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APPROVAL REPORT

FM APPROVAL EXAM OF AGWAY METALS INC. RD36, RD75-150 AND RD75-200 STEEL DECKS FOR MAXIMUM CLASS 1-90 WIND RATING PER FM APPROVALS STANDARD 4451

Prepared for:

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Project ID: 3043709
Class: 4451
Date of Approval: 10/16/2012
Authorized by: Cynthia E Frank

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From

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I INTRODUCTION

1.1 Agway Metals Inc. submitted their RD-36, RD75-150 and RD75-200 steel roof decks for evaluation to determine if they would meet the Approval requirements of the Standard listed below for steel roof deck.

1.2 Examination included a review of allowable live load deck deflection calculations, steel deck bending stress calculations for wind uplift resistance, foot traffic resistance of insulation, pullover resistance of fasteners (calculation), side lap crimping and interlocking resistance testing, and combination pull off / pull over resistance of arc spot welds calculations.

1.3 Evaluations show that the Agway Metals Inc. steel roof decks described in Section 2, meet the Approval criteria of FM Approvals for use as a profiled steel panel for use as decking in Class 1 roof construction when used as described in the CONCLUSIONS of this report.

1.4 This Report may be reproduced only in its entirety and without modification.

1.5 **Standard:**

Title	Class Number	Date
Approval Standard for Profiled Steel Panels for Use as Decking in Class 1 Insulated Roof Construction	4451	June 2012

1.6 **Listings:** The steel decks evaluated meet the Approval criteria of FM Approvals when installed as specified in the **CONCLUSIONS** of this report. The products will be listed in RoofNav.

II DESCRIPTIONS

2.1 The Type RD-36 Deck, galvanized and galvanneal steel roof deck is available in design thicknesses of 22 ga., 20 ga., 18 ga. and 16 ga. [0.030 in. (0.76 mm), 0.036 in. (0.91 mm), 0.048 in. (1.22 mm) and 0.060 in. (1.52 mm)] thick. The deck is 1.5 in. (38 mm) deep with a 6 in. (152 mm) o.c. module spacing. The steel deck is rolled from coil steel meeting the requirements of ASTM A653, Structural Steel (SS) Grade 33, 40, 50 or 80 or ASTM A1008 SS Grade 33, 40, 50 or 80. The manufactured width of the deck is 36 in. (914 mm) and is supplied in various lengths. The deck has an interlocking side lap. The minimum delivered uncoated steel thickness of the deck shall never be less than 95% of the design thickness.

2.2 The Type RD75-150 Deck, galvanized and galvanneal steel roof deck is available in design thicknesses of 22 ga., 20 ga., 18 ga. and 16 ga. [0.030 in. (0.76 mm), 0.036 in. (0.91 mm), 0.048 in. (1.22 mm) and 0.060 in. (1.52 mm)] thick. The deck is 3 in. (76 mm) deep with a 6 in. (152 mm) o.c. module spacing. The steel deck is rolled from coil steel meeting the requirements of ASTM A653, Structural Steel (SS) Grade 33, 40, 50 or 80 or ASTM A1008 SS Grade 33, 40, 50 or 80. The manufactured width of the deck is 24 in. (610 mm) and is supplied in various lengths. The deck has an interlocking side lap. The minimum delivered uncoated steel thickness of the deck shall never be less than 95% of the design thickness.

2.3 The Type RD75-200 Deck galvanized and galvanneal steel roof deck is available in design thicknesses of 22 ga., 20 ga., 18 ga. and 16 ga. [0.030 in. (0.76 mm), 0.036 in. (0.91 mm), 0.048 in. (1.22 mm) and 0.060 in. (1.52 mm)] thick. The deck is 3 in. (76 mm) deep with a 8 in. (203 mm) o.c. module spacing. The steel deck is rolled from coil steel meeting the requirements of ASTM A653, Structural Steel (SS) Grade 33, 40, 50 or 80 or ASTM A1008 SS Grade 33, 40, 50 or 80. The manufactured width of the deck is 32 in. (813 mm) and is supplied in various lengths. The deck has an interlocking side lap. The minimum delivered uncoated steel thickness of the deck shall never be less than 95% of the design thickness.

III EXAMINATIONS AND TESTS

3.1 Product drawings and calculations were submitted for examination as follows:

3.1.1 Examinations and evaluations were as required by the Standard listed in paragraph 1.5 above.

3.1.2 All data is on file at FM Approvals under Project ID 3043709 along with other documents and correspondence applicable t this program.

3.1.3 Testing was conducted as required by the **Standard** listed in paragraph 1.5 above. Several required tests were waived:

- Combustibility testing for fire exposure from below the roof deck is waived because only FM Approved assemblies meeting the requirements for Class 1 were requested and the deck does not have perforations.
- Combination pull out / pull over resistance of fastener testing and drivability of fasteners is waived because the Hilti, Inc. fasteners are FM Approved and a data release is on file, see Project ID No.'s 3021719 and 3036326 for details.
- Fastener pull out resistance testing for above deck components is waived because the deck does not have a stiffening rib.
- 12 x 24 ft (3.7 x 7.3 m) Simulated Wind Uplift Pressure Testing is waived because wind ratings are maximum Class 1-90.
- Bearing capacity of insulation testing is waived because the top flange width is greater than 2 in. (50 mm).
- Corrosion resistance testing is not requested.

3.2 Allowable Live Load Deflection

3.2.1 Live load deflection is a function of the span of the deck and the stiffness of the deck which is a function of the moment of inertia (I) of the deck profile. Under a static ultimate load of 200 lb (0.89 N) the deck shall not deflect more than 1/240 of the span (L) when the 200 lb (0.89 N) static load is applied at mid-span of a two span arrangement.

3.2.2 Agway Metals Inc. submitted calculations for the moment of inertia for each deck thickness for which Approval was sought. The moment of inertia value was verified.

3.2.3 From the calculated moment of inertia the maximum spans were calculated. The spans were calculated based on the limitation that steel deck deflection from a static 200 lb (0.89 N) load applied over a 1 ft² (0.09 m²) area shall not exceed 1/240 of the deck span under a two span condition using the following relationship:

	Two Span Condition	
Equation	D = $0.015\left(\frac{PL^3}{EI}\right)$	
Reduced Equation	International System of Units	U.S. Customary
	L = $\sqrt{64.0(I)}$	L = $\sqrt{40{,}970(I)}$

where:

D = deflection = L/240 (in., mm)
P = load = 200 lb (0.89 kN) concentrated load distributed over a 12 in. (305 mm) width
L = span (in., mm)
I = moment of inertia (in.^{4}/ft, mm^4/ft)
E = modulus of elasticity (steel =29,500,000 psi, 205 kN/mm^2)

3.2.4 The moments of inertia and calculated spans (two span condition) for each design thickness of each deck are as follows:

RD36 Deck

Thickness in., (ga.,mm)	Calculated Moment of Inertia in.^{4}/ft (EE3 mm^4)	Allowable Span in. (mm)
0.030 (22, 0.76)	0.163 (67.8)	82 (2000)
0.036 (20, 0.91)	0.204 (84.9)	91 (2311)
0.048 (18, 1.22)	0.280 (86.6)	107 (2718)
0.060 (16, 1.52)	0.349 (145.3)	120 (3408)

RD75-150 Deck

Thickness in., (ga.,mm)	Calculated Moment of Inertia in.^{4}/ft (EE3 mm^4)	Allowable Span in. (mm)
0.030 (22, 0.76)	0.866 (360)	188 (4775)
0.036 (20, 0.91)	1.07 (445)	209 (5309)
0.048 (18, 1.22)	1.46 (607)	245 (6223)
0.060 (16, 1.52)	1.82 (758)	273 (6934)

RD75-200 Deck

Thickness in., (ga.,mm)	Calculated Moment of Inertia in.^{4}/ft (EE3 mm^4)	Allowable Span in. (mm)
0.030 (22, 0.76)	0.677 (281)	167 (4242)
0.036 (20, 0.91)	0.88 (366)	190 (4826)
0.048 (18, 1.22)	1.27 (528)	228 (5791)
0.060 (16, 1.52)	1.64 (682)	259 (6578)

3.3 Steel Deck Bending Stresses Under Wind Uplift Service Loads

3.3.1 The steel deck bending stress under wind uplift service loads was evaluated to verify the ability of the steel deck to withstand wind uplift service loads without damage or overstressing the steel deck. Stresses induced to steel roof decking were determined by rational analysis and cannot exceed the allowable stresses per the latest edition of the *North American Specification for the Design of Cold-Formed Steel Structural Members,* AISI S100-2007.

3.3.2 For fully adhered roof covers and with mechanically attached single cover assemblies when the in-row fastener spacing is less than or equal to one-half of the deck span on steel deck with a three span condition, the maximum bending stress occurs at the support and the following relationship is used:

$$F_b = \frac{0.10\ W \times L^2}{S}$$

Where F_b must be less than $0.6\ F_y$

F_y = the yield stress of the deck =33,000 psi (227.5 MPa)

F_b = 19,800 psi (136.5 MPa)

W = Service Load per 1 ft (0.3 m) width of deck
[30 lb/ft (0.438 N/mm), 37.5 lb/ft (0.5472 N/mm), 45 lb/ft (0.6567 N/mm)]

S = Calculated Section Modulus of the deck supplied by Agway Metals. The values were verified.

3.3.3 Agway Metals Inc. submitted calculations showing that the deck is not overstressed for the given wind uplift load when used with fully adhered roof coverings and with mechanically fastened roof coverings where the line of fasteners is not spaced more than ½ of the allowable span. The calculated allowable spans are:

RD36 Deck

Thickness in. (ga., mm)	Section Modulus in.^{3}/ft (mm^3/ft)	Allowable Span, in. (mm)		
		Class 1-90	Class 1-75	Class 1-60
0.030 (22, 0.76)	0.183	100 (2540)	110 (2794)	124 (3150)
0.036 (20, 0.091)	0.233	113 (2870)	125 (3175)	141 (3581)
0.048 (18, 1.21)	0.315	133 (3378)	146 (3708)	165 (4191)
0.060 (16, 1.51)	0.389	149 (3784)	164 (4166)	186 (4724)

RD75-150 Deck

Thickness in. (ga., mm)	Section Modulus $in.^3/ft$ (mm^3/ft)	Allowable Span, in. (mm)		
		Class 1-90	Class 1-75	Class 1-60
0.030 (22, 0.76)	0.492	165 (4191)	182 (4623)	205 (5207)
0.036 (20, 0.091)	0.624	187 (4750)	206 (5232)	233 (5918)
0.048 (18, 1.21)	0.898	227 (5766)	251 (6375)	285 (7239)
0.060 (16, 1.51)	1.12	256 (6502)	284 (7214)	324 (8230)

RD75-200 Deck

Thickness in. (ga., mm)	Section Modulus $in.^3/ft$ (mm^3/ft)	Allowable Span, in. (mm)		
		Class 1-90	Class 1-75	Class 1-60
0.030 (22, 0.76)	0.397	148 (3759)	163 (4140)	184 (4674)
0.036 (20, 0.091)	0.503	167 (4242)	185 (4699)	208 (5283)
0.048 (18, 1.21)	0.724	203 (5156)	224 (5690)	254 (6452)
0.060 (16, 1.51)	0.904	229 (5817)	253 (6426)	288 (7315)

3.4 FM Approvals Foot Traffic Resistance of Insulation Test

3.4.1 Testing was conducted using the FM Approvals Resistance to Foot Traffic Test Apparatus to evaluate the ability of the insulation to resist simulated foot traffic without damage.

3.4.2 A 12 in. (305 mm) square test sample of steel deck was fastened to a 12 x 12 x 0.5 in. (305 x 305 x 13 mm) piece of plywood with the wide rib opening centered on the plywood. The insulation was placed on the steel deck and the insulation /deck sample was placed on the movable crosshead of the Tinius Olsen machine. The 3 in. (76 mm) square steel plate with rounded corners was centered on the centerline over the wide rib opening of the deck. A 200 lb load was applied to the insulation sample. The superimposed load was reduced to zero and the sample reloaded a minimum of four additional times. The top of the insulation specimen was inspected after the test and the condition of the cover noted at the steel plate interface.

3.4.3 There must be no fracture of the insulation, there shall be no visible damage to the insulation facer or compressible core material after five (5), 200 lb. (91 kg) load cycles.

3.4.4 Two samples were prepared. The components and sequence of installation were as follows:

Sample No.1: RD36, 22 ga. [(0.030 in.) (0.76 mm)] steel deck
IKO Ikotherm Polyisocyanurate foam, 2 in. (51mm) thick

3.4.5 Sample No.2: RD75-150, 22 ga. [(0.030 in.) (0.76 mm)] steel deck
IKO Ikotherm Polyisocyanurate foam, 2 in. (51mm) thick

3.4.6 No damage to the insulation board on any of the test samples was observed after the test.

3.5 FM Approvals Side Lap Crimping and Interlocking Resistance Test

3.5.1 The side lap securement testing is conducted to verify that individual sheets remain securely fastened at their side laps under moving loads during roof construction.

3.5.2 Test samples were prepared by cutting 6 in. (150 mm) long sections of the steel deck interlocking side lap and 6 in. (150 mm) long by 2 in. (50 mm) wide flat sections of the same steel deck. One end of the 2 in. (50 mm) wide section of deck was inserted into the center of the 6 in. (150 mm) long section of the interlocking side lap forming a "T" shape. The crimping and interlocking tool supplied by the manufacturer was used to crimp the section to the interlocking lap.

3.5.3 Side lap securements must withstand a load of 8.33 lb/in. (1.46 N/mm) strength along the length of the lap.

3.5.4 Three test samples for each deck shown below were prepared. Test results are as follows:

Sample #1: RD75-150 Deck, 22 ga. (0.030 in. [0.76 mm])

Average value: 105 lb (467 N). The required spacing of side lap securement is 12 in. (305 mm).

Sample #2: RD36 Deck, 22 ga. (0.030 in. [0.76 mm])

Average value: 146 lb (649 N). The required spacing of side lap securement is 17 in. (430 mm).

3.6 Pull Over Resistance of Fasteners (Calculation)

3.6.1 Pull over resistance calculation of the fasteners used to secure the steel deck to the building structure is conducted to verify the capacity of the deck to resist rupture over the fastener head. The securement of the deck to the structure must insure that the deck remains in place during the design windstorm. The pull over resistance of fasteners evaluation is in accordance with *North American Specification for the Design of Cold-Formed Steel Structural Members, 2007 Edition*, AISI S100-2007.

3.6.2 Agway Metals Inc. submitted calculations showing the capacity of the various deck thicknesses when used with a 0.465 in. (11.8 mm) diameter fastener head at 6 in. (152 mm) rib spacing are:

Thickness in., (ga.,mm)	Pull Over Resistance (P_{all}) lb, (N)	$P_{all} = P/\Omega$; $\Omega=3$ lb (N)	Class 1-90 Allowable Span in. (mm)	Class 1-75 Allowable Span in. (mm)	Class 1-60 Allowable Span in. (mm)
0.030 (22, 0.76)	914 (4065)	305 (1357)	170 (4328)	205 (5207)	256 (6502)
0.036 (20, 0.91)	1097 (4880)	366 (1626)	205 (5207)	246 (6284)	307 (7798)
0.048 (18, 1.22)	1463 (6507)	488 (2169)	264 (6706)	328 (8331)	410 (10414)
0.060 (16, 1.52)	1828 (8131)	609 (2710)	336 (8534)	409 (10389)	512 (13005)

3.6.3 Agway Metals Inc. submitted calculations showing the capacity of the various deck thicknesses when used with a 0.465 in. (11.8 mm) diameter fastener head at 8 in. (203 mm) rib spacing are:

Thickness in., (ga.,mm)	Pull Over Resistance (P_{all}) lb, (N)	$P_{all} = P/\Omega$; $\Omega=3$ Lb (N)	Class 1-90 Allowable Span in. (mm)	Class 1-75 Allowable Span in. (mm)	Class 1-60 Allowable Span in. (mm)
0.030 (22, 0.76)	914 (4065)	305 (1357)	128 (3251)	154 (3912)	193 (4902)
0.036 (20, 0.91)	1097 (4880)	366 (1626)	154 (3912)	185 (4699)	231 (5867)
0.048 (18, 1.22)	1463 (6507)	488 (2169)	205 (5207)	246 (6248)	307 (7798)
0.060 (16, 1.52)	1828 (8131)	609 (2710)	256 (6502)	307 (7798)	384 (9754)

3.7 Combination Pull Out / Pull Over Resistance of Fastener (Testing)

3.7.1 Combination pull out / pull over resistance testing of the fasteners used to secure the steel deck to the building structure is conducted to verify the capacity of the fastener to resist pull out from the substrate and the capacity of the fastener head to resist rupture. The securement of the deck to the structure must insure that the deck remains in place during the design windstorm.

3.7.2 Data released by Hilti, Inc. shows the Pull Out / Pull Over Resistance of the fasteners to be minimum 2010 lb (8940 N).

3.7.3 Based on the rated fastener capacity and wind uplift load of 90 psf (4.3 kPa), the maximum span length of the steel deck would be 536 in. (13,615 mm) with a 6 in. (152mm) fastener spacing.

3.7.4 Based on the rated fastener capacity and wind uplift load of 90 psf (4.3 kPa), the maximum span length of the steel deck would be 402 in. (10,221 mm) with a 8 in. (203 mm) fastener spacing.

3.8 Drivability Evaluation of Fasteners

3.8.1 Drivability evaluation of fasteners used to secure steel deck to the structure is conducted to confirm that the fasteners will perform as specified by the manufacturer.

3.8.2 Data released by Hilti, Inc. shows the fasteners to seat properly when driven through four layers of 18 ga [0.0474 in. (1.2 mm)] thick deck and into a 7/8 in. (22 mm) thick steel substrate with an average penetration depth of 0.39 in. (9.8 mm).

3.9 Combination pull off/pull over resistance of arc spot welds.

3.9.1 Combination pull off/pull over resistance of arc spot welds used to secure the steel deck to the building structure was evaluated to verify that the securement of the deck to the structure is sufficient to insure the deck remains in place during a design windstorm.

3.9.2 Data submitted by Agway Metals Inc. shows the diameter of arc spot weld to be sufficient to resist the design wind load 1-90 with welds placed at the bottom each rib.

3.9.3 The calculated allowable spans for Class 1-90 are:

Thickness in., (ga.,mm)	Allowable Span in. (mm) at 6 in. (152mm) module	Allowable Span in. (mm) at 8 in. (203mm) module
0.030 (22, 0.76)	309 (7848)	232 (5893)
0.036 (20, 0.91)	367 (9322)	275 (6985)
0.048 (18, 1.22)	482 (12243)	361 (9169)
0.060 (16, 1.52)	580 (14732)	436 (11074)

IV MARKING

4.1 The manufacturer shall mark each steel deck panel, packing container, or top of each bundle with the manufacturer's name and product trade name. In addition, the steel deck panel, bundle or container must be marked with the Approval Mark of FM Approvals.

4.2 Markings denoting Approval by FM Approvals shall be applied by the manufacturer only within and on the premises of manufacturing locations that are under the FM Approvals Surveillance program.

4.3 The manufacturer agrees that use of the FM Approvals name or Approval Mark is subject to the conditions and limitations of the Approval by FM Approvals. Such conditions and limitations must be included in all references to Approval by FM Approvals.

V REMARKS

5.1 The securement of the roof system must be enhanced at the building corners and perimeter as outlined in FM Global Property Loss Prevention Data Sheet 1-29.

5.2 The roof cover must be installed using a roof perimeter flashing system Approved by FM Approvals. See RoofNav.

VI SURVEILLANCE AUDITS

The Agway Metals Inc. location in Brampton, ON is subject to periodic audit inspections to determine that the quality and uniformity of the materials have been maintained and will provide the same level of performance as originally Approved. The facilities and quality control procedures in place have been found to be satisfactory to manufacture product identical to that examined and tested as described in this report.

VII MANUFACTURER'S RESPONSIBILITIES

7.1 To assure compliance with procedures in the field, the manufacturer shall supply to the installer such necessary instruction or assistance required to produce the desired performance achieved in the analysis.

7.2 The manufacturer shall notify FM Approvals of any planned change in the Approved products, prior to general sale or distribution, using Form 797, Approved Product Revision Report.

VIII DOCUMENTATION

The following document describes the products and is filed under project 3043709.

Document Title	Submitted Date
Surveillance Audit Manual	December 2011

IX CONCLUSIONS

9.1 Evaluations from this and previous programs indicate that Agway Metals RD36, RD75-150 and RD75-200 steel roof decks meet the Approval requirements of FM Approvals for use as a component in Class 1-60, Class 1-75 and Class 1-90 wind uplift rated insulated steel deck roof constructions when used as follows:

RD36 Deck Spans meet Class 1-90

Thickness in. (ga., mm)	Allowable Span, in. (mm)
0.030 (22, 0.76)	82 (2000)
0.036 (20, 0.09)	91 (2311)
0.048 (18, 1.21)	107 (2718)
0.060 (16, 1.51)	120 (3408)

RD75-150 Deck

Thickness	Allowable Span, in. (mm)		
in. (ga., mm)	Class 1-90	Class 1-75	Class 1-60
0.030 (22, 0.76)	165 (4191)	182 (4623)	188 (4775)
0.036 (20, 0.09)	187 (4750)	206 (5232)	209 (5309)
0.048 (18, 1.21)	227 (5766)	245 (6223)	245 (6223)
0.060 (16, 1.51)	256 (6502)	273 (6934)	273 (6934)

RD75-200 Deck

Thickness	Allowable Span, in. (mm)		
in. (ga., mm)	Class 1-90	Class 1-75	Class 1-60
0.030 (22, 0.76)	128 (3251)	154 (3912)	167 (4242)
0.036 (20, 0.09)	154 (3912)	185 (4699)	190 (4826)
0.048 (18, 1.21)	203 (5156)	224 (5690)	228 (5791)
0.060 (16, 1.51)	229 (5817)	253 (6426)	259 (6578)

9.2 The RD36, RD75-150 or RD75-200 decks are secured to the structural supports spaced at the maximum center to center spans shown above with Hilti, Inc. X-EDN19 THQ12, X-ENP19 L15 fasteners or with ¾ in. (19mm) diameter arc spot welds placed at each bottom rib. Minimum 2 in. (51 mm) thick polyisocyanurate insulation is installed and covered with a fully adhered roof covering or with mechanically attached single cover assemblies when the in-row fastener spacing is less than or equal to one-half of the deck span with a three span condition, per proprietary listings. Meets wind rating per securement of the deck and securement of the above deck components. Maximum Class 1-90.

9.3 Deck side laps are secured with a button punching spaced at maximum 12 in. (305mm) o.c. for the RD75-150 and RD75-200 deck and 17 in. (430 mm) for the RD36 deck.

9.4 The minimum uncoated steel thickness shall not be less than 95% of the design thickness.

9.5 Consult RoofNav for details of all constructions. At no time shall the deck span exceed the span allowed by the local authority having jurisdiction.

9.6 Since a duly signed Master Agreement is on file for this customer, Approval is effective as of the date of this report.

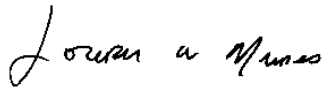
9.7 Continued Approval will depend upon satisfactory field experience and periodic Surveillance Audits.

TESTING SUPERVISED BY: **J. A. Nunes**

PROJECT DATA RECORD: **3043709**

ORIGINAL EVALUATION DATA: **Hilti, Inc. Project ID 3021719 and 3036326.**

REPORT BY:



J.A. Nunes
Advanced Engineer - Materials Group

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