



TEST REPORT

1 General Information:

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1.5 Documentation:

The final review and approval of this document before its release to the client are the joint responsibilities of the following personnel at Technical Safety Services. In signing this cover sheet, these individuals acknowledge the accuracy of the data and activities reported herein:

Brian Harrington
Calibration Technician

date: 21 Aug 2006

Pete Mackes
Validation Manager

date: 21 Aug 2006

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1.6 Revision History:

This is a revision of report version Aug 04, 2006 for project NC-ARC060804-01 and supersedes that report. The revisions were restricted to the following: 1) Section 4.1 Pre-test Qualification was added; and, 2) Photographs of test apparatus for each configuration were added.

2 Product Under Test:

2.1 Arcoplast, Inc. provided Technical Safety Services, Inc. (TSS) with three (3) preassembled panels for pressure leak testing. As supplied to TSS, the Arcoplast composite (6mm) center core wall and ceiling liner panels with antimicrobial gel-coat finish were bonded to the components listed below. The three panels were tested in four configurations:

- Standard 24"x24" Panel
- 12" sealed metal duct mounted on standard panel
- Electrical box with plug mounted on standard panel
- Electrical box without plug mounted on standard panel

3 Test Criteria:

- 3.1 The Public Health Agency of Canada document, *Laboratory Biosafety Guidelines: 3rd Edition* (2004), requires that a Containment Level 4 room exhibit a maximum of 12.5 Pascal (Pa) per minute pressure drop at 500 Pascal over a twenty minute period.
- 3.2 The Public Health Agency of Canada document, *Laboratory Biosafety Guidelines: 3rd Edition* (2004), requires that that the air handling system ductwork of a Containment Level 4 room exhibit a maximum leakage rate equal to 0.1% of air volume per minute at 1,000 Pa, utilizing the procedure from ASME Standard N510, *Testing of Nuclear Air Treatment Systems* (1995). The ASME N510 procedure utilizes pressure decay values to calculate an average flow rate. The volume of the test enclosure was calculated to be 5.6 cubic feet. Therefore, the maximum rate of air leakage at 1,000 Pa is 0.0056 standard cubic feet per minute (scfm) for this test case.

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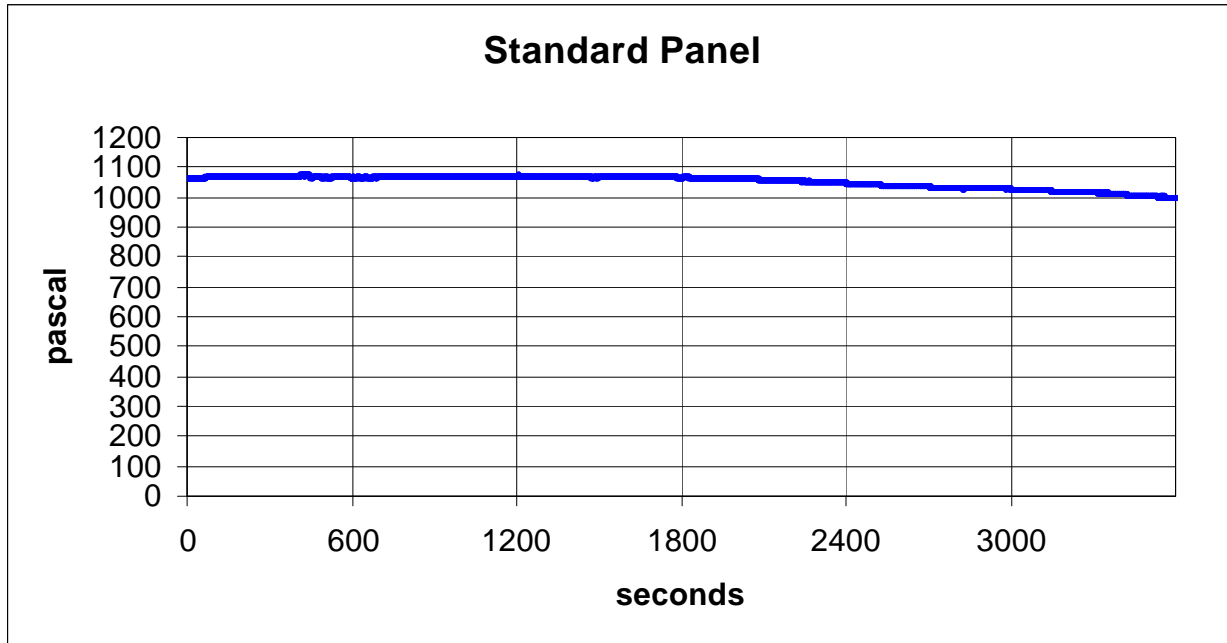
4 Test Procedure:

- 4.1 Pre-test Qualification: The acceptance criteria, as applied to the quantification of leakage rates, assumes that all leakage is attributed to the components sealed to the panel. Therefore, the sealing of the panel to the test apparatus must not significantly affect the measured leak rate. During the qualification of the test apparatus, it was determined that mounting the gel-side of the Arcoplast panels to the test apparatus produced almost no leakage. (Mounting to the unfinished side of the Arcoplast panels did not consistently create an effective seal.) Leakage is induced by establishing a quantifiable differential pressure across the panel. This pressure differential can be produced by either a vacuum or pressure source, with no effect on the leakage rate measurements. TSS chose to use a pressure source, since this methodology (pressurization with helium gas) had been used to qualify the test apparatus.
- 4.2 The Arcoplast panels were each (one configuration at a time) mounted gel-side down to a leak-free 0.5" thick Plexiglas enclosure using a foam rubber gasket, Dow Corning Type 111 grease, and sixteen (16) C-Clamps.
- 4.3 A hose-barb fitting was installed, and sealed to the enclosure. Tubing was connected between the fitting and an NIST traceable, calibrated pressure transducer (MKS Baratron EQ206).
- 4.4 The output (0-5V DC) of the pressure transducer was logged using an NIST traceable, calibrated multimeter (Fluke 189 EQ1283) connected to a laptop computer running FlukeView software.
- 4.5 A compressed air fitting and a valve were installed, and sealed to the enclosure.
- 4.6 The enclosure was pressurized to ~1,000 Pa with compressed air and the valve was closed.
- 4.7 The pressure transducer voltage was logged once every second. The panel with the electrical box without plug was logged over a two minute period. The other panel configurations had the pressure logged over a one hour period.
- 4.8 A control test was also performed. The valve was opened to atmosphere to log "zero" for a one-minute period. The valve was then closed and the pressure rise due to air density change was logged for a fifty-nine minute period.
- 4.9 The output of the pressure transducer (0-5V) corresponds to 0-10 mmHg. The logged voltages were copied into a spreadsheet. The voltages were then converted into mmHg, and then into Pascal (Pa). The pressure (Pascal) vs. Time (seconds) was graphed for each panel configuration. Note: 1,000 Pa is approximately 4" water column (w.c.).

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5. Test Results:

5.1 Standard 24"x24" Panel

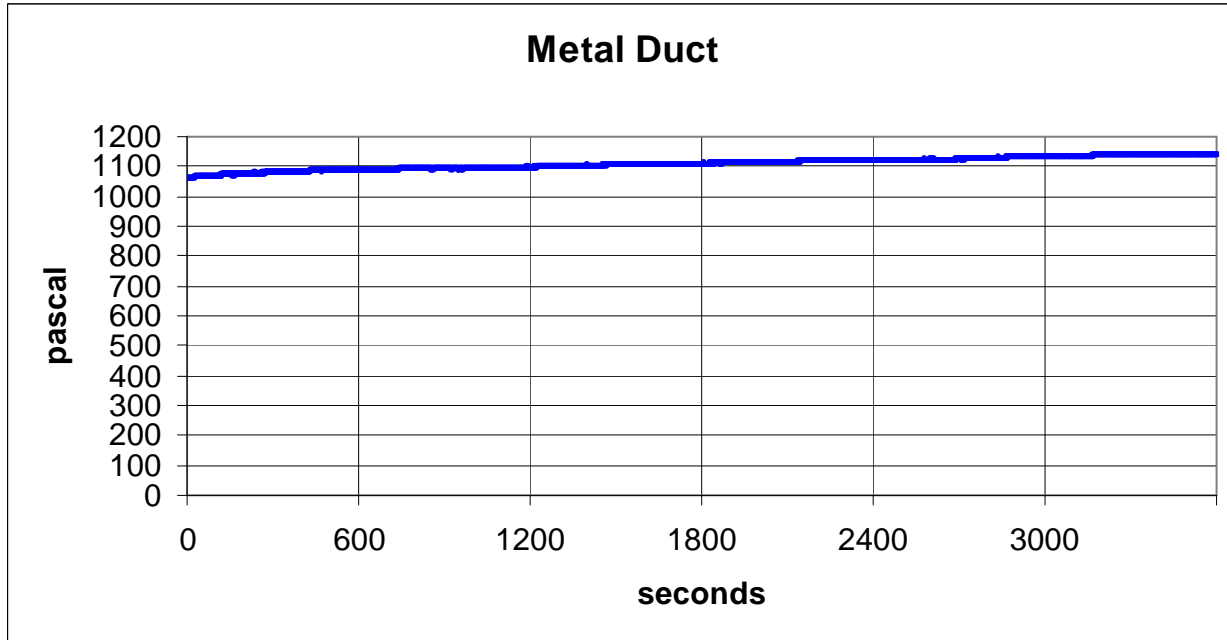


Start Pressure	1062.8 Pa
End Pressure	999.3 Pa
Average pressure drop over one hour period	1.6 Pa/min
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	less than 0.001 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS



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5.2 12" sealed metal duct mounted on standard panel



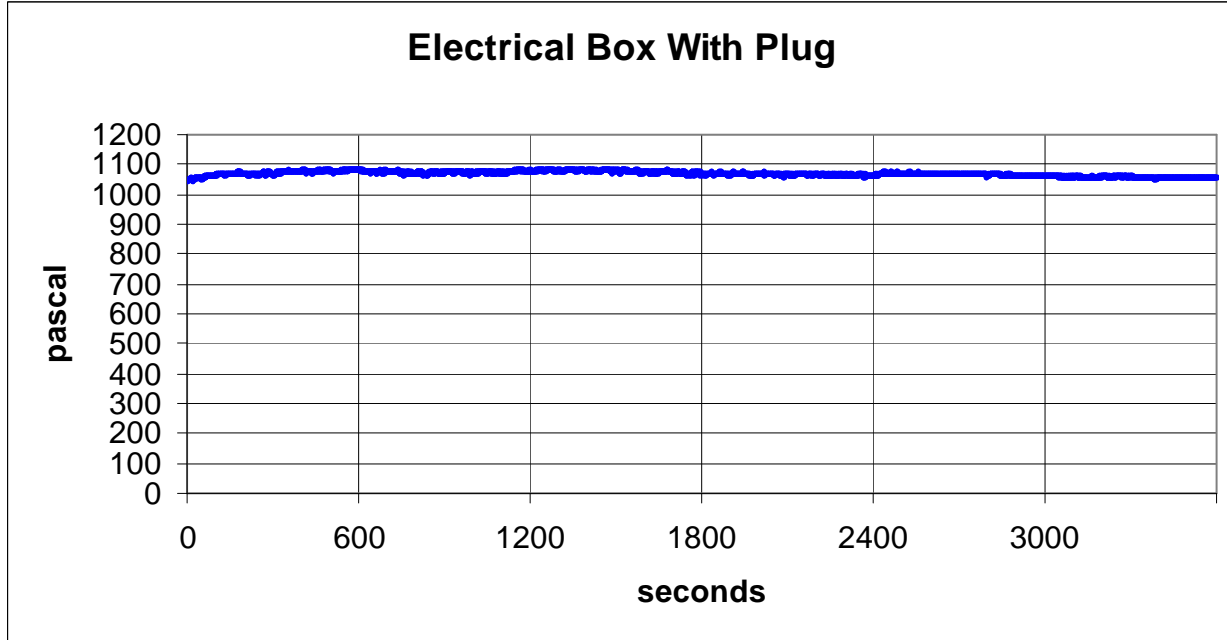
Start Pressure	1065.6 Pa
End Pressure	1143.7 Pa
Average pressure drop over one hour period	-1.3 Pa/min ¹
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	less than 0.001 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS



¹ Negative value indicates pressure increased. See discussion in Section 6.

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5.3 Electrical box with plug mounted on standard panel



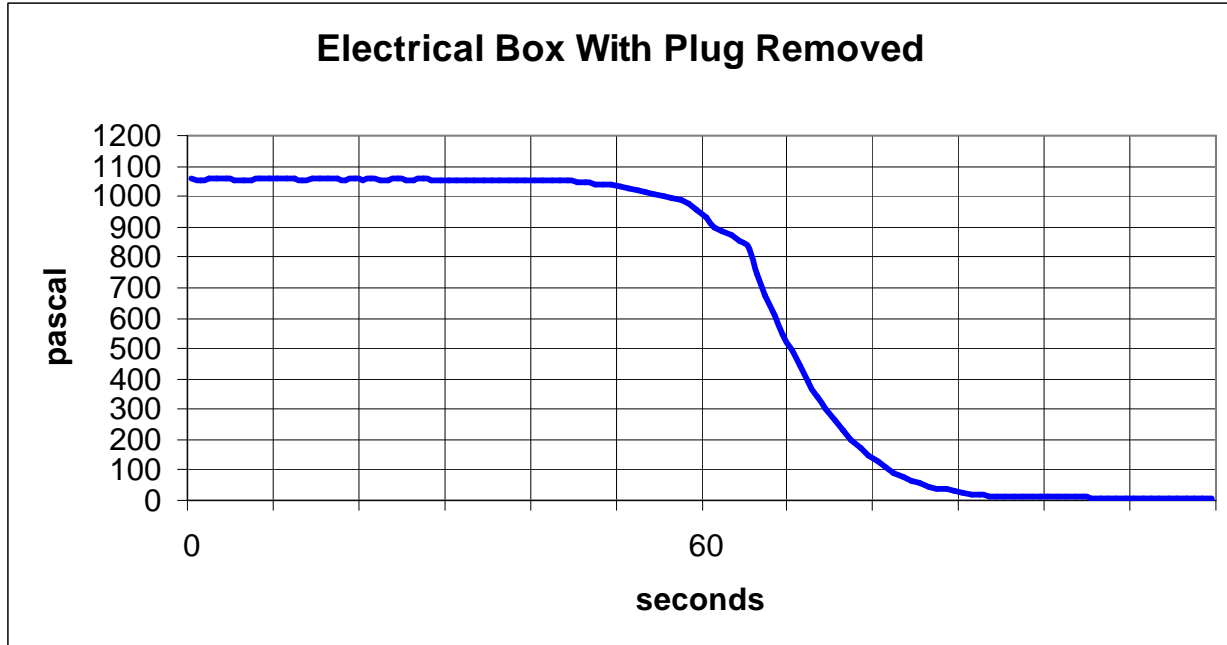
Start Pressure	1044.1 Pa
End Pressure	1056.3 Pa
Average pressure drop over one hour period	-0.2 Pa/min ²
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	less than 0.001 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS



² Negative value indicates pressure increased. See discussion in Section 6.

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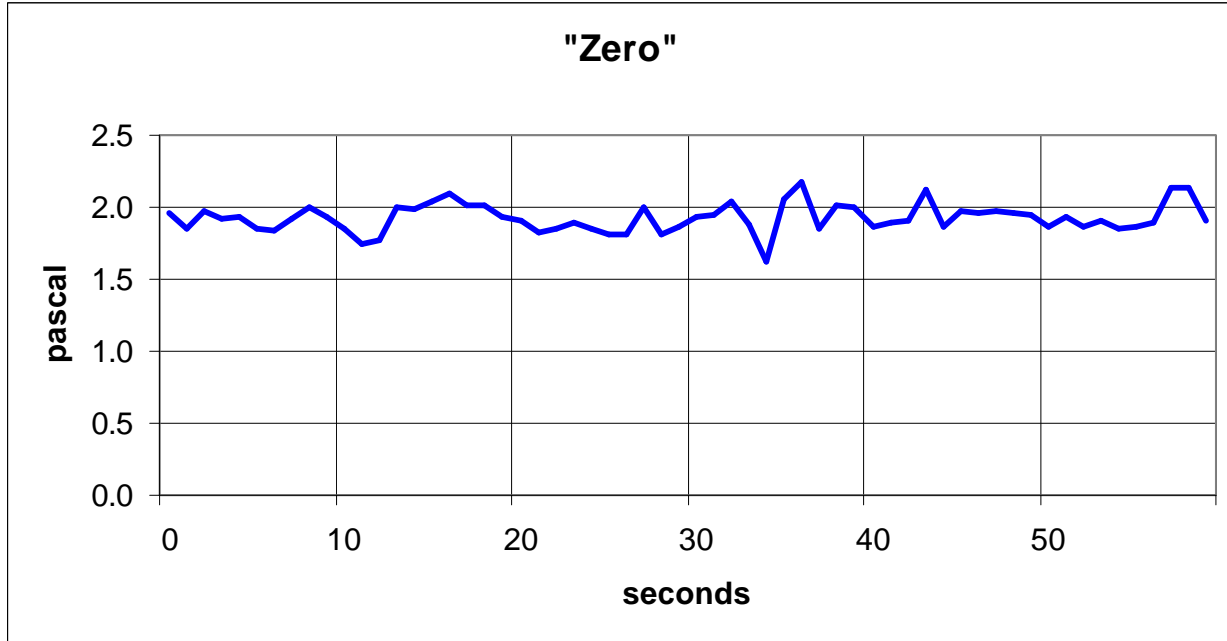
5.4 Electrical box without plug mounted on standard panel. Plug removal began at 50 second mark and completed at 70 second mark.



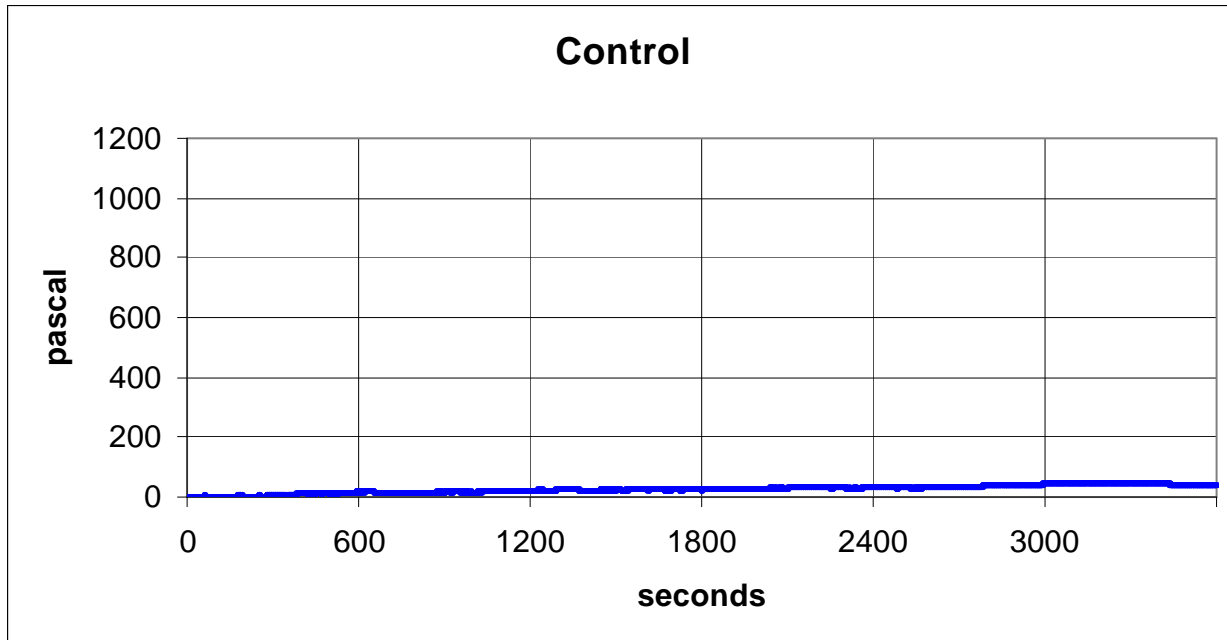
Start Pressure	1055.7 Pa
End Pressure	8.2 Pa
Average pressure drop per minute over two minute period	523.7 Pa/min
Test Criteria 3.1 (maximum 12.5 Pa/min)	FAIL
Average flow rate over two minute period	>> 0.0056 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	FAIL

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5.5 Control with standard 24"x24" panel. Valve opened to atmosphere at beginning of test.



Valve then closed at one minute mark.



Start Pressure	2.0 Pa
Pressure at one-minute	2.0 Pa
End Pressure	40.2 Pa
Average pressure rise over 59 minute period	0.6 Pa/min

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6 Discussion:

- 6.1 During the control test at “zero” (atmospheric pressure), an “offset” of 2 Pa was shown. This is within the tolerance of the pressure transducer. This does not affect the PASS/FAIL status of the panels tested. All tests were initiated well above 1,000 Pa; a 2 Pa offset is not significant.
- 6.2 During the control test under “sealed” conditions, an average pressure rise of 0.6 Pa/min was measured. This does not affect the PASS/FAIL status of the panels tested. All tests were well within the acceptance criteria of 12.5 Pa/min; a 0.6 Pa increase is not significant. This pressure rise was caused by changes in air density, predominantly due to temperature. Since pressure increases were seen for the electrical box test and the round duct test, the conclusion is that these panels approached the sealed conditions exhibited by the control apparatus. Since different materials have different coefficients of heat transfer, the “metal duct” conducted more heat into the box and therefore demonstrated a slightly higher pressure increase.

7 Conclusion:

- 7.1 The standard 24”x24” panel PASSES Test Criteria 3.1 and 3.2.
- 7.2 The 12” sealed metal duct mounted on standard panel PASSES Test Criteria 3.1 and 3.2.
- 7.3 The electrical box mounted on the standard panel with the plug PASSES Test Criteria 3.1 and 3.2.
- 7.4 The electrical box mounted on the standard panel without the plug FAILS Test Criteria 3.1 and 3.2. The plug must be in place or massive pressure loss results.