

*Bearing the UL Classification Marking.

TEST TYPE:	UL 580 - CONSTRUCTION NO. 603
TESTING AUTHORITY:	UNDERWRITERS LABORATORIES
TEST NAME:	UL 580 - WIND UPLIFT
TEST DATE:	APRIL 24, 2003
TEST COMPLETED BY:	ALPESH PATEL
TESTING LABORATORY	UNDERWRITERS LABORATORIES
PANEL TYPE:	1 1/2" MECHANICAL O32 ALUMINUM
PANEL WIDTH:	20 INCH
CLIP SPACING:	36 OC
DECKING CONSTRUCTION:	5/8 PLYWOOD

File R21264
Project 02NK11243

Date

REPORT

on

ROOF DECK CONSTRUCTIONS

Metal Forming Inc.
Peachtree City, GA

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File

Page G1

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:

“1-1/2 in. Mechanical Lock” with 1-1/2 in. Sliding Clip Assembly “1500SC”

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. Mechanical Lock" was generated under Project 01NK06682, File NC4291.

File

Page 1

Issued:

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 were 20 in. wide with a 1-1/2 in. high female rib and a 1 in. high male rib. They were fabricated from .032 in. thick embossed aluminum. The panel was identified as "1-1/2 in. Mechanically Lock" by the test sponsor.

Roof Deck Fasteners (Panel Clips) – The panel clips were a two part assembly, an upper tab 4-1/4 in. wide and 2 in. high. The upper portion was formed to engage the panel ribs and the lower portion formed to engage the base. The tab was fabricated from .030 in. thick stainless steel. The base was 1-7/8 in. wide and 1-5/8 in. long and formed to fold over the bottom of the tab with another leg formed to engage the bottom of the tab. The base was fabricated from No. 16 MSG coated steel. The clips were identified as 1-1/2 in. Sliding Clip Assembly “1500SC”.

Fasteners (Screws) - Fasteners used to attach the panels clips to the plywood decking were No. 1/4-13 by 1-5/8 in. long No. 3 Phillips drive, truss head coated 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. Mechanical Lock")

Panel clips were placed over the rib of the panel and fastened to the plywood deck using two No. 1/4-13 fasteners inserted through the guide holes in the base of the panel clip and into the plywood deck. The clips were spaced 36 in. OC. The panel ribs were seamed with an electric seamer. The panels were then fastened at the periphery with the fasteners spaced 12 in. OC at the north and south walls and with two fasteners used at each panel end.

File

Page T1-1 of 13

Issued:

“1-1/2 IN. MECHANICAL LOCK”
20 IN. WIDE, 0.032 IN. ALUMINUM

30 lb/ft² Uplift

Deflection In Inches –

Phase	Target Locations			
	1/4 Span Panel Over Rib	Mid-Span Panel Over Ribs	1/4 Span Panel Between Ribs	Mid-Span Panel Between Ribs
I	0.05	0.02	0.10	0.15
I	0.10	0.10	0.12	0.20
III				
Minimum	0.10	0.12	0.15	0.25
Maximum	0.18	0.20	0.22	0.40
IV	0.10	0.11	0.15	0.40
V	0.18	0.20	0.20	0.53

Specific Test Observations – Phase I – The panels are bowing in some areas between the ribs slightly.

Phase II – The assembly is in about the same condition as observed during Phase I.

Phase III – At 18 min, the assembly is in a breathing motion with slight movement present in the panels. The area between the panels is bowed slightly with little change in magnitude of bowing at pressure changes. On the undersurface, the joists do not appear to be moving at pressure changes and there is very little if any bowing present. All fasteners and panel clips are holding. At 64 min, no changes are observed in the condition or action of the assembly from the previous Phase III observations. At the end of Class 30 test, the assembly returned about to pretest conditions with bowing in some panels although the bowing is slight.

Phase IV – The panel bowing has increased very slightly from that observed during Phase I. The ribs appear to be unaffected. On the undersurface, the joists appear to be unaffected by the pressure.

Post Test – At the end of the Class 30 test, the assembly returned to pretest conditions.

60 lb/ft² Uplift

Deflection In Inches –

Phase	Target Locations			
	1/4 Span Panel Over Rib	Mid-Span Panel Over Ribs	1/4 Span Panel Between Ribs	Mid-Span Panel Between Ribs
I	0.10	0.12	0.08	0.23
I	0.25	0.30	0.22	0.55
III				
Minimum	0.22	0.28	0.22	0.50
Maximum	0.38	0.40	0.42	0.70
IV	0.15	0.18	0.12	0.45
V	0.40	0.42	0.37	0.85

Specific Test Observations –

Specific Test Observations – Phase I – The assembly is in about the same condition as prior to the start of the Class 60 test.

Phase II – The panel bowing has increased slightly from that observed during Phase I. The bowing still is slight, however. On the undersurface, the joists are bowing slightly. Other conditions are about the same as at pretest.

Phase III – At 16 min, the assembly is in a breathing motion with very slight movement and bowing present in the assembly. The ribs are about vertical with no rotation present. On the undersurface, the joists are bowing very slightly with very slight movement present. All screw fasteners and panel clip fasteners are holding. At 61 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 returned to pretest conditions with very slight bowing between the ribs. The joists are as at pretest. All panel clips and screw fasteners are holding.

Phase IV – The condition of the assembly is about the same as prior to the start of the Class 60 test.

Phase V – The panels are bowing slightly between the ribs. The ribs are intact with very little if any rotation. All fasteners appear to be holding. The joists are bowing very slightly.

Post Test – At the end of the Class 60 test, the assembly returned to pretest conditions with very slight residual bowing present in the panels.

90 lb/ft² Uplift
Deflection In Inches –

Phase	Target Locations			
	1/4 Span Panel Over Rib	Mid-Span Panel Over Ribs	1/4 Span Panel Between Ribs	Mid-Span Panel Between Ribs
I	0.18	0.18	0.13	0.35
I	0.38	0.43	0.28	0.60
III				
Minimum	0.30	0.38	0.28	0.40
Maximum	0.38	0.43	0.36	0.60
IV	0.20	0.26	0.18	+
V	0.48	0.56	0.58	0.80

+ - Not Recorded.

Specific Test Observations – Phase I – The panels are bowing very slightly between the ribs. The ribs are unchanged.

Phase II – The panels are bowing slightly more than observed during Phase I.

Phase III – At 12 min, the assembly is in a breathing motion with the panels bowing and moving slightly more than observed during Phase III, Class 60. The ribs are bowing very slightly. On the undersurface, the joists are moving very slightly. At 67 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 returned to pretest conditions with very slight residual bowing in the panels between the ribs.

Phase IV – The panels are in about the same condition as prior to the start of the Class 90 test.

Phase V – The panels are bowing slightly more than observed during Phase IV, about the same as observed during Phase III, maximum pressure.

Post Test – At the end of the Class 90 test, the assembly returned to pretest conditions with very slight residual bowing present in the panels. Other conditions are about the same as at pretest. The assembly is considered to have attained a Class 90 uplift rating.

File Page C1

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 tests will be Roof Deck Construction Nos. 603.

UL 1897

It is further judged that the roof deck assembly, constructed of the materials and in the manner described in Test Assembly No. 7, has attained a 145 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".

DISCUSSION:

After a review of the test data, assembly constructions and the contributory area of the "1-1/2 in. Standing Seam Clip" (Assembly 2) and 1-1/2 in. Sliding Clip Assembly "1500SC" (Assemblies 7-9) it was determined that the 1-1/2 in. Sliding Clip Assembly "1500SC" would be an acceptable replacement for the "1-1/2 in. Standing Seam Clip".

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. Mechanical Lock" metal roof panels is illustrated below:

METAL ROOF DECK PANELS
AS TO UPLIFT RESISTANCE
CLASS 90
AS SHOWN BY CONSTRUCTION NO. 603.

The Classification Mark for the TLSX category (UL 580) to be used on the "1500SNS", "1000FC", "1500SC" panel clip fasteners is illustrated below:

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. Mechanical Lock" 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: 145 psf

Deck: Min. 19/32 in. thick, APA Rated plywood, Grade C-D. All joints to be sealed with a one part urethane sealant feathered out from the joint.

Panel Fasteners: Fasteners used to attach the panels clips to the plywood decking were No. 1/4-13 by 1-5/8 in. long No. 3 Phillips drive, truss head coated steel screws. Two screws are to be used per clip.

Roof Deck Fasteners (Panel Clips): Two part assembly consisting of an upper tab and a base. The upper tab is 4-1/4 in. wide and 2 in. high and is fabricated from min. 0.030 in. thick stainless steel. The base is 1-7/8 in. wide and 1-5/8 in. long and is fabricated from min. No. 16 MSG coated steel. Clips are to be spaced 36 in. OC max. The clips are identified as "1500SC".

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

Metal Roof Deck Panels: Min. .032 in. thick embossed aluminum designated “1-1/2 Mechanical Lock”. Max. width 16 in., height of female rib 1-1/2 in., male rib 1-29/64 in. Panels continuous over three or more clips with no end-laps. A bead of sealant may be used at panel ribs. Panel ribs seamed with an electric seamer with seaming operation to include upper portion of panel Clip (Item 3).

Construction No. 603

1. Metal Roof Deck Panels – Min. .032 in. thick embossed aluminum; width 20 in. wide, height of female rib 1-1/2 in., male rib 1-29/64 in. Panels continuous over three or more clips with no end-laps. A bead of sealant may be used at panel ribs. Panel ribs seamed with an electric seamer with seaming operation to include upper portion of panel Clip (Item 2).

Metal Forming Inc. – “1-1/2 Mechanically Lock”

2. Roof Deck Fasteners (Panel Clips): Two part assembly consisting of an upper tab and a base. The upper tab is 4-1/4 in. wide and 2 in. high and is fabricated from min. 0.030 in. thick stainless steel. The base is 1-7/8 in. wide and 1-5/8 in. long and is fabricated from min. No. 16 MSG coated steel. Clips are to be spaced 36 in. OC max.

Metal Forming Inc. – “1500SC”

3. Panel Fasteners (Screws) - Fasteners used to attach the panels clips to the plywood decking were No. 1/4-13 by 1-5/8 in. long No. 3 Phillips drive, truss head coated steel screws. Two screws are to be used per clip.
4. 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. 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.
5. Joists - Graded dimensional lumber, No. 2 or better. Spaced 24 in. OC max.
6. Joist Hangers - (Not Shown) - No. 18 MSG coated steel, open seat type.
7. Ply Sheet - (Not Shown) - Any UL Classified underlayment, min. 2 in. sidelap, mechanically fastened.

*Bearing the UL Classification Marking.