

# Memo

**To:**

**From:** XXXXXXX

**CC:**

**Date:** April 16, 2010

**Re:** Leak Testing Using Isaac Leak Testers

The purpose of this memo is, in response to an earlier memo from XXXXXXXXXX, to document the preliminary testing results, analysis and recommendations regarding the equivalency between the Sprint and Isaac leak testers. This memo serves as a summary of the study; actual data and other details are retained and will be provided upon request.

## Analytical Review

Review of user guides for Isaac and Sprint leak testers show different internal volumes between the two instruments: 1cc for Isaac and 6.5cc for Sprint. Both the Isaac and Sprint user guides use the following equation to calculate the leak rate,

$$\text{Leak rate (cc / m)} = \frac{\Delta P \text{ (psig)} \times V \text{ (cc)}}{\Delta t \text{ (min)} \times \text{Atm (psi)}}$$

where,

$\Delta P$  = pressure decay,  $\Delta t$  = test time;  $V$  = internal volume (leak tester) and external volume (fixture and product);  $\text{Atm}$  = atmosphere pressure

Assuming constant leak rate, test time, external volume, atmosphere pressure; the equation reduces to

$$\frac{\Delta P_I \text{ (psig)}}{\Delta P_S \text{ (psig)}} = \frac{V_S \text{ (cc)}}{V_I \text{ (cc)}} = \frac{6.5 + V_{\text{External}}}{1 + V_{\text{External}}}$$

where 'I' stands for Isaac and 'S' for Sprint.

Therefore, under the same test parameters, the amount of pressure decay on the Isaac shall be higher than the Sprint as argued in Danny's memo that said, "If the internal testing volume of the Isaac tester is smaller, then the tester will be more sensitive". Also, as the external volume increases, the ratio of pressure decays decreases or the discrepancy between the two types decreases.

## Quantifying Evaluation

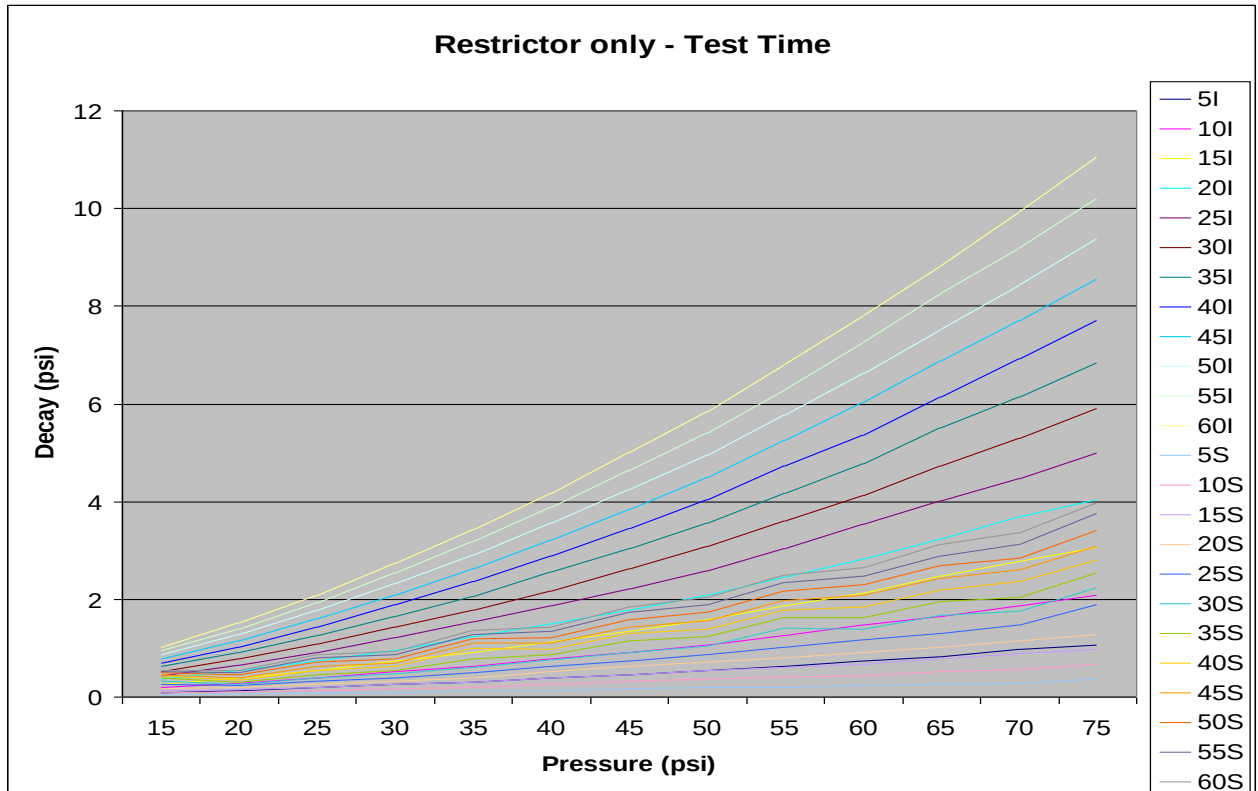
Evaluations are based on the assumption that leak rates for each test run are constant between the two testers since the same restrictor and fixture are used, correlation is based on test times since test pressures are designed to product performance that should not be changed.

**Equipments:** Isaac leak tester CZ2005, Sprint LC CI0048, restrictor CA208 (estimated volume of 4cc) and fixtures (connectors with tubes of different lengths, the fixture volumes were measured 4cc and 6cc).

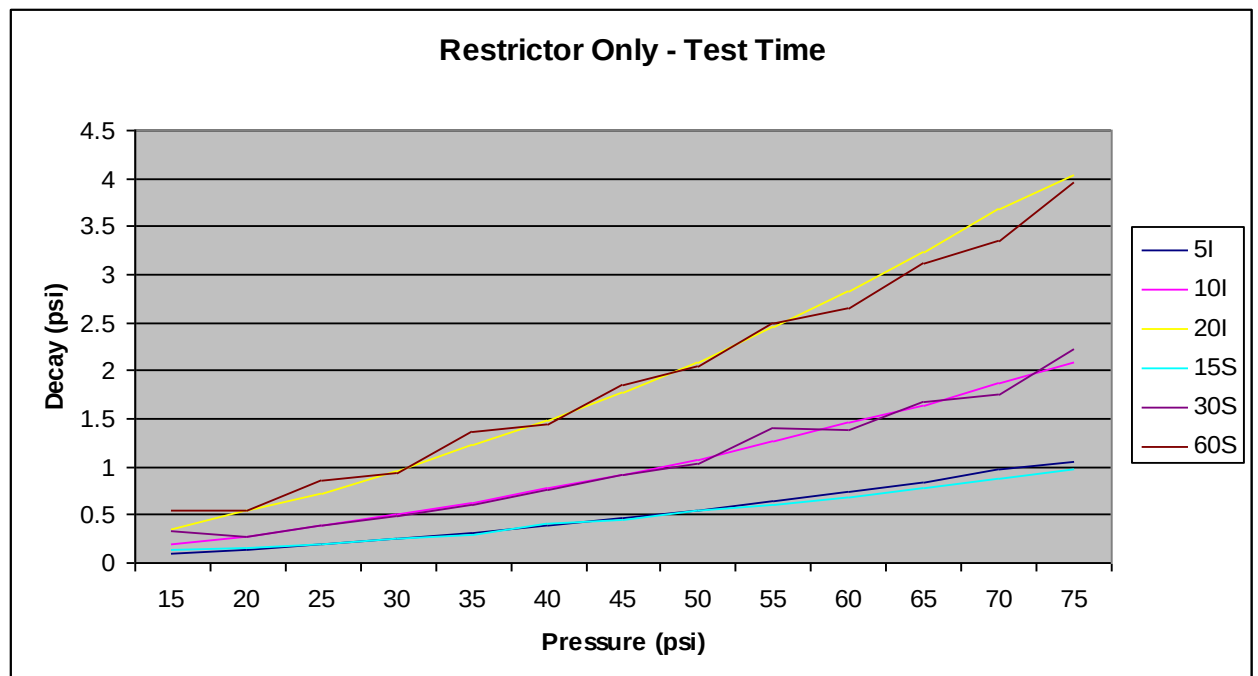
**Test procedures:** three test levels (restrictor only, restrictor + 4cc fixture, restrictor + 6cc fixture), combined runs for each test level (test times from 5 to 60 sec. with 5 sec. intervals, test pressures from 15 to 75 psi with 5 psi intervals, other test parameters are constant).

### Test results:

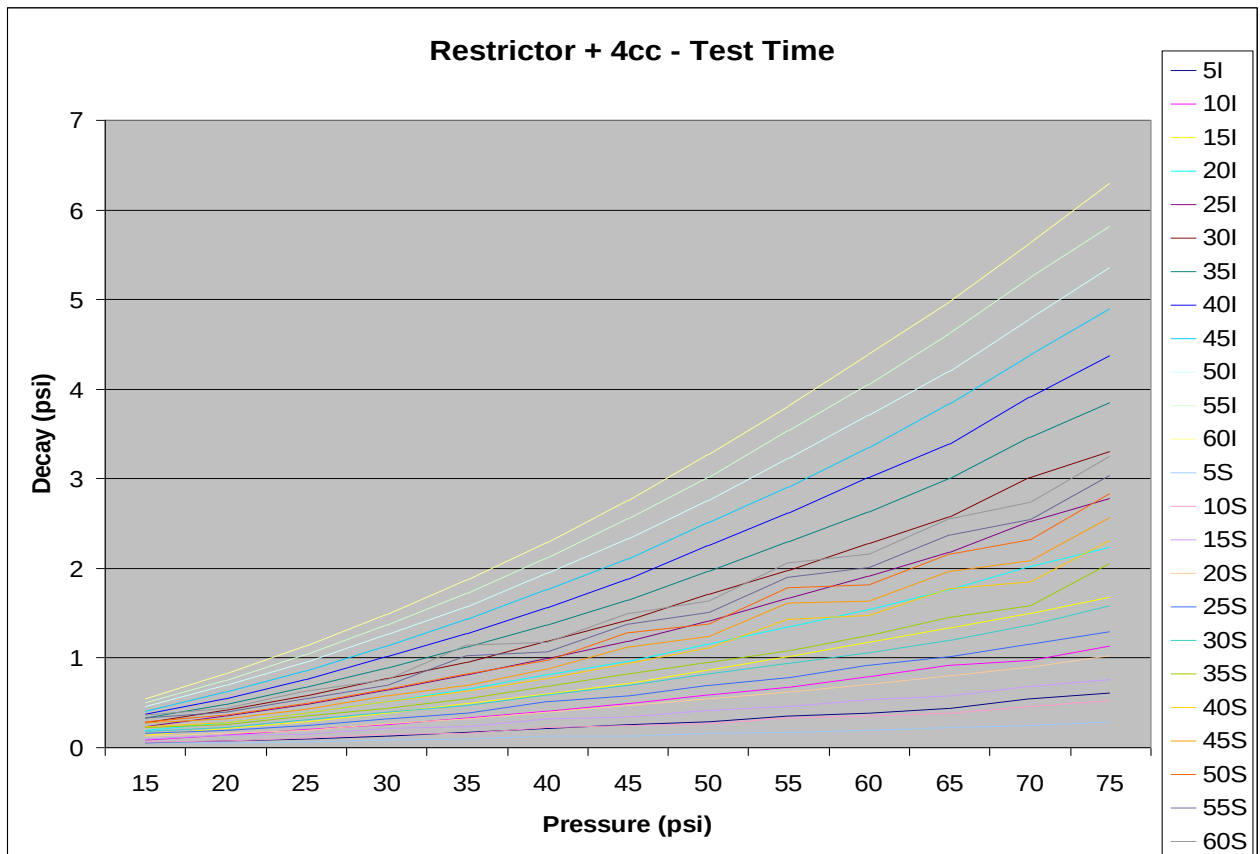
The following chart presents all the test runs with restrictor only,



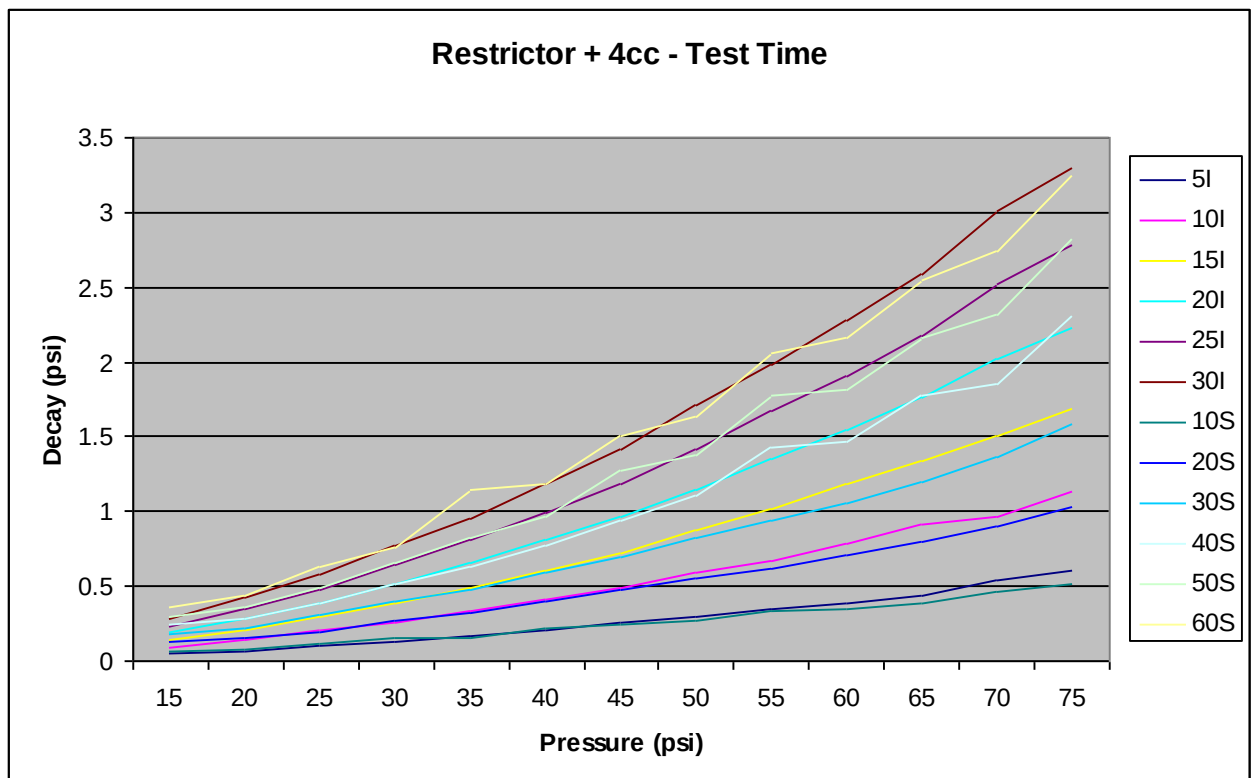
At this test level, the chart shows test runs on Sprint LC model at 60, 30, and 15 seconds are comparable to 20, 10, and 5 seconds on the Isaac model as shown on the chart below,



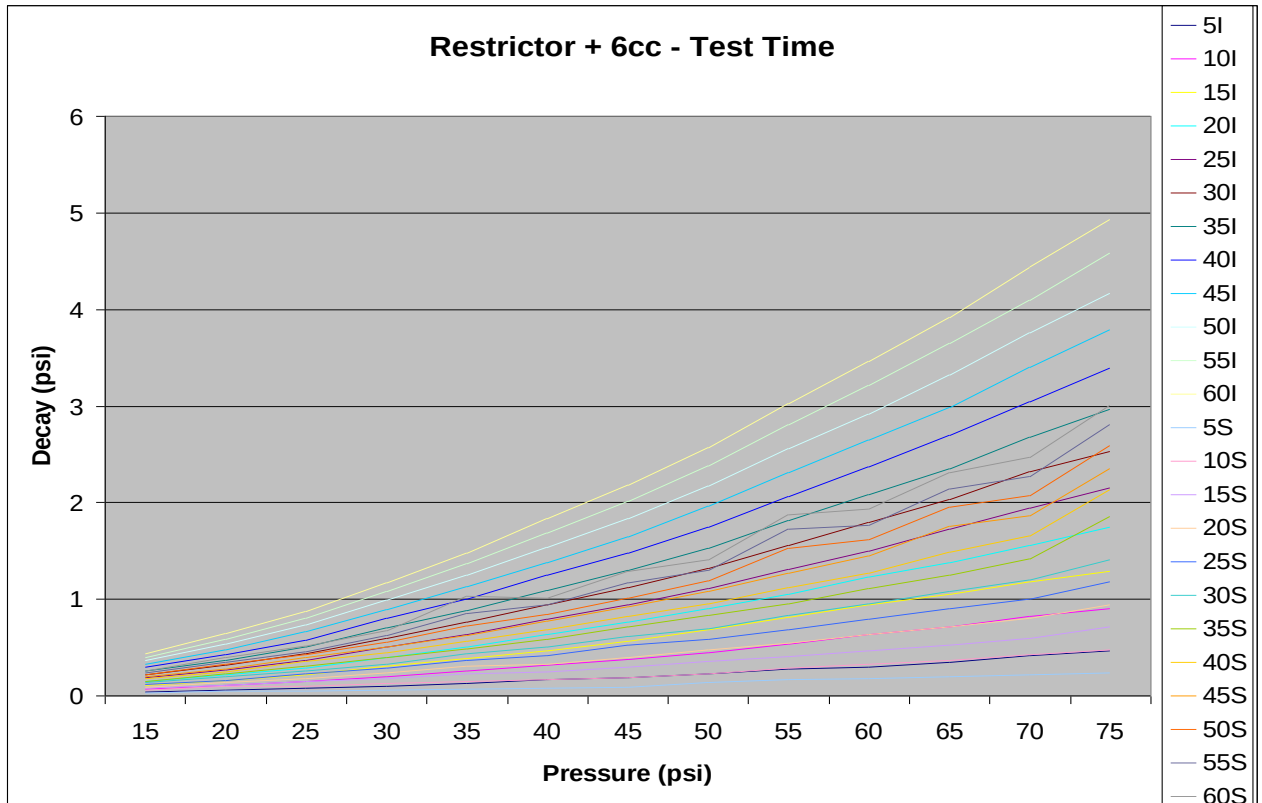
The following chart presents all the test runs with restrictor + 4cc fixture,



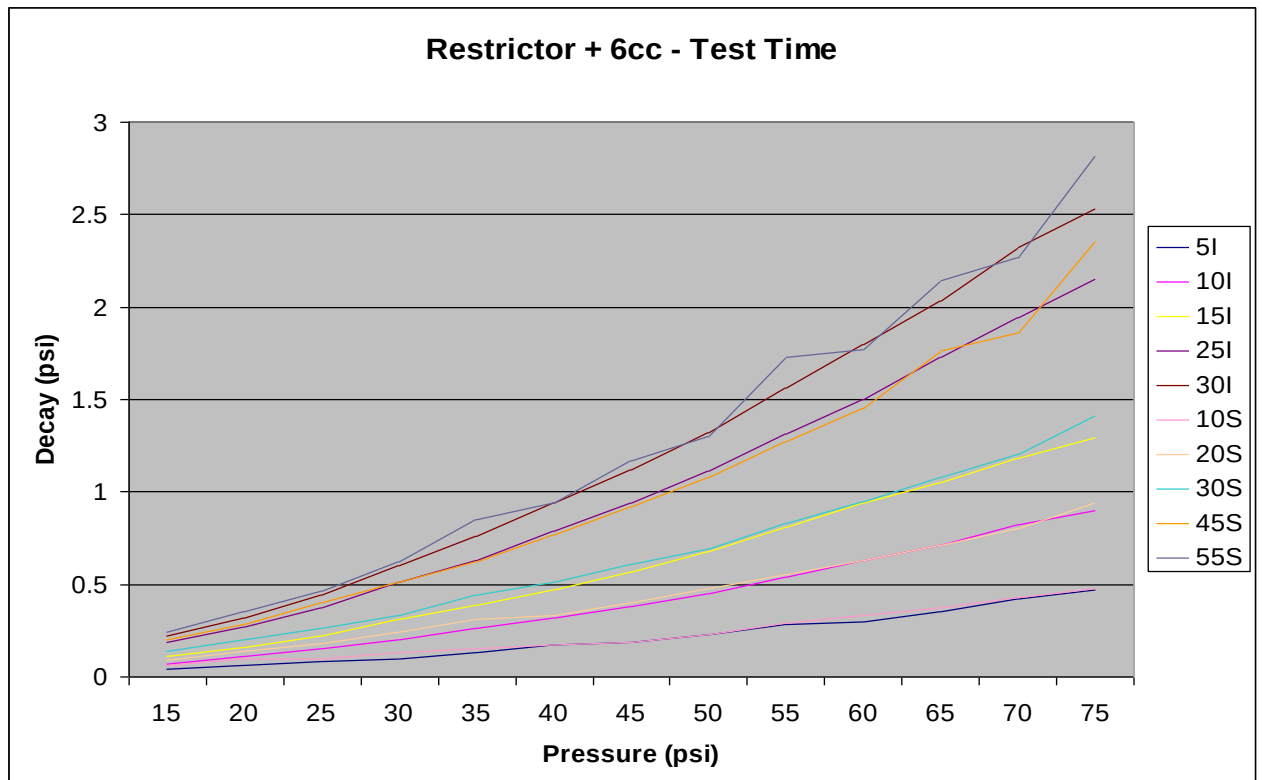
At this test level, the chart shows test runs on Sprint LC model at 60, 40, 30, 20 and 10 seconds are comparable to 30, 20, 15, 10, and 5 seconds on the Isaac model as shown on the chart below,



The following chart presents all the test runs with restrictor + 6cc fixture,



At this test level, the chart shows test runs on Sprint LC model at 55, 45, 30, 20 and 10 seconds are comparable to 30, 25, 15, 10, and 5 seconds on the Isaac model as shown on the chart below,



## Conclusions and recommendations

The test results show,

1. Due to the difference in internal volume, the Isaac that has smaller internal volume is more sensitive (i.e. larger pressure decay) than the Sprint using the same test parameters.
2. As the external volume increases, the ratio of pressure decays (Isaac/Sprint) decreases.

It is recommended that the required test time for Isaac is lowered. A conservative estimate is that most of the products tested for pressure decays have combined product and fixture volume less than 8cc. If this is the case, Isaac test time that is 50% less than Sprint test time would not, based on current leak acceptance of products using Sprint, allow the release of non-conformance products. In other word, the use of Isaac leak tester at one half of current test time for Sprint would lead to producer's risk of rejecting a good lot. A gage R&R should be completed to prove this hypothesis and to demonstrate that the risk is acceptable.