Hoerbiger Hydraulic Cylinders

Technical Bulletin information

1. Findings
"Excerpt from the letter from company Hoerbiger dated 11/08/2014"

Customer information with safety notices
regarding the restraint systems of the types LE 25 and LE 32

"Dear Customer,
Our LE units have been in use all over the world since 1995. You too put trust in these proven components by HOERBIGER when it comes to building your installations. Over the past 19 years, thousands of these parts have been installed in restraint systems for amusement rides and we do not know of any cases of personal injuries in connection with our components. That is the way it should stay. Therefore, today we are writing to you about a few safety notices.
Generally, it is a normal procedure in industry and at HOERBIGER, in particular, to also repeatedly check, revise and improve already launched quality products and processes. As part of our comprehensive product monitoring and quality assurance we also draw on hints and suggestions obtained from a trustful dialogue with our customers. In this process, we found that under certain circumstances concerning the application and usage of our above-mentioned components there may be a potential risk of failure for the operation of your end product. Together with internal and external experts we have worked at full speed to provide recommendations as to how a few simple measures can help to reduce the risk potential in three areas"...

However, only hydraulic units manufactured before June 2014 are affected by this!!!
After this date, all products were and are being manufactured according to new production processes and guidelines. These processes and guidelines as well as additional checks will ensure proper functioning and exclude failure through contamination within the hydraulic circuit, as experienced in the past.

A simultaneous failure of both systems is unlikely and this is not assumed even according to the current standard. Nevertheless, the measures suggested by company Hoerbiger must be implemented promptly. Otherwise, due to our double protection, a failure of the Hoerbiger unit cannot be detected immediately by the prescribed regular checks.

3. Proposal for further proceeding

After closer examination of the package of measures prepared by company Hoerbiger, we think that you can doubtlessly perform the modifications in Attachment 1 and 2 on site. However, without an appropriate test bench, the examination of the hydraulic units as described in Attachment 3 is not feasible on site at your premises.
Currently, an examination of the units can only be done on the test benches of company Hoerbiger.
The costs for the examination amount to approx. 95,-€ per unit.

Unfortunately, at the moment we do not see any legal means to pass on the costs for carrying out the prescribed examination of the parts to our supplier or even to get the existing cylinders replaced by new units.
At the same time, we do not want that you have to bear the full costs of these measures, although the warranty period our company offers has already expired. Therefore, we have drawn up the following customer-friendly proposal for you:
We offer you a one-time possibility of sending your hydraulic units back to us as soon as possible.
We will have the prescribed measures implemented at company Hoerbiger, which will be done **at our expense**.
We will then send the units back to you, so that you can install them in the course of your winter maintenance work. This way, your system will be available again in due time for the beginning of the season.

Please note, however, that the cost assumption only applies to modifications 1 & 2 as well as to the examination. Should it become evident on the examination that there are defective units, they must be re-purchased by you in case Hoerbiger discovers that a repair according to the new production processes and guidelines is no longer economically feasible.

Therefore, we recommend you to promptly follow our proposal, because it is only after implementing this measure that the safety of your system can be ensured in the future as well.

Our customer support team will be available at all times for further information and any questions you might have.

Munich, 27th October 2014

Guido Bäuerle
Manager Customer Support

Annex 1: Paint marking of the piston rod at joint head

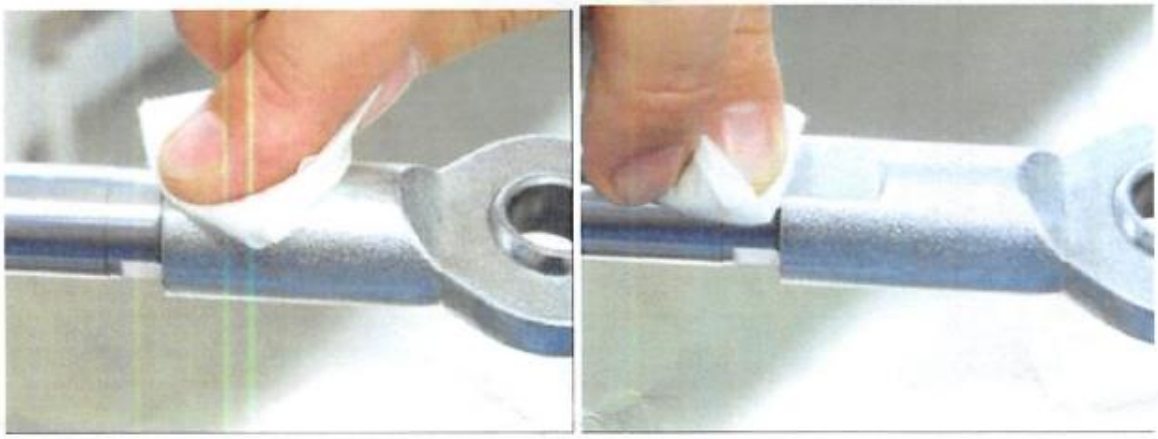
It is possible that a loose joint head connection could lead to a malfunction in the locking mechanism within the Personal Restraint System during a ride. Vibration or improper adjustment of the threaded screw assembly can cause the connection between the rod-side joint head and the piston rod end to loosen during normal use. We are aware of only one instance (not involving personal injury) where this connection came loose under load and we have also observed several cases in the field where joint heads were loose. The simple procedure described below will help reduce risk.

We recommend that the position of each head joint should be checked and the correct position be referenced marked with highly visible paint marking to facilitate a daily inspection. This recommendation should be shared by you with the end user customers.

Step1: Apply paint marking to the joint head

- Use a general purpose parts cleaner and degreaser prior to painting. The area should be free of residue after cleaning. The area to be marked on the joint head and piston rod should also be free of rust. We recommend Loctite® 7063 or DuPont 3608S™ or 3M™ S-151 Cleaner.
- Do not use brake cleaner or a nitro-cellulose combination thinner.
- Be careful not to damage the piston rod itself and keep the cleaning fluid off the section of the piston that moves in and out of the cylinder.

Cleaning Area:



Paint Marking

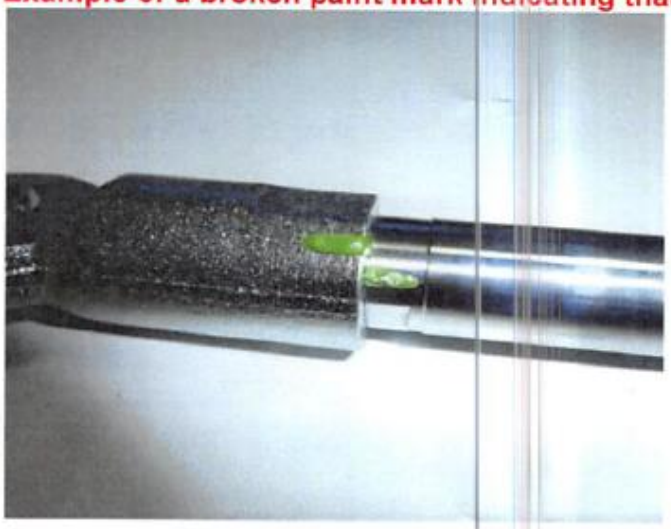
Use a high quality visible thread locking paint and follow the recommended application instructions. After consultation with you, we will determine the quantity of paint required and we will supply it to you. The paint marking should be one continuous line running from the joint head to the piston rod. The paint should be applied at a point where it will be visible to the operator during daily checking.

Step 2: daily inspection of correct position of joint

The correct position of the joint can be verified by checking to see that the paint marking between joint head and piston rod is undamaged.

Correct position of a paint marking

Example of a broken paint mark indicating that the joint thread has moved

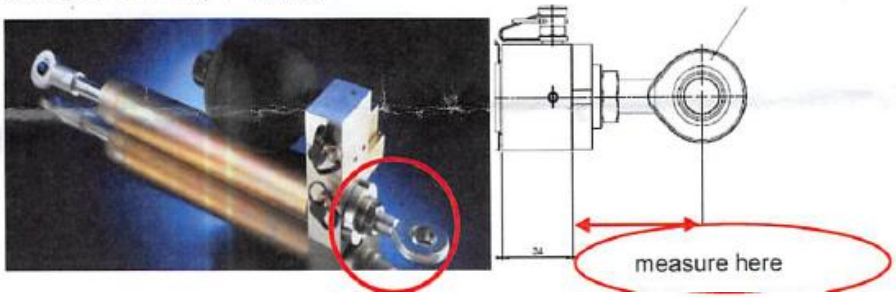


All units should be inspected daily before use. If the paint marking is discovered broken or if the joint head is not completely screwed in, the unit should not be used because the Personal Restraint System may fail possibly leading to personal injury or death of a rider. It must be exchanged immediately and returned to the manufacturer with a defect description.

Annex 2: Inspection of the Threaded Screw Assembly

This information is important for anyone performing installation or service on any personal restraint system using our LE assemblies and should be passed on. We have learned that some end users are sometimes unscrewing the threaded screw assembly out too far. This assembly is located on the cylinder base side and is circled in the picture below. Please note that the position of the thread is not intended as an adjustment for the spacing between two points within a personal restraint system. If this assembly is unscrewed too far there will be insufficient screw threads meeting the fitting to provide a secure connection. The result is an unsecure connection which *could lead to a malfunction of the locking mechanism in the Personal Restraint System during a ride*. This could cause serious injury or death. *Always check that screw thread depth is correct*. The diagram and photo below shows the measuring points to determine the correct screw thread depth.

The following data apply for all **LE 32** versions:
(see table below for measurements applicable to the LE 25 versions)
For LE 32 versions the screw thread depth is correct when the rod extends no farther than distance of 64 mm (+/- 1 mm).



The data in the table below applies to the **LE 25** versions: *x indicates the version number*

Material Number	Basic size of distance		Measurement Tolerance
850-7001-x	65	mm	+3mm
850-7002-x	65	mm	+3mm
850-7003-x	65	mm	+3mm
850-7004-x	65	mm	+3mm
850-7010-x	65	mm	+3mm
850-7013-x	62,5	mm	+3mm
850-7015-x	65	mm	+3mm
850-7016-x	65	mm	+3mm
850-7018-x	65	mm	+3mm
850-7019-x	65	mm	+3mm
850-7020-x	60,25	mm	+3mm
850-7021-x	60,25	mm	+3mm
850-8002-x	63	mm	+3mm
850-8003-x	63	mm	+3mm
850-8007-x	62,5	mm	+3mm
850-8008-x	65,25	mm	+3mm
850-8009-x	65,25	mm	+3mm

We strongly urge you to immediately check the measurement set out above on all Personal Restraint Systems in your possession and advise your technicians to adjust and maintain the measurements specified when installing the unit into a Personal Restraint System or during routine maintenance.

We recommend that the joint rod heads be secured at the specified dimensions and tightened with a torque wrench. The LE 25 version should be tightened to 80 Nm ±10 Nm. The LE 32 version should be tightened to 90 Nm ±10 Nm.

The correct measurement must be set and checked when installing or performing maintenance on the Cylinder Accumulator unit. In this way the required minimum screw thread depth engagement (as set out in VDI 2230) is maintained.

Annex 3: Particulate within the hydraulic cylinder

Regardless of stringently clean manufacturing processes and intensive quality control, hydraulic systems have very small quantities of particulate that can materialize in the hydraulic fluid contained within the cylinder. Under certain circumstances, these small particles can cause a valve within the cylinder to not close properly. *This could lead to a malfunction in the locking mechanism of the Personal Restraint System during a ride.* Although the probability of failure is small the possibility of failure cannot be completely eliminated. For that reason we have developed a test to detect any issues early on. This information should be shared by you with your end user customers.

Either of the two hydraulic cylinder function tests set out below can be applied:

The "Stationary-Test" is a test method performed multiple times on an individual Personal Restraint System to determine functionality.

The "Stream Test" is a test method performed before every ride over the course of a series of 2,100 rides during operations.

Procedure for the "Stationary-Test"

The "Stationary-Test" is an effective method to detect particulate within the hydraulic cylinder. It can also be performed in the field while the Personal Restraint System is mounted on the ride. It should be noted that the test is only effective if the ride's design mechanics permit sufficient opening force for the retaining clamp to open automatically when the Personal Restraint System is deactivated (in the opening-function). Depending on the design, this can be achieved with the Personal Restraint System alone or with the addition of integrated gas springs or comparable support.

Before the test begins, make sure **that only one** of the Personal Restraint Systems is active and in the locked position. Any other Personal Restraint Systems or mechanical locking mechanisms should not be activated or locked during the test. Make sure that no external force is applied to the Personal Restraint System.

1. Set the individual Personal Restraint System to the opening position.

2. Close the restraint bar and activate the lock position.

3. Now visually check for movement in the locking mechanism. Keep the restraint bar in place for at least 10 seconds. If the position of the restraint bar changes in any direction or if the cylinder moves more than 2 mm during the 10 second period, the unit may not be in order. It should be exchanged immediately and returned to the manufacturer with a defect description.

   Please note that when observing the restraint bar, the mechanical transmission ratio must be taken into account depending on the design specified by the ride manufacturer. The maximum tolerance of the Personal Restraint System at the cylinder is always 2 mm. Please note that the measured tolerance can also be measured at the restraint bar. Depending on the transmission rate between the unit and the restraint bar, the value must be converted accordingly considering the transmission rate. For example if the designed transmission rate is 10:1 the maximum measured tolerance of 2 mm at the cylinder will be ten times or 20 mm at the restraint bar. Likewise, if the designed transmission rate is 5:1 the maximum measured tolerance of 2 mm at the cylinder will be five times or 10 mm at the restraint bar.

4. Apply power to the valve and open the restraint bar. End of test cycle. Restraint bar is opened again.

5. Start a new test cycle at step 2 (above) beginning with closing the restraint bar. Repeat the test cycle (steps 2 to 4) 1,050 times.

Where the second Personal Restraint System is also an LE System, the test cycle should be performed by placing the unit in the opening position starting with step 1.

If an assembly fails during the 1,050 test cycles the affected system should be shut down and exchanged immediately.

Over the years we have also observed that some ride designers, manufacturers and even end users have incorporated a supplemental mechanical locking mechanism to add an additional margin of safety for their riders. This should be considered in your end product risk analysis.

Note:

Where the Personal Restraint System in use is a Type B "**Block against extension and comfort adjustment**" the electro-magnetic slide valve V2 (at position 8) must be observed to be in operation during the test.

Procedure for "Stream Test"

The following describes a test-procedure performed before every ride over in total 2,100 times during operations.

The test is only effective, if the ride's design mechanics permit sufficient opening force for the retaining clamp to open automatically when the Personal Restraint Systems are deactivated (in the opening-function). Depending on the design, this can be achieved with the Personal Restraint System alone or with the addition of integrated gas springs or comparable support.

Test procedure steps

1. Restraint bars of both Personal Restraint Systems begin in the closed and locked position.
2. The first Personal Restraint System should be deactivated and therefore in the opening position.
3. The function of the second Personal Restraint System is checked for retention by keeping the bar held in place for a minimum period of 10 seconds.
4. If the locked position of the restraint bar changes in any direction or if the cylinder moves more than 2 mm during this 10 second period, the Personal Restraint System may not be in order. The Personal Restraint System should be exchanged immediately and sent to the manufacturer with a description of what happened.
5. Before the next ride this test procedure should be performed to check the function of the first unit. Begin this by deactivating the second system and check that the first Personal Restraint System holds the bar in place without cylinder movement for at least 10 seconds.

Please note that when observing the restraint bar, the mechanical transmission ratio must be taken into account depending on the design specified by the ride manufacturer. The maximum tolerance of the Personal Restraint System at the cylinder is always 2 mm. Please note that the measured tolerance can also be measured at the restraint bar. Depending on the transmission rate between the unit and the restraint bar, the value must be converted accordingly considering the transmission rate. For example if the designed transmission rate is 10:1 the maximum measured tolerance of 2 mm at the cylinder will be ten times or 20 mm at the restraint bar. Likewise, if the designed transmission rate is 5:1 the maximum measured tolerance of 2 mm at the cylinder will be five times or 10 mm at the restraint bar.

Warning: If the cylinder movement is observed to be greater than 2 mm during the above test, the Personal Restraint System should be shut down and exchanged immediately. Cylinder movement during the test indicates there is a potential for system failure which could cause serious injury or death.