ANSI/AMCA Standard 540-13

Test Method for Louvers Impacted by Wind Borne Debris

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AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

The International Authority on Air System Components

ANSI/AMCA Standard 540-13

Test Method for Louvers Impacted by Wind Borne Debris

Air Movement and Control Association International
30 W. University Drive
Arlington Heights, Illinois
60004

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Air Movement and Control Association International
30 West University Drive
Arlington Heights, IL 60004-1893 U.S.A.

European Air Movement and Control Association
Nutkin Cottage
Barracks Road, Assington
Suffolk CO10 5LP
UK

Asia AMCA
27 Senoko Way (Level 2)
Singapore 758060

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Related AMCA Documents

Related Publications	ANSI/AMCA Standard 500-L	*Laboratory Methods of Testing Louvers for Rating*
	AMCA Publication 501	*Application Manual for Louvers*
	AMCA Publication 511	*Certified Ratings Program - Product Rating Manual for Air Control Devices*
	AMCA Publication 512	*AMCA Listing Label Program*
	ANSI/AMCA Standard 550	*Test Method for High Velocity Wind Driven Rain Resistant Louvers*

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Test Method for Louvers Impacted by Wind Borne Debris

1. Purpose

The purpose of this standard is to establish uniform methods for laboratory testing of louvers that are impact tested with the large missile described in ASTM E 1996-04 [1] and E 1886-05 [2].

2. Scope

The scope of this standard is for impact testing of louvers used on the outside of buildings as required by the ICC International Building Code [3] and the ICC International Residential Code [4].

The following precautionary statement pertains only to the test method portion, Section 5, of this specification: This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of the regulatory limitations prior to use.

3. Definitions

3.1 Enhanced protection (Essential Facilities)
Buildings and other structures designated as essential facilities, including, but not limited to, hospitals; other health care facilities having emergency treatment facilities; jails and detention facilities; fire, rescue and police stations, and emergency vehicle garages; designated emergency shelters; communication centers and other facilities required for emergency response; power generating stations; other public utility facilities required in an emergency; and buildings and other structures having critical national defense functions.

3.2 Basic protection
Any building or structure that is not an Essential Facility as described in Section 3.1.

3.3 Horizontal/vertical-bladed louver
Louvers shall be designated horizontal or vertical-bladed based on the orientation of the blades on the front or exterior side of the louver.

3.4 Specimen
A louver assembly for testing consisting of one or more louver sections.

3.5 Louver Section
A single louver panel. Panels can (but are not required to) be connected to each other to make up larger assemblies for testing purposes. For example, a 2-section wide louver assembly is two panels wide.

4. Test Specimens

4.1 Number of specimens

4.1.1
Per ASTM E 1996-04 and ASTM E 1886-05, a minimum of three sections shall be impacted. This requirement may be satisfied by testing one single-section and one multi-section unit or by testing three identical single-section units.

4.1.2
One additional specimen may be submitted for testing should any original submitted specimen described in Section 4.1 fail any portion of the AMCA Standard 540 testing. This is described in Section 9.2. If all specimens pass the AMCA Standard 540, and then some or all of the same specimens are then subjected to Cyclic testing as described in Section 8, and any one specimen fails any portion of the subsequent test(s), then one additional specimen may be submitted to re-test to the subsequent tests as long as the additional specimen first passes the AMCA Standard 540 tests.

4.2 Size of specimens

The test specimen selected is intended to evaluate the critical failure area of the louver and provide guidance for blade support requirements. The critical failure area for louvers is the connection between the louver blade end and the perimeter louver frame. Failures in this area result in loose material that can result in projectiles in high wind events. The most stringent test specimen for this connection is a section where the blade has no additional support between these end connections. Energy from the impact is transferred to the connection with little absorption by blade flexure. This test specimen also provides guidance regarding the maximum unsupported blade length that will not allow the projectile to pass through the louver blades. Louvers manufactured with blade spans greater than that of the test specimen shall have blade supports at a spacing that matches the tested specimen blade length. These supports are typically located behind the blade running perpendicular to the axis of the blade and are attached to the perimeter frame of the louver or to the surrounding building structure. Due to the fact that the test specimen is used to qualify support locations in this way, the manufacturer may wish to test an additional specimen with a width narrower than desirable support spacing to establish a smaller minimum section width.

The size of the test specimen shall be as defined in Section 4.2.1.1, 4.2.1.2, 4.2.1.3, or 4.2.1.4.

4.2.1 Single section louver qualification

4.2.1.1 Horizontal blade

The test specimen shall consist of a single section. The section width shall be equal to the maximum blade span the manufacturer would supply without providing a blade support plus the added width of the specimen jamb frames. The minimum height of the test specimen shall be 915 mm (36 in.). The test specimen shall also contain a minimum of five blades. This specimen shall qualify single sections of widths greater than the specimen, provided the manufacturer supports the louver blades at a spacing equal to the blade length of the specimen. The tested width becomes the minimum section certified by the impact test. The specimen qualifies all single section heights. If the manufacturer wishes to certify a width narrower than the test specimen, an additional test specimen shall be provided. The minimum height of this narrower test specimen shall also be 915 mm (36 in.), and it shall contain a minimum of five blades. See Annex A, Figure A.1.

4.2.1.2 Vertical blade

The test specimen shall consist of a single section. The section height shall be equal to the maximum blade span the manufacturer would supply without providing a blade support plus the added thickness of the specimen head and sill frames. The minimum width of the test specimen shall be 36 inches. The test sample shall also contain a minimum of five blades. This specimen shall qualify single sections of heights greater than the specimen, provided the manufacturer supports the louver blades at a spacing equal to the blade length of the specimen. The tested height becomes the minimum section certified by the impact test. The specimen qualifies all single section widths. If the manufacturer wishes to certify a height less than the test specimen, an additional test specimen shall be provided. The minimum width of this smaller test specimen shall also be 915 mm (36 in.), and it shall contain a minimum of five blades. See Annex A, Figure A.2.

4.2.2 Multi-section louver qualification

4.2.2.1 Horizontal blade

The test specimen shall consist of a minimum of two sections. Each section width shall be equal to the maximum blade span the manufacturer would supply without providing a blade support plus the added width of the specimen jamb frames. The height of the louver specimen shall be equal to the maximum height the manufacturer desires to be certified as impact resistant, or the maximum height allowed by the testing facility (rotation of the test sample 90° is permissible to overcome lab width/height limitations). This specimen shall qualify sections of widths greater than the specimen sections, provided the manufacturer supports the louver blades at a spacing equal to the blade length of the specimen. The multi-section minimum allowable width shall be based upon one of the following tests:

- The multi-section sample described in this section
- The narrowest single section tested sample
- A narrow multi-section sample

See Annex A, Figure A.3.

4.2.2.2 Vertical blade

The test specimen shall consist of a minimum of two sections. Each section height shall be equal to the maximum blade span the manufacturer would supply without providing a blade support plus the added thickness of the specimen head and sill frames. The width of the louver specimen shall be equal to the maximum width the manufacturer desires to be certified as impact resistant, or the maximum width allowed by the testing facility (rotation of the test sample 90° is permissible to overcome lab width/height limitations). This specimen shall qualify sections of heights greater than the specimen sections, provided the manufacturer supports the louver blades at a spacing equal to the blade length of the specimen.

The multi-section minimum allowable height shall be based upon one of the following tests:

- The multi-section sample described in this section
- The smallest single section tested sample
- A smaller multi-section sample with a shorter blade length

See Annex A, Figure A.4.

4.2.2.3

Testing of a multi-section louver shall also qualify a single section louver to the same blade span as the tested multi-section louver. Each connection joint design needs to be tested.

5. Test Methods

5.1 Specimens

The specimens shall be tested according to test method, ASTM E1886-05, for large-missile impact testing only, and with taking exception to ASTM E1886-05 Section 8.2 regarding required size for testing and Section 11.1 regarding specimen mounting anchors to the test frame.

5.2 Missile

Determine the missile based upon building classification according to Section 6.

5.3 Locations of impact

5.3.1 Single section impact locations

The initial contact between the missile and louver shall be in such a way that:

- the entire leading face of the missile shall impact within a 222 mm (8.75 in.) diameter tolerance circle;

and

- any portion of the leading face of the missile shall impact the exterior most edge or plane of the targeted blade.

The plane of the tolerance circle shall be on the same plane as the impacted face of the louver with the center of the circle at the targeted location as described in Section 5.3.1.1 or 5.3.1.2. See Figure 4. Once the leading face of the missile passes through the tolerance circle, it is permissible for the missile to make contact with the louver blades outside of the tolerance circle.

If the exterior most part of the targeted blade is a plane (vs. an edge), then the targeted location is adjusted after complying with Section 5.3.1.1 or 5.3.1.2 so that the targeted location is centered on the front plane of the blade. See Figure 4.

5.3.1.1 Horizontal blade impact locations

Impact each louver section three times as shown in Figure 1.

The first impact location shall be targeted on the front edge/surface of a blade closest to a point:

- 152 mm (6 in.) from the plane of the cut end of the louver blade;

and

- 152 mm (6 in.) from the front interior edge of the sill.

The impact shall not contact the jamb or sill frame.

The second impact location shall be targeted at the mid-span of a center blade on the front edge/surface of the blade.

The third impact location shall be targeted on the front edge/surface of a blade closest to a point:

- 152 mm (6 in.) from the plane of the cut end of the louver blade;

and

- 152 mm (6 in.) from the front interior edge of the head.

This third impact shall be adjacent to the jamb that is opposite of the jamb closest to the first impact. The impact shall not contact the jamb or head frame.

5.3.1.2 Vertical blade impact locations

Impact each louver three times as shown in Figure 2.

The first impact location shall be targeted on the front edge/surface of a blade closest to a point:

- 152 mm (6 in.) from the plane of the cut end of the louver blade;

and

- 152 mm (6 in.) from the front interior edge of the jamb.

The impact shall not contact the jamb or sill frame.

The second impact location shall be targeted at the mid-span of a center blade on the front edge/surface of the blade.

The third impact location shall be targeted on the front edge/surface of a blade closest to a point:

- 152 mm (6 in.) from the plane of the cut end of the louver blade;

and

- 152 mm (6 in.) from the front interior edge of the jamb.

This third impact shall be adjacent to the jamb that is opposite of the jamb closest to the first impact. The impact shall not contact the jamb or head frame.

5.3.2 Multi-section impact locations

5.3.2.1 Visible Mullions

The initial contact between the missile and louver shall be in such a way that the entire leading face of the missile shall impact within a 222 mm (8.75 in.) diameter tolerance circle. The plane of this tolerance circle shall be on the same plane as the impacted exterior mullion face of the louver, and the center of the circle shall be at the targeted location at mid-span and mid-width of the mullion as shown in Figure 3. Once the leading face of the missile passes through the tolerance circle, it is permissible for the missile to make contact with the louver mullion and/or blades outside of the tolerance circle.

The missile shall also impact the exterior face of the mullion.

10. Limitations

10.1
The maximum height of a horizontal bladed multi-wide section assembly or the maximum width of a vertical blade multi-high section assembly is governed by the height tested of the horizontal bladed multi-wide section assembly or by the width tested of the vertical blade multi-high section assembly.

10.2
The minimum blade length tested is the narrowest blade length that will be allowed to qualify to AMCA Standard 540. The louver width or height qualified consists of the blade length and frame width.

If a minimum section size with a blade length of 305 mm (12 in.) or less is tested, shorter blade lengths and narrower sections are qualified.

10.3
Shaped louvers shall be qualified, provided the mounting method, material of construction and attachment are the same as the tested configuration. If mounting attachments or construction differ, the shape shall be tested. Construction differences include methods of attachment and component material grades, alloys, or tempers.

Blade lengths of shaped louvers shall not be less than the minimum blade length tested. See Section 10.2 regarding minimum blade length.

11. Report

11.1 Report for impact testing shall contain the following information:

11.1 Date of test and date of report, and report number.

11.2 The name(s) of the author of the report.

11.3 Name and location of the facilities performing the test and the name and address of the requester of the test.

11.3.1 Names of the individuals performing the test and any witnesses.

11.4 Manufacturer's model number or any other method of identification.

11.4.1 A description of the test specimen, including all parts and components and the number of specimens tested.

11.5 For each missile impact, provide the following:

11.5.1 Description of missile(s) including dimensions and mass (weight).

11.5.2 Missile speed and data recorded to determine speed.

11.5.3 Impact location and description of any damage of .each impact

11.5.4 Pass / Fail Statement for each impact.

11.6 A statement that the tests were conducted in accordance with this test method.

11.7 A video recording of the test.

11.7.1 A statement that the laboratory is in possession of a video recording of the test. The video recording shall be retained by the laboratory for a minimum period of 5 years from the test report date.

11.8 Signature of persons responsible for supervision of the tests.

11.9 Detailed drawings of the test specimen, showing dimensioned section profiles, blade to frame connection details, frame to frame connection details (corners), fasteners and any other pertinent construction details.

11.10 Any deviation from the drawings or any modifications made to the test specimen to obtain the reported values shall be noted on the drawings and in the report.

11.11 For each sample the following items should be checked on the test specimen versus the manufacturer supplied drawing:

11.12.1 – Full sample
Louver overall width
Louver overall height
Louver depth
Blade Spacing

11.12.2 – Jamb Frame
Verify Material – visual, weight – verify aluminum components are aluminum, steel components are steel – not checking chemical composition
Verify Width of component
Verify Depth of component
Verify Thickness of component – 2 locations
Visually verify features and shape of component matches drawing

11.12.3 – Head Frame
Verify Material – visual, weight – verify aluminum compo-

nents are aluminum, steel components are steel – not checking chemical composition.
Verify Width of component
Verify Depth of component
Verify Thickness of component – 2 locations
Visually verify features and shape of component matches drawing

11.12.4 – Sill Frame
Verify Material – visual, weight – verify aluminum components are aluminum, steel components are steel – not checking chemical composition.
Verify Width of component
Verify Depth of component
Verify Thickness of component – 2 locations
Visually verify features and shape of component matches drawing

11.12.5 – Blade
Verify Material – visual, weight – verify aluminum components are aluminum, steel components are steel – not checking chemical composition.
Verify Width of component
Verify Depth of component
Verify Thickness of component – 2 locations
Visually verify features and shape of component matches drawing

11.12.6 – Other component details, such as Mullion details
Verify Material – visual, weight – verify aluminum components are aluminum, steel components are steel – not checking chemical composition.
Verify Width of component
Verify Depth of component
Verify Thickness of component – 2 locations
Visually verify features and shape of component matches drawing

11.12.7 – Connection details
Verify blade to frame connections
Verify sill to jamb connections
Verify head to jamb connections
Verification shall consist of visually inspecting weld sizes and lengths
Verification shall consist of inspecting fastener diameters and lengths
Verify other connections shown on manufacturer's drawings

11.13 All data not required herein, but useful to a better understanding of the test results, conclusions or recommendations, should be appended to the report.

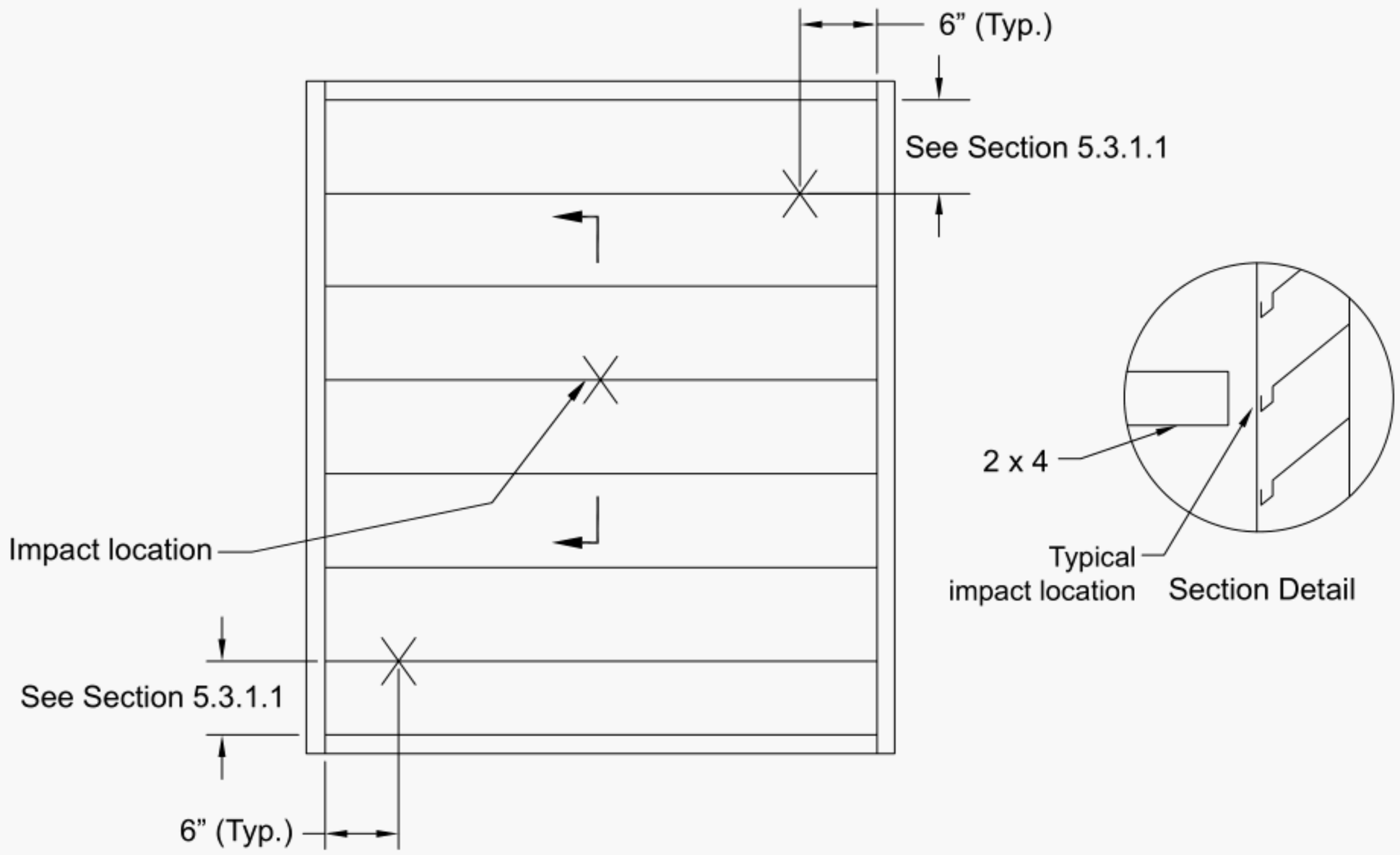


Figure 1
Impact Locations for Testing Single Section, Horizontal Blade Louver

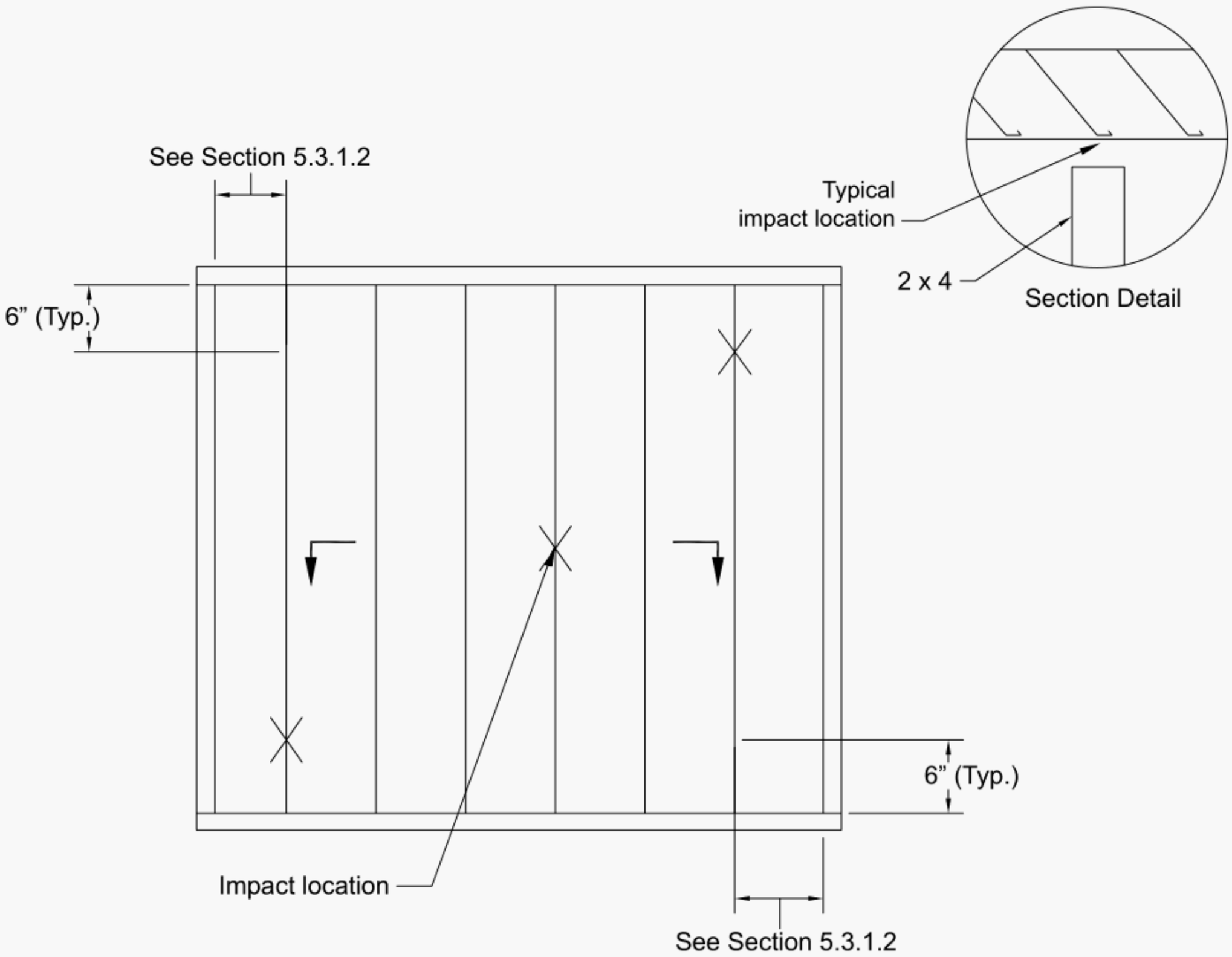


Figure 2
Impact Locations for Testing Single Section, Vertical Blade Louver

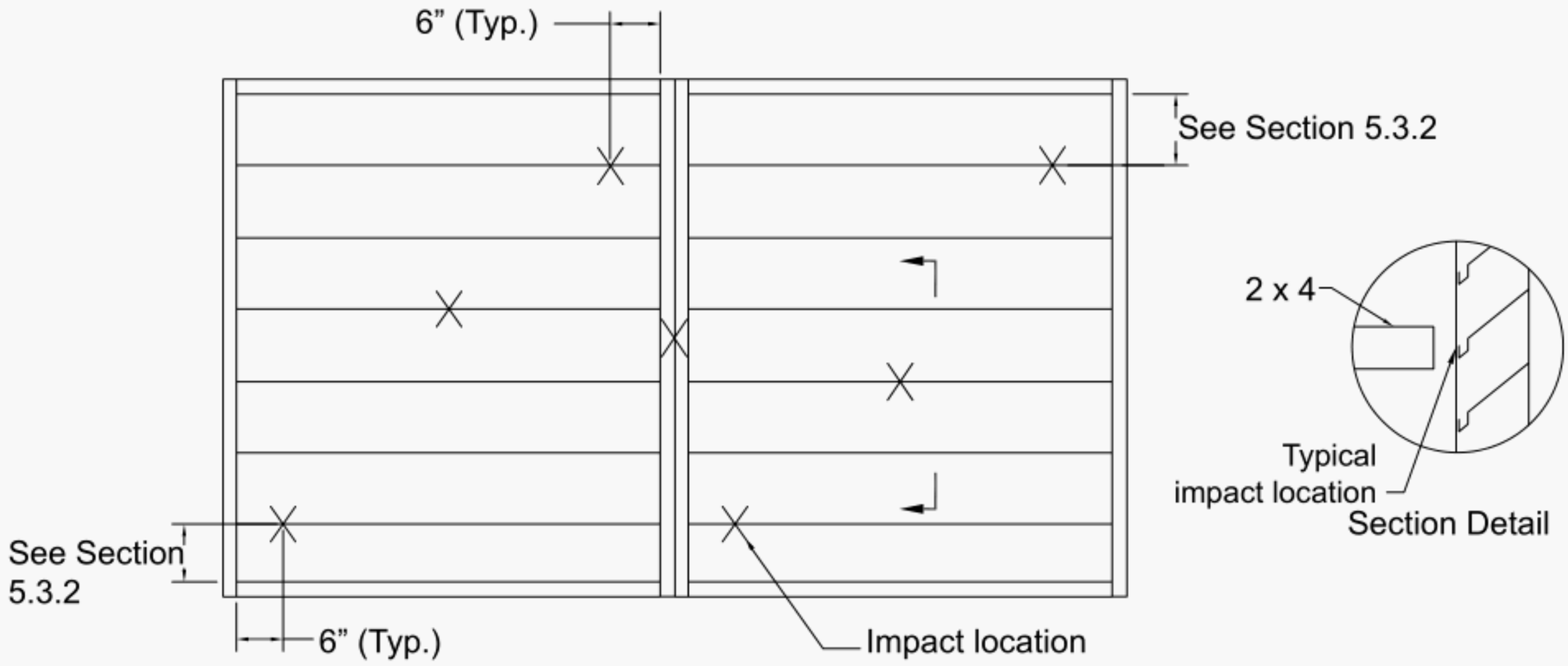
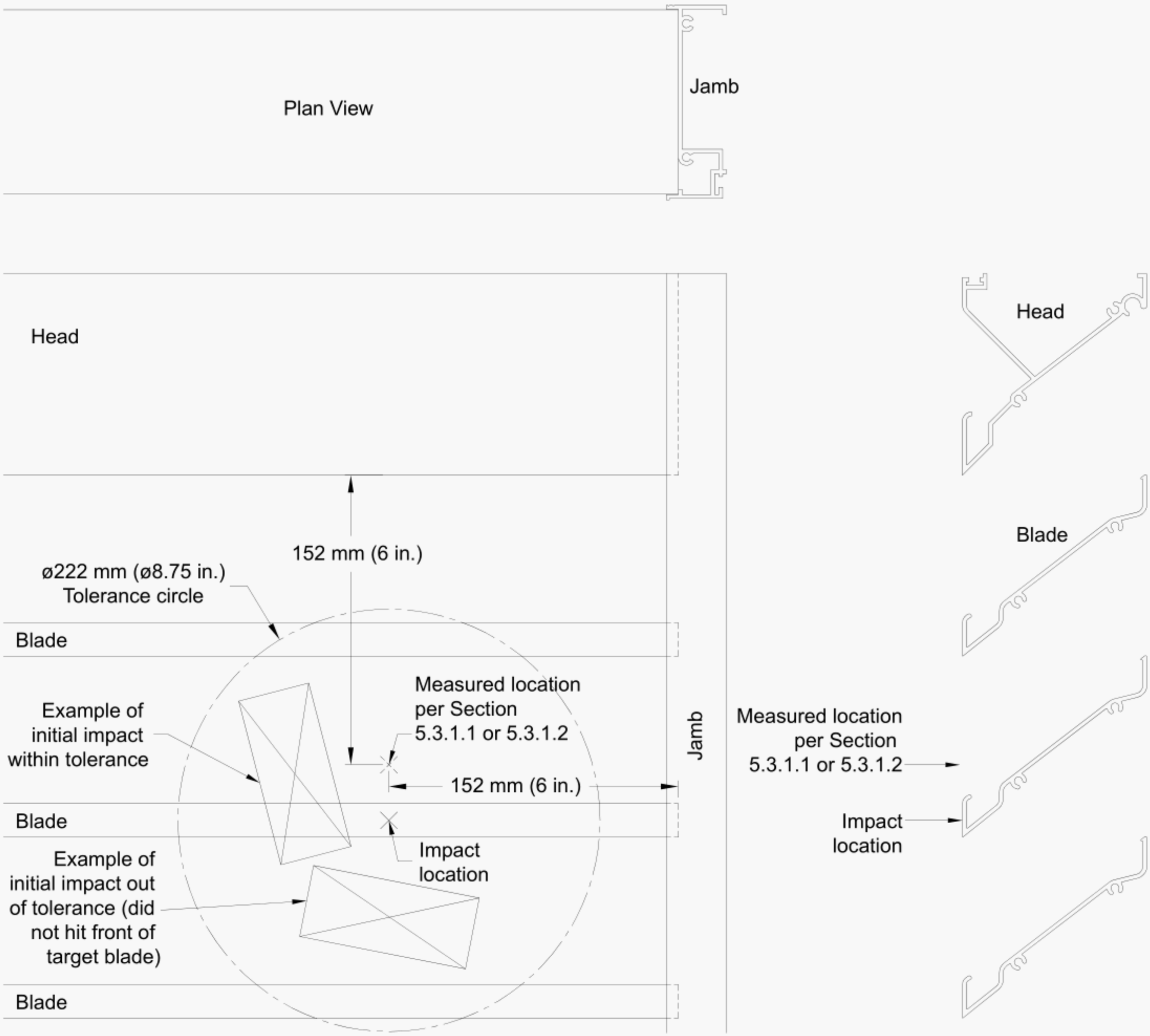


Figure 3
Impact Locations for Testing Multi-Section, Horizontal Blade Louver

Table 1
Missiles

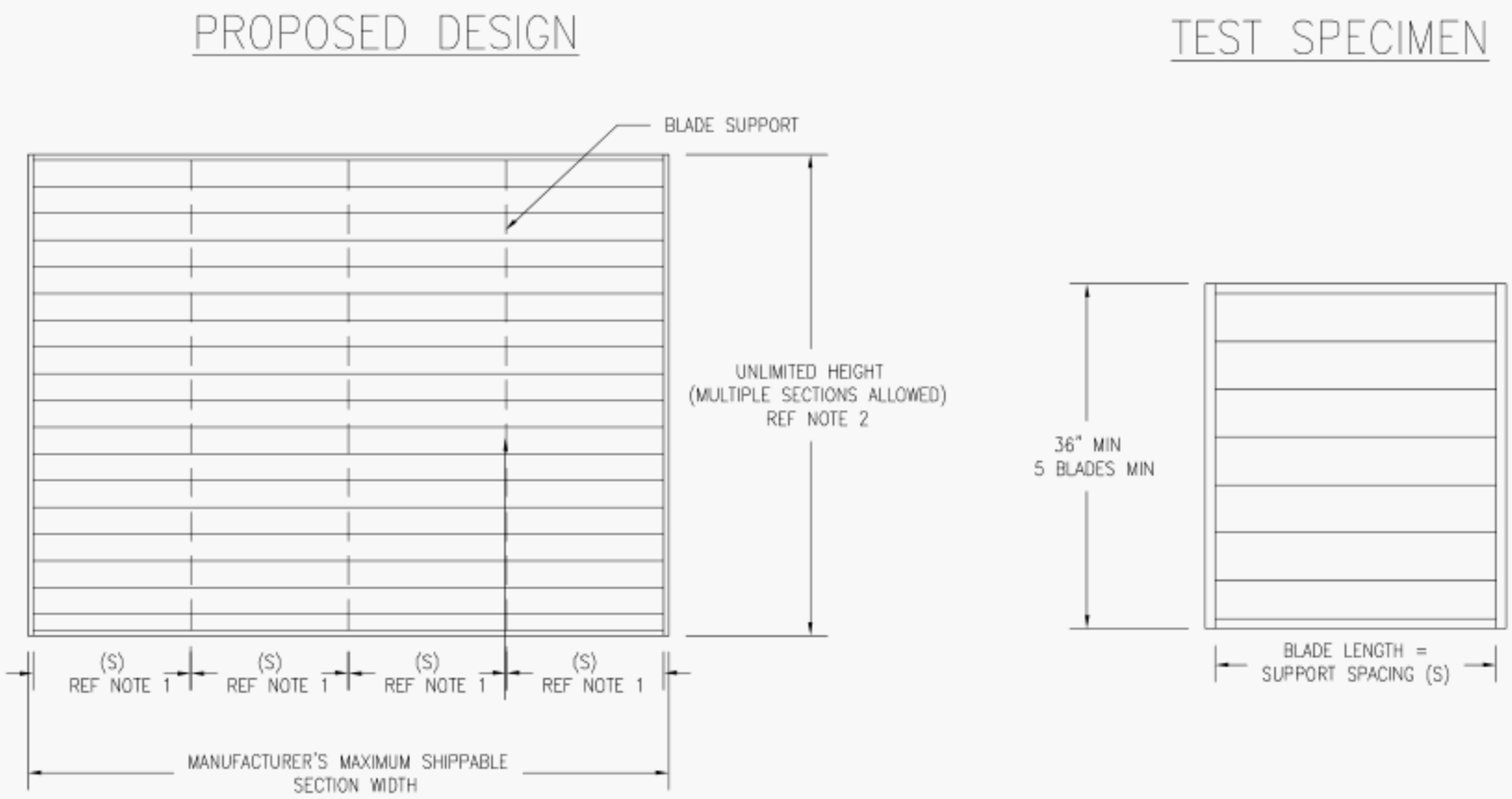
Missile Level	Missile	Impact Speed (m/s)
D	4100 g ± 100 g (9.0 lb ± .25 lb) 2x4 in. 2.4 m ± 100 mm (8 ft ± 4 in.) lumber	15.25 (50 ft/s) ± 2%
E	4100 g ± 100 g (9.0 lb ± .25 lb) 2x4 in. 2.4 m ± 100 mm (8 ft ± 4 in.) lumber	24.38 (80 ft/s) ± 1%



View of Exterior Face **Section Cut View**

Figure 4
Impact Location Details

Annex A
Test Specimen Reference Figures



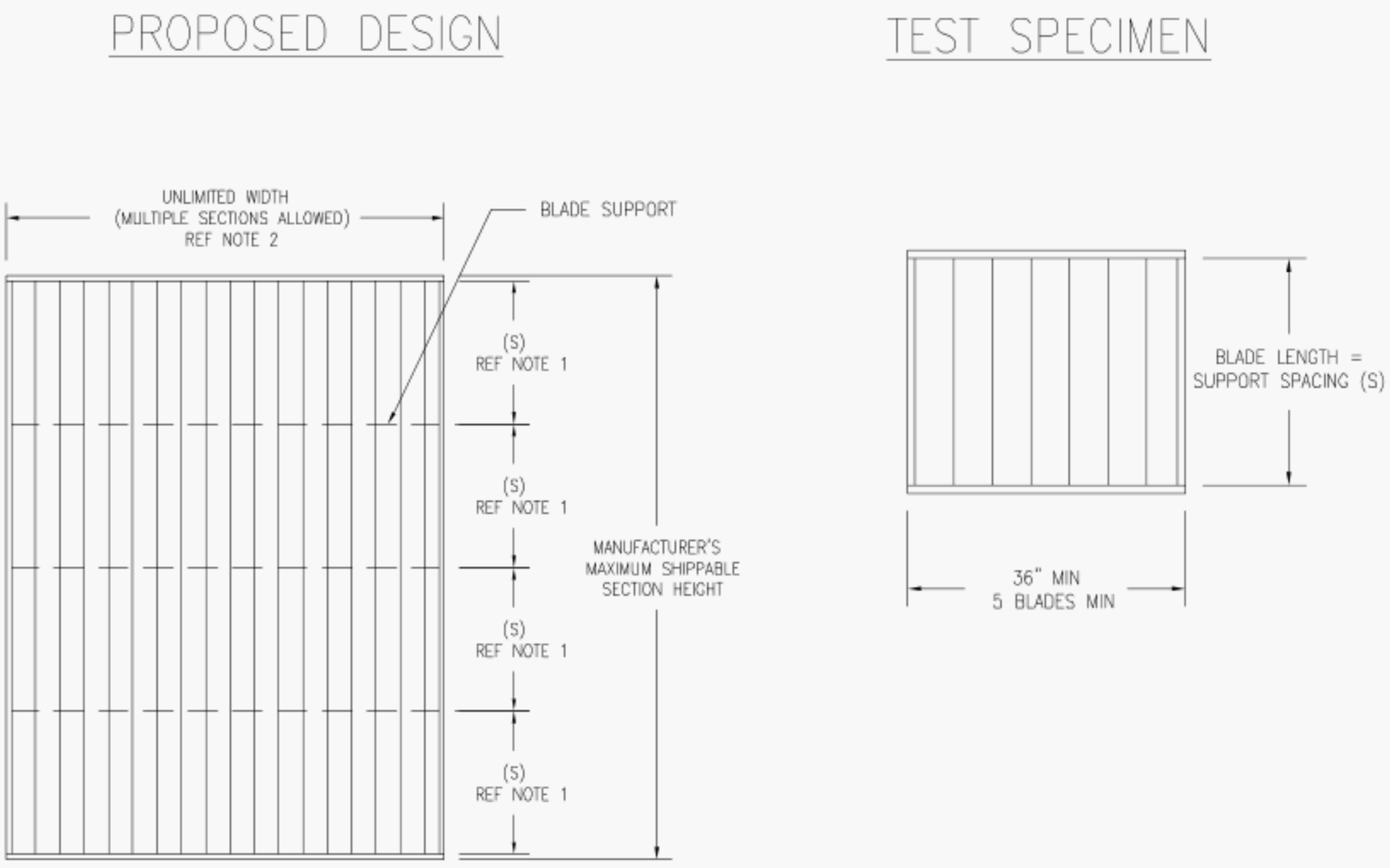
Notes:

1. Support spacing (S) shall be designed for the wind pressure rating of the louver.

2. When stacking multiple horizontal blade sections vertically, blade supports shall be moment spliced at ship sections or supported by other structures.

3. Qualification of widths smaller than test specimen requires additional test. See Section 4.2.1.1.

Figure A.1
Example of Single Section, Horizontal Blade Louver Qualification



Notes:

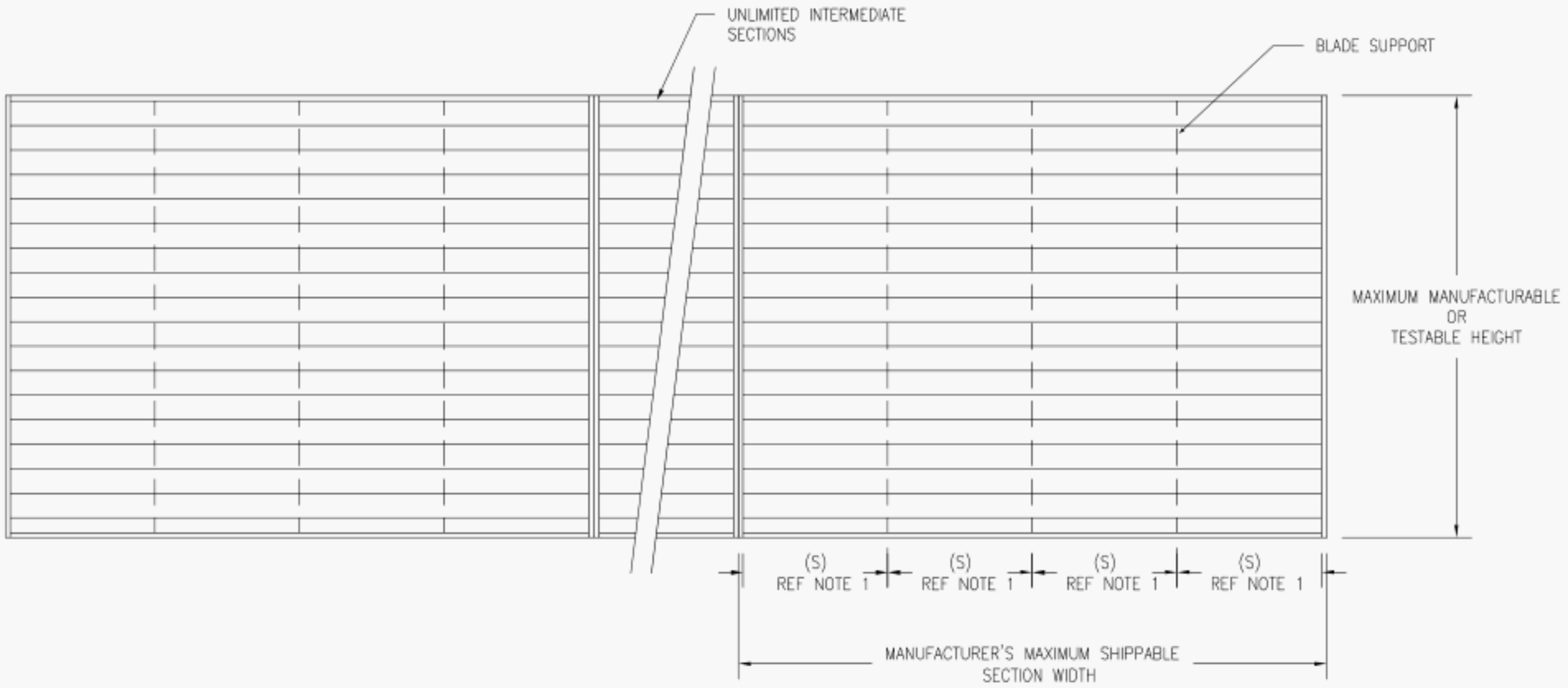
1. Support spacing (S) shall be designed for the wind pressure rating of the louver.

2. When placing multiple vertical blade sections horizontally, blade supports shall be moment spliced at ship sections or supported by other structures.

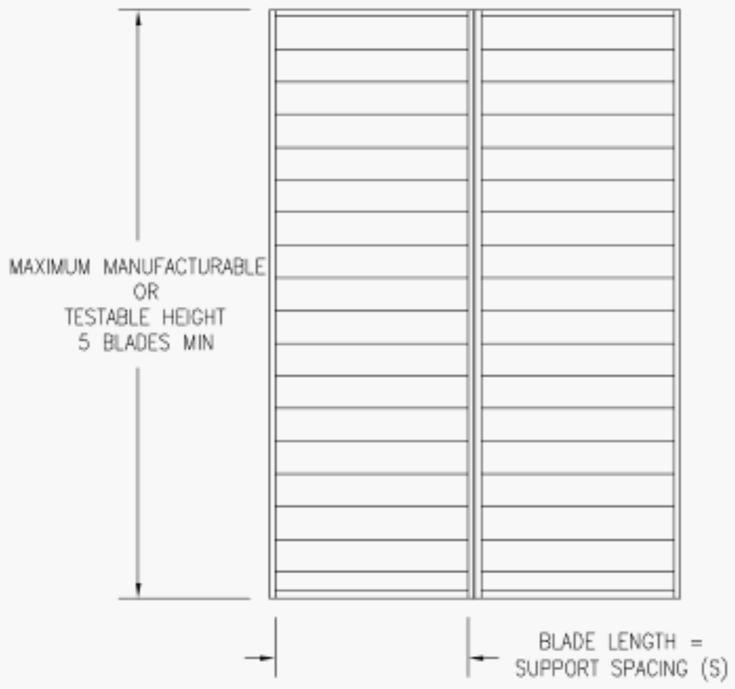
3. Qualification of heights smaller than test specimen requires additional test. See Section 4.2.1.2.

Figure A.2
Example of Single Section, Vertical Blade Louver Qualification

PROPOSED DESIGN



TEST SPECIMEN – NOTE 4



Notes:

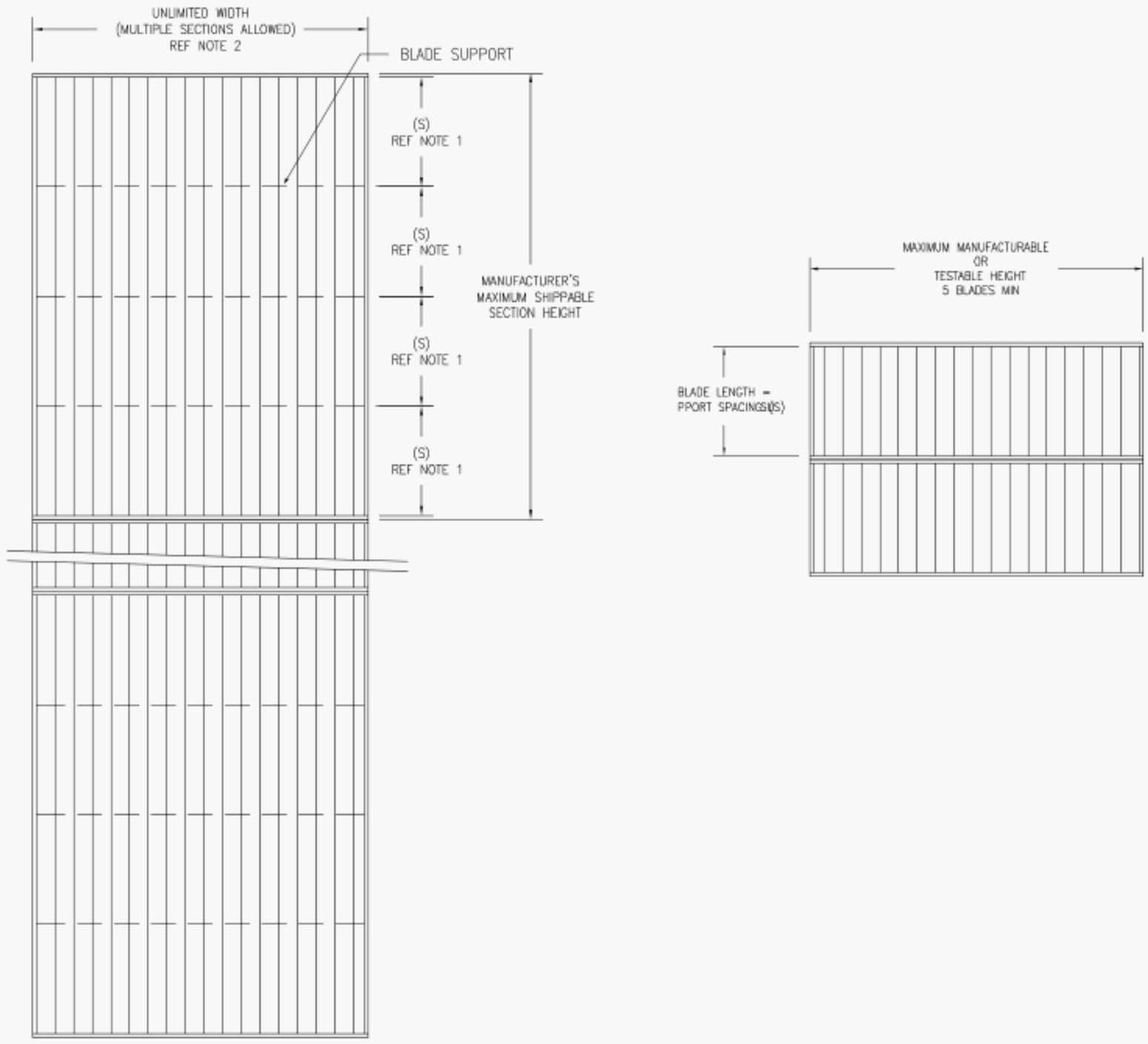
1. Support spacing (S) shall be designed for the wind pressure rating of the louver.

2. When placing multiple horizontal blade sections horizontally, blade supports shall be moment spliced at ship sections or supported by other structures.

3. Qualification of widths smaller than test specimen requires additional test. See Section 4.2.2.1.

4. Minimum two sections shown. Three or more sections may be tested to allow qualification of multiple mullion types with one test. For example, when trying to obtain qualification for an architectural, recessed, and visible mullion types with a single test.

Figure A.3
Example of Multi-Section, Horizontal Blade Louver Qualification



Notes:

1. Support spacing (S) shall be designed for the wind pressure rating of the louver.

2. When stacking multiple vertical blade sections vertically, blade supports shall be moment spliced at ship sections or supported by other structures.

3. Qualification of widths smaller than the test specimen requires an additional test. See Section 4.2.2.2.

4. Minimum two sections shown. Three or more sections may be tested to allow qualification of multiple mullion types with one test.

Figure A.4
Example of Multi-Section, Vertical Blade Louver Qualification

Annex B
Follow-up Service (Informative)

If the intent of qualifying a louver to this standard is to meet the requirements of the building code, AMCA 512, or approved third party agency, then a listing and labeling service shall be used. The reason for this is that the building code requires a third party follow-up service or annual inspection of the product.

Annex C
Bibliography

[1] ASTM E 1996-04
Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

[2] ASTM E 1886-05
Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

[3] International Code Council
2012 International Building Code

[4] International Code Council
2012 International Residential Code

[5] TAS 201
Impact Test Procedures

[6] TAS 203
Criteria for Testing Products Subject to Cyclic Wind Pressure Loading

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

30 West University Drive
Arlington Heights, IL 60004-1893 U.S.A.

Tel: (847) 394-0150 • Fax: (847) 253-0088
E-Mail : info@amca.org • Web: www.amca.org

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