Logan Industries Delivers Solution to Abnormal Cylinder Vibrations on 100 t Knuckle Boom Crane

Logan Industries performed a standard cylinder repair mounted on a 100 t knuckle boom crane. After observing abnormal low frequency vibrations when stroking cylinders under low pressure, Logan investigated further to find a solution to the problem.

Context

Logan Industries (Logan) was called upon to fix a cylinder, mounted on a 100 t knuckle boom crane, which was leaking through gland seals. Logan performed function testing on the cylinder in the form of a post-pressure test. During the test, low frequency vibrations were observed when stroking cylinders under low pressure. Both Logan and the operator deemed the presence of the vibrations under these conditions to be abnormal.

Challenge

Logan was tasked to investigate the cause of the vibration behavior and to resolve it.

Logan reviewed the seal and wear band designs with a leading industry expert in the design and manufacture of these items. No irregularities were detected that would cause this type of vibration.

In an effort to mitigate the abnormal vibrations, various different wear bands were utilized, including a very low friction Teflon variety and additional clearance was allowed for the wear bands. Alternative pumps and controls were implemented during testing. Logan engaged industry experts to perform vibration analysis and laser bore measurements.

Findings

Together, Logan and a team of handpicked experts discovered that the cylinders were vibrating at their natural resonance frequency when stroked at low pressure.

The natural frequency of the rod and piston was ~35 hz. The natural frequency when installed into a crane that weighs approximately 140 t is expected to be between 3 and 10 hz. It was deduced that the observed vibration was most likely caused by the stick-slip effect of wear bands in the gland.

Details of the observation

When the piston was mid-stroke, rotating the gland to attempt to alter the vibrations was far more challenging. The laser measurement of the bore showed that the honed profile was curved. The wear bands currently had adequate / standard clearance. However, this clearance was reduced due to manufacturing tolerances; gland TIR, gland threads, rod curvature, piston threads, etc. Overall, 25-50% of the clearance was lost due to the curved, honed profile.

Solution

Ultimately, Logan recommended the normal installation of the cylinder after repair, with no further modifications needed to the cylinder or the interfacing equipment. Due to the work Logan did to fully investigate this issue, we were confident in recommending that this apparent problem could be safely ignored.

Natural frequency was expected to be much lower when installed in the crane, and resonance was not expected. In Logan's subsequent experience, OEM original cylinders vibrate while being tested in the shop, but vibration is not typically observed after installation since vibration halts under higher pressure (>2000 psi). Adding additional clearance would have required increasing the extrusion gap on the seals, which would decrease seal life. Additionally, low friction wear bands are not as strong as standard wear bands and heighten the risk of failure. Neither of which was truly an option Logan wanted to consider.

Follow up

After installation, no vibrations were observed and it appears that Logan's solution to this complex problem was the most suitable one.

For more information:

Logan Industries can perform vibration analysis on installed cylinders and troubleshoot difficult problems on machinery if desired. For more information, call Dean W. Carey, Logan's Technical Director on +1 (713) 849-2979.

LOGAN INDUSTRIES INTERNATIONAL CORPORATION

1000 Blasingame Road
PO Box 1408
Hempstead, Texas 77445
United States of America

www.loganindustries.net
sales@loganindustries.net
Tel +1 713-849-2979
Fax +1 713-849-5266