Appendix E

IGU Removal Photos

APPENDIX E: IGU Removal and Investigation Photos

Three Visionwall IGUs were removed from the building between January and March 2009 for analysis and testing. One IGU at suite 3903 (44774) where the interior tempered lite and spontaneously broken due to a nickel sulphide inclusion, and two IGUs at suite 3803. Of the two IGUs removed at suite 3803, only the first IGUs could be used for laboratory testing. The second of the removed IGUs had to be reinstalled when it was discovered that the replacement IGU seal had already failed and the unit had low-e corrosion damage. Graham Finch, MASc, EIT and/or Brian Hubbs, P.Eng of RDH were present during the replacement of each of the IGUs and performed the documentation below.

Suite 3903 – Broken IGU Removed January 18, 2009 – Spontaneous Glass Breakage

Figure E1: IGU 44774, Suite 3903 to be removed. Inner lite of tempered glass broke in October 2007 as the result of a nickel sulphide glass inclusion.

Figure E2: Removal of IGU using crane and swing stage

Figure E3: Corner condition of IGU 44774.

Figure E4: Buckling of stainless steel edge band (edge seal discontinuity PH2). See Figure E76 for edge seal drawing.

Figure E5: Buckling of stainless steel edge band (edge seal discontinuity PH1)

Figure E6: Buckling of stainless steel edge band (edge seal discontinuity PH1). Knife inserted into fish-mouth to show un-adhered edge seal.

Figure E7: Buckling of stainless steel edge band (edge seal discontinuity PH1). Stainless steel edge seal cut away revealing sealant and vinyl/aluminum spacer joint.

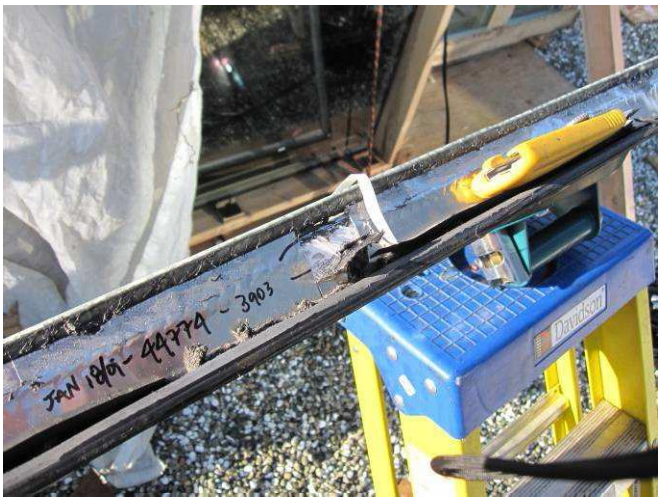

Figure E8: Buckling of stainless steel edge band (edge seal discontinuity PH2). Stainless steel edge seal cut away revealing sealant and vinyl/aluminum spacer joint.

Figure E8: Close-up of buckled of stainless steel edge band (edge seal discontinuity PH2). Stainless steel edge seal cut away revealing sealant and vinyl/aluminum spacer joint.

Figure E9: Buckling of stainless steel edge band (edge seal discontinuity PH3).

Figure E10: Buckling of stainless steel edge band (edge seal discontinuity PH4).

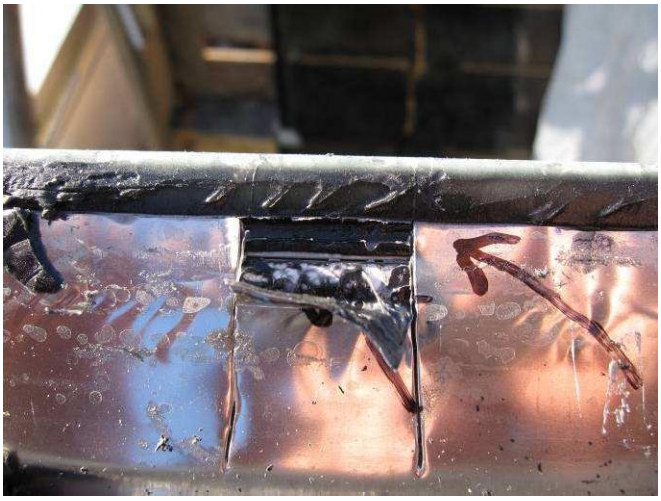

Figure E11: Buckling of stainless steel edge band (edge seal discontinuity PH4). Stainless steel edge seal cut away revealing sealant and vinyl/aluminum spacer joint.

Figure E12: Buckling of stainless steel edge band (edge seal discontinuity PH4). Stainless steel edge seal cut away revealing sealant and vinyl/aluminum spacer joint, close-up.

Figure E13: Vinyl extrusion edge spacer, note gap between components. Stainless steel spacer therefore acts as the primary air/vapour/moisture IGU seal.

Figure E14: Vinyl extrusion edge spacer, note gap between components.

Figure E15: Typical corner configuration with welded vinyl corner piece. Long extrusion along sill and jambs is not connected to the corner piece, a significant discontinuity and therefore relies on stainless steel foil to be air-tight.

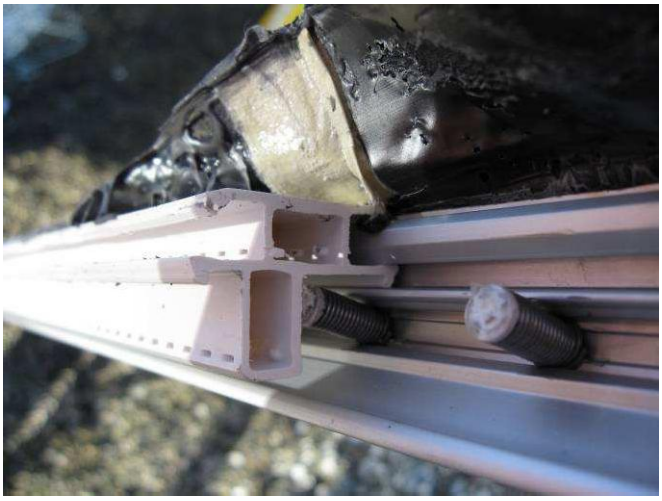

Figure E16: Vinyl/Aluminum spacer profile.

Figure E17: IGU 44789, moderate low-e corrosion, May 2008 dewpoint of -4°C. This IGU, to the west of replaced unit showed interstitial fogging during replacement of the adjacent unit – shown in detail in Figure E18/E19

Figure E18: Interstitial fogging within IGU 44789, as result of shading of swing-stage on unit. IGU heated by sunlight to drive moisture out of desiccant resulted in condensation of moisture on colder shaded surface.

Figure E19: Interstitial fogging within IGU 44789, as result of shading of swing-stage on unit. IGU heated by sunlight to drive moisture out of desiccant resulted in condensation of moisture on cold shaded surface.

Figure E20: Old unmarked IGU on roof previously replaced by a contractor as result of tempered lite glass breakage. IGU edge condition reviewed during visit.

Figure E21: Unmarked IGU, one of several fish-mouth openings in stainless steel edge band – similar to that observed on removed unit 44774.

Suite 3803 – Test IGU Removed February 28, 2009

Figure E22: IGU 43161 removed from suite 3803 – severe low-e corrosion noted.

Figure E23: Suite 3803 – dining/kitchen, removal of IGU.

Figure E24: Sill of glazing pocket, clean and dry. Drainage hole at center shown, additional drainage holes at each jamb.

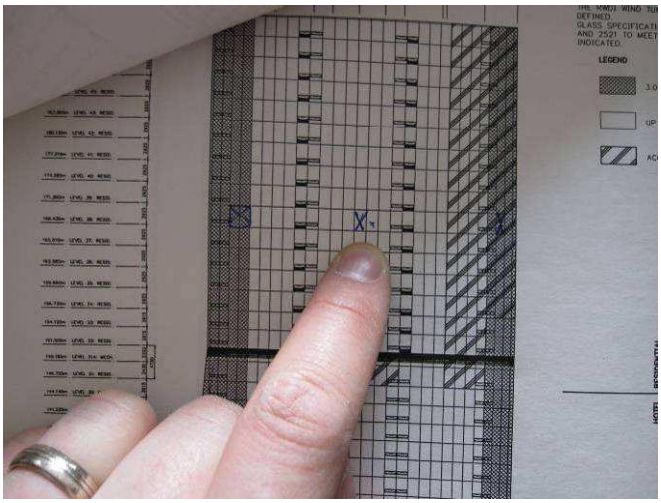

Figure E25: Location of removed unit at west corner of suite 3803.

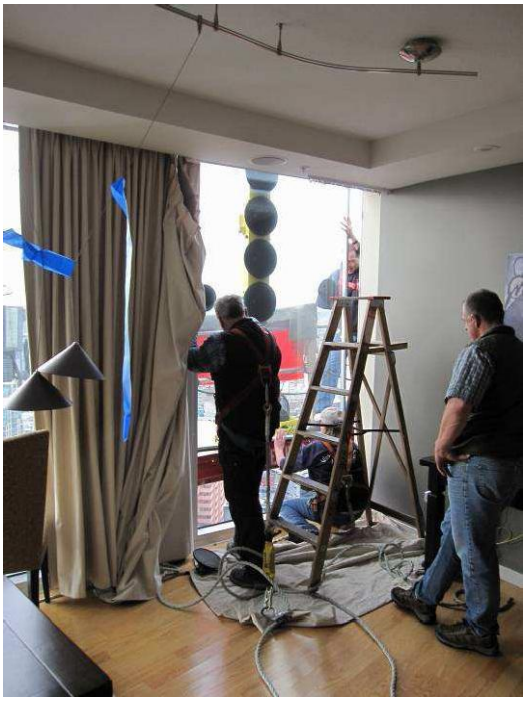

Figure E25: Removal of IGU from frame by contractor.

Figure E26: Sill corner drain hole into jamb. Drainage cavity clean and dry with no visible evidence of liquid water penetration.

Figure E27: IGU 43161, brought down to roof level for inspection.

Figure E28: Serial number and part number information for IGU 43161.

Figure E29: Location of desiccant tube – cut by contractor during glazing removal. The tube appeared well sealed into the IGU.

Figure E30: Lower left corner of IGU, as viewed from interior where several edge seal discontinuities were noted. When the IGU was removed, the stainless steel foil was not touched, cut or abraded as the cut structural sealant is on the exterior overhanging glass lite.

Figure E31: One of many fish mouth discontinuities in perimeter stainless steel foil edge seal.

Figure E32: Foil ripple edge seal discontinuity shown in Figure E31.

Figure E33: Location of large discontinuity in stainless steel edge seal. Delamination of stainless seal air-seal at the open joint between the vinyl corner and jamb spacer extrusion.

Figure E34: Close-up of edge seal discontinuity resulting in an opening directly through the edge seal into the IGU.

Figure E35: Insertion of smoke into IGU through edge seal at delaminated foil to confirm hermetic air-seal discontinuity.

Figure E36: Discontinuities in edge seal noted at lower left corner of IGU.

Figure E37: Discontinuities in edge seal noted at left jamb of IGU.

Figure E38: Discontinuities in edge seal noted an lower sill of IGU.

Figure E39: Tear in stainless steel edge band noted at sill.

Figure E40: Overview of failed IGU 43161 prior to crating up for laboratory testing.

Suite 3803, Unit 43161 – Laboratory Determination of Leakage Points

IGU 43161 removed from suite 3803 was setup in the laboratory in a horizontal configuration to locate and document the location of edge seal discontinuities. In addition, structural silicone samples were removed and tested from this window (which did not compromise or contact the edge seal). The structural silicone test results performed by RDH and DOW Corning are provided in Appendix G. The IGU was submerged into a water bath and pressurized (to at least 250 Pa above the applied water head to prevent water from entering the IGU) to locate and confirm the noted edge seal discontinuities. The testing is documented in the following figures.

Figure E41: Unit 43161 setup within a water bath to locate edge seal discontinuities.

Figure E42: IGU Submerged under water during testing. IGU was buoyant and therefore had to be restrained under the water for the test.

A total of 19 significant edge seal discontinuities resulting in air leakage through the perimeter edge seal were observed during the test. The location of each leak and its severity (a relative rating) is documented in Figure E43, with photographs of the leaks in Figures E44 through E63. See Figure E98 for an edge seal schematic.

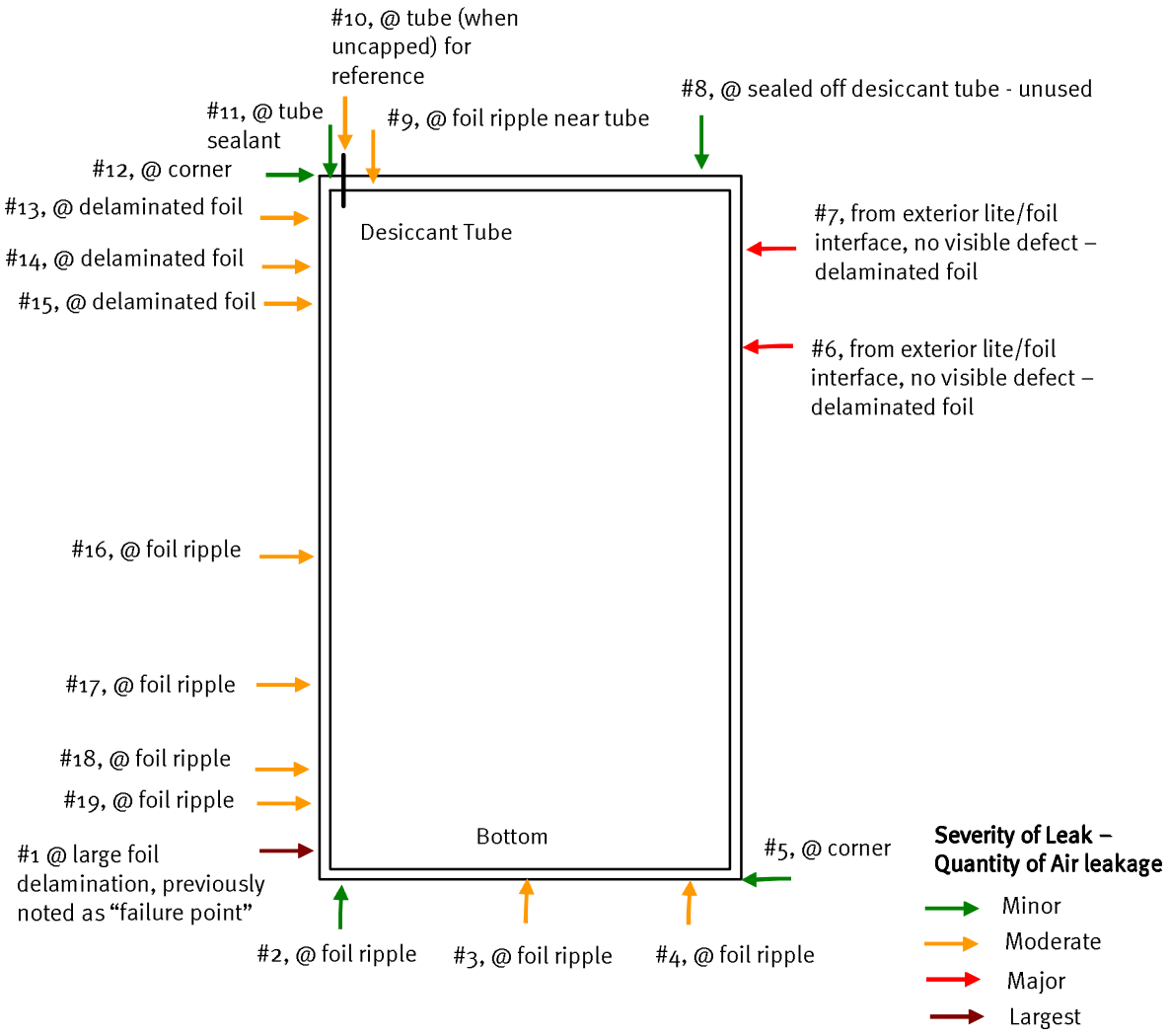

Figure E43: Documented Location of Edge Seal Discontinuities Identified During Water Bath Test

Figure E44: Injecting air into IGU through desiccant tube using air-compressor.

Figure E45: Lower left corner, largest visible discontinuity (#1) in foil. This obvious discontinuity was sealed with waterproof tape for first part of test to allow for IGU to be pressurized and locate other leakage paths.

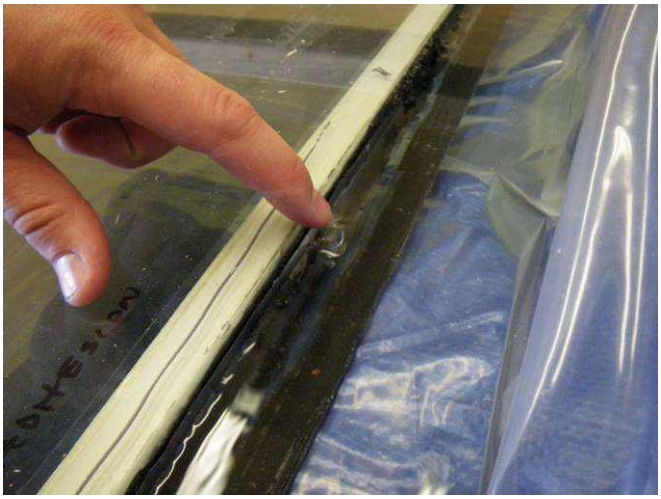

Figure E46: Edge seal discontinuity #15.

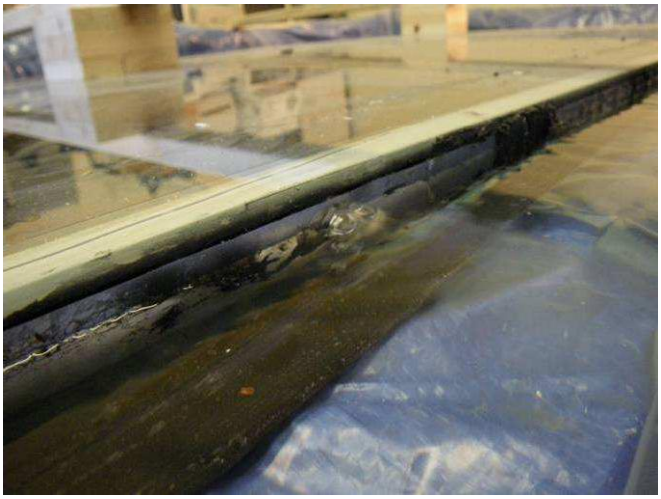

Figure E47: Edge seal discontinuity #15.

Figure E48: Edge seal discontinuities #6 and #7.

Figure E49: Edge seal discontinuity #1, continues to leak a small amount of air while sealed.

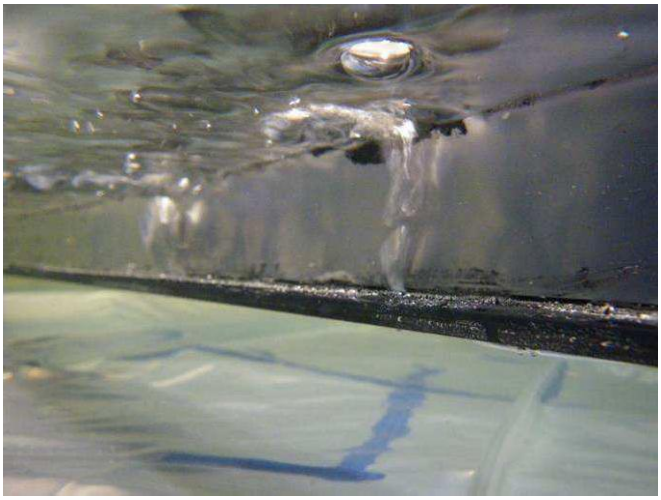

Figure E50: Edge seal discontinuity #7 (foreground) and #6, viewed underwater during test.

Figure E51: Desiccant tube used for pressurization during test, small leak through sealant around tube (#11). Note that sealant may have been damaged during removal of the IGU.

Figure E52: Minor leak at upper right side of IGU at the un-used but sealed-over desiccant tube hole (#8).

Figure E53: Discontinuities #9,11,12,13,14 at upper right corner of IGU.

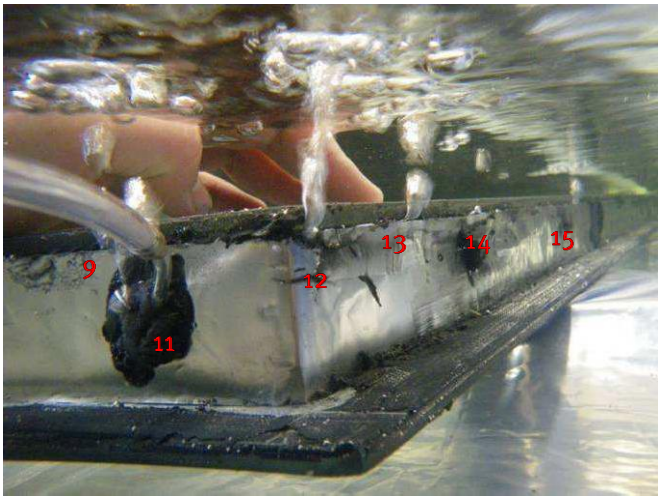

Figure E54: Discontinuities #9, 11, 12, 13, 14, & 15 at upper left corner as view from underwater.

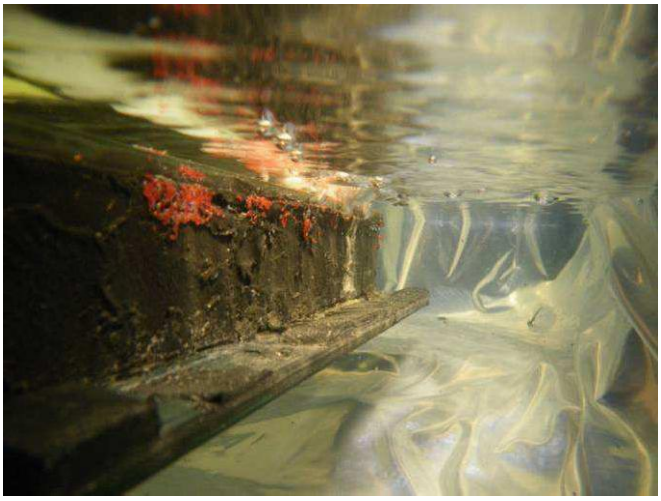

Figure E55: Discontinuity #1 at lower left corner of IGU.

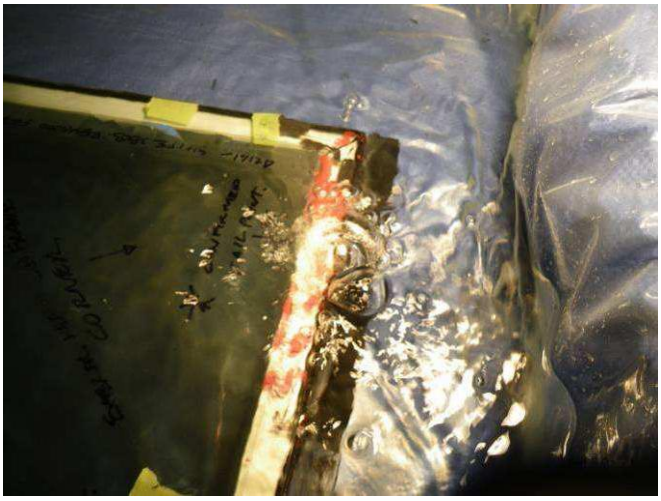

Figure E56: Discontinuities #1, #19 and #2 at lower left corner of IGU.

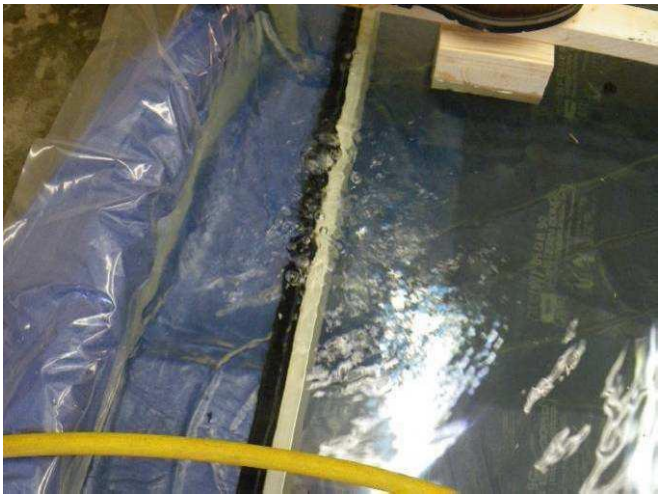

Figure E57: Discontinuities #6 and 7 and right side of IGU.

Figure E58: Discontinuity #16 at left side of IGU.

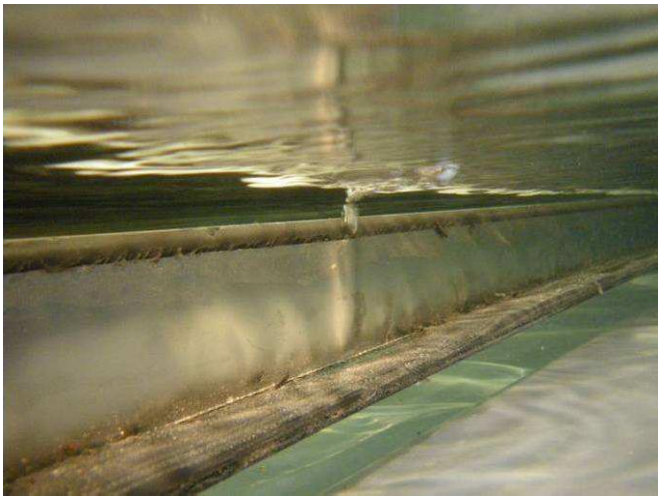

Figure E59: Discontinuity #16 viewed from underwater.

Figure E60: Discontinuity #12 @ upper left corner of IGU.

Figure E61: Discontinuities #9, 10, 11, and 12

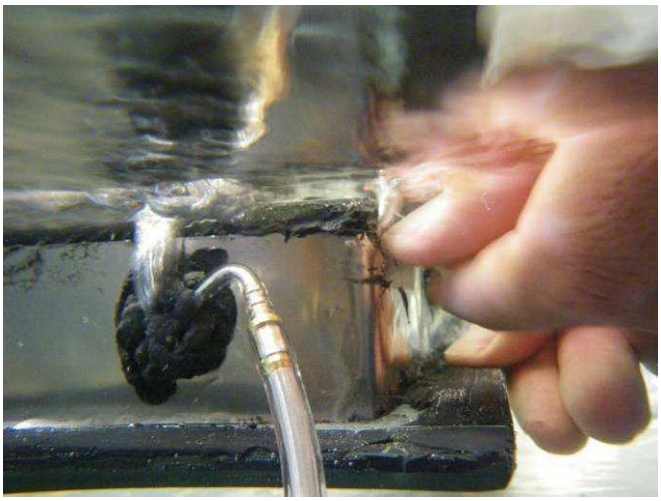

Figure E62: Discontinuities #11 and #12 (At corner)

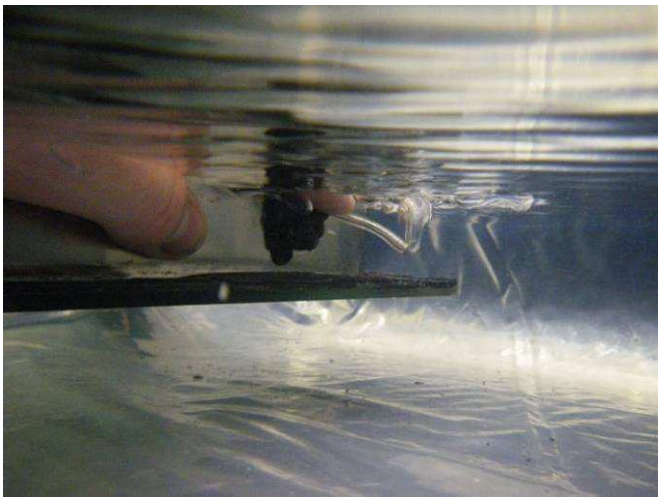

Figure E63: Air leakage at discontinuity #10 through desiccant tube, for reference. Volume coming through tube is approximately equal to that through a moderate sized discontinuity.

A video was also taken to document the location and relative volume of the discontinuities/air-leaks and is provided in electronic format with this report.

Suite 3803 – Test IGU Removed and Reinstalled March 22, 2009

Figure E64: IGU 43882 removed from suite 3803, master bedroom – severe low-e corrosion noted.

Figure E65: IGU 43882 prior to removal, severe low-e corrosion on IGU surface #2.

Figure E66: Removal of IGU 43882 from curtain wall framing.

Figure E67: Removal of IGU 43882 from suite 3803 at southeast corner of building.

Figure E68: Removed IGU 43882 placed in parking garage for visual inspection.

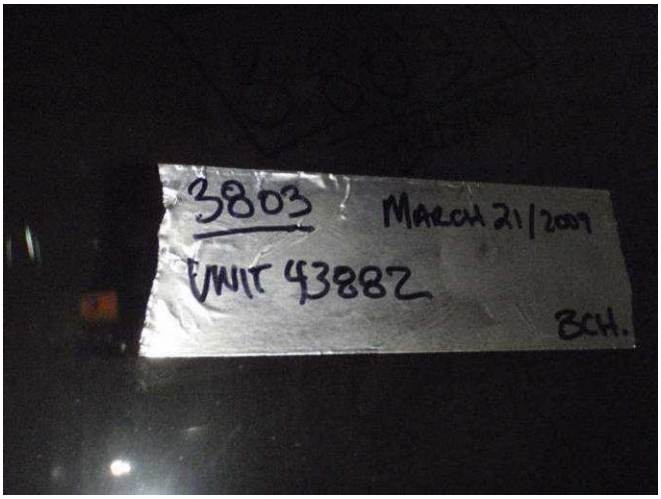

Figure E69: IGU 43882 removed from suite 3803.

Figure E70: Stainless steel edge band discontinuity #1 at corner of unit, allowing for air-leakage into IGU at vinyl corner/vinyl jamb extrusion joint. See Figure E98 for an edge seal schematic.

Figure E71: Stainless steel edge band discontinuity #2.

Figure E72: Stainless steel edge band discontinuity #2.

Figure E73: Stainless steel edge band discontinuity #3.

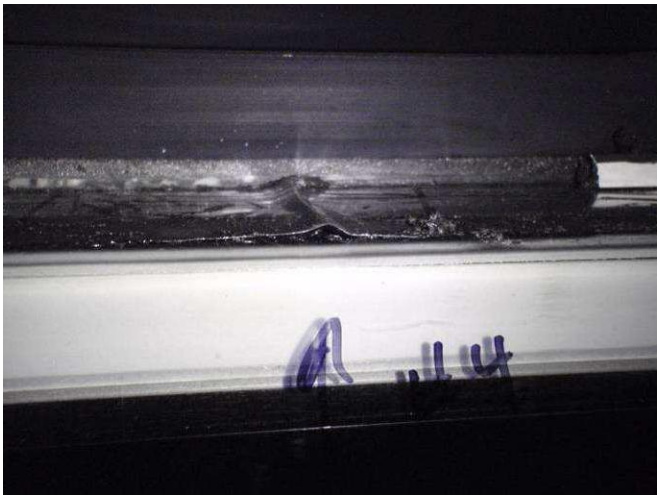

Figure E74: Stainless steel edge band discontinuity #4.

Figure E75: Stainless steel edge band discontinuity #4.

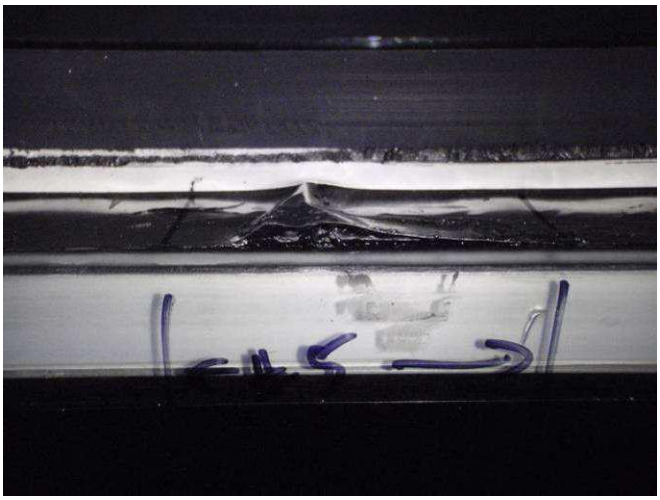

Figure E76: Stainless steel edge band discontinuity #5.

Figure E77: Stainless steel edge band discontinuity #5.

Figure E78: Stainless steel edge band discontinuity #6.

Figure E79: Stainless steel edge band discontinuity #6.

Figure E80: Stainless steel edge band discontinuity #7.

Figure E81: Stainless steel edge band discontinuity #7

Figure E82: Stainless steel edge band discontinuity #8.

Figure E83: Stainless steel edge band discontinuity #8.

Figure E84: Stainless steel edge band discontinuity #9, at corner.

Figure E85: Stainless steel edge band discontinuity #9 at corner.

Figure E86: Stainless steel edge band discontinuity #9 at corner.

Figure E87: Stainless steel edge band discontinuity #9 at corner.

Figure E88: Suite 3803 Replacement IGU 70017, in parking garage – severe low-e corrosion already noted. IGU not installed.

Figure E89: Suite 3803 Replacement IGU 70017, in parking garage – severe low-e corrosion already noted.

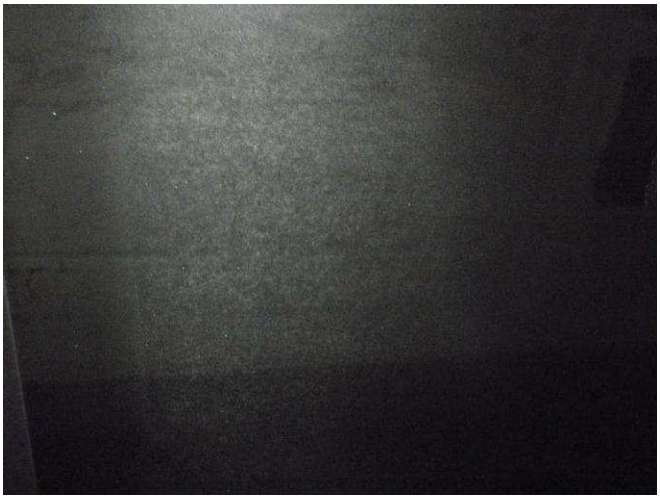

Figure E90: Suite 3803 Replacement IGU 70017, in parking garage – severe low-e corrosion already noted.

Figure E91: Suite 3803 Replacement IGU 70017, in parking garage – severe low-e corrosion already noted. Handprint on low-e coating visible.

Broken "New" Visionwall Unit Disassembly – February 28, 2009

Figure E92: Broken "new" style of Vision Wall IGU with alternate perimeter edge seal. Edge seal band was disassembled to determine as-built and air-sealing details. See Figure E99 for drawing.

Figure E93: Stainless Steel foil is covered with a black thermosetting sealant, but is not adhered to the vinyl spacer bar.

Figure E94: Gap in vinyl extrusions between corner and edge pieces allow air leakage directly into IGU should the perimeter edge seal be compromised (i.e. nicked during installation or at seal details).

Figure E95: Joint between vinyl extrusions – allows airflow directly into IGU if stainless steel foil is compromised.

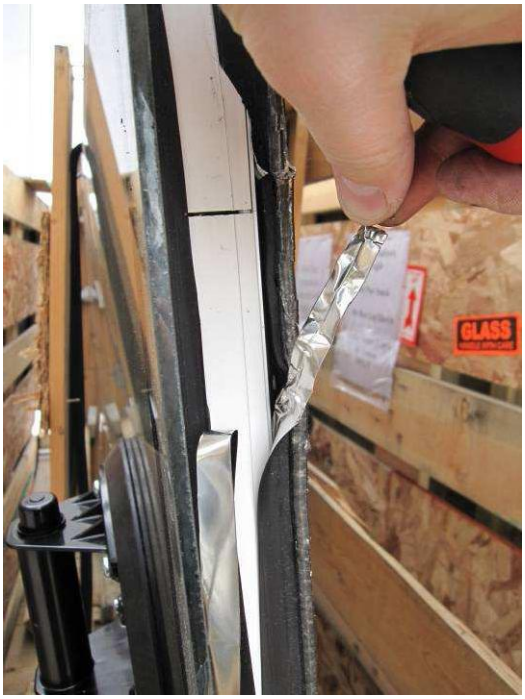

Figure E96: Edge of foil wrapped and sealed as shown in Figure E99.

Figure E97: Edge of foil wrapped and sealed as shown in Figure E99.

ONE WALL VISION WALL SPACER - AS BUILT

CA 02508173 2005-06-01

WO 2004/051045 PCT/CA2002/001889

1/2

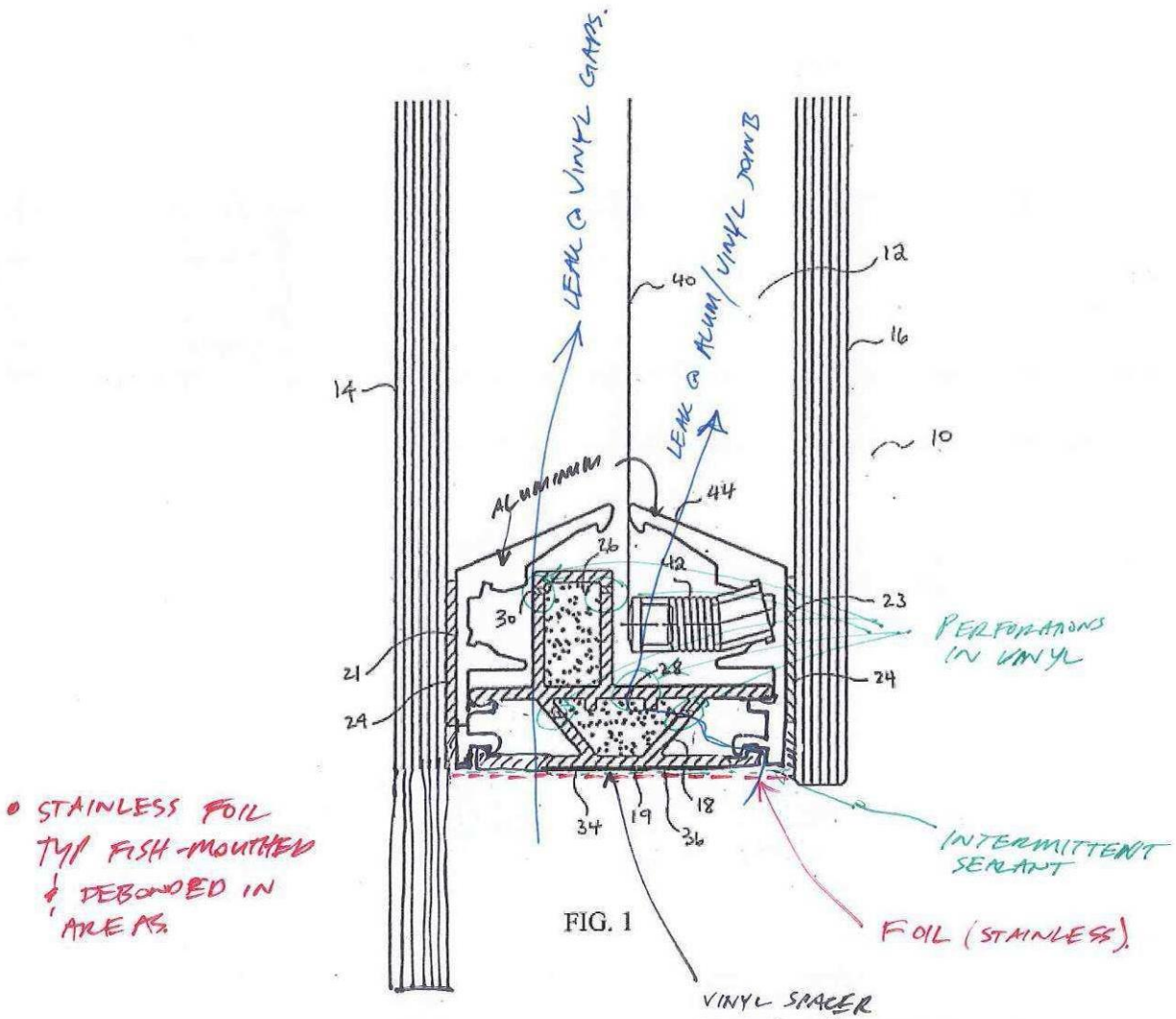

FIG. 1

CONFIGURATION OF ONE-WALL VISION WALL UNITS.

Figure E98: Style of VisionWall IGU edge seal as constructed at the units provided to One Wall

REPLACEMENT UNIT SPACER

CA 02508173 2005-06-01

WO 2004/051045 PCT/CA2002/001889

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PATENT DWG

FILED 2002
ENTERED 2005

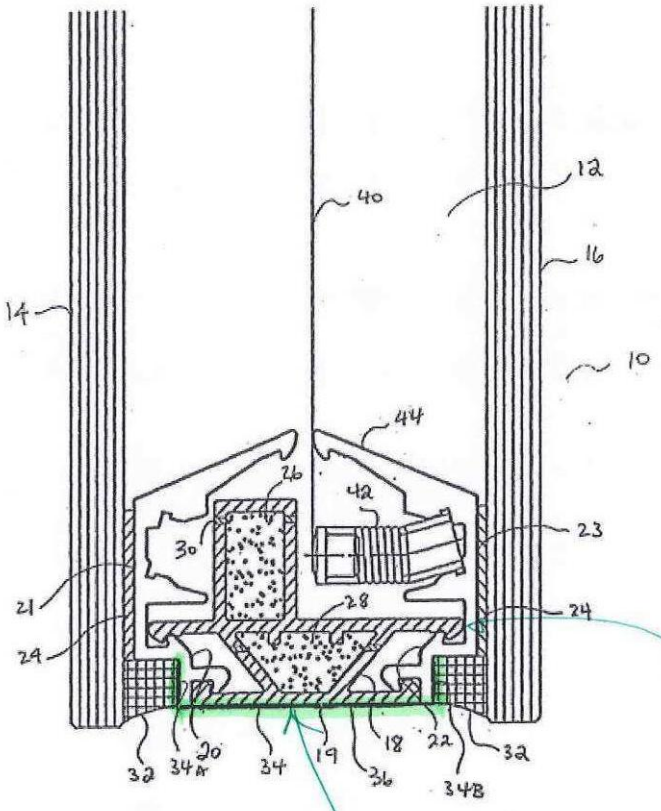

FIG. 1

- IF FOIL IS DAMAGED LEAK will occur TO INTERIOR OF UNIT

GAPS IN VINYL @ CORNER PIECES.

STAINLESS FOIL NOT BONDED TO SPACER - AIRSPACE

CONFIGURATION OF NEW VISION WALL UNITS.

http://patents.ic.gc.ca/cipo/cpd/page/2508173_20050829_drawings_page1_scale25_rotate0... 2/28/2009

Figure E99: "New" style of VisionWall Edge Seal provided at some of the replacement units at One Wall.

Appendix F

Photos

APPENDIX F: Photos of Fogging & Low-e Corrosion Damage

2004-2007, Suite 4702 – Photos from Suite Owner

Figure F1: Suite 4702, July 6, 2004, fogged/corroded IGUs.

Figure F2: Suite 4702, July 6, 2004, fogged/corroded IGU.

Figure F3: Suite 4702, July 7, 2004, fogged/corroded IGU. Note suction cup outline on surface #2.

Figure F4: Suite 4702, July 7, 2004, fogged/corroded IGUs.

Figure F5: Suite 4702, July 7, 2004, fogged/corroded IGU.

Figure F6: Suite 4702, December 27, 2004, fogged/frosted IGU.

Figure F7: Suite 4702, December 27, 2004, fogged/frosted IGUs.

Figure F8: Suite 4702, December 27, 2004, fogged/frosted IGUs.

Figure F9: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F10: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F11: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F12: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F13: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F14: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F15: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F16: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F17: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F18: Suite 4702, December 31, 2004, fogged/frosted IGUs.

Figure F19: Suite 4702, January 9, 2005, fogged/frosted IGUs.

Figure F20: Suite 4702, January 9, 2005, fogged/frosted IGUs.

Figure F21: Suite 4702, January 24, 2006, fogged/frosted IGUs.

Figure F22: Suite 4702, January 24, 2006, fogged/frosted IGUs.

Figure F23: Suite 4702, January 24, 2006, fogged/frosted IGUs.

Figure F24: Suite 4702, January 24, 2006, fogged/frosted IGUs.

Figure F25: Suite 4702, January 24, 2006, fogged/frosted IGUs.

Figure F26: Suite 4702, January 24, 2006, fogged/frosted IGUs.

2007, Suite 4602 – Photos from Owner

Figure F27: Suite 4602, January 14, 2007, fogged/frosted IGUs.

Figure F28: Suite 4602, January 14, 2007, fogged/frosted IGUs.

Figure F29: Suite 4602, January 14, 2007, fogged/frosted IGUs.

Figure F30: Suite 4602, January 14, 2007, fogged/frosted IGUs.

2008, Various Suites, Photos by RDH

Figure F31: Suite 3101, May 15, 2008, low-e corrosion spots on glass surface #2.

Figure F32: Suite 3101, May 15, 2008, low-e corrosion spots on glass surface #2.

Figure F33: Suite 3101, May 15, 2008, low-e corrosion spots on glass surface #2.

Figure F34: Suite 3101, May 15, 2008, low-e corrosion spots on glass surface #2.

Figure F35: Suite 3903, IGU 43864 at southeast corner, July 3, 2008, severe low-e corrosion on glass surface #2.

Figure F36: Suite 3903, July 3, 2008, low-e corrosion on glass surface #2.

Figure F37: Suite 3903, July 3, 2008, low-e corrosion on glass surface #2.

Figure F38: Suite 3903, July 3, 2008, low-e corrosion on glass surface #2.

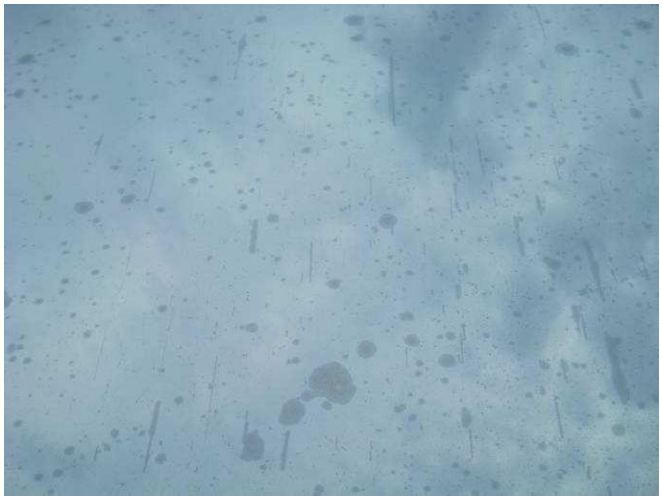

Figure F39: Suite 3903, July 3, 2008, low-e corrosion on glass surface #2.

Figure F40: Suite 3903, July 3, 2008, low-e corrosion on glass surface #2.

Figure F41: Suite 3903, IGU 45484, August 7, 2008, low-e corrosion on glass surface #2.

Figure F42: Suite 3903, IGU 45484, August 7, 2008, low-e corrosion on glass surface #2.

Appendix G

Dow Corning Report

DOW CORNING

May 22, 2009

RDH Building Engineering Limited
224 West 8th Avenue
Vancouver, BC V5Y1N5

Attention: Brian Hubbs E: bch@rdhbe.com

Reference: ***One Wall Centre, Vancouver, BC***
Dow Corning Project: 36691 / Job: 48681

Dear Mr. Hubbs:

Thank you for your patience in regards to the referenced project and for the information regarding use of Dow Corning sealant at the project.

Please find enclosed comments from Dow Corning regarding the project and the list of questions put forth by RDH.

***Based on the results of the testing to date what is the unfactored tensile strength of the installed sealant?**

1. To the best of Dow Corning's knowledge and testing of one unit performed March 30th, 2009 at the RDH facility, our testing shows the sealant has strength of 35-90 psi as it is installed today.

***Based on your own in house testing, what are the typical material properties of the installed sealant?**

2. The tensile adhesion strength of *Dow Corning*® 983 Silicone Glazing and Curtainwall Adhesive/Sealant (hereinafter referred to as "983") is 170 psi as tested in accordance with ASTM C 1135.

***How do the material properties for the installed sealant compare with the minimum requirements of the standard?**

3. The Silicone Structural Glazing (SSG) industry, by consensus, and per ASTM C1184, specifies that a silicone structural glazing sealant must have a tensile adhesion strength (tested per ASTM C 1135) of at least 50 psi. The 170 psi of 983 is 3.4 times greater than that minimum required standard.

Structural glazing systems are designed with a sealant design strength factor of 20 psi, per SSG industry consensus and ASTM C1401. This means a sealant with a minimum required tensile strength of 50 psi, in a system designed to 20 psi sealant stress, will have a safety factor of 2.5. The 170 psi of 983 is 8.5 times that design factor, creating a factor of safety of 8.5 for a 983 SSG system.

The installed sealant, as shown in the unit tested, at 35-90 psi is below the 50 psi industry standard in some areas and above the 20 psi design criteria in all areas (for this particular unit).

Dow Corning Corporation
Midland, Michigan 48686-0994
Phone: (989) 496-4000
www.dowcorning.com

Based on the results of the testing, width of the installed sealant, and the wind loads on this building, what is the actual factor of safety for this unit?

4. It is our understanding based on information from RDH, that the windload for this project is 85 PSF (4 kPa); and the typical unit size is 5.5' X 9.5' (1684 mm X 2894 mm). The typical bite size (sealant to substrate contact width) as measured on the unit tested on March 30th, 2009, was 0.71 inches (18 mm).

These conditions result in a stress on the sealant of 22.3 psi, which exceeds industry minimum design guidelines without even considering sealant strength.

For the data points tested on March 30th, 2009, with a calculated stress of 22.3 psi on the sealant during windload and the tested values of 35-90 psi on the actual sealant, the following safety factors result:

Data Point	Safety Factor
35 psi	1.6
49 psi	2.2
53 psi	2.4
54 psi	2.4
55 psi	2.5
83 psi	3.7
90 psi	4.0

The average safety factor of that particular unit based on the 7 data points is thereby 2.7, an average which exceeds the industry minimum of 2.5. On a point by point basis, not every point in the unit does meet the industry standard.

What has caused the loss of flexibility and strength?

5. We would typically expect a condition with this degree of strength loss to be related to the ratio of the sealant being improper at time of application or potential air entrapment in the sealant, either of which can potentially occur during dispensation of 983 using a 2 part pump. Improperly mixed material may not hold its expected properties over time as would proper ratioed material. The effect may not be immediately noticeable after sealant application but as the sealant is stressed over time due to thermal cycling and windload, it may not retain its expected properties if the ratio was off due to mixing or air. Part of the QC done by the unit manufacturer during sealant use is expected to include a method to check the ratio of the 983. Because of curing characteristics and sealant age, 10 years after the fact, it is not possible to backtrack and determine a ratio during the time of manufacture. Although we may never be able to fully answer this question, a review of the 983 Quality Control records from the sealant applicator/unit manufacturer, referring to the 983 as it was applied during this time, may help in revealing what could potentially have occurred during that time.

Do you expect the sealant to continue to lose flexibility and strength or will the existing properties remain constant for the remaining service life of the curtain wall system?

6. We would expect that the sealant as it is installed today has undergone thorough exposure to a variety of elements and approximately 10 winter/summer seasons. Whatever properties the sealant has today, we would typically expect to be maintained from this point through the service life of the sealant, but we cannot exclude the possibility of further change since we don't know the circumstances of its application as prior discussed.

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How many more units do you recommend that we test before you can make conclusions for the entire building?

7. This is a very difficult question to answer based on our witness of the testing of one unit. It is our understanding that similar sealant behavior has been documented for one other unit located on the same elevation, 4 floors away. Although we may never be able to provide a firm recommendation here other than 100% testing, we can have a more thorough discussion with RDH regarding this once we have an opportunity to review the 983 Quality Control records of the sealant applicator/unit manufacturer during the time of the units being manufactured. These records should show dates/timing of manufacture, equipment and sealant used, and should be tied to specific unit locations on the building. If we can cross reference the units with issues today to those records, we may be able to pick up a pattern and suggest more or less testing in certain areas of the building. With more information, we may be able to have a logical, data based discussion on what is reasonable given the situation and performance of the building to date.

Also, if there are areas at lower windloads, you may be able to consider making those a lower priority for testing.

Do you recommend any changes to our test procedures for future adhesion tests ?

8. The testing procedure we used on March 30th, 2009, is a reasonable field method by which to determine strength of sealant which has been cut apart. As RDH is aware, this is a cumbersome and time consuming effort which requires units to be removed from the building.

Alternatives and methods for field testing are discussed in ASTM C1392, *Standard Guide for Evaluating Failure of Structural Sealant Glazing* and ASTM C1394, *Standard Guide for In-Situ Structural Silicone Glazing Evaluation.*. Another useful reference is ASTM C1487, *Standard Guide for Remedying Structural Silicone Glazing.*

Do you recommend additional structural attachment at this time?

9. Based on the unit that we tested on March 30th, 2009, it is clear to Dow Corning that industry minimum requirements have not been met by that unit and potentially others on the building, from the time of installation (see comment 4 of this letter).

Ultimately, this is a risk assessment that must be evaluated and undertaken by the building owner.

Please note, Dow Corning does not have on file any warranty documentation nor any of the required testing and reviews required to obtain a warranty for this project. Dow Corning is happy to be of assistance in commenting on structural glazing design as it pertains to 983. Regarding any potential repairs or potential claims, the system appears to have been installed outside of our guidelines and it appears that the structural glazing requirements of both Dow Corning and the industry were not adhered to. Thereby assisting with industry information is the extent to which Dow Corning can be involved in this project.

Dow Corning Corporation
Midland, Michigan 48686-0994
Phone: (989) 496-4000
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DOW CORNING

Please feel free to contact me should you have any further questions.

Sincerely,

DOW CORNING CORPORATION

Kelly Charbonneau
Technical Services Engineer
Construction Industry
Dow Corning Corporation
4742 Liberty Road S. #346
Salem, OR 97302
503 581 6239 ph
k.charbonneau@dowcorning.com

cc: Lorne Andrusiak, Dow Corning Corporation
Brad Dawson, Dow Corning Corporation

Appendix H

AGS Tender Price

ADVANCED GLAZING SYSTEMS LTD

8315 Riverbend Court, Burnaby, B.C., V3N 5E7

email: info@advancedglazing.com (t) 604.521.4449
web: www.advancedglazing.com (f) 604.521.4433

Aug. 27, 2009

RDH Building Engineering Ltd.
224 west 8th Avenue,
Vancouver, BC
V5Y 1N5

Attention: Brian Hubbs

Reference Project:

One Wall Centre – glass replacement

We offer our tender prices as shown below for the glazing replacement:

Glass replacement L32 to L48
66 lites per floor x 16 floors = 1056 lites

	Price	Description of work
Option 1	$3,123,649	Materials of glazing adapters, fasteners and sealant New customized powered swing stage with glass hoisting device Customized outriggers on existing roof tracks Glass lifting suction cups Protection over the canopy below work area Disposal of old glass **All new glass units to be supplied by others(compatible with new glazing method)**
Option 2	$5,345,064	Materials of glazing adapters, fasteners and sealant New customized powered swing stage with glass hoisting device Customized outriggers on existing roof tracks Glass lifting suction cups Protection over the canopy below work area Disposal of old glass **Including supply of all triple glazed sealed units with double Low E coated glass** (#2 and #5 surface), Argon gas filled airspace, s/s spacer

Reglazing procedure using AGS's glass:

1. Apply temporary clips to vertical joints between glass
2. Cut out silicone sealant around the outboard lite of the existing IGU
3. Use powered suction cups to carry the weight of the glass units prior to removing the temporary clips.
4. Down hoist the glass in a carriage on the swing stage and lower to hoarding/deck
5. Clean out residual glazing gasket and sealant around the glass opening
6. Fasten interior glazing adaptor and seal to the curtainwall frame

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7 Up hoist new glass unit to opening and position glass on setting blocks
8 Fasten aluminum clips (factory applied to vertical glass edges) to mullion
9 Apply structural silicone sealant around the exterior glass edge (outside)
10 Apply structural silicone sealant/gasket around the inboard glass perimeter (inside)
11 Clean up and removal residual sealant on glass surfaces if necessary.

1. TENDER SCOPE OF WORK

- We have included local glass manufacturer
- We have scheduled for 3 crews on 3 separate swing stages. The duration is 180 days weather permitted.
- We have not included for security if required.
- Triple glazed units is based on Guardian 6 mm thick clear glass AG50(2) and SN68(5), Shading to be determined.
- We have included for standard working hour, with no security issue or interruptions.
- We have not included for attic stock.
- Testing, if required, is not included.
- Final Cleaning is NOT INCLUDED in above tender price. This item applies to the total project.

2. TENDER SPECIFIC QUALIFICATIONS CONDITIONS OF TENDER

1. All on site testing if required will be tested to the Canadian A440-98 requirements (mockup and testing are NOT included in above tender).
2. Bonding is NOT included.
3. Materials will be furnished in accordance with industry established tolerances on color variations, thickness, sizes, finishes, textures and performance standards.
4. It is understood that the project consultant and the owner/developer are aware of the glass manufacturers' limitations and standard qualifications. Items such as distortion, tempering roller wave distortion, glass color and coating reflectivity will have been considered for the above project. Our tender price reflects the glass as specified and or

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performance specified. AGS will not be held responsible for any costs and or penalties in regard to the above concerns. If the glass is not acceptable it can be replaced for an additional cost.

5. Work will be executed as promptly as possible in accordance with a mutually agreed schedule; however, we cannot be responsible for delays caused by events beyond our control, or single-source supplier delays.

6. We accept no contingent liability for work performed under this tender. We will not be responsible for any back charges or extra charges of any nature, including, but not limited to first aid attendant, cleaning up, barricades, flag persons and traffic control, temporary closing in and or temporary glazing, light, heat, power, lavatory and telephone facilities unless mutually agreed to in writing prior to commencement of the work.

7. AGS are to be provided with suitable space at the job site for storage of materials without charge. The assigned area will be reserved for AGS without the need to relocate material. If such a move is necessary, an additional charge will be assessed to cover costs.

8. The warranty period for the works shall be for a period of two (2) year commencing on the date of Substantial Performance of the Work. Manufacturer's product warranties in excess of this period, ie. sealed units, shall be obtained by the Trade Contractor from the Manufacturer in the name of the Owner. The warranty of insulating glass units is limited to rectangular shapes (4 - 90 degree corners), non-sloped (i.e. slope within 15 degree from vertical). If Argon gas filled IGU is required, there is no warranty concerning argon content or effectiveness. Manufacturers use best available practices to reach highest possible fill rates in accordance with standards in the glass industry.

9. Project schedule and changes to the schedule shall be mutually agreed. Our tender is based on work being performed during regular working hours and in a continuous uninterrupted fashion. Overtime hours are not included and will be considered an extra to contract. If overtime hours are required to meet the construction schedule they will be charged out at the following rates.
   Regular Rate - $65.00 per man hour
   Over time rate (1.5) -$97.50 per man hour
   Over time rate (2) -$130.00 per man hour

10. Form of contract shall be the CCA 1 or CCA 17 with no amending language, or other mutually acceptable form of Contract. The terms and conditions outlined in this document shall form part of the contract and shall take precedence.

11. All terms and conditions regarding payment shall be as per CCA I Article 4 without holdbacks, other than that required under the Builders Lien Act. Please consider this tender null and void if the General Conditions contain any language referencing "pay-when-paid" clauses or any language relating to, or including such conditions.

12. The General Contractor/Construction Manager/Owner shall provide both General Liability on a Wrap-up basis and Builder's risk (C.O.C.) Insurance, with deductibles not exceeding

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five thousand ($5,000.00). Evidence of such insurance in the form of a certificate or cover note must be filed with this office prior to commencement of work.

13. Our quotation is based upon the purchase of materials at current prices.

14. Trade Contractor shall be paid for shop drawings, engineering, materials receiving, force mobilization, bonding (if applicable), and project management all in accordance with a schedule of values submission, as progressed, irrespective of a site presence.

15. Pre-purchased, long-lead time, or single-source project specific products may, subject to special agreement, be progressed to the project in either a fabricated or un-fabricated state. Title to said product will transfer via Bill of Sale Absolute.

16. All change orders and change directives shall be subject to costs and markup for overhead and profit as recommended in CCA Document 16, irrespective of any other provisions in tender documents, unless mutually agreed.

17. All disputes arising under the contract and performance of the work shall be referred to the Arbitration Committee of VRCA or other mutually agreed upon Arbitrator.

Yours truly,

Arthur Chan
Advanced Glazing Systems Ltd.

Appendix I

Pressure and Flow Sensor Datasheets

Freescale Semiconductor
Technical Data

Document Number: MPXV7002
Rev 0, 09/2005

Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

MPXV7002 SERIES

INTEGRATED PRESSURE SENSOR
-2 to 2 kPa (-0.3 to 0.3 psi)
0.5 to 4.5 V OUTPUT

The MPXV7002 series piezoresistive transducers are state-of-the-art monolithic silicon pressure sensors designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This transducer combines advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

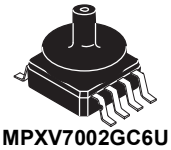
Features

- 2.5% Typical Error over +10°C to +60°C with Auto Zero
- 6.25% Maximum Error over +10°C to +60°C without Auto Zero
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Thermoplastic (PPS) Surface Mount Package
- Temperature Compensated over +10° to +60°C
- Patented Silicon Shear Stress Strain Gauge
- Available in Differential and Gauge Configurations

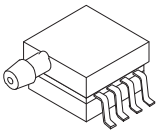
Typical Applications

- Hospital Beds
- HVAC
- Respiratory Systems
- Process Control

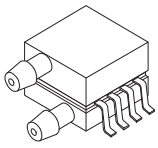
SMALL OUTLINE PACKAGE



MPXV7002GC6U
CASE 482A-01



MPXV7002GP
CASE 1369-01



MPXV7002DP
CASE 1351-01

ORDERING INFORMATION					
Device Type	**Options**	**Case No.**	**MPX Series Order No.**	**Packing Options**	**Device Marking**
SMALL OUTLINE PACKAGE (MPXV7002 SERIES)					
Ported Elements	Gauge, Axial Port, SMT	482A	MPXV7002GC6U	Rails	MPXV7002G
	Gauge, Axial Port, SMT	482A	MPXV7002GC6T1	Tape & Reel	MPXV7002G
	Gauge, Side Port, SMT	1369	MPXV7002GP	Trays	MPXV7002G
	Differential, Dual Port, SMT	1351	MPXV7002DP	Trays	MPXV7002G
	Differential, Dual Port, SMT	1351	MPXV7002DPT1	Tape & Reel	MPXV7002G

SMALL OUTLINE PACKAGE PIN NUMBERS(1)			
1	N/C	5	N/C
2	V_S	6	N/C
3	Gnd	7	N/C
4	V_{out}	8	N/C

1. Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

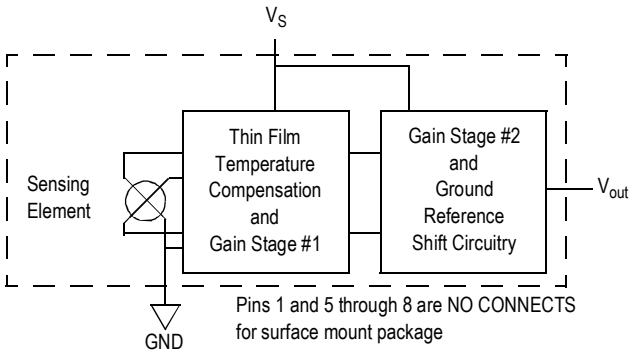


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Figure 1. Fully Integrated Pressure Sensor Schematic

Table 1. Maximum Ratings[1]

Rating	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{max}	8.0	kPa
Storage Temperature	T_{stg}	30 to +100	°C
Operating Temperature	T_A	10 to +60	°C

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

Table 2. Operating Characteristics (V_S = 5.0 Vdc, T_A = 25°C unless otherwise noted. Decoupling circuit shown in Figure 3 required to meet specification.)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range[1]		P_{OP}	2.0		2.0	kPa
Supply Voltage[2]		V_S	4.75	5.0	5.25	Vdc
Supply Current		I_o			10	mAdc
Pressure Offset[3] @ V_S = 5.0 Volts	(10 to 60°C)	V_{off}	2.25	2.5	2.75	Vdc
Full Scale Output[4] @ V_S = 5.0 Volts	(10 to 60°C)	V_{FSO}	4.25	4.5	4.75	Vdc
Full Scale Span[5] @ V_S = 5.0 Volts	(10 to 60°C)	V_{FSS}	3.5	4.0	4.5 V	Vdc
Accuracy[6]	(10 to 60°C)			±2.5[7]	±6.25	$\%V_{FSS}$
Sensitivity		V/P		1.0	-	V/kPa
Response Time[8]		t_R		1.0	-	ms
Output Source Current at Full Scale Output		I_{O+}		0.1	-	mAdc
Warm-Up Time[9]				20	-	ms

1. 1.0 kPa (kiloPascal) equals 0.145 psi.
2. Device is ratiometric within this specified excitation range.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. Full Scale Output (V_{FSO}) is defined as the output voltage at the maximum or full rated pressure.
5. Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
6. Accuracy (error budget) consists of the following:
   - Linearity: Output deviation from a straight line relationship with pressure over the specified pressure range.
   - Temperature Hysteresis: Output deviation at any temperature within the operating temperature range, after the temperature is cycled to and from the minimum or maximum operating temperature points, with zero differential pressure applied.
   - Pressure Hysteresis: Output deviation at any pressure within the specified range, when this pressure is cycled to and from the minimum or maximum rated pressure, at 25°C.
   - TcSpan: Output deviation over the temperature range of 10° to 60°C, relative to 25°C.
   - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 10° to 60°C, relative to 25°C.
   - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of V_{FSS}, at 25°C.
7. Auto Zero at Factory Installation: Due to the sensitivity of the MPXV7002 Series, external mechanical stresses and mounting position can affect the zero pressure output reading. Autozero is defined as storing the zero pressure output reading and subtracting this from the device's output during normal operations. Reference AN1636 for specific information. The specified accuracy assumes a maximum temperature change of ± 5°C between autozero and measurement.
8. Response Time is defined as the time for the incremental change in the output to go from 10% to 90% of its final value when subjected to a specified step change in pressure.
9. Warm-up Time is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.

ON-CHIP TEMPERATURE COMPENSATION, CALIBRATION AND SIGNAL CONDITIONING

The performance over temperature is achieved by integrating the shear-stress strain gauge, temperature compensation, calibration and signal conditioning circuitry onto a single monolithic chip.

Figure 2 illustrates the Differential or Gauge configuration in the basic chip carrier (Case 482). A gel die coat isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the sensor diaphragm.

The MPXV7002 series pressure sensor operating characteristics, and internal reliability and qualification tests are based on use of dry air as the pressure media. Media, other than dry air, may have adverse effects on sensor performance and long-term reliability. Contact the factory for information regarding media compatibility in your application.

Figure 3 shows the recommended decoupling circuit for interfacing the integrated sensor to the A/D input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

Figure 4 shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 10° to 60°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.

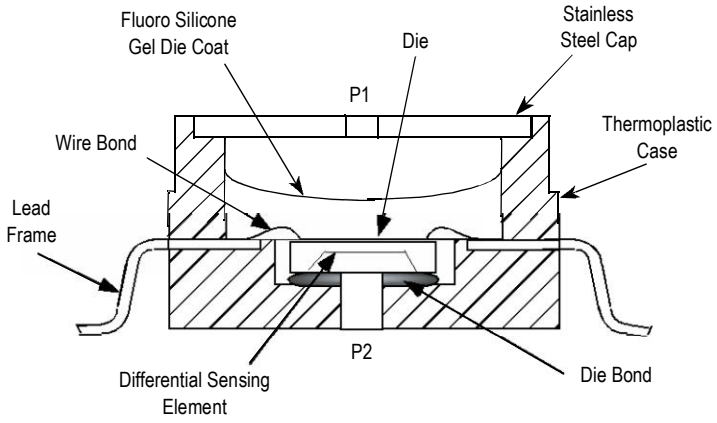


Figure 2. Cross-Sectional Diagram SOP (not to scale)

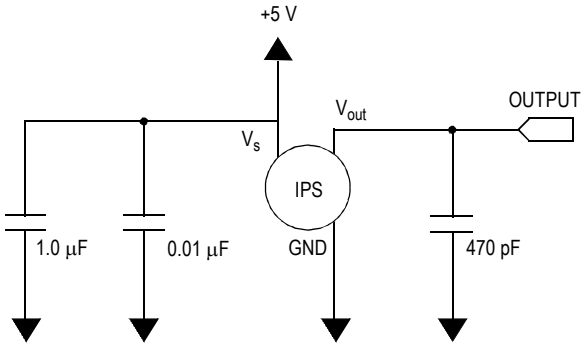


Figure 3. Recommended Power Supply Decoupling and Output Filtering
(For additional output filtering, please refer to Application Note AN1646.)

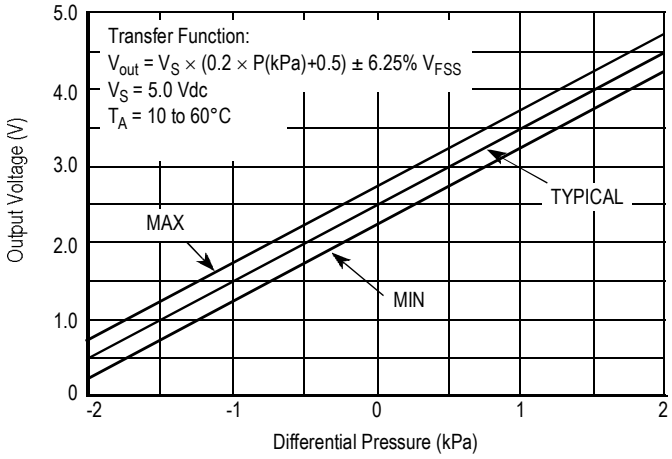


Figure 4. Output versus Pressure Differential

PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

Freescale designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing a gel die coat which protects the die from harsh media.

The Pressure (P1) side may be identified by using the table below:

Part Number	Case Type	Pressure (P1) Side Identifier
MPXV7002GC6U/GC6T1	482A-01	Vertical Port Attached
MPXV7002GP	1369-01	Side with Port Attached
MPXV7002DP	1351-01	Side with Dual Port Attached

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the surface mount packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct footprint, the packages will self align when subjected to a solder reflow process. It is always recommended to design boards with a solder mask layer to avoid bridging and shorting between solder pads.

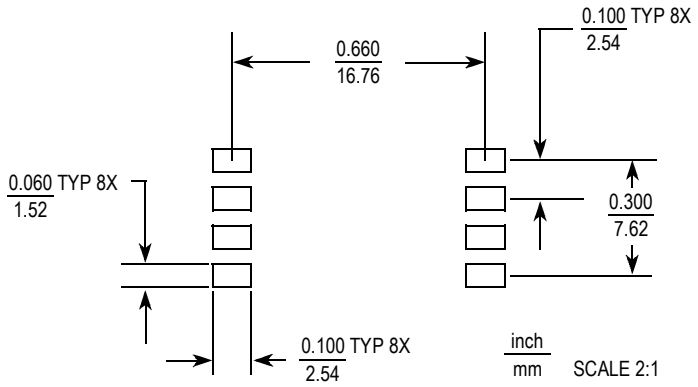
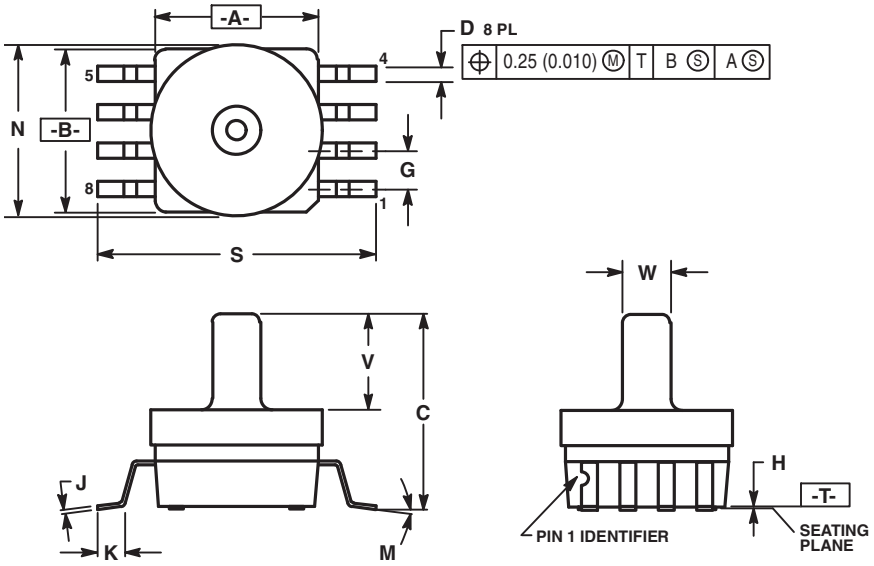


Figure 5. Small Outline Package Footprint

PACKAGE DIMENSIONS

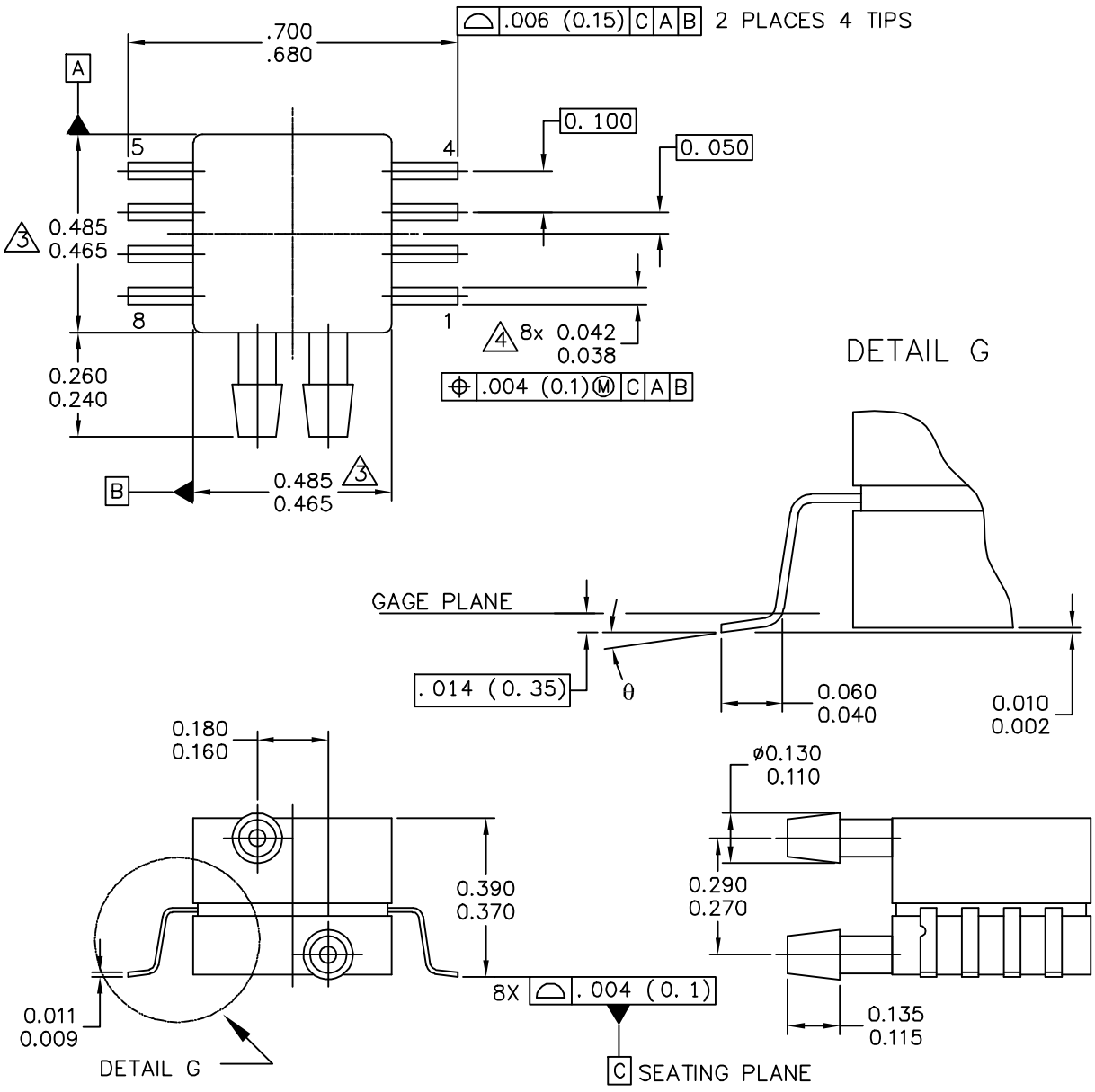


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.500	0.520	12.70	13.21
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0°	7°	0°	7°
N	0.444	0.448	11.28	11.38
S	0.709	0.725	18.01	18.41
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

CASE 482A-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: 8 LD SNSR, DUAL PORT	DOCUMENT NO: 98ASA99255D	REV: A
	CASE NUMBER: 1351–01	27 JUL 2005
	STANDARD: NON–JEDEC	

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

NOTES:

1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.

4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR
PROTRUSION SHALL BE .008 MAXIMUM.

STYLE 1:	STYLE 2:
PIN 1: GND	PIN 1: N/C
PIN 2: +Vout	PIN 2: Vs
PIN 3: Vs	PIN 3: GND
PIN 4: –Vout	PIN 4: Vout
PIN 5: N/C	PIN 5: N/C
PIN 6: N/C	PIN 6: N/C
PIN 7: N/C	PIN 7: N/C
PIN 8: N/C	PIN 8: N/C

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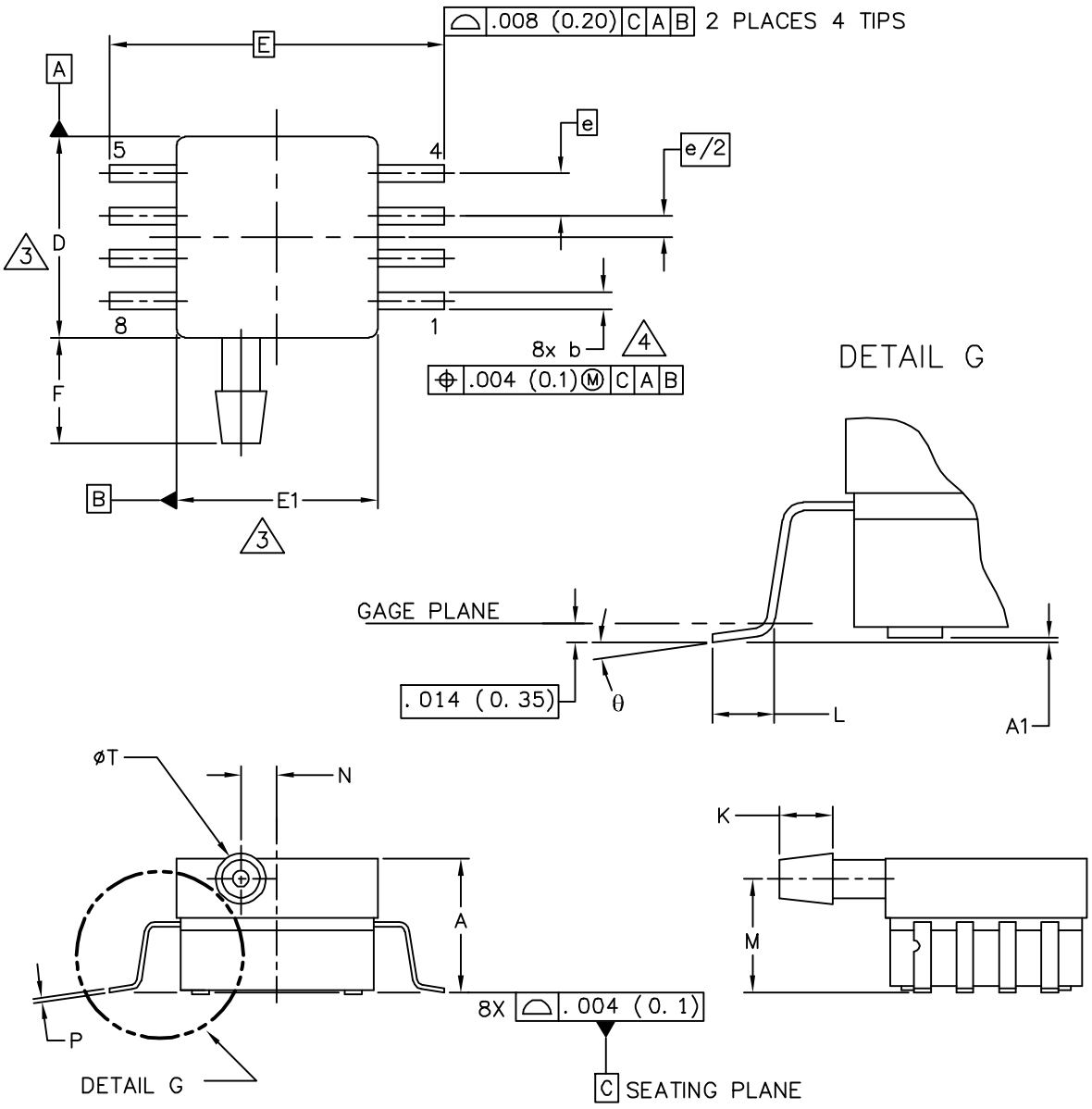
MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: 8 LD SNSR, DUAL PORT	DOCUMENT NO: 98ASA99255D	REV: A
	CASE NUMBER: 1351–01	27 JUL 2005
	STANDARD: NON–JEDEC	

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



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TITLE: 8 LD SOP, SIDE PORT	DOCUMENT NO: 98ASA99303D	REV: B
	CASE NUMBER: 1369-01	24 MAY 2005
	STANDARD: NON-JEDEC	

PAGE 1 OF 2

CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

NOTES:
1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.

4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR
PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.300	.330	7.11	7.62	θ	0°	7°	0°	7°
A1	.002	.010	0.05	0.25	–	---	---	---	---
b	.038	.042	0.96	1.07	–	---	---	---	---
D	.465	.485	11.81	12.32	–	---	---	---	---
E	.717 BSC		18.21 BSC		–	---	---	---	---
E1	.465	.485	11.81	12.32	–	---	---	---	---
e	.100 BSC		2.54 BSC		–	---	---	---	---
F	.245	.255	6.22	6.47	–	---	---	---	---
K	.120	.130	3.05	3.30	–	---	---	---	---
L	.061	.071	1.55	1.80	–	---	---	---	---
M	.270	.290	6.86	7.36	–	---	---	---	---
N	.080	.090	2.03	2.28	–	---	---	---	---
P	.009	.011	0.23	0.28	–	---	---	---	---
T	.115	.125	2.92	3.17	–	---	---	---	---

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MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASA99303D	REV: B
8 LD SOP, SIDE PORT	CASE NUMBER: 1369–01	24 MAY 2005
	STANDARD: NON–JEDEC	

CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE

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MPXV7002
Rev. 0
09/2005

OMRON

MEMS Flow Sensor

D6F-P0010A

Compact, Highly Reliable Flow-Sensor with Unique Dust Segregation System

- Cyclone flow structure diverts particulate from sensor element
- PCB-mounted & connector models available
- High accuracy, reliable mass flow measurement
- Alternative to differential pressure sensing
- Measure over 200 LPM with a bypass set-up

Ordering Information

Model	Wiring	Flow range	Gas	Case
D6F-P0010A1	PCB-mounting model	1L/min	Air	PBT
D6F-P0010A2	Connector model	1L/min	Air	PBT
D6F-CABLE2	Cable connector assembly	-	-	-

Electrical Performance

Item	Symbol	Rating	Unit
Power supply voltage	Vcc	5 – 10	VDC
Output voltage	Vout	0.5 – 2.5	VDC

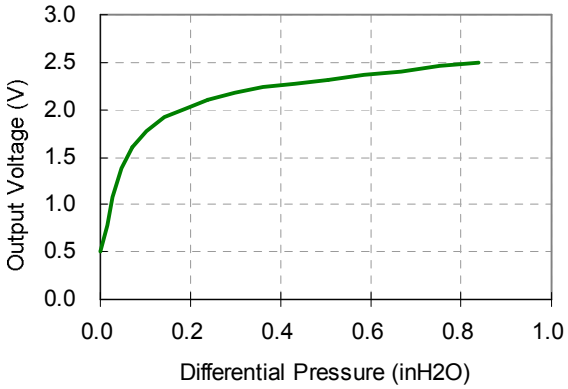
Sensor Specifications

Model	D6F-P0010A1	D6F-P0010A2
Termination	PCB Terminals	Connector JST SM03B-SRSS-TB
Flow range/ Pressure range	+ 1.0 SLM (+ 0.84 in H2O)	
Applicable gas	Air (contact Omron for other gases)	
Accuracy	+/- 5% F.S. (typical test results within +/- 2% F.S.)	
Temperature characteristic	+/- 5% F.S.	
Operating temperature	-10 to 60 deg C (without freezing and condensation)	
Operating humidity	85%RH max (without freezing and condensation)	
Storage temperature	-40 to 80 deg C (without freezing and condensation)	
Storage humidity	85%RH max (without freezing and condensation)	
Output signal	Analog 0.5 to 2.5 VDC, Amplified and Temperature Compensated	
Withstand pressure	50kPa (7psi)	
Current consumption	Max 15mA (No load, Vcc=5 VDC, 25 deg C)	
Insulation resistance	20M Ohm min.(DC 500VDC, between lead terminal and case)	

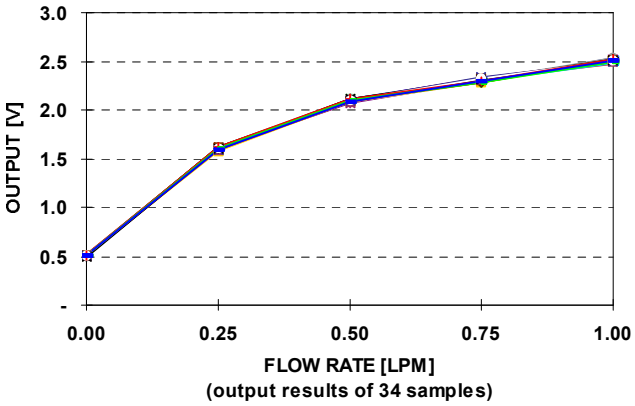
Output Characteristics

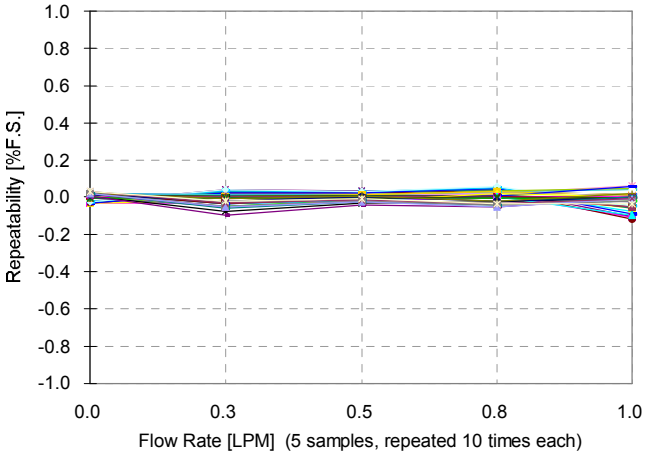
Differential Pressure	Flow Rate	Output
(inH2O)	(SLM)	(V)
0.00	0.00	0.50
0.07	0.25	1.60
0.24	0.50	2.10
0.51	0.75	2.31
0.84	1.00	2.50

Mass flow converted into volumetric flow rate SLM (standard liters per minute) at 0 °C, 1 atm. Note, 0 to 0.5V output indicates a negative flow direction.



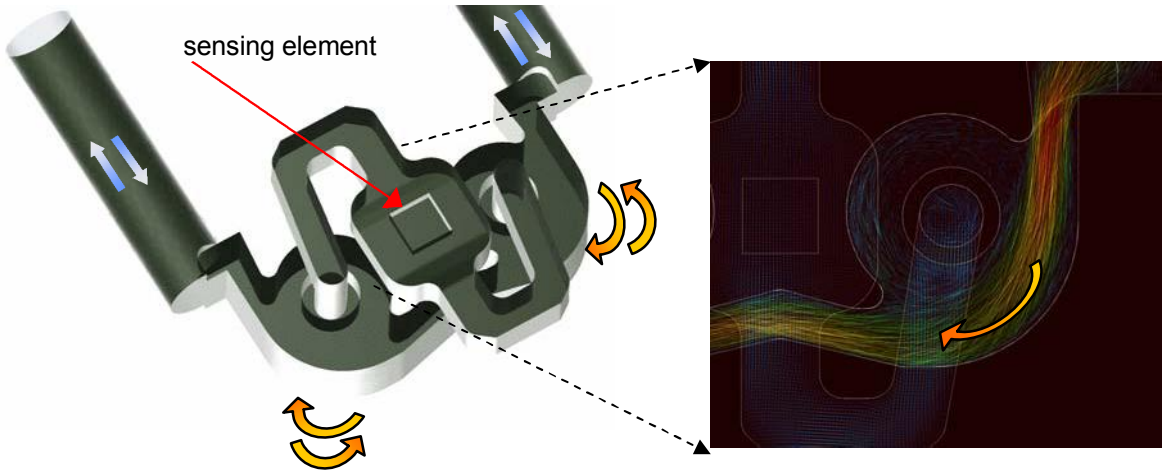
Repeatability, typical test results





Bidirectional Dust Segregation System

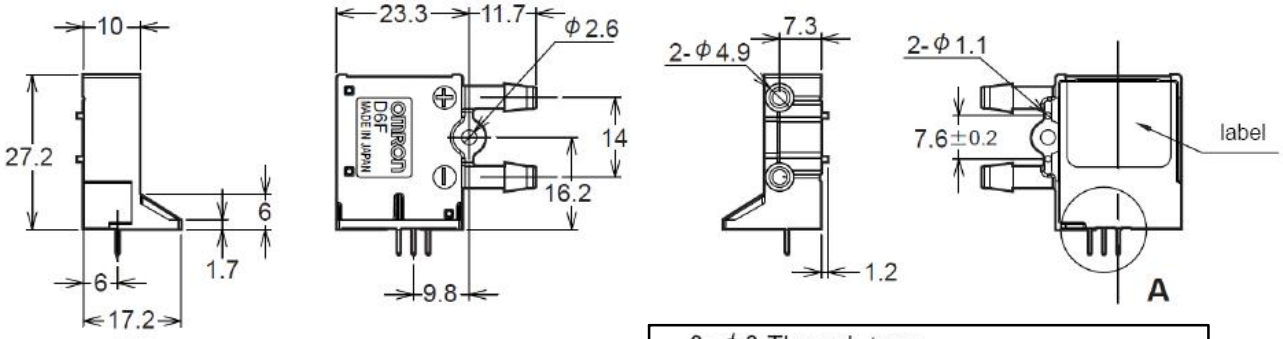
The D6F-P series has a patented dust segregation design. The flow path incorporates dual centrifugal chambers, in which particulate matter follows in the outer path, away from the MEMS sensor chip regardless of the flow direction. Note, standard products are calibrated for unidirectional flow, as shown above. Contact Omron for bidirectional calibration options.



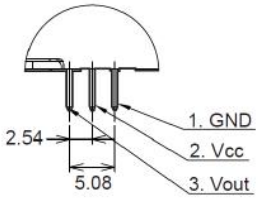
Dimensions

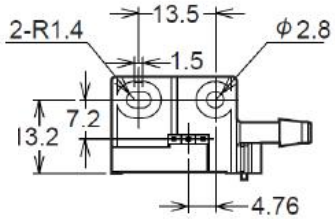
All dimensions are shown in mm.
Use 2 suitable M2.6 screws for mounting. Do not exceed a fixing torque of 0.59 Nm.

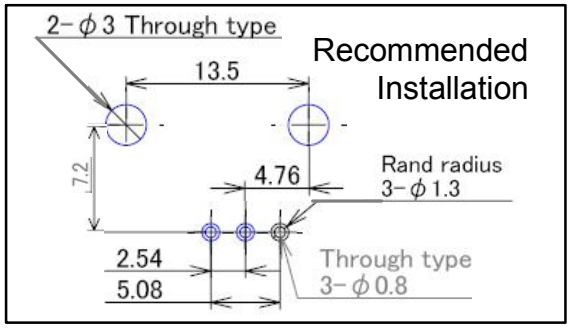
D6F-P0010A1 (PCB lead)



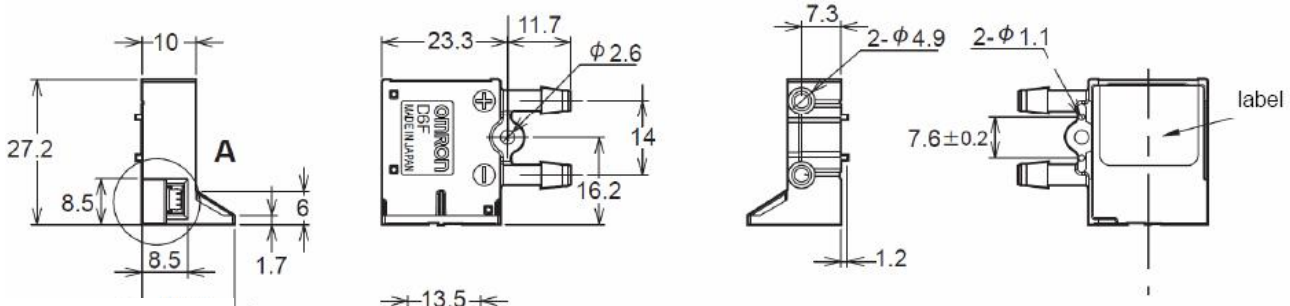
A (2:1)

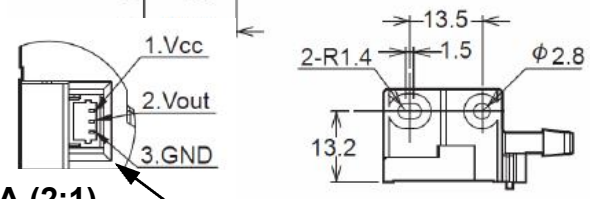






D6F-P0010A2 (connector)





A (2:1)

JST header SM03B-SRSS-TB

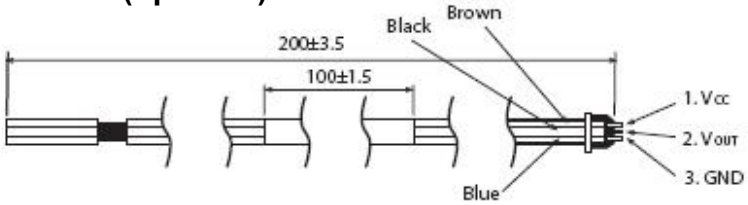
Connector Information

Omron: D6F-CABLE2

or JST IDC type: Receptacle 03SR-3
Wire AWG #30

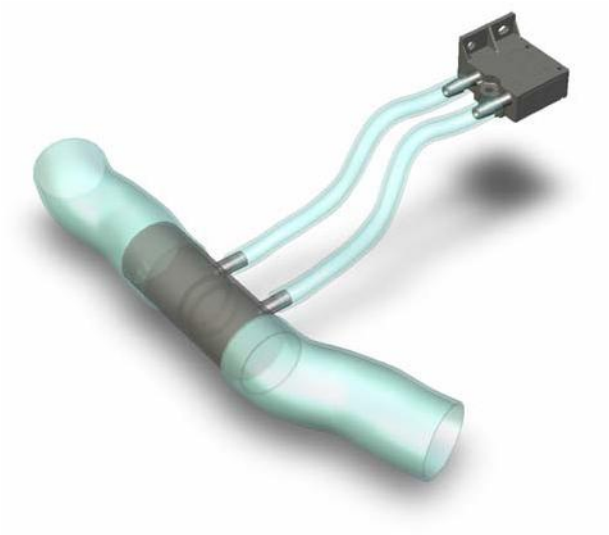
or JST crimp type: Contact SSH-003T-P0.2
Housing SHR-03V-S
Wire AWG #32 - #28

D6F-CABLE2 (optional)



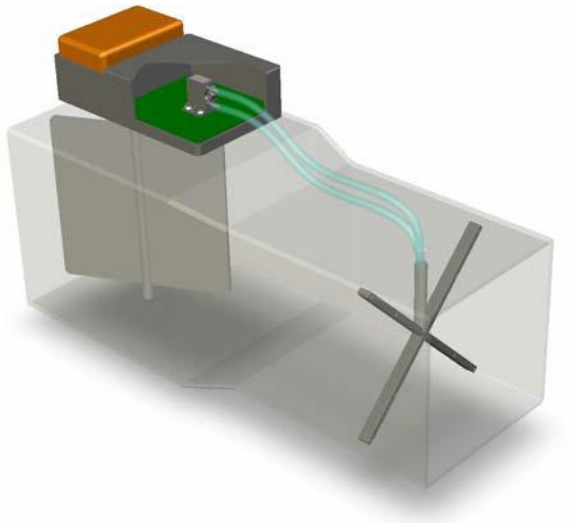
Bypass Set-up

When used in a bypass set-up, as illustrated below, the D6F-P mass flow sensors can measure flow rates far beyond the 1 LPM in-line rating. The pressure differential required to pull airflow through the sensor can be accomplished by installing a flow restrictor between the two ports or through the use of a flow cross in large ducts, as shown in the HVAC application.



HVAC Application

The D6F-P mass flow sensor is ideal for damper control in variable air volume systems, where low flow rates are difficult to measure with differential pressure sensors.



Precautions

1. Avoid use in excessively dirty, wet environments

2. Do not use in the presence of flammable gases (e.g. hydrogen, methane, ethane) and liquefied petroleum gas. In addition, do not use with corrosive gases (e.g. chlorine, sulfur, acids, alkalis, etc.).

3. Install so that gas flows from "+" to "-" stamped ports.

4. For best results (optimum accuracy), mount horizontally.

5. Use 2 suitable M2.6 screws for mounting. Do not exceed a fixing torque of 0.59 Nm.

6. Do not modify D6F- in any way.

7. Do not place any object in or close to the inlet and outlet orifices.

8. Do not use the sensor in any of the following environments:

- a location that receives significant radiant heat
- a place where intense light may radiate down
- where fast changing temperatures occur
- locations prone to freezing, high humidity, condensation
- where large magnitudes of vibration or shock could occur

9. Noise countermeasures: VERY IMPORTANT: Take suitable precautions to minimize the effects and potential for induced electrical noise. Install away from apparatus that generates strong high frequencies, surges and spikes. Take particular care to install away from AC power transformers, live mains power lines and high power magnetic circuits. Attach a surge suppressor and a noise filter to the peripheral equipment.

10. Ensure good grounding is achieved by grounding the GND terminal to the peripheral equipment's main ground frame connection and its associated regulated power supply.

11. Do not make a direct solder connection to the integral terminals on the connector model type. The use of optional cable 'D6F-CABLE2' is recommended for attachment to ensure correct connection (D6F-P0010A2). Solder PCB terminals after securing the sensor to the board (D6F-P0010A1).

12. D6F- is a precision component. Keep in original packaging and remove only when ready for installation. Damage may occur if subjected to excessive force (e.g. dropped or kicked). Any item suspected to be damaged should be discarded.

13. Immediately following installation, a qualified person should perform checks to ensure safe, satisfactory operation.

Omron Electronic Components, LLC

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1. Definitions: The words used herein are defined as follows.
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   (c)Buyer: The buyer of Products, including any end user in section III through VI
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   (e)Including: Including without limitation
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   (d) Systems, machines, and equipment that could present a risk to life or property.
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5. Errors And Omissions: The information on Seller's website or in other documentation has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.
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1. Waiver: No failure or delay by Seller in exercising any right and no course of dealing between Buyer and Seller shall operate as a waiver of rights by Seller.
2. Assignment: Buyer may not assign its rights hereunder without Seller's written consent.
3. Law: These Terms are governed by Illinois law (without regard to conflict of laws). Federal and state courts in Illinois have exclusive jurisdiction for any dispute hereunder.
4. Amendment: These Terms constitute the entire agreement between Buyer and Seller relating to the Products, and no provision may be changed or waived unless in writing signed by the parties.
5. Severability: If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision.

SMT Research received the NRC-IRAP 2007 New Technology Award for the WiDAQ.

Industrial Wireless Data Acquisition Node

General Description

The Industrial Wireless Data Acquisition Node (WiDAQ) is a high precision measurement device designed for distributed remote sensor data acquisition. The built-in 24-bit A/D converter and low noise high precision measurement circuitry facilitates data acquisition from a wide variety of precision sensors used in Building Science research.

The Industrial WiDAQ has the ability to communicate both wireless and wired to the SMT Building Intelligence gateway. When wired, the Industrial WiDAQ can serve as a CAN coordinator for other wireless WiDAQs. This configuration offers several benefits over a wireless only system as wired nodes act as coordinators for remote nodes resulting in increased battery life and facilitates wireless deployment in areas where wireless communication is not sustainable. The wired backbone operates over the industry standard Controller Area Network (CAN) permitting dense sensor deployments in harsh environments.

Applications

Building Science Research (long term)
- Window and wall module evaluation.
- External façade sensing.

Green Roof Research
- Mass moisture and temperature sensing

Field Applications/Research
- Long term structure monitoring
- Targeted repair monitoring

See the Mobile WiDAQ datasheet for fast deployment, short term monitoring solutions.

Features

- Eight resistance channels capable of reading wide moisture content ranges and precision thermistors.
- Circuitry is housed in a NEMA IP66 rated enclosure suitable for outdoor installations.
- Sensor inputs use screw down terminal connectors for universal field configurations. No special crimp tools required.
- Resistance measurements can be performed in either positive or negative polarity for the purpose of negating half cell voltages or diode effects in monitored structures.
- Each input is optically isolated from each other and earth ground preventing ground loops and external noise influences on the measurement (wireless mode operation).
- Integrated Temperature Sensor
- Internal 1Mbit EEPROM used for data logging.
- Communicates to SMT Building Intelligence Gateway (BiG) via USB WiKey or wired CAN clusterhead device.
- Powered by 4 AA batteries for long term monitoring.
- Optional built in solar panel for long term monitoring when used outdoors.
- Can be configured via on-board dip switches to measure up to eight micro-voltage channels.

Performance/Functional Specifications

Communication Electrical/Performance

Wired CAN mode per repeater	
Max Distance	1000m 22 AWG control wire
Max Nodes	128 nodes
CAN Interface	CAN 2.0B (ISO 11898)
CAN Speed	10kbps
Input Power	6VDC to 12VDC
Wireless	
Specification	IEEE 802.15.4
Max Distance from coordinator	30m (with included antenna, extended ranges up to 350m available with optional external antennas)
Max Nodes per coordinator	32 (depends on application density and acquisition speed)
Battery Life	2 years (depends on sampling frequency)
Other	
Memory	1Mbit EEPROM for data logging

Environmental

Operating Temperature	0° to 40°C / 32° to 104°F
Storage Temperature	-25° to 70°C / -13° to 158°F
Humidity	5% to 90% RH non-condensing
Electrostatic Discharge (ESD)	8kVdc air, 4 kVDC contact (exposed inputs)

Mechanical

Watertight Enclosure	
Dimensions	118mm (L) x 90mm (W) x 60mm (H)
Weight	200g
Rating	IP66
Connections	
CAN in/out	Single RJ45
Sensors	Terminal Block
Interface	
LEDs	Red/Green LEDs
Button	Power/Config Button

Measurement Electrical/Performance

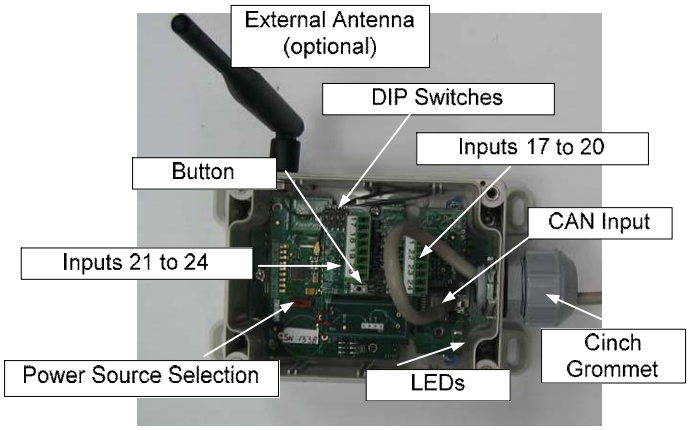
Internal Temperature – Input 2	
Sensor	Panasonic ERT-J1VS104FA Beta 4390K
Range	-40°C to +70°C
Resolution	0.1°C
Accuracy	±1°C
Resistance – Input 17 to 24	
Range	100Ω to 1KΩ
Resolution	10Ω
Accuracy	±5%
Range	1KΩ to 10KΩ
Resolution	100Ω
Accuracy	±5%
Range	10KΩ to 100KΩ
Resolution	1KΩ
Accuracy	±5%
Range	100KΩ to 1MΩ
Resolution	10KΩ
Accuracy	±5%
Range	1MΩ to 10MΩ
Resolution	100KΩ
Accuracy	±5%
Range	10MΩ to 100MΩ
Resolution	1MΩ
Accuracy	±10%
Range	100MΩ to 1GΩ
Resolution	10MΩ
Accuracy	±10%

Safety

Safety Requirements	12V SELV Separated Extra Low Voltage. See CAN power supply for cULus rating.

WiDAQ Connections

In applications where IP66 rating is important, ensure all cables are passed through the cinch grommet and the grommet tightened.



Power Source Selection Switch

Action	Result
LEFT (toward battery connector)	Battery Selection (if CAN Is not present, switch RIGHT for OFF)
RIGHT (toward CAN connector)	CAN Power selection

DIP Switches

Resistance or voltage selection – Note: some models may be hard wired to resistance only. The DIP switch will not be present on this.

Action	Result
Resistance (default)	1-ON 2-OFF 3-ON 4-OFF
Voltage	1-OFF 2-ON 3-OFF 4-ON

Push Button/LED Interface

(Software version 2.02 and higher)

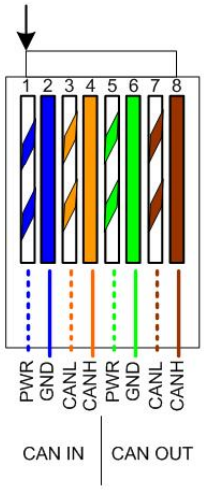
Action	Result
Turn ON/OFF	**Press button twice** ON – Green Flashes OFF – Red Flashes
Force Reading	**Press button once** Blink Green followed by communication status: Solid Green – Taking Reading Solid Red – Failed communication
State	**Result**
Powered ON	Green – Taking Reading Red – Failed communication
Powered OFF	**Press button once** Red – Unit OFF

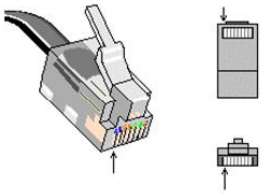
Sensor Input Configuration

WiDAQ inputs show up as Autonomous nodes with default values in resistance (ohms) or voltage (mV) depending on the sensor. Select the appropriate sensor type to have the converted units displayed.

WiDAQ Input	Input	Sensor Type
Internal Device Temperature	2	Temperature 104JT (ohms)
RSSI	15	RSSI (radio strength)
Battery Voltage	16	Default (mV)
Resistance (default)	17-24	Resistance - ohms (default) Change to specific sensor type
Voltage (see dip switch setting)	17 18 19 20 21 22 23 24 GND	Vin 5V Vin 5V Vin 5V Vin 5V Bus grounds together and connect to CAN GND pin or minus pin on PCB

Wired CAN Connectivity





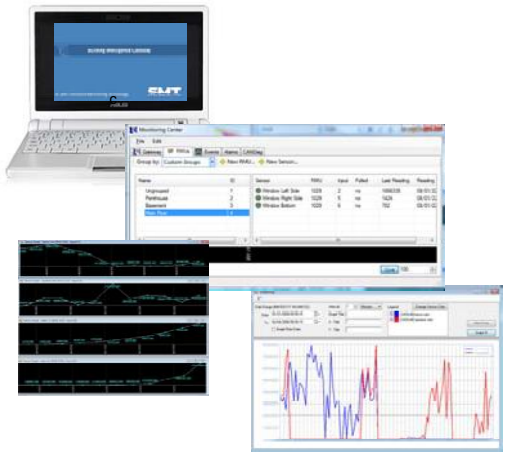
Arrow indicates pin 1

RJ45 Connector

- Connect gateway computer to the RJ45 connector on the WiDAQ.
- At least one wired WiDAQ is required per system. Depending on the topology of the sensors, quantity and placement will need to be specified.

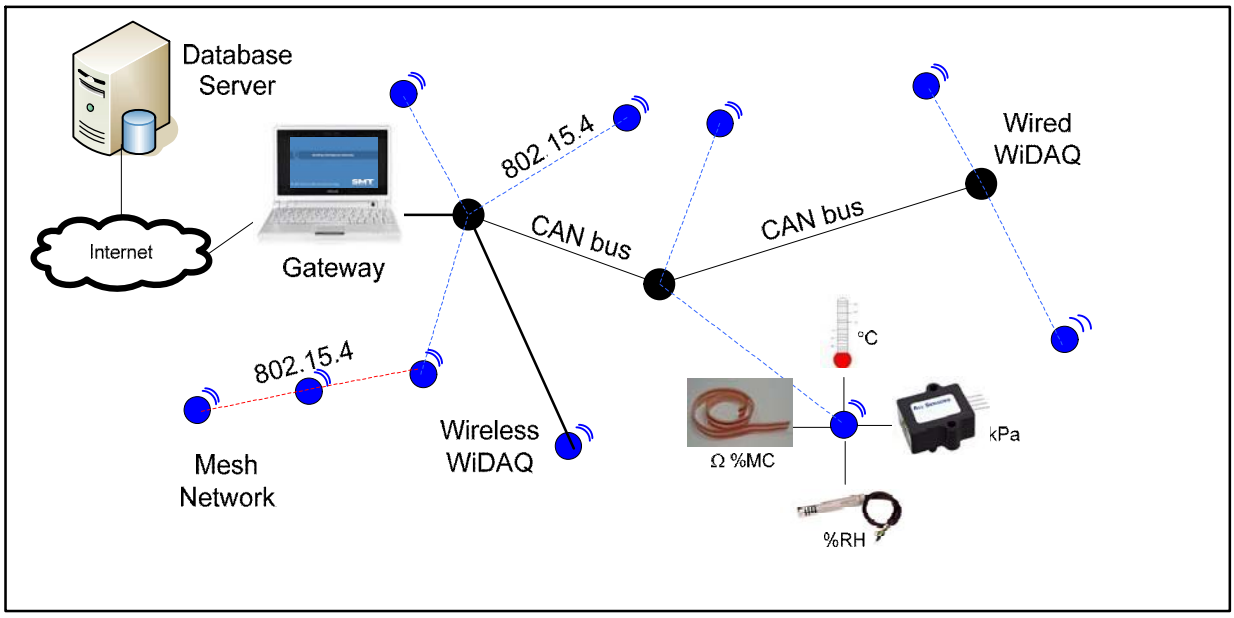
Data collection and analysis

Data from the WiDAQs is collected by the *Building Intelligence Gateway* (BiG) and forwarded to the *Building Analytics* server database for further analysis and user access. See the BiG and Analytics user manuals for sensor configuration and data analysis capabilities.



Ordering Information	
Industrial WiDAQ	WiDAQ-022-800-E
Industrial WiDAQ w/ external antenna	WiDAQ-022-800-EL
Industrial WiDAQ w/ external antenna and solar panel	WiDAQ-023-800-EL
External RH Sensor	HTM2500-02-005
Point Moisture Measurement w/ thermistor	PMM-01-06
Thermistor	104JT-01-005
AA Battery Pack	AABAT PACK

Specifications are subject to change without notice



Typical Application

Building Intelligence Gateway

General Description

The Building Intelligence Gateway is a compact yet powerful computer system used to provide continuous monitoring and data collection of distributed sensors used for automated structure monitoring.

The BIG system collects data from a wide variety of sensors located within the monitored structure and provides local analysis of data as well as distribution to a central monitoring database and reporting system.

The BIG system uses Windows XP to provide a familiar and user friendly interface for configuration and local data analysis. The software engine interfaces to both high speed wireless and wired sensors and is suitable for use in high density applications where real-time data of hundreds of sensors is required.

Applications

Building Science Research
- Window and wall module evaluation
- External façade sensing
- Moisture and temperature sensing

Field Applications/Research
- Long term structure monitoring
- Targeted repair monitoring

Roof Monitoring

Features

- Compact design. Fits in standard wall mount cabinets.
- Rugged and portable. Rugged case available for portable and outdoor applications.
- Local Windows XP user interface displayed on 7 inch backlit LCD display.
- Simple configuration. Keyboard and touchpad used for local configuration.
- Solid state storage permits rugged installations and is expandable using the local MMC/SD interface.
- Standard 10/100 Mbit Ethernet and 802.11 b/g wireless.
- USB ports permit expansion and compatibility to 3rd party systems.
- Optional GSM interface to cellular network for installations where internet is not available.
- Interface to 802.15.4 wireless and Controller Area Network wired sensor units.
- Multithreaded communication permits communication to large sensor networks.
- Event handling and alarm processing allows BIG to be used as a standalone monitoring center.
- Displays sensor data in real-time on demand.
- Unique graph manipulation tools available for viewing and scanning large data sets. Advanced graphing functions permit detailed analysis of sensor data.
- Collates sensor data and forwards to monitoring center for storage and further analysis.
- Unique sensor groupings and mass configuration schemes available.
- Real time clock and built in battery backup.

Hardware Specifications

Operating System	Windows XP
Display	7” with LED backlight
Memory	512MB
Storage	Solid State 4GB
Local Input	Keyboard/Touchpad
User Connectivity	10/100 Mbit Ethernet 802.11 b/g wireless LAN GSM cell network
Expansion	3 USB 2.0 ports MMC/SD card reader
Sensor Connectivity	Wireless 802.15.4 Wired CAN 2.0
Max Distance from coordinator node	Wireless 30m Wired 300m
Power	5200 mAh battery backup 120VAC
Dimension	---mm (L) x --- mm (W) x ---mm(H)
Weight	0.92 kg

Sensor Monitoring Performance

See specific sensor datasheets

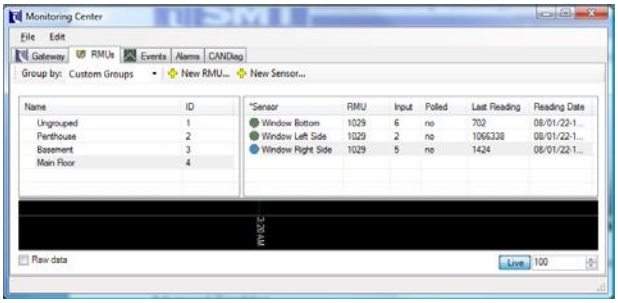
Regulatory

EMC Radiated and Conducted Emissions	FCC Part 15 Class B Industry Canada ICES 003
Safety Requirements	cULus and CE

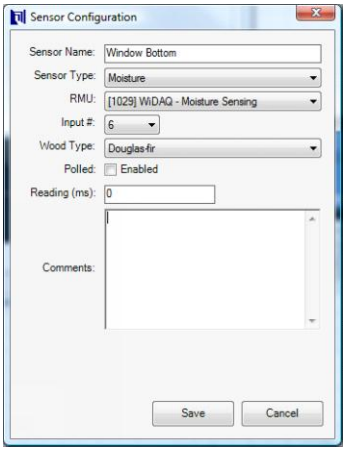
MMC/SD card reader and USB ports

Ethernet and USB port

BIG General Configuration

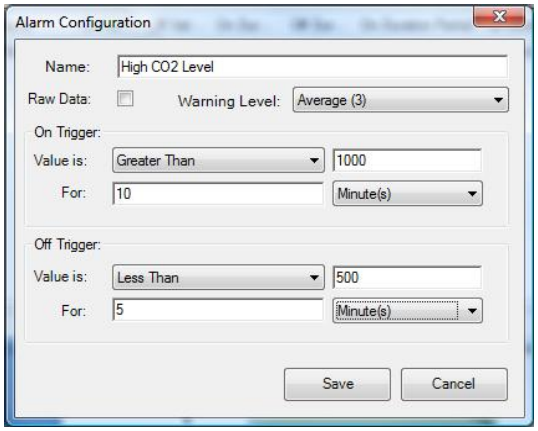


- Compatible sensors discovered on network are automatically added.
- Sensors are grouped according to hardware by default. Custom groupings can be defined.
- Ascending or descending sort can be applied to any column.



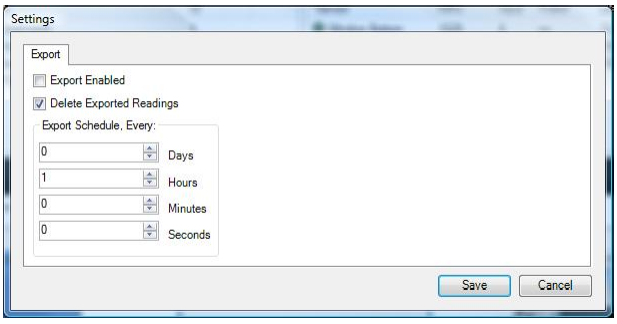
Parameters of each sensor can be easily modified. Batch modifications are possible for applying changes to more than one sensor.

Alarm Configuration



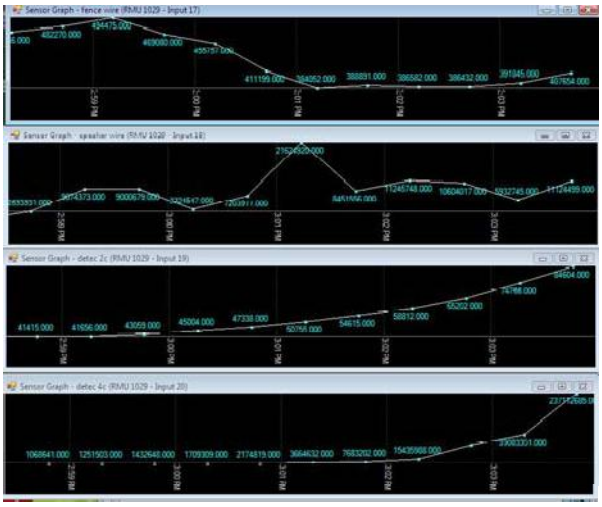
- Specific thresholds can be defined with custom hysteresis. Any number of alarms can be applied to a sensor.
- Sensors exceeding thresholds are listed in the Events tab.

Export Functionality



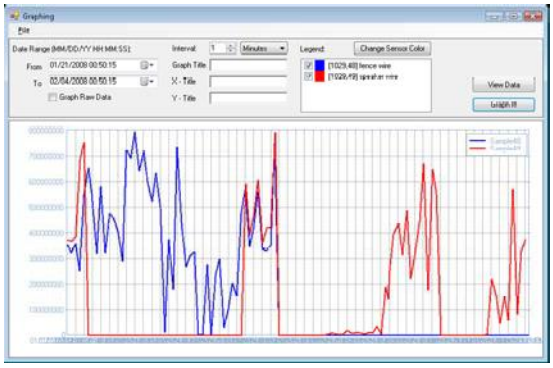
- Specific interval can be defined for forwarding data to monitoring center.
- All data can be easily exported for analysis in custom tools if desired.

Real Time Data Analysis



Sensor data is recorded and graphed in real-time. Using simple mouse controls the x-axis can be scrolled in either direction to view additional data points. X-axis can be easily zoomed in or out by using mouse strokes in the opposite direction.

Advanced Graphing



Sensor inputs can be analyzed using an advanced graphing feature. Graphs can customized, compared and printed.

Ordering Information	
Standard Gateway	BIG-001
Gateway with CAN	BIG-011
Gateway with 802.15.4	BIG-101
Gateway with CAN And 802.15.4	BIG-111

Specifications are subject to change without notice

Appendix J

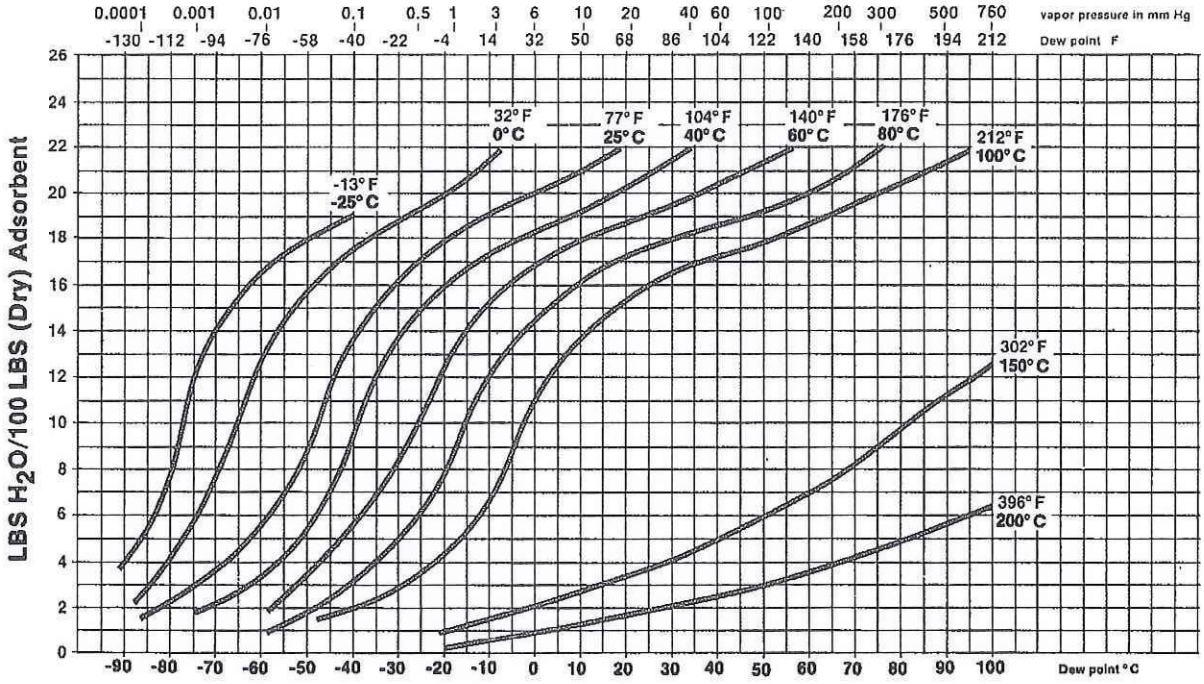
Zeochem Desiccant Information

ZEOCHEM®

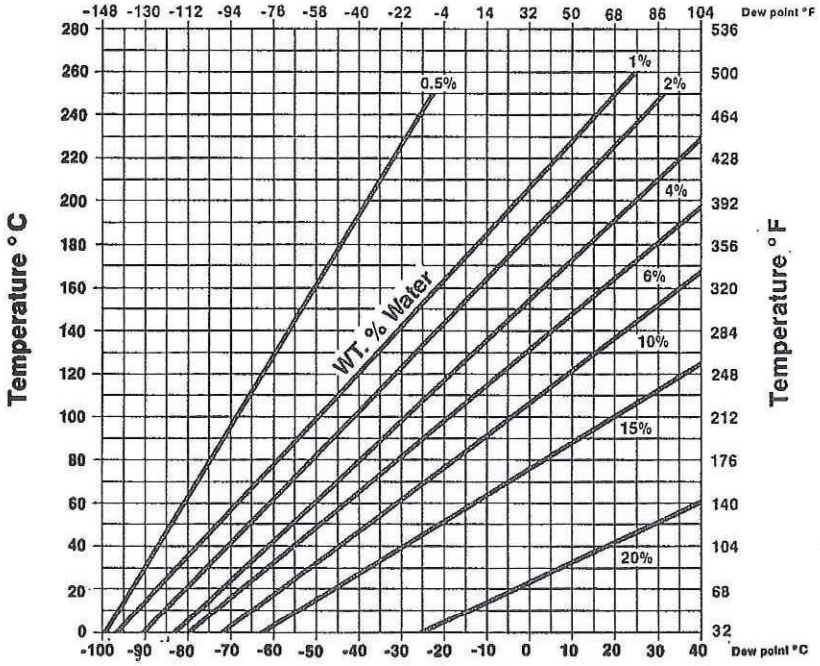
ADSORBENTS

Molecular Sieve Type 3A — Isotherms & Isosteres

Water Vapor Isotherms of ZEOCHEM® Molecular Sieve Type 3A



Water Vapor Isosteres of ZEOCHEM® Molecular Sieve Type 3A



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