MAFFEI
STRUCTURAL ENGINEERING

Technical Report

RP Watkins "OneLedge" connector
Allowable downward loads from experimental testing

To: Michael Summers, RP Watkins

Prepared by: Karl Telleen and Joe Maffei, Maffei Structural Engineering

9 February 2018

Scope

This report provides allowable loads for vertical (downward) load bearing capacity of the RP Watkins OneLedge connector in accordance with the experimental testing standard ASTM D7147-11 "Standard Specification for Testing and Establishing Allowable Loads for Joist Hangers," which is referenced by the 2015 International Building Code.

Maffei Structural Engineering provided recommendations for testing in a report dated 14 July 2017. RP Watkins fabricated test specimens. Applied Materials Engineering (AME) carried out testing as described in the testing report dated 6 February 2018 (attached herein as Appendix 1).

Description of the OneLedge connector

The OneLedge connector by RP Watkins, is a product for attaching a wooden ledger board to an Insulated Concrete Form (ICF) structural wall. The ledger board runs parallel to the length of the wall. Joists then attach to the ledger board perpendicularly, using a separate connection.

The OneLedge consists of a single piece of cold-formed galvanized steel. It comes in a range of widths to accommodate the width of the ledger board.

Before the wall concrete is placed, the vertical tabs of the OneLedge are inserted through cut slits in the ICF form such that they penetrate through the insulation and into the concrete. One reinforcing bar is placed horizontally through the holes in the tabs, and one bar is placed vertically, between the tabs. After the concrete wall is cast and cured, the ledger board is installed, bearing on the OneLedge connector's seat. The ledger board is fastened to the OneLedge using screws that penetrate through the front face of the OneLedge, through the ledger board, and through the back face of the OneLedge, such that the tips of the screws are in the wall ICF form.

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Summary of test results and allowable load

Table 1 summarizes key results from experimental testing and the resulting allowable load for design. This summary is based on the detailed test results shown in Appendix 1.

In accordance with ASTM D7147-11 Section 13, the allowable downward load is calculated as the lesser of:

(a) The lowest ultimate load per OneLedge connector divided by 3.

(b) The average, over each OneLedge connector in each specimen, load that produces a vertical deflection of 0.125 inches at the bottom of the OneLedge connector with respect to the wall.

The ultimate load measured in the test was limited by the strength of the wood joists.

Table 1 Summary of test results and allowable load

specimen	ultimate load per OneLedge (lbs)	load per OneLedge at 0.125" deflection (lbs)		allowable load per OneLedge (lbs)
		OneLedge 1	OneLedge 2	
1	8191	2991	3292	
2	8990	4083	4274	
3	8675	4256	3975	
	Minimum / 3 = 2730	Average = 3812		**Allowable = 2730**

Applicability of allowable load

Figure 1, Figure 2, and Figure 3 show the configuration and dimensions of the tested specimens. The allowable load specified above is applicable to OneLedge connectors having the configuration shown in Figure 2. Project parameters are permitted to vary within the ranges stated in Table 2.

Adjustments to allowable load

For applications on projects where the project specified concrete strength ($f'_{c,\ specified}$) for the ICF wall is less than 91% of the tested concrete strength ($f'_{c,\ tested}$) stated in Table 2, the allowable load stated above shall be reduced in accordance with ASTM D7147-11 Section 13.5.9 by multiplying by:

$$\sqrt{(f'_{c,\ specified} / f'_{c,\ tested})} \leq 1.0$$

For applications on projects where the project specified thickness (t_{spec}) and/or tensile strength (F_{u_spec}) for the OneLedge sheet metal material is less than the tested OneLedge sheet metal thickness (t_{tested}) and/or tensile strength (F_{u_tested}) stated in Table 2, the allowable load stated above shall be reduced in accordance with ASTM D7147-11 Section 13.5.7 by multiplying by:

$$(3.0/2.5)(F_{u\_spec}/F_{u\_tested})\ (t_{spec}/t_{tested}) \leq 1.0$$

Table 2 Range of applicability for selected parameters (continues on next page)

Parameter	**Test**	**Range of applicability on projects**
OneLedge seat depth (horizontal dimension to accommodate ledger board thickness)	1 5/8 inches	1 5/8" (2x dimension lumber ledger) or 1 7/8" (1.5" LVL ledger)
OneLedge other dimensions	See Figure 1.	As tested
OneLedge hole pattern	See Figure 1.	As tested
OneLedge thickness	14 gauge galvanized (t_{tested} = 0.072 inches)	As tested or thicker. If thinner, allowable load shall be reduced in accordance with ASTM D7147-11 Section 13.5.7. See "Adjustments to allowable load."
OneLedge material	Steel tensile strength F_{u_tested} = 58 ksi	As tested or greater. If less, allowable load shall be reduced in accordance with ASTM D7147-11 Section 13.5.7. See "Adjustments to allowable load."
Ledger board type and dimensions	Dimension lumber nominal 2x12	Dimension lumber nominal 2x12 or LVL 1.75"
Concrete strength	$f'_{c,\ tested}$ = 2490 psi	As tested or greater. If less, allowable load shall be reduced in accordance with ASTM D7147-11 Section 13.5.9. See "Adjustments to allowable load."
Thickness of concrete core of ICF wall	4 inches	As tested or thicker
Thickness of foam each side of concrete core	2.5 inches	As tested or thinner
Embedment of OneLedge tabs into concrete core	3.75 inches	As tested or greater

Parameter	Test	Range of applicability on projects
Steel reinforcing bars added in concrete wall at OneLedge (in addition to typical wall reinforcement)	1 bar horizontal. #3 18 inches long. 1 bar vertical. #3 18 inches long.	As tested or greater. Horizontal bar must be placed in holes in OneLedge as shown in Figure 2. Bar must be centered on OneLedge. Vertical bar must pass between OneLedge tabs and must be adjacent to the horizontal bar, between the horizontal bar and the OneLedge.
Horizontal edge distance	10 inches	As tested or greater (from centerline of OneLedge to end of ICF concrete wall or opening)
Fasteners of OneLedge to ledger board	6 screws, #12 diameter, 2 1/2" long: ITW Buildex "Teks 3 HWH CL 12-14 x 2-1/2"	As tested or greater

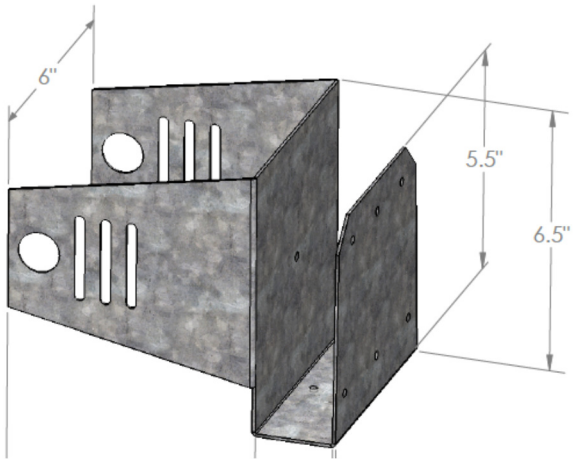

Figure 1 OneLedge connector dimensions. Dimensions are not shown here for (a) horizontal length of tabs and for (b) depth of seat (horizontal dimension to accommodate ledger board thickness) because these dimensions vary for different versions of the product. See Table 2 for ranges of applicability of testing. (Image from www.watkinshanger.com)

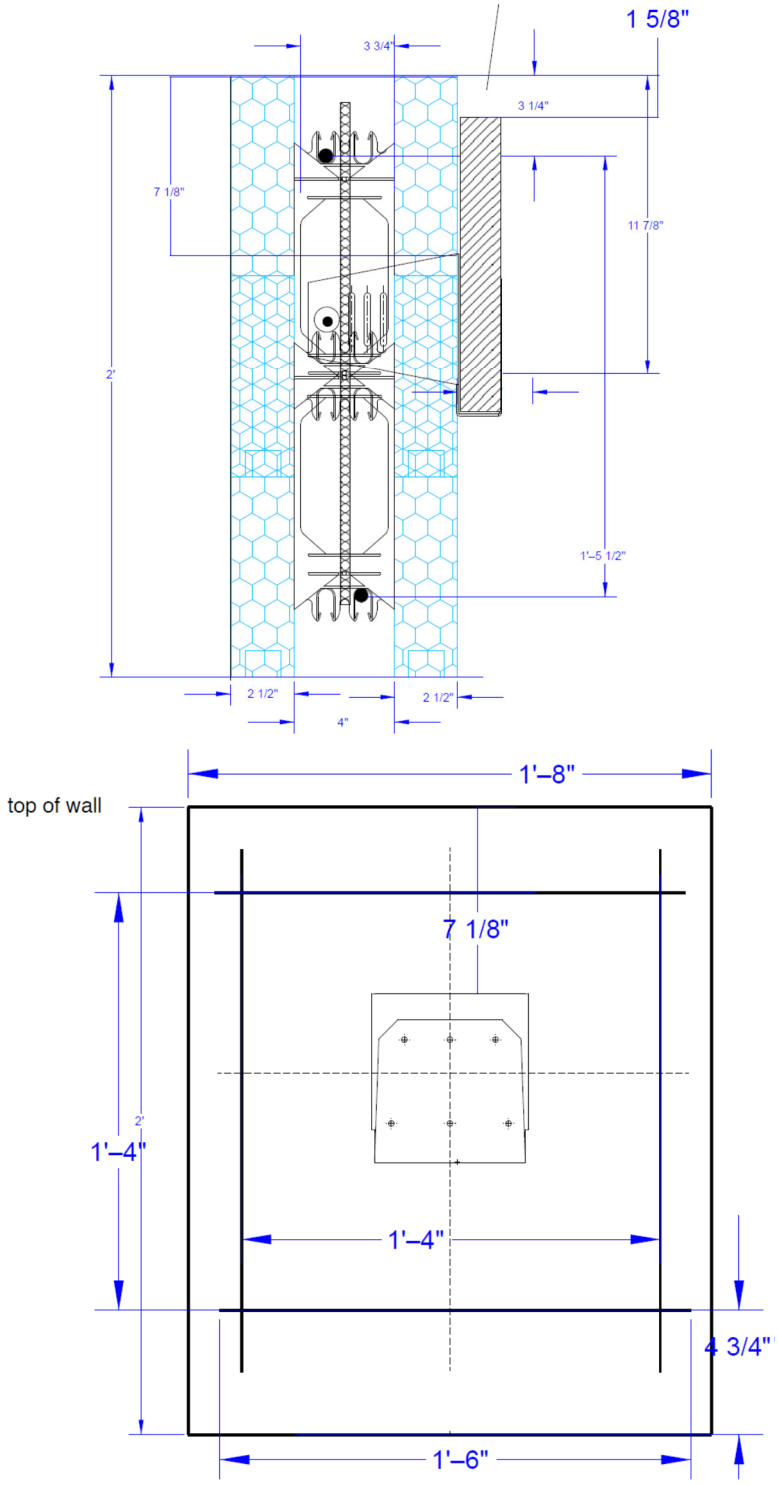

Figure 2 Tested specimen dimensions (drawing by RP Watkins).

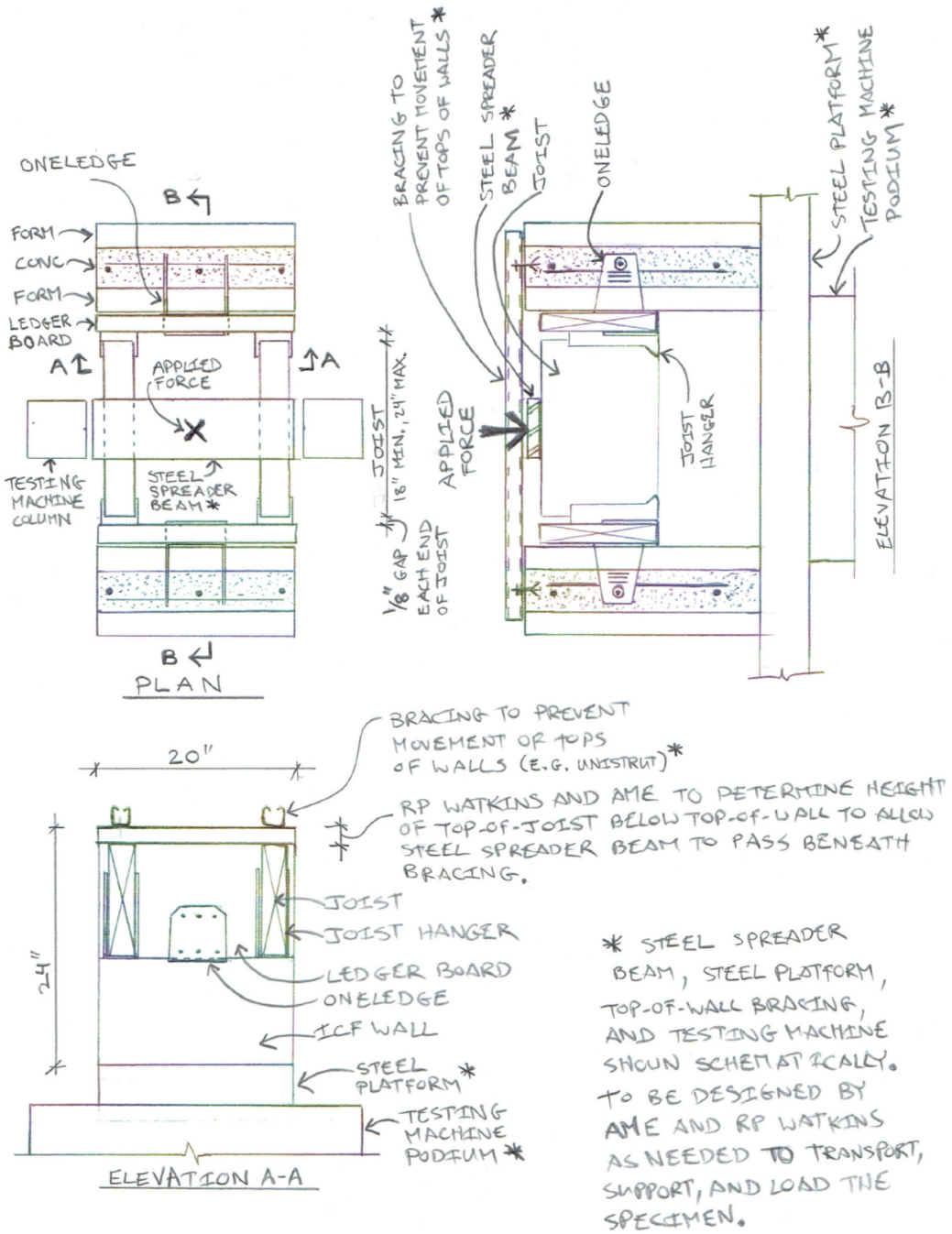

Figure 3 Test setup. Joist length is 24 inches.

Appendix 1: Testing report

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February 6, 2018

Mr. Michael Summers
RP Watkins LLC
13401 S 226th Street
Gretna, NE 68028

Project Number 1170972C

Subject: RP Watkins OneLedge Load Testing

Dear Mr. Summers:

As requested, Applied Materials & Engineering, Inc. (AME) has completed load testing the RP Watkins OneLedge. The intent of the testing was to determine the vertical downward load capacity of the RP Watkins OneLedge attached to mockup ICF walls.

SAMPLE DESCRIPTION

Three mockup samples were received on November 13, 2017. Mockup configuration consisted of two 20"x24"x9" thick ICF walls. Two wood I-joists spanning 24" in length were fastened with joist hangers to a single wooden ledger board at each end of the joists. The ledger board was seated in and fastened with screws to the RP Watkins OneLedge, which had been cast into the ICF walls. Specimen details are based on the test protocol from Maffei Structural Engineering dated July 14, 2017. Material test results for the materials used to construct the specimens are provided in Appendix A.

TEST PROCEDURE

Three samples were tested on November 27 and 28, 2017 using a calibrated universal testing machine. Samples were tested in general accordance with applicable procedures outlined in ASTM D7147-11, “Standard Specifications for Testing and Establishing Allowable Loads of Joist Hangers”, ASTM International. Samples were tested when (ICF) concrete reached an average compressive strength of 2490 psi (see Appendix B). A vertical compressive load was applied to the center of the web stiffened I-joist via a steel load transfer block at a constant rate of axial deformation of 0.1 in. /min. without shock until the specimen could not support any further loading and load-deflection curve showed that the vertical load resistance was no longer increasing with increased deflection.

A pre-load of 1000 lbf was applied before uniform loading began. Deflection of each OneLedge was continuously using a calibrated LVDT. Test setup is provided in Appendix C.

TEST RESULTS

Based on our testing, the average load at 0.125" deflection of the RP Watkins OneLedge was determined to be 6283 lbf, 8357, lbf and 8231 lbf for the three samples, respectively. Detailed results of our testing are provided in Table I. Load-deflection curves are shown in Figure 1, 2 and 3.

The typical failure mode observed at ultimate strength of the specimen was flexural cracking and splitting of the I-joist flanges. Failure modes are provided in Appendix D.

If you have any questions regarding the above, please do not hesitate to call the undersigned.

Respectfully Submitted,

APPLIED MATERIALS & ENGINEERING, INC.

Joseph Gapuz
Laboratory Manager

Reviewed by:

Armen Tajirian, Ph.D., P.E.
Principal

TABLE I

ASTM D7147-11
RP WATKINS ONELEDGE LOAD TESTING

PROJECT NUMER 1170972C

Test #	**1**	**2**	**3**	**Average of 3 Tests**
Load at 0.125" Deflection of Right Hanger, lbf	5982	8166	8512	..
Load at 0.125" Deflection of Left Hanger, lbf	6584	8547	7950	..
Average Hanger Load at 0.125" Deflection, lbf	6283	8357	8231	7624
Maximum Load at Failure, lbf	16382	17979	17350	17237
Specific Gravity of Right Ledger	0.398	0.328	.369	..
Specific Gravity of Left Ledger	0.354	0.362	.387	..
Moisture Content of Right Ledger Board, %	10.1	10.0	10.6	..
Moisture Content of Left Ledger Board, %	10.3	9.8	9.9	..

FIGURE 1

ASTM D7147
RP WATKINS ONELEDGE LOAD TESTING – TEST #1

PROJECT NUMER 1170972C

FIGURE 2

ASTM D7147
RP WATKINS ONELEDGE LOAD TESTING – TEST #2

PROJECT NUMER 1170972C

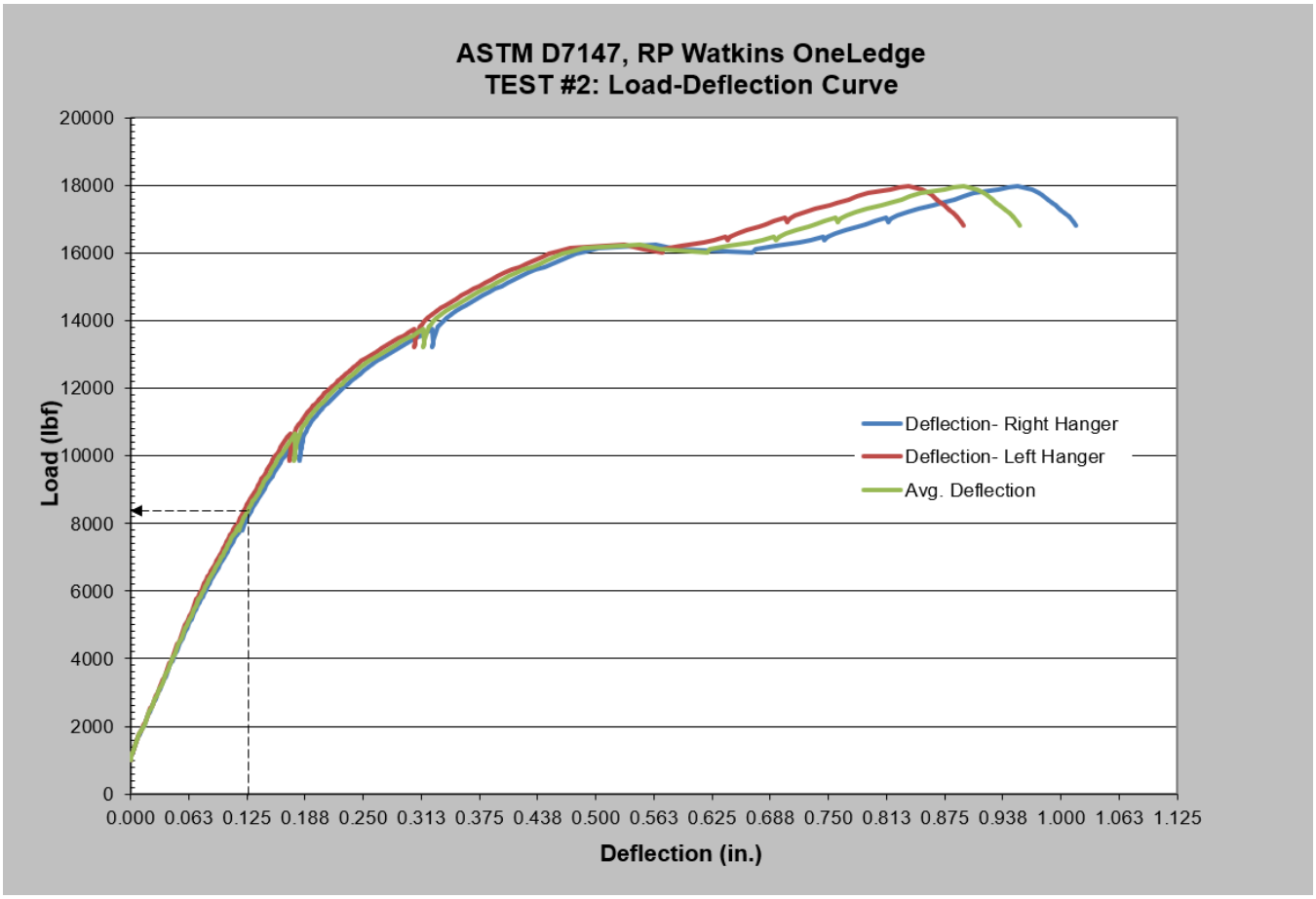
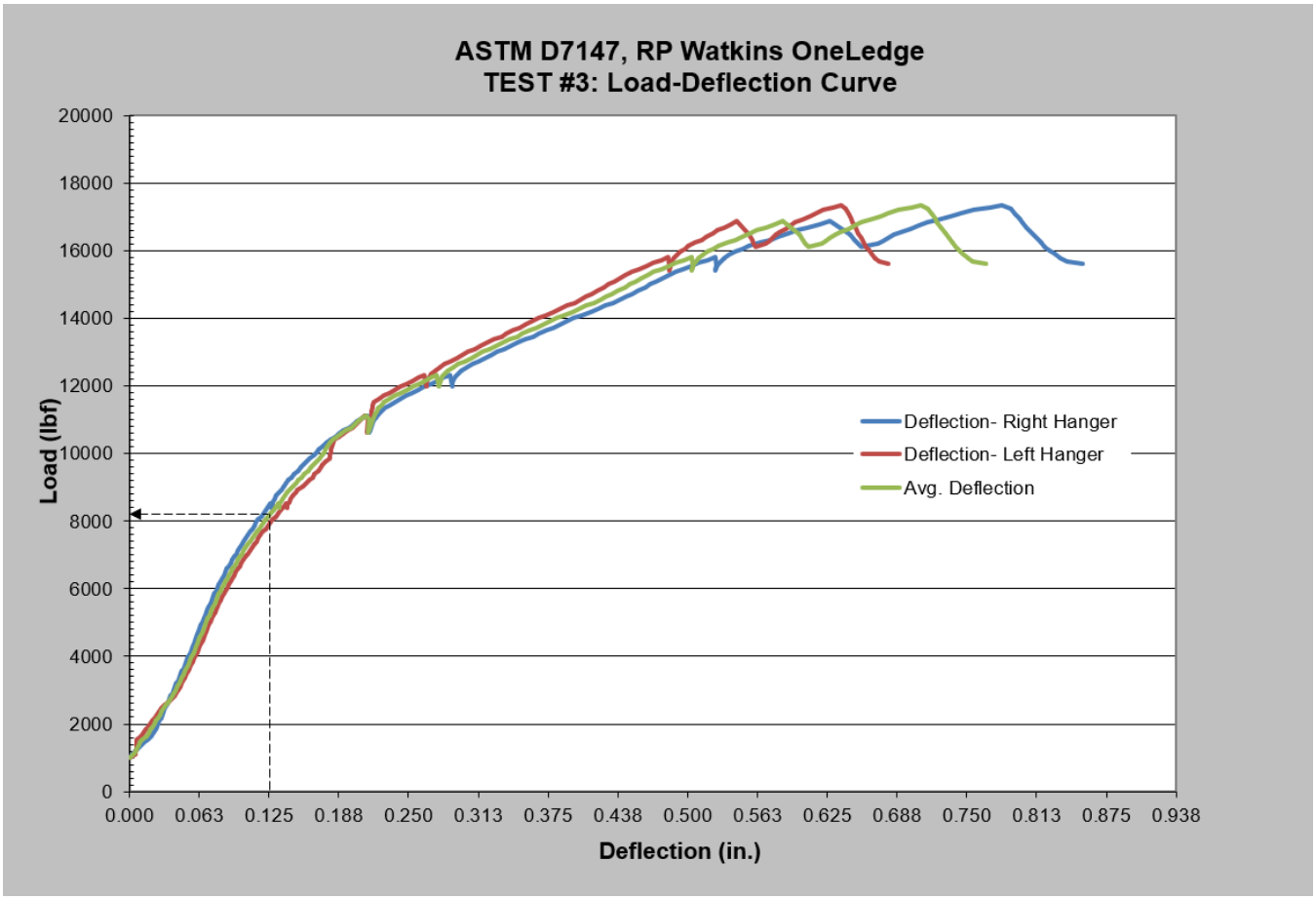


FIGURE 3

ASTM D7147
RP WATKINS ONELEDGE LOAD TESTING – TEST #3

PROJECT NUMER 1170972C



APPENDIX A

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element.com

Laboratory Report - EAR-Controlled Data

Attn: Michael Summers
RP Watkins
2904 N Harvard Ave.
OKLAHOMA CITY, OK 73127 US

Report No: B17110127
Date Reported: 11/10/2017
P.O. No: Credit Card

Material: Steel

Description: (2) 14 GA G90 Samples

Room Temperature Tensile Testing ASTM E8/E8M-16a, Not Specified, As Received

Sample ID	Width, Initial, in	Thickness, Initial, in	Tensile Strength, ksi	Yield (0.2% Offset), ksi	Elongation After Fracture (in 2 inches), %	Location of Fracture
Sample 1	0.496	0.072	57	50	37	Inside Middle Half of Gage

Room Temperature Tensile Testing ASTM E8/E8M-16a, Not Specified, As Received

Sample ID	Width, Initial, in	Thickness, Initial, in	Tensile Strength, ksi	Yield (0.2% Offset), ksi	Elongation After Fracture (in 2 inches), %	Location of Fracture
Sample 2	0.497	0.071	58	51	34	Inside Middle Half of Gage

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Approved by:

Doug Kooken
Operations Manager

ITW Buildex

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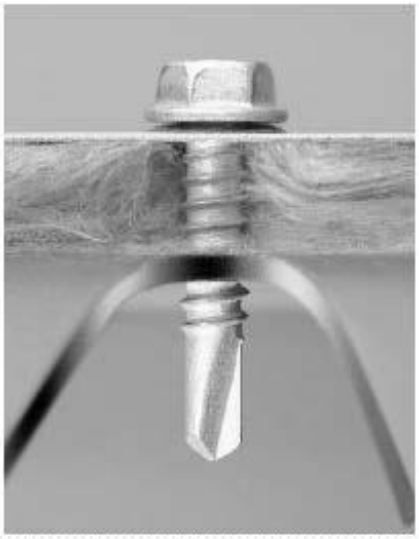


MEDIUM DUTY STEEL - TO - STEEL APPLICATIONS

PRODUCT REPORT NO. 02702

Applications

- Roof deck to steel framing.
- Wall panel to girt.
- Duct work to steel framing.
- Accessories to steel framing
- Roof clip to steel framing.
- Retrofit framing.
- Commercial overhead steel doors, hinges & latches.

Product Features

- Point has precise cutting edges to improve drill performance with less effort.
- Non-walking point provides fast material engagement.
- Point to thread design maximizes pullout performance and minimizes backout.
- Drills and taps in the broadest range of applications.
- Climaseal® finish provides excellent corrosion resistance and lower tapping torque.

Product Specifications

Diameter.....#12, 1/4
Thread Form.....12-14
1/4-14
Head Style.....#12: 5/16" HWH
1/4: 3/8" HWH
1/4 Overhead Door Fasteners
7/16" HWH with Serrations
Drill Point.....Teks 2
Teks 3
Finish.....Climaseal

Head Style

Hex Washer Head

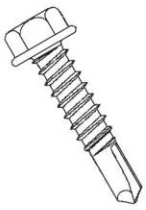
Hex Washer Head with Serrations

Approvals and Listings

Factory Mutual (J.I. 2 X 9A2.AM), ICC ER-3056, ICC ESR-1976

7

Selector Guide



Part Number	Description	Head Style	Drill Point	Drill & Tap Capacity	Max. Material Attachment	Box Qty	Applications
1134000	12-14 x 3/4"	HWH	#3	.036-.210	.270	5,000	• Roof deck to steel framing • Wall panel to girt • Duct work to steel framing • Accessories to steel framing • Clip to steel framing • Retrofit framing
1136000	12-14 x 1"	HWH	#3	.036-.210	.520	4,000	
1120000	12-14 x 1-1/4"	HWH	#2	.036-.210	.550	4,000	
1123000	12-14 x 1-1/2"	HWH	#2	.036-.210	.800	2,500	
1140000	12-14 x 2"	HWH	#3	.036-.210	1.450	2,000	
1553000	12-14 X 2-1/2"	HWH	#3	.036-.210	1.950	1,000	
1143000	12-14 x 3"	HWH	#3	.036-.210	2.450	1,000	
1146000	12-14 x 4"	HWH	#3	.036-.210	3.450	500	
1147000	1/4-14 x 3/4"	HWH	#3	.036-.210	.210	3,000	
1149000	1/4-14 x 1"	HWH	#3	.036-.210	.400	2,500	
1150000	1/4-14 x 1-1/4"	HWH	#3	.036-.210	.650	2,000	
1152000	1/4-14 x 1-1/2"	HWH	#3	.036-.210	.900	2,000	
1155000	1/4-14 x 2"	HWH	#3	.036-.210	1.400	1,500	
1554000	1/4-14 x 2-1/2"	HWH	#3	.036-.210	1.900	1,000	
1157000	1/4-14 x 3"	HWH	#3	.036-.210	2.400	1,000	
1304000	1/4-14 x 4"	HWH	#3	.036-.210	3.400	500	
1586000	1/4-14 x 3/4"	*HWH	#3	.036-.210	.250	3,000	• Commercial overhead steel doors, hinges & latches.
1587000	1/4-14 x 1"	*HWH	#3	.036-.210	.500	2,500	

* 7/16" Across Flats HWH with serrations under head.

Performance Data

PULLOUT VALUES (average lbs. ultimate)

Fastener		Steel Gauge								
Dia.	Pt.	26	24	22	20	18	16	14	12	3/16
12	2	156	243	283	375	605	848	1181	1856	3520
	3	142	211	289	341	551	757	1063	1631	2998
1/4	3	141	231	293	346	613	880	1145	1858	4550

SHEAR VALUES (average lbs. ultimate)

Fastener		Steel Gauge (lapped)							
Dia.	Pt.	26	24	22	20	18	16	14	12
12	2	365	600	623	898	1370	1758	2138	2202
	3	-	-	-	769	1358	1620	1970	1986
1/4	3	-	-	-	930	1442	2100	2584	2650

FASTENER VALUES

Fastener (dia-tpi)	Tensile (lbs. min.)	Shear (avg. lbs. ult.)	Torque (min. in. lbs.)
12-14	2778	2000	92
1/4-14	4060	2600	150

SHEET STEEL GAUGES

Gauge No.	12	14	16	18	20	22	24	26
Decimal Equivalent	.105"	.075"	.060"	.048"	.036"	.030"	.024"	.018"

The values listed are ultimate averages achieved under laboratory conditions and apply to Buildex manufactured fasteners only. Appropriate safety factors should be applied to these values for design purposes.

Installation Guidelines

- A standard screwgun with a depth sensitive nosepiece should be used to install Teks. For optimal fastener performance, the screwgun should be a minimum of 6 amps and have an RPM range of 0-2500.
- Adjust the screwgun nosepiece to properly seat the fastener.
- New magnetic sockets must be correctly set before use. Remove chip build-up as needed.
- The fastener is fully seated when the head is flush with the work surface.
- Overdriving may result in torsional failure of the fastener or stripout of the substrate.
- The fastener must penetrate beyond the metal structure a minimum of 3 pitches of thread.

ITW Buildex

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www.itwbuildex.com

APPENDIX B

APPLIED MATERIALS & ENGINEERING, INC.
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FAX: (510) 420-8186
e-mail: info@appmateng.com

COMPRESSION TEST REPORT

Project Number:	1170972C	Report Date:	12/19/17
Project Name:	RP Watkins OneLedge Load Testing	Type of Sample:	Concrete Cylinder C39
		Size of Sample:	4"x8" Cylinder
		Capping Method:	ASTM C1231
		Specimens Made By:	Client
Client Name:	RP Watkins LLC	Date Sampled:	11/07/17
		Time Sampled:	..
		Date Received:	11/13/17

Field Test Conditions and Results

Supplier:	..	Slump, inch:	..	ASTM C143
Mix Number:	..	Air Temperature, °F:	..	
Ticket Number:	..	Mix Temperature, °F:	..	ASTM C1064
Truck Number:	..	Air Content, %:	..	ASTM C231
Location in Structure:	..	Fresh Unit Weight, PCF:	..	ASTM C138

Laboratory Test Results

Test Schedule	**11/28/17**	**11/28/17**	**11/28/17**			
Identification	**1A**	**1B**	**1C**			
Diameter, in.	**4.00**	**4.00**	**4.00**			
Length, in.	**8.00**	**8.00**	**8.00**			
Width, in.						
Correction Factor	**1.00**	**1.00**	**1.00**			
Area, in.^{2}	**12.56**	**12.56**	**12.56**			
Ultimate Load, lbs	**31,050**	**31,450**	**31,520**			
Ultimate Strength, psi	**2470**	**2500**	**2510**			
Average Strength, psi			**2490**			
Fracture Type						
Age Tested, days	**21**	**21**	**21**			
Specified Strength, psi						

Specimens not scheduled for testing will be discarded after 28 days

Remarks:

Cc: michael@watkinshanger.com
karl@maffei-structure.com

Reviewed by

Joseph Gapuz

Joseph G Gapuz
Laboratory Manager

Form CTR Rev 0 3/25/05

APPENDIX C

Figure 1. Test Setup

Figure 2. Test Setup Top View

Figure 3. Test Setup- Right Joist Hanger

Figure 4. Test Setup- Left Joist Hanger

APPENDIX D

Figure 1. Typical failure mode of specimen at ultimate load

Figure 2. Typical failure mode of specimen at ultimate load.