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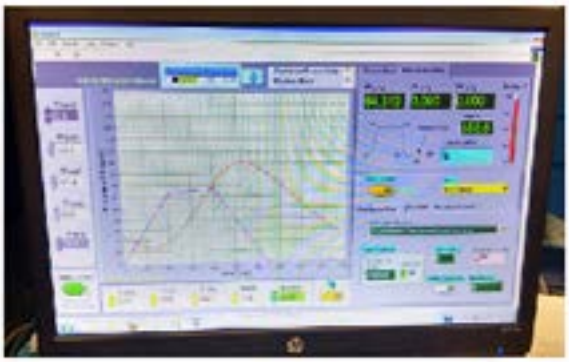
BHR

# Fixed Wing Aircraft Hydraulic Tank

## AAR INTERNATIONAL CORP



Fatigue Testing is carried out with the objective of determining the relationship between the stress range and the number of times it can be applied before causing failure.

SAE ARP1383 is the International standard that specifies the minimum requirements for impulse testing of fluid system components of aerospace hydraulic systems.

After completing approximately ¼ of the required 100,000 pressure cycles, the hydraulic tank failed along a section of the vertical seam weld. The component was removed from test and returned to the client for further investigation.

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Hydraulic reservoirs in a fluid power system primarily serve as a storage tanks to contain sufficient volume of hydraulic fluid and subsequently cater to the fluid demand by the pump during system operation. Additionally, the reservoirs account for the thermal expansion/contraction of the hydraulic fluid and also provide for acceptable levels of external leakage at the dynamic seals. Fatigue Testing is carried out with the objective of determining the relationship between the stress range and the number of times it can be applied before causing failure.

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"We went to BHR in order to ensure that our hydraulic tank met the SAE ARP1383 standard. The tests were effective in that they identified that the tank required more work. Through working with the BHR team we were quickly able to identify the problem and undertake further actions in-house to resolve the situation."

Marc Roberts
PRODUCTION MANAGER
AAR INTERNATIONAL CORP

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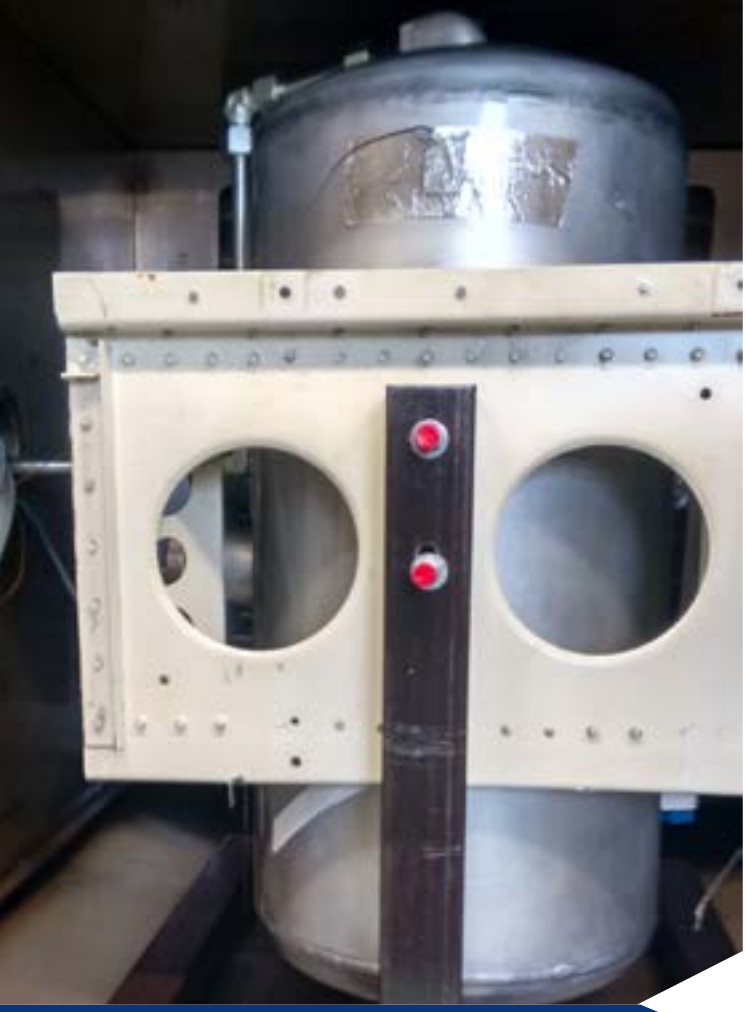
AAR Corp. Defence Systems & Logistics contracted BHR Group to undertake pressure cycle testing on the hydraulic tank assembly for a fixed wing aircraft, in accordance with SAE ARP1383. This SAE ARP establishes the minimum requirements and procedures for impulse testing of aerospace hydraulic actuators, valves, pressure containers, and similar fluid system components, except accumulators, for use in aerospace hydraulic systems. It also refers to standard impulse test equipment, which may be used in conducting these impulse tests.



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Cyclic hydraulic pressure testing ensures that aircraft components can withstand the fatigue effects of all cyclic pressures (including transients) and can reveal unforeseen stress concentrations.

The testing undertaken by BHR met the following requirements:

- Cycle frequency: 1 Hz
- Number of cycles: 100,000
- Maximum peak pressure: 90 PSIG
- Temperature: 180° + 27°/ -0°F
- Test fluid: Shell Tellus 46

"The BHR team were able to test our hydraulic tank across a complex temperature range in a controlled environment. The team were great to work with and enabled us to identify challenges with our product that we were then able to rectify"

Marc Roberts
PRODUCTION MANAGER
AAR INTERNATIONAL CORP

There were a number of challenges associated with this project. Pressure cycle testing a large volume component makes it more difficult to achieve the required pressure waveform profile, due to the greater compliance in the system. Our engineers were able to use our servo hydraulic system with pressure feedback control to achieve the required waveform.

The test was conducted on BHR Group's Pressure Fatigue Rig, and the hydraulic system was set up to achieve the required 1 Hz pressure cycle frequency. The test unit was mounted inside an environmental chamber for the duration of the test programme, on a jig that replicated the aircraft mounting. A safety valve, set to lift at 7 bar (100 psi), was installed in the hydraulic pressure supply line to prevent over pressurisation of the hydraulic tank and an external dial pressure gauge was fitted, and functioned as a system residual pressure measurement device. Conducting the test at elevated ambient and process temperatures meant we had to provide localised cooling for the pressure sensor for it to maintain its functionality.

After completing approximately ¼ of the required 100,000 pressure cycles, the hydraulic tank failed along a section of the vertical seam weld, with a crack of approximately 50mm in length being observed. The test was aborted and the client immediately informed of the failure. The component was removed from test and returned to them for further investigation.

BHR engineers overcame a number of challenges associated with this project:

**LARGE VOLUME COMPONENT**
Using a servo hydraulic system with pressure feedback control, our engineers were able to achieve the required pressure waveform profile.

**ELEVATED AMBIENT & PROCESS TEMPERATURES**
Localised cooling was installed for the pressure sensor for it to maintain its functionality across the complex temperature range required.

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