

UFC 3-110-04
11 January 2007

UNIFIED FACILITIES CRITERIA (UFC)

ROOFING MAINTENANCE AND REPAIR



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD\(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

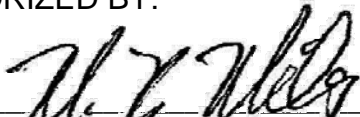
UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request \(CCR\)](#). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site <http://dod.wbdg.org/>.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.


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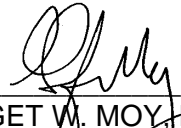
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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Description of Changes: UFC 3-110-04 unifies the roofing maintenance and repair criteria for DOD.

Reasons for Changes: Uses industry standards such as National Roofing Contractor Association and specifically the following:

- Roof Repair Manual for Low-Slope Membrane Roof Systems (www.nrca.net).
- Roofing Maintenance Manual – Publication of Roofing Industry Educational Institute (RIEI), Revised 1998 (www.nrca.net/riei).
- Architectural Sheet Metal Manual - Publication of Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), Revised 1993 (www.smacna.org).

Impact: There are negligible cost impacts. However, the following benefits should be realized.

- By using the industry standards, on-going revision due to industry changes will minimize the need for future revisions.
- By using the industry standards to accomplish improved maintenance and repair of roofs, facility sustainment costs will be reduced.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE

This UFC replaces Maintenance and Operation Manual MO-113, *Maintenance and Repair of Roofs*, by adopting available industry reference sources as Non-Government Standards describing repair methods and materials for various types of low-slope roof membranes and related components. Supplemental technical guidance has been added to complement the industry standards referenced and account for unique conditions that may be encountered by the user on Government facilities.

1-2 APPLICABLE DOCUMENTS

The documents listed in this section are specified throughout this standard. This section does not include documents cited in Appendix A.

1-3 NON-GOVERNMENT STANDARDS

The following publications form a part of this UFC to the extent specified herein.

1-3.1 *Roof Repair Manual for Low-Slope Membrane Roof Systems*

A joint publication of NRCA, ARMA and SPRI. 1997 (www.nrca.net).

1-3.2 *Roofing Maintenance Manual*

A publication of Roofing Industry Educational Institute (RIEI), Revised 1998 (www.nrca.net/riei).

1-3.3 *Architectural Sheet Metal Manual*

A publication of Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), Revised 1993 (www.smacna.org).

1-3.4 *Maintenance Manual for Spray Polyurethane Foam Roof Systems* (AY-127)

A publication of Spray Polyurethane Foam Alliance (SPFA), (www.sprayfoam.org).

1-4 DEFINITIONS

1-4.1 Bituminous and Single Ply Roof Systems

Refer to “Glossary” tab of *Roof Repair Manual for Low-Slope Membrane Roof Systems* (NRCA, 1997) for definitions and terms common to low-slope roof repair and related terms.

1-4.2 Spray Applied Urethane Foam (SPUF) Systems

Refer to “Glossary of Terms Common to the Spray Polyurethane Foam Industry,” (AY-119 – SPFA, 1994) for definitions and terms common to spray foam roofing.

1-4.3 **Sheet Metal Flashings and Components**

Refer to *Architectural Sheet Metal Manual* (SMACNA, 1993) for definitions and terms common to architectural and roofing sheet metal work.

1-4.4 **Maintenance**

The proactive efforts expended on a recurrent, periodic schedule that are necessary to preserve the condition of the roof components and systems as they were designed for their anticipated service life. Maintenance efforts generally occur prior to failure of the roof system to perform as intended, and include periodic inspections and resulting diagnosis of required repairs.

1-4.5 **Repairs**

The reactive work that is necessary to restore functionality to roof components and systems, typically following a failure.

1-4.6 **Alterations**

Changes to functional portions of the roof system, typically done in order to accommodate additional rooftop equipment.

1-4.7 **Warranties and Guarantees**

The contractual responsibility on the part of an outside party for repair of deficiencies during the term of the warranty. These are typically provided by the installing contractor, the roof system manufacturer, or both. For the sake of clarity, reference to warranties within this manual shall include guarantees.

1-5 **GENERAL REQUIREMENTS**

1-5.1 **Maintenance Versus Repair**

Facility roof maintenance requirements and standards shall be performed by personnel responsible for this task. An effective roof maintenance/management program is the platform on which the roof repair work standards specified herein are based. This UFC does not attempt to define standards for a maintenance or management program, including inspection and diagnosis of roof components and systems. The standards defined in this UFC relate to the actual repair methods and materials to be used only. The appropriate personnel shall determine the need for and appropriateness of repairs to roof components and systems prior to referencing this UFC and performing the specified repair work.

1-5.2 **Warranties**

The appropriate personnel shall determine the applicability of warranties prior to performing repairs to roof components or systems. If a warranty is in effect, the warrantor (contractor or manufacturer) should be contacted for recommendations as to the correct course of action. Warranties typically require this notification for both repairs and alterations, and any work performed must meet the warrantor's requirements in order to preserve the status of the warranty. The standards defined in this UFC assume that there are no warranties in effect.

1-5.3 Manufacturer's Information

The generic standards defined in this UFC represent established procedures known to be successful within the roofing industry for the majority of commonly available roof components and systems. The user is advised to ascertain the manufacturer of a roof component or system if possible prior to performing repairs in order to obtain technical information on the specific materials to be repaired and the appropriateness of proposed repair methods and materials. Manufacturer's technical information is particularly useful for repairs to single ply and modified bitumen systems, which tend to be more proprietary than traditional built-up roof materials.

1-5.4 Qualifications of Personnel

Roofing work by its nature can be difficult and dangerous for inexperienced, untrained workers. The repair standards and procedures cited in this UFC require varying levels of competency and training in order to be effective. The use of hot asphalt, torches, and solvent containing materials is common to roof repair work and misuse or lack of training on the part of workers can create more problems than solutions. The user shall ensure that qualified personnel are assigned or contracted to accomplish the repair work.

1-5.5 Hierarchy of Repair Work

Spot repairs, general repairs, and major repairs are commonly recognized classifications of repairs and the general level of effort required for accomplishing the work. Refer to the Introduction section of the *Roof Repair Manual for Low-Slope Membrane Roof Systems* for a detailed description of these classifications. Personnel responsible for making decisions related to assigning or contracting of repair work shall consider these classifications and the impact of considerations noted in 1-5.1 through 1-5.4 of this UFC.

1-5.6 Identification of Existing Roofing Components and Systems

Proper identification of the type of existing roofing materials and construction is crucial to the eventual success of the selected repair work. Assigning or contracting experienced, trained personnel and compiling proper documentation of the existing conditions shall be considered essential to the process of selecting a repair method specified below. Refer to the Identification Matrices for built-up, modified bitumen and single ply roof membranes in the Introduction section of

the *Roof Repair Manual for Low-Slope Membrane Roof Systems* for generic components that make up these systems.

1-5.7 Identification of Leak Related Repair Work

The initial phase of repairing defects in roof components and systems related to moisture infiltration is accurately identifying and locating the defect that is the source of the moisture infiltration. This step can be relatively simple or complex depending on the circumstances. Interior moisture infiltration that is observed and reported as a roof leak can be a result of defects or inadequate systems at adjacent elements of the structure, such as walls, windows, and rooftop mechanical units. Maintenance personnel shall perform an investigation to identify and locate leak damage related roof defects prior to performing repairs. This investigation shall include the following steps:

1-5.8 Location of Leak

Locate the interior leak damage by measuring from a reference point that can be easily identified on the roof. Typical penetrations such as vent pipes, drains and curbs are useful in the field of the roof. Exterior or rising wall elements and expansion joints can be used at perimeters. If roof defects are readily apparent at the correlated location on the roof, proceed with roof repair work.

1-5.9 Other Potential Leak Sources

If roof defects are not readily apparent and adjacent building elements are located close enough to be potential sources of the moisture infiltration, continue to investigate to determine the source of the leak causing the damage.

1-5.10 Moisture Damaged Roof Components

Maintenance personnel shall investigate areas of defects in roof membranes and flashings related to reported interior moisture infiltration to ensure that insulation components and other substrates that have been wetted as a result of leaks are replaced if necessary. In addition, should leak investigations conducted according to paragraph 1-5.7 result in the determination that the source of the moisture infiltration is an adjacent element and not the roof system, further investigation shall be performed to determine if the moisture has infiltrated and damaged the roofing substrates and components.

1-5.11 Fall Protection

Any person involved in roofing maintenance or repair work and exposed to fall hazards at heights shall be protected from falling to a lower level by the use of an approved fall protection system. Fall protection systems shall be installed and utilized in accordance with the US Army Corps of Engineers Safety and Health Requirements Manual (EM385-1-1) and OSHA standards as applicable. Prior to accessing the work location, it shall be determined that the roof has the strength

and structural integrity to safely support the weight of the workers, material and equipment related to their work. Workers shall not be permitted to work until it has been determined that the roof has the requisite strength and structural integrity to support the workers and equipment related to roofing work.

1-6 DETAILED REQUIREMENTS

1-6.1 Built-Up Roof Membranes

1-6.1.1 **Membrane Repairs.** Refer to Section 1, Parts 1 through 16 of *Roof Repair Manual for Low-Slope Membrane Roof Systems*.

1-6.1.2 **Flashing repairs.** Refer to Section 1, Parts 17 through 21 of *Roof Repair Manual for Low-Slope Membrane Roof Systems*.

1-6.1.3 **Sheet Metal and Penetration Repairs.** Refer to Section 1, Parts 22 through 30 of *Roof Repair Manual for Low-Slope Membrane Roof Systems*. If sheet metal components are determined to be non-repairable, refer to *Architectural Sheet Metal Manual* for technical information, specifications and drawings related to replacement sheet metal components.

1-6.2 Modified Bitumen Membranes

1-6.2.1 **Membrane repairs.** Refer to Section 2, Parts 1 through 13 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.2.2 **Flashing repairs.** Refer to Section 2, Parts 14 through 23 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.2.3 **Sheet metal and penetration repairs.** Refer to Section 2, Parts 24 through 32 of *Roof Repair Manual for Low-slope Membrane Roof Systems*. If sheet metal components are determined to be non-repairable, refer to *Architectural Sheet Metal Manual* for technical information, specifications and drawings related to replacement sheet metal components.

1-6.3 Thermoplastic Membranes

1-6.3.1 **Membrane Repairs.** Refer to Section 3, Parts 1 through 9 and 15 through 20 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.3.2 **Insulation Repairs.** Refer to Section 3, Parts 10 through 14 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.3.3 **Flashing Repairs.** Refer to Section 3, Parts 21 through 26 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.3.4 **Sheet Metal and Penetration Repairs.** Refer to Section 3, Parts 27 through 44 of *Roof Repair Manual for Low-slope Membrane Roof Systems*. If

sheet metal components are determined to be non-repairable, refer to *Architectural Sheet Metal Manual* for technical information, specifications and drawings related to replacement sheet metal components.

1-6.4 **Thermoset Membranes**

1-6.4.1 **Membrane Repairs.** Refer to Section 4, Parts 1 through 23 and 27 through 32 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.4.2 **Insulation Repairs.** Refer to Section 4, Parts 24 through 26 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.4.3 **Flashing Repairs.** Refer to Section 4, Parts 33 through 41 of *Roof Repair Manual for Low-slope Membrane Roof Systems*.

1-6.4.4 **Sheet Metal and Penetration Repairs.** Refer to Section 4, Parts 42 through 53 of *Roof Repair Manual for Low-slope Membrane Roof Systems*. If sheet metal components are determined to be non-repairable, refer to *Architectural Sheet Metal Manual* for technical information, specifications and drawings related to replacement sheet metal components.

1-6.5 **Spray Applied Urethane Foam Systems (SPF)**

1-6.5.1 **Coating Repairs.** Refer to Page 20 of the *Maintenance of Membrane Roofing Systems (RIEI)*. Identification of the type of coating (typically silicone, polyurethane, or acrylic) is crucial to the longevity of the repair. Personnel who have experience with these coatings shall do this determination.

1-6.5.2 **Insulation repairs.** Refer to Page 20 of the *Maintenance of Membrane Roofing Systems (RIEI)*. Detail 1 shall be used whenever long term repairs are necessary. Detail 2 shall only be used for short-term repairs.

1-6.5.3 **General.** SPF roof systems by their nature can be difficult for maintenance personnel to effectively repair even the most minor deficiencies. It is highly recommended that all repair work for SPF roof systems be contracted to an experienced SPF roof contractor.

1-6.6 **Protected Membrane Roof Systems (PMR)**

1-6.6.1 **General.** PRM systems are differentiated from traditional roof systems in that the thermal insulation is installed loose laid over the membrane and held in place with ballast such as gravel or concrete pavers. Removal and storage of the overburden components is necessary in order to perform repairs to the membrane. Due to the difficulty of the removal work, and the potential for additional damage as a result, maintenance personnel shall attempt to locate as closely as possible the areas of needed repairs in accordance with paragraph 1-5.7 in order to minimize the amount of overburden removed.

1-6.6.2 **Membrane and Flashing Repairs.** Remove existing gravel or paver ballast, geotextile fabric, and insulation boards in the area of the defect. Due to the nature of these systems, the area of overburden removal will be considerably larger than the repair area. Perform repairs in accordance with paragraph 1-5.1 through 1-5.4 of this UFC.

1-6.6.3 **Reinstallation of Overburden.** Reinstall insulation boards with tight joints and drainage channels facing down. Reinstall geotextile filter fabric so that all joints of insulation are completely covered and fabric is lapped a minimum of 6-inches (152mm). If fabric has been cut or excessively torn during removals, replace fabric. Reinstall ballast. Distribute gravel evenly to match existing conditions prior to repairs. Reset pavers on pedestals if used, so that pavers are solidly set and do not rock. Replace pavers broken as a result of removals.

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APPENDIX A ADDITIONAL RESOURCES

Handbook of Accepted Roofing Knowledge Manual – Publication of National Roofing Contractors Association (NRCA), 10255 W. Higgins Road, Suite 600, Rosemont, Illinois 60018-5607, 1996.

Manual for Inspection and Maintenance of Built-up and Modified Bitumen Roof Systems: A Guide for Building Owners - Joint publication of ARMA and NRCA. Revised 1988 [ARMA-Center Park, 4041 Powder Mill Rd, Ste 404, Calverton, MD 20705 – (301) 231-9050]

Manual of Roof Inspection, Maintenance and Emergency Repair for Existing Single Ply Roofing Systems – Jointly published by NRCA and SPRI. (SPRI – 200 Reservoir St, Suite 309A, Needham, MA 02194 – (781) 444-0242

Repair Methods for Reattaching EPDM Membrane & Flashing Experiencing Shrinkage – MRCA, 4840 W. 15th Street, #1000, Lawrence, KS 60049-3846 – (913) 843-4888

Accreditation Manual for Polyurethane Foam Contractors – Society of the Plastics Industry, Inc. (SPI), Spray Polyurethane Foam Division, 1801 K St. NW, Ste 600K, Washington, DC 20006 – (800) 523-6154

Roof Repair Handbook – Koppers Industries, Inc., 436 Seventh Avenue, Pittsburgh, PA 15219 – (412) 227-2537

Guidelines to Maintaining Good Roofs – Tremco, 3777 Green Road, Beachwood, OH 44122 – (216) 292-5000

BURSI Maintenance Manual – BURSI – c/o Johns Manville Corp., P.O. Box 5108, Denver, CO 80217 – (303) 978-2000

Roofing Coverings – 1-47 and Repair Procedures – 1-48, Factory Mutual System, 1151 Boston-Providence Turnpike, Norwood, MA 02063 (617) 762-4300

Moisture Migration in Buildings – ASTM STP 779, ASTM, 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959

Periodic Roof Inspection & Maintenance Program – Sarnafil Inc., P.O. Box 380, Canton, MA 02021 – (617) 828-5400

Guidelines For Roof Mounted Outdoor Air Conditioner Installations – NRCA, SMACNA, ARI Joint Publication

Manual for Maintenance, Repair & Reroofing/Insulation – GAF Mat'ls. Corp., 1361

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NRCA Roofing & Waterproofing Manual – NRCA, O'Hare International Center,
10255 W. Higgins Road, Suite 600, Rosemont, IL 60018-5607 – (847) 299-9070

USA CERL Technical Report M-90-04 – CERL, P.O. Box 4005, Champaign, IL
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