

EVALUATION REPORT
Anchor Calculations
H16-4 8080 Single & Double Commercial
Steel Flush Entry Door

Client: Ingersoll-Rand Company
Report: IR2009-001R5
Date: 9/13/10
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I. OVERVIEW / SCOPE

The following evaluation report provides supporting anchor calculations for Dade County submittal along with the tests conducted on the H16-4 8080 Double Commercial Steel Flush Entry Door. In addition to the anchor tested (3/8" lag screws), there are five different anchors (masonry anchors, wire ties, T straps, jamb anchor-wood & jamb anchor-steel). The calculations are based on a design pressure of +/- 150 psf along with results contained in test reports NCTL-210-3580-1 and 210-3580-1A.

All door testing listed in NCTL-210-3580-1A were conducted per ASTM E1886 (Cyclic Wind Pressure Loading), ASTM E1996 (Missile Impact) and ASTM E330 (Uniform Static Pressure).

All door testing listed in NCTL-210-3580-1 were conducted per TAS 201-94 (Impact Test Procedures), TAS 202-94 (Uniform Static Air Pressure) and TAS 203-94 (Criteria for Testing Products Subject to Cyclic Wind Pressure Loading).

The calculations do not check the design of the lock, door hinges or door panel. Calculations assumes door to be a rigid member and failure to be a result of shearing of the anchor connection. All anchor connections are located at the left & right jambs and header and the loads are transmitted to the jamb attachment.

The results are summarized at the end of the report.

II. REFERENCE MATERIAL

The following reference materials were provided in support of the product evaluation

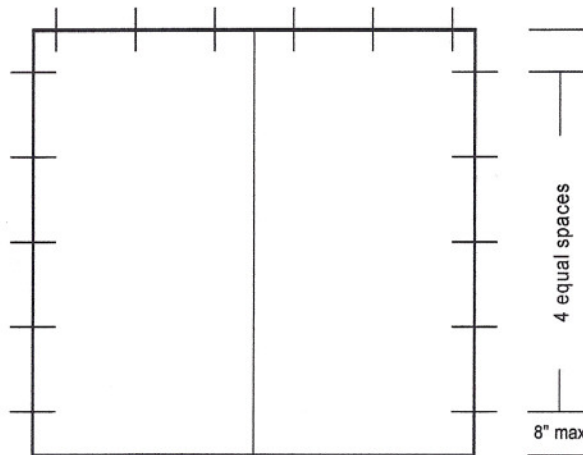
1. IR Drawing 3580-1 (6 shs) – H Series Single & Double Doors, Rev C
2. National Certified Testing Laboratories Report # NCTL-210-3580-1, Date 2/26/09
H-Series Flush Double Door with Von-Duprin Exit Device
3. National Certified Testing Laboratories Report # NCTL-210-3580-1A, Date 3/10/09
H-Series Flush Double Door with Von-Duprin Exit Device



III. FRAME EVALUATION

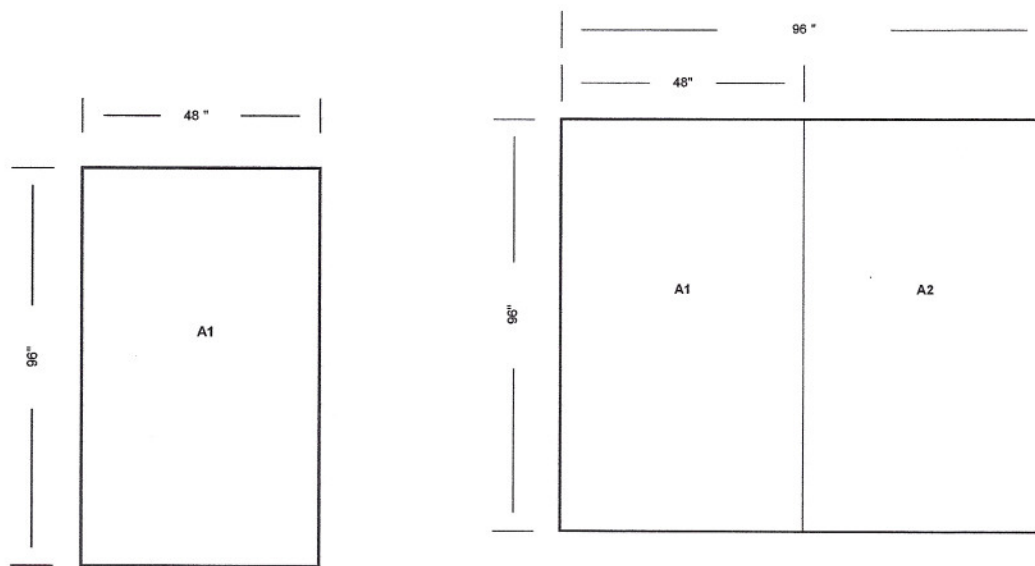
A. Door Frame Tested

The specimens were installed into the wooden test buck with Sixteen (16) 0.375" x 5" long lag bolts. Six (6) in the head located at 8", 23" and 38" from each end to the centerline. Five (5) in each jamb located at 8", from each end 26.5" on center thereafter measuring from sill to head.



1. Load distribution

Area



Single Door

Double Door

Area:

$$A_1 = A_2 = 96" \times 48" = 4608 \text{ in}^2 = 32 \text{ ft}^2$$

$$A_{\text{total (Single)}} = 32 \text{ ft}^2$$

$$A_{\text{total}} (\text{Double}) = 96" \times 96" = 9216 \text{ in}^2 = 64 \text{ ft}^2$$

Pressure/ Loads

$$P_1 = P_2 = 32 \text{ ft}^2 \times 150 \text{ psf} = 4800 \text{ lbs}$$

All of the loads of the door go back to the locking hardware and hinges. For the worse case, this would be for a double door, outswing, negative wind load with single point latching. This would cause $\frac{1}{2}$ the door load to go to the jamb and vertical rods for the exit device. With a factor of safety, the frame loads at the jamb would be:

$$W_{\text{jamb}} = 4800 \text{ lbs}/2 * 1.5 = 3600 \text{ lbs}$$

Lag Bolts

Type: Min 3/8" dia Lag bolt, 6" long

Material: Assume specific gravity, G, of oven-dry wood to be 0.42-0.50.

Allowable lateral resistance

for parallel-to-grain loading (1-1/2" side member): 280 lbs/ lag bolt

$$\text{Lag bolt Qty (jambs)} = 3600/280 = 12.8$$

Use 13 bolts, minimum

B. Door Frames Evaluated

Alternate Anchors

a. Masonry Anchors

Type: 3/8" Rawl-Bolt, or approved equivalent

Wall Type: Min 2000 psi concrete

Embed Depth: Min 2"

Design Criteria

- Allowable shear: $4015 \text{ lbs}/4 = 1004 \text{ lbs/ bolt}$
- Allowable tension: $6525 \text{ lbs}/4 = 1631 \text{ lbs/ bolt}$
- Spacing between anchors: Min 2-1/2"
- Edge distance – shear: Min 3"
- Edge distance – tension: Min 3"

$$\text{Anchor Qty (jambs)} = 3600/1004 = 3.6$$

Use 4 anchors, minimum

b. Wire Ties

Type: 0.188" wire masonry wire anchor

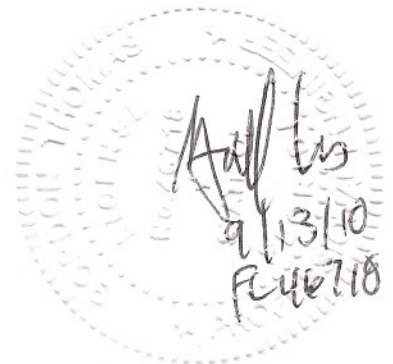
$$\text{Wire Shear Area: } 3.14 (0.188^2)/4 = 0.0277 \text{ in}^2$$

$$\text{Allowable load per wire: } 0.4 \times (36 \text{ ksi}) \times 0.0277 \text{ in}^2 = 398.9 \text{ lbs}$$

$$\text{Allowable load per wire tie: } 2 \times 398.9 = 798 \text{ lbs}$$

$$\text{Wire tie Qty (jambs)} = 3600/798 = 4.5$$

Use 5 wire ties, minimum –or- 4 wire ties with base anchor (Refer to 3480-1)



c. T Anchor

Type: 18 ga T anchor

Shear Area: $0.048" \times 1.75" = 0.084 \text{ in}^2$

Allowable load per wire: $0.4 \times (36\text{ksi}) \times 0.084 \text{ in}^2 = 1210 \text{ lbs}$

(does not include the extra holding force of the masonry to the frame)

T Anchor Qty (jambs) = $3600/1210 = 2.98$

Use 4 T anchors, minimum

d. Wood Stud Anchor

Type: IR Part Number 3An0100P016 – Universal Adjustable Jamb Anchor

Shear Failure – Assume strap failure

Shear Area = $0.63" \times 0.048" = 0.03 \text{ in}^2$ each side

Max Shear Load: $2 \times 0.03 \times 36,000 \times .6 = 1296 \text{ lbs}$

Wood stud Qty (jambs) = $3600/1296 = 2.78$

Use 4 wood studs, minimum

e. Steel Stud Anchor

Type: IR Part Number 3An0100P016 – Universal Adjustable Jamb Anchor

Shear Failure – Assume screw diameter

Shear Area = $3.14 \times (0.164)^2/4 = 0.0211 \text{ in}^2$ each screw

Max Shear Load: $2 \times 0.0211 \times 36,000 \times 2/3 = 1013 \text{ lbs}$

Steel stud Qty (jambs) = $3600/1013 = 3.55$

Use 4 steel studs, minimum

C. Summarized Results

In summary, the performance loading for each of the anchors are as follows:

Figure 1 (Single Door)

Masonry Anchors (1004 lbs)

T Anchors (1210 lbs)

Wood stud anchor (1296 lbs)

Steel stud anchor (1013 lbs)

Wire Ties w/ base anchor

Figure 2 (Single Door)

Wire Ties (798 lbs) w/o base anchor

Figure 3 (Double Door)

Masonry Anchors (1004 lbs)

T Anchors (1210 lbs)

Wood stud anchor (1296 lbs)

Steel stud anchor (1013 lbs)

Wire Ties w/ base anchor

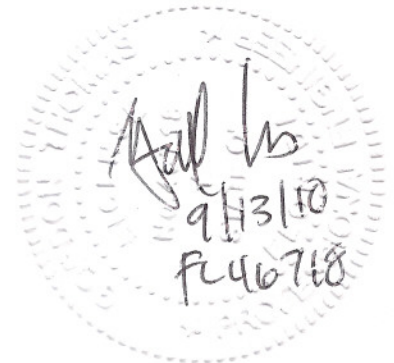


Figure 4 (Double Door)

Wire Ties (798 lbs) w/o base anchor

The figures below summarize the results for the 5 optional anchor spacings.

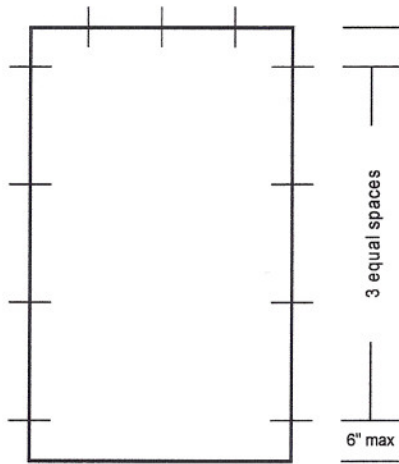


Figure 1
4 jamb/ 5 header anchor spacing

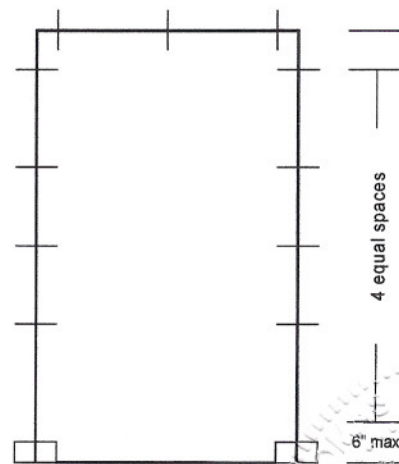


Figure 2
4 Jamb w/ base anchor
/ 6 header anchor spacing

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FL 46718

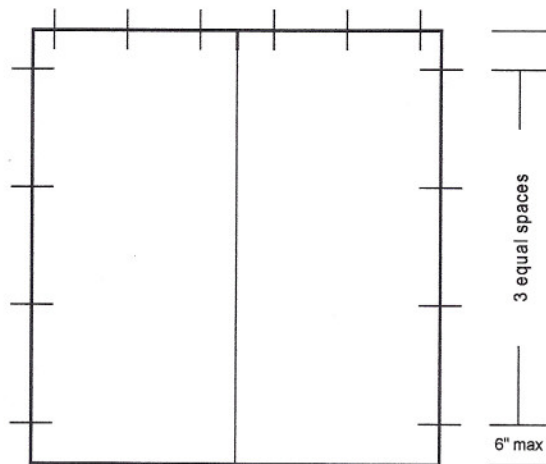


Figure 3
4 jamb/ 5 header anchor spacing

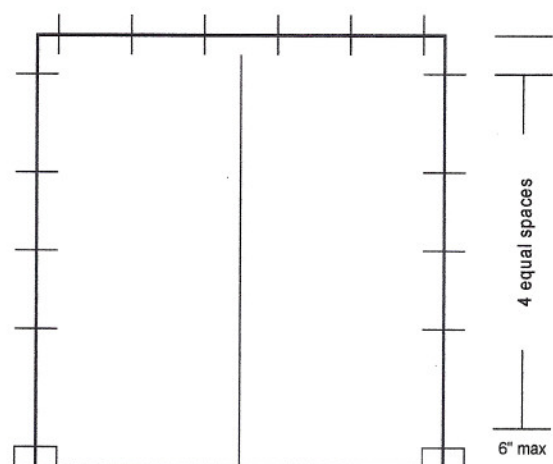


Figure 4
4 Jamb w/ base anchor
/ 6 header anchor spacing