Toronto Green Standard V3 – Tier 2-4 Guidance Document
Air Tightness Testing Protocol & Process May 13, 2019

This document was prepared for the City of Toronto, City Planning Division by contributing authors from WSP Canada Inc, Ryerson University, Department of Architectural Science and RDH Building Science Inc.

Purpose:

This guidance document applies to large, multizone buildings being constructed in Toronto and should be read and applied in conjunction with ASTM-3158-18 *Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building* to be followed in conducting an air tightness test.

The purpose of this Guidance document is to clarify the testing protocol to be used for projects pursuing Toronto Green Standard (TGS) V3, Tiers 2 through 4 and help them achieve more air tight buildings. Air tightness testing and processes associated with testing should produce more airtight buildings and improve durability, occupant comfort, mechanical ventilation system effectiveness, lower utility costs, and enhance resiliency. This document provides specific guidance for the standards to be referenced, testing procedures including the use of guarded testing, and how to test large multizone buildings.

Air tightness testing is a new requirement under TGS V3, required for all Tier 2 large (Part 3) buildings. Testing is not required for Part 9 buildings by the TGS. The requirement is to submit air tightness related submittals, to perform the test as outlined below, and to report the results of the test to the City and the third party Tier 2 verifier. Information from the test should inform future developments and ways to reduce air leakage in design and construction to achieve better testing results on a go forward basis.

1. Testing target

1.1. The testing target is 2.0 L/s m2 @75Pa (0.4 cfm/ft^2 @75Pa); this target is not enforced at this stage under TGS V3 however the testing report is required to be submitted to the City of Toronto.

2. Testing Procedures

2.1. Follow *ASTM E-3158-18 Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building*. Additional guidance can be found in US Army Corps of Engineers (USACE) Air Leakage Test Protocol.

2.2. Whole-building air tightness testing is preferred. If the air tightness testing plan identifies that whole-building testing is not feasible, guarded testing is permitted. Guarded testing shall

include testing a sampling of floors including: podium, base of tower, top of tower, unique floors, and 2 contiguous floors for every 10 floors (to capture slab bypass condition).

For example, a building consisting of an 18-storey tower, with identical floor plates for the entire tower, and a podium would require the following tests, as a minimum:

- One (1) test at the podium
- One (1) test at the base/bottom floor of the tower
- One (1) test at the top floor of tower
- One (1) test at any one floor within the tower (not top or bottom)
- Two (2) tests each incorporating 2 contiguous floors, to capture the slab by-pass condition.

2.3. Test method:

2.3.1. Projects shall conduct an *operational envelope* (see ASTM E3158, Table 1) air tightness test under negative pressure producing a multi-point regression. If desired, projects are permitted to pursue negative and positive pressure testing and produce a building envelope test where HVAC-related openings are excluded, as in the Passive House standard. We acknowledge that the difference between positive and negative infiltration tests is acceptably small for large buildings with adhered or mechanically-attached air barrier systems.

2.3.2. Projects shall target a test pressure of 75Pa. Projects unable to achieve 75Pa must follow either ASTM E-3158-18 alternative test methods, Repeated Single-Point Test, or a Repeated Two-Point test and demonstrate compliance using projected curves for air tightness at 75Pa.

2.3.3. Baseline pressure is reported at 75Pa for enclosure leakage rates and Equivalent Leakage Area (EqLA) is reported in cm^2 at 10Pa.

2.3.4. If the whole building cannot be tested as one zone, it is acceptable to test a zone that can be partitioned temporarily with adjacent zones “guarded” as buffer zones using blower door equipment. Note that the air leakage rate should be normalised to the exterior surface area and not include the guarded surface areas.

2.3.5. When determining the normalized air leakage rate for ASTM E3158, include all surfaces separating the conditioned space from the exterior, above and below ground (i.e. six sides of the box).

2.3.6. Conditions for the test: All materials, assemblies, and systems that form the air barrier must be installed plus any HVAC equipment, ducts, and fittings included in the test boundary. The Builder and Testing agency will identify the Test Enclosure volume and clearly delineate any volume(s) that are not part of the test boundaries. An agreement will also be made on who will prepare and treat the HVAC penetrations and overhead doors and dock levelers prior to testing.

2.3.7. On test day the builder shall provide the following conditions that must be met before test can be conducted: Power for test fans; person authorized to place HVAC and combustion equipment in test mode; access to all spaces within the test boundaries, and; safe access to all HVAC and overhead doors, related penetrations, openings, and dampers.

2.3.8. Compliance with a specified air leakage rate does not imply that all potentially problematic leaks have been sealed. While this test determines the air leakage rate of an envelope it does not identify the location of leakage sites.

2.3.9. Air tightness testing must be undertaken by a qualified, experienced, third party air tightness testing professional or agency. Air tightness certification training is under development in Canada. Until such a time as there is a clear designation, the qualified professional must provide project references showing that they have completed air tightness testing on Part 3 buildings in Canada or the U.S and/or have undertaken relevant education and training.

3. Reference documents

3.1. ASTM E 3815 *Standard Test Method for Measuring the Air Leakage Rate of Large or Multi-zone Buildings* (Must be followed).
3.2. US Army Corps of Engineers (USACE) *Air Leakage Test Protocol for Building Envelopes*
3.3. Air Barrier Association of America (ABAA) *Air Leakage Test Protocol for Building Envelopes* (Version 3, May 11, 2012)
3.4. ASTM E779-19 *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization*
3.5. ASTM E1827 – 11 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
3.6. ISO 9972:2015 Thermal performance of buildings -- Determination of air permeability of buildings -- Fan pressurization method
3.7. CGSB - CAN/CGSB-149.10-M86 *Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method*

3.8. ATTMA 2015 TECHNICAL STANDARD L2. MEASURING AIR PERMEABILITY IN THE ENVELOPES OF BUILDINGS (Non-Dwellings)

4. TGS Tier 2 Submittal Requirements for Third Party Verification

4.1. Construction Documents (CD) Stage Submittal

4.1.1. Submit signed confirmation of contract with air tightness testing firm name, team members, and credentials.

4.1.2. Drawings shall include intended line of air tightness (operational envelope).

4.1.3. Include a short narrative that describes the project's approach to achieving air tightness, proposed testing procedure (i.e. pressurized, depressurized, both), with related quality assurance / quality control activities which may include partial building air tightness testing and a representative sampling strategy for selecting parts of the building for "guarded" testing methods where whole building testing is not feasible or possible. Refer to Section 5 for additional information.

4.2. Project Completion Submittal

4.2.1. Completed air tightness testing report in accordance with reference documents.

4.2.2. If results are below target, report shall include practical steps to identify areas of significant air leakage and improve air tightness for this project report shall also include strategies for improving air tightness on future projects.

5. Guidance

5.1. At the 50-75% CD stage, an *airtightness testing plan* should be submitted by the testing agency engaged on the project. In the submission, the testing agency should include, but is not limited to, the following documentation:

5.1.1. The associated calculations to identify the number of blower door fans required for testing;

5.1.2. The location of the equipment set up on the construction drawings;

5.1.3. Identify the power source and electrical circuits that will be used to operate the fans on applicable drawings;

5.1.4. A comprehensive testing procedure plan; and,

5.1.5. Identification of all persons associated with the testing (for example – testing agency, construction project manager, construction site supervisor, the mechanical contractor responsible for the temporary shut-down of mechanical equipment, security [if required]).

5.2. Investing in the planning efforts early in the project will help ensure that the construction project team is fully aware of the testing activities that will be taking place, make all parties aware of what their responsibilities are, and ensure that the testing agency is prepared with the adequate equipment to perform the testing.

5.3. The Building Enclosure Commissioning Agent (BECxA) may be engaged during the design development phase and provide input into building enclosure systems as they relate to energy, water, indoor environmental quality, and durability throughout the project. Air tightness is a key attribute and should be part of the BECxA's scope. Including BECx in the Owner's Project Requirements will create a smooth transition to a successful air tightness test.