TEST REPORT

1 General Information:

1.1 Project Site:
Technical Safety Services, Inc.
620 Hearst Avenue
Berkeley, CA 94710
1.800.877.7742

1.2 Project Contacts:
Ghislain Beauregard
President
Arcoplast, Inc.
1873 Williamstown Drive
St. Peters, MO 63376
1.888.736.2726

Ben Gonzales, PE, CSP
President
Technical Safety Services, Inc.

1.3 TSS Project Lead:
Martin Burke
Engineering Manager
Technical Safety Services, Inc.

1.4 Documentation:

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

Martin Burke _____ date: 3/8/2007
Manager, Engineering

2 Product Under Test and Purpose of Testing:

2.1 Arcoplast, Inc. provided Technical Safety Services, Inc. (TSS) with four (4) preassembled panels for pressure leak testing. Each panel was a 24"x24" section of Arcoplast composite (6 mm) center core wall and ceiling liner material with antimicrobial gel-coat finish. Each panel had a single, #12 stainless steel, pan-head, self-tapping screw inserted approximately in the middle of the panel from the gel-side, and each screw received a different sealing treatment, as follows:

Panel 1 Screw without additional sealing.

Panel 2 Screw and hole cleaned with IPA and sealed with Dow/Corning Type 999A Glazing Sealant (a premium, construction-grade sealant).

Panel 3 Screw and hole cleaned with IPA and sealed with Arcoplast finishing compound X279233 (a custom-formulated sealant).

Panel 4 Screw, hole and bracket cleaned with IPA and sealed with Arcoplast finishing compound X279233.

2.2 The purpose of this study was to evaluate the differences between the four sealing treatments.

2.3 This March 3, 2007 report supercedes the February 15, 2007 report for the same data, which misstated the size of the reference screw and hole.

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.

4 Test Procedure:

4.1 Pre-test Qualification: The test apparatus was qualified during an earlier project (TSS Project NC-ARC060804-01A (Aug 01-04, 2006)). 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 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 EQ 1283) connected to a laptop computer running FlukeView v3.0 software.

4.5 A compressed air fitting and a valve were installed, and sealed to the enclosure.

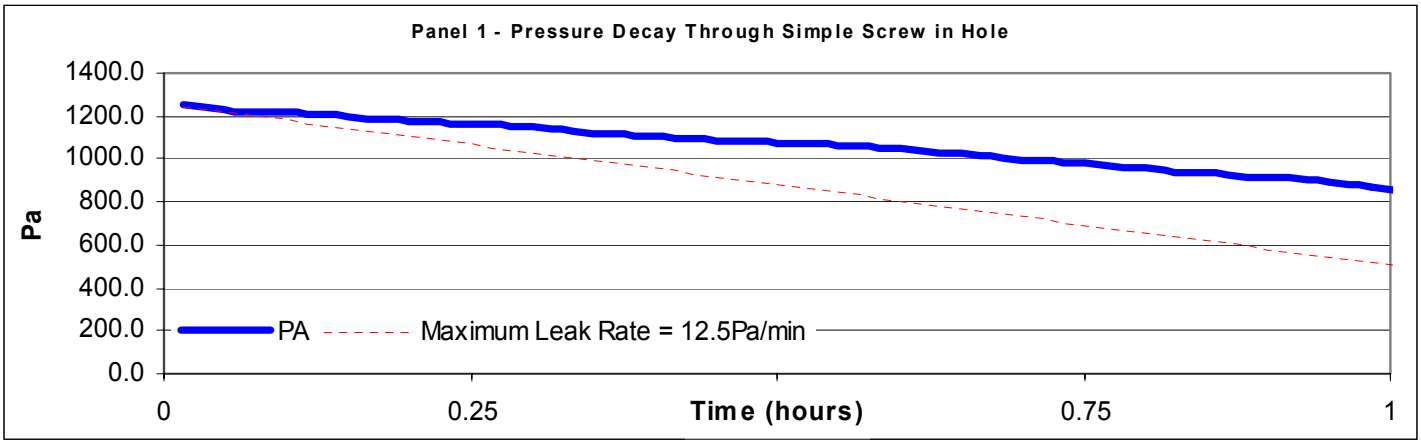
4.6 The enclosure was pressurized to ~1,000 Pa with compressed air and the valve was closed.

4.7 The pressure transducer voltage was logged once every second, over a one hour period.

4.8 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 (hours) was graphed for each panel configuration. Note: 1,000 Pa is approximately 4” water column (w.c.).

5. Test Results:

5.1 Panel 1 - Screw without additional sealing



Start Pressure	1255.3 Pa
End Pressure	859.0 Pa
Average pressure drop over one hour period	6.8 Pa/min
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	0.00037 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS

Panel 1 – Screw seen from non-gel side

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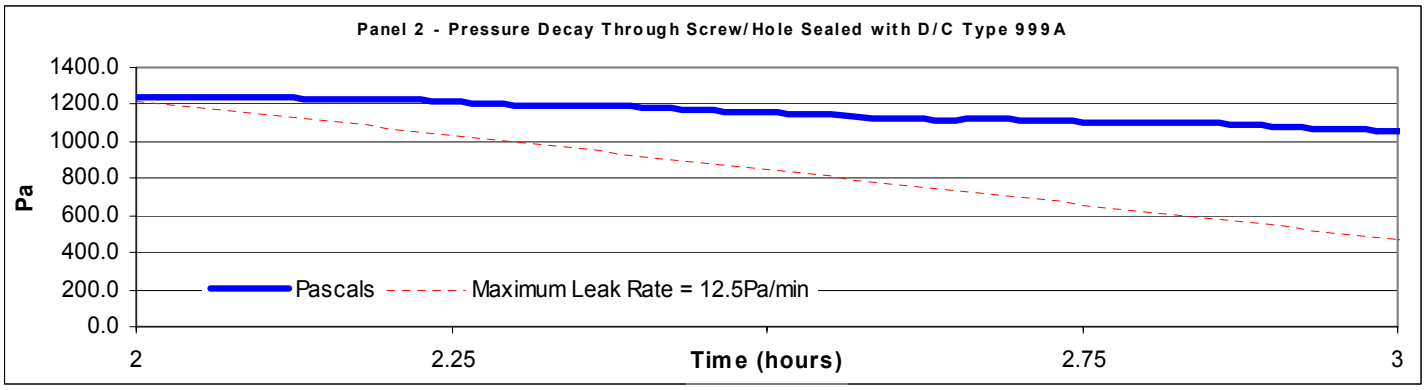
5.2 Panel 2 - Screw and hole cleaned with IPA and sealed with D/C 999A

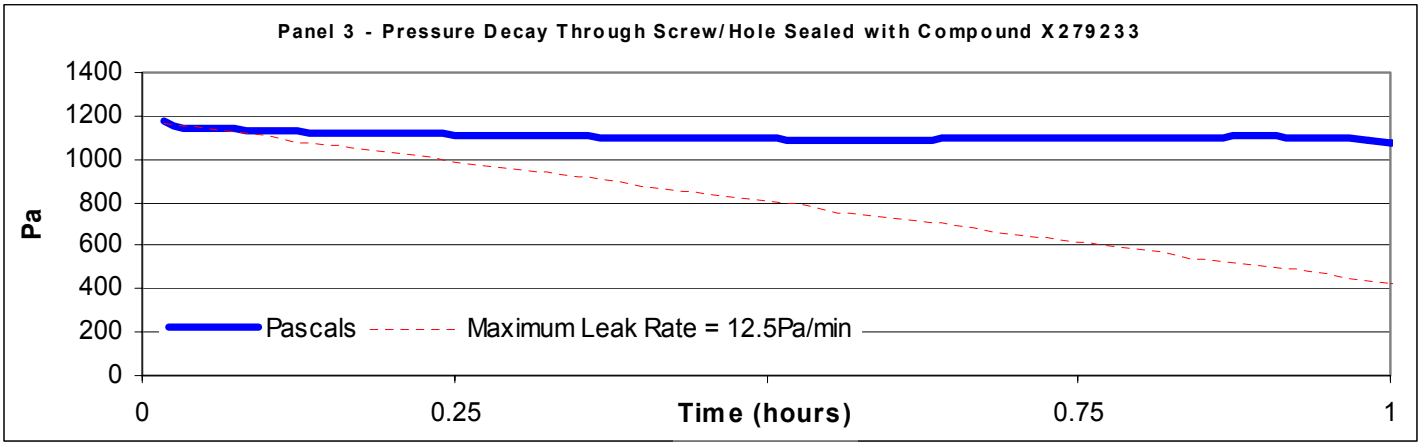


(Note, this is the second hour of data; the first hour of data-logging Panel 2 showed negligible leakage)

Start Pressure	1214.9 Pa
End Pressure	1017.5 Pa
Average pressure drop over one hour period	3.3 Pa/min
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	0.00018 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS

Panel 2 – Screw seen from non-gel side

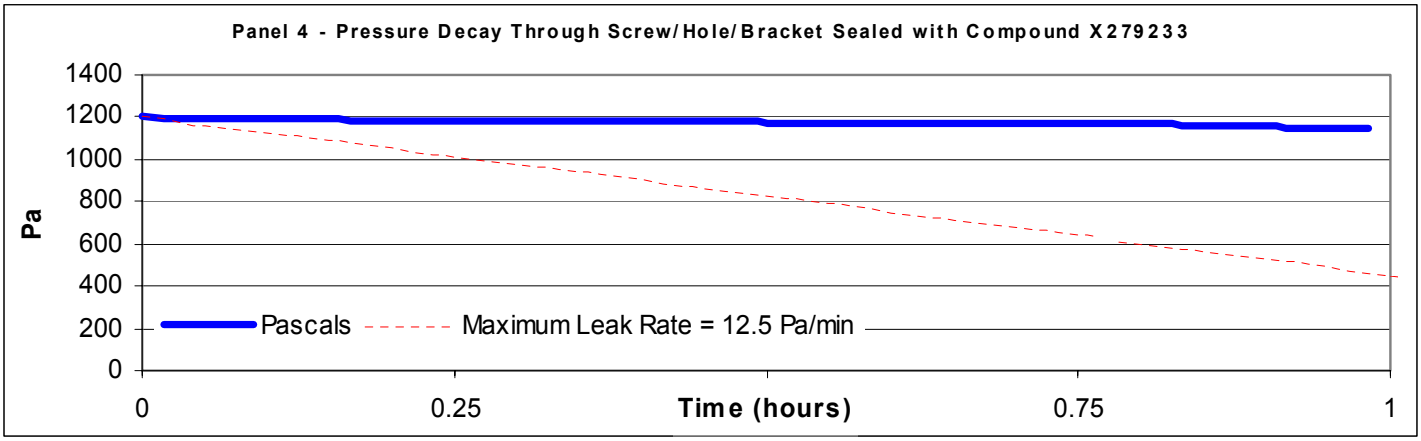
5.3 Panel 3 - Screw and hole cleaned with IPA and sealed with Arcoplast finishing compound X279233



Start Pressure	1178.5 Pa
End Pressure	1070.8 Pa
Average pressure drop over one hour period	1.7 Pa/min
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	0.00010 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS

Panel 3 – Screw seen from non-gel side

5.4 Panel 4 - Screw, hole and bracket cleaned with IPA and sealed with Arcoplast finishing compound X279233



Start Pressure	1063.9 Pa
End Pressure	993.2 Pa
Average pressure drop per minute over one hour period	0.9 Pa/min
Test Criteria 3.1 (maximum 12.5 Pa/min)	PASS
Average flow rate over one hour period	0.000065 scfm
Test Criteria 3.2 (maximum 0.0056 scfm)	PASS

Panel 4 – Screw seen from non-gel side; screw head on gel side of panel holds a bracket

6 Discussion:

6.1 The study was conducted simply and without unusual complication. TSS notes that the test apparatus requires particular attention to greasing the flange-seal during the installation of each test article (panel).

6.2 The photographs of the screws in panels 2-4 suggest that move of the sealing compound in the actual hole is carried away by the tip of the screw. Very little sealant is likely left in the threaded portion of the panel, providing a properly-sized pilot hole is made.

6.3 Considerations regarding the inherent accuracy/drift of the apparatus are presented in earlier studies. TSS took every reasonable effort to minimize temperature and barometric pressure effects, the data collected and reported herein was sensitive to those considerations and is presented here as accurate.

7 Conclusion and Summary:

7.1 All four (4) test panels PASS Test Criteria 3.1 and 3.2.

7.2 The nude screw performed the least satisfactorily, the screw with the D/C compound had about half the leakage of the nude screw, and the two screws treated with the Arcoplast finishing compound performed the best in this study.

7.3 The overall results are summarized here:

Panel	1-Hour Leak rate, Pa/min	Meets Criterion, <=12.5 Pa/min?	1-Hour Leak rate, scfm	Meets Criterion, <=0.0056 scfm?	Comment
1	6.76	Pass	0.000374	Pass	Panel with a simple screw in it and no additional sealing
2	3.29	Pass	0.000182	Pass	Panel with screw and hole cleaned with IPA and sealed with D/C 999A
3	1.69	Pass	0.000099	Pass	Panel with screw and hole cleaned with IPA and sealed with Arcoplast finishing compound X279233
4	0.92	Pass	0.000065	Pass	Panel with screw, hole and bracket cleaned with IPA and sealed with Arcoplast finishing compound X279233