PAC-TIE

Introduction

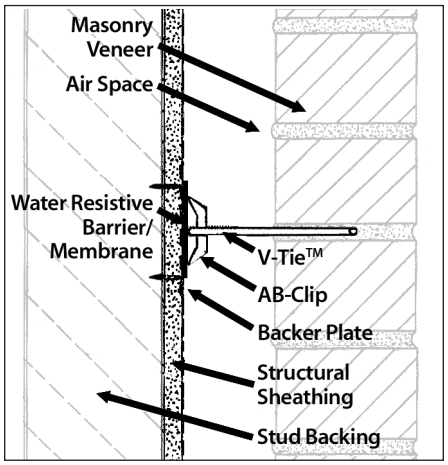

Figure 1 Pac-Tie System Application

The Pac-Tie (Plate Adjustable Connector Tie) System consists of a slotted AB-Clip, a V-Tie™ (a V-shaped wire), and a Backer Plate. The individual components are shown in *Figures 2*, *3*, and *4*, respectively. The installed Pac-Tie System is illustrated in *Figure 1*.

The Pac-Tie System is an adjustable multi-component tie designed specifically to be placed on the surface of an intervening secondary component that is fastened directly to the structural backing (of wood/steel studs or otherwise). Secondary components include protected gypsum board and other common construction/structural sheathings permitted for use by the National Building Code of Canada and the International Building Codes. The Pac-Tie System is a "surface-mounted" masonry tie system.

The AB-Clip with Backer Plate are fastened to the structural backing through the intervening secondary component. Tensile lateral loads applied to the masonry veneer are transferred through the V-Tie™ and resisted by the AB-Clip and fasteners. Compressive lateral loads transferred through the V-Tie™ are resisted by the Backer Plate. The vertical slot formed by the AB-Clip and Backer Plate, through which the wire V-Tie™ is inserted, provides a positive connection without the possibility of V-Tie™ disengagement during construction and in-service (in compliance with requirements in CSA A370, "Connectors for Masonry", and ACI 530/ASCE 5/TMS 402, "Building Code Requirements for Masonry Structures"). The slot permits up to 30 mm (1.2") of in-situ vertical adjustment, and also accommodates vertical differential movement between the masonry veneer and the structural backing.

Intervening secondary components must have sufficient compressive strength to convey incident lateral tie loads from the Backer Plate to their supporting primary structural components such as wood or steel studs. They also must satisfy the requirements for "structural integrity" stated in CSA A370, and protection requirements for exterior sheathing stated in ACI 530/ASCE 5/TMS 402. These requirements relate to strength, resistance to moisture-related deterioration, and protection from moisture.

Using a Backer Plate, the Pac-Tie System prevents damage to the surface of construction/structural sheathings by distributing an otherwise concentrated compressive load from the wire V-Tie™ over a larger sheathing area. This maintains the tie system compression resistance and serviceability performance over the required service life of the exterior wall system.

Pac-Tie Components and Specifications

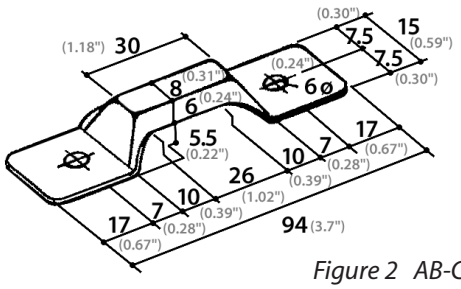

Figure 2 AB-Clip

The Pac-Tie System is ideally suited for wood frame construction where insulation is often not included in the cavity (and tie surface-mounting is thereby facilitated), where frame shortening of the structure due to shrinkage must be accommodated, and for most Building Code jurisdictions, where masonry veneer can be supported from the foundation of the structure to heights of about 11 m (36 ft.).

AB-Clip: The AB-Clip *(Figure 2)* is manufactured from 16 gauge sheet steel [(1.367 mm (0.0538") minimum base steel thickness] and is available in both hot-dip galvanized finish and stainless steel. The weight of the hot-dip galvanized finish in not less than 460 g/m^2/side (1.5 oz/ft^2/side), and satisfies the requirements of CSA A370 (which references ASTM A123), ACI 530.1/ASCE 6/TMS 602 (which references ASTM A153, Class B), and the International Codes (which reference ASTM A153, Class B). The AB-Clip is offered in one standard size and configuration, as detailed in *Figure 2*.

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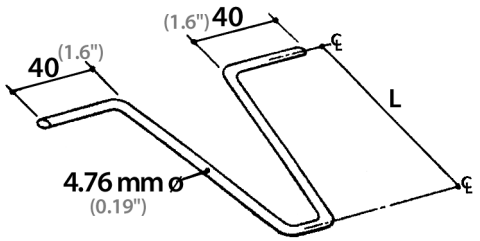

Figure 3 V-Tie™

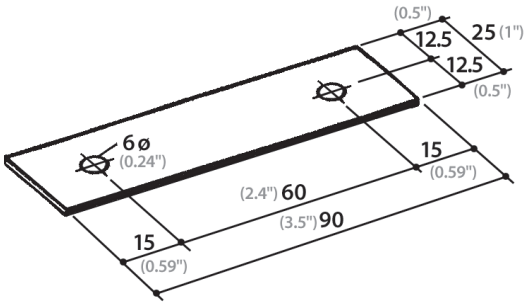

Figure 4 Backer Plate

V-Tie™: The V-Tie™ *(Figure 3)* is manufactured from 4.76 mm (0.19″) diameter wire and is available in both hot-dip galvanized finish and stainless steel. The weight of the hot-dip galvanized finish is not less than 460 g/m² (1.5 oz/ft²), and satisfies the requirements of CSA A370 (which references ASTM A123), ACI 530.1/ASCE 6/TMS 602 (which references ASTM A153, Class B), and the International Codes (which reference ASTM A153, Class B).

The V - Tie™ is available in a variety of standard lengths to accommodate different thicknesses of masonry veneer and design widths of air space. The design length of V-Tie™ should be selected so its legs are positioned along the centreline of the masonry veneer. Varying lengths of V-Tie™ can be appropriately selected by the mason on the jobsite to facilitate in-situ adjustment normal to the structural backing (where needed to accommodate construction tolerances). Standard lengths of V-Tie™ include 60 (2.4″), 80 (3.1″), 100 (3.9″), 120 (4.7″), 140 (5.5″), 160 (6.3″), 180 (7.1″), 200 (7.9″), 225 (8.9″) and 250 mm (9.8″) lengths. By selecting the appropriate length of wire V-Tie™, cavity widths of 15 mm (0.59″) to 200 mm (8″) can be accommodated. Specify the V-Tie™ size as the distance from the exterior face of the structural sheathing to the centreline of the masonry veneer.

Backer Plate: The Backer Plate *(Figure 4)* is manufactured from 16 gauge sheet steel [(1.367 mm (0.0538″) minimum base steel thickness] and is available in both hot-dip galvanized finish and stainless steel. The weight of the hot-dip galvanized finish in not less than 460 g/m²/side (1.5 oz/ft²/side), and satisfies the requirements of CSA A370 (which references ASTM A123), ACI 530.1/ASCE 6/TMS 602 (which references ASTM A153, Class B), and the International Codes (which reference ASTM A153, Class B). The Backer Plate is offered in one standard size and configuration, as detailed in *Figure 4*.

Pac-Tie System Structural Action

The Pac-Tie System is designed to transfer the lateral load from the exterior masonry veneer axially and normal to the structural backing. By way of the vertical slot, the connection between the V-Tie™ and the AB-Clip does not resist differential movement in the vertical direction and therefore does not offer composite action between the structural backing and the masonry veneer. For the design of shear connected masonry veneer systems, see Fero Stud Shear™ Connector product literature.

The fasteners connecting the AB-Clip and Backer Plate to the structural backing resist loads in direct tension. The Pac-Tie System is normally mounted coincident with a primary structural member such as a wood/steel stud. Fasteners penetrate through the intervening sheathing and into the primary structural member. Two (2) fasteners must be used and the fasteners must have sufficient diameter, length, and embedment depth to safely resist the lateral load imposed by the V-Tie™. Alternatively, the Pac-Tie System can be mounted directly to the sheathing (without placement coincident with a primary structural member) where the sheathing has sufficient strength and thickness to satisfactorily resist the pullout loads introduced by the Pac-Tie System fasteners, satisfactory resistance to mechanisms of deterioration due to moisture, and sufficient rigidity spanning between primary members to suitably limit veneer deflection.

Pac-Tie System Design Data *(Canada)*

Design data for the Pac-Tie are reported separately for Canada and the United States in the following tables because design methods and requirements for masonry ties and their uses differ between their respective codes and standards.

Design Parameter	Design Data [(i),(iii)]	
1. Mechanical Free Play [(iv)] (with FERO V-Tie™)	0.74 mm (max) [0.029″]	
2. Serviceability at 0.45 kN [100 lbs.] [(iv)]	Tie Mounted Directly to Steel Stud	Tie Mounted on Surface of Protected Exterior Gypsum Sheathing Over Steel Stud [(ii)]
Displacement Displacement + Mechanical Free Play	0.45 mm [0.018″] 1.19 mm (max) [0.047″]	1.13 mm [0.044″] 1.87 mm (max) [0.074″]
3. Factored Resistance (φP_{ult}) [(v),(vi),(vii)]	1.34 kN [300 lbs.]	
4. Maximum Recommended Spacing [(viii)]	Horizontal 800 mm [32″]	Vertical 600 mm [24″]

Notes:

(i) These design data are based on testing in accordance with CSA A370-04 with no surcharge, and with test samples having the following configuration: 102 mm [4″] cavity; standard AB-Clip, Backer Plate, and Fero V-Tie™; two (2) fasteners connecting the Pac-Tie System to the structural backing; and V-Tie™ positioned at the AB-Clip centreline. Smaller cavity widths will increase the tabled factored resistance of the tie and reduce tie deflections.

(ii) "Protected Exterior Gypsum Sheathing" consisted of Perma-Barrier (by W.R. Grace) adhered over 12.7 mm (0.5″) exterior gypsum sheathing.

(iii) These design data reflect both the windward (compression) and leeward (tension) capacities of the Pac-Tie System, with the governing values listed.

(iv) The Pac-Tie System satisfies the limiting requirements for serviceability (tie displacement and free play) in CSA A370-04. Tabled mechanical free play is for stainless steel components. The mechanical free play for hot-dip galvanized components is less.

(v) The ultimate strength of the Pac-Tie System, P_{ult}, is determined in accordance with CSA A370-04, and is calculated by multiplying the average tie strength established by testing by (1 – 1.64 cov). The factored resistance of the tie system (φP_{ult}) is calculated using Limit States Design, with $\varphi = 0.9$, and following the procedures of CSA A370-04.

(vi) The stated tie factored resistance is based on the capacity of Fero tie components and does not consider fastener resistance. A compatible fastener having an adequate factored resistance must be selected (by design in accordance with CSA A370-04).

(vii) The factored resistance of the mortar pull-out or push-out for the V-Tie™ embedded at the centreline of 90 mm (3.5″) brick veneer utilizing Type S or N mortar exceeds or equals the tabled factored resistance, φP_{ult}. That is, failure by pullout/pushthrough of the mortar joint does not govern.

(viii) Maximum recommended tie spacings are the maximum spacings permitted by CSA S304.1-04, *Design of Masonry Structures*. For a particular design, the actual tie spacings are calculated such that the factored resistance of the tie, φP_{ult}, equals or exceeds the effect of factored loads. See S304.1-04 for the design of masonry veneer systems.

Pac-Tie System
Design Data *(United States)*

Design Parameter	Design Data [(i),(iii)]	
1. Mechanical Free Play [(iv)]	0.74 mm (max) [0.029″]	
2. Serviceability at 0.45 kN [100 lbs.] [(iv)]	Tie Mounted Directly to Steel Stud	Tie Mounted on Surface of Protected Exterior Gypsum Sheathing Over Steel Stud [(ii)]
Displacement Displacement + Mechanical Free Play	0.45 mm [0.018″] 1.19 mm (max) [0.047″]	1.13 mm [0.044″] 1.87 mm (max) [0.074″]
3. Nominal Strength [(v),(vi),(vii),(ix),(x)]	400 lb [1.78 kN]	
4. Recommended Design Load [(v),(vi),(vii),(ix),(x)]	178 lb [0.79 kN]	
5. Maximum Recommended Spacing [(viii)]	Horizontal 32″ [813 mm]	Vertical 18″ [457 mm]

Notes:

(i) These design data are based on connector testing in accordance with CSA A370-04, *Connectors for Masonry*, with no surcharge and with test samples having the following configuration: 102 mm [4″] cavity; standard AB-Clip, Backer Plate, and Fero V-Tie™; two (2) fasteners connecting the Pac-Tie System to the structural backing; and V-Tie™ positioned at the AB-Clip centerline. The test method for ties in CSA A370-04 is comparable to that of ASTM E754, *Test Method for Pullout Resistance of Ties and Anchors Embedded in Masonry Mortar Joints*, and provides similar and more conservative results. Smaller cavity widths will increase the nominal strength of the tie and reduce tie deflection. Prescriptive requirements for anchored masonry veneer under ACI 530/ASCE 5/TMS 402 limit the cavity to a maximum width of 4-1/2″ (114 mm) unless the veneer is alternatively designed using a rational, engineered design method *(termed "Alternative Design of Anchored Masonry Veneer")*.

(ii) "Protected Exterior Gypsum Sheathing" consisted of Perma-Barrier (by W.R. Grace) adhered over 12.7 mm (0.5″) exterior gypsum sheathing.

(iii) These design data reflect both the windward (compression) and leeward (tension) capacities of the Pac-Tie System, with the governing values listed.

(iv) The Pac-Tie System with V-Tie™ satisfies the 1/16″ (1.6 mm) maximum permissible clearance between connecting parts required by change to ACI 530/ASCE 5/TMS 402. Tabled mechanical free play is for stainless steel components. The mechanical free play for hot-dip galvanized components is less.

(v) The nominal strength of the Pac-Tie System is determined by test and is reported as the average ultimate strength of the tie samples. In accordance with ACI 530/ASCE 5/TMS 402, using Strength Design, a suitable strength-reduction factor must be applied to the nominal strength to determine the tie design strength. Similarly, under Allowable Stress Design, an appropriate safety factor must be applied to determine an allowable load value. The tabled "Recommended Design Load" reflects a safety factor of 2.25 (that is, 75% of 3.0). [See also Note (vii) when assigning a strength-reduction factor to the nominal strength].

(vi) The stated nominal strength and recommended design load do not consider fastener capacity. A compatible fastener having an adequate strength must be selected (by design in accordance with ACI 530/ASCE 5/TMS 402).

(vii) The nominal strength (and corresponding recommended design load) of the mortar pull-out or push-through for the V-Tie™ embedded at the centerline of 3.5″ (90 mm) brick veneer utilizing Type M, S or N mortar exceeds or equals the tabled nominal strength (and recommended design load). That is, failure by pull-out/push-through of the mortar joint does not govern.

(viii) Maximum recommended tie spacings are the maximum spacings permitted by ACI 530/ASCE 5/TMS 402 using prescriptive requirements for anchored masonry veneer. The prescriptive requirements in ACI 530/ASCE 5/TMS 402 further limit a tie tributary area to not more than 2.67 ft.^{2} (0.25 m^2) wall area [with reduced tributary areas for high Seismic Design Categories and in areas of high winds] unless the veneer is alternatively designed using a rational, engineered method *(termed "Alternative Design of Anchored Masonry Veneer")*. Where an Alternative Design is used, the required tie spacing may be calculated such that the design strength of the tie equals or exceeds the required strength. See ACI 530/ASCE 5/TMS 402 for the design of masonry veneer systems.

(ix) The V-Tie™ satisfies ACI 530/ASCE 5/TMS 402 requirements for minimum wire size of W1.7 (MW11) and for ends bent to form a minimum 2 in (50.8 mm) extension.

(x) ACI 530/ASCE 5/TMS 402 requires joint reinforcement in masonry veneer in high Seismic Design Categories to be mechanically attached to the masonry tie.