

<b>TEST TYPE:</b>	<b>UL 580- CONSTRUCTION No. 604</b>
<b>TESTING AUTHORITY:</b>	<b>UNDERWRITERS LABORATORIES</b>
<b>TEST NAME:</b>	<b>UL 580 - WIND UPLIFT</b>
<b>TEST DATE:</b>	<b>APRIL 24, 2003</b>
<b>TEST COMPLETED BY:</b>	<b>ALPESH PATEL</b>
<b>TESTING LABORATORY</b>	<b>UNDERWRITERS LABORATORIES</b>
<b>PANEL TYPE:</b>	<b>1 1/2 IN. NAIL STRIP 22 GA</b>
<b>PANEL WIDTH:</b>	<b>16</b>
<b>CLIP SPACING:</b>	<b>18 INCH</b>
<b>DECKING CONSTRUCTION:</b>	<b>5/8 PLYWOOD</b>

File R21264  
Project 02NK11243

Date

REPORT

on

ROOF DECK CONSTRUCTIONS

Metal Forming Inc.  
Peachtree City, GA  
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File

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Issued:

## GENERAL

## INVESTIGATION:

The subject of this Report is the investigation, per the UL 580 Standard "Tests for Uplift Resistance of Roof Assemblies", of six metal roof deck panels with their roof deck fasteners (panel clips) identified as:

1. "1-1/2 in. Nail Strip" (no clips are used)

The object of this investigation was to establish, by test, the uplift Classification for the roof deck assemblies described in this Report. The tests were conducted in accordance with the Standard UL 580, "Tests for Uplift Resistance of Roof Assemblies". After completion of the UL 580 tests, all pressure was released from the assemblies and testing was conducted in accordance with the Standard UL 1897, "Uplift Tests for Roofing Systems". The UL 1897 tests began at a negative pressure of 30 psf.

The uplift tests were supplemented by examination of the physical properties of the materials used with particular attention given to the materials which will be Classified in the Roofing Materials and Systems Directory, for use in the factory Follow-Up Program of Underwriters Laboratories Inc.

Test data for the "1-1/2 in. Nail Strip" was generated under Project 01NK06682, File NC4291.

## DESCRIPTION

## PRODUCT COVERED:

The products covered by this Report are metal roof deck panels and roof deck fasteners as identified in Page G1.

The metal roof deck panels and roof deck fasteners (panel clips) covered by this Report are Classified as to uplift resistance only.

## USE:

The products are intended for use as building materials as permitted by authorities having jurisdiction.

## MATERIALS:

The materials used for the wood deck and supports together with the fasteners were the same for all three assemblies.

Peripheral Supports - The supports used at the periphery of the test assemblies were 2 by 10 in. lumber, No. 2 Grade.

Wood Joists - The joists were 2 by 10 in., No. 2 Grade lumber.

Joist Hangers - The hangers used at the ends of the joists for support and attachment to the peripheral supports were seat type, fabricated from No. 18 MSG coated steel.

Wood Deck - The deck was nominal 5/8 in. thick (19/32 in. actual) plywood, Grade C-D, APA rated sheathing.

Fasteners (Screws) - The fasteners used to attach the peripheral supports to the test frame were 5/8 in. machine bolts. Fasteners used to attach the joist hangers to the peripheral supports and the joists to the joist hangers were coarse thread, No 2 Phillips drive bugle head, steel screws, 2-1/2 in. long. Fasteners used to attach the plywood decking to the joists and peripheral supports were the same type as those used for the joist hangers.

Roofing Felt - The felt used over the plywood deck was a 30 lb type.

The metal roof deck panels and panel clips (where used) in each assembly are described as follows:

Metal Roof Deck Panels - The panels used in Test Assembly No. 5 were 16-3/16 in. wide (15 in coverage width) with a 1-1/2 in. high female rib and a 3/4 in. high male rib. They were fabricated from No. 22 MSG coated steel. The panel is identified as "1-1/2 in. Nail Strip" by the test sponsor.

Fasteners (Screws) - Fasteners used to attach the panels to the plywood decking were No. 10-12 by 1 in. long No. 2 Phillips drive, pancake head, plated steel screws.

#### CONSTRUCTION OF TEST ASSEMBLIES:

The wood deck subassemblies were constructed in the same manner, for all nine constructions, as follows:

The 2 by 10 in. peripheral supports were located adjacent to the walls of the test frame and fastened to them using 5/8 in. machine bolts driven through the lumber into machine nuts welded to the steel frame. The supports formed a continuous shelf around the test frame. The joist hangers were installed at a spacing of 24 in. OC using the No. 8 by 1-1/2 in. coarse thread screws driven into the peripheral supports. The joists were then slipped into the joist hangers and fastened to them using the No. 8 screws with three screws used on each side of each joist.

The plywood deck was installed in the assembly using the No. 8 by 2-1/2 in. long coarse thread screws driven into the joists with the screws spaced 6 in. OC at the butt ends and 12 in. OC in the field. The decking was attached to the peripheral supports using the No. 8 screws spaced 6 in. OC throughout. All joints were then sealed, except for assembly no. 1, with a one part sealant feathered out from the joint. A layer of felt was placed over the plywood deck and fastened to it using staples in a random spacing. A layer of plastic sheeting was then placed over the felt.

## INSTALLATION OF ROOF DECK PANELS

("1-1/2 in. Nail Strip")

The panel was fastened to the plywood deck using the No. 10-12, 1 in. long, pancake head screws, spaced 20-3/4 in. OC. The female rib snapped over the male rib of the panel. The panels were fastened at the periphery using the No. 10-12 screws, spaced 9 in. OC at the north and south walls and with four fasteners used at each panel end.

## TEST RECORD NO. 1

### UPLIFT TESTS:

The uplift tests were conducted in accordance with the Standard UL 580 entitled "Tests for Uplift Resistance of Roof Assemblies".

### METHOD

The standard test equipment of Underwriters Laboratories, Inc. for roof deck constructions was used for each uplift test.

Four deflection targets were mounted on top of the central panel for each assembly; at the panel mid-span (one between the ribs and one over a rib), and at the panel quarter span (one between the ribs and one over a rib) as shown in ILL. 5.

Throughout each test, observations were made of the control of positive and negative pressures and of the behavior of the top and under surfaces of the assembly.

### RESULTS

General Notes - The action of the roof decks upon application of the steady pressures (Phases I, II, IV and V) was upward bowing between points of attachment with the purlins following the same pattern.

The action of the joists and panels during the oscillating period of the tests (Phase III) was a rising and settling of the members. The degree to which the members deflected during each Phase can be determined from the readings preceding the specific test notes. All dimensions cited in the specific test notes are approximate.

“1-1/2 IN. NAIL STRIP”/ FASTNERS SPACED 20-3/4 IN. OC

30 lb/ft<sup>2</sup> Uplift

Deflection In Inches –

Phase	Target Locations			
	1/4 Span Panel Over Rib	Mid Span Panel Over Rib	1/4 Span Panel Between Ribs	Mid Span Panel Between Ribs
I	0.04	0.08	0.01	0.01
II	0.10	0.13	0.07	0.10
III				
Minimum	0.12	0.13	0.09	0.10
Maximum	0.14	0.20	0.11	0.15
IV	0.09	0.11	0.07	0.09
V	0.17	0.22	0.14	0.20

Specific Test Observations – Phase I – The panels are bowing slightly between the ribs, approximately one-fourth the height of the ribs.

Phase II – The panel bowing between the ribs has increased slightly. Other conditions are about the same as at pre-test.

Phase III – At 43 min, the assembly is in a breathing motion with the panels bowing at maximum pressure approximately one-third the height of the ribs. There is a slight change in height at pressure changes. The ribs are bowing slightly with very slight movement observed. On the undersurface, no changes are observed. All screw fasteners appear to be holding. The exposed edge of the ribs at the male side of the panels are open about the same as observed during Phase II with no change in width observed at pressure changes. At the end of Phase III, the assembly has returned to pretest conditions with slight residual bowing present in the panels. The exposed joints in the ribs had returned about to pretest conditions.

Phase IV – The conditions are about the same as observed during Phase I.

Phase V – The panel bowing has increased from that observed during Phase IV and is about the same as observed during Phase III, minimum pressure. The open joints in the ribs are opened about the same as observed during Phase III, maximum pressure. No changes are observed on the undersurface.

60 lb/ft<sup>2</sup> Uplift

Deflection In Inches –

Phase	Target Locations			
	1/4 Span Panel Over Rib	Mid Span Panel Over Rib	1/4 Span Panel Between Ribs	Mid Span Panel Between Ribs
I	0.08	0.09	0.09	0.10
II	0.20	0.24	0.19	0.27
III				
Minimum	0.21	0.27	0.21	0.30
Maximum	0.30	0.42	0.29	0.40
IV	0.14	0.19	0.17	0.20
V	0.28	0.36	0.29	0.40

Specific Test Observations – Phase I – The condition of the assembly is about the same as observed during Phase IV, Class 30.

Phase II – The panels are bowing about the same as observed during Phase V, Class 30. There are some wrinkles adjacent to the ribs, especially the male side of the panel. The ribs also are bowing very slightly lengthwise. The openings at the exposed joints are slightly greater than observed previously with some changes in opening at the locations of the panel clips. On the undersurface, no changes are observed.

Phase III – At 38 min, the assembly is in a breathing motion with the panels bowing to a slightly greater extent than observed during Phase III, Class 30. The maximum bowing is approximately one-third the height of the ribs. The ribs are also bowed to a greater extent than Phase III, Class 30, with slightly greater movement. At the end of Phase III, the assembly has once again returned about to pretest conditions but with the bowing between the ribs slightly greater and also with the ribs also bowing slightly more and with some rotation present. The exposed edges of the ribs appear to be a little wider than prior to the start of the Class 60 test. No changes are observed on the undersurface.

Phase IV – The assembly is in about the same condition as observed during Phase II. The exposed joints in the ribs appear to be slightly greater in opening width.

Phase V – The panel bowing has increased from that observed during Phase IV and is greater than observed during Phase III, maximum pressure. The ribs are also bowed to a greater extent with the curvature slightly greater than observed during Phase III, maximum pressure. There are wrinkles or dished areas present between the locations of the panel clips. These are located on the male side of the panel. On the undersurface, the joists are bowing slightly.

Post Test – At the end of the Class 60 test, the assembly has returned about to pretest conditions with some bowing and dished areas slightly more noticeable than prior to the start of the Class 60 test. The exposed edges of the ribs are opened about the same as prior to the start of

the Class 60 test but there are dished areas between the location of the clips. No changes are observed on the undersurface.

90 lb/ft<sup>2</sup> Uplift

Deflection In Inches –				
Phase	Target Locations			
	1/4 Span Panel Over Rib	Mid Span Panel Over Rib	1/4 Span Panel Between Ribs	Mid Span Panel Between Ribs
I	0.13	0.18	0.12	0.13
II	0.29	0.40	0.29	0.39
III				
Minimum	0.30	0.40	0.30	0.37
Maximum	0.36	0.44	0.33	0.42
IV	0.20	0.28	0.20	0.24
V	0.42	0.54	0.41	0.52

Specific Test Observations – Phase I – The panels are bowing approximately one-third the height of the ribs with the areas between the clips at the exposed joint showing dished areas. The joints are open at these areas to a greater extent than observed previously. The ribs are rotated slightly. No changes are observed from the undersurface.

Phase II – The panel bowing has increased from that observed during Phase I both between the ribs and in the ribs lengthwise. The magnitude of bowing between the ribs is approximately one-third the height of the ribs throughout most of the length of the panel. The ribs are bowing to a greater extent than observed previously and the opened areas of the exposed joints are greater in width. The ribs are also rotating to a greater extent than observed previously. The joists appear to be bowing slightly. The plywood appears to be tight against the upper surface of the joists.

Phase III – At 26 min, the assembly is in a breathing motion with the movement and action about the same as observed during Phase III, Class 60. The wrinkles in the assembly are also about the same as Phase III, Class 60. On the undersurface, the joists are bowing and moving slightly. At 59 min, no changes are observed in the condition or action of the assembly from the previous Phase III observations. At the end of Phase III, the assembly has returned about to pretest conditions with the residual bowing slightly greater than observed during Phase III, Class 60. The exposed joints appear to be closed to about the same extent as observed prior to the beginning of the Class 90 test. There are no changes observed in the undersurface.

Phase IV – The condition of the assembly is about the same as observed during Phase II.

Phase V – The panel bowing has increased from that observed during Phase IV and is also greater than observed during Phase III, maximum pressure. The bowing, however, is slight. The ribs are also bowing lengthwise to a greater extent than observed previously. The joints in

the ribs at the male side of the panels are opened slightly. There are some wrinkles which have formed adjacent to the ribs. On the undersurface, the joists are bowing slightly more than observed during Phase III, maximum pressure. The plywood appears to be mostly tight against the upper surface of the joists although there is a slight gap in some areas.

Post Test – At the end of the Class 90 test, the assembly has returned about to pretest conditions with some residual bowing present in the areas between the ribs. The ribs are also bowed slightly lengthwise and they are rotated slightly. The exposed edges of the ribs appear to have returned about to pre-test conditions. No changes are observed on the undersurface. The assembly is considered to have attained a Class 90 uplift rating.

Issued:

#### CONCLUSION:

The following conclusions represent the judgment of Underwriters Laboratories, Inc, based upon the results of the examination and tests presented in this Report as they relate to established principles and previously recorded data.

#### UPLIFT RESISTANCE PROPERTIES:

##### UL 580

It is judged that the roof deck assembly, constructed of the materials and in the manner herein described, has obtained a Class 90 uplift resistance rating. The test assembly did not fail structurally or sustain any permanent deformation during the Class 90 uplift test. The results of the uplift test will be Roof Deck Construction 601.

##### UL 1897

It is further judged that the roof deck assembly, constructed of the materials and in the manner described in Test Assembly, has attained a 210 psf uplift rating. The mode of failure was withdrawal of the plywood from the joists.

Secondary supports (beams, purlins, joists, bulb tees, lateral bracing, etc.), connections of these assemblies to the main structural members (girders, columns, etc.) and construction details along the edges of the roof or around roof openings (skylight panels, mechanical equipment, chimneys, etc.) have not been evaluated.

#### PRACTICABILITY:

The materials used in the test assemblies can be readily installed by qualified workmen with tool and methods commonly used for construction work of a similar nature.

The materials and installation procedures described in this Report are judged to be significant factors in the uplift resistance of the constructions.



## CONFORMITY:

The assemblies were tested in accordance with the Standard UL 580 entitled "Tests for Uplift Resistance of Roof Assemblies" and the Standard UL1897 entitled "Uplift Tests for Roof Covering Systems".

## CLASSIFICATION AND FOLLOW-UP SERVICE:

The metal panels as described herein, are judged to be eligible for Classification and Follow-Up Service of Underwriters Laboratories Inc. Under the service, the manufacturer is authorized to use the Laboratories' Classification Marking on such products which comply with the Follow-Up Service procedure and any other applicable requirements of Underwriters Laboratories Inc.

The Classification Mark for the TJPV category (UL 580) to be used on the "1-1/2 in. Nail Strip":

METAL ROOF DECK PANELS  
AS TO UPLIFT RESISTANCE  
CLASS 90  
AS SHOWN BY CONSTRUCTION NO. 601.

ROOF DECK FASTENERS  
AS TO UPLIFT RESISTANCE  
CLASS 90  
AS SHOWN BY CONSTRUCTION NOS.  
SEE UL ROOFING MATERIALS AND SYSTEMS DIRECTORY

The Classification Mark for the TGIK category (UL 1897) to be used on the "1-1/2 in. Nail Strip" metal roof deck panel is illustrated below:

PANELS FOR  
ROOFING SYSTEMS, UPLIFT RESISTANCE  
AS TO UPLIFT RESISTANCE

Roofing System, Uplift Resistance Classification will be promulgated as described below:

## PANELS SYSTEMS

**Uplift Resistance:** 210 psf

**Deck:** Min. 19/32 in. thick, APA Rated plywood, Grade C-D.

**Panel Fasteners:** Fasteners used to attach the panels to the plywood to be No. 10-12 by 1 in. long, No. 2 Phillips Drive, pancake head, plated steel wood screws. Spacing to be 20-3/4 in. OC.

**Ply Sheet:** Any UL Classified underlayment, min. 2 in. sidelap, mechanically fastened.

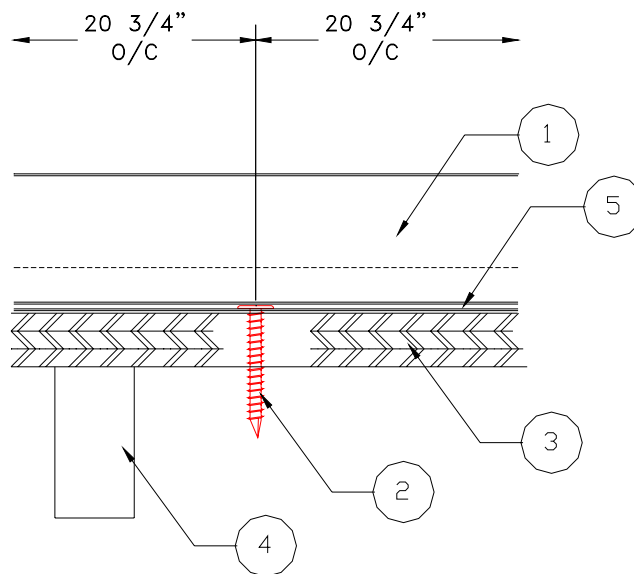
**Metal Roof Deck Panels:** Min. 22 MSG (.0299 in. thick steel) designated "1-1/2 in. Nail Strip". Max. width 16-3/16 in., height of female rib 1-1/2 in., male rib 3/4 in. A bead of sealant may be used at ribs.

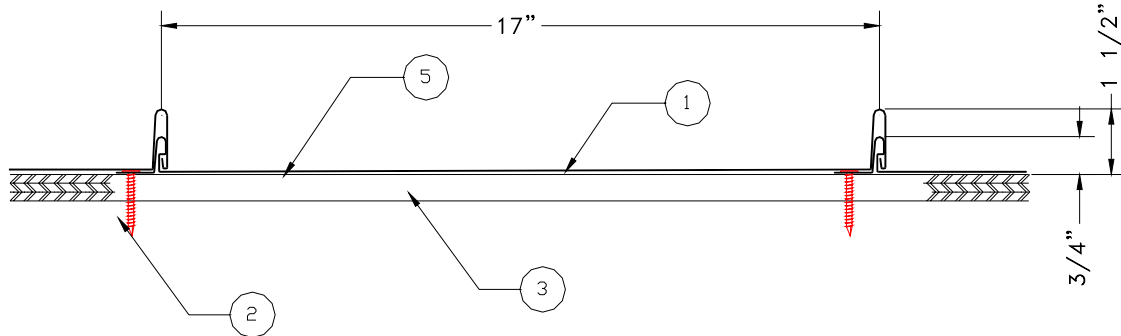
Part 1 – See Part 2 for Description of Numbered Items

Construction No. 601

Uplift – Class 90

Fire Not Investigated





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Construction No. 601

1. Metal Roof Deck Panels\* - Min. 22 MSG (.0299 in.) thick coated steel; max. width 16-3/16, height of female rib 1-1/2 in., male rib 3/4 in.

Metal Forming Inc. - 1-1/2 in. Nail Strip

2. Panel Fasteners (Screws) - Fasteners used to attach the panels to the plywood to be No. 10-12 by 1 in. long, No. 2 Phillips Drive, pancake head, plated steel wood screws. Spacing to be 20-3/4 in. OC.
3. Plywood Deck - Nominal 5/8 in. (19/32 in. actual) plywood, Grade C-D, APA rated. Fastened to supports (joists) using No. 8 by 2-1/2 in. long, No. 2 Phillips Drive, coarse thread, bugle head, steel screws. Screws spaced 6 in. OC at the butt ends and 12 in. OC in the field. All joints to be sealed with a one part polyisocyanurate sealant feathered outward from the joint.
4. Joists - Graded dimensional lumber, No. 2 or better. Spaced 24 in. OC max.
5. Joist Hangers - (Not Shown) - No. 18 MSG coated steel, open seat type.
6. Ply Sheet - Any UL Classified underlayment, min. 2 in. sidelap, mechanically fastened.

\*Bearing the UL Classification Marking.