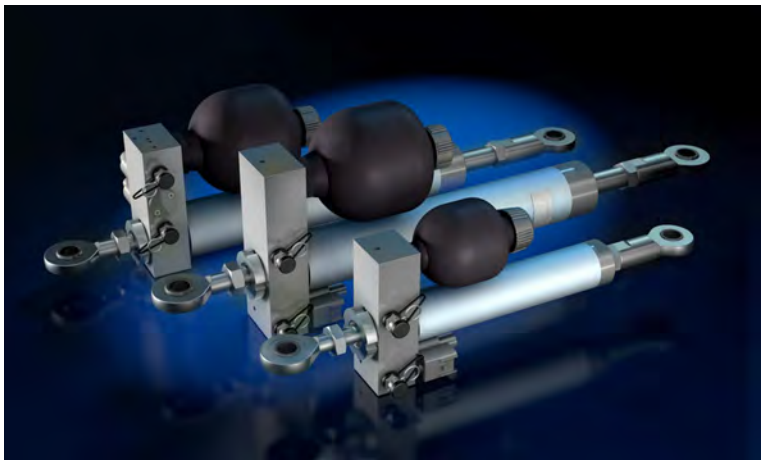
Hydraulic Locking Unit (HLU) for Passenger Restraint Systems

HLU formal definition of load cases

size	LE25 / LE32 / LE-X
type	A, E, K, RL, EX, RE, DL



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HAWE HYDRAULIK

Guidelines

The following definitions of load cases are standard-compliant to DIN EN 13814 and ISO 17842. They are crucial for dimensioning and calculation of the Hydraulic Locking Units (HLU) type LE made by HAWE.

The load cases listed below have to be taken into account within dimensioning and designing of the restraint system and have to be checked against the loads specified by HAWE for the Hydraulic Locking Units type LE.

The loads specified and approved by HAWE for the Hydraulic Locking Units type LE must not be exceeded.

As functional redundancy in terms of DIN EN 13814 HAWE takes a second Hydraulic Locking Unit type LE as a basis.

Fatigue load (EN ISO 13814:2019; 4.3.3.1.2.1)

Cylinder load during a „normal“ ride according to EN 13814 / ISO 17842 with 75 kg per person.

For the fatigue calculation the material fatigue strength and according to DIN EN 1993 EC 3 a safety factor of 1,1 x 1,35 is taken into account.

The experimental verification follows the specifications regarding SIL3/PLr e for seat class 4 & 5 and SIL1/PLr c for seat class 3 (EN ISO 13814, annex A; ISO 17842, annex A; EN ISO 13849).

Within the calculation of the fatigue load only one particular HAWE Hydraulic Locking Unit type LE is considered. Once a second Hydraulic Locking Unit type LE is used as redundancy, after an experimental verification of the load distribution done by the supplier of the restraint system (integrator of the Hydraulic Locking Unit type LE), a higher fatigue load for the entire restraint system can be approved where applicable. Within determination of this load during the design of the restraint system any additional influences, such as impacts, over speed, inertia forces, a “heavy” passenger, etc., have to be considered.

Maximum static load (EN ISO 13814:2019; 4.3.3.1.2.1)

As a general rule for the maximum static load the assumption that the redundancy failed and a “heavy” passenger (136 kg, according to ASTM) is hanging in the restraint bar “upside down” is crucial.

HAWE assumes that this is a malfunction of the ride which is encountered within the daily inspection and that corrective actions are taken immediately. An example is the “heavy” passenger who´s hanging in the restraint bar „upside down“.

Examine if extraordinary ride situations or an unique geometry of the restraint bar may cause situations (for example a heavy passenger during braking with redundancy in working order) which lead to higher loads.

For the calculation of the maximum static load the material yield strength and according to DIN EN 1993 EC 3 a safety factor of 1.1 x 1.35 is taken into account. The experimental verification follows the specifications regarding SIL3/PLr e for all seat classes (EN ISO 13814, annex A; ISO 17842, annex A; EN ISO 13849).

Panicload / emergency situation (EN ISO 13814:2019; 4.3.3.3)

Maximum cylinder load under the assumption that the redundancy failed and that a panicked passenger tries to open the restraint bar by force.

Even (over-)loads caused by vandalism or misuse must not exceed the value specified and approved by HAWE.

For the calculation of the panic load the material yield strength and a safety factor >= 1 is taken into account.

The experimental verification of this load is done via burst pressure tests.

Accelerations

HAWE ensures the safety relevant components of the valve assembly calculatory against accelerations of maximum 6G and a safety factor of 1.5.