

## **CITY OF CHICAGO**

# **WINDOW EVALUATION AND MITIGATION VINYL ACOUSTICAL WINDOWS CHICAGO, IL**

**PROJECT NUMBER**  
I1935.01-601-17 R0

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### REPORT ISSUED TO

**City of Chicago**

30 North LaSalle Street

Chicago, IL 60602

### SECTION 1

#### SCOPE

Architectural Testing, Inc., an Intertek company (Intertek-ATI), has been retained by the City of Chicago to perform an independent evaluation of vinyl windows installed as part of the noise mitigation program around O'Hare and Midway airports. The primary purpose of the evaluation is to assist with developing a mitigation plan for odorous vinyl acoustical windows, and secondarily to make recommendations regarding contract specifications to address these concerns.

This report presents our findings and recommendations for mitigation. Our findings are based on documentation of the reported concerns, review of analysis reports prepared by Wood Environment and Infrastructure Solutions, Inc. (Wood), and on-site observations and testing. The information contained in this report is based on the information provided, and limited on-site observations and testing. Additional conditions may exist that can contribute to the reported concerns that are not noted in this report. If additional information becomes available, we reserve the right to revise this report and the opinions stated herein, as necessary.

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### SECTION 2

#### BACKGROUND INFORMATION

For many years, the City of Chicago Department of Aviation (City) has installed acoustical windows at multiple residences at or around the Midway and O'Hare Chicago Airports as a part of the noise mitigation program. Following installation, it was reported that a subset of the vinyl replacement windows are creating an odor. In 2017, the City hired Wood to perform environmental and chemical analysis testing to determine the cause(s) and/or source(s) of the reported odors, so a mitigation plan could be established. Intertek-ATI was retained to assist with developing a mitigation plan for the existing windows.

### SECTION 3

#### INFORMATION FROM OTHERS

Interviews: In the planning of the project and during our site observations and testing, the City, Wood, and CMC Partners representatives provided the following pertinent information:

- Odors are mainly reported for the vinyl replacement acoustic windows manufactured by Sound Solutions.
- Odors have been smelled at windows on all elevations, and while most common during warmer months, odors have been smelled in all months.
- Not all Sound Solution windows have reported odors.
- The majority of windows with reported odors are double-hung windows.
- In some instances, odors are not noticed by residents until the inner sash of the window system is opened, while some residents smell odors even when the windows are closed.

Evaluation Report: We reviewed reports prepared by Wood (formerly Amec Foster Wheeler Environment and Infrastructure, Inc.). The following summarizes pertinent information:

- Various testing techniques and methods may have identified the window screen of the Sound Solutions windows to be a significant contributor to the reported odors.
- Secondary contributors to the reported odor may be the vinyl component of the sash and frame, with the frame appearing to contribute less than the sash.
- Heat appears to be an important factor in the odor levels.

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### SECTION 4

#### OBSERVATIONS AND TESTING

The following summarizes our observations from site investigations and testing of the Sound Solutions windows at limited residences.

Eric Seaverson, Derek Cavataio, Nick Rydzik, and Dave Libbin of Intertek-ATI visited limited residences during various days in June and July of 2018. The primary purpose of the visits was to review the condition of the existing windows and its components, and perform air infiltration testing. The following summarizes our observations.

In general, the majority of the Sound Solutions acoustical windows are vinyl double-hung windows (*reference Photo Nos. 1 and 2*). The typical double-hung window system consist of an inner operable window system with insulated glass units, and an integral outer operable storm window (single pane glass). A framed screen is located between the inner window and storm window (*reference Photo No. 3*). The framing of the inner window is vinyl and the integral storm window is aluminum. Large weeps are present through the sill framing (between the inner window and storm window) to drain water leakage.

Other window types include casements (*reference Photo No. 4*), where the screen is located inboard of the inner insulated window, with the storm window integrated with the face of the inner window (*reference Photo No. 5*).

Due to the reported odors, observations were primarily focused on the double-hung windows. The windows reviewed include tilt-in features, commonly marketed for ease of cleaning the exterior glass surfaces. Brush-type weatherstripping is typically attached to the ends of the operable sash and other locations, to create air and water seals. In general, the weatherstripping reviewed appears continuous and intact (*reference Photo Nos. 6 and 7*). Most of the sash were relatively "tight" within the frame; however, we did note isolated windows where the sash was relatively loose, with one area where daylight was visible between the sash and frame.

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Air Infiltration Testing: Air infiltration testing of the inner window of Sound Solutions windows was performed at various residences to assess the amount of air leakage through the window assembly. Testing of the inner window was performed in general accordance with ASTM E783 – *Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors*. The following summarizes the results.

Test Designation	Results (CFM/SF)
#1A	0.39
#1B	0.16
#2A	0.29
#2B	0.36
#3A	0.26
#3B	0.35
#4A	2.56
#5A	0.47
#5B	0.50
#6A	0.78

*Note: While not applicable for windows installed for more than 6 months, for reference, the acceptable air infiltration rate for new windows of this type is 0.45 CFM/SF. Based on this, 60% of the windows tested meet new window standards for airtightness, and an additional 20% of the windows (#5A and #5B) are within a reasonable range above of the new window standard. Only one (1) window has significantly excessive air leakage (#4A), where daylight could be seen between the sash and frame.*

**SECTION 5  
DISCUSSION**

As indicated by the Wood report, it appears that the primary source of the reported odor is likely the screen material used in the Sound Solutions window. Potential secondary contributors include the vinyl sash material and vinyl frame material; however, the extent of their contribution is unclear.

We suspect the cavity between the inner window and storm window, when both are closed, can greatly exceed exterior ambient temperatures during summer months, especially for south and west facing windows. The elevated temperatures may accelerate deterioration of components and compounds, leading to the various odors.

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While the cause of the screen deterioration is not completely understood, the dynamics of most acoustical windows are different than conventional windows, making the durability of the screen material more important. For conventional non-acoustical windows, where the screen is completely outboard of the system, if the screen material deteriorated and off-gassed, the odor would dissipate and likely be not noticed by residents. The screen in the Sound Solutions windows is located between two systems (inner window and storm window). Further, in many instances the airtightness performance is relatively good. Therefore, the odor can become trapped and concentrated within the system, and not noticed by residents until the inner window sash is opened, releasing the odorous air into the residence. However, because all windows (including new) have acceptable levels of air leakage, windy or other conditions that create pressure differential across the inner window can cause infiltration of odorous air into the residence even when the windows are closed and secured.

### SECTION 6

#### CONCLUSION AND POTENTIAL MITIGATION

While additional contributors may be present, based on Wood's findings, the screen material appears to be the most significant odor causing component. Therefore, a mitigation plan will likely include replacing the window screen materials with a more stable screen material. That said, while the headspace testing performed by Wood indicated the vinyl sash and frame materials as potential contributors to the odors, headspace testing creates very concentrated levels of odors, which may not be smelled during in-service conditions.

Because of this, the following mitigation evaluation protocol is based on removing the screen (the apparent greatest contributor to the reported odors) to determine whether additional odors can be smelled after the existing odors have been removed, and the windows returned to standard operating conditions (i.e. closed). To ensure the windows remain intact and actual conditions are not altered, we recommend that mitigation evaluation be performed in-situ, as opposed to removing windows for evaluation in a laboratory. Also, since Wood has indicated that heat is a variable that appears to increase odor levels, windows with direct and prolonged sun exposure should be considered, which will create the highest temperatures within the assembly. Lastly, to determine if a residue on the vinyl window sash and framing contributes to the odors, wiping of those components should be considered.

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### Proposed Mitigation Evaluation Protocol:

- Identify Sound Solutions windows with reported odors; south, east, and west elevation only, with prolonged direct exposure to sunlight.
- Remove screen, then:
  - Subset #1: No additional work.
  - Subset #2: Wipe inner sash and frame vinyl with isopropyl alcohol.
  - Subset #3: Wipe inner sash and frame vinyl with solvent cleaner.
- Open storm window, and inner window as acceptable, for a minimum of 24 hours.
- Fully close and latch inner window, and fully close storm window.
- Windows must remain fully closed for the duration of evaluation (see below). Open inner window at end of evaluation duration (as noted below) to review for odors. If odors are smelled, stop the evaluation. Otherwise, continue to next duration.
  - Duration #1: 24 hours
  - Duration #2: 72 hours
  - Duration #3: 7 days

For initial sample size, evaluation of three (3) to five (5) Sound Solutions windows per subset (nine (9) to fifteen (15) windows total) could be considered. Based on the results, additional evaluation, with or without modifications to the protocol, will be reviewed and considered. We note that because heat is a variable for the level of smell odors, it is important that this evaluation be performed during the summer months. If sash or frame vinyl is identified as an issue after screen removal, other mitigation steps will be evaluated including replacement of weatherstripping, increasing size of the weeps, additional venting, etc.

In addition to performing the mitigation evaluation noted above, we recommend that potential replacement window screen materials be tested to ensure durability, confirm odors are not created under service conditions, etc. Following the mitigation evaluation noted above, assuming acceptable results (i.e. no odors smelled), follow-up evaluation with replacement screens in place should be considered.



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**SECTION 7  
CLOSING**

Please contact our office if you have questions regarding this report. As additional results are obtained, we will continue to support the City with additional consulting and testing services, including assisting with the development of contract specifications to address the reported concerns.

For INTERTEK-ATI:

<b>COMPLETED BY:</b>	Eric J. Seaverson, P.E.
<b>TITLE:</b>	Director Building Science Solutions
<b>SIGNATURE:</b>	
<b>DATE:</b>	07/19/18

EJS:wam

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### *SECTION 8* PHOTOGRAPHS



**Photo No. 1**  
Interior view of typical double-hung window.



**Photo No. 2**  
Exterior view of typical double-hung window.

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**Photo No. 3**

**Typical screen location for double-hung windows.**



**Photo No. 4**

**Interior view of typical casement (and fixed) window.**

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**Photo No. 5**

**Typical screen location for casement windows.**



**Photo No. 6**

**Typical condition of brush-type weatherstripping.**

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**Photo No. 7**

**Typical condition of brush-type weatherstripping.**