Hydraulic Locking Unit (HLU)

Maximum safety for passenger restraint systems in amusement rides

HAWE HYDRAULIK

Innovation for lasting customer benefits

HAWE Hydraulik SE is a responsible development partner with application expertise and experience in more than 70 branches of mechanical engineering. The product range includes hydraulic power units, fixed and variable displacement pumps, valves, sensors and accessories. Electronic components that are exactly attuned to the hydraulic components provide an easy initial operation, precise control and condition monitoring. The intelligent system solutions reduce energy consumption and operating costs. Compact drives save space and allow an innovative machine design.

Around 2470 employees in 16 countries and sales partners in over 40 countries provide local, professional and personal support to customers worldwide.

- Turnover (2018): 363 Mio. Euro
- Number of employees: 2470
- Certified according ISO 9001, ISO 14001, ISO 50001, OHSAS 18001

IAAPA MEMBER

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Hydraulic Locking Unit (HLU)

Unconditional fun thanks to maximum safety

Amusement park and fairground rides are popular among young and old alike. Roller coasters must become increasingly attractive to the public - and more often than not they challenge the physical limits of people and materials.
Safety is absolutely essential - without compromises.

Hydraulic Locking Units from HAWE make your amusement rides safe in every respect as a result of:

- TÜV-Süd product certification following the latest standards
- Self-contained and low-maintenance hydraulic system
- Infinitely variable positioning and silent bar adjustment.

For decades, leading manufacturers of amusement rides have relied on HAWE hydraulic locks and gained the confidence of numerous amusement park and ride operators.

The proven hydraulic components are implemented in a modular system, guaranteeing customized solutions and fast project engineering.

The Hydraulic Locking Units - types LE25 and LE32 - developed by HAWE specifically for amusement rides and mobile structures forms the core of the system, ensuring maximum safety in over-the-shoulder restraints, lap bars and abdominal restraints.

A special feature is that maximum safety standards have allowed the product to achieve a “PLr E-ready” performance level status.

Shoulder bar **Lap bar** **Waist bar**

Tested standards:

- ISO 17842-01:2015
- DIN EN 13814
- ASTM 2291-15

Not all Hydraulic Locking Units have the TÜV-Süd product certification. It only affects the following classes (Report No.): 2 749 967 PTU G1; 2,749,967 PTU G2; 2,749,967 PTU G3; 2,749,967 PTU G4; 2,749,967 PTU G5.
Please inquire at HAWE whether your requested Hydraulic Locking Units falls into one of these classes and has the associated advantages.

СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD
Industrie Service

Component Certificate

Subject: Hydraulic Locking Unit
LE25-1 "Group 1"
LE32-1 "Group 2"
LE32-1-V "Group 3"
LE25-5 "Group 4"
LE25-5-D "Group 5"

Certificate no.: **2 749 967 Cert Rev. 0**

Applicant: **Hoerbiger Micro Fluid GmbH**
Borsigstraße 11
93092 Barbing
Germany

Confirmation: It is hereby certified that the above mentioned subject has been assessed successfully by TÜV SÜD Industrie Service GmbH concerning the design review, initial examination, manufacturing inspection and certification audit.

Normative Reference: DIN EN 13814:2005
ISO 17842:2015

The evaluation is based on the following reference document:

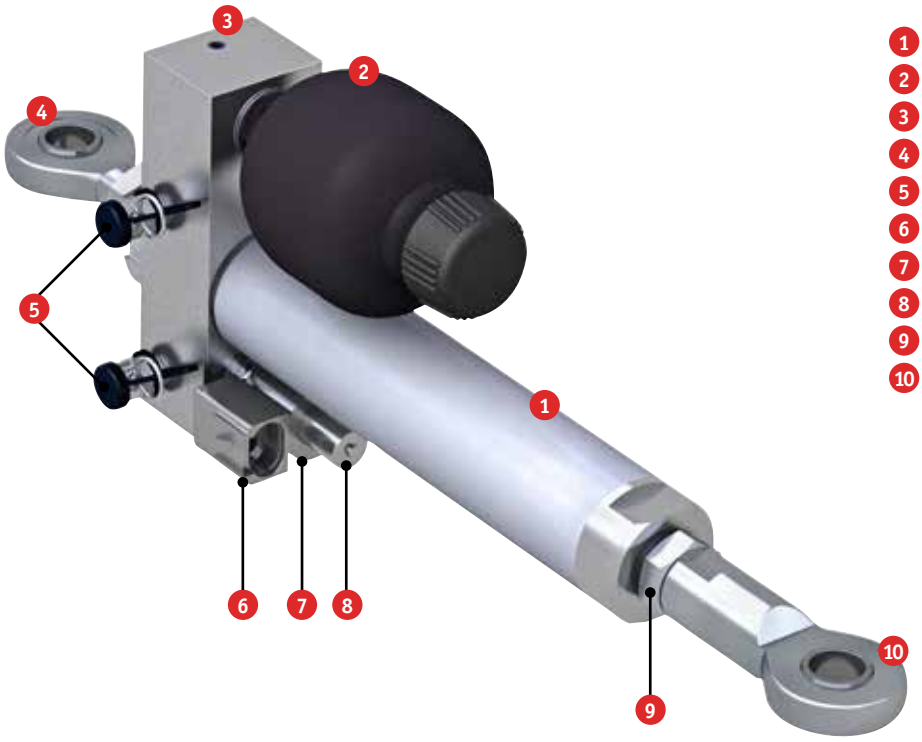
Report No.:	dated	Report
2749967 Eval	2017-12-13	Final Evaluation Hydraulic Locking Unit and affiliated reports

Figure: HLU-LE25

Main components

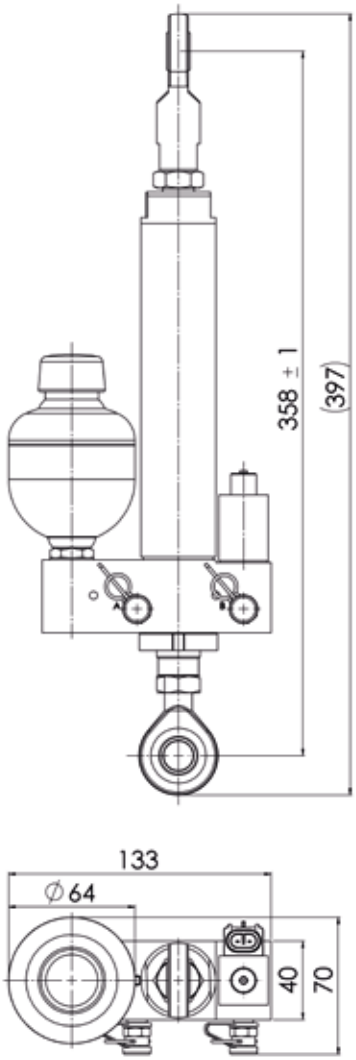
Unconditional fun thanks to maximum safety

- **Bolted twin-pipe cylinder:** The inner pipe guides the piston rod with the piston; the outer pipe conducts the oil from the rod side to the flange-mounted connection block on the cylinder base.
- **Connection block:** Accommodates a diaphragm accumulator, an electromechanically piloted or manually operated check valve as well as two pressure ports.
- **Diaphragm accumulator:** Precharges the unit to a predefined pressure and accepts the oil volume displaced by the piston rod during retraction.
- **Poppet valve:** Allows oil flow only in one direction, blocks the flow in the other direction. Oil flow is possible in both directions by electromechanical activation during normal operation or manual activation in an emergency.
- **Pressure ports:** Are used for filling the unit with oil and setting the pressure configuration at the factory.

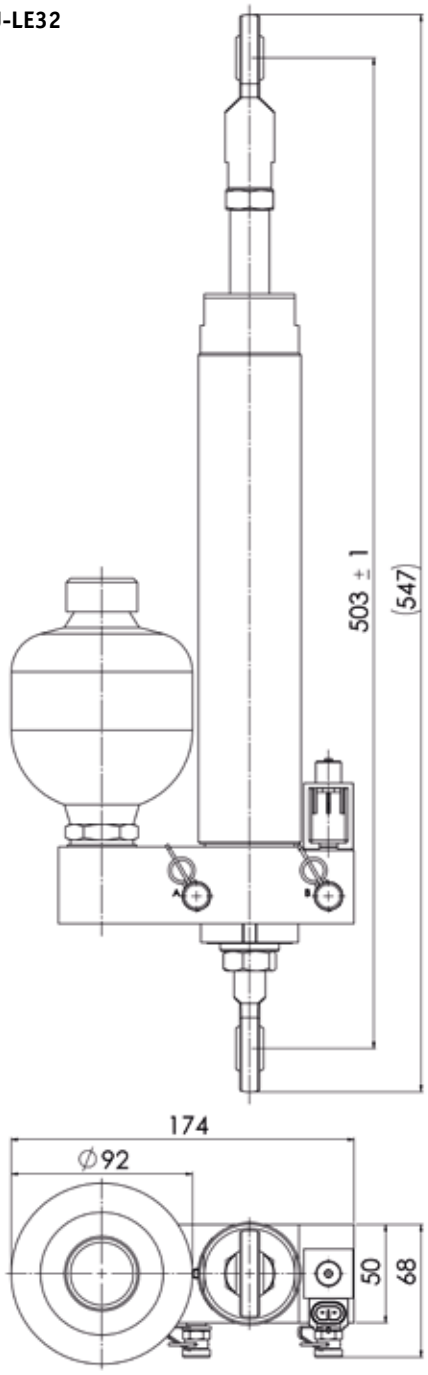


1. Twin-pipe cylinder
2. Accumulator
3. Connection block with double S
4. Rod end, base-side
5. Port for factory-configuration and filling
6. AMP Super Seal 1.5 electrical connector
7. Solenoid-piloted poppet valve
8. Push button for manual emergency operation
9. Piston rod
10. Rod end, rod-side

HLU-LE25



HLU-LE32



Customer benefits at a glance

Greater passenger comfort and all-round safety for riders

Primary function—bar lock

It blocks the movement of the cylinder, locking the restraining bar.

- **Greater passenger comfort:** Unlike mechanically latching systems, hydraulic cylinders ensure infinitely variable baradjustment customized to the rider.
- **Maximum reliability:** Due to extremely low-leak specialty valve with hardened seat edge.

Figure:
HLU-LE32 with comfort adjustment

Secondary function - bar drive

The energy stored in the accumulator during closing is used to open the restraining bar.

- **Only one system, no attachments:** Additional gas springs, spring systems or pneumatic drives normally required to open the bar are completely eliminated.

Other advantages

- **TÜV Süd homologation:** Significantly simplified acceptance process as a result of approved design and calculation, including documentation for the standards ISO 17842-1:2015, DIN EN 13814 and ASTM 2291-15.
- **Low wear:** Hydraulic systems are low-maintenance and not subject to the mechanical wear and tear of a ratchet system.
- **A safe feeling for riders:** Silent bar adjustment eliminates rider discomfort.
- **Plug & Play:** Simple installation - the system is filled with oil, tested and immediately ready to use.
- **Manual emergency operation:** Unlocks and opens the bar without electrical power, even when not at the station.

Type distinction

The difference lies in size and blocking direction of the Hydraulic Locking Unit

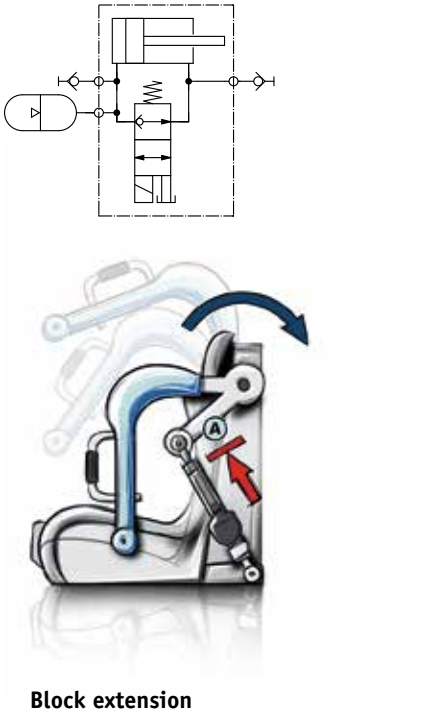
Size

HLU-LE25: The small and lightweight HLU-LE25 units have a piston diameter of 25 mm and an overall length of approximately 355 mm in the retracted state.

HLU-LE32: HLU-LE32 systems have a piston diameter of 32 mm and are generally 503 mm long.

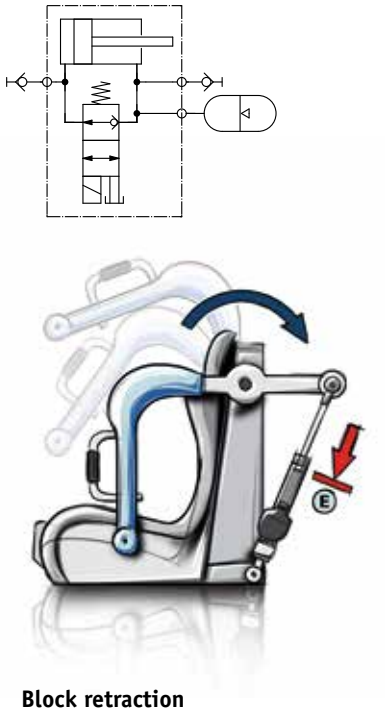
Blocking direction

The second distinguishing feature within the portfolio is the blocking direction. This refers to the direction of movement of the piston rod blocked by valve technology.



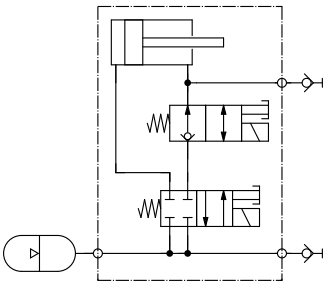
Block extension

In the safe, non-energized state, the units blocks the oil flow and prevents the piston rod from extending during the ride. At the station, the bar can be opened by way of the piston extension force. (bar drive)



Block retraction

In the safe, non-energized state, the units blocks the oil flow and prevents the piston rod from retracting during the ride. In this variant, a bar drive function is physically not possible.



Comfort adjustment option

In the open state of the passenger restraint system, the bilateral block of the additional valve V2 prevents the cylinder from retracting under load.

Benefits: Passengers can use the restraint system as a handle for entering and exiting. During operation, further excessively tight closing of the restraint system is prevented. Both functions increase the comfort of the rider.

Range of products

An overview of available product types

Flexibility is crucial, allowing the pressure and retraction force configurations for this portfolio to be adapted to the needs of our customers' ultimate design.

HLU-LE25

Piston diameter [mm]	Blocking direction	Safety valve	Secondary function: Extension force F2 [N] *1)3)	Installation length [mm] *3)	Cylinder stroke [mm] *3)	Retention force until (fatigue) [N] *2)
25	Extend	Yes	210 – 530	355	80	3.700
25	Retract	Yes	Not relevant	355	80	10.500
25	Retract	Yes	Not relevant	393,5	110	10.500
25	Retract	Yes	Not relevant	413,5	140	10.500
25	Retract	Yes, flow-optimized	Not relevant	443	80	10.500

HLU-LE32

Piston diameter [mm]	Blocking direction	Safety valve	Secondary function: Extension force F2 [N] *1)3)	Installation length: [mm] *3)	Cylinder stroke [mm] *3)	Retention force until (fatigue) [N] *2)
32	Extend	Yes	300 – 840	503	150	6.400
32	Extend	Yes, with additional non-return valve (comfort adjustment)	300 – 840	503	150	6.400
32	Extend	Yes	300 – 840	503	150	9.100

1) *F2 denotes the maximum extension force. The range of values in the table shows the available scope at room temperature (20°C). The specific value is adapted within certain boundaries to the customer's needs by way of the system's pressure configuration. Extension forces are speed-dependent. See data sheet for further details.*
2) *Maximum cylinder load during normal operation according to ISO 17842-01:2015. Retention forces are additionally influenced by the pressure setting. The higher the forces of the secondary function, the lower the retention forces. Safety integrity for indicated value: PLr C*
3) *Adaptations and applications are billed separately.*

Diverse adaptation options

We are able to modify a number of additional features for you as part of an application of the design:

- **Retraction forces and pressure configuration:**
  The configuration of the pneumatic and hydraulic precharge pressure influences both the maximum retention forces and the retraction and extension forces of the piston rod for the secondary function. Different seat and restraining bar designs generally result in different force requirements with respect to the bar drive function of Hydraulic Locking Unit. The planning of this pressure configuration is coordinated with our customers' needs within physical design conditions. The adjacent table shows the range of possible retraction forces of each system by way of the pressure configuration. Due to hysteresis friction, the retraction forces are approximately 30 percent higher than the extension forces.

- **Coil:**
  In general, a 10W coil can be used for systems featuring standard valves as part of an application.

- **Installation length:**
  The total length L0 can be extended up to a maximum of 503 mm as part of an application.

- **Cylinder stroke:**
  The cylinder stroke can be adapted within the following boundaries as part of an application:
  Blocking direction extend minimum 0 mm to maximum 300 mm
  Blocking direction retract minimum 0 mm to maximum 200 mm

- **Angle of joint head housing, base end:**
  It is possible to continuously vary the joint head housing 180° about the axis of the cylinder housing.

Hydraulic Locking Units (HLU) are is certified according to DIN EN 13814

You can find further information available for download here (see QR code)

Quality and reliability

Hydraulic Locking Units (HLU) by HAWE are subject to the highest quality standards

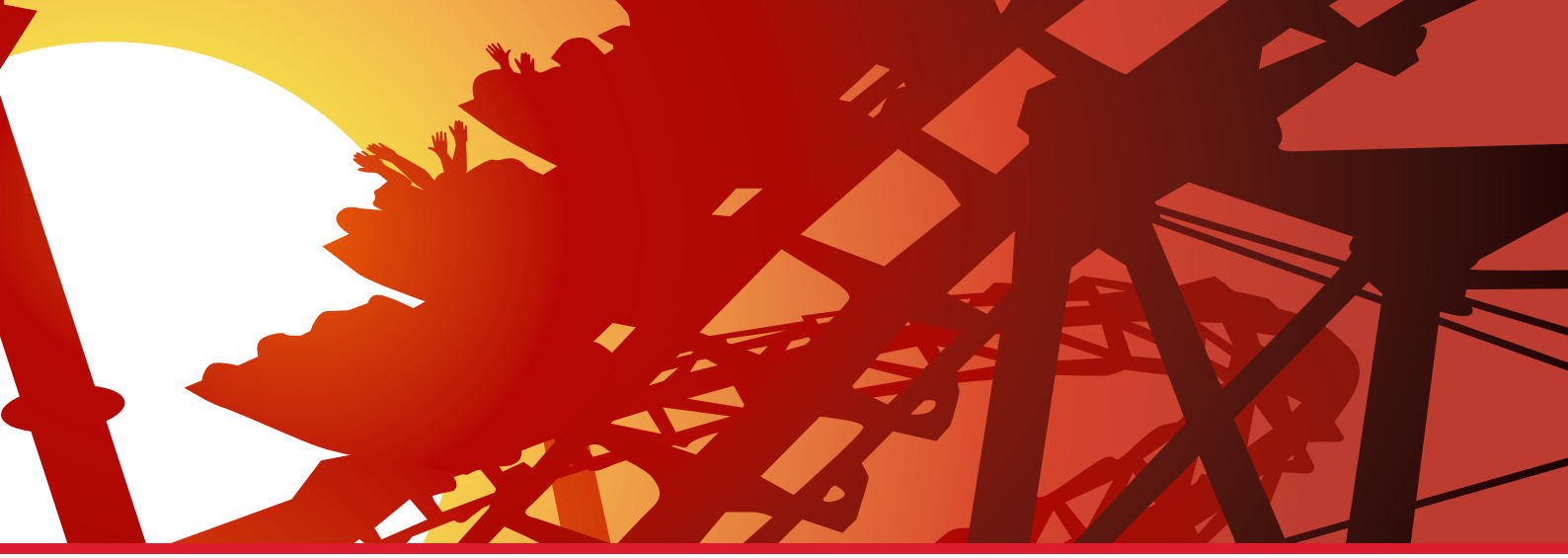
Safety and performance level

Based on an operating period of 35,000 hours as stipulated in DIN EN 1381 - or 7 years according to HAWE's specification—and associated anticipated stress of 5 million loads, the Hydraulic Locking Units undergo fatigue testing on a validation test bench installed specifically for this purpose.

In keeping with the safety standard DIN EN ISO 13849-1, HAWE checks the safety function of the Hydraulic Locking Units. This additionally meets the special requirements that are in effect for the safety integrity of passenger restraint systems under prEN 13814:2016.

For your final diagnostic monitoring process, this means that you are using a product already rated with a "PLr E-ready" status.

Figure: Burn-in test bench



Assembly

Throughout the entire process – ranging from procurement, to production in an ISO 9001-certified plant, to delivery—HAWE ensures stable and transparent processes to the highest degree. Particular emphasis is placed on quality and cleanliness.

- Strict packaging regulations for suppliers
- Comprehensive incoming goods inspections for oil-conducting parts using microscopy
- Additional individual parts cleaning
- Maximum purity of the added medium
- Maximum cleanliness by rinsing the Hydraulic Locking Units in additional rinse cycles.

End-of-line testing

All unit details relevant for the function and safety of every Hydraulic Locking Unit are checked on an end-of-line test bench, and the results are documented:

- Inspection of length and stroke
- Determination of the force parameters
- Examination of the maximum load (leak testing)
- Inspection of the emergency actuation function (manual emergency actuation)

Burn-in test

And finally, a burn-in test is conducted on a test bench specifically developed for this purpose. Every Hydraulic Locking Unit is subjected to more than 1,050 load cycles with a predefined force after installation for a certain duration. Under load, only a specific extension or retraction movement of the piston rod is permitted. With this, HAWE ensures a failure rate of $\lambda < 10^{-9}$ 1/h, equivalent to less than one expected failure per one billion operating hours.

The HAWE Life Cycle Concept

The advantages for you at a glance

- **Low-maintenance design:** Hydraulic Locking Units by HAWE are low-maintenance.
- **Short-notice exchange:** If a substitute unit is needed, new exchange units can be available in a matter of days, preventing a shutdown of the amusement ride.
- **Planning reliability:** Within the product life cycle, customers have the option to replace old inventories in a predictable, cost-effective process.
- **Replacement units:** Because HAWE offers brand new replacement units, repairs are generally not available. The replacement of complete Hydraulic Locking Units eliminates risks that arise from partial repairs. You benefit at all times from maximum quality and reliability of the products, as well as the latest, tried and tested production processes.

What we offer

Documentation

- Operating manual
- Technical Drawings
- Data sheets
- Material Safety Data Sheet
- Certificate of Conformity
- TÜV homologation

Accessories and spare parts

- Tool for operating the emergency release or manual emergency operating function
- Electrical connection cable, including plug
- Replacement joint heads and solenoid coils
- Auxiliary fixture for correctly installing the base-side rod ends

Contact persons

We have contacts available to assist you around the globe

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