Test Procedure for the Wind Resistance of Asphalt Shingle Roofing Systems for Canadian Climate Conditions

Non-sensitive

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Executive Summary

An asphalt shingle roof (ASR) is one of the most common steep-slope roofing systems in North America. ASR is composed of three major components: asphalt shingles, underlayment, and wood sheathing, mechanically fastened to the roof structure. ASR performance is influenced by material properties, fastening patterns, sealant activation, and environmental conditions such as wind loads. As a result, the wind resistance test method is essential for evaluating the resilience of ASR and ensuring compliance with building code requirements.

Currently, to satisfy the wind load requirement of the ASR, ASTM D3161 "Standard *Test Method for Wind-Resistance of Steep Slope Roofing Products (Fan-Induced Method)"* (ASTM International, 2020) is referenced in the National Building Code of Canada (NBCC) (Canadian Commission on Building and Fire Codes, 2020) via the CSA A123.5 "*Asphalt shingles made from glass felt and surface with mineral granules"* (Canadian Standards Association, 2020) standard. TAS 100 "*Test Procedure for Wind Driven Rain Resistance of Discontinuous Roof Systems*" (Florida Building Commission, 1995) is also widely used in some codes and or Authority Having Jurisdiction (AHJ). While TAS 100 is commonly used, it primarily evaluates water infiltration rather than wind performance. In regions where TAS100 is referenced, ASR wind load requirements are typically addressed using ASTM D3161 (ASTM International, 2020) or D7158 (ASTM International, 2020). By combining the elements of both ASTM D3161 and TAS100, the present study developed TAS 100+ (Shyti et. al., 2025).

The TAS 100+ wind profile of the TAS 100 was modified by eliminating the lower wind speed ranges and incorporating higher wind speed requirements. The lower wind speed ranges of the TAS 100 were eliminated because, to comply with NBCC, the ASR must meet Class F [177 km/h (110 mph)]. Therefore, testing at speeds substantially lower provides less meaningful performance insights. Compared to ASTM D3161, the time duration of the test at 177 km/h (110 mph) was significantly reduced from 2 hours to 10 minutes. Two higher wind speed requirements were added, with a duration of 3 minutes at 193 km/h (120 mph) and 1 minute at 209 km/h (130

mph). The higher wind speed requirements were incorporated to evaluate the ASR performance under more extreme wind conditions. This aims to account for the increase in frequency of extreme wind events across Canada, even in zones not designated as high wind areas. Manufacturers can provide guidance for high-wind installations, such as the application of asphalt cement.

The test specimens under the TAS 100+ are designed to evaluate the performance of the ASR more comprehensively by incorporating elements that extend beyond merely representing the field of the roof. This includes assessing areas such as the edges and valleys, which are often considered weak links in the ASR for wind and water resistance. This broader evaluation helps to ensure a more thorough understanding of the ASR's overall performance and resilience under various climatic conditions.

Test Procedure for the Wind Resistance of Asphalt Shingle Roofing Systems

The wind and wind-driven rain resistance of the asphalt shingle roofing system can be evaluated by applying *the Testing Application Standard (TAS) No. 100-23 – Test Procedure for Wind and Wind-Driven Rain Resistance of Discontinuous Roof Systems,* with the following modifications:

- Apparatus – Wind Generator: (Figure 1)
    - The wind generator(s) shall deliver a constant wind profile across the entire width of the test specimen for the specified duration, with a maximum wind speed of 209 km/h (130 mph).
- Apparatus – Water Supply:
    - The rain test component is optional.
- Test Specimen: (Figure 2)
    - The test specimen shall consist of a 1.5 m × 1.5 m (5 ft × 5 ft) base structure constructed from wood framing and plywood sheathing. Deck support joists shall be spaced at 0.6 m (2 ft) centers. The deck shall have a slope of 4:12 and be oriented as follows:
        - “Silver”: 5 ft eave facing directly toward the wind generator.
        - “Gold”: Test specimen positioned diagonally facing the wind generator.
    - Edge protection in the form of self-adhered membrane shall be installed along the perimeter and the valley. This shall be followed by eave edge flashing installed at the eave edge and valley metal installed at the valley.
    - Underlayment and prepared roof covering shall be installed. Other components, if any, shall be installed as per the manufacturer/proponent/client’s instructions.
- Conditioning: (Figure 3)

- The completed test specimen shall be exposed for 16 continuous hours at a minimum temperature of 67°C to 70°C (152°F to 158°F) in an environmental chamber.

- A wind profile, as shown in Figure 4, shall be followed.
- Failure modes: The test mock-up is failed when one or more of the following conditions are observed:
  1. Any component of the ASR (the “system”) blows off or tears, or detaches from the mock-up during the system wind flow test.
  2. During the rest interval between wind load intervals, any component:
     a. exhibits damage (i.e., creasing, tearing, cracking or splitting, or curling), or
     b. is deformed upward without resuming its original position.
  3. Any upward lifting of an entire shingle (excluding fluttering), regardless of how long the shingle has lifted during the wind flow test.
- Sustained wind speed: It is defined as the highest sustained wind load interval [a minimum of 193 km/h (120 mph) for Silver and 209 km/h (130 mph) for Gold] during which no failure occurred.

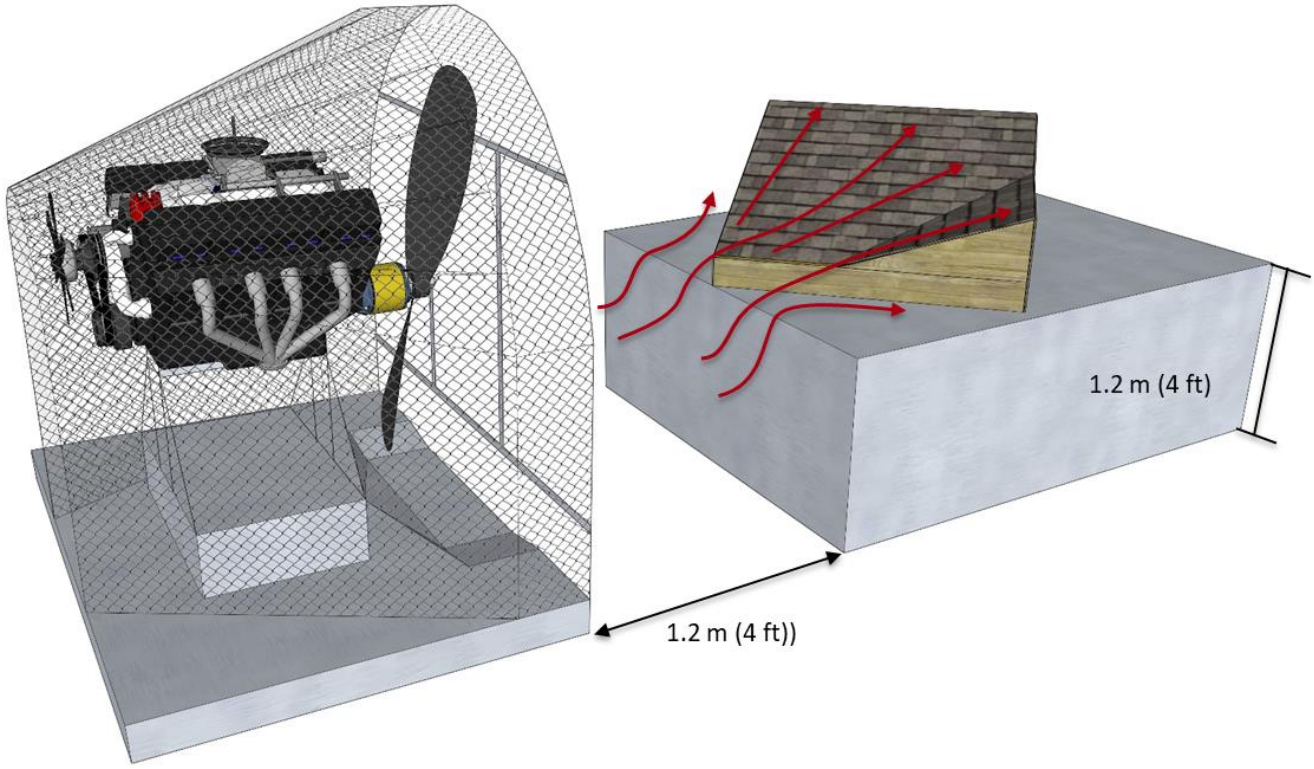

Figure 1. Test specimen positioned at a 45° yaw angle relative to the wind flow and anchored 1.2 m (4 ft) from the wind flow generator

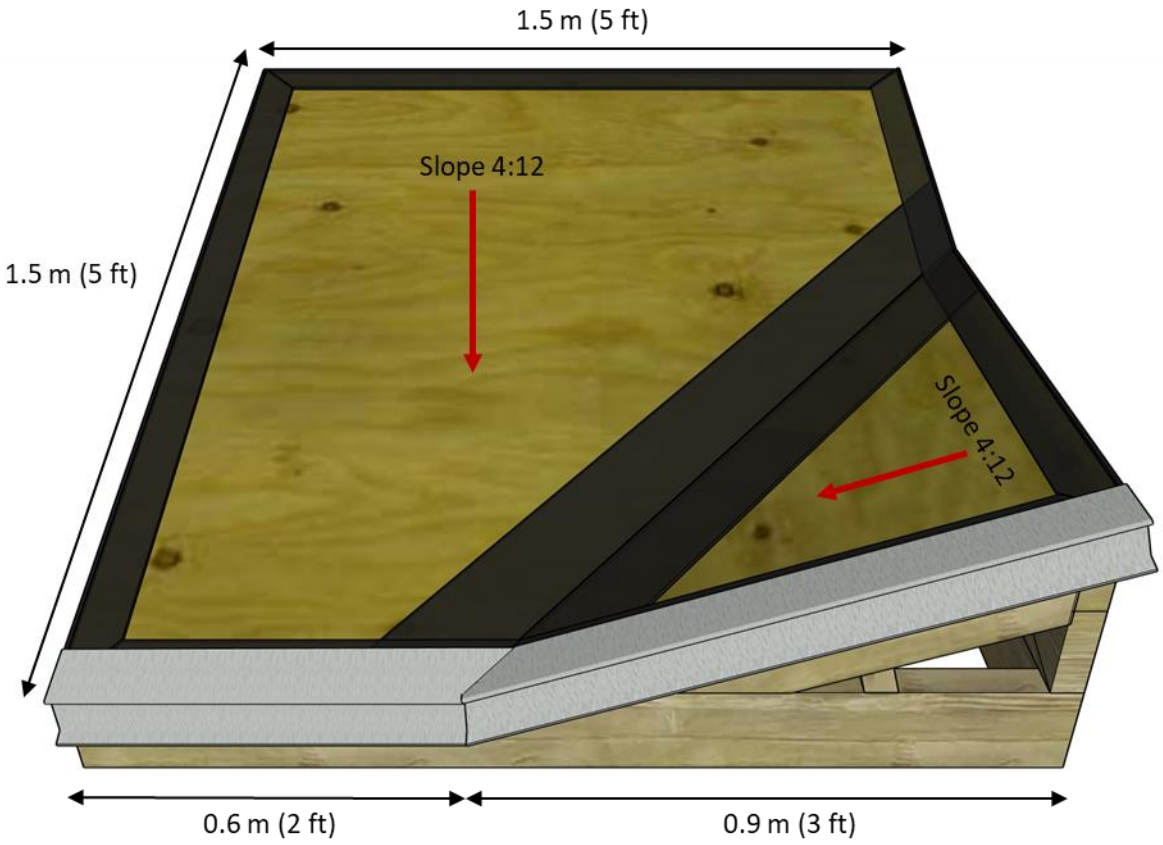

Figure 2. Test specimen deck constructed from wood framing and plywood sheathing

Figure 3. Environmental chamber to condition the test specimen

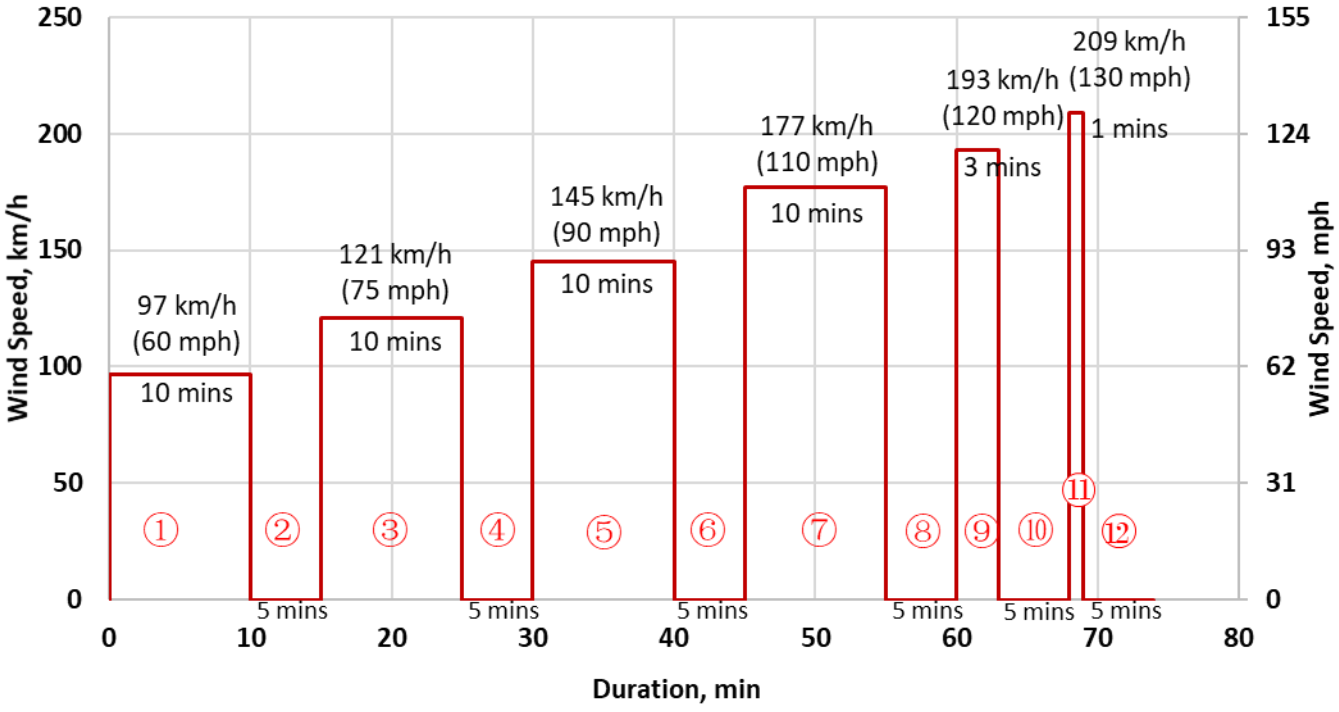

Figure 4. Wind speed profile used in TAS 100+ test program

Reference

ASTM International, ASTM D3161/D3161M-20(2020), *Standard Test Method for Wind Resistance of Asphalt Shingles (Fan-Induced Method)*. West Conshohocken, PA, 2020.

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