

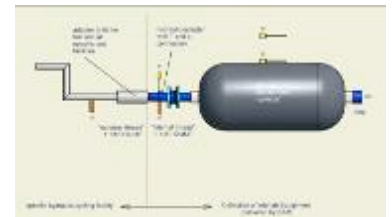
Safety Assessment and Requirements: Benchmarking of Hydraulic Cycling Facilities by Interlaboratory Tests

Objectives

- ❖ Test results on cylinder fatigue life gained by cycling tests scatter significantly. The assessment of the influence of facilities on tests results has become necessary in order to exclude misinterpretations of life cycle test results caused by the testing equipment itself.

Achievements and Test Results

- ❖ A procedure for benchmarking facilities by an interlaboratory test campaign was developed (see below). This included obtaining a reference cylinder, a set of connectors and the measurement equipment (see right).
- ❖ The concept was applied to all facilities used for 700 bar testing within StorHy. As a result, significant differences in actual values were identified.



	Step A.1	Step A.2	Step A.3	Step A.4	Step A.5	Step B.1	Step B.2
Temperature of medium	ambient temperature					-40° C	
Cycling speed [per minute]	1	2	3	5	10	2	5 (3)
number of load cycles	30	30	30	50	100	5000	2000
pressure [bar]	20 - 875						

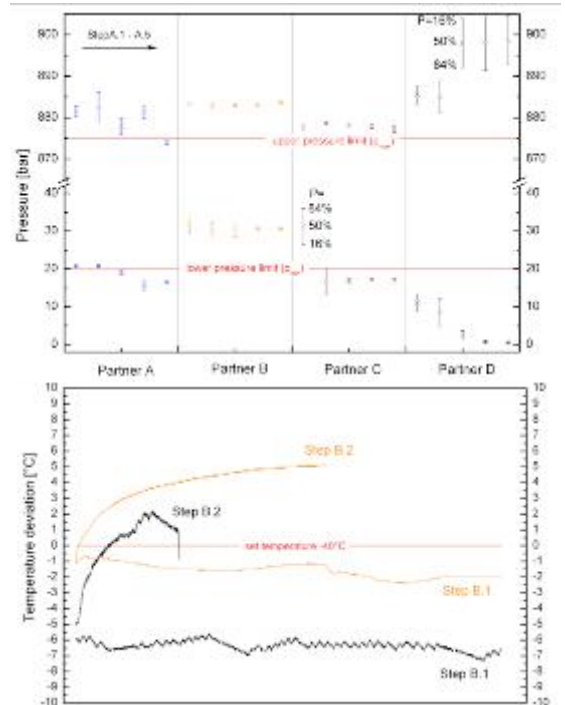
The interlaboratory tests revealed test bench specific deviations from the nominal values regarding pressure and medium temperature sequences:

- ❖ The mean values of pressure extremes and their scatter differ significantly (see right). While an offset on mean values can be corrected easily by a better zero compensation and improved set-points, reducing the high variation of the pressure value maxima requires significantly more effort.

Due to its impact on residual stresses and creeping of composite / plastic liners as well as the fatigue strength of metal liners, the pressure medium temperature deserves special attention:

- ❖ Temperatures of pressure media tend to increase during testing. Especially in the starting phase of low temperature tests, significant changes occur when the tempered medium in the testing cylinders and an ambient temperature medium in the hydraulic engines are involved, (below right). But in general, the measurement results mostly depend on the cycling speed.

This analysis of the measurement results gives a survey of possibilities and limits of current hydraulic cycling equipment. Nevertheless, additional research efforts will be necessary to reach an acceptable reproducibility level of test results and assess scattering of cylinder behaviour.



Future Perspectives

- ❖ Concerning the comparability of cycling test results, it is recommended to assess and certify all cycling facilities for testing high pressure cylinders for automotive use.
- ❖ For this purpose, a set of minimum performance data including maximum allowable deviations from the nominal values has to be defined. The StorHy test program could be applied directly.
- ❖ The StorHy test results should be used as starting point for further detailing.

Partners



Website www.storhy.net

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