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SHEFFIELD METALS
TEST REPORT

SCOPE OF WORK
UL 580 UPLIFT RESISTANCE TESTING OF 24 GA STEEL 2.0" MECHANICAL SEAM ROOF OVER 22GA B-DECKING

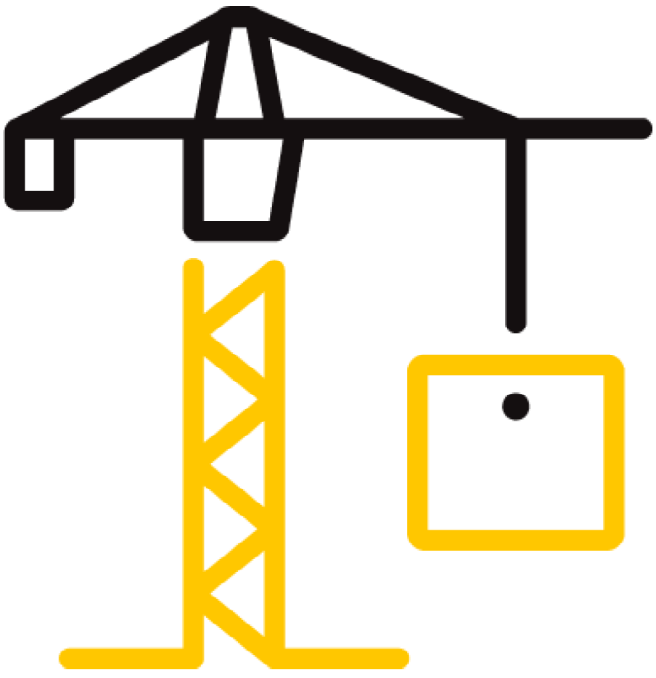
REPORT NUMBER
J8065.09-450-18 R1

TEST DATE(S)
01/27/12 – 06/11/21

ISSUE DATE 10/11/21

REVISION DATE 12/03/21

PAGES
19



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Report No.: J8065.09-450-18 R1
Date: 10/11/21 Revision Date: 12/03/21

REPORT ISSUED TO

SHEFFIELD METALS
5467 Evergreen Parkway
Sheffield Village, OH 44054

SECTION 1

SCOPE

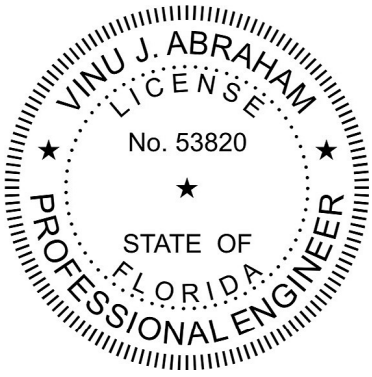
Architectural Testing, Inc. (an Intertek company), dba Intertek Building & Construction (B&C) was contracted by Sheffield Metals to perform testing in accordance with UL 580, *Standard for Safety, Tests for Uplift Resistance of Roof Assemblies*, on their 24 Ga Steel 2.0" Mechanical Seam Roof Panels. Results obtained are tested values and were secured by using the designated test method(s). Uplift testing was conducted at the Intertek B&C test facility in West Palm Beach, FL. Tensile testing was conducted at Intertek B&C test facility in York, PA.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. Intertek B&C will service this report for the entire test record retention period. The test record retention period ends four years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation, will be retained for the entire test record retention period. Unless differently required, Intertek reports apply the "Simple Acceptance" rule, also called "Shared Risk approach," of ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity.

SECTION 2

SUMMARY OF TEST RESULTS

Product Type: Metal Roof Panels
Series/Model: 2.0" Mechanical Seam
Specimen 1 - Ultimate Test Load Achieved: -202.0 psf
Specimen 2 - Ultimate Test Load Achieved: -183.5 psf
Specimen 3 - Ultimate Test Load Achieved: -217.0 psf



For INTERTEK B&C:

COMPLETED BY:	Melissa Nuttall	**REVIEWED BY:**	Vinu J. Abraham, P.E.
TITLE:	Technician Team Leader - Product	**TITLE:**	Vice President – Products
SIGNATURE:	Digitally Signed by: Melissa Nuttall	**SIGNATURE:**	Digitally Signed by: Vinu Abraham
DATE:	12/03/21	**DATE:**	12/03/21

MMN:sar

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SECTION 3
TEST METHOD(S)

The specimens were evaluated in accordance with the following:

UL 580, *Standard for Safety, Tests for Uplift Resistance of Roof Assemblies,* Underwriters Laboratories, Inc. (Fifth Edition November 2, 2006, revised through July 9, 2009).

ASTM A370-20, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

The specimens were evaluated in general accordance with the following:

UL 1897, *Uplift Tests for Roof Covering Systems,* Underwriters Laboratories, Inc. (Seventh Edition September 23, 2015).

SECTION 4
MATERIAL SOURCE/INSTALLATION

Test specimens were provided by the client. Representative samples of the test specimen(s) will be retained by Intertek B&C for a minimum of four years from the test completion date.

Installation of the tested product was performed by the client.

SECTION 5
EQUIPMENT

Cycling and Static Load Mechanism: Computer controlled centrifugal blowers with electronic pressure measuring device.

Deflection Measuring Device: Linear Transducers

SECTION 6
LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Veron Wickham	Intertek B&C
Melissa Nuttall	Intertek B&C

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SECTION 7
TEST PROCEDURE

This test evaluates the comparative resistance of roof assemblies to positive and negative pressures by simulating the effects of wind gusts by use of oscillating exterior pressure and constant interior pressures. Three assemblies were tested per UL 580 at each class rating. (Reference Chart No. 1 for test pressures and load durations.) The measurements were taken via linear transducers for assemblies 1 & 3. The measurements were taken via a transit and steel scales mounted to the roof panels for assembly 2. The initial measurements were "zero" point, not actual deflection. Actual deflection is Phase 1, 2, 3 maximum, 4 or 5 reading less the initial (0.0 psf) reading. For all assemblies the final reading was taken after the completion of an entire class had been completed and became the initial reading for the following class test.

		NEGATIVE PRESSURE		POSITIVE PRESSURE	
TEST PHASE	**DURATION minutes**	**POUNDS PER SQUARE FOOT psf (kPa)**	**INCHES OF WATER inches (mm)**	**POUNDS PER SQUARE FOOT psf (kPa)**	**INCHES OF WATER inches (mm)**
Class 30					
1	5	16.2 (0.79)	3.1 (79)	0.0 (0.00)	0.0 (0)
2	5	16.2 (0.79)	3.1 (79)	13.8 (0.66)	2.7 (69)
3	60	8.1 - 27.7 (0.39 - 1.33)	1.5 - 5.3 (38 - 135)	13.8 (0.66)	2.7 (69)
4	5	24.2 (1.16)	4.7 (119)	0.0 (0.00)	0.0 (0)
5	5	24.2 (1.16)	4.7 (119)	20.8 (1.00)	4.0 (102)
Class 60					
1	5	32.3 (1.55)	6.2 (157)	0.0 (0.00)	0.0 (0)
2	5	32.3 (1.55)	6.2 (157)	27.7 (1.33)	5.3 (135)
3	60	16.2 - 55.4 (0.79 - 2.66)	3.1 - 10.7 (79 - 272)	27.7 (1.33)	5.3 (135)
4	5	40.4 (1.94)	7.8 (198)	0.0 (0.00)	0.0 (0)
5	5	40.4 (1.94)	7.8 (198)	34.6 (1.66)	6.7 (170)
Class 90 (maximum combined uplift pressure of 105 psf)					
1	5	48.5 (2.33)	9.3 (236)	0.0 (0.00)	0.0 (0)
2	5	48.5 (2.33)	9.3 (236)	41.5 (1.99)	8.0 (203)
3	60	24.2 - 48.5 (1.16 - 2.33)	4.7 - 9.3 (119 - 236)	41.5 (1.99)	8.0 (203)
4	5	56.5 (2.71)	10.9 (277)	0.0 (0.00)	0.0 (0)
5	5	56.5 (2.71)	10.9 (277)	48.5 (2.33)	9.3 (236)

Chart No. 1
UL 580 Load Table Test Pressures

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SECTION 8
TEST SPECIMEN DESCRIPTION

Product Type: Metal Roof Panels
Series/Model: 2.0" Mechanical Seam

Product Size:

OVERALL AREA:	**WIDTH**		**HEIGHT**	
9.3 m^2 (100.0 ft^2)	**millimeters**	**inches**	**millimeters**	**inches**
Overall Size	3048	120	3048	120
Panel Size	457	18	3048	120

Test Deck Construction:
The 10' 0" wide by 10' 0" long by 1' 3" deep test frame was fabricated from C15 by 33.9 steel channels. One W6 x 12 steel purlin was located at the midspan of the test frame (purlin spacing of 5' on center). The purlin was welded to the test frame at each end. Continuous 2" by 2" by 3/16" thick L-shaped steel angle was welded around the interior perimeter of the test frame. The deck was sheathed with 22-gauge 33ksi steel B-decking and secured with #12 x 1-1/4" long HWH screws spaced 6" on center through the deck and into the purlins.

Specimens #1 & 2 Roof System:

COMPONENTS	DETAILS	ATTACHMENT METHOD
30# Asphalt saturated organic felt paper	A single layer was used with a 5" overlap between adjacent sheets.	The felt was secured with #12 x 1" pancake head screws with 32 Ga tin caps at each corner.
Clip	The 1-3/4" high x 4-1/2" long two-piece clips were constructed from 18 Ga steel bases and 22 Ga steel butterfly tab.	The clips were spaced 24" on center and attached using two #12 x 1" pancake head fasteners.
2.0" 180° Mechanical Seam Panels	The panels were constructed from 24 Ga steel and had a 18" coverage width. Six full and two partial width panels were tested.	The male leg of the panels were secured with clips spaced 24" on center. The female leg of the panels was placed over the male leg of the panel and mechanically seamed 180°. The perimeter was secured with #12 x 1" pancake head screws spaced 4" on center at the ends and 6" on center at the sides.

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Specimen #3 Roof System:

COMPONENTS	DETAILS	ATTACHMENT METHOD
30# Asphalt saturated organic felt paper	A single layer was used with a 5" overlap between adjacent sheets.	The felt was secured with #12 x 1" pancake head screws with 32 Ga tin caps at each corner.
Clip	The 1-3/4" high x 4-1/2" long two-piece clips were constructed from 18 Ga steel bases and 22 Ga steel butterfly tab.	The clips were spaced 6" on center and attached using two #12 x 1" pancake head fasteners.
2.0" 180° Mechanical Seam Panels	The panels were constructed from 24 Ga steel and had a 18" coverage width. Six full and two partial width panels were tested.	The male leg of the panels were secured with clips spaced 6" on center. The female leg of the panels was placed over the male leg of the panel and mechanically seamed 180°. The perimeter was secured with #12 x 1" pancake head screws spaced 4" on center at the ends and 6" on center at the sides.

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SECTION 9
UPLIFT TEST RESULTS

The temperature during testing was 83°F – 85°F. The results are tabulated as follows.

Test Specimen #1

TEST TITLE	OBSERVATIONS	DEFLECTION MEASUREMENTS	RESULTS
Class 30, Phases 1-5	No visible damage to system	Reference Table No. 1	PASSED
Class 60, Phases 1-5	No visible damage to system	Reference Table No. 1	PASSED
Class 90, Phases 1-5	No visible damage to system	Reference Table No. 1	PASSED
Supplemental Loads -112 psf to -202 psf	No visible damage to system	Reference Table No. 2	PASSED
Supplemental Loads -217 psf	Seams buckled	Reference Table No. 2	FAILED

Test Specimen #2

TEST TITLE	OBSERVATIONS	DEFLECTION MEASUREMENTS	RESULTS
Class 30, Phases 1-5	No visible damage to system	Reference Table No. 3	PASSED
Class 60, Phases 1-5	No visible damage to system	Reference Table No. 3	PASSED
Class 90, Phases 1-5	No visible damage to system	Reference Table No. 3	PASSED
Supplemental Loads -78.5 psf to -183.5 psf	No visible damage to system	N/A	PASSED
Supplemental Loads -198.5 psf	Seams buckled	N/A	FAILED

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Test Specimen #3

TEST TITLE	OBSERVATIONS	DEFLECTION MEASUREMENTS	RESULTS
Class 30, Phases 1-5	No visible damage to system	Reference Table No. 4	PASSED
Class 60, Phases 1-5	No visible damage to system	Reference Table No. 4	PASSED
Class 90, Phases 1-5	No visible damage to system	Reference Table No. 4	PASSED
Supplemental Loads -112 psf to -217 psf	No visible damage to system	Reference Table No. 5	PASSED
Supplemental Loads -232 psf	Seams buckled	Reference Table No. 5	FAILED

Notes:
Reference Chart No. 1 for test pressures and load durations.
Reference Sketch No. 1 for location of deflection measurement devices.
A loose fitting, pleated 2-mil plastic film was utilized to assist in obtaining uniform pressure on the roof system. The plastic film was located between the moisture barrier and the roof panels to facilitate testing. In our opinion, this did not influence test results.

Supplemental loads per UL 1897 started at -112 psf total load for Specimens 1 & 3 and at 78.5 psf total load for Specimen 2.

SECTION 10
TENSILE TEST RESULTS

Tensile tests were conducted on three coupons. The test specimens were evaluated in accordance with the most recent revision of ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products.* The tensile coupons were machined from the metal members to the dimensions of the sheet-type 0.5" wide specimen given in Figure 3 of ASTM A370.

Test Method:	ASTM A370		
Orientation:	Longitudinal		
Specimen No.	**Yield Strength @ 0.2% Offset (ksi)**	**Tensile Strength (ksi)**	**Elongation in 2" (%)**
1	60.4	61.8	11.7
2	58.3	62.0	7.3
3	59.2	62.6	11.6
Average	**59.3**	**62.2**	**10.2**

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SECTION 11
CONCLUSION

The product tested per UL 580 and UL 1897 achieved an ultimate test load of:
Specimen 1: -202.0 psf
Specimen 2: -183.5 psf
Specimen 3: -217.0 psf

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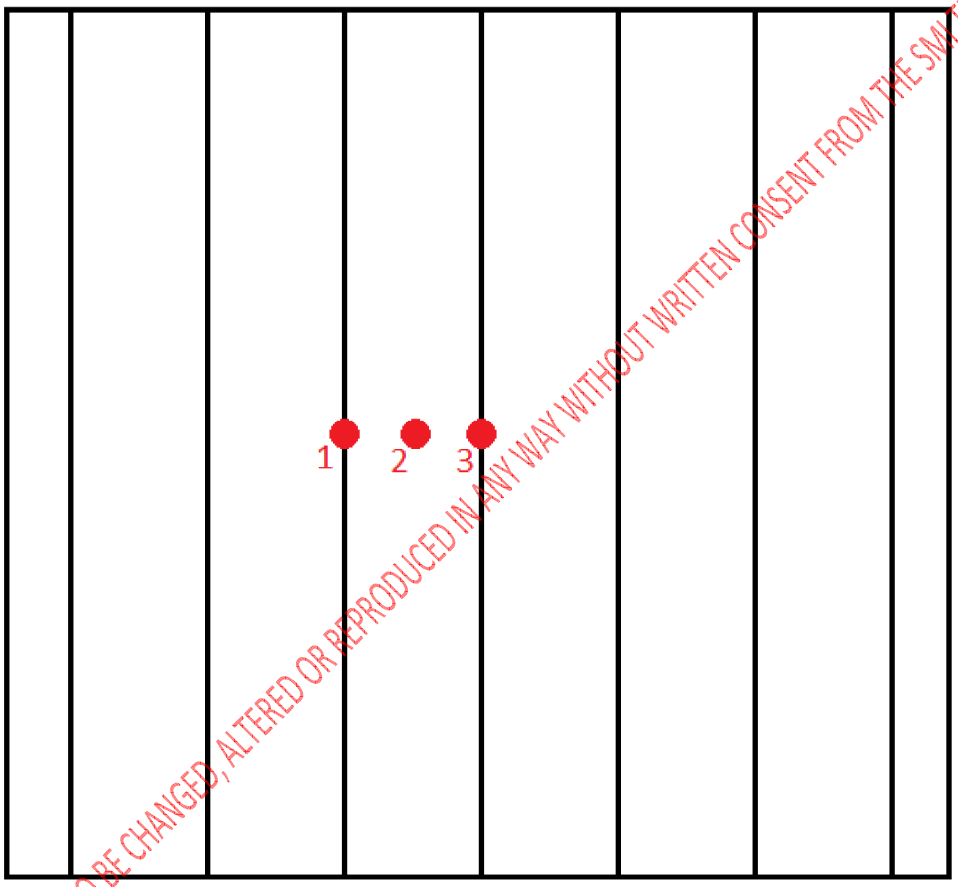
SECTION 12
SKETCH(ES)



Sketch No. 1
Deflection Measurement Device Locations

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SECTION 13
TABLES

CLASS	PHASE	DEFLECTION MEASUREMENTS (inches) INDICATOR #1	#2	#3
30	1	0.14	0.81	0.12
	2	0.10	1.13	0.22
	3 Minimum	0.22	0.97	0.18
	3 Maximum	0.30	1.32	0.28
	4	0.07	1.03	0.17
	5	0.19	1.43	0.32
	Final (0.0 psf)	0.03	0.01	0.01
60	1	0.12	1.24	0.24
	2	0.28	1.68	0.43
	3 Minimum	0.35	1.52	0.35
	3 Maximum	0.52	2.00	0.58
	4	0.31	1.48	0.32
	5	0.49	1.94	0.55
	Final (0.0 psf)	0.00	0.03	0.01
90	1	0.35	1.63	0.38
	2	0.59	2.15	0.67
	3 Minimum	0.49	1.88	0.51
	3 Maximum	0.57	2.10	0.65
	4	0.40	1.79	0.44
	5	0.66	2.34	0.77
	Final (0.0 psf)	0.02	0.09	0.00

Table No. 1
Deflection Measurements – Test Specimen #1

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VACUUM (psf)	UPLIFT (psf)	LOAD (psf)	SUPPLEMENTAL DEFLECTION MEASUREMENTS (inches) INDICATOR		
			#1	#2	#3
-63.5	-48.5	-112.0	**0.71**	**2.44**	**0.83**
-78.5	-48.5	-127.0	**0.79**	**2.64**	**0.95**
-93.5	-48.5	-142.0	**0.88**	**2.88**	**1.07**
-108.5	-48.5	-157.0	**0.96**	**3.09**	**1.19**
-123.5	-48.5	-172.0	**1.17**	**3.76**	**1.59**
-138.5	-48.5	-187.0	**1.31**	**4.11**	**1.85**
-153.5	-48.5	-202.0	**1.65**	**4.87**	**2.41**
-168.5	-48.5	-217.0	**Failed**		

Table No. 2
Supplemental Deflection Measurements – Test Specimen #1

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CLASS	PHASE	DEFLECTION MEASUREMENTS (inches) INDICATOR #1	#2	#3
30	Initial (0.0 psf)	6.1	6.2	6.1
	1	6.2	7.3	6.2
	2	6.6	7.8	6.4
	3 Maximum	6.6	7.9	6.4
	4	6.5	7.6	6.4
	5	6.6	8.0	6.4
	Final (0.0 psf)	6.1	6.2	6.2
60	1	6.6	7.8	6.4
	2	6.7	8.2	6.5
	3 Maximum	6.8	8.4	6.5
	4	6.6	8.0	6.4
	5	6.8	8.4	6.5
	Final (0.0 psf)	6.1	6.2	6.4
90	1	6.6	8.1	8.4
	2	6.8	8.6	6.6
	3 Maximum	6.9	8.7	6.6
	4	6.7	8.4	6.5
	5	6.9	8.8	6.6
	Final (0.0 psf)	6.1	6.2	6.3

Table No. 3
Deflection Measurements – Test Specimen #2

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CLASS	PHASE	DEFLECTION MEASUREMENTS (inches) INDICATOR #1	#2	#3
30	1	0.12	0.88	0.19
	2	0.21	1.08	0.28
	3 Minimum	0.17	0.96	0.25
	3 Maximum	0.28	1.35	0.35
	4	0.21	1.18	0.27
	5	0.32	1.41	0.39
	Final (0.0 psf)	0.02	0.06	0.02
60	1	0.27	1.40	0.34
	2	0.42	1.69	0.50
	3 Minimum	0.35	1.50	0.44
	3 Maximum	0.52	2.03	0.63
	4	0.35	1.70	0.45
	5	0.53	1.96	0.62
	Final (0.0 psf)	0.04	0.09	0.03
90	1	0.41	1.83	0.50
	2	0.62	2.13	0.72
	3 Minimum	0.50	1.83	0.59
	3 Maximum	0.60	2.08	0.69
	4	0.47	1.98	0.56
	5	0.71	2.29	0.81
	Final (0.0 psf)	0.05	0.11	0.05

Table No. 4
Deflection Measurements – Test Specimen #3

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VACUUM (psf)	UPLIFT (psf)	LOAD (psf)	SUPPLEMENTAL DEFLECTION MEASUREMENTS (inches) INDICATOR #1	#2	#3
-63.5	-48.5	-112.0	**0.78**	**2.47**	**0.89**
-78.5	-48.5	-127.0	**0.85**	**2.63**	**0397**
-93.5	-48.5	-142.0	**0.95**	**2.85**	**1.08**
-108.5	-48.5	-157.0	**1.07**	**3.10**	**1.24**
-123.5	-48.5	-172.0	**1.18**	**3.34**	**1.37**
-138.5	-48.5	-187.0	**1.31**	**3.58**	**1.51**
-153.5	-48.5	-202.0	**1.43**	**3.84**	**1.65**
-168.5	-48.5	-217.0	**1.88**	**4.40**	**1.82**
-183.5	-48.5	-232.0	**Failed**		

Table No. 5
Supplemental Deflection Measurements – Test Specimen #3
*Gauge Error

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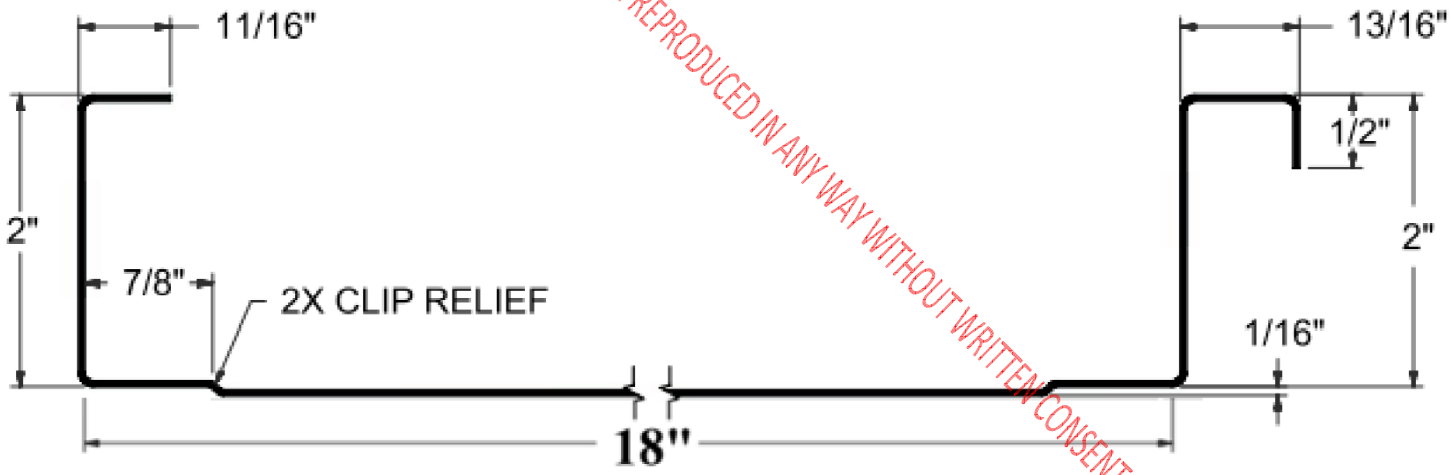
SECTION 14
DRAWINGS

The test specimen drawings have been reviewed by Intertek B&C and are representative of the test specimen(s) reported herein. Test specimen construction was verified by Intertek B&C per the drawings included in this report. Any deviations are documented herein or on the drawings.



Drawing No. 1
Panel Profile

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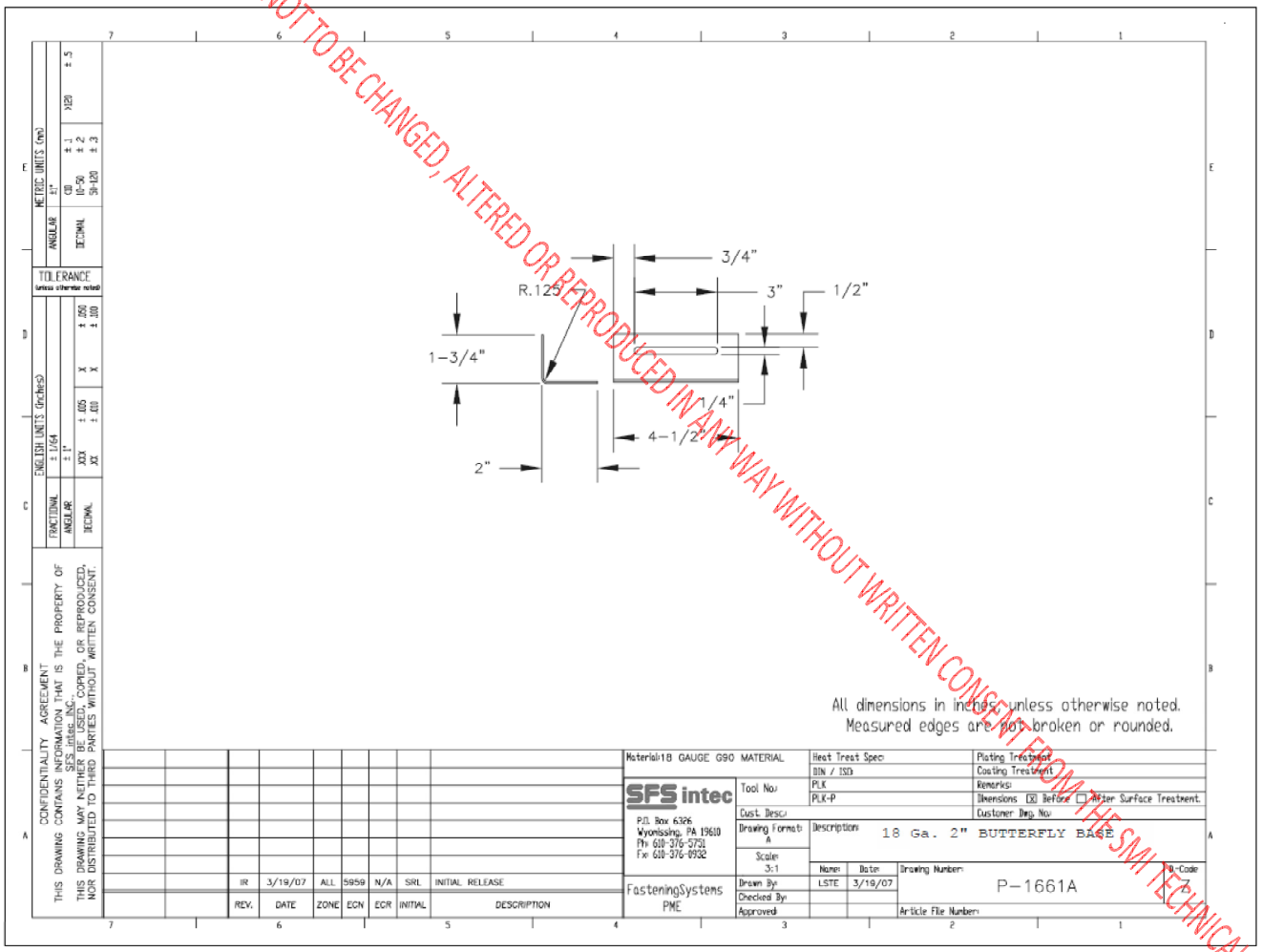

Drawing No. 2
Clip Base Details

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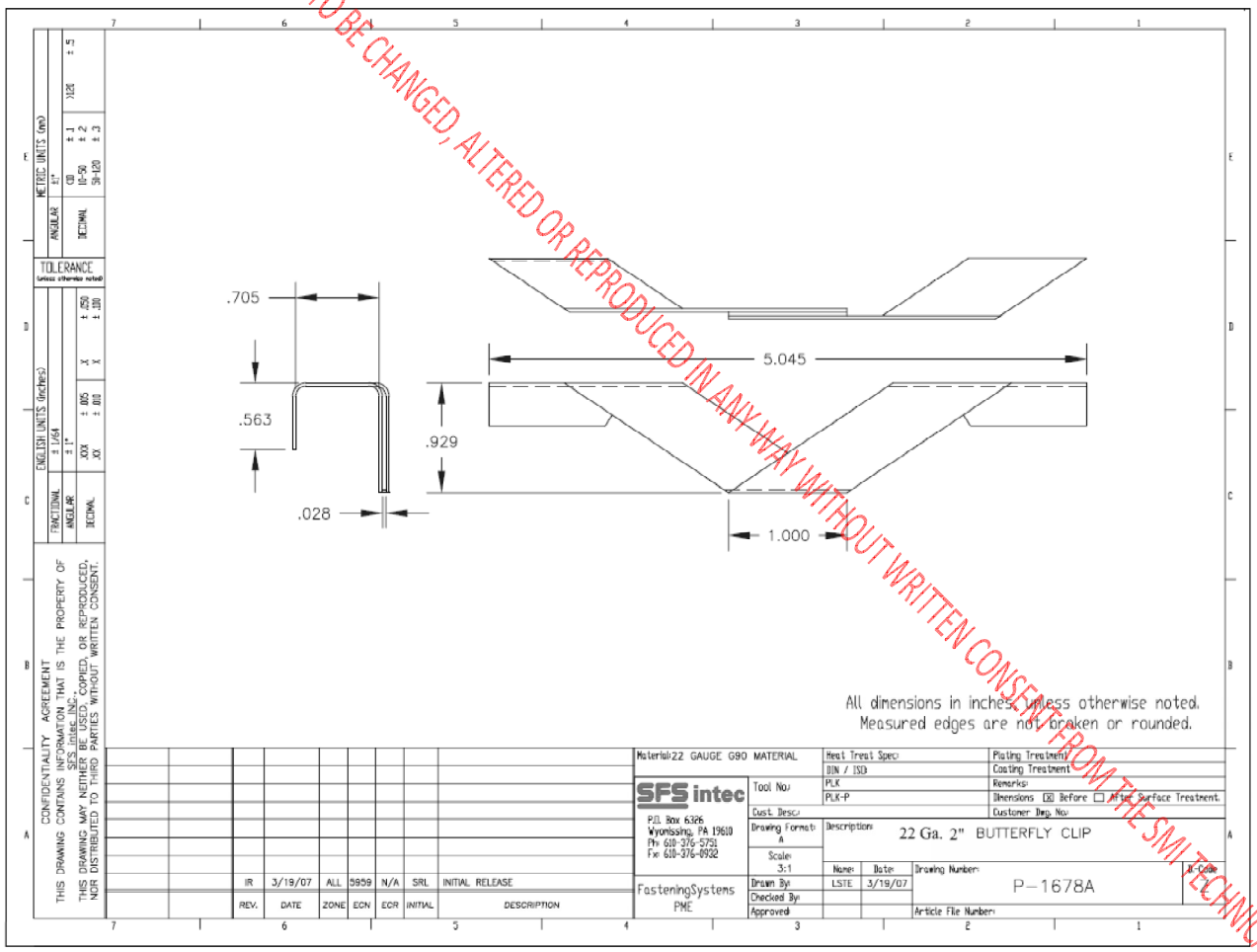

Drawing No. 3
Clip Butterfly Tab Details

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SECTION 15
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	10/11/21	N/A	Original Report Issue
1	12/03/21	1-3, 8	Added tensile test results