STRUCTURAL THERMAL BREAK

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This guide specification is provided to the AEC community as a recommended starting point for architects, engineers and building enclosure consultants that utilize structural thermal break materials in their projects.

PART 1 - GENERAL

1.1 SECTION INCLUDES

1. Structural Thermal Break Material

2. Structural thermal breaks fabricated from the following material:

a. STB-1 thermal break material

2. Thermal breaks at the following connection locations to meet ASHRAE 90.1 wall or roof assembly U-value and continuous insulation requirements.

Specifier note: Edit the following list of locations as required for the project.

a. Masonry shelf angles.
b. Canopies.
c. Balconies.
d. Curtain wall mullions.
e. Roof equipment screen posts.
f. Fall arrest anchors.
g. other

1.2 RELATED SECTIONS

Specifier note: Edit the following list of related sections as required for the project.

A. Section 01 xx xx – Passive House Design Requirements
B. Section 01 xx xx – LEED™ Documentation
C. Section 04 xx xx – Unit Masonry
D. Section 05 xx xx – Structural Steel
E. Section 07 xx xx – Cladding/Rainscreen Attachment System

1.3 REFERENCE STANDARDS

Specifier note: Edit the following list of related sections as required for the project.

A. American Institute of Steel Construction (AISC):

1. AISC 360 - Specification for Structural Steel Buildings, July 7, 2016.

B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

1. ASHRAE 90.1-2016 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International (ASTM): Latest versions of:

1. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

2. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.

3. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

4. ASTM D 695 – Standard Test Method for Compressive Properties of Rigid Plastics.

5. ASTM D 732 – Standard Test Method for Shear Strength of Plastics.

6. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics

7. ASTM E1354 - Standard Test Method for Heat and Visible Smoke Release Rates for Materials.

D. National Fire Protection Association (NFPA):

1. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components, 2019 Edition.

E. Research Council on Structural Connections (RCSC):

1. Specification for Structural Joints Using High Strength Bolts, August 1, 2020.

F. United States Green Building Council (USGBC):

1. LEED v4 - Leadership in Energy and Environmental Design for Building Design and Construction, January 22nd, 2019.

1.4 SUBMITTALS

Specifier note: Edit the following list of submittals as required for the project.

A. Product Data: Submit manufacturer's product data, specifications and other data needed to prove compliance with the specified requirements.

B. Shop Drawings: Submit shop drawings showing details of construction including the dimensions and locations of STB-1, structural thermal break material.

C. Delegated-Design Submittal: Structural calculations using design load conditions and wind loads if applicable.

1.5 DESIGN REQUIREMENTS

A. Thermal Design: Wall or roof assembly shall meet the prescriptive R-value or performance-based U-value as given in the ASHRAE 90.1 relevant code by state and climate zone. Wall assemblies shall meet the ASHRAE requirement for “continuous insulation” which prohibits thermal bridging.

B. Structural Design: Bolted steel, bearing connections, façade attachment connections and all other structural connections using thermal break materials shall be designed to the applicable AISC, RCSC, ASCE and local building design codes.

1.6 WARRANTY

A. Warranty: Provide manufacturer's standard limited warranty against defects in manufacturing.

1.7 DELIVERY, STORAGE AND HANDLING

A. Exercise care to avoid damage during loading, unloading storage and installation.

B. Inspect material immediately upon delivery at site. Notify manufacturer of any damage prior to installation of material.

C. Store, protect and handle material per manufacturer recommendations to avoid, damage or deterioration. Keep material clean, dry and free of dirt or other foreign matter and protect f rom weather and other construction activities.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide structural thermal break material that meets or exceeds the requirements for the applicable design code. Thermal break material shall be designed to safely transfer moment, shear and wind loads as given and satisfy deflection and/or creep requirements per applicable code.

Specifier: Thermal break materials used in bolted, steel connections are not currently recognized by the AISC or RCSC and as such, do not have explicit structural design code requirements. The AISC specification states that “where conditions are not covered by this specification, designs are permitted to be based on tests or analysis, subject to the approval of the authority having jurisdiction. Alternative methods of analysis and design are permitted, provided such alternative methods or criteria are acceptable to the authority having jurisdiction”. The RCSC specification specifically prohibits compressible materials to be used in bolted, steel connections within the grip of the bolts.

Therefore, it is recommended that the supplier or manufacturer be asked to provide the thermal break material properties in their submittal so that the properties can be used in the steel connection calculations to show compliance by design analysis for approval. Thermal break material properties should not be used or set specifically, rather connection design calculations should be used to verify that there is no compression/deflection nor any long-term creep potential.

B. Thermal Performance: Wall or roof assembly shall meet ASHRAE 90.1 prescriptive R-value or performance-based U value requirements. Effective R and U values of assemblies should be calculated or modeled per ASHRAE guidelines. Select thermal break material thickness to meet project requirements. Wall assemblies shall not have structural connections which create thermal bridging (through beams, cladding clips, z-girts, support framing). Roof assemblies shall not have structural connections which create a thermal bridging (roof posts, dunnage, fall arrest anchors).

1 Accessories: STB-1 washers and bushings. Use if applicable to further reduce heat loss via the bolts through a bolted, steel connection.

Specifier: Specify the thickness of the thermal break here by location and/or on the interface details on drawings. Also specify whether thermal washers and bushings are required.

2.2 MANUFACTURER

A. Basis-of-Design Manufacturer: Benchmark Group, Tel: 800-580-4195. Email: sales@bmssi.ca. Web: www.bmssi.ca.

B. Structural Thermal Break Material: STB-1, with the following properties:

1.Compressive Strength:	**ASTM D695**	**48,000 psi.**
2.Compressive Modulus:	**ASTM D695**	**400,670 psi.**
3.Thermal Conductivity:	**ASTM C518**	**1.8 BTU in/ hr/sf/ degree F.**
4.Thermal Resistance (R value):	**ASTM C518**	**0.60**
5.Shear Strength:	**ASTM D732**	**15,000 psi.**
6.Tensile Strength:	**ASTM D638**	**11,000 psi.**
7.Flexural Strength:	**ASTM D790**	**25,000 psi.**
8.Surface Burning Characteristics:	**ASTM E84**	
a. Flame Spread: 25		
b. Smoke Developed: 120		
9. Heat Release:	**ASTM E1354**	**rate 1.5kW/sf**

C. Other acceptable manufacturers include:

1. Fabreeka TIM

a. All thermal break materials are subject to compliance with design code requirements.

Specifier: SBM-1 thermal break material is Red List free.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine substrates for compliance with requirements for installation. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Faces or surfaces which will make contact with the thermal break material shall be smooth, flat and parallel.

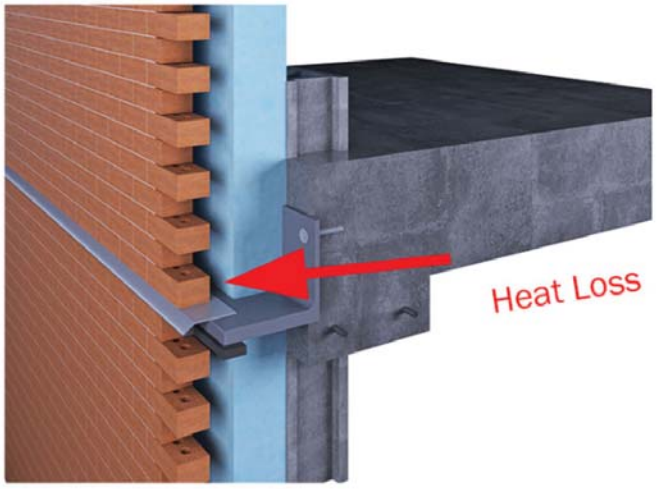
2 - Concrete surfaces must be free from ridges or high spots.

3.2 INSTALLATION

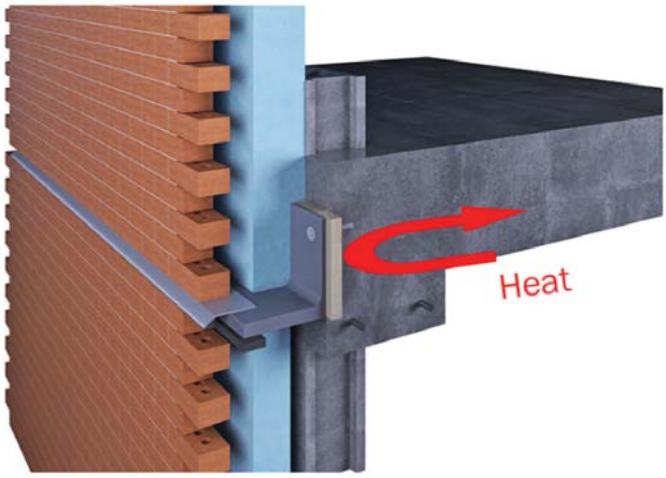
A. Install thermal break material in accordance with manufacturer's instructions and approved submittals in accordance with the original design.

END OF SECTION

SPECS



Without Thermal Break



With Thermal Break

The purpose of thermal break materials and systems (thermal breaks) is to reduce the impact of thermal bridging by preventing conductive heat flow through the thermal envelope. Thermal breaks keep the heat in and push the dew point out. They break the bridge.

Research has shown that thermal bridging can increase the whole-building conductive heat loss by more than 15%. The percentage is a function of the following variables: climate, building type, location and type of the thermal bridges. The magnitude and quantity of the thermal bridging is a large factor. Some interface details increase the U value of a wall by 45% or more, other transition details increase the U value by only 5%.

The heat flow created by thermal bridging varies by the detail and the number of details. If the building design contains lots of poor or inefficient details, the contribution to overall heat loss through the envelope will be high. To improve the energy efficiency of a building, we need to improve the efficiency of the thermal envelope.

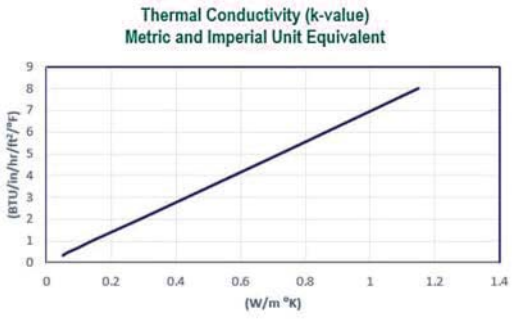


Figure 1

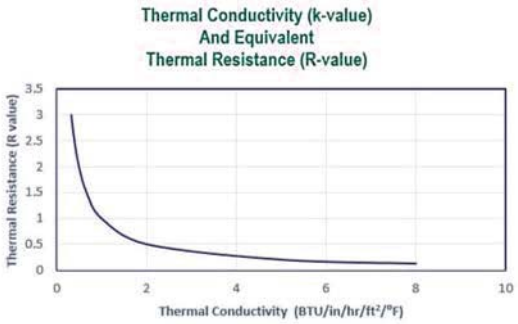


Figure 2

STRUCTURAL THERMAL BREAK

Mechanical Properties (STB-1)

Tensile Strength	PSI (MPa)	ASTM D638	11,000 (75.8)
Flexural Strength	PSI (MPa)	ASTM D790	25,000 (172.4)
Compressive Strength	PSI (MPa)	ASTM D695	48,000 (330.9)
Compressive Modulus - 1/2" (12.7mm) thk	PSI (MPa)	ASTM D695	291,194 (2,007.7)
Compressive Modulus - 1" (25.4mm) thk	PSI (MPa)	ASTM D695	519,531 (3,582.0)
Shear Strength	PSI (MPa)	ASTM D732	15,000 (103.4)
Operating Temperature Range *Loss in Ultimate Property Strength = 30% at 250°F	°F (°C)	-	-20 to +250* (-29 to +121*)
Thickness	in (mm)	-	1/4, 1/2, 3/4, 1, 2 (6.4, 12.7, 19.1, 25.4, 50.8)

Flame Resistance (Nominal)

Oxygen Index	%O2	ASTM D2863	21.8

Thermal Properties (Nominal)

Coefficient of Thermal Expansion	in/in/°Cx10-5	ASTM D696	2.2
Thermal Conductivity	BTU/Hr/ft2/in/°F	ASTM C177	1.8
Density	lb/ft3 (Kg/M3)		115 (1842)
***Reference: Thermal Conductivity of Steel*	BTU/Hr/ft2/in/°F W/m*°K		374.5 54.0

Physical	Test Method	Init	Result
Barcol Hardness	Barcol	Scale	48
Water Absorption, %	D-229	%	0.35
UL Flammability	UL94	Class	HB
Flame Resistance, Seconds			
Ignition Time	D-229	Seconds	103
Burning Time	D-229	Seconds	211

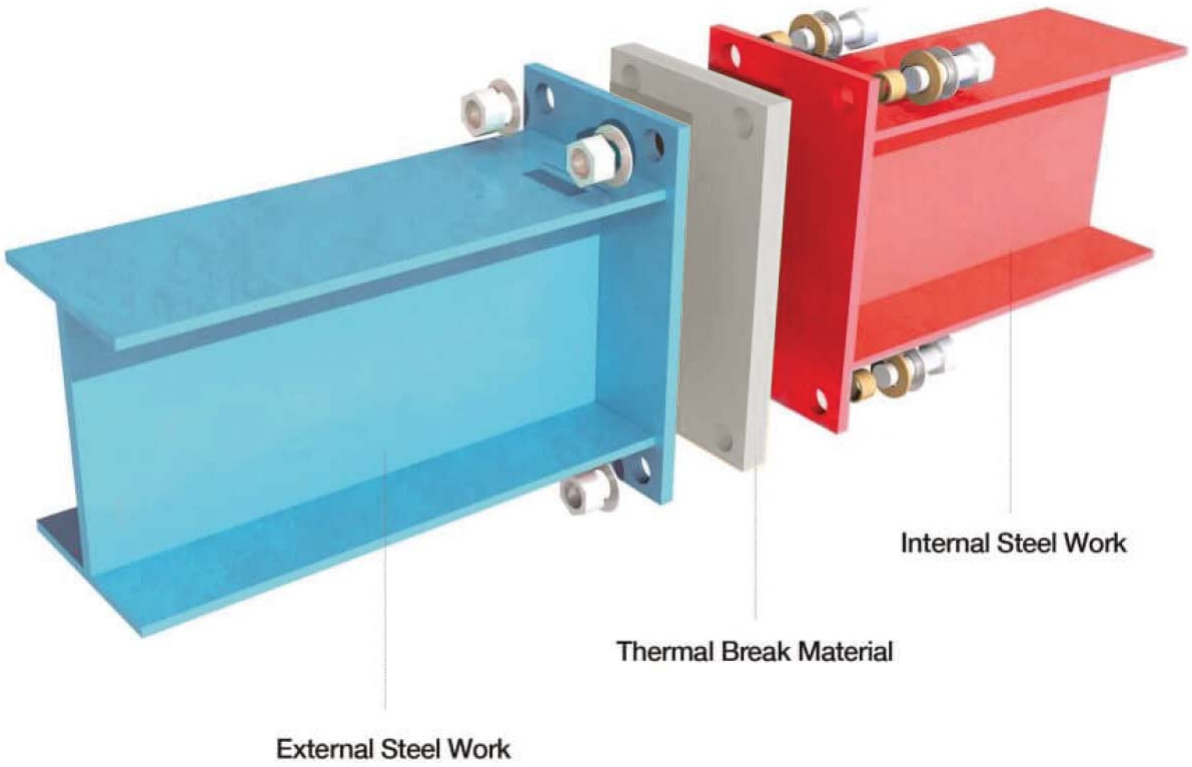
Mechanical

Modulus of Elasticity in Flexure,	PSI D-790	PSI	1.6 x 106
Bond Strength, 1/2" Thickness, PSI	D-229	PSI	1,200
Impact Strength, Izod Edgewise	D-256	Ft lbs/In. Notch	8.5

Electrical

Dielectric Strength, , Short Time In Oil 1/16", VPM	D-149	VPM	500
Dielectric Strength, Parallel, Step-By-Step In Oil, KV	D-149	KV	60.0
Arc Resistance, Seconds	D-495	Seconds	150
Dielectric Constant @60HZ	D-150		4.8
Dissipation Factor @ 60 Hz	D-150		0.02

Unless otherwise indicated, all properties published are based on test performed on standard ASTM test samples and according to ASTM test methods. Values shown are for test samples made from production materials and they are believed to be conservative. No warranty is to be construed, however, in fabricated or molded form, parts may vary considerably from this standard test data.



The purpose of a thermal break is to reduce the impact of thermal bridging by preventing conductive heat flow through the building thermal envelope. Thermal breaks also help to keep surface temperatures within the thermal envelope above the dew point. This eliminates potential condensation risk.

Structural Thermal Break (STB-1) conducts heat 820 times less than aluminum, 220 times less than steel and 65 times less than stainless steel. For any material, conduction is a function of thickness and temperature difference, so the thickness of a thermal break material should be carefully considered.

The thermal conductivity of a material is a function of its conductance and is an important value in determining the rate at which heat flows through that material. He at flow is also dependent on area and temperature. To be effective, a thermal break has to have a much, much lower thermal conductivity than the material it is "breaking". Since the conductance of a material is a function of its thickness, both thickness and area are important in heat flow calculations for a thermal break.

Structural Thermal Break (STB-1) is available in thickness of 1/4", 1/2", 3/4", 1"and 2". In any connection design using a thermal break, the goal is to find the appropriate thickness and area combination that helps the wall or roof assembly meet the U value requirement based on climate zone and energy code.

Structural Thermal Break (STB-1) reduces heat loss at balcony, canopy, shelf angle, roof post and other structural connections.

Structural Thermal Break (STB-1) is a thermoset, reinforced composite. It can transfer loading conditions up to 48,000 psi and has very good fire properties. The material has been designed to form a char when exposed to flame and reduce the amount of oxygen available to a fire.


STRUCTURAL
THERMAL BREAK