics

Check hydraulic locking unit for any external leakage	Part of the daily functional check page 39.	
Check emergency actuation button and clean if necessary		✓
Check rod side rod end bolt connection, retighten if necessary and then renew / apply paint marking. The rod end must be screwed in to the stop.	DAILY for systems that are not equipped with a countered, rod side rod end bolt connection.	For systems with a countered, rod side rod end bolt connection (delivered after 10/2013).
Check foot side rod end bolt connection, retighten if necessary and then renew / apply paint marking. The rod end must be screwed in to the stop		✓
Check spherical bearings	Weekly	
Replace rod ends		✓

Functional checks

Functional check 'locking'	Daily and before each commissioning	
Functional check 'opening'	Daily and before each commissioning	
Functional check 'holding and drifting'	Weekly	

Load distribution on the locking systems

Note the effects of the mutual check on the load distribution of the locking units, see "Functional test", page 50.

Electrics

Check electrical contacts (AMP Superseal 1.5 series)	In the event of a malfunction	
Check solenoid and replace if necessary	In the event of a malfunction	

8.2 Cleaning and visual inspection for damage

NOTICE

Damage due to incorrect cleaning

Use of incorrect cleaning agents will damage the piston rod and the seals, resulting in leakage.

Observe the following points when cleaning the hydraulic locking unit:

- ▶ Clean only with a damp non-fluffing cloth.
- ▶ Do not use cleaning wool or the like.
- ▶ Never use brake cleaner and universal thinner to clean stuck-on labels and markings.
- ▶ Sharp, angular or pointed implements must not be used for cleaning.
- ▶ Make sure that the piston rod is not scratched.
- ▶ Do not use high-pressure cleaners.
- ▶ Never spray the electronics/electronics cover with water (e.g. using a garden hose, high-pressure cleaner)
- ▶ Use only the care and cleaning products listed below.

Care and cleaning products

Corrosion and rust protection

Corrosion and rust protection	BRANOTect; Ballistol Spray ProTec
Preservative for storage	Bubble wrap, oiled paper or film wrap (protecting against mechanical damage and damp)

Greases/oils/lubricants

Multi-purpose grease	Castrol Tribol GR 2 EP
Oils/lubricants	WD-40

Cleaning products

Universal thinner	Staufen (Remondis Medison GmbH)
Brake cleaner	Keller & Kalmbach GmbH (Art. # 616715)

Degreaser

to clean the pivot mount threads	LOCTITE 7063; Dupont Prepclean 3608S
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Other

Threadlocking adhesive	LOCTITE 243
Threadlocker	Standard commercial products
Hydraulic fluid	AVIA Fluid RSL 22
Non-fluffing cloth	Clean cloth with high cellulose and low binder content, e.g. with itex® Soft WIP.
Brass brush (Use only to clean thread when replacing pivot mount.)	Brass wire hand brush (crimped 0.25 mm)

8.2.1 Locking unit

Maintenance intervals

Check interval is defined by the system manufacturer.

It must be ensured that any damage, such as spalling or scratches and the accompanying corrosion, are identified reliably. None of the above issues may be present on the sliding surface in particular.

Aids, tools, materials

- Listed cleaning and care products
1. Extend the piston rod.
 2. Switch off the hydraulic locking unit and secure it from being unintentionally switched on again.
 3. Remove any component coverings preventing checks.
 4. Check the piston rod, wiper and rod ends and clean.
 5. Then use the listed care agents to protect the hydraulic locking unit.
 6. The hydraulic locking unit must be replaced in the event of damage. Contact HAWE Micro Fluid GmbH.

8.2.2 Emergency override

WARNING

Risk of injury in event of inadequate qualification

Improper operation of the emergency override can result in severe injury and damage to property.

- ▶ The emergency override may only be operated by trained personnel or instructed persons.
- ▶ After the emergency override has been operated, the locking, opening and holding function, as well as the drift, must be checked as per the functional check procedure.

Maintenance intervals

Check interval is defined by the system manufacturer.

It must be ensured that any damage to the pressure tube and actuating button which leads to a functional failure of the emergency release is reliably detected. The area around the button must always be kept clean to prevent dirt from entering the valve. The emergency override valve is better protected against environmental effects when fitted with a rubber cap, and cleaning it is then also much easier.

Aids, tools, materials

- Type-specific version of the auxiliary tool for triggering emergency actuation (page 17).
 - Listed cleaning and care products
1. Unlock and switch off the hydraulic locking unit (depressurise) and secure it against being unintentionally switched on again.
 - ▶ HLU type A and K: Piston rod extended
 - ▶ HLU type E, RL and RD (E): Piston rod retracted
 2. Remove any component coverings preventing checks.
 3. Remove the rubber cap if present.
 4. Clean the area around the emergency actuation button with brake cleaner. Stubborn contamination can be removed with a cloth wet with universal thinner.
 5. Press the emergency actuation button again 5x after an exposure time of around 2 minutes.
 - ▶ Use a suitable tool.
 6. Repeat the last two steps until the emergency actuation button resets smoothly and practically frictionless.
 - ▶ Replace the hydraulic locking unit if the emergency actuation button no longer operates smoothly.
 - ▶ Contact HAWE Micro Fluid GmbH.
 7. Then clean the area around the emergency actuation button with brake cleaner again.
 8. Recommission hydraulic locking unit in the system (see "Start-up", page 27).

8.2.3 Piston rod

Maintenance intervals

Inspection interval specified by ride manufacturer.

It must be ensured that damage to the piston rod, such as scratches, chipping, or dents in the surface, as well as corrosion, is reliably detected. None of the above irregularities must be present, particularly on the sliding surface of the piston rod.

Aids, tools, materials

- Listed cleaning and care products
1. Extend piston rod
 2. Shut down hydraulic locking unit and secure it against inadvertent restarting.
 3. Remove any component coverings that obstruct checking.
 4. Check and clean piston rod.
 5. Afterward, use the care products listed below to protect the locking unit.
 6. Recommission hydraulic locking unit in the system, [see "Start-up", page 27](#).
 7. The locking unit must be replaced if damaged. Get in touch with HAWE Micro Fluid GmbH.

8.2.4 Diaphragm accumulator

Maintenance intervals

Check interval is defined by the system manufacturer.

It must be ensured that any damage, such as chipping or scratches and associated corrosion, is reliably detected.

Aids, tools, materials

- Listed cleaning and care products
1. Clean diaphragm accumulator from the outside.
 2. In the event of corrosion, use listed care agents to protect the hydraulic locking unit.
 3. The hydraulic locking unit must be replaced in the event of damage. Contact HAWE Micro Fluid GmbH.

8.3 Mechanism

Corrosion and mechanical damage will result in leaks in the hydraulic system.

- ▶ Check the hydraulic locking unit periodically for mechanical damage and corrosion.
- ▶ The inspection intervals must be defined by the manufacturer/operator on the basis of a risk assessment. If damage is prevented by coverings and preventive corrosion protection, inspection can be scheduled at correspondingly long intervals. Otherwise short inspection intervals should be scheduled.

8.3.1 Check for leaks in the locking unit

Maintenance intervals

Daily

The daily check of the locking function also includes checking the locking unit for leaks.

Aids, tools, materials

- None

1. Test the following functions in the order given to check for leaks:
 - a) Test locking.
 - b) Test opening.
 - c) Test holding.
2. If you discover leaks during function testing, replace the locking unit. Get in touch with HAWE Micro Fluid GmbH.

8.3.2 Check function of emergency override button

WARNING

Risk of injury in event of inadequate qualification

Improper operation of the emergency override can result in severe injury and damage to property.

- ▶ The emergency override may only be operated by trained personnel or instructed persons.
- ▶ After the emergency override has been operated, the locking, opening and holding function, as well as the drift, must be checked as per the functional check procedure.

Maintenance intervals

Check interval is defined by the system manufacturer.

Aids, tools, materials

- Type-specific version of the auxiliary tool for triggering emergency actuation (page 17).
- Listed cleaning and care products

1. Switch off the hydraulic locking unit and secure it from being unintentionally switched on again.
2. Clean area around the emergency actuation button according to instructions in "[Emergency override](#)", page 37.
3. Switch on hydraulic locking unit and establish hydraulic pressure as noted in the table Function sequences on page 18 .
 - ▶ HLU type A and K: Retract piston rod
 - ▶ HLU type E, RL and RD (E): Extend piston rod

4. Trigger the emergency actuation and check whether the piston rod extends/retracts.
 - ▶ If it functions correctly, recommission the hydraulic locking unit in the system (chapter "Start-up", page 27).
 - ▶ If the piston rod does not move, check the fault catalogue.

8.3.3 Check pivot mount bolt connection

Maintenance intervals

Foot side:	Check interval is defined by the system manufacturer
Rod side:	Daily for systems delivered before 10/2013
	For systems delivered after 10/2013, the check interval is defined by the system manufacturer.

⚠ WARNING

Injury due to negligent checking of the pivot mount bolt connection

Negligent checking of the pivot mount bolt connection can lead to failure of the hydraulic locking unit, and to fatal accidents during operation.

- ▶ Check the paint markings between the pivot mount and piston rod, and the pivot mount and connection block, according to the maintenance schedule.
- ▶ Take the hydraulic locking unit out of service if damage occurs to the paint markings between the pivot mount and piston rod, and the pivot mount and connection block.
- ▶ If the unit does not have a paint marking (depending on the customer), check the rod-side rod end is seated correctly. If present, check the rod-side nut and the nut of the foot-side rod end according to the information from the engineering drawing.



Aids, tools, materials

- See instructions for replacing pivot mounts in chapter 7.4.5.

1. Switch off the hydraulic locking unit and secure it from being unintentionally switched on again.
2. Remove any component coverings preventing checks.
3. Inspect the specified point.
4. If the paint marking is damaged or rod ends/nuts should become loosened: immediately shut down hydraulic locking unit. Then perform the steps mentioned in chapter ("Bar-side pivot mount", page 42) or chapter ("Foot-side pivot mount", page 45).

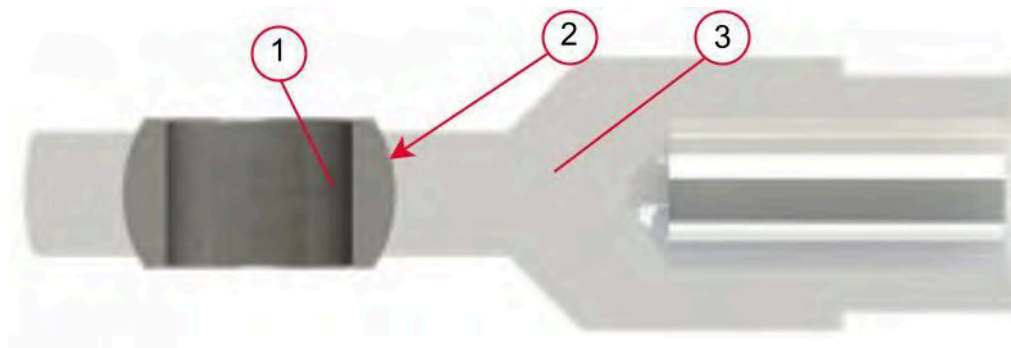
8.3.4 Check pivot bearing clearance

Maintenance intervals

Weekly


Aids, tools, materials

- Measuring systems for checking the pivot bearing clearance (e.g. feeler gage)



1. The ball joints (1) of the hydraulic locking unit must be freely accessible.
 - ▶ Shut down hydraulic locking unit and secure it against inadvertent restarting.
 - ▶ Remove any component coverings that obstruct checking.
2. Apply an alternating radial force to the ball joint (1).
 - ▶ Measure the rod end bearing gap between the ball joint (1) and bearing case (2).
3. Replace the rod end (3) if gap between the ball joint (1) and the bearing case (2) exceeds 0.2 mm.
 - ✓ HAWE-approved pivot mount used.
 - ✓ Rod end replaced in accordance with "[Replace pivot mounts](#)", page 42.

8.3.5 Replace pivot mounts

 Pivot mounts are wearing parts which are subject to load-dependent wear. Unless otherwise separately agreed, the pivot mounts are factory-sealed with threadlocking adhesive.

NOTICE

Damage due to incorrect procedure when replacing pivot mounts

- ▶ Replacement to be carried out only by trained specialist personnel.
- ▶ Make sure that the connection block and piston rod are protected against damage.

Maintenance intervals

Inspection interval specified by ride manufacturer.

8.3.5.1 Bar-side pivot mount



CAUTION

Caution: hot surfaces

The pivot mounts must be heated to 200°C for disassembly.

- ▶ Pivot mounts must be freely accessible.
- ▶ Wear protective gloves.

Aids, tools, materials

- Replacement pivot mount according to the technical data specifications
 - Hot air gun
 - When replacing on a HLU-LE 25:
 - Open-end wrench, sizes 19 and 22 mm
 - Torque wrench with fork size 22 mm
 - Torques according to technical drawing
 - When replacing on a HLU-LE 32:
 - Open-end wrench, sizes 22 and 24 mm
 - Torque wrench with fork size 24 mm
 - Torques according to technical drawing
 - Degreaser, threadlocking adhesive, brass brush and lint-free cloth as per the recommended cleaning and care agents on page (36).
1. Switch off the hydraulic locking unit, and secure it to prevent it from being switched back on unintentionally.
 2. Remove the hydraulic locking unit from the ride.
 3. Clamp the hydraulic locking unit in a vise so that the pivot mount is freely accessible.
 - ▶ Use protective jaws.
 - ▶ Do not damage the connection block.
 4. Remove the red rubber cap to gain access to actuate the emergency release.



5. Fully extend the piston rod (2) by operating the emergency override (1).
- Observe procedure from chapter 6 "Opening with power supply disconnected", page 30.



6. Heat the marked area (2) of the pivot mount (1) to 200°C with a hot air gun (3).
- This causes the threadlocker to lose its adhesive strength.



7. Open the heated pivot mount using the open-end wrench.
- LE 25: wrench size 19 (1); wrench size 22 (2)
- LE 32: wrench size 22 (1); wrench size 24 (2)



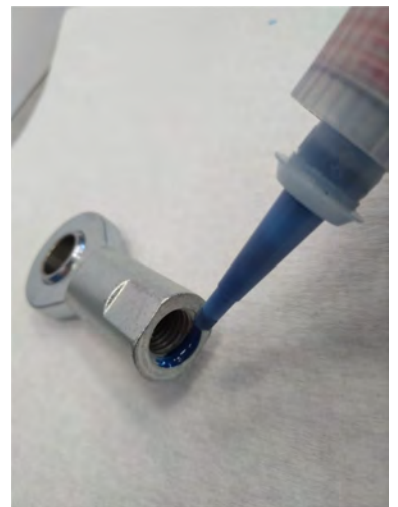
8. Unscrew the pivot mount from the piston rod so that the nut stays on the piston rod.



9. Clean and degrease the thread up to the nut using a brass brush.
 - a) When using the brass brush, make sure that no particles fall into the gap between the piston rod and seal.
 - b) Mask over this area.
 - c) Clean the piston rod.



10. Apply threadlocking adhesive to the female thread of the new pivot mount.
 - ▶ Distribute the adhesive visibly in the first thread turns.
 - ▶ Fill at least one turn of the female thread with adhesive.



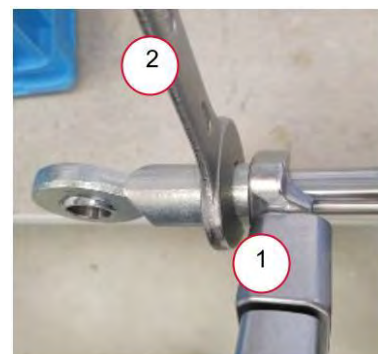
11. Screw the pivot mount onto the thread of the piston rod as far as it will go.



12. Using the open-end wrench (2) and torque wrench (1), tighten the pivot mount to the required torque according to the technical drawing.

LE 25: wrench size 19 (2); wrench size 22 (1)

LE 32: wrench size 22 (2); wrench size 24 (1)



13. After torque tightening, mark the nut and the articulated lug with threadlocker.

14. After 24 hours of curing time, the hydraulic locking unit can be used again and recommissioned in the system (chapter "Start-up", page 27).



8.3.5.2 Foot-side pivot mount

Aids, tools, materials

- replacement pivot mount according to the technical data specifications
- When replacing on a HLU-LE 25:
 - Open-end wrench, sizes 19 and 22 mm
 - Torque wrench with fork size 22 mm
 - Tap M 14
 - Torques according to technical drawing
- When replacing on a HLU-LE 32:
 - Open-end wrench, sizes 22 and 24 mm
 - Torque wrench with fork size 24 mm
 - Tap M 16
 - Torques according to technical drawing
- Degreaser, threadlocking adhesive, brass brush and lint-free cloth as per the recommended cleaning and care agents on page (36).
- gap checker according to technical data

! NOTICE

Damage due to heat-up of the foot-side pivot mounts

Heating-up of the foot-side pivot mounts will damage seals and cause leaks in the hydraulic system.

- ▶ Never heat the base-side rod ends.
- ▶ Use the listed open-end wrenches to unscrew the rod ends.

1. Switch off the hydraulic locking unit, and secure it to prevent it from being switched back on unintentionally.
2. Remove the hydraulic locking unit from the ride.
3. Clamp the hydraulic locking unit in a vise so that the pivot mount is freely accessible.
 - ▶ Use protective jaws.
 - ▶ Be careful not to damage the connection block.
4. Open the pivot mount using the open-end wrench.
LE 25: wrench size 22
LE 32: wrench size 24



5. Unscrew the pivot mount bearing from the cylinder base using the open-end wrench.



6. Clean adhesive residues and dirt from the female thread of the cylinder base with the tap.
LE 25: M 14
LE 32: M 16



7. Blow off the thread of the cylinder base with compressed air.



8. The gradation in the nut thread points:
- ▶ in the direction of the piston rod in the case of the rod-side rod end
 - ▶ in the direction of the foot in the case of the foot-side rod end



9. Apply threadlocking adhesive to the female thread of the cylinder base.
- ▶ Distribute the adhesive visibly in the first thread turns.
 - ▶ Fill at least one turn of the female thread with adhesive.



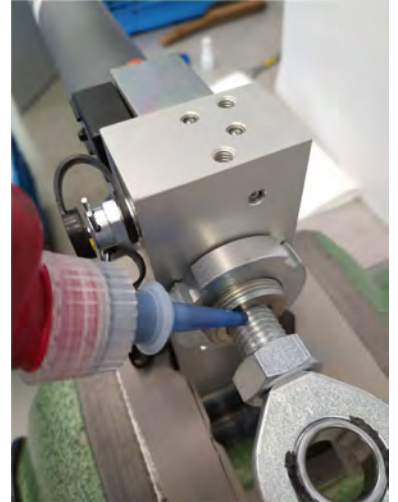
10. Screw the pivot mount with nut into the thread of the cylinder base.



11. Adjust the spacing and angle of the pivot mount with the gap checker.



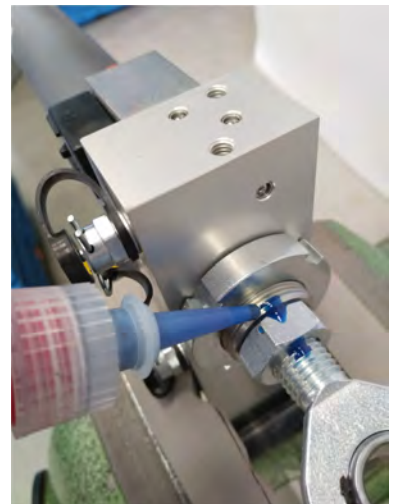
12. Apply threadlocking adhesive to the thread of the pivot mount.
- ▶ Distribute the adhesive visibly 3 mm away from the base.
 - ▶ Fill at least one thread turn with adhesive.



13. Use a torque wrench to tighten the nut all the way with the required torque according to the technical drawing.
- ▶ Use pliers to stop the pivot mount twisting while doing so.
 - ▶ LE 25: wrench size 22
 - ▶ LE 32: wrench size 24



14. Mark the nut and the articulated lug with threadlocker.
15. After 24 hours of curing time, the hydraulic locking unit can be used again and commissioned in the system "[Start-up](#)", [page 27](#).



8.4 Electrics

8.4.1 Check and replace coil

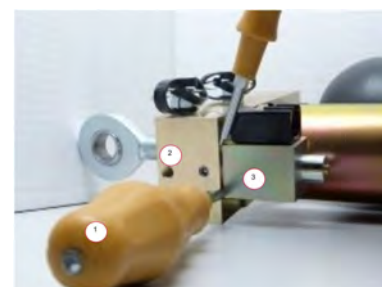
Maintenance intervals only in the event of malfunctions

Aids, tools, materials

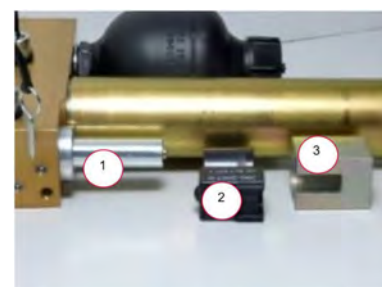
- new coil according to the technical data sheet
- Multimeter
- 2 small size 4 screwdrivers to remove housing
- Plastic hammer
- Mounting aid: Plastic ring or tube with 14 mm inner diameter and 24 mm outer diameter; length min. 30 mm

1. Switch off the hydraulic locking unit and secure it from being unintentionally switched on again.
2. Remove component coverings.
3. Disconnect the cable from the coils of the solenoid valves.
4. **Use a multimeter to check the resistance on the coils one after the other.**
 - ▶ Specified resistance: 26 ohms, permissible deviation ± 6 ohms
 - ▶ If the deviation is more, the coil is faulty and must be replaced.

5. At the same time, place two screwdrivers (1) in the gap between the connection block (2) and solenoid housing (3). Press the solenoid housing carefully and evenly off the pressure tube.



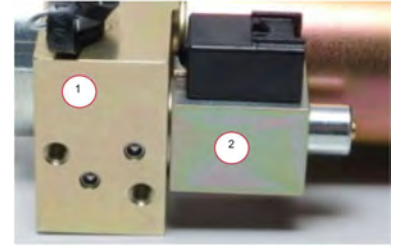
6. The pressure tube (1) is free. Remove the coils (2) from the solenoid housing (3).
7. Position the coil centrally on the pressure tube.
8. Place the solenoid housing over the coil and pressure tube so that the oblong hole of the solenoid housing is pushed over the bottom part of the coil. Press on the solenoid housing until it engages.



9. Place the assembly aid (1) on the solenoid housing (2) and fix the solenoid housing carefully with light knocks with a plastic hammer on the assembly aid.



10. Check that the gap between the connection block (1) and solenoid housing (2) is between 0.5 and 1 mm wide and even all around.
11. Repeat process 9 if the gap between the connection block and solenoid housing is too large.
12. Connect the connection cable with the coils of the solenoid valves.
13. Check the function of the solenoid valves through actuation.
14. Recommission hydraulic locking unit in the system (chapter "Start-up", page 27).



8.5 Functional test

It must be ensured that valves switch reliably and are tight over the valve seat when closed, and that leaks are reliably detected. The fill pressure and accumulator preload pressure must also be monitored regularly.

i Load distribution to the locking systems with mutual testing

When testing for leaks by switching the valve coils alternately in a redundant system, the load can be unequally distributed by up to 70:30. One HLU bears 70% of the force introduced and the other HLU 30%.

- ▶ Both valves must be blocked after the mutual check.
- ▶ The unequal distribution described can then be corrected by a renewed closing movement of the restraint bar ("push in").
- ▶ Note unequal load distribution when planning and calculating the load.

8.6.1 Locking function

Interval

daily

Aids, tools, materials

- Measuring systems (e.g. calliper gage etc.)
- Tool to remove any component covering

i To check the locking function, the locking unit is loaded with 10 to 20% of the permissible dynamic locking force in the opening direction for 3 to 5 seconds.

Friction losses and lever forces of the seat kinematics (transmission ratios) must be taken into account when converting the force to be applied to the restraint system.

If during the check the 'locked' position on the cylinder changes by more than 1 mm, or if oil leaks out, the locking unit is faulty, and must be replaced.

1. Always check one hydraulic locking unit only (alternating check).
 - ▶ Switch off all other hydraulic locking units or mechanical redundancies and secure them against being switched on unintentionally.
 - ▶ Ensure that no external force acts on the hydraulic locking unit so that the check valve can open in the event of load.
 - ▶ Close the restraint system.
 - ▶ For the type K hydraulic locking unit, open the electromagnetic spool valve V2.

- ▶ In the case of type RD hydraulic locking units, the relevant check valves V1 and V2 must be checked in succession to ensure that both valves fulfil their restraint/locking effect. For this purpose, the valves must be actuated as follows:
 - a) V1 energised and V2 not energised.
 - b) V1 not energised and V2 energised.
- 2. Load the hydraulic locking unit with 10-20 % of the permissible **dynamic locking force** specified in the technical data sheet in the opening direction for 3-5 seconds.
- 3. Note the position of the piston rod before and after loading.
 - ✓ Any component coverings preventing checks are removed.
 - ▶ If any component coverings cannot be removed, determine the relative movement of the piston rod as an inspection indicator. In addition, calculate by how many mm the restraint system can be adjusted with 1 mm extension/retraction of the piston rod. Take into account seat kinematics and bar relationship.
 - ▶ Take into account potential permissible play in the mechanics of the restraint system.
 - ▶ If during the check the lock position on the cylinder changes by more than 1 mm in the locking direction, or if oil leaks out, the locking unit is faulty.
 - ▶ Replace faulty hydraulic locking unit.

Special case for HLU type RD of variant RD (E):

In the case of the hydraulic locking unit type RD of variant RD (E), a cyclical test is required before each ride.

1. Check locking, opening and holding function as well as the drift as per "Functional test", page 50 onwards and maintenance plan.
2. Perform a cyclical test* of the check valves before each ride.
 - Locking function of the units checked by pulling on the safety bar against the locking direction.
 - No noticeable or visible opening movement detected in this process.

Valve wiring

3. Inspect check valves V1 and V2 in succession:
 - a) Before the first ride: V1 not energised, V2 energised.
 - b) Before the second ride: V1 energised, V2 not energised.
 - c) Before the third ride: Continuing the pattern.

8.6.2 Opening function

DANGER

Danger to life due to damage to the pressure vessel

Damaged pressure vessels can cause hydraulic fluid or gas to escape at high pressure and penetrate deep into the body via the skin and eyes. This can lead to severe and irreparable injury, or even death.

- ▶ Assembly only by trained specialist personnel.
- ▶ Never weld, solder or drill pressure accumulators.
- ▶ Do not disconnect the pressure accumulator from the hydraulic locking unit.
- ▶ Never modify the hydraulic locking unit with pressure accumulator.
- ▶ Never perform any maintenance on the hydraulic accumulator yourself.

Interval

daily

Aids, tools, materials

- None

i Do not carry out checks in an extreme temperature range (see technical data sheet).

1. Close the restraint system.
 - ▶ HLU type K: Energize V2.
 - ▶ HLU type E, A, RL and RD: The restraint system is closed manually, i.e. without electricity.
2. To open the restraint system:
 - ▶ HLU type A and E: Actuate solenoid valve V1. This unlocks the hydraulic locking unit and the restraint system opens.
 - ▶ HLU type K, RL and RD: Energize V1 and V2 at the same time.
3. Replace the system in the following cases:
 - ▶ HLU type A and K: If the restraint system is no longer sufficiently opened by the extension force of the hydraulic locking unit, stop using the system.
 - ▶ HLU type E, RL and RD: Inspection of the accumulator pressure using loosening check, i.e. close the restraint system with the max. permissible extension speed of the piston rod specified in the data sheet. No loosening may occur here. If loosening occurs, stop using the system.
4. Contact HAWE Micro Fluid GmbH service.
5. Replace faulty hydraulic locking unit.

8.6.3 Hold and drift function

Interval

weekly

Aids, tools, materials


- Tool to adjust the restraint system
- Distance measuring systems (e.g. caliper gage, etc.)
- Tool to remove any component covering

i To check the holding function, the locking unit must be loaded with at least 25% of the permissible static holding force in the restraint system's opening direction for at least 5 minutes.

- The higher the force and the longer the test lasts, the more resilient the result will be. HAWE specification: 1.5 mm / 30 min.
- If during the check the lock position on the cylinder changes by more than 1.5 mm in the locking direction, or if oil leaks out, the locking unit is faulty, and must be replaced.

1. Always check one hydraulic locking unit only (alternating check).
 - a) Switch off all other hydraulic locking units or mechanical redundancies and secure them against being switched on unintentionally.
 - b) Ensure that no external force acts on the hydraulic locking unit. Otherwise, the check valve could not open due to the counter-pressure.
 - c) Close the restraint system.
 - d) For a type K hydraulic locking unit, open the electromagnetic spool valve V2.
 - e) With a type RL restraint system hydraulic locking unit. The valves V1 and V2 must not be energized.
 - f) In the case of type RD hydraulic locking units, the relevant check valves V1 and V2 must be checked in succession to ensure that both valves fulfil their restraint/locking effect. For this purpose, the valves must be actuated as follows:
 - a) V1 energised and V2 not energised.
 - b) V1 not energised and V2 energised.
2. Adjust the restraint system with the auxiliary device.

- ▶ At the start of the load check ensure that the permissible play of the restraint system as well as potential elastic influencing factors (e.g. bar and seat padding) are balanced or compensated for and the measurement is therefore not distorted.
3. Load the hydraulic locking unit with min. 25 % of the permissible **static holding force** specified in the technical data sheet in the opening direction for min. 5 minutes.
 4. Note the position of the piston rod before and after loading.
 - ▶ Remove any component coverings preventing checks.
 - ▶ Take into account potential permissible play in the mechanics of the restraint system.
 - ▶ If the locking position in the locking direction on the cylinder changes by more than 1.5 mm or if oil escapes during the check, the hydraulic locking unit is faulty.
 - ▶ If any component coverings cannot be removed, determine the relative movement of the piston rod as an inspection indicator. Calculate by how many mm the restraint system can be adjusted with 1 mm extension/retraction of the piston rod. Take into account seat kinematics and bar relationship.
 5. Replace faulty hydraulic locking unit.

-  On request, HAWE Micro Fluid GmbH can offer you the following service in fulfillment of product monitoring obligations under Section 31 of Germany's Product Liability Act:
- ▶ Take back, dismantle and dispose of single units (< 10) free of charge at the end of their lifetime. HAWE Micro Fluid GmbH will provide matching shipping boxes free of charge for shipping to HAWE Micro Fluid GmbH (shipping costs not included).
 - ▶ Please speak to your Key Account Manager for details.

⚠ DANGER**Danger to life from pressurized systems**

When lines and components on pressurized systems are disconnected, hydraulic fluid escapes at high pressure and penetrates deep into the body via the skin and eyes. Severe injury or death.



- ▶ Depressurize the hydraulic system including the pressure tank.
- ▶ Secure the hydraulic system against unintentional restart.
- ▶ Check components for correct assembly before pressure is applied.
- ▶ Observe maximum pressure load for fittings and lines.

⚠ CAUTION**Risk of falling from leaking hydraulic fluid**

Spilled or leaked hydraulic fluid can form a slippery film on the floor.



- ▶ Use suitable aids when filling or bleeding.
- ▶ Check all connecting elements that convey oil for leaks before switching on the motor in the parent system.
- ▶ Wipe up leaked hydraulic fluid with suitable aids.

⚠ CAUTION**Burn hazard from hot surfaces and hydraulic fluid**

A burn hazard results from directly or indirectly coming into contact with hot hydraulic fluid and hot components of the hydraulic system.

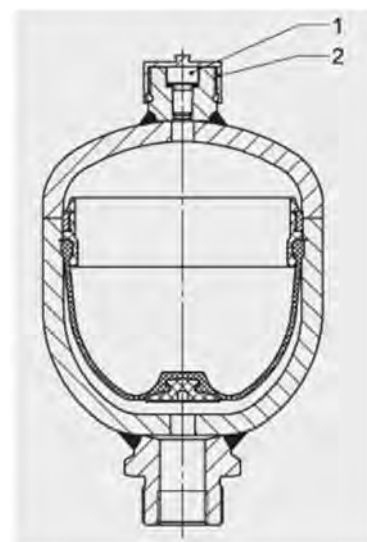


- ▶ Wear work gloves and protective goggles.
- ▶ Arrange the access to the hydraulic system in such a way that hot surfaces are not accessible to the user.
- ▶ Wait until the hydraulic system has cooled down before servicing or disassembling.

Disassembly procedure

Disassemble the hydraulic locking unit as follows:

1. Switch off the hydraulic locking unit via the ride control system and secure it to prevent it from being switched back on unintentionally.
2. Connect the ends of the two Minimesh hoses to a fluid collecting vessel (> 0.4 l).
3. Connect the Minimesh hoses to the locking unit:
 - ✓ **HLU type A, E, RD:** Connect the Minimesh hose lines with the plug-in connector to the two Minimesh hose connections of the hydraulic locking unit.
 - ✓ **Type K:** Connect the Minimesh hoses by the plug-in coupling to the two Minimesh ports on the locking unit, and additionally actuate the slide valve V2 by energizing it or by the emergency override.
 - ✓ **Type RL:** Connect the Minimesh hoses by the plug-in coupling to the two Minimesh ports on the locking unit, and actuate valve V1 by energizing it to drain the oil. Alternatively, if there is no power, you can also use the manual override for V1.
4. The hydraulic fluid flows out of the locking unit.
5. Relieve the pressure from the diaphragm accumulator:
 - ✓ The diaphragm accumulator and all lines connected to the hydraulic accumulator on the fluid side must be depressurized, and must not be closed again.
 - ✓ Unscrew the protective cap (2) from the diaphragm accumulator.
 - ✓ Loosen the hexagon socket screw (1) on the diaphragm accumulator slightly (about half a turn) using a size 6 hex screwdriver as per DIN 911.
6. The hydraulic locking unit has been depressurized and can be disassembled.
7. Dispose of all hydraulic locking unit components in accordance with local regulations.



Disposal

Dispose of hydraulic fluid and system components as follows:

- ▶ Dispose of hydraulic fluid, packaging/containers, soaked cleaning cloths, etc., as stipulated in the specifications for hydraulic fluid according to the regional waste disposal requirements.
- ▶ Dispose of the electronic components at approved collection points or with approved disposal companies according to local regulations.
- ▶ Dispose of metal with approved specialist disposal companies.

10 Troubleshooting

⚠ WARNING

Danger of accident and death in event of improperly performed troubleshooting and fault repair

- ▶ Switch the hydraulic system off immediately if faults or damage occur.
- ▶ Evacuate rider from the affected seat.
- ▶ Secure the seat against further use.
- ▶ Observe the safety instructions.
- ▶ Only perform the actions described in the **Maintenance** chapter.

⚠ WARNING

Danger of crushing/malfunction from unexpected startup

Body parts may be crushed or shorn off if the system starts up unexpectedly.



- ▶ Wear protective clothing.
- ▶ Take precautions to prevent anyone from entering the danger zone throughout all commissioning or maintenance work.
- ▶ Do not energize solenoid valves while uninstalled.
- ▶ Do not trigger emergency release while uninstalled.

⚠ WARNING

Risk of injury in event of inadequate qualification

Improper operation of the emergency override can result in severe injury and damage to property.

- ▶ The emergency override may only be operated by trained personnel or instructed persons.
- ▶ After the emergency override has been operated, the locking, opening and holding function, as well as the drift, must be checked as per the functional check procedure.

! NOTICE

Damage due to improper heating of the hydraulic locking unit

Using non-approved aids to heat the hydraulic system will damage seals and cause leaks in the hydraulic system.

- ▶ Never use heaters, gas burners or other similar heating devices to heat the system.
- ▶ Operate the hydraulic locking unit within the permissible operating temperatures.

The following table lists possible faults and measures to eliminate these. Contact the manufacturer in case of faults that cannot be remedied by following the descriptions here.

Fault	Possible cause	Check	Remedy
Emergency actuation button is stiff	Contamination		see "Cleaning and visual inspection for damage", page 36
Piston rod does not move (unlocking not possible)	Emergency actuation button faulty	Trigger the emergency actuation and check the smooth operation of the emergency actuation button.	Inspect if the emergency actuation button is stiff. (see "Check function of emergency override button", page 39)
	Solenoid M1 faulty	Check resistance R; if $R \rightarrow \infty$, solenoid M1 faulty.	Replace solenoid M1. Contact HAWE.
	Solenoid M2 faulty	Check resistance R; if $R \rightarrow \infty$, solenoid M2 faulty.	Replace solenoid M2. Contact HAWE.
	Check valve is heavily hydraulically loaded and solenoid valve can not switch the check valve.	Triggering of the emergency actuation. If unlocking is not possible by triggering the emergency actuation, the restraint system must be opened according to chapter 6.4.3 Opening under high static load. Valve V2 can not switch against the hydraulic pressure during deactivation ($V2=0$) and the hydraulic locking unit remains locked.	Hydraulic locking unit must be replaced. Contact HAWE. Actuate V1 ($V1=1$) and retract the cylinder piston briefly at the same time.
Piston rod only extends or retracts when the emergency actuation is triggered (unlocking only possible by triggering the emergency actuation)	Solenoid M1 faulty	Check resistance R; if $R \rightarrow \infty$, solenoid M1 faulty.	Replace solenoid M1.
	Solenoid M2 faulty	Check resistance R; if $R \rightarrow \infty$, solenoid M2 faulty.	Replace solenoid M2.
Piston rod does not extend completely	Pressure loss of the nitrogen in the diaphragm accumulator	- Blocking against extension: Bar of the restraint system does not open completely during operation. - Anti-retraction lock: Inspection resolutely not possible.	Hydraulic locking unit must be replaced. Contact HAWE.
Piston rod does not hold the locking position (lock faulty)	Internal leakage	Can be detected by means of a daily or weekly check (preferably weekly check, as this is more meaningful).	Hydraulic locking unit must be replaced. Contact HAWE.
	Associated check valves V1 and/or V2 not working		Hydraulic locking unit must be replaced. Contact HAWE.
	Rod end worn and does not hold the force	Spherical bearing play according to chapter "Check pivot bearing clearance", page 41.	If the spherical bearing play is exceeded, then the rod end must be replaced. (see "Replace pivot mounts", page 42)
Piston rod can move between 2 and 10 mm in locking direction at 20°C. (Locking delayed after closing the restraint system.)	Extension speed of the piston rod was exceeded (temporary loosening).	Check the speed of the closing movement of the restraint system and compare with specified technical data.	Reduce the speed of the closing movement of the restraint system.
	Insufficient hydraulic fluid flows from the accumulator into the hydraulic locking unit due to excessively cold outside temperature (temporary loosening).	Check the outside temperature and operating temperature of the hydraulic system and compare with specified technical data.	Hydraulic locking unit must be operated within the specifications. (System must be adapted in the event of permanent changes to the operating temperature. Contact HAWE.)
	Piston rod can be moved permanently in locking direction (permanent loosening).	Permanently trapped air in the hydraulic locking unit.	Hydraulic locking unit must be replaced. Contact HAWE.

11 Annex

Further documentation, such as technical data sheets, circuit diagrams, bills of material, installation drawings, as well as optional documents (e.g. works test certificate) form part of the technical documents and are delivered separately upon request.

The attached product information from third-party manufacturers is not necessarily the most current version. To obtain the latest product information, contact the respective manufacturer.

11.1 Technical data

i Maximum loads in drawings and product documentation are calculated according to DIN EN 13814. For locking units on seat classes* 4 and 5 a 70/30 load distribution was applied, and for locking units on seat class* 3 a direct load of 100%. The loads relate to the linear forces acting directly on the piston rod of the hydraulic locking unit.

If the restraint system is not safeguarded by redundancy, the maximum permissible holding forces must be recalculated. Get in touch with HAWE Micro Fluid GmbH.

* Seat classes defined in DIN EN 13814

You will be provided with the hydraulic and electrical data of the individual product variants as accompanying external documentation with the product-specific technical data sheet.

11.1.1 Operating conditions

permissible ambient temperature (operation)	-10°C to +60°C
permissible ambient temperature (transport and storage)	-10°C to +60°C
Service life	7 years (regardless of the intensity of use; starting from the delivery date)
Warranty	2 years
Shutdown/storage time	6 months (Longer downtimes will increase the risk of seals degrading.)
Installation position	Any, taking into account the tilt angle
Noise emission (emission sound pressure level of HLU)	< 72 dB(A)
Hydraulic fluid	AVIA FLUID RSL 22

11.1.2 Weights and measures

i The shipping designation and data given under the UN numbers are basic descriptions. There are variations between national governments (such as emergency numbers for the USA) and individual airlines.

Note the following exceptions: IMDG code (Chapter 2.2 in 2.2.2.5 Class 2.2) IATA/DGR (Section 3 in 3.2.2.4 Division 2.2), exemption in ADR regulations (in 1.1.3.2).

Note: The Material Safety Data Sheet (MSDS) is available on request.

In operation	
Weight	As per technical data sheet
Installation dimensions (WxHxD)	As per technical data sheet

In transportation	
Transport dimensions	As per technical data sheet
Transport weight	As per delivery note/packing list

11.2 Shipping data

Shipping	
Correct technical name Shipping designation for national and international road and rail transport, international maritime transport, and transport by inland waterway	GEGENSTÄNDE UNTER PNEUMATISCHEN DRUCK, ARTICLES, PRESSURIZED, PNEUMATIC (containing non-flammable gas)
Correct technical name Shipping name for air transport	ARTICLES, PRESSURIZED, PNEUMATIC (containing non-flammable gas)
UN number for national and international road and rail transport, and transport by inland waterway	UN 3164 Nicht beschränkt auf Grund der Bestimmung des Europäischen Übereinkommen über die internationale Beförderung gefährlicher Güter auf der Straße (ADR): SV283, SV594. Not restricted as per special provision ADR: SV283, SV594.
UN number for international maritime transport	UN 3164 Nicht beschränkt auf Grund der Bestimmung des International Maritime Dangerous Goods Code (IMDG): SV283. Not restricted as per special provision IMDG-Code: SV283.
UN number for air transport	UN 3164 Nicht beschränkt auf Grund Bestimmung der International Air Transport Association Dangerous Goods Regulations (IATA-DGR): A114. Not restricted as per special provision IATA-DGR: A114.
Class	None
Danger label number	None
Packaging group	None
Packaging specification	None

11.3 System - parts list

Only use original spare parts from HAWE. Exact order information can be taken from the external additional information, the technical data sheet.

Contact details

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Further information

HAWE Hydraulik SE is a responsible development partner with application expertise and experience in more than 70 areas of mechanical and plant engineering. The product range includes hydraulic power packs, constant and variable pumps, valves, sensors and accessories. Electronic components, ideally matched to hydraulic components, complement modular systems and facilitate control, signal evaluation and error detection. The intelligent system solutions reduce energy consumption and operating costs. Compact drives save space and permit innovative machine design.

The company is certified to ISO 9001, ISO 14001, ISO 45001, ISO 50001.



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You can find further information on HAWE Hydraulik, your local contact and the range of hydraulics training sessions offered at: www.hawe.com.

