

Part 1 General

1.1 REFERENCES

- .1 ASTM International (ASTM)
 - .1 ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A755: Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - .3 ASTM A792: Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .4 ASTM A924: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - .5 ASTM C273: Standard Test Method for Shear Properties of Sandwich Core Materials.
 - .6 ASTM C591: Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - .7 ASTM C1363: Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
 - .8 ASTM C1371: Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
 - .9 ASTM C1549: Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
 - .10 ASTM D570: Standard Test Method for Water Absorption of Plastics.
 - .11 ASTM D638: Standard Test Method for Tensile Properties of Plastics.
 - .12 ASTM D1004: Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
 - .13 ASTM D1204: Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - .14 ASTM D1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

Supplemental Architectural Specifications

City of Winnipeg
Water and Waste
Department

METAL ROOF PANELS

Section 07 41 13
Page 2 of 10
2015-11-20

- .15 ASTM D1622: Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- .16 ASTM D1623: Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- .17 ASTM D2126: Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- .18 ASTM D2136: Standard Test Method for Coated Fabrics Low Temperature Bend Test.
- .19 ASTM D3045: Standard Practice for Heat Aging of Plastics without Load.
- .20 ASTM D5602: Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens.
- .21 ASTM D5635: Standard Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens.
- .22 ASTM D6226: Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
- .23 ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- .24 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
- .25 ASTM E283: Standard Test Method for Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .26 ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- .27 ASTM E408: Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection Meter Techniques.
- .28 ASTM E1980: Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low Sloped Opaque Surfaces.
- .29 ASTM G154: Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

1.2 SYSTEM DESCRIPTION

- .1 Design Requirements

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Supplemental Architectural Specifications

City of Winnipeg
Water and Waste
Department

METAL ROOF PANELS

Section 07 41 13
Page 3 of 10
2015-11-20

- .1 Design metal roof to provide for thermal movement of component materials without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .2 Include expansion joints to accommodate movement in roof system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
- .3 Design members to withstand all dead load and climatic loads calculated in accordance with the National Building Code of Canada (NBCC) and applicable local regulations, to maximum allowable deflection of 1/240th of span.
- .4 The panels shall be designed to resist all NBCC post-disaster loading requirements in accordance with the climatic data provided on the Drawings.
- .5 Provide for positive drainage of condensation occurring within roof construction and water entering at joints, to exterior face of wall in accordance with National Research Council (NRC) "Rain Screen Principles".

1.3 SUBMITTALS

- .1 Submit submittals in accordance with the Specifications.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and datasheets for each type of product.
- .3 Shop Drawings:
 - .1 Submit detailed drawings and panel analysis showing:
 - .1 Profile
 - .2 Gauge of both exterior and interior sheet
 - .3 Location, layout and dimensions of panels
 - .4 Location and type of fasteners
 - .5 Shape and method of attachment of all trim
 - .6 Locations and type of sealants
 - .7 Installation sequence
 - .8 Coordination Drawings: Provide plans which show panels in relationship to required locations for structural support. Include panel details and details showing attachment to structural support.
 - .9 Other details as may be required for a weathertight installation

Supplemental Architectural Specifications

City of Winnipeg
Water and Waste
Department

METAL ROOF PANELS

Section 07 41 13
Page 4 of 10
2015-11-20

- .4 Panel Analysis: Provide panel calculations to verify panels will withstand the design loads indicated without detrimental effects or deflection exceeding $L/240$. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout.
- .5 Samples: Provide nominal 75 x 125 mm of each color indicated. Provide panel width by 200 mm long minimum.
- .6 Manufacturer's Instructions: Provide manufacturer's written installation instructions including proper material storage, material handling, installation sequence, panel location(s), and attachment methods, details and required trim and accessories.

1.4 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Manufacturer shall have a minimum of five (5) years' experience in the production of insulated roof panels. Manufacturer shall demonstrate past experience with examples of projects of similar type and exposure.
- .2 Installer Qualifications: Authorized by the manufacturer and the work shall be supervised by a person having a minimum of five (5) years' experience installing insulated roof panels on similar type and size projects.
- .3 Pre-installation meeting: Conduct a pre-installation meeting at the job site attended by the City, Contract Administrator, Manufacturer's Technical Representative, Panel Installer, and Contractors of related trades. Coordinate structural support requirements in relation to insulated roof panel system, installation of any separate air/water barriers, and other requirements specific to the project.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver panel materials and components in manufacturer's original, unopened, undamaged packaging with identification labels intact.
- .2 Store roof panel materials on dry, level, firm, and clean surface. Stack no more than two bundles high. Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.

Part 2 Products

2.1 MANUFACTURER

- .1 Kingspan Insulated Panels Ltd.
- .2 MR 100 Series Insulated Roof Panels

2.2 EXTERIOR ROOF PANELS

- .1 Design Criteria – Roof Panels:

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Supplemental Architectural Specifications
METAL ROOF PANELS

- .1 Uplift Rating
 - .1 Design criteria shall be L/240 for roof.
 - .2 Units shall be rated and carry the following listings:
 - .1 Factory Mutual 1-120 uplift rating.
 - .2 FM 4471 – Class 1 Approval
- .2 Performance Criteria – Roof Panels:
 - .1 Structural Test: Structural performance shall be verifiable by witnessed structural testing for simulated wind loads in accordance with ASTM E72.
 - .2 Fatigue Test: There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads (positive and negative loads), when applied for two million alternate cycles of L/240 deflection.
 - .3 Freeze / Heat Cycling Test: Panels shall exhibit no delamination, surface blisters, permanent bowing or deformation when subjected to cyclic temperature extremes of negative 20 deg. F to positive 180 deg. F temperatures for twenty one (21), eight-hour (28) cycles.
 - .4 Water Penetration: There shall be no uncontrolled water penetration through the panel joints at a pressure differential of 20 psf, when tested in accordance with ASTM E331.
 - .5 Air Infiltration: Air infiltration through the panel shall not exceed 0.01 cfm/sf at 20 psf air pressure differential when tested in accordance with ASTM E283.
 - .6 Humidity Test: Panels shall exhibit no delamination or metal interface corrosion when subjected to plus 140 deg. F temperature and 100 percent relative humidity for a total of 1000 hours.
 - .7 Autoclave Test: Panels shall exhibit no delamination or shrinkage/melting of the foam core from the metal skins after being subjected in an autoclave to a pressure of 2psig (13.8kPa) at a temperature of plus 212 deg. F (plus 100 deg. C) for a period of 2 1/2 hours.
 - .8 Thermal Properties: The panel shall provide an R-value of 31 (4 inch panel) °F·ft²·hr/BTU when tested in accordance with ASTM C1363.
 - .9 Hailstorm Rating for roof panels: Factory Mutual 1 SH hailstorm rating
 - .10 Flame Spread and Smoke Developed Tests on exposed Insulating Core in accordance with ASTM E84:
 - .1 Flame Spread: Less than 25

Bid Opportunity 930-2015 Wilkes Reservoir North Cell Rehabilitation

City of Winnipeg
Water and Waste
Department

Supplemental Architectural Specifications
METAL ROOF PANELS

Section 07 41 13
Page 6 of 10
2015-11-20

- .2 Smoke Developed: Less than 450
- .11 Factory applied membrane:
 - .1 Thickness: 0.034 inch D638
 - .2 Tensile Strength (min., psi) 2000 D638
 - .3 Elongation at Break (min.) 400 percent D638
 - .4 Seam Strength (min.) 80 D638
 - .5 Retention of Properties after heat aging
 - .1 Tensile Strength (min.) 90 D638
 - .2 Elongation (min.) 90 D638
 - .6 Tearing Resistance (min., lbf) 10 D1004
 - .7 Low Temperature Bend Pass D2136
 - .8 Accelerated Weathering Test
 - .1 Cracking (7 x magnification) None --
 - .2 Discoloration (by observation) Negligible --
 - .3 Crazeing (7 x magnification) Negligible --
 - .9 Weight Change after immersion in water 2.5 percent D570
 - .10 Static Puncture Resistance (33 lbf) Pass D5602
 - .11 Dynamic Puncture Resistance (7.3 ft-lbf) Pass D5635
 - .12 Initial Solar Reflectance 0.83 C1549
 - .13 Emissivity 0.90 E408, C1371
 - .14 Solar Reflective Index 104 E1980
- .12 Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free, compliant with Montreal Protocol and Clean Air Act, with the following minimum physical properties:
 - .1 Core is minimum 90 percent closed cell when tested in accordance with ASTM D6226

Supplemental Architectural Specifications
METAL ROOF PANELS

- .2 Foam has a density of 2.4 pounds per cubic foot when tested in accordance with ASTM D1622
- .3 Compressive Stress when tested in accordance with ASTM D1621:
 - .4 Parallel to Rise: minimum of 22 psi
 - .5 Perpendicular to Rise: 22 psi
 - .6 Shear Stress: Minimum of 38 psi when tested in accordance with ASTM C273
 - .7 Tensile Stress: Minimum of 33 psi when tested in accordance with ASTM D1623
 - .8 Dimensional stability when tested in accordance with ASTM D2126:
 - .1 High Temperature Aging at 158 deg. F and 100 percent plus relative humidity for seven (7) days: less than 6.7 percent volume change
 - .2 High Temperature Aging at 200 deg. F and ambient humidity for seven (7) days: less than 1.4 percent volume change
 - .3 Low Temperature Aging at -20 deg. F and ambient humidity at seven (7) days: less than 0.0 percent volume change
- .3 Roof Panel Assembly:
 - .1 Panel thickness: 100 mm (4 inches) thick.
 - .2 Panel width: 40 inches
 - .3 Panel Lengths: Minimum 10 feet, maximum 40 feet and As indicated on Drawings.
 - .4 Panel Attachment: Shall consist of concealed fasteners and clips.
 - .5 Exterior Face of Panel:
 - .1 Material:
 - .1 Steel coil material shall be in accordance with ASTM A755: AZ50 Galvalume®/ Zinalume® (55 percent aluminum, 45 percent zinc) in accordance with ASTM A792.
 - .2 Gauge: 24 gauge.
 - .3 Texture: Non-directional stucco embossed.
 - .4 Membrane: 1.0 mil. Fluoropolymer (PVDF) Two Coat system: 0.2 mil primer with 0.8 mil Kynar 500 (70%) SOLID color coat
 - .5 Exterior Color: Ascot White (Category 1)

- .4 Interior Face of Panel:
 - .1 Material: Steel coil material shall be in accordance with ASTM A755: AZ50 Galvalume®/ Zinalume® (55 percent aluminum, 45 percent zinc) in accordance with ASTM A792.
 - .2 Profile:
 - .1 Profile description - Minor Rib.
 - .2 Texture: Non-directional stucco embossed.
 - .3 Gauge: 26 gauge.
 - .4 Interior Finish: modified polyester (MP), dry film thickness of 1.0 mil including primer.
 - .5 Color: Imperial White

2.3 ACCESSORIES

- .1 Fasteners:
 - .1 Structural fasteners shall be flat-head type, cadmium plated steel with neoprene washer, or as recommended by manufacturer.
 - .2 Clip for panel attachment shall be 16 gauge, straddle the panel sidejoints, and supplied by the manufacturer.
 - .3 Size and spacing: As recommended by manufacturer.
 - .4 Membrane batten strip: 48 mil., manufacturer's standard, color to match membrane.
- .2 Perimeter Trim and Penetration Treatments, expansion joint covers:
 - .1 Fabricated perimeter trim, penetration treatments and flashing: Shall be same gauge material with factory applied membrane to match insulated metal roof and panels.
- .3 Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

Supplemental Architectural Specifications

City of Winnipeg
Water and Waste
Department

METAL ROOF PANELS

Section 07 41 13
Page 9 of 10
2015-11-20

3.2 PREPARATION

- .1 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.3 INSTALLATION

- .1 Provide alignment bars, brackets, clips, inserts, shims as required to securely and permanently fasten roof system to building structure.
- .2 Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.4 PANEL INSTALLATION

- .1 Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
- .2 Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions. Personnel should wear respiratory and eye protection devices.
- .3 Butyl Vapor Barrier Sealant:
 - .1 Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
 - .2 Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
 - .3 Do not use non-skinning butyl tube sealant to bridge gaps.
- .4 Place panel fasteners through pre-punched holes in attachment clips. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the approved shop drawings.
- .5 Cover panel joints with 8 inch wide membrane batten strip, continuously heat weld joint.

3.5 TRIM INSTALLATION

- .1 Place trim, expansion joint covers and fasteners only as indicated per details on the approved shop drawings.
- .2 Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces of panels for proper vapor seal.
- .3 Fasten the exterior ridge cap to the panels as shown on shop drawings with 1/4 inch by 7/8 inch truss head fasteners. Seal juncture with membrane tape by manufacturer. Overlay entire ridge area with 12 inch wide membrane batten strip, continuously heat weld joint.

3.6 FIELD QUALITY CONTROL

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Supplemental Architectural Specifications

City of Winnipeg
Water and Waste
Department

METAL ROOF PANELS

Section 07 41 13
Page 10 of 10
2015-11-20

- .1 Testing Agency: General Contractor shall engage an independent testing and inspection agency acceptable to the Contract Administrator to perform field tests and inspections and to prepare reports of findings.

3.7 CLEANING AND PROTECTION

- .1 Touch-up, repair or replace metal panels and trim that have been damaged.
- .2 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Wash down exposed interior and exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths. Wipe interior surfaces clean as part of final clean-up.
- .4 Remove excess sealant with recommended solvent.
- .5 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION