**ANNEX B – QUALIFICATION OF METAL STRAPS AS ALTERNATIVES TO 1 BY 4 WOOD LET-IN BRACES (METHOD LIB)**

**B1.0 SCOPE**

This annex describes the testing requirements, procedures, and analytical methods used to determine the suitability of metal braces (straps) as a substitute for 1-by-4 wood let-in braces (LIB) in braced walls, and the documentation required for review for compliance with IBC Section 2308.6 or IRC Section R602.10. The reason for this Annex is the IBC and IRC permit metal straps that are “approved” but do not provide the basis for approval. The results shall be reported in an evaluation report issued by an approved certification body complying with IBC Section 1703.1 and accredited in accordance with ISO/IEC 17065.

**B2.0 REFERENCE STANDARDS**

**B2.1** ASTM A90/A90M - 13(2018), Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

**B2.2** ASTM A370–19e1, Standard Test Methods and Definitions for Mechanical Testing of Steel Products

**B2.3** ASTM E72–15, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction

**B3.0 TEST AND PERFORMANCE REQUIREMENTS**

**B3.1 Racking Resistance:** The test procedures, equipment, and materials shall be in accordance with the IBC or IRC, ASTM E72, and the provisions of this Annex. A minimum of four replicate tests for each installation configuration is required. The results of each test shall be normalized and averaged in accordance with Section B4.1 of this criteria.

The specific gravity of the framing lumber shall be determined in accordance with Section 14.2.2.2 of ASTM E72. To conform to the provision for variations in specific gravity, the targeted average specific gravity shall be that specified by the NDS for the species tested. For example, in the case of spruce-pine-fir, the targeted average specific gravity shall be 0.42, and the maximum permitted shall be 0.42 + 0.03 = 0.45.

The moisture content of dimension lumber at the time of testing shall be 8 to 12 percent and shall be determined in accordance with Section 14.2.3 of ASTM E72.

Each test frame receiving the metal bracing shall be constructed in accordance with Section 14.2.2.2 of ASTM E72. In addition, the following requirements shall be observed:

* Wall height: 8 feet
* Wall width: 9 feet - 4 inches minimum
* Framing lumber
	+ Studs: 2 by 4 SPF Stud Grade at 16 inches on center with two 2 by 4 corner studs
	+ Top and bottom plates: 2 by 4 SPF No. 2 Grade, two at top, one at bottom
* Anchor bolts: ½ inch diameter bolts with round cut washers spaced a maximum of 6 feet on center and located at 12 inches from ends of sill plate

The metal braces shall be installed in accordance with the manufacturer’s installation instructions. The brace ends may bear on the plates or the test frame, if this condition is permitted under the manufacturer’s installation instructions. Recognition shall be limited to the angles used in testing. For general use in accordance with the IBC and IRC, the braces shall be installed on the outside face of the framing and tested at angles of 45º and 60º from horizontal. Fastener types used shall be described and dimensions reported.

Metal braces intended to be installed in opposing pairs (tension only) at each bracing location need only be tested singly in the tension orientation. Metal braces intended to be installed singly (tension-compression) at each bracing location shall be tested in pairs reflecting the opposing orientations.

**B4.2 Metal Brace Properties:** The material properties of the braces shall be verified by testing. Tensile strength, yield strength, and elongation on the base metal shall be determined in accordance with ASTM A370 using coupons cut from the braces or specimens taken from the same coils used to produce the braces. Coating thicknesses shall be determined in accordance with ASTM A90.

**B4.0 CONDITIONS OF ACCEPTANCE**

**B4.1 Tension Only Braces:** The load-deflection data shall be recorded for each test assembly. The peak load shall occur at a deflection of 1 inch or greater. The peak loads for each assembly shall be normalized in accordance with Eq. B1:

$P\_{pk,n}=R\_{B}P\_{pk, test}$ Eq. B1

Where:

*Ppk,n* = normalized peak load, lbf.

*Ppk,test* = peak load of test assembly, lbf.

*Rb* = reduction factor accounting variations in metal strength and stiffness

=$ \left(^{Fu,spec }/\_{Fu,tested }\right)\left(^{tspec}/\_{ttested}\right)$ ≤ 1.0

*Fu,spec* = specified tensile strength of the brace metal (from the manufacturer’s specifications or standard specification), which shall be ≤ *Fu,tested*, psi.

*Fu,tested* = measured tensile strength of the brace metal used in the test specimens, psi.

*tspec* = specified minimum metal thickness of the brace, inch.

*ttested* = measured steel thickness of tested brace, inch.

The average of *Ppk,n* shall be 1,330 pounds or greater provided the standard deviation is 15 percent or less. Where the standard deviation exceeds 15 percent, the least *Ppk,n* among the test assemblies shall be 1,330 pounds or greater.

**B4.2 Tension-Compression Braces:** The load-deflection data shall be recorded for each test assembly. The peak load shall occur at a deflection of 1 inch or greater. The peak loads for each assembly shall be normalized in accordance with Eq. B1. The average of *Ppk,n*, considering the contribution of the two braces in total, shall be 4,105 pounds or greater provided the standard deviation is 15 percent or less. Where the standard deviation exceeds 15 percent, the least *Ppk,n* among the test assemblies shall be 4,105 pounds or greater.

**B5.0 EVALUATION REPORT RECOGNITION**

In addition to the requirements in Section 7.0 of this criteria, the following items shall be reported for the metal braces:

**B5.1** Installation details for the metal braces shall be reported. These details shall include allowable uses including wall dimensions, wall heights, orientation on wall, framing spacing, angle of application (as applicable), and required fastening.

**B5.2** The evaluation report shall state that the braces shall not replace engineered shear wall elements with assigned load capacities.

**B5.3** The report shall state that the metal braces comply as an approved metal strap in accordance with IBC Section 2308.6 and IRC R602.10 and are permitted for use where the let-in-bracing (LIB) method is allowed.