AT MACHINE: TEST AND RESULTS ANALYSIS

In order to prove the capabilities of the Accumulation Testing Machine and to demonstrate the repeatability and the reliability of its results, it was decided to carry out a set of test cycles using the same component but in different conditions.

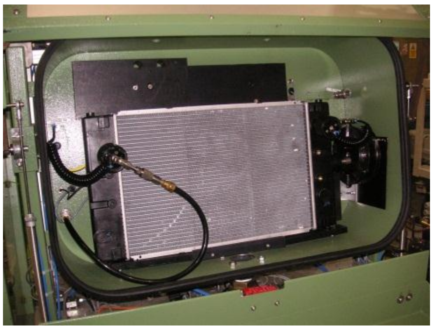
The component used for this demonstration was a car radiator, with an operating pressure of 1.2Bar (differential pressure) and a pass/fail leak rate of 3.20E-2mbar litre/sec.

This paper describes the results of the following test cycles:

1. PASS component test
2. Calibrated leak test – 5 tests
3. Heated PASS component – 5 tests
4. Gross leak component test
5. PASS component – 5 tests

First Test Cycle

The first test cycle was executed with a radiator which passed the test successfully and was marked as "PASS". The value of the leak rate detected by the machine in this case was 100 times lower than the pass/fail leak rate value.



Second Test Cycle – Calibrated Leak

Once identified a pass component, it was decided to prove the repeatability of the results, by using a calibrated leak rate of 5.4 mbar litre/sec. The machine enclosure was left empty with the two pneumatic ports (which would normally be connected to the couplings through flexible hoses) connected to a blank and to the calibrated leak.

By doing so, the worst case scenario was considered, as the free volume inside the enclosure could not have been any bigger. As explained in other papers, the free volume inside the enclosure should theoretically be as small as possible, as the bigger it is the more difficult it becomes to create a uniform gas blend inside the enclosure (this is important as the T-Guard measures the helium leak rate based on samples of air taken at different times during the test cycle). However in this case it decided to test the machine in the worst conditions.

The test cycle with the calibrated leak was repeated five times to analyse the repeatability and the reliability of the results.

As expected, the machine identified a leak higher than the pass/fail leak rate, therefore the test results have always been negative (fails). The results of the five tests are reported here below:

CALIBRATED LEAK (5.40E-2 mbar litre/sec) - fine leak fails -	
Test Number	**Detected Leak Rate [mbar litre/sec]**
1	5.40E-2
2	5.40E-2
3	5.40E-2
4	5.30E-2
5	5.30E-2

Third Test Cycle – Heated PASS Component

In order to demonstrate that the AT Machine results do not depend on the temperature of the component and on whether this is changing (critical issue for all pressure decay systems) or not, it was decided to test the machine using the same PASS radiator after heating it up with a hot air gun.

This test was supposed to simulate similar conditions to those a heat exchanger is in after it has just come out of the brazing furnace, with a high temperature and slowly decreasing to the ambient one. This is a critical issue in the manufacture of heat exchangers and other brazed products, because if tested with a pressure decay system, they require a certain period for temperature stabilisation, in order to avoid the issues related to the temperature change which with no doubt will affect the pressure decay measurements (identifying false leaks). Obviously this period which needs to be allowed for temperature stabilisation requires space for product storage, product handling operations, and time which are all related to additional costs for the manufacturer.

The problem given by the temperature changes affect he performance of a pressure decay system also when the component to test is subject to temperature increase, like when it is affected by a warm air draught. In this case a small leak can be masked by a pressure increase due to a small temperature increment.

For consistency, the test was repeated five times giving the following results:

PASS COMPONENT - Heated -	
Test Number	**Detected Leak Rate [mbar litre/sec]**
1	1.00E-4
2	4.50E-4
3	1.00E-4
4	3.50E-4
5	1.00E-4

The results of this test show how reliable the AT Machine is even when the temperature conditions of the component under test are not stable.

Results also show a high level of repeatability and they demonstrate an excellent level of performance even after the a few failing components have been subject to a test cycle (previous five cycles with the calibrated leak).

Fourth Test Cycle – Gross Leak Component (FAIL)

Another test cycle was then executed with a different component, on which an artificial gross leak was created.

As expected the machine stopped the test cycle in its early stages, when the component subject to evacuation could not reach and hold the pre-set level of vacuum.

This test was carried out with the objective of showing that in case a gross leak is present in the component, there is no risk to contaminate the enclosure and the T-Guard sensor with Helium, as the coarse leak is identified before the tracer gas is supplied to the part.

Fifth Test Cycle – PASS Component

To complete the demonstration, it was decided to test the PASS component again to show how repeatable are the results when a standard good part is tested.

Even in this case the part was tested five times, and the results are shown here below:

PASS COMPONENT Standard conditions	
Test Number	**Detected Leak Rate [mbar litre/sec]**
1	1.00E-4
2	9.60E-4
3	1.00E-4
4	6.30E-4
5	1.00E-4

Conclusions

With the tests described in this paper it was demonstrated that the AT Machine…

…is **reliable**

…produces **repeatable results**

…is **independent of the temperature**

Depending on the dimensions of the component and of the enclosure, the AT Machine is the perfect tool to replace the Air Under Water Test and the Pressure Decay Test giving high quality performances for leaks down to 1.00E-2 mbar litre/sec (6 std.cc/min).

Provided that the pass/fail leak rate is higher than the value stated above, the machine will always be able to distinguish passes from fails and to measure the corresponding leak rate. For leaks smaller than 1.00E-2 mbar litre/sec (6 std.cc/min) the level of sensitivity of the machine diminishes, and this is the reason why for leaks in the 1.00E-3 – 1.00E-4 range the results are characterised by a lower level of repeatability.