

The Air Force manual goes under the knife

The U.S. Air Force's roofing manual has been a subject of controversy since its release six and a half years ago. Contractors who have attempted to comply with the manual have found it to be a strict and rigid document that made unnecessary demands on the workmanship of the roofing crew.

All that has changed. After some major surgery, a new document has emerged with a point of view much closer to the Association's own. Contractors working with the new manual will find its approach toward quality control and application tolerances to be much more in line with real-world applications.

Original lacked industry input

It has taken more than seven years to get these changes into the manual. The original manual, officially titled the Air Force Manual—Real Property Operation and Maintenance—Built-Up Management Program, AFM 91-36, was prepared by Construction Consultants, Inc., (CCI), and released by the Air Force in 1980 without any input from the roofing industry. Since the document's release, the industry has had much to say about its requirements and guidelines. The revised manual is the Air Force's response to this criticism.

The Air Force developed the original document to help base civil engineering create and maintain ongoing built-up roof management programs. One of the purposes of the Air Force's management programs was the establishment of in-house preventive maintenance plans for Air Force roofs already in service. The preventive maintenance measures included cataloging and quantifying roof serviceability and using established in-house repair techniques.

Another purpose was to outline procedures for purchasing and supervising contract work. The manual offered guidelines for determining the best roofing solutions, preparing construction documents that defined and controlled construction quality, and holding suppliers accountable.

Chapters 5 and 6 of the original manual were the sections that most directly involved the roofing industry. Chapter 5 covered specification development and Chapter 6 application tolerances. The balance of AFM 91-36 was intended to help in-house crews assess and maintain the Air Force's roofs. The manual only involved roof repair and replacement. New roofing for the Air Force is bid under contract with the Corps of Engineers.

It was the manual's two chapters on specifications and tolerances that had roofing contractors up in arms. Working through NRCA, the contractors voiced their objections to the manual's suggested field evaluation methods (test cuts), its limited acceptance of roofing materials, the quality controller concept it expressed, and its provisions for including the Air Force's established application tolerances in bid documents.

NRCA urged the document's developers to revise the manual almost from the beginning. As early as 1981, an NRCA task force was working with CCI on manual changes it thought were needed. In 1983, the task force began working directly with Air Force representatives from Tyndall Air Force base in Florida.

In the early stages of negotiations with the Air Force, NRCA submitted extensive revisions to Chapters 5 and 6 of the manual. The Association followed up these suggestions with a comparison of built-up roof sample data from the Chicago Testing Laboratory and data from Air Force samples that had been tested by Lincoln Laboratories. This data included the average amounts of headlap, interply bitumen, surfacing bitumen, aggregate and voids found by the two labs in the samples. Chicago Testing Laboratory also tested built-up roof samples from the field for load strain properties, and these test results were also compared with Lincoln's.

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Chicago Testing's lab data formed the basis for a series of BUR application tolerances, which NRCA submitted to the Air Force for inclusion in AFM 91-36. These tolerances were submitted with the endorsement of the Asphalt Roofing Manufacturers Association.

Quality Control makes difference

NRCA's work with the Air Force took a new direction with the 1985 release of the Association's *Quality Control in the Application of Built-Up Roofing*. NRCA submitted *Quality Control* to the Air Force and suggested that the criteria in AFM 91-36 be revised according to the document's guidelines, which show a definite preference for continuous visual on-site evaluation and inspection rather than off-site or laboratory test cut analysis. NRCA believes on-site analysis allows corrections and adjustments to be made promptly, permitting work to continue, and reducing the size and costs of repairs or corrective actions.

Quality Control also emphasizes those parameters of application that are important to roof system performance. The document says that if verification of applied weights and quantities is required for accounting or documentation purposes, this information can be obtained more effectively by means other than test cut analysis.

After reviewing *Quality Control*, the Air Force asked NRCA to explain the differences between the tolerance criteria NRCA had submitted earlier and the criteria that could be found in the document. NRCA told the Air Force that the document is much broader in scope than the original tolerances because it discusses the overall responsibilities for quality control and successful roof system performance. In addition, it was claimed, the document recommends specific techniques for observation, measurement and sampling, and discusses the acceptable variances that visual examinations or test cut analyses may reveal.

Another important section of *Quality Control* that was pointed out to the Air Force contains recommendations for corrective actions should anticipated variances be exceeded.

NRCA also pointed out the differences between *Quality Control* and the Air Force manual. The most significant difference highlighted by the Association was *Quality Control's* inclusion of visual examination criteria for rates of interply moppings, surfacings and aggregate. NRCA strongly believes the document's five visual criteria, which are easily identified, measured and corrected in the field, are the most important factors governing roof quality.

NRCA prefers *Quality Control's* criteria because they provide a realistic way to monitor roof system applications, and they do not attempt to use precise measurements of applied materials as a way to evaluate roof system performance. The criteria stress the importance of a continuous film of interply bitumen and complete coverage of surfacing bitumen and aggregate. These criteria permit evaluation of the entire roof area, and not just the small sections represented by sampling.

Another difference between *Quality Control* and the Air Force manual is the way the two documents view test cuts. While AFM 91-36 relies on them to evaluate the application, *Quality Control* discourages the use of test cuts as the sole means to determine if a roof passes or fails. *Quality Control's* objection to test cuts is based on the fact that a uniform application of materials is not possible in built-up roofing. Consequently, using isolated test cuts to represent a larger roof area is misleading. The document does, however, recognize that in some cases contracts will require test cuts. In these situations, *Quality Control* recommends that the cuts be made prior to final surfacing, immediately evaluated in the field, and then replaced and repaired. These procedures permit immediate correction of deficiencies and adjustments to application techniques.

NRCA also suggested to the Air Force that *Quality Control* offers a better way to evaluate membrane integrity and interply voids. Like the Air Force, NRCA believes that interply voids must be controlled and reduced to the point where they do not effect the performance of the roofing system. But by specifying the maximum allowable size and number of voids in the original manual, the Air Force chose a controversial and arbitrary way to deal with this problem, according to the Association.

NRCA's approach, as outlined in *Quality Control*, is to use an on-site edge analysis of a 4-by-40-inch test cut to check for voids. If dry voids of any size or through voids are found, the roof does not pass. *Quality Control* also lists the percentage of encapsulated voids found in the sample that will be permitted. This amount is greater than the Air Force's because a greater area is being sampled. Also, *Quality Control's* size criteria for individual voids has been changed to be more in line with voids that are typically encountered in satisfactory roofs.

The Air Force responds

One of the first steps taken by the Air Force in response to the roofing industry's comments was to change AFM 91-36's insulation selection criteria. In the original

manual, only fiber glass insulation was allowed. After studying the matter, the Air Force released a report in early 1984 that called for the inclusion of all roof insulations in AFM 91-36. At the same time, the Air Force commissioned other reports that outlined BUR insulation systems basics and provided a decision guide for roof insulation R-value. The latter report gave the Air Force life-cycle cost formulas for estimating the optimum R-value on typical Air Force buildings throughout the United States.

Chapters 5 and 6 of the manual were revised when both sections were replaced with a section titled the Built-Up Roofing Repair/Replacement Guide Specification. NRCA was asked to review a draft of this revision in October 1986.

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New Air Force manual will include several major changes

The primary changes to the Air Force's built-up roofing manual agreed upon by the Air Force and NRCA include:

■ **Description of Work.** Under this heading, the wording was changed from requiring the BUR to satisfy the quality control standards of the "manufacturer's 20-year type system" to satisfying the standards of the "manufacturer's best quality system."

■ **Storage of Materials.** This section was made less restrictive.

■ **Quality Controller.** The Air Force representatives agreed to insert the following sentence, which appears in the NRCA's *Quality Control*: "The most effective means to evaluate quality installation is by thorough, continuous visual examination at the time of application, conducted by a person who is knowledgeable in roofing technology and good workmanship practices."

The Air Force will provide its own personnel to evaluate roof system applications daily and accept or reject the roof on a daily basis. The Air Force will also no longer require the passing or failing of roofs based on an independent laboratory's evaluation of test samples.

■ **Slope.** Changes in the requirements for slope and positive drainage were included in accordance with NRCA's recommendations.

■ **Expansion joints.** The revised manual's criteria for expansion joints will follow NRCA's details.

■ **Flashings.** NRCA's recommendations have also been followed in the flashing installation section of the manual.

■ **Flood coat and aggregate.** The original manual's requirements that the flood coat and aggregate be applied on the same day as the felts are laid has been deleted. The wording will stipulate that graveling-in may be delayed for designated roof areas if approved in writing by the contracting officer and job conditions dictate this procedure.

■ **Membrane sampling.** The revised manual will require only one test cut measuring 4 inches by 40 inches per day as directed. The sample is to be cut perpendicular to the long dimension of the felts and examined for voids, trapped moisture, felt on felt, embedment of felt and the presence of harmful foreign materials as well as compliance with the roof specifications. It will be no longer necessary to

take 12-inch-by-12-inch test cuts and send them to a government-approved laboratory.

■ **EVT.** NRCA's recommendations on equiviscous temperature (EVT) will be followed.

■ **Laps and voids.** NRCA's recommendations on headlaps, endlaps, fastener spacings, insulation joint gaps and maximum voids will be included in the revision.

■ **Glass felts.** The use of glass fiber felts in addition to the use of coal tar felts will be allowed in the new manual.

■ **Insulation.** The new manual also includes all insulations. The old document restricted Air Force specifiers to fiber glass insulation.

■ **Bitumen.** Both asphalt and coal tar are included in the revised AFM 91-36. Only coal tar was specified previously.

NRCA and the Air Force reached an agreement on many other minor changes and corrections as well. In general, NRCA's main concerns and recommended changes involving application requirements, on-the-job sampling and analysis, construction tolerances, and test cuts were found acceptable by the Air Force representatives.



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During this review, a task force consisting of contractor Dick Baxter, NRCA Research Associate Bill Cullen and myself discovered that even with the Air Force's changes the manual was still in opposition to NRCA's positions. It was decided that the Association would propose further changes to the manual, and a meeting with the Air Force to discuss these revisions would be set up.

At the meeting, which occurred Feb. 4, 1987, a list of about 30 concerns, comments and recommended changes to the Air Force's Built-Up Roofing Repair/Replacement Guide Specification was presented for discussion. This action resulted in many major changes being agreed upon by both groups for inclusion in the final copy of the Air Force manual. (See sidebar.)

The final revision copy will be sent to NRCA sometime this month for a final review. It is possible that the document will receive NRCA's full concurrence at this time.

A final word from the Air Force

Dennis Firman, coordinator and principle contact for the Air Force on the revision to AFM 91-36, has prepared a statement on these revisions, which I am reprinting in its entirety.

"The Air Force Roof Management Program policy is set forth in AFM 91-36, Built-Up Roof Management Program, dated Sept. 3, 1980. Chapters 5 and 6 of this manual contains the built-up roof specifications and guidance for contract procedures of these systems for the Air Force. The entire program is currently under revision to better conform with the Air Force way of doing business.

Program policy will be provided in Air Force Regulation 91-36, Low-Slope Roof Management Program. This regulation will reference an Air Force pamphlet and an engineering technical letter that will contain recommended procedures and specifications to be used in implementing the roofing program. Basic changes to the specifications will include the following:

- *updated material specifications and installation procedures;*
- *on-the-job roof membrane sampling and analysis (no laboratory sample analysis);*
- *daily audit of work by an Air Force technical representative;*
- *detailed construction tolerances; and*
- *deletion of daily graveling-in requirements.*

The new revised built-up roofing specification should be available for use on Air Force reroof projects by spring 1987."

As a result of the cooperation between the Air Force, NRCA and others, this revision of the Air Force manual will be a vast improvement over the present edition. With the criteria changes, it will avoid future problems with compliance and offer more opportunity for NRCA member contractors to bid on Air Force roofing jobs.