UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 41 13.16

COPPER ROOF PANELS

08/09

PART 1 GENERAL

1.1 REFERENCES
1.2 DESIGN REQUIREMENTS
1.2.1 Wind Uplift Loads
1.2.2 Panel and Clip Design
1.2.3 Provisions for Expansion
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE
1.4.1 Manufacturer
1.4.2 Installer
1.4.3 Manufacturer's Representative
1.4.4 Mock-Ups
1.5 DELIVERY, STORAGE AND HANDLING
1.6 WARRANTY

PART 2 PRODUCTS

2.1 ROOF PANELS
2.2 ACCESSORIES
2.3 SOLDER AND FLUX
2.4 SLIP SHEETS
2.5 VAPOR RETARDER
2.6 BITUMINOUS COATING
2.7 SEALANT
2.8 FASTENERS

PART 3 EXECUTION

3.1 INSTALLATION
3.1.1 Tolerances
3.1.2 Substrates
3.1.3 Vapor Retarder
3.1.4 Slip Sheets
3.2 FIELD TESTING

3.3 CLEANING
3.4 PROTECTION

ATTACHMENTS:

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-- End of Section Table of Contents --

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SECTION 07 41 13.16

COPPER ROOF PANELS
08/09

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NOTE: This guide specification covers the requirements for copper roof system applied to solid roof decking.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

****
NOTE: This guide specification will be used in the preparation of project specifications for flat-seam, standing-seam, batten-seam, or custom-design type copper roofing installed over a substrate. The structural adequacy of the supporting system will be established prior to design of copper roof system.

Drawings will show scope of sheet metalwork and structural framing system, including type of decking and blocking, type of fire-retardant materials (if used), type and details of seams, and design requirements. When this specification is used for onsite fabricated copper roof, the Contractor may not be able to verify performance criteria such as

wind uplift. In such cases, drawing details of proven reliability and SMACNA recommended guidelines should be used and specified.

Copper roof systems in cold climates subjected to high snow accumulation must include snow guards, steep slopes (generally 6 on 12), and other approved details.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D1970/D1970M	(2019) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D2523/D2523M	(2013; E 2019; R 2019) Standard Practice for Testing Load-Strain Properties of Roofing Membranes

ASTM D4397	(2016) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D5147/D5147M	(2014) Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
ASTM E28	(2014) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus
ASTM E72	(2015) Conducting Strength Tests of Panels for Building Construction

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4050	(2016) Copper in Architecture - Design Handbook

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC48	(2012; R 2015) Acceptance Criteria for Self-adhered Roof Underlayment for Use as Ice Barriers

1.2 DESIGN REQUIREMENTS

Copper shall be formed to provide proper installation of elastomeric sealants. Form expansion joints of intermeshing hooked flanges not less than 25 mm 1 inch deep in accordance with CDA A4050.

1.2.1 Wind Uplift Loads

****
NOTE: Select the basic wind speed value from UFC 3-301-01. The importance and exposure factors will be obtained from ASCE 7-16.
****

The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of [_____] km miles per hour (fastest km mile), an importance factor of [_____], and an exposure factor of [_____]. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

Single fastener in each connection	3.0
wo or more fasteners in each connection	2.25

1.2.2 Panel and Clip Design

Panel and clip strength characteristics such as panel buckling strength, panel stiffness, side joint strength and clip/side joint shall meet requirements of ASTM E72. For the clip-to-substrate fastener selection,

incorporate a safety factor of 3.0 based on ultimate pull-out strength. Selection shall consider the pry effect which the outstanding leg of clip exerts on the fastener. Design end-laps for thermal movement. Use concealed anchor clips, and submit two samples of each type.

1.2.3 Provisions for Expansion

****
NOTE: Select appropriate temperature range based on effects of direct sun and general climatic conditions of the project site.
****

Copper roof panels shall be free to move in response to the expansion and contraction forces resulting from a total [110] [_____] degrees C [200] [_____] degrees F temperature range during the life of the structure.

1.3 SUBMITTALS

****
NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a

code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Copper Roof System; G[, [_____]]

SD-03 Product Data

Sealant
Qualifications

SD-04 Samples

Accessories; G[, [_____]]
Roof Panels
Fasteners; G[, [_____]]
Concealed Anchor Clips; G[, [_____]]

SD-06 Test Reports

Field Testing; G[, [_____]]

SD-07 Certificates

Copper Roof System

1.4 QUALITY ASSURANCE

Submit Qualifications for the following, as specified:

1.4.1 Manufacturer

Copper roof system shall be the product of a recognized copper roof system manufacturer who has been in the practice of manufacturing copper roof systems for a period of not less than [10] [_____] years and has been involved in at least 5 projects similar in size and complexity to this project. Submit design and erection drawings containing data necessary to clearly describe design, materials, sizes, layouts, seam configuration, construction details, provisions for thermal movement, line of panels, fastener sizes and spacings, sealants and installation procedures. Also submit certification that materials used in the copper roof system meet specified requirements.

1.4.2 Installer

The installer shall be skilled in the installation of the type of copper roof system required for this project, shall have a minimum of [10] [_____] years of experience, and shall have been involved in installing at least 3 projects that are of comparable size, scope and complexity as this project for the particular roof system furnished.

1.4.3 Manufacturer's Representative

A representative of the copper roof system manufacturer, who is familiar with the design of the roof system supplied and experienced in the erection of roof systems similar in size to the one required under this contract, shall be present at the project site during installation of the

copper roof to ensure that the roof system meets the contract requirements.

1.4.4 Mock-Ups

****
NOTE: Complexity of work and scope of quality control should be carefully evaluated before requiring Contractor to construct a mock-up. Delete paragraph if mock-up is not required.
****

Before proceeding with final purchase of materials and fabrication of copper roofing components, construct a mock-up of the work at the site in the size and location directed, including at least one example of each critical detail (ridge, hip, valley, etc.) as required in the project. The approved mock-up will establish the minimum standard of quality required for copper roofing work.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver materials to the project site in a dry and undamaged condition and stored them out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage accommodations for materials shall provide good air circulation and protection from twisting, bending, abrasion, discoloration or staining.

1.6 WARRANTY

Warrant the copper roofing installation for a period of 20 years against blow-off and leakage arising out of or caused by ordinary wear and tear by the elements. A sign shall be permanently attached to the building at the most likely roof access point advising of the existence of the warranty. The warranty shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier. The warranty shall guarantee that the design, detailing, materials, and accessories used for roofing work are approved by the roofing manufacturer and installed in accordance with specifications, drawings and other documents approved by manufacturer prior to installation.

PART 2 PRODUCTS

2.1 ROOF PANELS

Roofing sheets shall be cold-rolled copper sheets conforming to ASTM B370 temper designation, H00, minimum 4.9 kg per square meter 16 ounces per square foot containing 99.9 percent copper. Copper roof panels shall be factory-fabricated in accordance with approved drawings and CDA A4050 recommendations. Form sections true to shape in the longest practical lengths, accurate in size and free of distortion and defects. Exposed edges shall be hemmed on underside. Fabricate exposed copper work without excessive oil-canning, buckling, and tool marks. Submit one piece 225 mm 9 inches long, full width.

2.2 ACCESSORIES

Factory fabricate components required for a complete roofing system, including [trim,] [copings,] [fascias,] [corner units,] [ridge closures,] [clips,] [gutters,] [closure strips,] and similar items. Clip bases shall have factory punched or drilled holes for attachment. Clips used with

panel width greater than 305 mm 12 inches shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Provide cleats which are interlockable with the panels and of type and size to meet design requirements. Accessories shall be fabricated of type and thickness of sheet copper complying with CDA A4050. Submit one sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

2.3 SOLDER AND FLUX

Copper solder shall conform to ASTM B32. Flux shall be rosin, muriatic acid neutralized with zinc or an approved soldering paste.

2.4 SLIP SHEETS

Slip sheets shall be smooth rosin-sized unsaturated building paper weighing a minimum of 295 grams per square meter 6 pounds per 100 square feet. Sheets shall be attached with approved fasteners. Slip sheets shall be applied over vapor retarder, where applicable.

2.5 VAPOR RETARDER

****

NOTE: Vapor retarder requirements will be shown on the drawings when required for local climatic conditions. In northern climates, where ice and snow are considerations, a waterproof secondary membrane may be specified. Delete this paragraph if not required.

****

Vapor retarder shall be [non-perforated asphalt-saturated organic roofing felts conforming to ASTM D226/D226M, Type II (No. 30).] [polyethylene sheeting conforming to ASTM D4397. Provide a fully compatible tape which has equal or better water vapor control characteristics than the vapor retarder material.]Add a non-asphaltic underlayment as follows: Post consumer recycled content-35 percent; Thickness ASTM D5147/D5147M-30 mils min; Tensile strength ASTM D2523/D2523M -25 lbF/in min; Slip resistance ASTM D1970/D1970M; pass elongation ASTM D2523/D2523M; 20 percent min UV resistance ICC-ES AC48-210 hours @ 135-140 degrees F; tensile strength after UV resistance ASTM D2523/D2523M-25 lbF/in min. Also add a non-asphaltic self-adhered membrane as follows: Pass all ASTM D1970/D1970M tests plus: Post consumer recycled content-35 percent UV resistance ICC-ES AC48-210 hours @ 135-140 degrees F; tensile strength after UV resistance ASTM D2523/D2523M-25 lbF/in min thermal stability per ASTM E28 -260 degrees F.

2.6 BITUMINOUS COATING

Bituminous coating shall be cold-applied inert-type noncorrosive compound, nominally free of sulfur components and other deleterious impurities.

2.7 SEALANT

Provide sealant in accordance with CDA A4050 and manufacturer's recommendations. Submit descriptive information.

2.8 FASTENERS

****

NOTE: For projects in hurricane areas, edit this paragraph to provide the higher quality fastener types recommended.

****

Fasteners in contact with copper shall be copper, brass or Series 300 stainless steel capable of resisting the specified wind uplift and allowing for movement of roof panel system. Exposed fasteners shall be copper and shall only be used at batten caps and closures. Submit two samples of each type to be used, with statement regarding intended use. If so requested, random samples of each type of fastener, as delivered to the project site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

****

NOTE: Lumber and plywood in contact with copper will be non-treated or have a "non-corrosive" fire-retardant treatment.

****

Copper shall be separated from noncompatible metal and corrosive substrates with permanent type separators recommended by manufacturer. Install roofing panels, flashings and related accessories with approved fasteners in accordance with approved drawings and CDA A4050. Roofing components shall be set true to line and shall accurately fit together to form leak-proof joints. Fold panels back to form a hem on concealed side of exposed edges. Form exposed surfaces flat and free of buckles, waves, and tool marks. Provision shall be made for thermal expansion and contraction. Seams shall be uniform and neat with minimum of solder, welds and sealant. Fasteners and expansion provisions shall be concealed where possible in exposed work. Field-cutting of panels by torch is not permitted.

3.1.1 Tolerances

Panels shall be shimmed and aligned within a tolerance of 9 mm in 12 meters 3/8 inch in 40 feet vertically and horizontally and within 3 mm 1/8 inch offset of adjoining surfaces and of vertical alignment of matching profiles.

3.1.2 Substrates

Concrete substrates shall be made smooth with a wash of neat cement or with a heavy application of bituminous coating. If concrete is not nailable, set nailable inserts into the concrete. Substrates shall be clean, smooth, sound, dry, and free of defects and projections which might affect the installation. Projecting nails and other types of fasteners shall be secure and flush with substrate. Roof openings, pipes, vents, and other roof penetrations shall be securely set in place.

3.1.3 Vapor Retarder

****
NOTE: Delete this paragraph if vapor retarder is not required. If vapor retarder is required keep the appropriate brackets for roofing felts or polyethylene.
****

[Install roofing felts in accordance with manufacturer's recommendations.] [Install a single ply of 0.254 mm 10 mil polyethylene sheet or, at the Contractor's option, a double ply of 0.152 mm 6 mil polyethylene sheet over the entire support surface. Use tape to seal the edges of the sheets to the support surface, or to the sheet below. Sheet edges shall be lapped not less than 150 mm 6 inches. Provide sufficient material to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with the tape.]

3.1.4 Slip Sheets

****
NOTE: Slip sheets are required for all installations. Slip sheets must be installed over vapor retarder when vapor retarder is specified.
****

Install slip sheets with joints overlapped a minimum of 50 mm 2 inches, and secured with approved fasteners.

3.2 FIELD TESTING

****
NOTE: Field testing may not be required for all projects. Delete if not required.
****

Conduct [_____] random fastener pull tests in areas designated by the Contracting Officer. Fasteners for structural connections shall provide tensile and shear strength of not less than 3.3 kN 750 pounds per fastener. Submit test reports for uplift resistance of the copper roof system.

3.3 CLEANING

Upon completion of copper roofing work, remove grease and oil films, excess sealants and handling marks and clean the work in accordance with manufacturer's recommendations. Copper surfaces shall be cleaned of substances that would interfere with uniform oxidation and weathering. Exposed copper surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 PROTECTION

Protect copper roofing work to ensure the roof is without damage or deterioration. Roof panels and other components, which have been damaged or have deteriorated beyond successful repair, shall be replaced with new copper sheet metalwork. Storing, walking, wheeling or trucking directly on completed copper roofing work is not permitted. When required,

temporary walkways, runways and platforms fabricated of smooth clean boards shall be used to avoid damage to completed copper work. Maintain copper roofing work in a clean condition until final acceptance.

-- End of Section --