

Public Review

BC Building Code 2023

Proposed change to harmonize fenestration standards with the National Model Codes 2020

Topic: Windows, Doors, and Skylights

Code change number: BCBC2023-PR-08-WD

Code reference: BC Building Code 2018 – Division B; Table 1.3.1.2. and Section 5.9

Related code reference(s): Part 9 of Division B, Section 9.7.

Description of the proposed change

Requirements for windows, doors, skylights and other fenestration assemblies and other glazed products are proposed to be further harmonized with the requirements of the National Building Code 2020 (NBC). One B.C. change is to extend a permission for “Limited Water” doors to Part 5 as it is in Part 9.

Changes to referenced standards related to glass include:

- Reference to the 2017 edition of AAMA/WDMA/CSA 101/I.S.2/A440, “North American Fenestration Standard/Specification for windows, doors, and skylights” (NAFS)
- Reference to the 2019 edition of CSA Z440S1, “Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-17, “North American Fenestration Standard/Specification for windows, doors, and skylights” (Canadian Supplement to NAFS)
- A new standard for spandrel glass (Table 5.9.1.1.)
- Standards for light and heat reflecting glass as well as for wired safety glass have been removed (Table 5.9.1.1.)
- Several material standards have been updated to newer versions (Table 5.9.1.1.)

Except for the referenced editions of NAFS and the Canadian Supplement to NAFS, requirements in Section 9.7 of Division B, Part 9 are proposed to be unchanged.

Justification

B.C. requirements in Part 5 were varied from those of the NBC to address a lack of compliance options for fenestration assemblies that are not covered within the scope of the North American Fenestration Standard, such as curtain walls and window walls. The NBC has since introduced similar requirements that B.C. can adopt. Some B.C. variations, such as the permission for engineered design using environmental loads from Part 5 have been retained, to help ensure custom engineered solutions are still available. For example, fenestration assemblies, except those required to have a fire-protection rating, may follow either:

- Subsection 5.1.4., Section 5.4. and Section 5.6.
- Article 5.9.2.2. (NAFS), or
- Subsection 5.9.3. (which is substantially the same as following Subsection 5.1.4., Section 5.4. and Section 5.6. but with some specific criteria)

The intent of these changes is to substantially harmonize with the requirements of the NBC, while minimizing change for the industry.

B.C.'s permission for "Limited Water" doors in specific applications provides design flexibility and incentivises accessibility. "Limited Water" doors are already permitted in Article 9.7.4.2., Division B, of the British Columbia Building Code 2018.

Proposed National Building Code content and B.C. specific content

Legend

Black Text – 2018 BC Building Code content

Green Text – Proposed 2020 National Building Code and BC specific content

Red Text – 2018 BC Building Code content removed

5.9.2. Windows, Doors, and Skylights, ~~and Other Glazed Products~~

5.9.2.1. General

- 1) This Subsection applies to windows, doors, and skylights, ~~and other glazed products and including~~ their components, that separate
 - a) interior space from exterior space, or
 - b) environmentally dissimilar interior spaces.
- 2) For the purpose of this Subsection, the term “skylight” refers to unit skylights, roof windows and tubular daylighting devices.
- 3) Windows, doors, and skylights, ~~other glazed products and including~~ their components, that are required to have a *fire-protection rating* need not conform to the requirements of this Subsection.
(See Note A-5.9.2.1.(3).)

5.9.2.2. ~~Design and Construction~~ Applicable Standards

(See Note A-5.9.2.2.)

- 1) Except as permitted in Sentence (5) and Sentence 5.9.2.3.(1), windows, doors, skylights and their components shall conform to the requirements in
 - a) ~~Subsection 5.1.4., Section 5.3., Section 5.4. and Section 5.6., or~~ AAMA/WDMA/CSA 101/I.S.2/A440, “North American Fenestration Standard/Specification for windows, doors, and skylights” (Harmonized Standard), and
 - b) except as permitted in Sentence (~~34~~), CSA A440S1, “Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, ~~NAFS-17~~, North American Fenestration Standard/Specification for windows, doors, and skylights.”
(See Note A-5.9.2.2.(1).)
- 2) ~~Other glazed products and their components shall be designed and constructed in accordance with Subsection 5.1.4., Section 5.3., Section 5.4. and Section 5.6. (See Note A-5.9.2.2.(2).)~~ Performance grades for windows, doors and skylights shall be selected according to the Canadian Supplement referenced in Clause (1)(b) so as to be appropriate for the conditions and geographic location in which the window, door or skylight will be installed.
- 3) Windows, doors and skylights shall conform to the performance grades selected in Sentence (2) when tested in accordance with the Harmonized Standard referenced in Clause (1)(a).
- 34) For the purposes of conformance with Clause (1)(b)(ii), loads and procedures from Section 5.2 may be used instead of the loads and procedures set out in the standard. (See Note 5.9.2.2.(4).)

5) A door designated as a “Limited Water” door in accordance with the standard referenced in Clause (1)(a) shall not be used unless the door

- a) separates a *dwelling unit* from an unconditioned *storage garage* or a carport,
- b) is designed with a clear width, a clear and level space, a door-opening device and a door closer in conformance with Subsection 3.8.3. (see Article 3.8.3.6.), or
- c) meets the criteria in Sentence 9.27.3.8.(3) such that flashing would not be required.

5.9.2.3. Structural and Environmental Loads, Air Leakage and Water Penetration **Reserved**

1) Windows, doors, skylights and their components that do not conform to Article 5.9.2.2. shall be designed and constructed in accordance with Subsection 5.1.4., Section 5.4. and Section 5.6.
(See Note A-5.9.2.3.(1).)

5.9.2.4. Heat Transfer

- 1) Windows, doors and skylights shall meet the heat transfer performance requirements stated in Section 5.3. (See Note A-5.3.1.2.)
 - 2) Except as provided in Sentence (3), all metal-framed glazed assemblies separating interior *conditioned space* from interior unconditioned space or exterior space shall incorporate a thermal break to minimize condensation.
 - 3) Metal-framed glazed assemblies need not comply with Sentence (2) where these assemblies are
 - a) storm windows or doors, or
 - b) windows or doors that are required to have a *fire-protection rating*.
- (See Note A-5.9.2.4.(3).)

5.9.3. Other Fenestration Assemblies **Reserved**

(See Note A-5.9.3.)

5.9.3.1. General

1) For the purpose of this Subsection, the term “other fenestration assemblies” refers to curtain walls, window walls, storefronts and glazed architectural structures. (See Note A-5.9.3.1.(1).)

2) Other fenestration assemblies and their components that are required to have a fire-protection rating need not conform to the requirements of this Subsection. (See Note A-5.9.2.1.(3).)

5.9.3.2. Structural and Environmental Loads

1) Other fenestration assemblies and their components shall be designed and constructed in accordance with Subsection 5.1.4. (See Note A-5.9.3.2.(1).)

5.9.3.3. Heat Transfer

1) Other fenestration assemblies and their components shall meet the heat transfer performance requirements stated in Section 5.3. (See Note A-5.9.3.3.(1).)

2) Other fenestration assemblies using metal framing that separate interior conditioned space from interior unconditioned space or exterior space shall incorporate a thermal break to minimize condensation.

5.9.3.4. Air Leakage

1) Other fenestration assemblies and their components shall be designed and constructed in accordance with Section 5.4.

2) Except as provided in Sentence (3), other fenestration assemblies and their components shall have an air leakage characteristic, measured at an air pressure difference of 75 Pa, when tested in accordance with ASTM E283, "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen," that is not greater than

a) 0.2 L/(s×m²) for fixed portions, including any opaque portions, and

b) 1.5 L/(s×m²) for operable portions.

(See Note A-5.9.3.4.(2).)

3) The following systems need not comply with Sentence (2):

a) interior windows and interior doors that do not serve as environmental separators,

b) vehicular access doors (garage doors),

c) storm windows and storm doors,

d) commercial entrance systems,

e) revolving doors,

f) smoke and relief air vents,

g) site-built door systems, and

h) commercial steel doors.

(See Note A-5.9.3.4.(3).)

5.9.3.5. Water Penetration

1) Other fenestration assemblies and their components shall be designed and constructed in accordance with Section 5.6. (See Note A-5.9.3.5.)

5.9.4. Exterior Insulation Finish Systems

5.9.4.1. Structural Loads, Heat Transfer, Air Leakage, Vapour Diffusion and Water Penetration

- 1) Exterior insulation finish systems and their components shall comply with
 - a) Subsection 5.1.4. and Sections 5.3. to 5.6.,
 - b) CAN/ULC-S716.1, "[Standard for](#) Exterior Insulation and Finish Systems (EIFS) – Materials and Systems," where covered in the scope of that standard.

(See Note A-5.9.4.1.(1).)

Notes

A-5.9.1.1.(1) Selection of Materials and Components and Compliance with Referenced Standards. It is important to note that Sentence 5.9.1.1.(1) is stated in such a way that the selection of materials and components is not limited to those traditionally recognized as serving particular functions or those for which a standard is identified in Table 5.9.1.1. This approach permits more flexibility than is provided by similar requirements in Part 9. As long as the selected material meets the performance requirements stated elsewhere in Part 5, the material may be used to serve the required function.

However, where the selected material or component, or its installation, falls within the scope of any of the standards listed in Table 5.9.1.1., the material, component or installation must comply with that standard. For example, if some resistance to heat transfer is required between two interior spaces and standard partition construction will provide the necessary resistance, the installation of one of the "thermal insulation" materials identified in the standard list is not required. If, on the other hand, one decides to install glass fibre insulation, the material must conform to CAN/ULC-S702.1, "[Standard for](#) Mineral Fibre Thermal Insulation for Buildings, [Part 1: Material Specification](#)."

A-Table 5.9.1.1. Selection and Installation of Sealants. Analysis of many sealant joint failures indicates that the majority of failures can be attributed to improper joint preparation and deficient installation of the sealant and various joint components. The following ASTM guidelines describe several aspects that should be considered when applying sealants in unprotected environments to achieve a durable application:

- ASTM C1193, "[Standard Specification for](#) Use of Joint Sealants," [and](#)

- ~~ASTM C1299, “Selection of Liquid-Applied Sealants,” and~~
- ASTM C1472, “[Standard Guide for](#) Calculating Movement and Other Effects When Establishing Sealant Joint Width.”

The sealant manufacturer's literature should always be consulted for recommended procedures and materials.

A-5.9.2.1.(3) Airtightness and Watertightness of Windows, Doors, Skylights, Other Fenestration Assemblies ~~Glazed Products~~ and their Components Required to have a Fire-Protection Rating. The airtightness and watertightness requirements are waived for these products when used in such an application, in recognition of the fact that the availability of assemblies that meet both the requirements of the applicable standards and the requirements for fire resistance may be limited. However, control of air and water leakage should not be ignored: measures should be taken to attempt to comply with applicable requirements.

A-5.9.2.2. [Manufactured](#) ~~Design and Construction of~~ Windows, Doors, and Skylights.

~~A-5.9.2.2.(1) Two Compliance Paths.~~ It is intended that any fenestration product that conforms to this ~~Part~~ [Subsection](#) may choose to comply with either Article 5.9.2.2. or Article 5.9.2.3. Even if a product is in scope of the standards referenced ~~via Clause (b) in~~ [Article 5.9.2.2.](#) (NAFS and the Canadian Supplement to NAFS), the compliance path in ~~Clause (a)~~ [Article 5.9.2.3.](#) may be used. However, it is not intended that the compliance path in ~~Clause (b)~~ [Article 5.9.2.2.](#) be used where fenestration products are not within the scope of the referenced standards.

Design Values

CSA A440S1, “Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-~~17~~, ~~NAFS—~~ North American Fenestration Standard/Specification for windows, doors, and skylights,” requires that the individual performance levels achieved by the product for structural resistance, water penetration resistance and air leakage resistance be reported on the product's performance label.

Storm Doors and Windows

Where storm doors and storm windows are not incorporated in a rated window or door assembly, they should be designed and constructed to comply with the applicable requirements of Part 5 regarding such properties as appropriate air leakage and structural loads.

Forced Entry Test

Even though the performance label on rated windows, doors and skylights does not explicitly indicate that the product has passed the forced entry resistance test, products are required to pass this test in order to be rated.

A-5.9.2.2.(43) Loads and Procedures. For windows within the scope of the “Canadian Supplement” referred to in Sentence 5.9.2.2.(1), structural and wind loads are included and may be calculated in accordance with that standard. As an alternative, structural and wind loads from Section 5.2. may be used to select fenestration products that are appropriate for the

point of installation. Values derived from the referenced standard, which uses a simplified calculation method, are typically higher than those derived from calculations done in conformance with Section 5.2.

A-5.9.2.3.(1) Installation and Field Testing of Windows, Doors and Skylights.

Installation and Field Testing of Windows, Doors and Skylights

The installation details of windows, doors, skylights and their components must be appropriately designed and implemented for the building envelope assembly to perform acceptably overall. The proper design of the installation details provides the information necessary to integrate the structure and air, vapour and moisture barrier functions of windows, doors and skylights into the overall design of the building envelope assembly. Construction should be carried out in accordance with these details to achieve an appropriate level of long-term performance. Further guidance on installation detailing can be found in CAN/CSA-A440.4, “Window, Door, and Skylight Installation.”

Field Testing

It is recommended that the performance of installed windows, doors and skylights be field tested early in the envelope construction phase so that any discontinuities can be readily identified and corrected before construction of the building envelope assembly is completed. Additional field testing during subsequent construction phases to monitor installation consistency is also recommended. Field test procedures should be carried out in accordance with test standards such as ASTM E 783, “Field Measurement of Air Leakage Through Installed Exterior Windows and Doors,” and ASTM E 1105, “Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.” Further guidance can be found in Annex D of CAN/CSA-A440.4, “Window, door, and skylight Installation,” ~~however, the~~ which also includes performance requirements developed in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, “NAFS – North American Fenestration Standard/Specification for windows, doors, and skylights,” ~~should to~~ be used ~~rather than the industry performance data values listed in CAN/CSA-A440.4~~ when performing field testing.

A-5.9.2.4.(3) Heat Transfer through Fire-Rated Glazed Assemblies. Thermal bridging through fire-rated glazed assemblies should not be ignored; measures should be taken to minimize condensation consistent with the intent of Sentence 5.9.2.4.(2).

A-5.9.3. Testing Standards for ~~of Other Glazed Products Fenestration~~

Assemblies. Subsection 5.9.3. references ASTM test methods. The following AAMA standards can also be used to evaluate the performance characteristics of other fenestration assemblies: Although other glazed products are generally not within the scope of the standards referenced in Clause 5.9.2.2.(1)(b), they can be tested using other standards such as:

- AAMA 501, “Methods of Test for Exterior Walls,”
- AAMA 501.1, “Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure,”

- AAMA 501.2, “Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems,”
- AAMA 501.4, “Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drifts,”
- AAMA 501.5, “Test Method for Thermal Cycling of Exterior Walls,” and
- AAMA 501.6, “Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall System.”
- ~~ASTM E 283, “Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.”~~
- ~~ASTM E 330/E 330M, “Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.”~~
- ASTM E 331, “Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.”
- ASTM E 547, “Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.”
- ~~ASTM E 783, “Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.”~~
- ~~ASTM E 1105, “Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.”~~

A-5.9.3.1.(1) A-5.9.2.2.(2) Terminology for Other Glazed Products Fenestration Assemblies.

~~Glazed products such as curtain walls or sloped glazing that are not typically considered windows but are installed as part of a separation described in Sentence 5.9.2.1.(1) are not within the scope of the referenced standards and therefore must conform to Subsection 5.1.4. and Sections 5.3., 5.4. and 5.6. The following are considered to be “other glazed products”:~~

Curtain Wall

A curtain wall is considered to be a continuous wall cladding assembly (which may include fenestration and opaque portions) that is hung away from the edge of the primary floor structure. Curtain wall assemblies do not generally support vertical loads other than their own weight. Anchorage is typically provided by anchors that connect back to the floor structure. Curtain wall assemblies can be either “stick built,” meaning each main unit is assembled on-site, or a “unitized” system, meaning factory-assembled main units are installed and connected together on-site.

Window Wall

A window wall is considered to be a wall cladding assembly (which may include fenestration and opaque portions) that spans from the top of a primary floor structure to the underside of the next higher primary floor structure. Window wall assemblies do not generally support vertical loads other than their own weight. Primary provision for anchorage occurs at head and sill connections with the adjoining floor structure. Window wall assemblies may include separate or integral floor edge covers.

Storefront

A storefront is considered to be a non-residential assembly (which may include fenestration and opaque portions) consisting of one or more elements that could include doors, windows and curtain wall framing. Storefronts do not generally support vertical loads other than their own weight. Storefront profiles are typically narrow, rectilinear framing members that hold a combination of pocket glazing and applied glazing stops to securely retain the infills. Vertical framing members typically span the height of one floor or are retained within a structural punched opening.

Storefront assemblies are designed/selected to take into account the anticipated service and exposure conditions, which may be different than those for other portions of the building.

Glazed Architectural Structures

Glazed architectural structures are considered glazing assemblies that are supported in a non-traditional manner, such as corner-clamped, point-supported, linear-supported and edge-clamped glazing. Structural support systems can include, but are not limited to, tension cables, tension rods, steel and glass. Glazed architectural structures do not generally support vertical loads other than their own weight. These assemblies are designed/selected to take into account the anticipated service and exposure conditions, which may be different than those for other portions of the building.

Skylights that are not covered by AAMA/WDMA/CSA 101/I.S.2/A440, “North American Fenestration Standard/Specification for windows, doors, and skylights,” are considered glazed architectural structures.

A-5.9.3.2.(1) Structural and Environmental Loads. The applicable laboratory test method for demonstrating adequate structural performance of other fenestration assemblies is ASTM E330/E330M, “Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.”

A-5.9.3.3.(1) Resistance to Condensation. Notwithstanding that other ~~glazed products fenestration assemblies~~ are not fully covered under the testing scope of CSA A440.2, “Fenestration energy performance,” the test method described therein can be used to evaluate their resistance to condensation, with technical modifications to accommodate differences in the size and configuration of the specimen. It is also common practice to use one cold cycle of AAMA 501.5, “Test Method for Thermal Cycling of Exterior Walls,” to assess the potential for condensation. Both methods can be used for mock-ups in laboratory performance evaluations, however, only the test method in CSA A440.2 should be used if a Temperature Index is required. In most cases, the project specification documents establish the hygrothermal conditions (i.e., exterior temperature, interior temperature, interior relative humidity) for which the potential for condensation should be minimized. Under these conditions, the aforementioned test methods can be used to aid in the selection of the appropriate system performance to minimize the potential for interior surface condensation. In all cases, care should be taken in the construction and configuration of the specimen, as these parameters may have an impact on its thermal performance and resistance to condensation. These parameters may include, without limitation, interior wall construction and finishes, heating

systems, ventilation systems, etc., to simulate the actual in-service conditions as closely as practicable.

A-5.9.3.4.(2) Air Leakage.

Air Leakage Rate and Test Pressure

A lower air leakage rates and/or higher differential test pressure can be selected for specific applications of other ~~glazed products~~ fenestration assemblies where tight control of airflow is required to prevent interstitial condensation (e.g., in concealed spaces), improve thermal comfort (e.g., in hospitals, seniors' residences), or prevent the migration of airborne contaminants (e.g., in food and drug research, manufacturing applications, biological laboratories). It is typical of other ~~glazed products~~ fenestration assemblies to be used as the sole building envelope component; where this is the case, a correspondingly higher degree of airtightness may be required.

In addition, higher test pressure differentials can be used to evaluate assemblies with low air leakage, such as non-operable or fixed fenestration systems whose air leakage rates are not easily measurable at the lower standard pressure differentials.

Standard Test Methods

The applicable laboratory test method for determining the rate of air leakage is ASTM E283, "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen." If field testing for air leakage is to be conducted, the applicable test method is ASTM E783, "Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors."

A-5.9.3.4.(3) Systems Excluded from Air Leakage Requirements. The systems listed in Sentence 5.9.3.4.(3) perform different functions than other fenestration assemblies and are therefore exempted from complying with the air leakage requirements.

A-5.9.3.5. Water Penetration. Notwithstanding that other ~~glazed products~~ fenestration assemblies are not covered under the testing scope of CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-17, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights," they ~~may~~ must be tested at the driving rain wind pressure calculated in accordance with the procedure described therein.

A-5.9.4.1.(1) Exterior Insulation Finish Systems (EIFS). The reference to CAN/ULC-S716.1, "Standard for Exterior Insulation and Finish Systems (EIFS) - Materials and Systems," in Clause 5.9.4.1.(1)(b) does not preclude the use of other component materials that may also meet the intent of the Code. For example, using mineral-fibre insulation in lieu of other rigid insulation types, mechanical fastening methods for the insulation component in lieu of adhesive, or a type of water-resistive barrier other than a liquid-applied water-resistive barrier could be acceptable.

The following two companion standards facilitate the application of and conformance with CAN/ULC-S716.1:

- CAN/ULC-S716.2, “[Standard for](#) Exterior Insulation and Finish Systems (EIFS) - Installation of EIFS Components and Water Resistive Barrier,” and
- CAN/ULC-S716.3, “[Standard for](#) Exterior Insulation and Finish System (EIFS) - Design Application.”

Additional information on EIFS design and installation can be found in the EIFS Council of Canada's “EIFS Practice Manual” and the manufacturer's literature.

EIFS Selection

CAN/ULC-S716.1 provides minimum performance criteria for EIFS materials and systems that are tested under specific laboratory test protocols identified in the standard. However, compliance with this standard does not ensure that a system is appropriate for all projects. When selecting an EIFS product, designers should consider all relevant criteria—not only those covered by the tests in CAN/ULC-S716.1—including, but not limited to,

- building exposure
- local climate characteristics (wind, precipitation, temperature variations, solar exposure)
- intended building use
- intended resistance to damage and deterioration
- construction tolerances
- constructability

Design and Construction of EIFS Drainage Cavity

The drainage capacity and thermal performance of the EIFS assembly can be affected by the dimensions and configuration of the EIFS drainage cavity.

EIFS are installed over other building materials such as sheathing and primary structural components, which have various construction installation tolerances. Designers should take into consideration the cumulative effects of construction tolerances and sequencing when specifying the drainage method and the cavity dimensions and configuration in order to ensure adequate drainage.

Designers should also take into account the impact of air movement, which varies depending on cavity size and the extent of venting, on the EIFS' thermal performance when reviewing the overall thermal performance of the building envelope. ASTM C1363, “[Standard Test Method for](#) Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus,” presents one method for assessing the thermal performance of assemblies.