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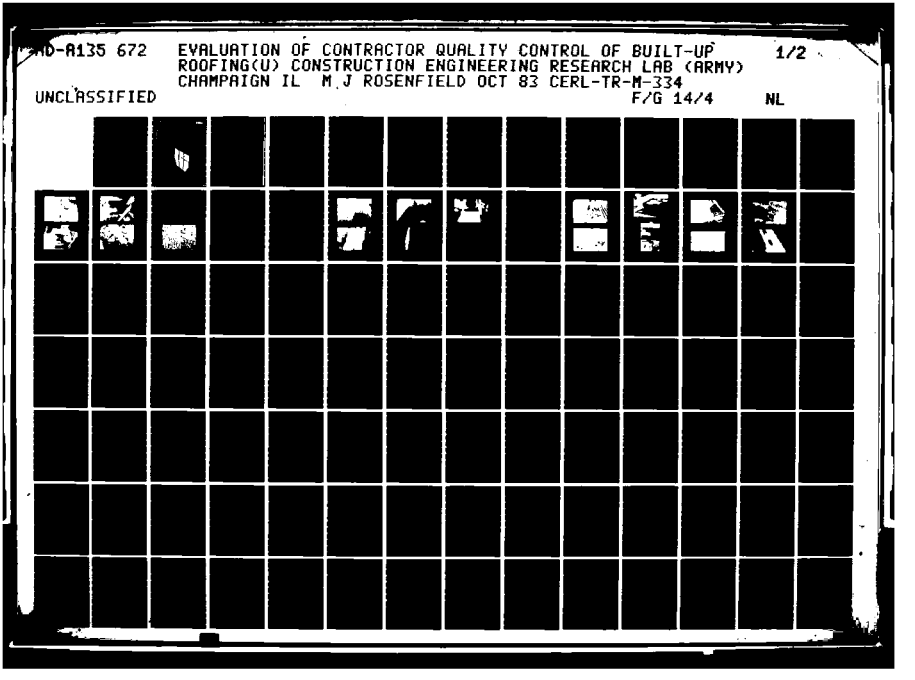

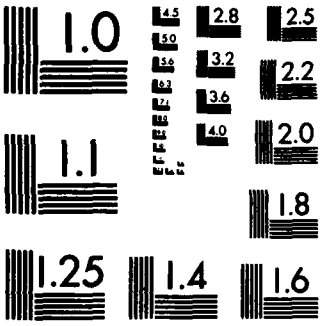

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US Army Corps
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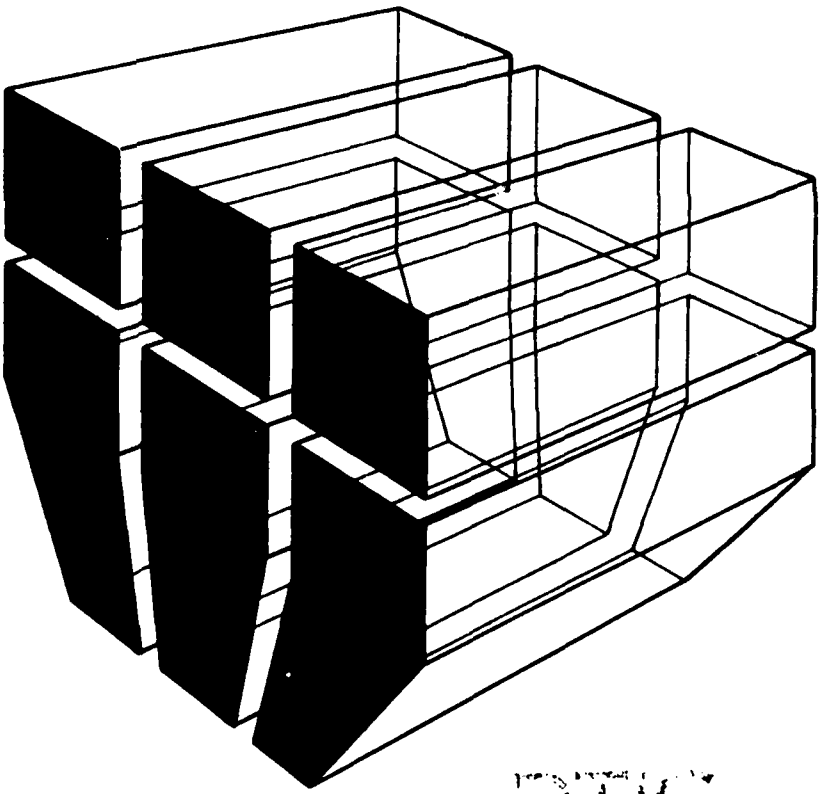
TECHNICAL REPORT M-334
October 1983

EVALUATION OF CONTRACTOR QUALITY CONTROL OF BUILT-UP ROOFING

by
Myer J. Rosenfield



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Special requirements for contractor quality control (CQC) of built-up roofing (BUR) were written and incorporated into the contract for construction of three tactical equipment maintenance shops. The site was visited during the construction of each shop to observe the roofing application and evaluate the effectiveness of the CQC specification. It was found that the specification is not observed as much as it should be.

(Continued on next page)

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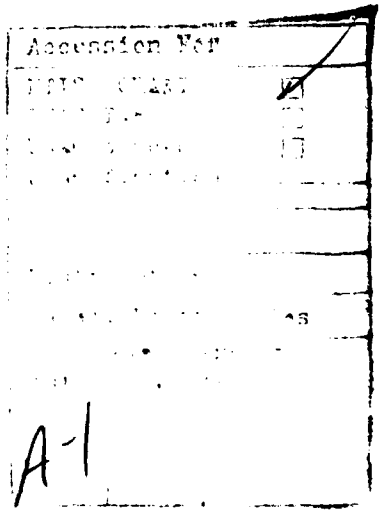
The quality of the CQC function depends to a great extent on the capabilities of the CQC representative and the number of other duties he must perform. CQC can best be improved by insuring that the quality assurance representative spends enough time on the roof during its construction to note and correct deficiencies in a timely manner and to insure that the CQC representative is performing properly.

FOREWORD

This research was conducted for the Assistant Chief of Engineers under Project 4A162731AT41, "Military Facilities Engineering and Technology"; Task A, "Facilities Planning and Design"; Work Unit 044, "Improved and New Roofing for Military Construction." The work was performed by the Engineering and Materials Division (EM), U.S. Army Construction Engineering Research Laboratory (CERL). The Technical Monitors were Mr. J. Ichter, DAEN-ECE-S, and Mr. J. Seifer, DAEN-ZCF-B.

Appreciation is expressed to Mr. Herbert Fishman and Mr. Bruce Darling of H. B. Fishman & Co., Inc., who performed the three field inspections and provided an analysis of their observations.

Dr. R. Quattrone is Chief of CERL-EM. COL Paul J. Theuer is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.



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1 INTRODUCTION

Background

Before the late 1960s, four-ply built-up roofing (BUR), installed on Army facilities in accordance with Corps of Engineers Guide Specification (CEGS) 220.12,[1] could be expected to have a useful service life of 20 or more years if an adequate maintenance program were established. Since then, the life expectancy of BUR has decreased to an average of less than 12 years, with some roofing requiring complete replacement after only 18 months. There are many possible reasons for this situation:

Quality of Felts

For nearly a century, organic roofing felts were made from mashed rags rolled into a sheet and treated with pitch. However, as cotton cloth became scarcer and replaced with synthetic fibers, roofing felts were made from wood pulp (paper), commonly called cellulose. These paper felts are much weaker than the previous rag felts; they are also more hygroscopic, tending to absorb and retain more moisture. These felts cannot be fully saturated with asphalt during either manufacture or installation; this can cause them to absorb water during service.[2]

Bitumen Used for Roofing

Originally, BUR was commonly made from coal-tar pitch, a byproduct of the manufacture of coke used in the steel industry and of coal-gas for heating and illuminating. Coal tar was gradually replaced with asphalt during the 1960s and 1970s. Very little of it is used today, even though it becomes almost liquid when heated by the sun, and all cracks formed when it is cold and brittle tend to disappear. Although asphalt softens, it does not liquefy, and cracks tend to remain, allowing moisture to penetrate. One reason for not using coal tar is its cost; asphalt costs about $250 to $300 per ton, while coal tar costs $450 to $500 per ton. Another reason is that coal tar fumes are a health hazard.

Quality of Asphalt

When the Arab oil embargo started in 1973, refiners started cracking their crude oil to a greater degree, and the quality of the remaining asphalt deteriorated. This has been reflected in ASTM D 312,[3] the recognized standard for roofing asphalt, which was revised in 1978. Recently, it has been recognized in the literature[4] that the quality and characteristics of various BUR asphalts differ. The National Roofing Contractors Association[5] has completed a testing program which investigated differences in asphalt quality on a nationwide basis, as well as lack of compliance with ASTM D 312. The results of these tests will be available soon.

Quality of Workmanship

The number of roofing contractors and their employees has increased over the past few decades, but roofing crews have become less skilled. Also, users have demanded quick completion of roofing and have increasingly emphasized lowest initial cost. These and other factors have contributed to a decline in the quality of workmanship in BUR installation. A report published by the U.S. Army Construction Engineering Research Laboratory (CERL) discussed these factors and described current practices of controlling BUR quality.[6]

Contractor Quality Control

The Department of Defense has been making the contractor responsible for controlling the quality of work performed by both his* own organization and any subcontractors employed on the project. Requirements for this function are interpreted differently by the Army, Navy, and Air Force, reflecting

[1] *Built-Up Roofing for Application Directly on Decks and on Insulation (or Underlayment)*, CE 220.12 (Corps of Engineers, June 1968) (superseded in 1977 by CEGS 07510, *Built-Up Roofing*).

[2] Robert Bynoe, "Saturated Organic Felts: Let's Perceive Them As They Are," *Roofing, Siding, Insulation (RSI)*, Vol 57, No. 10 (October 1980), p 79.

[3] *Specification for Asphalt Used in Roofing*, ASTM D 312 (American Society for Testing and Materials, 1971 and 1978).

[4] John W. Hopkins, "There's More to Built-Up Roofing Asphalt Than Black and Sticky," *Western Roofing*, Vol 4, No. 1 (February 1981), p 6.

[5] Robert LaCosse, "NRCA/ARMA Undertake Ambitious, Yearlong Asphalt Sampling Testing Program," *The Roofing Spec*, Vol 10, No. 3 (March 1982), p 42.

[6] E. S. Lindow, et al., *Built-Up Roof Construction Quality Control*, Technical Report M-267/ADA073619 (U.S. Army Construction Engineering Research Laboratory, July 1979).

* The male pronoun is used throughout this report to refer to both genders, except where referring to a specific individual.

their individual needs, but causing inconsistency in roofing quality. These requirements are summarized in Chapter 2.

These problems have caused high maintenance and repair costs for BUR at permanent Army installations. It is therefore necessary to improve the Army's current methods of quality control/quality assurance of BUR to decrease these costs.

Objective

The objective of this report was to study and recommend measures for improving roof construction contractor quality control (CQC) in order to upgrade the performance of BUR on Army facilities.

Approach

Existing CQC requirements as used in Army, Navy, and Air Force BUR contracts were reviewed. A proposed standard CQC specification combining features of these sources was prepared and forwarded to the Omaha District, which incorporated portions into the Special and Technical Provisions of the contract for construction of three facilities. CERL personnel attended the roof preconstruction conferences and followed up by actually monitoring the roof construction at all three projects.

Mode of Technology Transfer

It is recommended that the proposed CQC specification be included in CEGS 07510, *Built-Up Roofing*.

2 SUMMARY OF EXISTING QUALITY CONTROL REQUIREMENTS

Corps of Engineers Requirements

Defense Acquisition Regulation (DAR) 7-602.10(a), *Contractor Inspection System*, authorizes Department of Defense agencies to require contractor quality control (CQC) on construction projects. This regulation resulted in the adoption of the following contract General Provision clause by the ASPR Committee in 1961:

> The contractor shall (i) maintain an adequate inspection system and perform such inspections as will assure that the work performed under the contract conforms to contract requirements, and shall (ii) maintain and make available to the government adequate records of such inspections.—ASPR (now DAR) 7-602.10(a)

Engineer Regulation (ER) 1180-1-6[7] provides current CQC requirements of the Corps of Engineers. This regulation was adopted as authorized by DAR 7-602.10(a). It applies to all construction contracts of more than $10,000 awarded and supervised by Corps of Engineers districts or divisions. It does not apply to contracts awarded by Army installations. Since the regulation applies to all types of construction, the Contracting Officer of each project is charged with preparing (1) contract special provisions which "establish the requirements for a Contractor Quality Control program," and (2) contract technical provisions which "establish the level of quality required and should clearly state the specific inspections and tests the contractor will be required to perform to maintain quality control." Carrying out the regulation requires that each construction project have a CQC program tailored to its specific needs.

In practice, the use of ER 1180-1-6 has led to the inclusion of generalized paragraphs, most of which are taken almost verbatim from the regulation. These paragraphs apply to all phases of construction and do not address the specific needs of any one operation (e.g., land clearing, roofing, etc.). Appendix A gives two typical Army CQC specifications.

U.S. Navy Requirements

The U.S. Navy has included all its generalized requirements in its General Provisions for Construction Contracts (see Appendix B). The Naval Facilities Engineering Command (NAVFAC) has also issued two formal specifications: NFGS-01400, *Contractor Quality Control System*,[8] and NFGS-01401, *Contractor Inspection System*.[9] The two documents relate to DAR 7-602.10(a), but are written in the form of construction guide specifications, with standardized wording for the various requirements. They also include standard forms for use by the contractor in logging his submittals and in submitting his daily CQC reports. Like the Army requirements, the Navy provisions are general in nature and do not address the specific needs of any one construction operation. Appendix C provides the NAVFAC specifications.

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[7] *Construction Quality Control*, Engineer Regulation 1180-1-6 (Office of the Chief of Engineers, 17 July 1978).

[8] *Contractor Quality Control System*, NAVFAC Specification NFGS-01400 (Naval Facilities Engineering Command, June 1981).

[9] *Contractor Inspection System*, NAVFAC Specification NFGS-01401 (Naval Facilities Engineering Command, June 1981).

U.S. Air Force Requirements

The U.S. Air Force has prepared a CQC specification which is required on all Air Force BUR work, whether it is contracted by Corps of Engineers districts or by base civil engineers. This CQC specification is contained in AFM 91-36.[10] This manual contains a complete BUR guide specification for Air Force use and a CQC specification tailored to the BUR requirements. It also includes forms for daily CQC reports, again tailored to BUR requirements. Appendix D gives the Air Force CQC requirements.

Relationship of Quality Assurance to Quality Control

Although CQC has replaced Government inspection of construction work, it has not relieved the Government of verifying that the work is done properly. For this reason, quality assurance (QA) personnel are assigned by the Contracting Officer to oversee and monitor the CQC program. These personnel do not perform the inspection formerly performed by Government inspectors, but are primarily required to monitor the CQC program for the entire construction project. Their main function is to assure that the Contractor performs the quality control functions as specified in the contract documents and that the proper reports are completed and submitted. However, the QA personnel do have the authority to take any measures necessary to assure that the Government receives the product as specified, including performing inspection and conducting tests as deemed necessary.

3 QUALITY CONTROL SPECIFICATIONS

Recognizing the need for better control of CQC, the Office of the Chief of Engineers (OCE) requested that CERL develop and test a candidate specification for use in Army contracts for new or replacement BUR. The first step in this development was to review current practices and determine their effectiveness. Investigators visited several sites where roof construction was in progress, and reviewed and evaluated methods for performing and controlling CQC.[11] This evaluation emphasized the need for CQC contract provisions directly related to BUR contract specifications.

Specifications Developed for the Test Program

Navy and Air Force standard requirements for CQC (Appendices B, C, and D) were compared with Corps of Engineers' contracts for BUR. The common features of each were extracted and included in a proposed BUR CQC requirement. The Air Force daily report form and the Navy submittal form were also adapted and included, and a supplement was prepared with specific application to BUR. It was intended that this requirement replace the variations as given in Appendix A, so it was rather lengthy (see Appendix E). It was reviewed by personnel at OCE, Huntsville Division, Missouri River Division, and CERL, as well as by two outside consultants. All reviewers commented that the document was too long and should be reduced. This could be done by: (1) inserting all technical provisions into the technical specifications, (2) issuing a supplement to the technical provisions containing all CQC requirements which pertain only to BUR, and (3) leaving all general CQC requirements in the Special Provisions.

Specifications Included in the Contract

The above three steps were performed for a specific construction contract. Appendix F contains the Special Provision paragraphs on CQC, the technical specifications for insulation and BUR, and the Quality Control Guide for Built-Up Roofing from this contract.

The original CERL document specified that the CQC representative report directly to an officer of the Contracting company and not be subordinate to the job superintendent or project manager. This requirement was not included in the contract, with the result that the CQC representatives appointed were all employees of the roofing subcontractor, and so did not report to an officer of the General Contractor.

4 TEST SITE SELECTION

It was necessary to find a construction project which was still in its earliest planning stages, so that the requirements could be incorporated with as little impact on the estimate, plans, and specifications as possible. Early in calendar year 1980, the Missouri

[10] *Built-Up Roof Management Program*, Air Force Manual 91-36 (Department of the Air Force, 3 September 1980).

[11] E. S. Lindow, et al.

River Division offered the use of proposed construction of three tactical equipment maintenance and repair shops at Fort Carson, CO. Roofing would be performed during calendar year 1982. This timing was agreeable to all interested parties, so the contract was used for this project.

5 CONSTRUCTION OF TEST ROOFS

The pre-roofing conference was held on 9 February 1982 at Fort Carson. This conference was attended by the field superintendent and CQC representative of the general contractor, the roofing foreman, the CQC representative and sheet metal foreman of the roofing subcontractor, the mechanical foreman of the mechanical subcontractor, the area and resident engineers of the District Corps office, and a CERL representative. The contract provisions were reviewed line by line. It rapidly became apparent that neither the general contractor nor the subcontractor had read the specifications before, since no submittals had been made, samples were not from materials delivered for the job, and the kettles were not equipped with the required temperature recorders. Requirements regarding delivery and storage of materials were emphasized, and the contractor admitted that many of his planned actions were not permitted by the contract. Both the general contractor and the subcontractor were surprised by many of the contract requirements, but agreed that they were necessary to test the CQC specification.

Armor Battalion

Construction of the Armor Battalion shop roof began on 16 March 1982. The site was visited on 24 March 1982 to inspect and determine compliance with the contract's CQC requirements. The first step was to interview the key personnel associated with the roofing operations. These were the field superintendent and CQC representative of the general contractor, the CQC representative of the roofing subcontractor, and the Omaha District project engineer. The contract specifies that a separate quality control group shall be provided, who shall report to the contractor's management at an executive level. This is not the same as requiring that the individual appointed as CQC representative report to an officer of the Contracting company. That the roofing CQC representative is an employee of the roofing subcontractor raises serious questions about compliance with this contract requirement. This person also had other responsibilities on other phases of the overall construction work; the requirement that he be physically on the roof at all times during roofing operations seriously affected his performance of these other duties. As a result, he could not concentrate on controlling the roofing work.

Figure 1 shows the Quality Control Record for 24 March 1982. This record, signed by the QC representative of the roofing subcontractor, indicates compliance with specified requirements for work items except Number 19. Inspection of the workmanship by the CERL investigator indicated that many variances actually occurred, but were not noted on the official report. Some of these were:

- Item 2, Equipment Requirement: Verify accuracy of thermometers and metering devices. Indicated temperatures of asphalt in kettles varied as follows:

Kettle	Asphalt	Recorder	Kettle Thermometer	Inspector's Thermometer
300 Gal	Type III	400°F	430°F	460°F
500 Gal	Type II	460°F	470°F	500°F

These differences could seriously affect the properties of the asphalts.

- Item 8, Insulation Requirement: Check insulation orientation, staggered lap, joint width, and nailing. Variances:

The bottom layer of insulation had voids greater than the specified limit of 1/16 in. (1.6 mm) (Figure 2).

The second row of the bottom layer of insulation was not properly mechanically fastened according to Factory Mutual requirements (Figure 3).

Joints in the second layer of insulation were not staggered the maximum dimension with respect to joints in the first layer, and damaged units of insulation were not replaced (Figure 4).

- Item 11, Membrane Construction Requirements: Check for proper installation practices, including bitumen quantities, brooming, etc. Variance: Felts not fully adhered in bitumen (Figure 5).

QUALITY CONTROL RECORD

RECORD NO. 8 | DATE 3-24-82

PROJECT NUMBER: DACA 15-81-C-0155 | BLDG NO.: ARMOR

WEATHER (Describe): Sunny - Breezy | AVERAGE TEMPERATURE:

ROOFING CREW: START 7-10 Make Ready (AM) 1000 Start B&S (PM) | STOP 3:30 (AM) (PM)

QUALITY CONTROLLER: START 8:30 (AM) (PM) | STOP 4:30 (AM) (PM)

TOTAL ROOF AREA (Squares): 14720' NW Lower Level Area 3 | COMPLETED TODAY: 7 square | TEST SAMPLES REMOVED: None

PRODUCTS (See Project Specifications) (Check Appropriate Box Below) / EXECUTION (See Quality Control Guide) (Check Appropriate Box Below)

COMPONENTS (Type, Quantity, Size)	COM-PLIES	VARIES	NOT APPLI-CABLE	WORK ITEM	COM-PLIES	VARIES	NOT APPLI-CABLE	WORK ITEM	COM-PLIES	VARIES	NOT APPLI-CABLE
UNDERLAYMENT			X	1	X			13	X		
INSULATION	X			2	X			14	X		
MEMBRANE	X			3	X			15	X		
COMPO. FLASHING	X			4	X			16	X		
SHEET METAL	X			5	X			17	X		
FASTENERS	X			6	X			18			X
WOOD	X			7			X	19		X	
SEALANTS	X			8	X			20	X		
EXPANSION JOINTS			X	9			X	21	X		
ALL OTHER MATERIALS	X			10	X			22			X
Crickets	X			11	X			23	X		
				12	X			OTHERS			

EXPLAIN VARIANCE (If none write NONE)

(19) Excess Gravel not removed as yet.

Crew - 5

Equipment - 1 Dump truck, 1 crew truck, 2 Kettles

UNRESOLVED VARIANCES ON RECORDS NOS.

Report #7 Item #16 (Scuppers area 1 need changed)

ACTION TAKEN TO RESOLVE VARIANCE

On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

QUALITY CONTROLLER (Signature): [signature]

RECEIVED BY (Signature): | DATE 3-24-82

Figure 1. Quality control record for 24 March 1982.

Figure 2. Voids in insulation joints greater than 1/4 in.

Figure 3. Mechanical fastening of bottom layer of insulation.

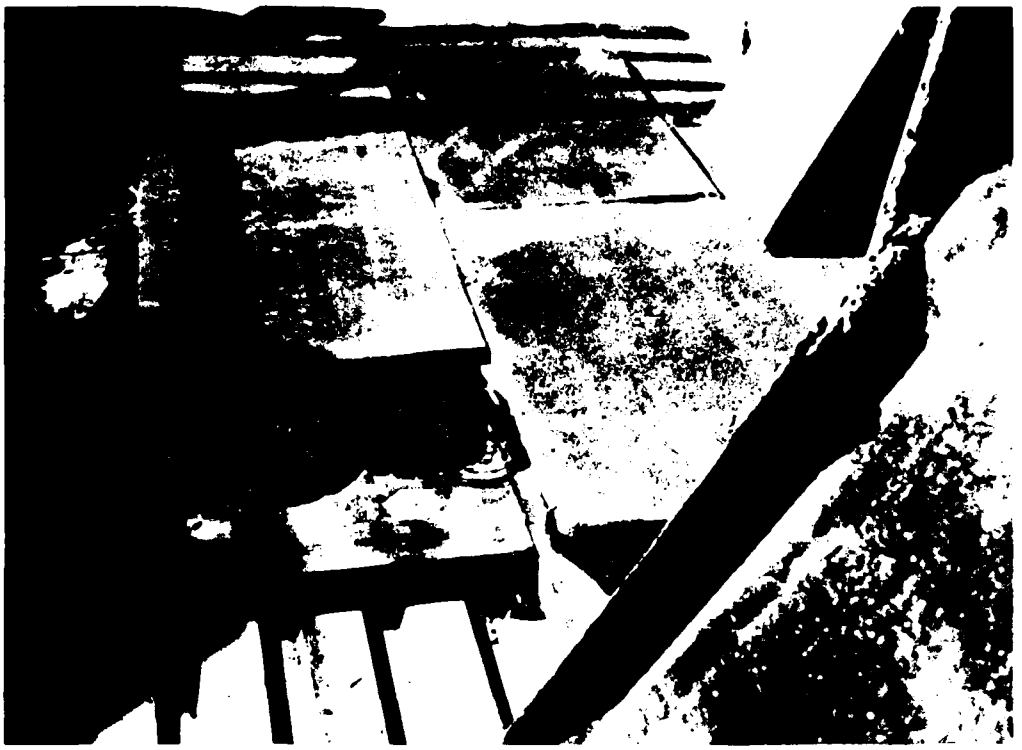


Figure 4. Staggering of joints between layers of insulation.

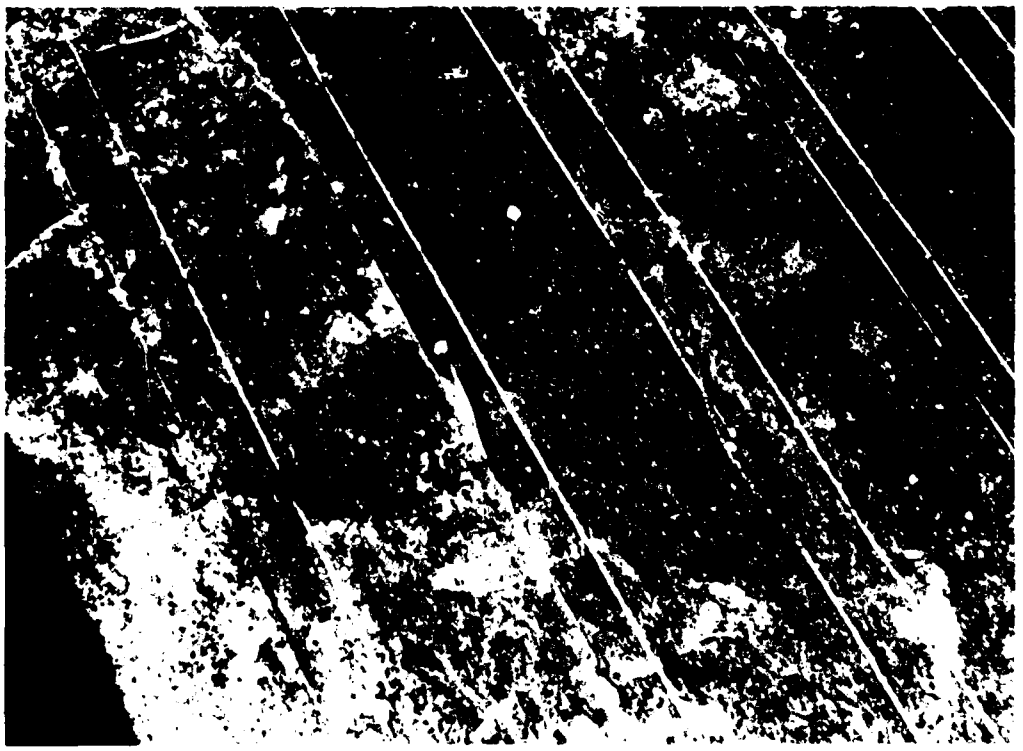


Figure 5. Felts not fully adhered, showing dry laps.

• Item 17, Protection Requirement: Check for rubber-tired equipment. Variance: Lack of tires on asphalt bucket wheels (Figure 3).

• Item 19, Gravel Topping Requirement: Verify proper application of flood coat and gravel. Variance: Voids in gravel application (Figure 6). This work item had been done previously and is not reflected in the report for 24 March. Table 1 lists all the work items shown in Figure 1. Appendix F gives a complete description of these items.

The CERL investigator noted that neither the CQC or QA representatives observed these variances. The investigator also noted that asphalt had been delivered before the equiviscous temperature (EVT) and flash point were certified, causing doubts about the accuracy of this information. Another problem was the installation of siding simultaneously with roofing. The siding contractor's staging, which was in the roofer's way until noon of the day of the visit, interfered with roofing operations until it was removed.

Table 1
Work Items on Quality Control Record

1. Materials at point of application
2. Type, quality, and condition of equipment
3. Weather
4. Condition of roof deck
5. Wood items
6. Bituminous materials
7. Vapor barrier
8. Insulation
9. Edge envelope
10. Membrane placement
11. Membrane construction
12. Ridges and valleys
13. Nailing
14. Penetrations
15. Base flashing
16. Sheet metal work
17. Protection of membrane—rubber-tired equipment and planking
18. Walkways
19. Gravel topping
20. Completion
21. Edge protection of insulation and felts
22. Samples
23. Weather protection

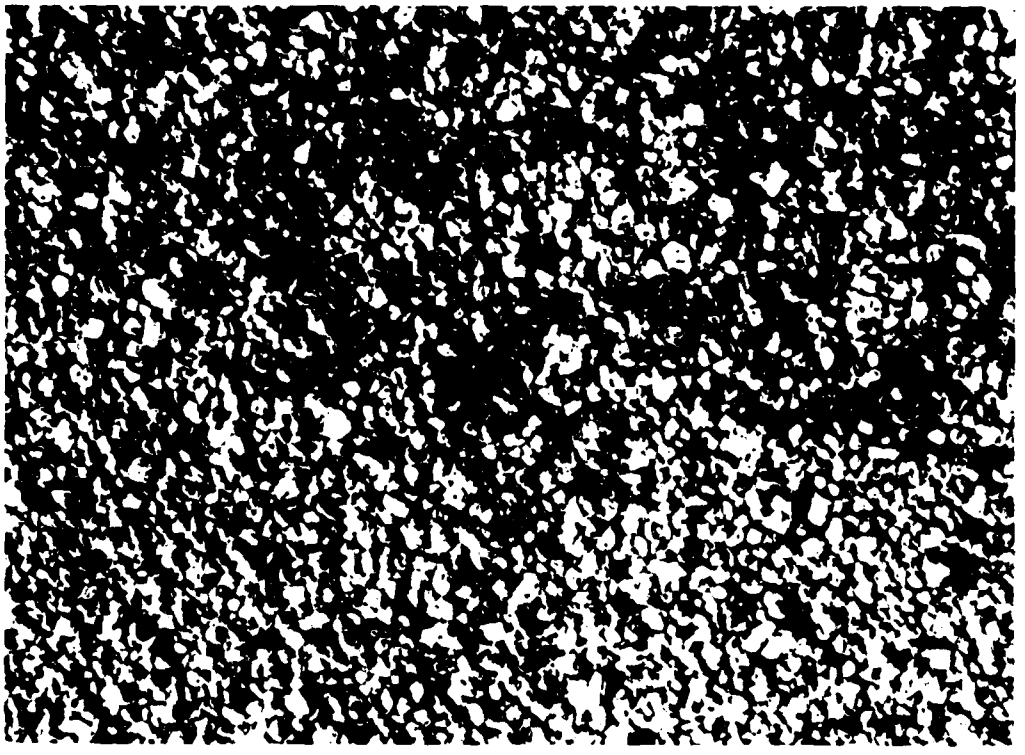


Figure 6. Voids in gravel application.

43rd Support Battalion

Construction of the 43rd Support Battalion Shop roof began on 21 June 1982. The investigator visited the site on 29 June to inspect and determine compliance with the CQC contract requirements. Key personnel associated with the roofing operations were interviewed. It was found that a different employee of the roofing subcontractor had been substituted for the CQC representative. Figure 7 shows the Quality Control Record for 29 June 1982. As before, this record indicates compliance with specified requirements for all items. However, several variances were observed which were not noted on the report:

- Item 2, Equipment Requirement: Verify accuracy of thermometers and metering devices. Variance: Indicated temperatures of asphalt in kettles varied as follows:

Kettle	Asphalt	Recorder	Kettle Thermometer	Inspector's Thermometer
300 Gal	Type III	440°F	425°F	455°F
500 Gal	Type II	400°F	450°F	445°F

- Item 8, Insulation Requirement: Check insulation orientation, staggered lap, joint width, and nailing. Variances:

The bottom layer of insulation was installed with edges above flutes in decking, not on flanges (Figure 8).

The void in the top layer of insulation was greater than the specified limit of 1/16 in. (1.6 mm) (Figure 9).

The top surfaces of insulation boards were not flush (Figure 10).

The void between insulation and cant was about 1 in. wide (25.4 mm) (Figure 11).

- Item 11, Membrane Construction Requirement: Check for proper installation practices, including bitumen quantities, brooming, etc. Variance: Felts were not fully adhered in the bitumen (Figure 12).

- Item 17, Protection Requirement: Check for rubber-tired equipment. Variance: Lack of tires on asphalt bucket wheels (Figure 12).

The CERL investigator noted a marked improvement in roofing operations since his initial inspection in March. For this project, the CQC representative was able to devote all his time to roofing operations, since he had no other duties to perform; also, he had worked as a roofer previously and fully understood the need for care in BUR installation. Although he did not observe the variances noted by the investigator, many of the variances noted in March were not evident at this inspection. The investigator noted that different EVT and flash point temperatures were printed on the asphalt wrappers from those that were on the kettle. Also, other procedures were not interfering with roofing operations, as observed previously.

4th Engineer Battalion

Construction of the 4th Engineer Battalion shop roof began on 20 September 1982. The investigator visited the site on 29 September to inspect and determine compliance with the contract's CQC requirements. When key personnel were interviewed, it was again found that a different employee of the roofing subcontractor was performing as the CQC representative.

Figure 13 shows the Quality Control Record for 29 September 1982. With one exception (Work Item Number 4), this record indicates compliance with all specified requirements. However, several variances were observed which were not noted on the report:

- Item 2, Equipment Requirement: Verify accuracy of thermometers and metering devices. Variance: Indicated temperatures of asphalt in kettles varied as follows:

Kettle	Asphalt	Recorder	Kettle Thermometer	Inspector's Thermometer
300 Gal	Type III	450°F	460°F	475°F
500 Gal	Type II	425°F	475°F	450°F

- Item 8, Insulation Requirement: Check insulation orientation, staggered lap, joint width, and nailing. Variances:

Gasoline was spilled on the insulation while filling the generator. The contaminated board was not replaced (Figure 14), which could cause it to disintegrate.

Broken edge of the bottom layer of insulation was not repaired (Figure 15).

Fasteners were not installed in insulation as required in Factory Mutual Data Sheet 1-28[12] (Figure 16).

[12] *Insulated Steel Deck*, Loss Prevention Data Sheet 1-28 (Factory Mutual Engineering Corporation, June 1980).

QUALITY CONTROL RECORD

RECORD NO. 7 | DATE 6-29-82

PROJECT NUMBER: DACA45 81 · 80049 | BLDG NO. 43rd

ROOFING CREW: START 7:00 AM (Kettle Manger at 6:00 p.m.) PM | STOP 3:00 AM PM

QUALITY CONTROLLER: START 7:00 AM PM | STOP AM PM

WEATHER (Describe): Partly Cloudy Winds calm to mild | AVERAGE TEMPERATURE: 75°F

TOTAL ROOF AREA (Squares): 1560 sq. ft. Area B | COMPLETED TODAY: 750 sq. ft. | TEST SAMPLES REMOVED: None

PRODUCTS (See Project Specifications) (Check Appropriate Box Below)				EXECUTION (See Quality Control Guide) (Check Appropriate Box Below)							
COMPONENTS (Type, Quantity, Size)	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE
UNDERLAYMENT			X	1	X			13	X		
INSULATION	X			2	X			14	X		
MEMBRANE	X			3	X			15	X		
COMPO. FLASHING	X			4	X			16	X		
SHEET METAL	X			5	X			17	X		
FASTENERS	X			6	X			18			X
WOOD	X			7			X	19	X		
SEALANTS	X			8	X			20	X		
EXPANSION JOINTS			X	9			X	21	X		
ALL OTHER MATERIALS	X			10	X			22			X
Crickets	X			11	X			23	X		
				12	X			OTHERS			

EXPLAIN VARIANCE (If none write NONE): None

UNRESOLVED VARIANCES ON RECORDS NOS.

ACTION TAKEN TO RESOLVE VARIANCE

On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

QUALITY CONTROLLER (Signature): Bill Stratton

RECEIVED BY (Signature) | DATE

Crew of 1 Foreman, 3 Roofers, 3 Apprentices
3 Kettles, 3 trucks, 1 hoist misc roofing equipment

Figure 7. Quality control record for 29 June 1982.

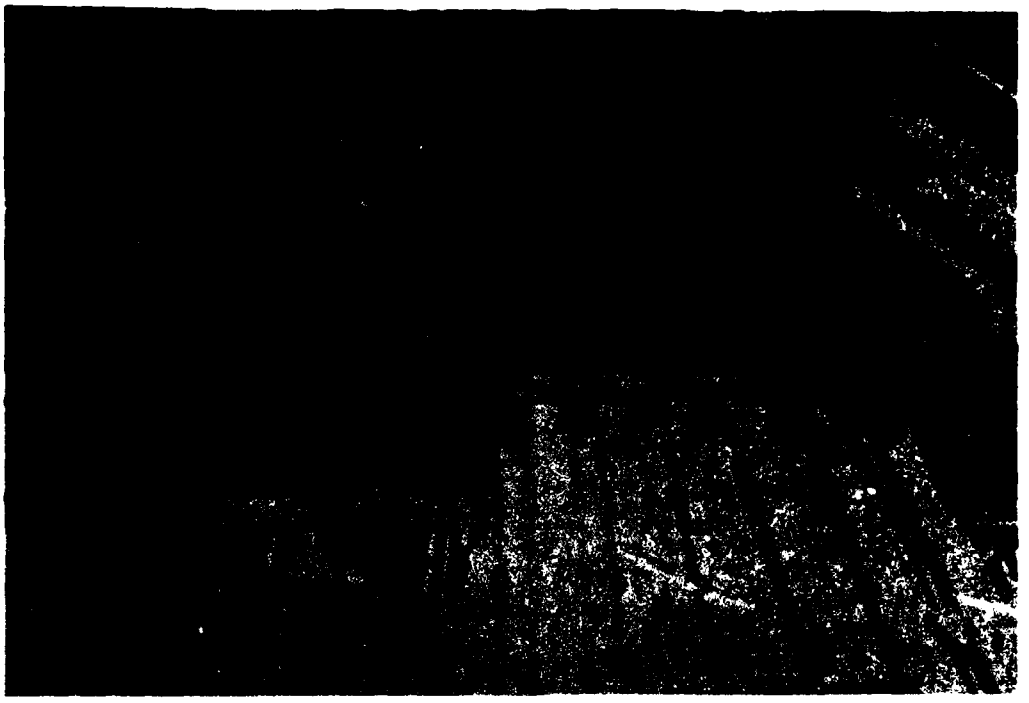


Figure 8. Edges of insulation not supported.

Figure 9. Void in top layer of insulation greater than 1/4 in.

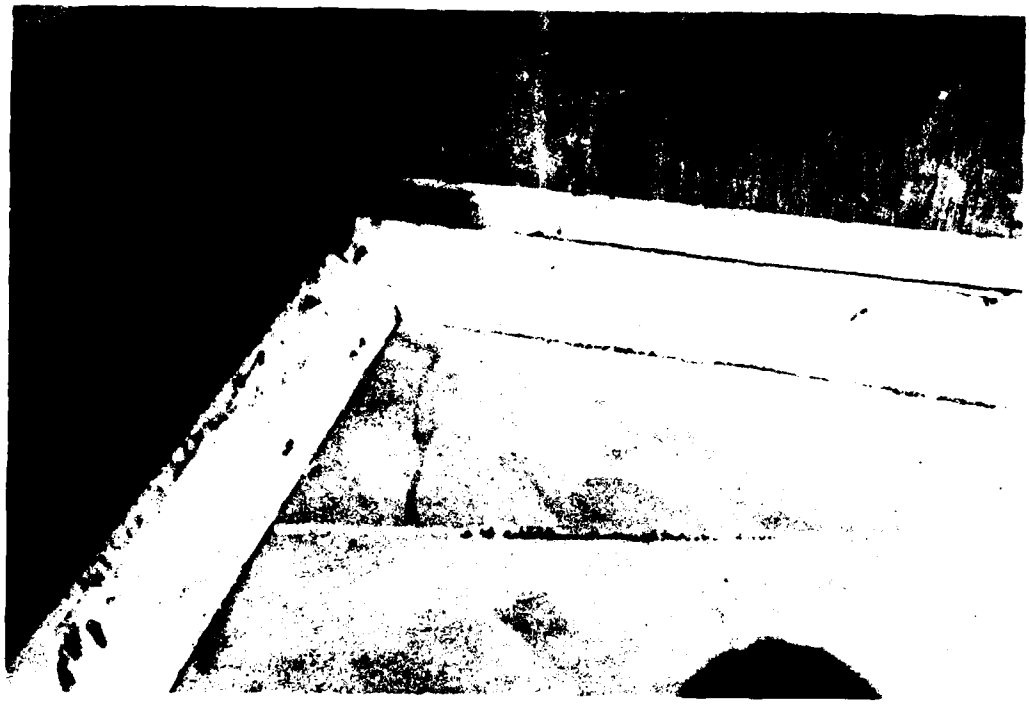


Figure 10. Differences in elevation between insulation boards.

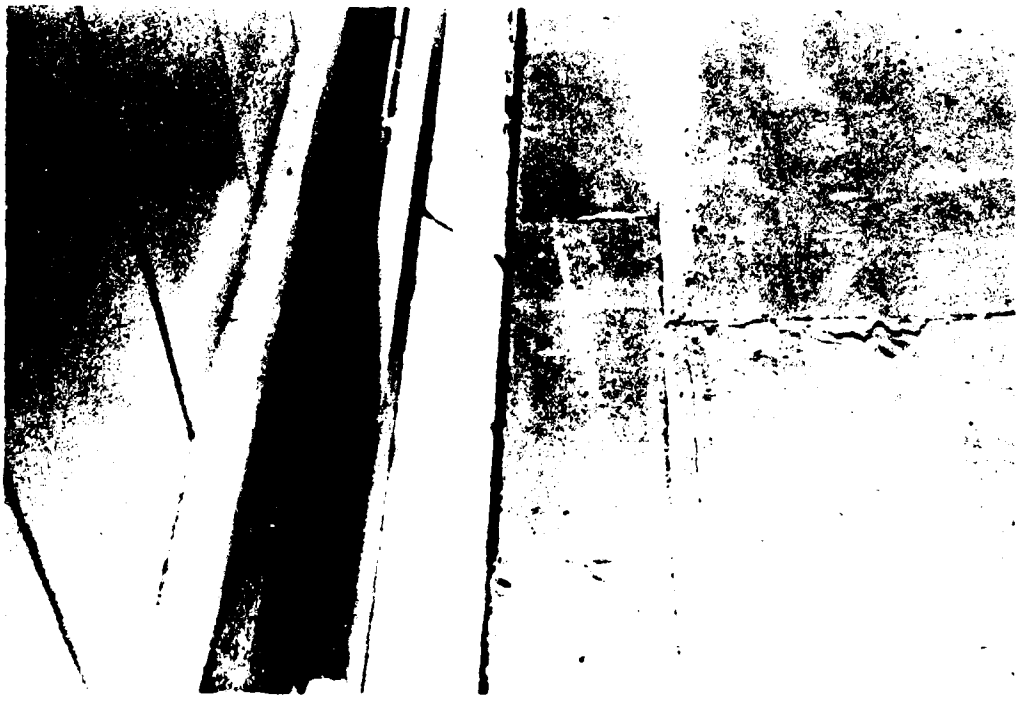


Figure 11. 1-in.-wide void between insulation and cant.

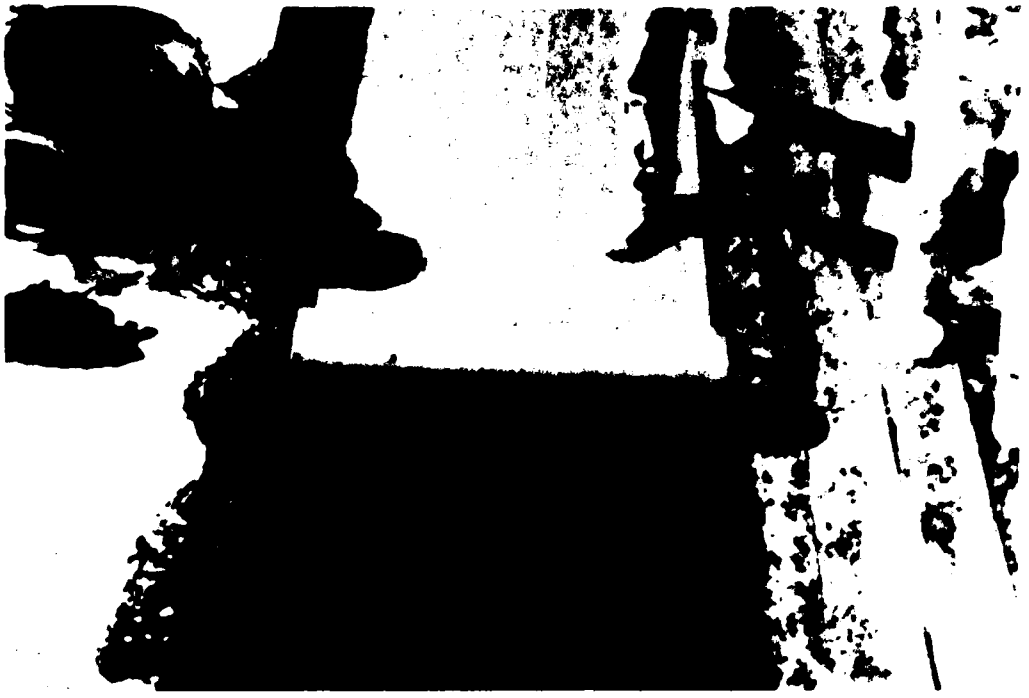


Figure 12. Felts not fully adhered, showing dry laps.

Joints in second layer of insulation were not staggered the maximum dimension with respect to joints in the first layer (Figure 17).

• Item 11, Membrane Construction Requirement: Check for proper installation practices, including bitumen quantities, brooming, etc. Variances:

A hole in the felt was not patched (Figure 18).

Felts were not fully broomed in, and fishmouths were not cut and repaired (Figure 19).

Felts were not fully adhered in bitumen (Figure 20).

• Item 15, Base Flashing Requirement: Verify proper installation of base flashings. Variance: Manufacturer's requirements specify that the top layer of base flashing should overlap the first layer. Flashing was installed with the first layer protruding beyond the top layer (Figure 21).

The investigator observed that the improvements in roofing operations noted during the second inspection did not continue into the third inspection. Installation deficiencies were similar to those observed during the first inspection in March. The CQC representative observed variances only when they were first identified by the CERL investigator, despite the fact that they were obvious, as shown in Figures 14 through 21.

Although the contract required the use of automatic thermostatic controls on the kettles as well as the temperature recorders, the CERL investigator noted that these controls were not installed. Control was effected by manual firing of the burners to maintain temperature. It should be mentioned that automatic thermostatic controllers do not always work satisfactorily. The kettle operator frequently must override them in anticipation of copious rapid draw-off of hot bitumen, firing the kettle with an extra amount of asphalt at a fast rate of heat input.

The CQC representative used for the 43rd Support Battalion Shop was a retired roofing contractor

QUALITY CONTROL RECORD

RECORD NO. 1 | DATE 9-29-82

PROJECT NUMBER: DACA 45-81-C-0155 | BLDG NO.: 4T Eng

WEATHER (Describe): Mild, Slight Wind | AVERAGE TEMPERATURE: 70°

TOTAL ROOF AREA (Squares): 40

ROOFING CREW: START 8:00 AM/PM | STOP 5:30 AM/PM

COMPLETED TODAY: 19

QUALITY CONTROLLER: START 8:00 AM/PM | STOP 5:30 AM/PM

TEST SAMPLES REMOVED: None

PRODUCTS (See Project Specifications) (Check Appropriate Box Below)				EXECUTION (See Quality Control Guide) (Check Appropriate Box Below)							
COMPONENTS (Type, Quantity, Size)	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE
UNDERLAYMENT			✓	1	✓			13	✓		
INSULATION	✓			2	✓			14	✓		
MEMBRANE	✓			3	✓			15	✓		
COMPO. FLASHING	✓			4		✓		16	✓		
SHEET METAL	✓			5	✓			17	✓		
FASTENERS	✓			6	✓			18			✓
WOOD	✓			7	✓			19	✓		
SEALANTS	✓			8	✓			20	✓		
EXPANSION JOINTS			✓	9	✓			21	✓		
ALL OTHER MATERIALS	✓			10			✓	22	✓		
				11	✓			23	✓		
				12	✓			OTHERS	✓		

EXPLAIN VARIANCE (If none write NONE)

Item #4 Metal Cap Flashing was Temporary

UNRESOLVED VARIANCES ON RECORDS NOS.

ACTION TAKEN TO RESOLVE VARIANCE

On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

QUALITY CONTROLLER (Signature): Dana R. Hunt

RECEIVED BY (Signature) | DATE

1 Foreman 2 Apprentices
3 Journeymen

Figure 13. Quality control record for 29 September 1982.

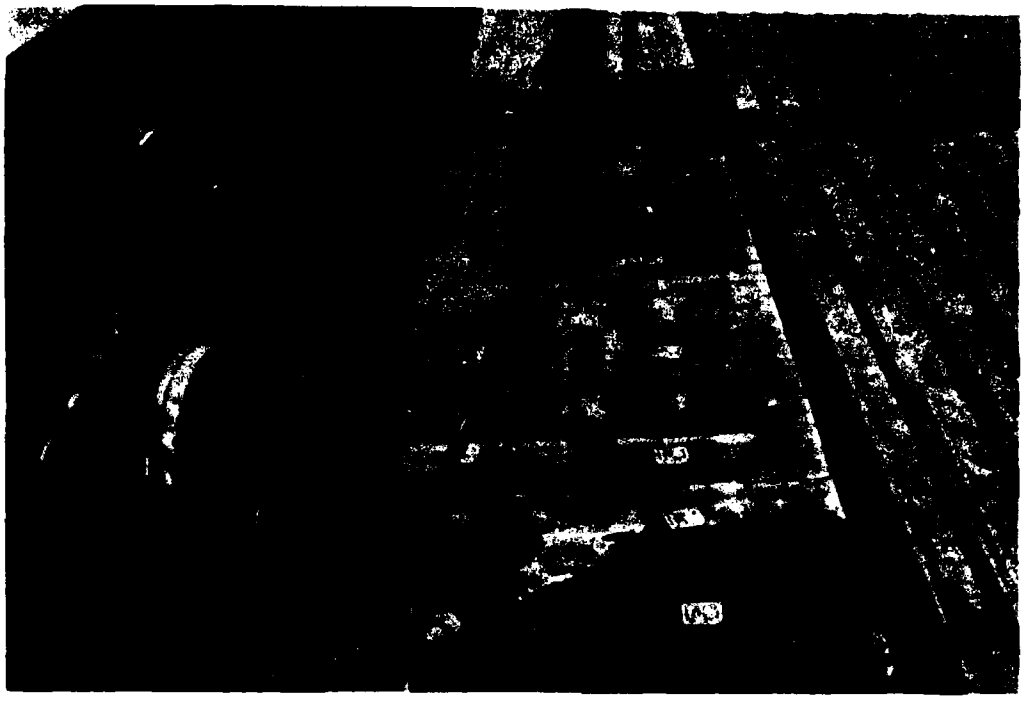


Figure 14. Gasoline spilled on insulation.

Figure 15. Damage to bottom layer of insulation.

Figure 16. Sheet of insulation not completely fastened.

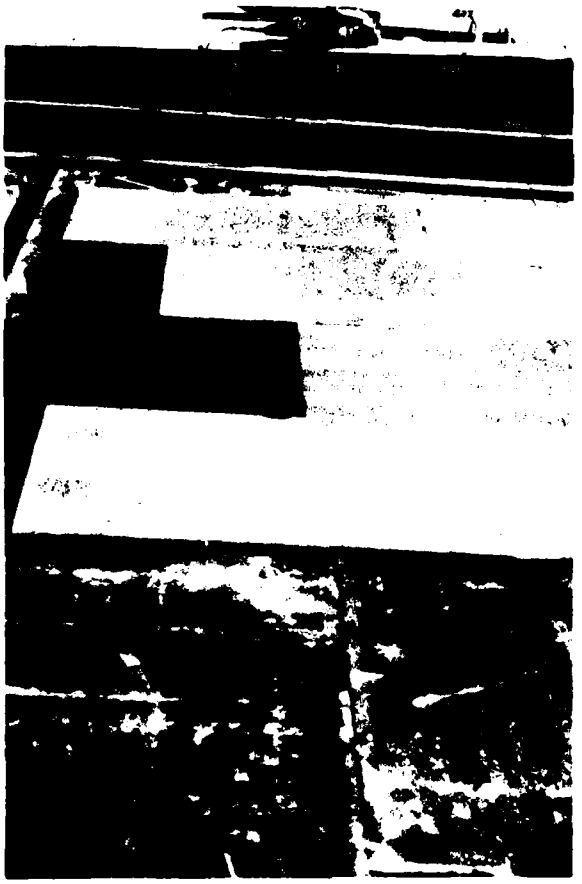


Figure 17. Staggering of joints between layers of insulation.

Figure 18. Hole in felt not patched.

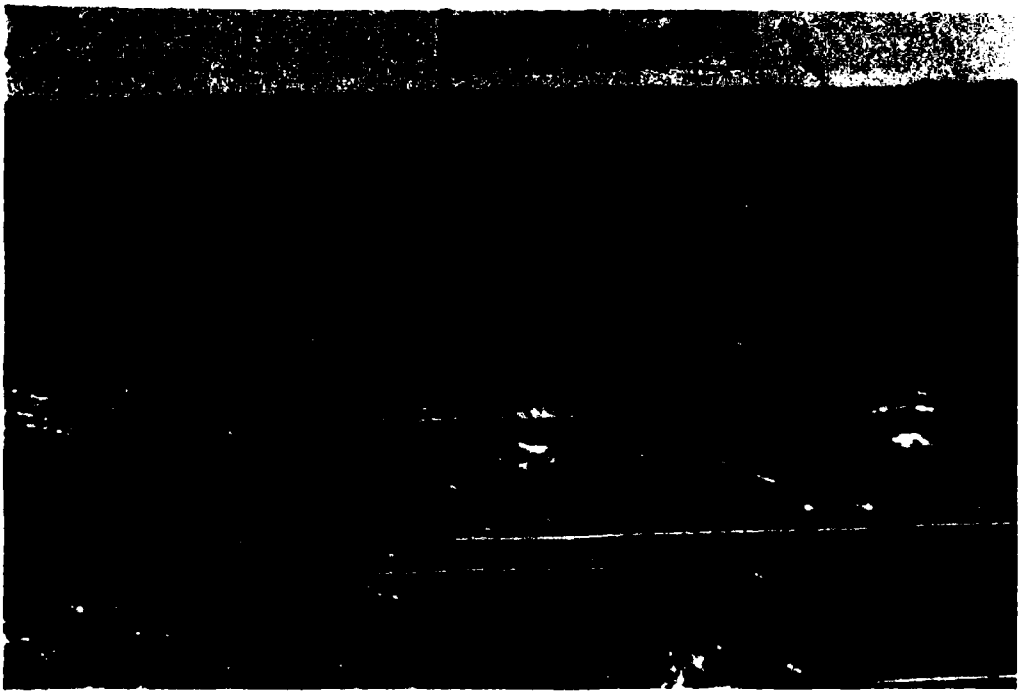


Figure 19. Felt not fully broomed in.

Figure 20. Felts not fully adhered, showing dry laps.

Figure 21. Base flashing installed contrary to specifications.

who was hired by the roofing subcontractor specifically to perform the CQC for this one project. He did not rely on this employment by the subcontractor for his income, so had a more independent attitude towards controlling the quality of the work than the representatives for either the Armor Battalion or the 4th Engineer Battalion. This independence undoubtedly resulted in the fact that fewer deficiencies were observed during construction of the 43rd Support Battalion Shop.

6 SUMMARY OF QUALITY CONTROL OPERATION

The three tactical equipment maintenance shops were inspected on 24 March, 29 June, and 29 September 1982 to ascertain the effectiveness of the CQC program. Key personnel were interviewed at each inspection. These interviews indicated that all personnel involved are working together to try to provide the best possible roofs. However, most of these people have too many duties in more than one location, which prevents them from devoting the time necessary to produce the desired results.

A good attempt was being made to keep complete records. However, the various people keeping daily reports were not using the same identification symbols for the same items. For example, one person was using numbers, while another was using letters. This did not affect the quality of the work, but caused some confusion when the reports were discussed. This situation was corrected and, when the second visit was made in June, nomenclature among the various reports was uniform.

The contractor objected to several of the specification requirements because he thought they contradicted National Roofing Contractor Association (NRCA) recommendations[13] and usual roofing practice. The following paragraphs note the nature of contractor's objections and the Corps' response to them. (Paragraph numbers refer to the contract specifications given in appendix F.)

[13] *The NRCA Roofing and Waterproofing Manual* (National Roofing Contractors Association, January 1981).

7C-2.4.1, continuous recording thermometer. The contractor was informed that this requirement was part of the CQC specification to verify asphalt kettle temperatures.

7C-4.7, gradation requirements for surfacing gravel. The contractor was informed that the Corps wants the materials used to comply with all applicable American Society for Testing and Materials (ASTM) specifications.

7C-7.1, need for daily completion. The contractor's reasoning was the same as that of roofing contractors at other locations. It would be better for the roof to apply a glaze coat on it at the end of each day's work, let it cool and become hard, and then apply gravel to the roof when all of it was complete. He was told that it has always been Corps policy to complete all roofing work the same day it is started and his operations, including application of gravel, would have to comply.

7C-2.4.1, asphalt temperature. The contractor claimed that the need for the CQC representative to check the kettle temperature while felts were being applied kept him from detecting improper felt application. He was told that the specification requires him to check the temperature in the mop bucket or applicator on the roof, and that the kettle temperature could be verified just before the felt was applied.

A1-1, continuous presence of CQC representative while roofing work is in progress. The CQC representative's other duties interfered with smoothness of operations. He was told that the contract was written to reflect Corps needs and that he must comply.

Other problems observed during construction, while not specifically variations from contract requirements, led to legitimate differences of opinion between the contractors and Corps personnel. Among these were:

7B-2.3.4, insulation fastening requirements. The contract requires mechanical fastening for "all insulation within the 4-foot wide band at the building exterior perimeter." It then states that the "method of attachment shall be in accordance with insulation manufacturer's recommendations and the requirements specified hereinafter." The insulation manufacturer's literature did not specify the methods of mechanical fastening. The fastener manufacturer's

literature specified the method of attaching an entire board, showing boards of different sizes. Only Factory Mutual (FM) data sheet 1-28 shows that for 4-ft × 8-ft (1.2- × 2.4-m) boards, the entire board must be mechanically fastened, even though the board is installed perpendicular to the perimeter, but more fasteners are required at the 4-ft (1.2-m) perimeter. Since FM fastening is not referred to either in the contract specifications or in any manufacturer's literature, only the 4-ft (1.2-m) perimeter was mechanically fastened to the deck and not at the FM recommended fastener spacing. The NRCA manual[14] recommends that the entire first layer of insulation on steel decks be mechanically fastened.

Felts were not installed properly at cricket valleys. Section 7C-7.3.1 specifies the appropriate method for constructing such valleys. This method insures that water will flow over the lap properly. The felts had been installed so that the the laps were bucking water, so additional plies were installed to correct the condition.

The temperature recorders used on the asphalt kettles were not reliable. The indicator could be changed at will with a screwdriver, so it is conceivable that the recorder could be set to agree with the contract requirement, rather than accurately measure the actual kettle temperature.

Drain sumps were so small and the insulation so thick that slopes of 3 to 4 in. per foot (250 to 330 mm per m) resulted when the insulation was tapered to the drains. This is so steep that gravel is sure to roll down the slope and enter the drain. The drain sumps should have been specified at no less than 4 × 4 ft (1.2 × 1.2 m). Also, the roof drains were only 2 in. (51 mm) or less in diameter. This leads to a high probability of drain blockage and roof flooding.

The contract specifications (7C-1.2) specify ASTM D 1863-77 for the roofing aggregate. This was the most recent issue at the time the specifications were prepared, but has since been superseded by ASTM D 1863-80. The requirements are not identical, particularly for moisture content, and the contractor objected to the stricter requirement of the 1977 issue (0.5 percent moisture), rather than the 1980 issue (2.0 percent). He was informed that the Corps specified the year of issue to avoid this type of argument and that, even though the guide specifications are updated annually, these revisions need not be reflected in contracts prepared before the change.

Materials used for roofing were the products of several different manufacturers:

Roof insulation	— Johns-Manville
Cricket material	— Lucas
Roofing felt	— Bird
Roofing asphalt	— GAF
Asphalt roof cement	— GAF and Johns-Manville

The various materials all met the specification requirements, but application instructions may vary by manufacturer. Also, the felts, roofing asphalt, and asphalt cement used may not be mutually compatible since asphalts vary widely in chemistry. Best results are more probable if all materials are made by the same manufacturer, but even then cannot be guaranteed.

Since the Corps QA man could not devote very much time to the roofing work, an assistant QA man was assigned; however, he had no roofing experience. The CERL investigator commented that the success of the plan to have the contractor perform his own quality control depended on several factors:

- The CQC representative spending full time on the job with no other duties.

- When variances are observed, the willingness to enforce contract requirements when both the CQC representative and the roofing foreman are employees of the same subcontractor.

- The ability of the CQC representative to recognize variances and to appreciate the consequences of not correcting them.

The CERL investigator emphasized that the attitude of the CQC representative was the prime factor in influencing the success or failure of the CQC system. This was evident in the differences between the first and third representatives, who did not perform fully satisfactorily, and the second representative, who did his work properly.

[14] *The NRCA Roofing and Waterproofing Manual* (National Roofing Contractors Association, January 1981).

7 CONCLUSIONS AND RECOMMENDATIONS

1. In many instances, the Contractor Quality Control (CQC) program was not performed as outlined in the specifications.

2. The Corps Quality Assurance (QA) personnel were unable to monitor the CQC program properly because of inadequate staffing.

3. The effectiveness of any CQC program depends greatly on the capabilities and attitude of the individual performing this function. In the one instance where the CQC representative was specifically hired to perform this function, the quality control was markedly improved.

4. Deficiencies in contract specifications, such as the one cited for mechanical fastening, can lead to honest differences of opinion between government engineers and contractor personnel that can result in substandard work or litigation.

5. Subcontractor personnel should not be appointed the CQC representative for their own work because of an obvious conflict of interest.

6. Temperature-recording instruments must be sealed so that settings cannot be altered in the field.

7. Close cooperation between engineering and construction personnel is essential to the successful completion of the project.

8. Stricter enforcements of the CQC provisions should be observed, particularly in the selection of the CQC representative.

It is recommended that:

1. An unambiguous, uniform specification for BUR CQC be prepared. All members of the Quality Control Group must be specified as employees of the general contractor or of an independent company engaged by the general contractor to perform the CQC function.

2. Government roof quality assurance personnel be experienced in roofing operations. The amount of time they spend on the roof should be sufficient to assure the performance of the contractor's quality control function.

REFERENCES

Built-Up Roofing for Application Directly on Decks and on Insulation (Or Underlayment), CE 220.12 (Corps of Engineers, June 1968) (superseded in 1977 by CEGS 07510, *Built-Up Roofing*).

Built-Up Roof Management Program, Air Force Manual 91-36 (Department of the Air Force, 3 September 1980).

Bynoe, Robert, "Saturated Organic Felts: Let's Perceive Them As They Are," *Roofing, Siding, Insulation (RSI),* Vol 57, No. 10 (October 1980), p 79.

Construction Quality Control, Engineer Regulation 1180-1-6 (Office of the Chief of Engineers, 17 July 1978).

Contractor Inspection System, NAVFAC Specification NFGS-01401 (Naval Facilities Engineering Command, June 1981).

Contractor Quality Control System, NAVFAC Specification NFGS-01400 (Naval Facilities Engineering Command, June 1981).

Hopkins, John W., "There's More to Built-Up Roofing Asphalt Than Black and Sticky," *Western Roofing,* Vol 4, No. 1 (February 1981), p 6.

Insulated Steel Deck, Loss Prevention Data Sheet 1-28 (Factory Mutual Engineering Corporation, June 1980).

LaCosse, Robert, "NRCA/ARMA Undertake Ambitious, Yearlong Asphalt Sampling Testing Program," *The Roofing Spec,* Vol 10, No. 3 (March 1982), p 42.

Lindow, E. S., et al., *Built-Up Roof Construction Quality Control,* Technical Report M-267/ADA073619 (U.S. Army Construction Engineering Research Laboratory, July 1979).

The NRCA Roofing and Waterproofing Manual (National Roofing Contractors Association, January 1981).

Specification for Asphalt Used in Roofing, ASTM D 312 (American Society for Testing and Materials, 1971 and 1978).

APPENDIX A:
TYPICAL ARMY CQC SPECIFICATIONS

Example 1

SP-16 QUALITY CONTROL SYSTEM: The inspection system required by paragraph, CONTRACTOR INSPECTION SYSTEM of the General Provisions shall include the following minimum requirements:

a. Inspection procedures: The inspection procedure which the Contractor uses shall be reported on the Contractor's Daily Quality Control Report and shall conform to the following:

(1) Preparatory inspection: This shall be performed prior to beginning any work on any definable feature. It should include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted, and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all necessary materials and/or equipment are on hand.

(2) Initial inspection: This shall be performed as soon as work begins on a representative portion of the particular feature of work and should include examination of the quality of workmanship as well as a review of control testing for compliance with contract requirements.

(3) Follow-up inspections: These should be performed daily to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The Contracting Officer may require joing Government-Contractor inspections at any time and on a periodic basis to evaluate the effectiveness of the quality control system.

b. Prior to submittal, all shop drawings, certificates of compliance, materials, fixtures and equipment lists called for under the TECHNICAL PROVISIONS of these specifications shall be reviewed in detail by the Contractor. The Contractor shall certify with each submittal that he has reviewed the submittal in detail and that it is correct and in strict accordance with the contract drawings and specifications except as may be otherwise expressly stated. Submittals, after review and certification, shall be furnished to the Contracting Officer in accordance with the CONTRACTROS SUBMITTAL paragraph of these Special Provisions. The Contractor is responsible for the review and certification of submittals.

c. The Contractor shall provide and maintain an effective quality control program or Contractor inspection system, as required by the General Provision paragraph CONTRACTOR INSPECTION SYSTEM, which will assure that all supplies and services required under the contract conform to contract requirements whether constructed or processed by the Contractor, or procured from subcontractors or vendors. The Contractor shall perform or have performed the inspections and tests required to substantiate that all supplies and services conform to drawings, specifications, and contract requirements unless the required inspection and/or test is specifically designated in SECTION: CONSTRUCTION QUALITY CONTROL, paragraph WORK NOT INCLUDED, to be performed by the Government. The Contractor's inspection system shall be documented as specified herein, and shall be available for review by the Government prior to the start of construction and throughout the life of the contract. The Contractor shall notify the Government in writing of any proposed change to his inspection system.

d. The Contractor shall implement this program by the establishment of a quality control organization. This organization shall be headed on a full-time basis by the Contractor's quality control representative, who whall be physically on the project site for the duration of the project, and whose sole responsibility is to insure compliance with the contract plans and specifications. He shall be assisted as necessary, by other personnel, industry-recognized testing laboratories, or manufacturers' representatives, who are qualified to perform the various inspections, tests, and equipment adjustments required by the Technical Provisions and by the "Sacramento District Construction Control Manual".

e. The Contractor's inspection system shall require personnel of his organization to perform or cause to be performed (a) inspections of the scope and character necessary to achieve the quality of construction required by the contract plans and specifications and; (b) perform the number and type of tests required by the contract specifications, the "Sacramento District Construction Control Manual", and by other publications referenced.

f. The Contractor shall maintain current records on an appropriate format of all inspections and tests performed. These records should provide factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspection or tests; nature of defects, causes for rejection, etc.; proposed remedial action, and corrective actions taken. The Contractor shall not build upon or conceal any feature of the work containing uncorrected defects. Payment on deficient items will be withheld until defects are satisfactorily corrected or other actions taken as authorized pursuant to the General Provisions paragraph INSPECTION AND ACCEPTANCE. These records shall cover both conforming and defective items and shall include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies shall be furnished to the Contracting Officer daily. The report shall cover all work placement subsequent to the previous report, and shall be verified by the prime Contractor's designated quality control representative.

g. The Contractor shall maintain a positive system for identifying the inspection status of supplies.

h. The Contractor shall establish and maintain an effective and positive system for controlling nonconforming material.

i. The Contractor shall maintain full size marked-up drawings, survey notes, sketches; nameplate data, pricing information, description, and serial numbers of all installed equipment; and other information depicting as-built conditions. This information shall be maintained in a current condition at all times until completion of the work and shall be available for review by Government personnel at all times. All variations from the contract plans, for whatever reason including those occasioned by the required coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the contract plans. Upon completion of the work, this information shall be furnished to the Contracting Officer a minimum of two weeks prior to final inspection.

j. After the contract is awarded and before construction operations are started, the Contractor shall meet with the Contracting Officer or his representative, and discuss the inspection system requirements. The meeting shall develop mutual understandings relative to details of the system, including the forms to be used for recording the inspections, administration of the system, and the interrelationship of Contractor and Government inspection. The Contractor shall furnish to the Government within five days after receipt of the Notice to Proceed an inspection system plan which shall include the procedures, instructions, and reports to be used. This documents shall include as a minimum:

(1) The inspection organization.

(2) Number and qualifications of inspection personnel to be used.

(3) Authority and responsibilities of inspection personnel.

(4) Methods of inspection, including subcontractor's work.

(5) Schedule for use of inspection personnel by types and phase of work.

(6) Test methods including, as specified, name of qualified testing laboratory to be used, if applicable.

(7) Schedule for use of non-Contractor personnel and facilities, such as manufacturer's representatives and approved testing laboratories.

(8) Method of documenting inspection and testing.

(9) A copy of a letter of direction to the Contractor's quality control representative, outlining his duties and signed by a responsible officer of the firm.

k. The Contractor shall provide and maintain all measuring and testing devices, laboratory equipment, instruments, transportation, and supplies necessary to accomplish the required testing and inspection. All measuring and testing devices shall be calibrated at established intervals against certified standards which have known valid relationships to national standards. The Contractor's measuring and testing equipment shall be made available for use by the Government for verification of their accuracy and condition as well as for any inspection or test desired pursuant to the General Provisions paragraphs INSPECTION AND ACCEPTANCE and GOVERNMENT INSPECTORS.

l. The Contractor's inspection system shall provide for procedures which will assure that the latest applicable drawings, including shop drawings, specifications, and instructions required by the contract, as well as authorized changes thereto, are used for fabrication, inspection, and testing.

m. The Government reserves the right to inspect at source supplies of services not manufactured or performed within the Contractor's facility. Government inspection will not constitute acceptance; nor will it in any way replace Contractor inspection or otherwise relieve the Contractor of his responsibility to furnish an acceptable end item. When inspection at subcontractors' plants is performed by the Government, such inspection shall not be used by Contractors as evidence of effective inspection by such subcontractors.

n. The Contracting Officer will notify the Contractor of any non-compliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

o. Each Quality Control Inspector shall also be inspecting the work under his surveillance for compliance with Corps of Engineers manual EM 385-1-1, General Safety Requirements, and shall immediately bring to the attention of the Contractor's supervisory personnel any unsafe working condition and/or instance of noncompliance noted.

p. The Contractor's inspection system is subject to evaluation and verification inspection by the Government to determine its effectiveness in supporting the quality requirements established in the detail specification, drawings, and contract.

q. IF RECURRING DEFICIENCIES INDICATE THAT THE QUALITY CONTROL SYSTEM IS NOT ADEQUATE, CORRECTIVE ACTION SHALL BE TAKEN AS DIRECTED AND PROGRESS PAYMENTS WILL BE WITHHELD UNTIL SUCH CORRECTIVE ACTION HAS BEEN COMPLETED.

Example 2

1C-10. CONTRACTOR'S ACCIDENT PREVENTION PLAN:

Prior to commencement of work under this contract, the Contractor shall submit in writing an Accident Prevention Plan in accordance with the requirements of subparagraph 1B-01b(1) of the SAFETY REQUIREMENTS.

1C-11. CONTRACTOR QUALITY CONTROL:

The Contractor shall provide and maintain an effective quality control program that complies with General Provisions 32 of the contract, entitled "Contractor Inspection System."

a. The Contractor shall establish a quality control system to perform sufficient inspection and tests of all items of work, including that of his subcontractors, to insure conformance to applicable specifications and drawings with respect to the materials, workmanship, construction, finish, functional performance, and identification. This control will be established for all construction except where the technical provisions of the contract provide for specific Government control by inspections, tests, or other means. The Contractor's control system will specifically include the surveillance and tests required in the technical provisions of the contract specifications. For purposes of the above description, shop manufacture of standard products is not defined as construction. Quality control personnel shall also be charged with the responsibility of policing Contractor's Safety Program. This duty will be clearly set forth in the Quality Control Program.

b. The Contractor's quality control system is the means by which he assures himself that his construction complies with the requirements of the contract plans and specifications, including both on-site and off-site fabrication and will be keyed to the proposed construction sequence and shall include as a minimum at least three phases of inspection for all definable items or segments of work, as follows:

(1) Preparatory Inspection. To be performed prior to beginning any work or any definable segment of work. To include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted, and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. As a part of this preparatory work, Contractor's Quality Control organization will review all shop drawings, certifications, and other submittal data

prior to submission to the Contracting Officer. Contractor's Quality Control chief shall affirm by signing and dating each submittal, prior to offering it to the Contracting Officer for his approval, that the material or equipment conforms to the plans and specifications. Any departures from plans and specifications shall be clearly pointed out on the submittal. Submittals which do not contain evidence of review and approval by the Contractor's Quality Control organization are unacceptable and will be returned with no approval action taken. Final approval of those submittals designated elsewhere in this contract for action by Contractor's CQC is also a part of the preparatory inspection process.

(2) Initial Inspection. To be performed as soon as a representative segment of the particular item of work has been accomplished and to include examination of the quality and workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements.

(3) Follow-up Inspections. To be performed daily or as frequently as necessary to assure continuing compliance with contract requirements, including control testing, until completion of the particular segment of work.

c. The Contractor shall maintain current records of all inspections and tests performed on an appropriate approved format similar to Exhibit C-1, attached at the end of this section. These records should provide factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, causes for rejection, etc.; proposed remedial action; and corrective actions taken. The Contractor shall not build upon or conceal any feature of the work containing uncorrected defects, and payment on deficient items will be withheld until they are satisfactorily corrected or other action has been taken as authorized pursuant to the General Provision entitled "Inspection and Acceptance." These records must cover both conforming and defective items and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the Contract. Legible copies of these records must be furnished to the Contracting Officer daily. Records will be verified by the prima Contractor's designated representative daily.

d. The Contractor's job supervisory staff may be used for quality control, supplemented, as necessary, by special technicians, or testing facilities, to perform all specified tests, balancing, adjusting and/or regulating mechanical and electrical devices, equipment and/or systems. As an option, control testing to be performed by laboratory technicians may be accomplished by an industry-recognized testing laboratory approved by the Contracting Officer or his authorized representative.

(1) The minimum qualifications for a technician employed directly by the Contractor shall be the completion of a full 4-year or senior high school curriculum and two (2) years of experience in work related to that which he is to perform and three (3) years of specialized experience in the work he is to perform.

e. The Contractor shall furnish to the Government as soon as practicable, and in no event later than seven (7) days after receipt of the Notice to Proceed, an original and five (5) copies of a quality control plan which shall include the personnel, procedures, instructions, and records to be used. This document will include as a minimum:

(1) The quality control organization.

(2) Qualification of personnel to be used for this purpose.

(3) Authority and specific areas of responsibilities of each of the quality control personnel.

(4) Methods of performing quality control inspections including that for his subcontractor's work. This requires a statement concerning quality control measures to be used in work described in each technical section of the specifications. It also requires that all mechanical and electrical testing procedures be described in quality control plan in detail and approved prior to performing actual work. Where technical specifications require recording of test data, proposed test log, including planned duration of test, readings to be taken, and instrumentation to be used, will be made a part of the Quality Control Program. Test logs should, in general, be submitted and approved at least 60 days prior to their planned use, if not included in the original Quality Control Plan. Tests of air-conditioning systems, boilers, chillers, and the like, would be covered as described above.

(5) Designate how testing will be performed either by technicians employed by the Contractor or by an industry-recognized testing laboratory. The following information shall be made a part of his plan:

(a) Latest calibration data for concrete testing machines and Marshall machine (where applicable).

(b) Name and qualifications of each employee designated for the performance of specific types of tests.

(c) A list of the control tests which he understands he is to perform, not only by name, but also by numerical designation, together with a statement to the effect that the laboratory has a copy of each such procedure, and has facilities and serviceable testing equipment to perform tests conforming thereto. (Testing relating to Earthwork, Concrete, Masonry Construction, Base Courses, and Asphalt Pavements.)

(d) His understanding of the procedure to be followed should his test results indicate lack of compliance with specification requirements.

(6) Method of documenting quality control operation, inspection, and testing. A copy of proposed daily record form shall be made a part of the submittal.

(7) A copy of a letter of direction to the Contractor's representative responsible for quality control, outlining his duties and responsibilities, and signed by a responsible officer of the firm.

f. Before construction operations are commenced, the Contractor shall meet with the Contracting Officer, or his representative, and discuss his quality control plan. The meeting shall develop mutual understanding relative to details of the system, including the forms to be used for recording the quality control operations, inspections, administration of the system, and the interrelationship of Contractor and Government inspection.

g. Unless specifically authorized by the Contracting Officer, no construction and/or off-site fabrication will be started until the Contractor's quality control plan is approved. Construction of any feature of the work will only be permitted after approval of the quality control plan, or at least approval of that portion of the plan applicable to the specific feature of the work. As a rule, except for the start of the construction period, quality control and test techniques should be approved at least 60 days in advance of their planned application. No payment estimate will be processed under this contract until the quality control program has been approved by the Government. The Contractor shall notify the Contracting Officer or his authorized representative in wirting of any proposed change to this inspection system; no such change shall be implemented prior to approval in writing by the Contracting Officer or his authorized representative.

h. If recurring deficiencies in an item or items indicate that the quality control system is not adequate, such corrective actions will be taken as directed by the Contracting Officer.

i. In the event the Contractor utilizes the service of a commercial testing laboratory, the Contracting Officer reserves the right to check laboratory equipment for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques.

j. The Contracting Officer reserves the right to utilize the Contractor's control testing laboratory and equipment to make spot tests and to check the Contractor's testing procedures, techniques, and test results.

APPENDIX B:
NAVY GENERAL PROVISION FOR CQC

79. CONTRACTOR QUALITY CONTROL (CQC) (4-77)

This clause applies only when specifically required by the specifications.

(a) The contractor shall provide a quality control organization and system to perform inspections, tests, and retesting in the event of failure of all items of work, including that of his subcontractors, to assure compliance with the contract provisions. Quality control will be established for all work, except where specific provisions of the contract provide for Government approvals, inspections, and tests. The CQC system will specifically include, but not be limited to, the inspections and tests required in the technical provisions of the contract specifications and shall cover all construction operations, including both on-site and off-site fabrication.

(b) The contractor shall provide a CQC representative, supplemented as necessary by additional personnel, who shall be on the work at all times during progress, with complete authority to take any action necessary to ensure compliance with the contract. The CQC representative shall be appointed by a letter addressed to him and signed by an officer of the firm. This letter shall detail the CQC representative's authority and responsibility to act for the contractor. The CQC representative shall report directly to an officer of the firm, and shall not be the same individual as, nor be subordinate to, the job superintendent or project manager. The CQC representative shall have no job-related responsibilities other than quality control.

(c) The contractor shall furnish four copies of the CQC plan to the Contracting Officer within fifteen calendar days after receipt of the Notice of Award. The CQC plan shall detail the procedures, instructions, and reports to be used to assure compliance with the contract. Unless specifically authorized by the Contracting Officer in writing, no construction will be started until the CQC plan is approved. This plan will include, as a minimum:

(1) A copy of the letter appointing the CQC representative, signed by an officer of the firm, outlining the CQC representative's duties, responsibilities, and authority. This letter must include the authority to direct removal and replacement of any defective work.

(2) The quality control organization in chart form, showing the relationship of the quality control organization to other elements of the firm.

(3) Names and qualifications of personnel in the quality control organization.

(4) Area of responsibility and authority of each individual in the quality control organization.

(5) A listing of outside organizations such as testing laboratories, architects, and consulting engineers that will be employed by the contractor, and a description of the services these firms will provide.

(6) Procedures for reviewing all shop drawings, samples, certificates, or other submittals for contract compliance, including the name of the person(s) authorized to sign the submittals for the contractor, as complying with the contract.

(7) An inspection schedule, keyed to the construction schedule and following the order of the specification technical sections, indicating what inspections and tests, the names of persons responsible for the inspection and testing for each segment of work, and the time schedule for each inspection and test.

(8) The procedures for documenting quality control operation, inspection, and testing, with a copy of all forms and reports to be used for this purpose. The contractor shall also include a submittal status log listing all submittals required by the specifications and stating the action required by contractor or the Government. The contractor shall complete columns (a) through (e) of this log and name the persons authorized to review the submittals.

(d) Inspection procedures shall include, as a minimum:

(1) Preparatory Inspection. Preparatory Inspection shall be performed before beginning any work, and in addition, before beginning each segment of work. Preparatory Inspection shall include a review of the contract requirements, the review and approval of shop drawings and other submittal data, a check to assure that required control testing will be provided, a physical examination to assure that all materials and equipment conform to approved shop drawings and submittal data, and a check to assure that all required preliminary work has been completed.

(2) Initial Inspection. An Initial Inspection shall be performed as soon as a representative segment of the particular item of work has been accomplished. Initial inspection shall include performance of scheduled tests, examination of the quality of workmanship, a review of test results for compliance with contract requirements, a review for omissions or dimensional errors, and approval or rejection of the initial segment of the work.

(3) Follow-up Inspections. Follow-up Inspections shall be performed daily, and more frequently as necessary, and shall include continued testing and examinations to assure continued compliance with the contract requirements.

(e) At least five days after the CQC Plan is submitted, but before construction operations are started, the contractor shall meet with the Contracting Officer and discuss the quality control requirements. The purpose of the meeting shall be to develop a mutual understanding relative to details of the system, including forms to be used for recording the quality control operations, inspections, tests, approvals, certifications, administration of the system, and Government surveillance. This meeting shall also develop a schedule for future weekly or biweekly CQC meetings and shall establish procedures for submission of daily reports and other records and documents.

(f) The contractor shall submit daily CQC reports to the Contracting Officer identifying prime and subcontractor personnel and equipment on the site, idle equipment and personnel, material deliveries, weather conditions, work accomplished, inspections and tests conducted, results of inspection and tests, nature of defects found, causes for rejection, proposed remedial action, and corective actions taken, together with the following certification. "On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above." This certification shall be signed for the contractor by the authorized CQC representative.

(g) Test results provided shall cite the contract requirements, the test or analysis procedures used, and the actual tests results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a testing laboratory representative authorized to sign certified test reports. The contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

(h) All submittals, shop drawings, catalog cuts, samples, etc., unless otherwise specifically noted, shall be approved and certified by the contractor as conforming to the drawings and specifications. Four copies of all shop drawings, catalog cuts, or other submittals, with the contractor's approval indicated thereon, shall be sent to the Contracting Officer within one working day of the contractor's approval.

APPENDIX C:
NAVFAC QUALITY CONTROL GUIDE SPECIFICATIONS

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
GUIDE SPECIFICATION

NFGS-01400 (June 1981)
~~~~~~~~~~~~~~~~
Superseding
TS-01400 (June 1977)

SECTION 01400 (B)

CONTRACTOR QUALITY CONTROL SYSTEM (A)

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. (C)

1.1.1 American Society for Testing and Materials (ASTM) Publications:

D 3666-78	Inspection and Testing Agencies for Bituminous Paving Materials
D 3740-78	Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Construction
E 329-77	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
E 543-76	Nondestructive Testing Agencies, Rec. Practice for Determining the Qualifications of
E 548-79	Testing and Inspection Agencies, Rec. Practice for Generic Criteria for Use in Evaluation of

1.2 QUALITY CONTROL: This contract will be administered under the General Provisions Clause entitled "Contractor Quality Control (CQC)." [The CQC representative] [A member of the CQC staff] shall have the following specific minimum qualifications: _____ (D)

_____

_____

_____.

1.3 DEFINITIONS:

1.3.1 Contractor Quality Control (CQC): The quality control and inspection system established and maintained by the Contractor that assures compliance with the contract drawings and specifications.

1.3.2 Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.
~~~~~~~~~~~~~~~~

1.3.3 Field Tests: Tests or analyses made at, or in the vicinity of the job site in connection with the actual construction.

1.3.4 Product: The term "product" includes the plural thereof and means a type or a category of manufactured goods, constructions, installations, and natural and processed materials or those associated services whose characterization, classification, or functional performance determination is specified by standards.

1.3.5 Person: The term "person" means associations, companies, corporations, educational institutions, firms, Government agencies at the Federal, State and local level, partnerships, and societies, as well as divisions thereof, and individuals.

1.3.6 Testing Laboratory: The term "testing laboratory" means any "person," as defined above, whose functions include testing, analyzing, or inspecting "products," as defined above, and/or evaluating the designs or specifications of such "products" according to the requirements of applicable standards.

1.3.7 Certified Test Reports: Test reports signed by an authorized official stating that tests were performed in accordance with the test method specified, that the results reported are accurate, and that items tested either meet or fail to meet the stated minimum requirements. These test reports include those performed by Factory Mutual, Underwriters Laboratories, Inc. and others.

1.3.8 Certified Inspection Reports: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report.

1.3.9 Manufacturer's Certificate of Conformance: A certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the specification requirements.

1.4 SUBMITTALS: Those required by the technical sections of the contract specifications shall be approved and certified by the Contractor in accordance with the Contractor Quality Control Clause of the General Provisions, unless specifically stated otherwise, in which case the Clauses entitled "Shop Drawings" and "Catalog Data" of the General Provisions apply. In addition, clearly mark and identify in the submittals and catalog cuts each item proposed to be incorporated into the project with cross-references to the contract drawings and specifications so as to identify clearly the use for which it is intended. The Contractor shall maintain at the job site an up-to-date submittal status log showing the status of all submittals required by the contract. A sample format of an acceptable log is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample. (E)

1.4.1 Shop Drawings and Manufacturer's Data: Stamp each sheet of catalog cuts, technical data sheets, and descriptive literature with the Contractor's approval stamp, except that data submitted in a bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only. The approval stamp shall have blanks to indicate whether Government approval or Contractor approval is required by the contract. The stamp shall be worded as follows: (E)

"It is hereby certified that the (material) (equipment) shown and marked in this submittal, shop drawings, catalog cut(s), etc., and approved/proposed to be incorporated into Contract Number _____ is in compliance with the contract drawings and specifications and can be installed in the allocated space, and is ____ approved for use/ ____ submitted for Government approval.

Authorized Reviewer _____ Date _____

Signature CQC Rep _____ Date _____"

The person(s) signing the certification shall be the one(s) designated in the Contractor Quality Control Plan as having this authority. The signature(s) shall be in original ink. Stamped signatures will not be acceptable.

1.4.2 Samples: Prepare and submit in accordance with the General Provisions Clauses entitled "Contractor Quality Control (CQC)" and "Samples." (E)

1.4.3 Certified Test Reports: Before delivery of materials and equipment, [_____] certified copies of the reports of all tests listed in the technical sections shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified herein. The tests shall have been performed within [3 years] [_____] of submittal of the reports for approval. Test reports shall be accompanied by certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as that tested. (E)

1.4.4 Manufacturer's Certificates of Conformance: Before delivery Manufacturer's Certifications shall be furnished by the Contractor as required on items of materials and equipment indicated in the technical sections. Pre-printed certifications will not be acceptable. All certifications shall be in the original. The original of all manufacturer's certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test data upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance or compliance. (E)

1.4.5 [Tabulation of Tests: In addition to the General Provisions requirements for CQC test reports, prior to final payment the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract, including conforming, nonconforming, and repeated test results. The tabulation(s) shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.] (F)

1.4.6 [Formwork, Falsework, and Erection Procedures Certification: When the Contractor is required to submit a [design] [certification] for [formwork] [falsework] [erection procedures], CQC Daily Reports must certify that the work has been inspected [by a Professional Civil or Structural Engineer registered in any jurisdiction] for conformance to the [design] [certification]. A specific statement for these items rather than a general statement is required.] (G)

PART 2 - EXECUTION

2.1 QUALITY CONTROL REQUIREMENTS: The Contractor, through his CQC representative and staff, shall inspect, sample, test, and perform the required approvals for all work under the contract. [[Masonry,] [structural steel bolting,] [and] [welding] inspections and tests shall be considered specialty inspections to be performed and submitted as certified test and inspection reports by an approved testing laboratory.] Approvals, except those required for field installations, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. As a minimum, inspection, sampling, testing, and approvals shall be performed and recorded on a Contractor Quality Control Daily Report Form in accordance with the General Provisions Clause entitled "Contractor Quality Control (CQC)." A sample format of an acceptable form is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample. The Officer in Charge of Construction will assign a Resident Officer in Charge of Construction (ROICC) to the project. The ROICC will designate a Navy Construction Representative who will be the primary point of contact between the Contractor and the Government. The Navy Construction Representative will review the Contractor's Quality Control Reports, perform surveillance of the Contractor's testing and inspection procedures, and perform such job inspections as deemed necessary. He will visit the construction site whenever it is considered necessary or advisable. The ROICC will exercise the right of the Government to accept materials, workmanship, and construction-in-place in accordance with the General Provisions Clause entitled "Inspection and Acceptance." (H)(I)

2.1.1 Factory Tests: Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the contract. (J)

2.1.2 Factory Inspections by the Contractor: Unless otherwise specified, the Contractor shall arrange and perform all factory inspections specifically required in the technical sections of the specifications. These inspections shall be reported on the CQC Daily Report as to the type and locations of the work. (J)

2.1.3 Factory Inspections by the Government: The Contracting Officer will arrange for factory inspections specified to be performed by the Government.

2.1.4 Field Inspections and Tests by the Contractor: They shall be in accordance with the General Provisions Clause entitled "Contractor Quality Control (CQC)." (J)

2.1.5 Field Inspections and Tests by the Government: If deemed necessary by the Contracting Officer, field inspections and tests will be made in accordance with the General Provisions Clause entitled "Inspection and Acceptance."

2.1.6 Approval of Testing Laboratories: All laboratory work under this contract shall be performed by a laboratory approved by the Government, whether the laboratory is employed by the Contractor, or is owned and operated by the Contractor. The basis of approval includes the following:

a. Testing laboratories performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E 329 and ASTM D 3666, respectively.

b. Testing laboratories engaged in the testing and inspection of soils and rock or performing non-destructive testing shall comply with ASTM D 3740 and ASTM E 543, respectively.

c. Testing laboratories performing work not in connection with concrete, steel, bituminous materials, soils and non-destructive testing shall comply with ASTM E 548.

2.1.6.1 Laboratory Inspection: Prior to approval the laboratory shall submit in writing the following:

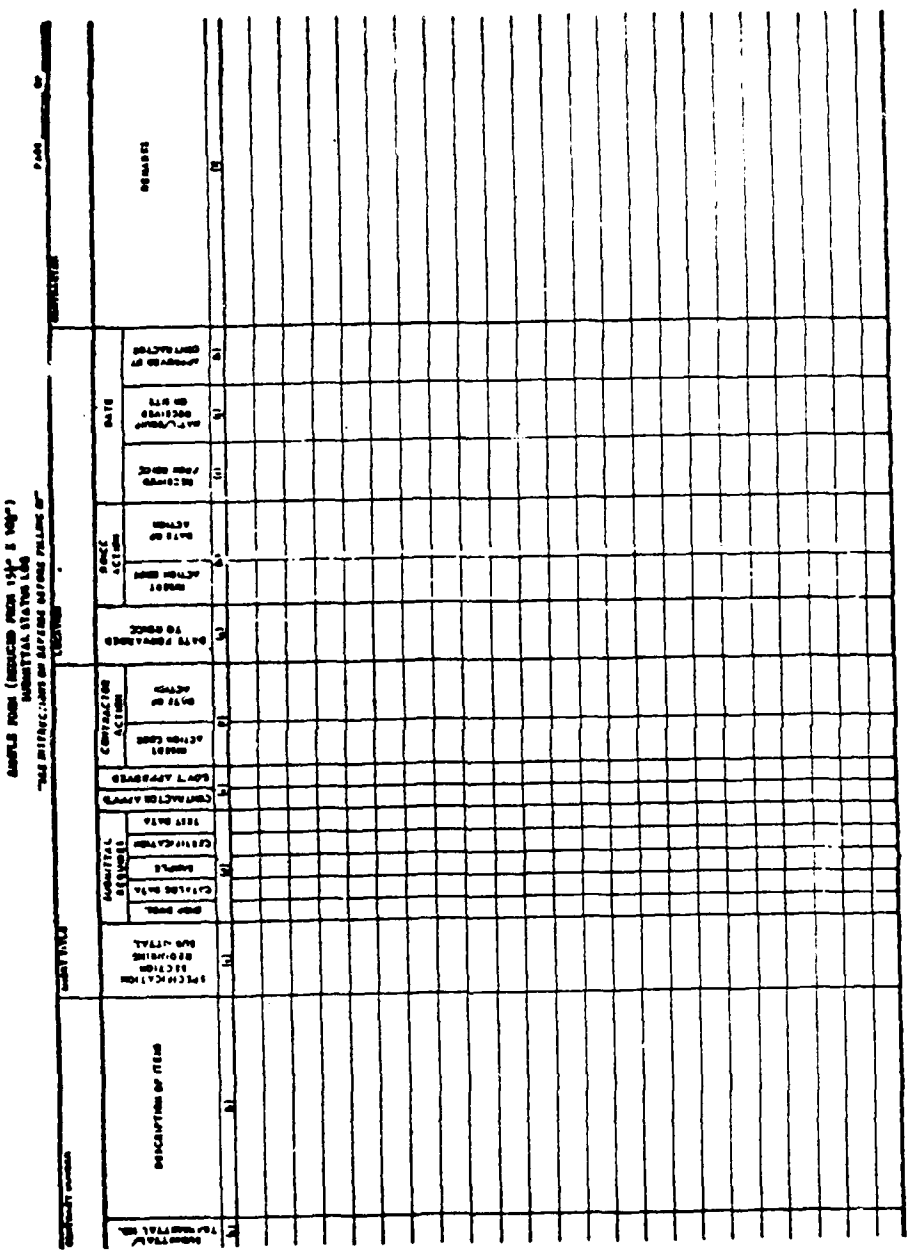
a. Functional description of the laboratories organizational structure, operational departments, and support departments and services.

b. A list and resume of the personnel assigned to the proposed testing, including the person charged with engineering managerial responsibility.

c. Affidavit of compliance with the applicable ASTM publication and certification that the laboratory performs work in accordance with technical requirements as required by the contract specification

d. A list of test and inspection equipment for each of the proposed test procedures and certification that the equipment is calibrated at prescribed intervals to insure the validity of the test and inspection data.

e. A copy of any recent certification or inspection report of the laboratory by a nationally recognized agency, including a statement of corrections made based on the findings of the agency. In the absence of inspection by a nationally recognized agency, the laboratory will be subject to inspection by the Contracting Officer upon receipt of all the above information 30 days before the required approval of the testing laboratory.



(Best available copy.)

INSTRUCTIONS

1. This form may be used by the Contractor for listing all material submittals that require action by either the Contractor or the Government.

2. Columns (a) through (e) should be completed by the Contractor and must include all submissions that are required by the specifications. This partially completed form then becomes the submittal log portion of the CQC Plan.

3. As submittals are received and processed, the remaining columns are to be completed by the Contractor.

4. In those instances where the Contractor has approved the submittal under his contract responsibility, there may be a dual action code indicated under column (f): e.g., "A/E," indicating approved as submitted and forwarded to the ROICC for record purpose.

5. In column (f) for those items requiring ROICC action (action code "D"), THE REASON FOR FORWARDING TO THE ROICC should be entered in the column (l), the remarks column; e.g., Government approval required; waiver requested because of variance substitution, etc.

6. Where no Government action is required, (for Contractor review/approval items), there need be no entry in columns (h) and (i).

7. Column (j) is completed when material or equipment is delivered to the project. Column (k) is completed only after verification that the delivered item is that represented by the approved submittal.

ACTION CODE: To be used when completing columns (f) and (h)

A - Approved as submitted
B - Approved as noted
C - Disapproved
D - Forwarded to ROICC for action
E - Forwarded to ROICC for record purpose

NFGS-01400 (June 1981)

CONTRACTOR'S QUALITY CONTROL DAILY REPORT (SAMPLE FORMAT)

Complete report in detail daily. If more space is needed, attach additional sheets. COC REP to date and initial additional sheets. Attach test reports, delivery slips, and references.

CONTRACT NO.	TITLE AND LOCATION	DATE REPORT NO
CONTRACTOR (Prime or Subcontractor)	NAME OF SUPERINTENDENT OR FOREMAN	
WEATHER – A.M.	TEMPERATURE – A.M.	°F
WEATHER – P.M.	TEMPERATURE – P.M.	°F

PRIME CONTRACTOR/SUBCONTRACTOR WORKFORCE (If space provided below is inadequate, use additional sheets)				LOCATION AND DESCRIPTION OF WORK PERFORMED
NUMBER	TRADE	HOURS	EMPLOYER	

TOTAL WORK HOURS ON JOB SITE THIS DATE	
CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT	
TOTAL WORK HOURS FROM START OF CONSTRUCTION	

WERE THERE ANY LOST TIME ACCIDENTS THIS DATE?

☐ YES ☐ NO

IF "YES", A COPY OF THE COMPLETED OSHA REPORT IS REQUIRED

INSPECTION AND/OR TESTING PERFORMED TODAY – FOLLOW WITH REPORT	LOCATION AND/OR ELEMENT OF WORK	REMARKS RESULTS OF INSPECTIONS/TESTING

Sheet of

SPEC. PARA. AND/OR DRAWING NO	EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB (Description, Size, Quantity)	SUBMITTAL NO. OR CERTIFICATION	DATE APPROVED

SPEC. PARA. AND/OR DRAWING NO.	LOCATION AND DESCRIPTION OF DEFICIENCIES (Materials, Equipment, Safety, and/or Workmanship) ACTION TAKEN OR TO BE TAKEN

DEFICIENCIES CORRECTED THIS DATE	REFERENCE	
	REPORT NO.	COMPLIANCE NOTICE NO.

CONSTRUCTION AND PLANT EQUIPMENT LEFT ON JOB SITE UNTIL USE IS COMPLETED

DESCRIPTION	DATE FIRST ON JOB (First time only)	HOURS WORKED THIS DATE	HOURS IDLED	DATE OF FINAL REMOVAL FROM JOB SITE

CONSTRUCTION AND PLANT EQUIPMENT NOT LEFT ON JOB SITE PERMANENTLY
(This will include pickup trucks and mobile mounted items, such as compressor, that are also used for transportation to and from the job)

DESCRIPTION	HOURS WORKED	HOURS IDLED

REMARKS *(Include directions received from ROICC/AROICC, visitors, compliance notices received, errors and/or omission in P/S; pertinent information)*

CONTRACTOR'S CERTIFICATION - ON BEHALF OF THE CONTRACTOR, I CERTIFY THAT THIS REPORT IS COMPLETE AND CORRECT AND ALL EQUIPMENT AND MATERIAL USED AND WORK PERFORMED DURING THIS REPORTING PERIOD ARE IN COMPLIANCE WITH THE CONTRACT PLANS AND SPECIFICATIONS, TO THE BEST OF MY KNOWLEDGE, EXCEPT AS NOTED ABOVE.

Authorized CQC Rep At Site — Date

GENERAL NOTES

1. This guide specification supersedes NAVFAC TS-01400, Quality Control [For CQC Projects] of June 1977.

2. This guide specification shall not be referenced but is to be used as a manuscript in preparing project specifications. APPROPRIATE CHANGES AND ADDITIONS AS MAY BE NECESSARY AND AS REQUIRED BY THE NOTES MUST BE MADE. Where the phrase "unless indicated or specified otherwise", "as indicated", or words of similar import are used, appropriate requirements, as necessary, shall be included in the project drawings or specifications.

3. The capital letters in the right hand margins indicate that there is a technical note pertaining to that portion of the guide specification. It is intended that the letters in the margins be deleted before typing the project specification.

4. Where numbers, symbols, words, phrases, clauses, or sentences in this specification are enclosed in brackets [], a choice or modification must be made; delete inapplicable portion(s) carefully. Where blank spaces occur in sentences, insert the appropriate data. Where more than one paragraph has the same number, delete those paragraphs that are not applicable. Where entire paragraphs are not applicable, they should be deleted completely.

5. CAUTION: Coordination of this section with other sections of the specification and with the drawings is mandatory. If materials or equipment are to be furnished under this section, but installed, connected, or placed in operation under other sections of the specification and/or the drawings, then state that fact clearly and concisely in this section and in all other sections involved. EACH DISCIPLINE SHALL REVIEW THE ENTIRE SPECIFICATION TO INSURE THAT LANGUAGE IS INCLUDED TO PROVIDE COMPLETE AND OPERABLE SYSTEMS AND EQUIPMENT.

6. DO NOT INCLUDE TABLE OF CONTENTS, GENERAL NOTES, AND TECHNICAL NOTES IN THIS SECTION IN FINAL MANUSCRIPT.

7. Suggestions for improvement of this specification will be welcomed and should be forwarded using the DD Form 1426 attached to this specification or in any other format to:

COMMANDER
NAVAL FACILITIES ENGINEERING COMMAND
Code 0432
200 Stovall Street
Alexandria, VA 22332

TECHNICAL NOTES

A. This guide specification covers requirements for the general quality control paragraphs to appear in the "Contractor Quality Control System" section in Division 1 of project specifications when Contractor Quality Control (CQC) is to be included. NAVFAC P-445, NAVFAC Construction Quality Management Manual contains procedures for administration of CQC and sample forms referred to as "available from the Contracting Officer."

B. Specification, section, and page numbers shall be centered at the bottom of each page of this section.

EXAMPLE:

05-76-1776
01400-1

C. Paragraph 1.1: The listed designations for publications are those that were in effect when this guide specification was being prepared. Designations that are known to be out of date when project specifications are prepared should be changed to those current at that time, and the nomenclature, type, grades, classes, etc., referenced in the guide should be checked for conformance to the latest revision or amendment. To minimize the possibility of error, the letter suffixes, amendments, and dates indicating specific issues should be retained here and omitted elsewhere in the project specification.

D. Paragraph 1.2: Qualifications of CQC Representative or staff. The specification of minimum qualifications must be approved by NAVFAC Headquarters (05D) prior to advertisement. The Engineer-in-Charge shall submit a copy of the General Description of the work with the proposed CQC qualifications when requesting approval.

E. Paragraphs 1.4, 1.4.1, 1.4.2, 1.4.3, and 1.4.4: A check must be made to assure that all required submittals and samples are listed in each technical section.

F. Paragraph 1.4.5: Specify tabulation of tests for projects which require considerable field inspections and tests by the Contractor.

G. Paragraph 1.4.6: Specify formwork, falsework, and erection procedure certification in accordance with NAVFAC directive for projects which require critical or unusual form-work, falsework, or erection procedures.

H. Paragraph 2.1: A copy of the Contractor Quality Control Report Form to be attached is in NAVFAC P-445, NAVFAC Construction Quality Management Manual.

I. Paragraph 2.1: Specify specialty inspection where masonry, structural steel bolting, or welding is critical to the project.

J. Paragraph 2.1.1, 2.1.2, and 2.1.4: A check must be made to assure that all required Factory Tests, Factory Inspections, and Field Inspections and Tests are listed in each technical section.

*** E N D ***

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
GUIDE SPECIFICATION

NFGS-01401 (June 1981)

Superseding
TS-01401 (June 1977)

SECTION 01401 (B)

CONTRACTOR INSPECTION SYSTEM (A)

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. (C)

1.1.1 American Society for Testing and Materials (ASTM) Publications:

D 3666-78	Inspection and Testing Agencies for Bituminous Paving Materials
D 3740-78	Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Construction
E 329-77	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
E 543-76	Nondestructive Testing Agencies, Rec. Practice for Determining the Qualifications of
E 548-79	Testing and Inspection Agencies, Rec. Practices for Generic Criteria for Use in Evaluation of

1.2 QUALITY CONTROL: Quality Control of this contract will be administered under the General Provisions Clause entitled "Contractor Inspection System."

1.3 DEFINITIONS:

1.3.1 Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.

1.3.2 Field Tests: Tests or analyses made at, or in the vicinity of the job site in connection with the actual construction.

1.3.3 Product: The term "product" includes the plural thereof and means a type or a category of manufactured goods, constructions, installations, and natural and processed materials or those associated services whose characterization, classification, or functional performance determination is specified by standards.

1.3.4 Person: The term "person" means associations, companies, corporations, educational institutions, firms, government agencies at the Federal, State and local level, partnerships, and societies, as well as divisions thereof, and individuals.

1.3.5 Testing Laboratory: The term "testing laboratory" means any "person," as defined above, whose functions include testing, analyzing, or inspecting "products," as defined above, and/or evaluating the designs or specifications of such "products" according to the requirements of applicable standards.

1.3.6 Certified Test Reports: Test reports signed by an authorized official stating that tests were performed in accordance with the test method specified, that the results reported are accurate, and that items tested either meet or fail to meet the stated minimum requirements. These test reports include those performed by Factory Mutual, Underwriters Laboratories, Inc. and others.

1.3.7 Certified Inspection Reports: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exception included in the report.

1.3.8 Manufacturer's Certificate of Conformance: A certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the specification requirements.

1.4 SUBMITTALS: Prepare in accordance with the General Provisions and submit to the Contracting Officer for approval. Each submittal shall be accompanied with a cover letter signed by the Contractor. Clearly mark each item proposed to be incorporated into the contract and identify in the submittals, with cross-references to the contract drawings and specifications so as to identify clearly the use for which it is intended. Stamp each sheet of submittal with the Contractor's certification stamp. Data submitted in a bound volume or on one sheet printed on two sides, may be stamped on the front of the first sheet only. The Contractor's certification stamp shall be worded as follows: (D)

"It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into Contract Number _____, is in compliance with the Contract drawings and specifications, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by _____ Date _____"

The person signing the certification shall be one designated in writing by the Contractor as having that authority. The signature shall be in original ink. Stamped signatures are not acceptable.

1.4.1 Submittal Status Logs: Within [15] calendar days after receipt of the "Notice of Award" the Contractor shall submit to the Contracting Officer a copy of a submittal status log listing all submittals required in this contract. The Contractor shall maintain at the job site an up-to-date log showing the status of all submittals required by the contract. A sample format of an acceptable log is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample.

1.4.2 Shop Drawings: These submittals shall be in accordance with the requirements of the General Provisions Clause entitled "Shop Drawings." (D)

1.4.3 Manufacturer's Data: Catalog cuts, technical data sheets, and descriptive literature, shall be in accordance with the General Provisions Clauses entitled "Catalog Data" and "Proposed Material Submittals Required of the Contractor." (D)

1.4.4 Samples: Prepare and submit in accordance with the General Provisions Clause entitled "Samples." (D)

1.4.5 Certified Test Reports: Before delivery of materials and equipment, [_____] certified copies of the reports of all tests listed in the technical sections shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified herein. The tests shall have been performed within [3 years] [_____] of submittal of the reports for approval. Test reports shall be accompanied by the certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as that tested. (D)

1.4.6 Manufacturer's Certificates of Conformance: Before delivery, manufacturer's certifications shall be furnished by the Contractor as required on items of materials and equipment indicated in the technical sections. Pre-printed certifications will not be acceptable. All certifications shall be in the original. The original of all manufacturer's certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test data upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance. (D)

1.4.7 Laboratory Reports: Reports shall cite the contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a

representative of the testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

1.4.8 [Tabulation of Tests: Prior to final payment the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract. Conforming, nonconforming, and retesting shall be tabulated. The tabulation(s) shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.] (E)

1.4.9 [Formwork, Falsework, and Erection Procedures Certification: When the Contractor is required to submit a [design] [certification] for [formwork] [falsework] [erection procedures], daily inspection reports must indicate that the work has been inspected [by a Professional Civil or Structural Engineer registered in any jurisdiction] for conformance to the [design] [certification]. A specific statement for these items rather than a general statement is required.] (F)

PART 2 - EXECUTION

2.1 QUALITY CONTROL REQUIREMENTS: In accordance with the General Provisions Clause entitled "Contractor Inspection System," the Contractor shall inspect and test all work under the contract and maintain records of the inspections and tests. Approvals, except those required for field installations, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. Surveillance of the inspection system will be performed by the Contracting Officer.

2.1.1 Factory Tests: Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the contract. (G)

2.1.2 Factory Inspections by the Contractor: Unless otherwise specified, the Contractor shall arrange and perform all factory inspections specifically required in the technical sections of the specifications. These inspections shall be reported in the Daily Report to Inspector. (G)

2.1.3 Field Inspections and Tests by the Contractor: The Contractor shall furnish all equipment, instruments, qualified personnel, and facilities necessary to inspect all work and perform all tests required by the contract. All inspections and tests performed and test results received each day shall be included in the Daily Report to Inspector. (G)

2.1.4 Field Inspections and Tests by the Government: If deemed necessary by the Contracting Officer, field inspections and tests will be made in accordance with the General Provisions Clause entitled "Inspection and Acceptance."

2.1.5 [{Masonry,} {Structural Steel Bolting,} [and] {Welding} Inspections and Tests: These inspections and tests shall be considered specialty inspections to be performed and submitted as certified test and inspection reports by an approved testing laboratory.] (H)

2.1.6 Approval of Testing Laboratories: All laboratory work under this contract shall be performed by a laboratory approved by the Government, whether the laboratory is employed by the Contractor, or is owned and operated by the Contractor. The basis of approval includes the following:

a. Testing laboratories performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E 329 and ASTM D 3666, respectively.

b. Testing laboratories engaged in the testing and inspection of soils and rock or performing non-destructive testing shall comply with ASTM D 3740 and ASTM E 543, respectively.

c. Testing laboratories performing work not in connection with concrete, steel, bituminous materials, soils and non-destructive testing shall comply with ASTM E 548.

2.1.6.1 Laboratory Inspection: Prior to approval the laboratory shall submit in writing the following:

a. Functional description of the laboratories organizational structure, operational departments, and support departments and services.

b. A list and resume of the personnel assigned to the proposed testing, including the person charged with engineering managerial responsiblility.

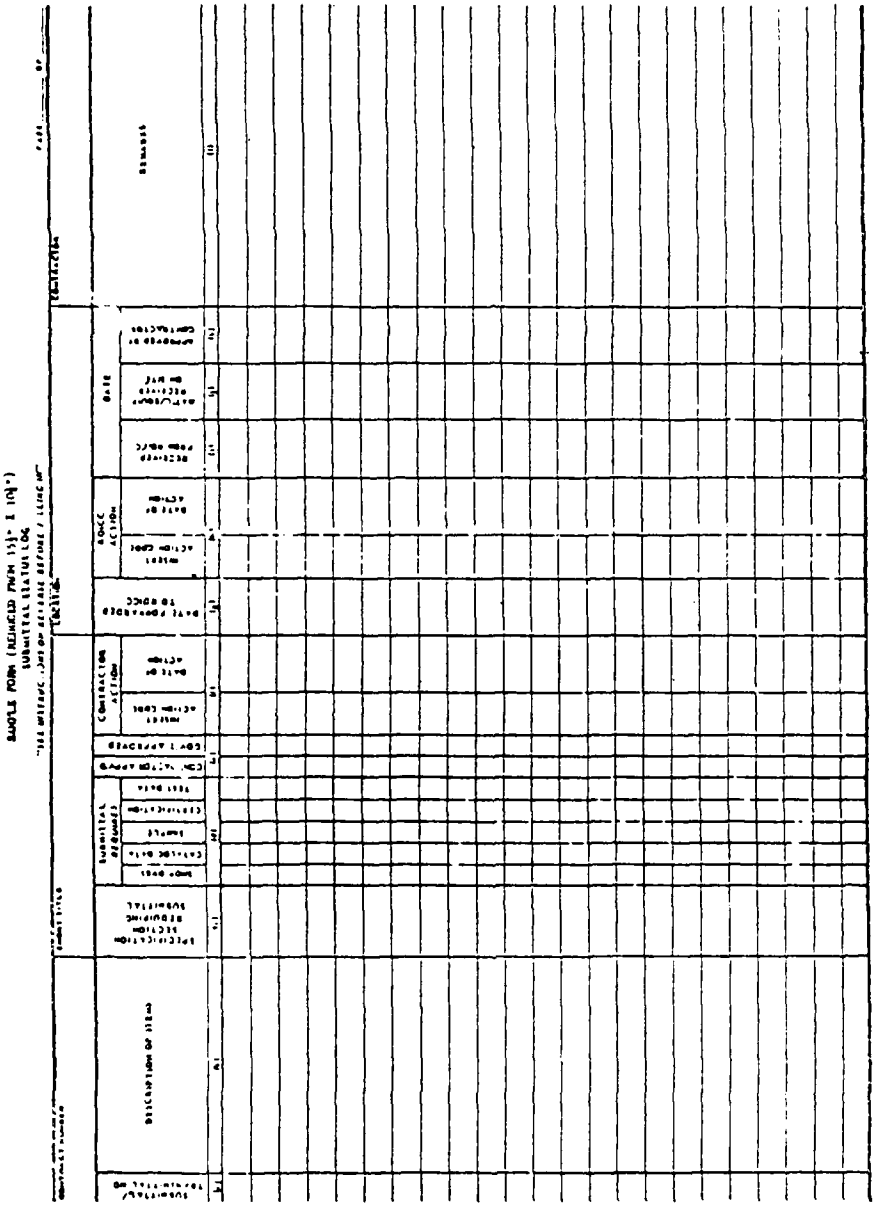
c. Affidavit of compliance with the applicable ASTM publication and certification that the laboratory performs work in accordance with technical requirements as required by the contract specifications.

d. A list of test and inspection equipment for each of the proposed test procedures and certification that the equipment is calibrated at prescribed intervals to insure the validity of the test and inspection data.

e. A copy of any recent certification of inspection report of the laboratory by a nationally recognized agency, including a statement of corrections made based on the findings of the agency. In the absence of inspection by a nationally recognized agency, the laboratory will be subject to inspection by the Contracting Officer upon receipt of all the above information 30 days before the required approval of the testing laboratory.

2.1.7 Repeated Tests and Inspections: The Contractor shall repeat tests and inspections after each correction made to nonconforming materials and workmanship until tests and inspections indicate the materials, equipment, and workmanship conform to the contract requirements. The retesting and reinspections shall be performed at no additional cost to the Government.

2.1.8 Daily Report to Inspector: The signed "Daily Report to Inspector" Form NAVFAC 4330/34 shall be submitted to the Contracting Officer by 10:00 AM on the working day following the day the work was performed.



(Best available copy.)

INSTRUCTIONS

1. This form may be used by the Contractor for listing all material submittals that require action by either the Contractor or the Government.

2. Columns (a) through (e) should be completed by the Contractor and must include all submissions that are required by the specifications.

3. As submittals are received and processed, the remaining columns are to be completed by the Contractor.

4. In column (f) for those items requiring ROICC action (action code "D"), THE REASON FOR FORWARDING TO THE ROICC should be entered in the column (l), the remarks column; e.g., Government approval required; waiver requested because of variance, substitution, etc.

5. Column (j) is completed when material or equipment is delivered to the project. Column (k) is completed only after verification that the delivered item is that represented by the approved submittal.

ACTION CODE: To be used when completing columns (f) and (h)

A - Approved as submitted
B - Approved as noted
C - Disapproved
D - Forwarded to ROICC for action
E - Forwarded to ROICC for record purpose

GENERAL NOTES

1. This guide specification supersedes NAVFAC TS-01401, Quality Control [For Non-CQC Projects] of Ju. 1977.

2. This guide specification shall not be referenced but is to be used as a manuscript in preparing project specifications. APPROPRIATE CHANGES AND ADDITIONS AS MAY BE NECESSARY AND AS REQUIRED BY THE NOTES MUST BE MADE. Where the phrase "unless indicated or specified otherwise", "as indicated", or words of similar import are used, appropriate requirements, as necessary, shall be included in the project drawings or specifications.

3. The capital letters in the right hand margins indicate that there is a technical note pertaining to that portion of the guide specification. It is intended that the letters in the margins be deleted before typing the project specification.

4. Where numbers, symbols, words, phrases, clauses, or sentences in this specification are enclosed in brackets [], a choice or modification must be made; delete inapplicable portion(s) carefully. Where blank spaces occur in sentences, insert the appropriate data. Where more than one paragraph has the same number, delete those paragraphs that are not applicable. Where entire paragraphs are not applicable, they should be deleted completely.

5. CAUTION: Coordination of this section with other sections of the specification and with the drawings is mandatory. If materials or equipment are to be furnished under this section, but installed, connected, or placed in operation under other sections of the specification and/or the drawings, then state that fact clearly and concisely in this section and in all other sections involved. EACH DISCIPLINE SHALL REVIEW THE ENTIRE SPECIFICATION TO INSURE THAT LANGUAGE IS INCLUDED TO PROVIDE COMPLETE AND OPERABLE SYSTEMS AND EQUIPMENT.

6. DO NOT INCLUDE TABLE OF CONTENTS, GENERAL NOTES, AND TECHNICAL NOTES IN THIS SECTION IN FINAL MANUSCRIPT.

7. Except as noted otherwise herein, all paragraphs and subparagraphs are to be used in the contract specification.

8. Suggestions for improvement of this specification will be welcomed and should be forwarded using the DD Form 1426 attached to this specification or in any other format to:

COMMANDER
NAVAL FACILITIES ENGINEERING COMMAND
Code 0432
200 Stovall Street
Alexandria, VA 22332

TECHNICAL NOTES

A. This guide specification covers requirements for the general quality control paragraphs to appear as the "Contractor Inspection System" when the Contractor Quality Control System is not to be included.

B. Specification, section, and page numbers shall be centered at the bottom of each page of this section.

EXAMPLE:

12-80-1776
01401-1

C. Paragraph 1: The listed designations for publications are those that were in effect when this guide specification was being prepared. Designations that are known to be out of date when project specifications are prepared should be changed to those current at that time, and the nomenclature, type, grades, classes, etc., referenced in the guide should be checked for conformance to the latest revision or amendment. To minimize the possibility of error, the letter suffixes, amendments, and dates indicating specific issues should be retained here and omitted elsewhere in the project specification.

D. Paragraphs 1.4, 1.4.2, 1.4.3, 1.4.4, 1.4.5, and 1.4.6: A check must be made to assure that all required submittals and samples are listed in each technical section.

E. Paragraph 1.4.8: Specify tabulation of tests for projects which require considerable field inspections and tests by the Contractor.

F. Paragraph 1.4.9: Specify formwork, falsework, and erection procedure certification in accordance with NAVFAC directive for projects which require critical or unusual formwork, falsework, and erection procedures.

G. Paragraphs 2.1.1, 2.1.2, and 2.1.3: A check must be made to assure that all required Factory Tests, Factory Inspections, and Field Inspections and Tests are listed in each technical section.

H. Paragraph 2.1.5: Specify specialty inspection when masonry, structural steel bolting, or welding is critical to the projects.

*** E N D ***

APPENDIX D:
AIR FORCE CQC REQUIREMENTS

****

Specifier: Appendix 1, the Basic Quality Control Requirements that follow are an attachment to Part 1 - General, of the Master Specifications. Do not alter these Basic QC Requirements. The Basic QC Requirements may be omitted from projects with a total scope less than 100 squares.

****

APPENDIX 1: BASIC QUALITY CONTROL REQUIREMENTS

A. Introduction:

1. The quality controller is a new person on the roofing contractor's team. This position is different from all others. The sole responsibility of the person in this position is to assure that the customer is getting exactly what is required by the contract.

2. To accomplish this, the quality controller must continuously observe work in progress, including testing and measuring, and report findings on a daily record form. The customer is assured of "getting exactly what is required" when the record form does not contain any variances from the contract. See page 1-13 of this appendix for a sample AF Form 1063, Quality Control Record.

B. Before actual work begins, the Quality Controller must:

1. Read the specifications and study the drawings.

2. Understand the required tests and measurements.

3. Understand AF Form 1063, Quality Control Record, and reporting procedures.

4. Visit the roof and become familiar with its layout.

5. Attend the preconstruction conference.

C. Supply the following equipment for tests and measurements required to be performed under this contract.

1. Charted temperature recorder for kettles or tanker, to continuously record the bitumen temperature within the container.

2. Caliorated portable thermometer.

3. Postal-type platform scale.

4. Measuring tape for measuring distance between chalk lines, felt exposures, and daily work locations.

5. Moisture meter for determining moisture content of materials (such as nailers and curbing) at time of installation.

D. Allowable Tolerances. The following tolerances establish the range of acceptable variances. Assure that work outside this range is removed. Act to keep it from happening again.

1. Dimensions. lus or minus:

a. 1/16 inch for any single lineal dimension less than 2 inches.

b. 1/4 inch for any single lineal dimension 2 inches or more.

c. 1/2 inch overall for any 2 to 10 consecutive increments of a standard dimension.

d. 3/4 inch overall for 11 to 20 consecutive increments of a standard dimension.

e. 1 inch overall for 21 or more consecutive increments of a standard dimension.

2. Bitumen Temperatures:

a. Maximum at kettles: Asphalt - 500°F, Coal Tar Bitumen - 425°F.

b. Minimum at point of application: Asphalt - 450°F, Coal Tar Bitumen -375°F.

c. Holding period for 1,000 gallons or less: 4 hours maximum: Asphalt - 425°F maximum; Coal Tar Bitumen - 350°F maximum.

d. Holding period for 1,000 gallons or more, thermostatically controlled heating: 4 to 96 hours maximum: Asphalt -350°F maximum; Coal Tar Bitumen - 275°F maximum.

3. Insulation joint gap: 1/16 inch maximum.

4. Bitumen and aggregate quantities as required: Plus or minus 15 percent.

5. Percentage of aggregate embedment: 60 percent minimum (by weight).

E. Quality Control Record: Complete AF Form 1063, daily as follows (see completed sample, page 1-13):

QUALITY CONTROL RECORD

RECORD NO. 10 | DATE 10 AUG 79

PROJECT NUMBER: AFF 79-0032 | BLDG NO: 301

WEATHER (Describe): SUNNY & HOT | AVERAGE TEMPERATURE: 90°

ROOFING CREW — START: 7:00 AM | STOP: 4:00 PM

QUALITY CONTROLLER — START: 7:00 AM | STOP: 4:00 PM

TOTAL ROOF AREA (Squares): 1000 | PREVIOUSLY COMPLETED: 250 SQS. | COMPLETED TODAY: 25 SQS. | TEST SAMPLES REMOVED: 1

PRODUCTS (See Project Specifications) (Check Appropriate Box Below) / EXECUTION (See Quality Control Guide) (Check Appropriate Box Below)

COMPONENTS (Type, Quantity, Size)	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE
UNDERLAYMENT			✓	1	✓			13	✓		
INSULATION	✓			2	✓			14	✓		
MEMBRANE	✓			3	✓			15	✓		
COMPO FLASHING	✓			4	✓			16	✓		
SHEET METAL	✓			5	✓			17	✓		
FASTENERS	✓			6				18			✓
WOOD	✓			7	✓			19	✓		
SEALANTS	✓			8	✓			20	✓		
EXPANSION JOINTS	✓			9	✓			21	✓		
ALL OTHER MATERIALS	✓			10	✓			22			✓
				11	✓			23	✓		
				12	✓			OTHERS			

SAMPLE

EXPLAIN VARIANCE (If none write NONE)

NONE

UNRESOLVED VARIANCES ON RECORDS NOS.

QC RECORD No. 8

ACTION TAKEN TO RESOLVE VARIANCE

50 SQUARE FEET OF INSULATION LEFT ON ROOF OVER NIGHT WAS REMOVED FROM JOB

I CERTIFY THAT I HAVE PERSONALLY PERFORMED THE REQUIRED TESTS AND MEASUREMENTS AND ATTEST THAT THIS Q C RECORD IS AN ACCURATE RECORD OF ALL WORK ACCOMPLISHED TODAY.

QUALITY CONTROLLER (Signature): Thomas R Jefferson

RECEIVED BY (Signature): [illegible] | DATE: 10/8/79

AF FORM SEP 79 1063

****

Specifier: An example of a completed AF Form 1063 appears on page 1-13 of the Master Specification. Supply the contractor with AF Forms 1063 at the preconstruction conference.

****

1. Top Section:

   a. Insert date and record no.

   b. Insert weather description and temperature.

   c. Indicate crew start and stop times.

   d. Indicate your start and stop times.

   e. Indicate total roof area.

   f. Indicate roof area previously completed.

2. Products Section. This section is divided into major categories. Each category may include several materials:

   a. Examine each material within the category and check the proper box.

   b. Check the "Not Applicable" box for materials not included in today's work.

   c. Assure that all materials in a category comply with the contract to result in a check in the "Complies" box. To determine compliance, compare the material with the project specifications and drawings, and also with the approved manufacturer's literature submitted. Since materials other than those covered by the components listed may be used, enter their compliance in the "All Other Materials" category.

3. Execution Section:

   a. The work item numbers in this section of the record correspond to the work items in these Basic QC Requirements. The work items are specification items considered to be of major concern. These items are in the Basic QC Requirements for convenience and tabulation.

   b. Performance of the "actions" below the work item will result in an entry in the proper box on the QC record. Specification items not in the Basic QC Requirements must also be considered, and their acceptability grouped and documented in the "Other" box.

4. Variance Section:

   a. An entry in any "Varies" box under the "Products" or "Execution" Sections requires an explanation of the variance in this section. The explanation should be limited to a description of the variance only; reasons for variance are not necessary.

   b. Indicate action taken to resolve each variance to result in complying work. Certain actions resulting from variances from some of the specification requirements are included with the specified requirement. If a variance is not resolved on the same day it occurs, the number of that day's record must be entered in the space provided on records for all succeeding days, until the variance is resolved.

5. Closing Section. Sign the record at the end of the workday and submit it to the Government inspector.

F. WORK ITEMS (Corresponds to Work Item under Execution on AF Form 1063).

WORK ITEM 1. Do not expose materials to moisture in any form before, during, or after delivery to the site.

Action. Inspect materials upon delivery for intact manufacturer's shipping containers.

Verify that the vehicle delivering materials has provided protection of the materials. The vehicle must be enclosed or materials must be completely covered with tarps.

Inspect materials before acceptance for evidence of contact with moisture (such as felt wrappers that are wet or stained, insulation with torn or missing transit covers, or other evidence of moisture by feel or sight).

Inspect storage at the job site. Be sure enclosed storage or other storage completely protects material from moisture in any form.

Observe material handling from storage area to roof. Total protection is required and must be immediately available in case of inclement weather. Delivery to the job site requires the same attention as delivery to the storage area.

Mark conspicuously, all materials exposed to any form of moisture and have them permanently removed from the project site.

WORK ITEM 2. Equip kettles and tankers for bitumen with automatic thermostatic controls. Provide accurate charted temperature recorders on all kettles and tankers.

Action. Periodically check the accuracy of the thermostatic controls and temperature recorders by using a portable thermometer. Periodically check bitumen temperature within tanker or kettle and at the point of application.

The recorded chart will be removed at the end of each workday and will be submitted with the contractor's quality control record.

WORK ITEM 3. Use separate kettles, materials application, and transporting equipment for unlike bitumens.

Action. Inspect equipment upon arrival at job site for condition and identification of previous use. Maintain identification of use throughout the project.

WORK ITEM 4. Execute the work so that each area of the BURS installation is completed on the same day it is begun. Included is the final roof surfacing and all bituminous flashings within and adjoining the membrane. Application of cap sheets may be delayed when roofing during temperatures of less than 50°F.

Action. Determine area of work planned and make sure that enough materials are on hand to complete that area.

Inspect work completed at day's end.

Verify completion to include final roof surfacing on all material installed except the area required for tie-in of future work. The tie-in area is glaze-coated with bitumen.

WORK ITEM 5. Install temporary water cutoffs and tie-ins at the end of each workday. Remove temporary cutoffs and tie-ins on resuming work so that all vertical faces of insulation are exposed.

Action. Observe tie-in to verify that insulation joints are staggered and ply structure is continued.

Verify removal of temporary work and check previously installed system for moisture.

WORK ITEM 6. Except for expedient temporary work, do not proceed with roofing work during inclement weather.

Action. During bad weather, make sure that work being performed is only temporary and protects the facility and previously completed roofing system.

Assure that all temporary work is removed before installation of permanent components when work is resumed.

WORK ITEM 7. Do not apply BURS components if moisture in any form can be seen or felt on the substrate to which the components will be applied.

Action. Assure that components are not applied if the hot bitumen steams, foams, or bubbles.

Inspect application of bitumen to felts for similar evidence that shows moisture in felts.

Inspect application of aggregate into flood coat for similar evidence that would indicate wet aggregate.

WORK ITEM 8. If wheeled or other traffic over the partially or fully completed roofing is unavoidable, provide and use adequate plank or plywood protection for the roofing.

Action. Inspect activities and methods used to transport materials over the completed or partially completed roofing system.

Check adequacy of plank or plywood to protect system.

WORK ITEM 9. Do not load or permit any part of a structure to be loaded with a weight that will adversely affect its safety.

Action. Assure that runways (such as wood planks or plywood) are used to distribute the load of materials and equipment hauling over the deck so as not to cause deflection of the deck. Check for broken welds or bends in metal decking due to materials or equipment handling.

WORK ITEM 10. Removal of existing materials must result in a clean and dry substrate, except for residual stains, providing a surface suitable to apply new materials.

Action. Inspect substrate for excessive roughness, cracks, holes, or deteriorated material.

Assure that decking or other substrate determined to be defective is repaired, replaced, or brought to the attention of the contracting officer.

Assure that deck joints are treated to prevent bitumen drippage through the joints.

WORK ITEM 11. Insulation boards, cant strips, and tapered edge strips, which can be readily lifted or displaced by hand, are not adequately secured.

Action. Assure that the perimeter insulation (first layer) is secured to steel deck with mechanical fasteners.

Measure the distance from the inner row of fasteners to the perimeter. Count and locate fasteners with respect to insulation board.

Test bond of insulation boards, cant strips, and tapered edge strips by trying to lift them after installation. Materials that are readily lifted without breaking the board or strip are not securely fastened.

WORK ITEM 12. Use chalk lines to accurately lay out the roofing plies, beginning at low points or drains.

Action. Determine the distance required between chalk lines as follows: Distance equals 36 inches (felt width) minus 2 inches (headlap) over X (number of plies).

$$\text{Distance} = \frac{34}{\text{X (No. of plies)}}$$

Measure the distance being marked off on the substrate and compare with the required distance. Measure across 10 ply marks and compare that distance with 10 times the required distance between chalk lines.

Long measurement must be plus or minus 1/2 inch of computed distance. Measure as frequently as required to assure compliance before felt installation.

Assure that ply structure starts at low point on roof (eave or valley). Measure width of felts used as starters.

Evaluate layout measurements to assure headlap is obtained. See pages 1-20 and 1-21.

Assure that starter strips are used at eaves only. At valleys or drains, full sheets of felt are positioned to obtain ply structure and headlap in two directions.

Assure that the felt edge is not positioned so that the flow of water would be against the exposed edge of the lap.

WORK ITEM 13. Apply felts shingle fashion and keep proper lap distance to result in a 2-inch headlap. Maintain a straight run of felts so that kinks or fishmouths do not result, and the felts are completely flat.

Action. Assure that felts are rolled true to chalk lines and that the chalk lines are not mopped over.

Assure that immediately upon deviating from the chalk line, the roll of felt is cut and restarted with specified endlap. Do not allow roll to be forced back on line without cutting.

Assure that fishmouths or kinks do not appear at the felt edges due to a run of felts other than in a straight line.

Measure lap exposure (the distance between two exposed adjacent edges) and compare this to the required chalk line distances. These distances must be equal (plus or minus 1/4 inch).

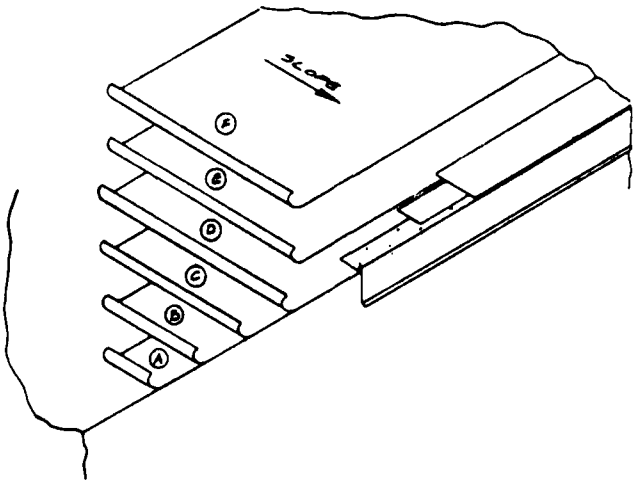
WORK ITEM 14. Once established, do not change the direction of felt application.

Action. Assure that the ply lines are parallel for entire roof area and that the direction of felt application is not changed.

WORK ITEM 15. Broom each ply of roll goods into place, full width, while the bitumen is hot and fluid, so that felt does not touch felt and that the bitumen layer does not have voids or skips.

Action. Daily, check the first drawn bitumen from each kettle to assure that the minimum application temperature has been reached. Periodically, check the temperature of the bitumen at the point of application.

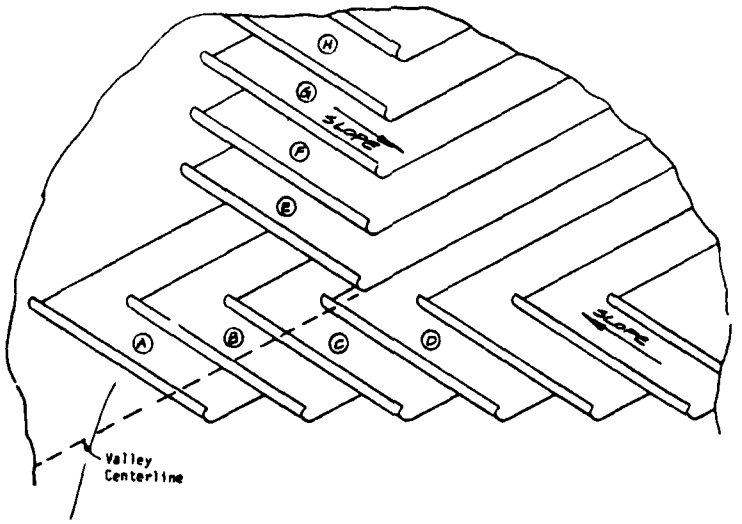
Each ply of the rolled goods must be pressed in place with a stiff, heavy broom, the full width of the roll. Verify that brooming is adequate to embed the goods into the bitumen and to make sure that bitumen is between all surface areas of the goods, including the edges.



FELT

A = First felt strip -- 9½ inches wide.
B = Second felt strip -- 18 inches wide.
C = Third felt strip -- 26½ inches wide.
D, E, F, and rest of felts -- full width.

How To Apply Felts Up-Slope



FELTS

A = First felt strip laps valley centerline 8½ inches.
B,C,D, and rest of felts are applied shingle fashion.

E = First felt strip in other direction starts at valley centerline and laps felt D by 2 inches.
F, G, H, and rest of felts are applied shingle fashion.

All felts are 36 inches wide.

How To Apply Felts in a Valley

WORK ITEM 16. Provide asbestos or organic felt envelopes at roof edges and sheet metal bitumen dams at deck penetrations to prevent bitumen drippage.

Action. Before the start of felt application, assure that a felt strip, at least 12 inches wide, is set in steep asphalt or plastic cement and is applied so that 6 inches are set on the nailer around perimeter of building and 6 inches are lapped over the edge of the building.

Assure that after felt application is complete, the 6-inch overlapped section of felt is folded back over the BUR and mopped down to form an envelope around the edge of the roof membrane.

Assure that for at all penetrations, a metal bitumen dam is installed with its flange set in plastic cement at the level of the insulation. The felts are then applied over the flange with the sleeve of the dam preventing the bitumen from dripping into the facility. Sleeve and flange must be measured and compared to drawings and specification for conformance.

Assure that flanges of metal are primed before installation into system.

WORK ITEM 17. Apply membrane to meet requirements and recommendations of the BURS manufacturer.

Action. Observe the bitumen handling at the kettles and on the roof to make sure that asphalt-saturated felts are being placed in asphalt bitumen and that coal tar-saturated felts are being placed in coal tar bitumen.

Assure that proper bitumen is being used for roof slope by checking the slope of the roof in the field as well as on the drawings. Review manufacturer and contract specifications for material requirements and compare them with those ordered and being placed.

WORK ITEM 18. Insulation boards over underlayment or existing BURS. First (bottom) layer: Stagger end joints by maximum dimension; bring boards into moderate, uniform contract at sides and ends while the asphalt is hot and fluid. Stagger all joints between layers by maximum dimensions in both directions.

Second or additional layers: Secure in full and uniform moppings of hot, fluid asphalt; stagger end joints by maximum dimensions; bring boards into moderate, uniform contact at sides and ends and press insulation boards firmly into the asphalt while the asphalt is hot and fluid. Stagger all joints between layers by maximum dimensions in both directions.

Action. Assure that a staggered pattern of insulation joints is begun at start of placement and develop a pattern to establish the joints at one-half the length of a full piece of insulation board.

Assure that contact at sides and ends of board is obtained when insulation boards are placed in hot and fluid asphalt.

Assure that insulation covers entire area of deck to within 1/4 inch of vertical surfaces and wood insulation stops.

For insulation installation over existing BURS, assure that the same bitumen is used as the existing BURS bitumen.

WORK ITEM 19. Insulation boards on steel deck. First (bottom) layer: Apply hot asphalt, in ribbon application, running parallel to and on top of every flange of the deck. Position insulation with long sides of boards parallel with deck flanges so that side joints between boards do not occur over deck ribs. Stagger end joints by maximum dimension.

Second or additional layers: Secure in full and uniform moppings of hot, fluid asphalt; stagger end joints by maximum dimensions; bring boards into moderate, uniform contact at sides and ends while the asphalt is hot and fluid. Stagger all joints between layers by maximum dimensions in both directions.

Action. Observe application of asphalt by machine; assure that jets are flowing evenly and consistently. Application rate must be controlled to the rate of 12 to 15 pounds per square.

Assure that long edges of insulation are parallel to the flanges and that joints do not occur over a rib opening.

Assure that staggered pattern of insulation joints is begun at start of placement and develop a pattern to establish the joints at one-half the length of a full piece of insulation board.

Assure that contact at sides and ends of board is obtained when insulation boards are placed in hot and fluid asphalt.

Assure that insulation covers entire area of deck to within 1/4 inch of vertical surfaces and wood insulation stops.

WORK ITEM 20. Two-ply flashing system (for use over nailable substrates): Use an asbestos felt inner ply and a reinforced asbestos flashing sheet as the outer ply. Install according to BURS manufacturer's requirements and, in addition, to the specification requirements.

Action. Assure that proper materials are being applied and that materials are the products of the BURS manufacturer.

Before start of application, assure that roofing felts extend to the top of cant strips.

Assure that all previously uncontaminated vertical surfaces are primed before receiving flashing. The primer must be dry before applying the flashing.

Assure that vertical surfaces are not contaminated with membrane bitumen.

Assure that flashing cement or hot asphalt is applied over the entire area to receive asbestos felt sheet. Layer of flashing cement or hot asphalt is to be uniform in thickness and applied to the thickness specified by BURS manufacturer. Asbestos felt application must extend to a point immediately below the reglet for counterflashing.

Assure that flashing cement or hot asphalt is applied over the asbestos felt in full coating to thickness specified by manufacturer. Assure bond of reinforced asbestos flashing sheet into coating of flashing cement or hot asphalt along the entire length of flashing.

Measure spacing of nails applied to top edges of flashing. Spacing between nails must be 8 inches on center.

Assure that 4-inch-wide seal has been applied to top edge and vertical seams of flashing. Sealing material must be woven glass fabric embedded into and coating with flashing cement.

Assure that the complete exposed surface of reinforced flashing sheet has been coated with specified coating, applied to a smooth, even finish.

Check for flashing bond to all areas of contact and for overlap of all end joints.

Assure that end joints between asbestos 15-pound sheet and reinforced asbestos sheet do not coincide during application.

WORK ITEM 21. Three-ply flashing system (for use over nailable substrates): Use two plies of asphalt-impregnated glass mat as the inner plies and a glass fiber base cap sheet as the outer ply. Install according to BURS manufacturer and also, to the specification requirements.

Action. Assure that proper materials are being applied and that materials are approved.

Before application, assure that roofing felts are extended to the top of cant strips.

Assure that all previously uncontaminated vertical surfaces are primed before receiving flashing.

Assure that flashing cement or hot asphalt has been applied over the entire area to receive flashing plies.

Assure that the inner flashing plies are fully embedded into the flashing cement or hot asphalt and subsequent coating of the area with an additional covering of flashing cement or hot asphalt.

Assure that the glass fiber base cap sheet outer ply is embedded in the adhesive.

Check for complete bond of all materials to each other and to the cant and vertical wall where applied.

Assure that end joints between plies do not coincide throughout application.

Measure spacing of nails applied to top edges of flashing. Spacing between nails should be 6 inches on center.

Assure that 4-inch-wide seal has been applied to top edge and vertical seams of flashing. Sealing material must be woven glass fabric, embedded into and coated with flashing cement.

WORK ITEM 22. Three-ply flashing (for use over non-nailable substrates): Use an inner ply of woven glass fabric followed by two plies of asbestos felt. Embed each ply in flashing cement and cover the top felt with a 1/8-inch coating of flashing cement.

Action. Assure that proper materials are being applied and that materials are approved.

Before application, assure that roofing felts are extended to the top of cant strips.

Assure that all previously uncontaminated vertical surfaces are primed before receiving flashing.

Assure that flashing cement has been applied over the entire area to receive glass fabric. Cement must be uniform thickness, approximately 1/8-inch thick.

Assure that the glass fabric is embedded into flashing cement and coat the area with another covering of flashing cement. Repeat this procedure for the two layers of asbestos felt.

Assure that the final ply of flashing cement, over last ply of asbestos felt, receives a full trowel coating.

Check for complete bond of all materials to each other and to the cant and vertical wall where applied.

Assure that end joints between plies do not coincide during application.

WORK ITEM 23. The contractor must remove samples and repair the area of sample removal.

Action. Witness removal of test samples required by the project specification. Samples must be cut accurately, using a template.

Direct removal of test samples in locations selected by the Government Inspector.

Examine sample components for adhesion to each other and presence of moisture. Record observations and record insulation thickness and type.

Complete and include Submittal 3 according to its instructions.

Direct and observe repair of sample area.

APPENDIX E:
PROPOSED ARMY CQC REQUIREMENT—
FIRST DRAFT

SP-____. CONTRACTOR QUALITY CONTROL OF BUILT-UP ROOFING SYSTEMS (BURS). The Contractor shall provide and maintain an effective quality control program that complies with General Provision ____ of the contract, entitled "Contractor Inspection System."

a. Quality Assurance (QA) is the means by which the Government fulfills its responsibility in assuring that the Contractor's Quality Control is functioning and through reviews, inspections, and tests assures that the completed product complies with the contract.

b. Contractor Quality Control (CQC) is the Contractor's management and control of his own, his supplier's, and his subcontractor's activities. It is the means by which the Contractor assures himself that the construction complies with the requirements of the contract.

(1) The Contractor shall provide a quality control organization and system to perform inspections, tests, and retesting in the event of failure of test or rejection of all items of work, including that of his subcontractors, to assure compliance with the contract provisions, and to inform his work force of the contract requirements including all changes. Quality control will be established for all work, except where specific provisions of the contract provide for Government approvals, inspections, and tests. The CQC system will specifically include, but not be limited to, the inspections and tests required in the technical provisions of the contract specifications and shall cover all construction operations, including both on-site work and off-site fabrication of items to be installed in the work.

(2) The Contractor shall provide a CQC representative, supplemented as necessary by additional personnel, who shall be present at the work at all times during progress of the work, with complete authority to take any action necessary to ensure compliance with the contract requirements. The CQC representative shall be appointed by a letter addressed to him and signed by an officer of the firm (Attachment 2 of the Supplement). This letter shall detail the CQC representative's authority and responsibility to act for the Contractor. The CQC representative shall report directly to an officer of the firm, and shall not be the same individual as, nor be subordinate to, the job superintendent or project manager. The CQC representative shall have no job-related responsibilities other than quality control.

(3) The Contractor shall furnish to the Government as soon as practicable, and in no event later than _____ days after receipt of the Notice to Proceed, an original and _____ copies of a quality control plan which shall include the personnel, procedures, instructions, training of work force, and records to be used. Unless specifically authorized by the Contracting Officer in writing, no construction will be started until the CQC plan is approved. No payment estimate will be processed under this contract until the quality control program has been approved by the Government. This plan will include, as a minimum:

(a) A copy of the letter appointing the CQC representative, signed by an officer of the firm, outlining the CQC representative's duties, responsibilities, and authority. This letter must include the authority to direct removal and replacement of any defective work and to remove incompetent workmen (Attachment 2 of the Supplement).

(b) The quality control organization in chart form, showing the relationship of the quality control organization to other elements of the firm.

(c) Names and qualifications of personnel in the quality control organization.

(d) Area of responsibility and authority of each individual in the quality control organization.

(e) A listing of outside organizations and personnel that will be employed by the Contractor, and a description of the services these firms will provide.

(f) Procedures for reviewing all shop drawings, samples, certificates, or other submittals for contract compliance, including the name(s) of the person(s) authorized to sign the submittals for the Contractor, as complying with the contract, and procedures for all submittals.

(g) An inspection schedule, keyed to the construction schedule and following the order of the specification technical sections, indicating what inspections and tests will be performed, and the time schedule for each inspection and test.

(h) The procedures for documenting quality control operation, inspection, and testing, and for training of the work force. The Contractor shall also include a submittal status log (Attachment 5 of the Supplement) listing all submittals required by the specifications and stating the action required by the Contractor or the Government. The Contractor shall complete columns (a) through (e) of this log.

(4) Forms and Submittals.

(a) The Contractor's Quality Control Record (Attachment 1 of the Supplement) shall be completed and submitted daily to the Contracting Officer identifying starting and stopping times of roofing crew and Quality Controller, weather conditions, work accomplished, samples taken from roof, nature of defects found, work rejected and reason for rejection, proposed remedial action, and corrective actions taken, together with the following certification: "On behalf of the Contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my

knowledge, except as noted above." This certification shall be signed for the Contractor by the authorized CQC representative.

(b) Within _____ days after receipt of Notice to Proceed, the Contractor shall submit a request for approval of materials to be used, and the required certifications that the listed materials comply with the contract specifications. Pre-printed certifications will be acceptable. All certifications shall be in the original. The original of all manufacturer's certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test data upon which the certifications are based. All certificates shall be signed by the Contractor.

(c) Within _____ days after issuance of Notice to Proceed, the Contractor shall submit evidence that the approved materials have been ordered, the latest edition of each BURS Manufacturer's published general requirements and copies of applicable literature for each roofing system designated for use on the buildings included in this contract, limited to the extent that the system meets the specifications, the latest edition of all other materials manufacturers' product and installation literature, and shop drawings.

(d) Recorded bitumen temperature charts and suppliers' certificates for bitumen in hot bulk and truckloads of aggregate shall be submitted daily to the Contracting Officer.

(e) Prior to final acceptance of completed work, the Contractor shall submit to the Contracting Officer a plan view drawing of each roof showing location and date of each day's work, BUR membrane samples and BUR sample identification tags (Attachment 4 of the Supplement), and the As-Built Roof Summary (Attachment 3 of the Supplement), all completed and signed by the Contractor.

(f) Test results provided shall cite the contract requirements, the test or analysis procedures used, and the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a testing laboratory representative. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

c. At least _____ days after the CQC Plan is submitted, but before construction operations are started, the Contractor shall meet with the Contracting Officer and discuss the quality control requirements. The purpose of the meeting shall be to develop a mutual understanding relative to details of the system, including a review of all forms to be

used for recording the quality control operations, inspections, tests, approvals, certifications, administration of the system, and Government surveillance. At this meeting a schedule shall be developed for future weekly or biweekly CQC meetings. Personnel attending this meeting shall include the CQC representative and the foreman or superintendent who will supervise the installation of the system.

d. The Contractor shall adhere to the following inspection procedures:

(1) A Preparatory Inspection which shall include a review of the contract requirements, the review and approval of shop drawings and other submittal data, a check to assure that required control testing will be provided, a physical examination to assure that all materials and equipment conform to approved shop drawings and submittal data, and a check to assure that all required preliminary work has been completed.

(2) An Initial Inspection, which shall be performed as soon as a representative segment of the particular item of work has been accomplished. The initial inspection shall include performance of scheduled tests, examination of the quality of workmanship, a review of test results (if available) for compliance with contract requirements, a review for omissions or dimensional errors, and approval or rejection of the initial segment of the work.

(3) Follow-up Inspections, which shall be performed daily, and more frequently as necessary, and shall include continued testing and examinations to assure continued compliance with the contract requirements.

(4) The Contractor shall notify the Contracting Officer in writing of any proposed change to the approved inspection system; no change shall be implemented prior to approval in writing by the Contracting Officer.

(5) The Contracting Officer reserves the right to perform independent testing for compliance with the standards set forth in the contract specifications. The Contractor will be held responsible for any differences in test results.

(6) The Contracting Officer reserves the right to utilize the control testing laboratory and equipment owned by the Contractor to make spot tests and to check the Contractor's testing procedures, techniques, and test results.

e. All specified submittals, shop drawings, catalog cuts, samples, etc., unless otherwise specifically noted, shall be certified by the Contractor as conforming to the drawings and specifications. Copies of all shop drawings, catalog cuts, or other submittals, with the Contractor's certification indicated thereon, shall be sent to the Contracting Officer within one working day of the Contractor's certification.

f. If recurring deficiencies in an item or items indicate that the quality control system is not adequate, actions shall be taken to revise the quality control plan and remove and replace all such deficiencies.

SUPPLEMENT TO CONTRACT
FOR
BUILT-UP ROOFING

a. The following guides are provided for use by the Contractor in implementing his Quality Control Plan:

(1) The following equipment is required for the specified tests and measurements:

(a) Charted temperature recorder for kettles or tanker, to continuously record the bitumen temperature within the container.

(b) Calibrated portable thermometer.

(c) Scale for weighing samples.

(d) Measuring tape for measuring felt exposure and daily work locations.

(2) Allowable Tolerances: Traditionally, tolerances have not been included in roofing specifications. The following tolerances establish the range of acceptable variances. Assure that work outside of this range is removed and that action is taken to keep it from happening again.

(a) General Tolerances for felt spacings (not applicable to nailing spacing):

- Plus or minus 1/16-inch for any single lineal dimension less than 2 inches.
- Plus or minus 1/4-inch for any single lineal dimension 2 inches or more.
- Plus or minus 1/2-inch overall for any 2 to 10 consecutive increments of a repeated dimension.
- Plus or minus 3/4-inch overall for 11 to 20 consecutive increments of a repeated dimension.
- Plus or minus one-inch overall for 21 or more consecutive increments of a repeated dimension.

(b) Bitumen Temperatures:

- Maximum at kettles: Asphalt -- 475°F, Coal Tar Pitch -- 400°F, unless a lower temperature is recommended by the manufacturer.
- Minimum at point of application: Asphalts -- 350°F, Coal Tar Pitch -- 300°F, unless a higher temperature is recommended by the manufacturer.

- Holding period for 1,000 gallons or less: 4 hours maximum: Asphalts -- 425°F Maximum, Coal Tar Pitch -- 350°F Maximum.

- Holding period for 1,000 gallons or more, thermostatically controlled heating: 4 to 96 hours maximum: Asphalts: 350°F Maximum, Coal Tar Pitch: 275°F Maximum.

(c) Insulation joint gap: 1/16-inch maximum.

(3) Quality Control Record: Complete the QC Record (Attachment 1) as follows:.

(a) Top Section:

- Insert date and record no.

- Insert weather description and temperature

- Indicate crew start and stop times

- Indicate CQC representative start and stop time

- Indicate total roof area covered that day

- Indicate roof area previously completed

(b) Products Section: This section is divided into major categories, each of which may include several materials. Examine each material within the category and check the appropriate box. Check the "Not Applicable" box for materials not included in the day's work. All materials in a category must comply with the contract in order to result in a check in the "Complies" box. To determine compliance, compare the material with the project specifications and drawings and additionally, with the approved proprietary materials submitted. Since materials other than those covered by the components listed may be used, enter their compliance in the "All Other Materials" category.

(c) Execution Section: The Work Item numbers in this section of the record correspond to the Work Items listed in this Provision. The Work Items are considered to be of major concern. These items are listed for convenience and tabulation purposes in Paragraph g(4). Performance of the "actions" listed below the work item will result in an entry in the appropriate box on the QC Record.

Specification items not listed must also be considered and their acceptability grouped and documented on the reverse side of the form.

(d) Variance Section: An entry in any "Varies" box under the "Products" or "Execution" Sections requires an explanation of the variance in this section. The explanation should be limited to a description of the variance only; reasons for variance are not necessary.

Indicate action taken to resolve variance to result in complying work. Certain actions resulting from variances from some of the specification requirements are included with the specified requirement.

Where a variance is not resolved on the same day it occurs, the number of that day's Record must be entered in the space provided on Records for all succeeding days, until the variance is resolved.

(e) Closing Section:

Sign the Record at the end of the work day and submit it to the Contracting Officer, with copy to the Government Inspector.

(4) WORK ITEMS:

(a) WORK ITEM NO. 1: Do not expose materials to moisture in any form before, during, or after delivery to the site.

Action: Inspect materials upon delivery for intact manufacturers' shipping containers, correct labels and contents.

Verify that vehicle delivering materials has provided protection of materials, either by being an enclosed vehicle or by providing complete coverage with tarps.

Inspect materials before acceptance for evidence of contact with moisture (such as felt wrappers that are wet or stained, insulation with torn or missing transit covers or other evidence of moisture by feel or sight).

Inspect storage methods at the job site. Be sure enclosed storage or other storage provides total protection from free moisture.

Observe material handling from storage area to roof. Total protection is required and should be available in case of inclement weather. Delivery to the job site requires same attention as delivery to the storage area.

Mark in a conspicuous manner all material exposed to any form of moisture, and do not allow use of these materials.

(b) WORK ITEM NO. 2: Use separate kettles and materials application and transporting equipment for unlike bitumens.

Action: Inspect equipment upon arrival at job site for condition and identification of previous usage. Maintain identification markings of usage throughout the project. Kettles should be clean and empty upon arrival at job site.

(c) WORK ITEM NO. 3: Equip kettles and tankers for bitumen with automatic thermostatic controls. Provide accurate charted temperature recorders on all kettles and tankers.

Action: Using a portable thermometer, periodically check bitumen temperature within tanker or kettle and at the point of application. Compare thermometer reading with temperature controller chart. Readjust controls if there is danger of overheating.

The recorded chart is to be removed at the end of each work day and submitted with the Contractor's Quality Record.

(d) WORK ITEM NO. 4: Removal should result in a clean and dry substrate, except for residual stains, providing a surface suitable to apply new materials.

Action: Inspect substrate for excessive roughness, cracks, holes, or deteriorated material. Concrete decks should be primed.

Assure that decking or other substrate which is determined to be defective is repaired, replaced, or brought to the attention of the Contracting Officer.

Assure that deck joints are treated to prevent bitumen drippage through the joints.

(e) WORK ITEM NO. 5: Execute the work so that each area of the BURS installation begun on a day is completed the same day. Included is the final roof surfacing and all flashings within and adjoining the membrane.

Action: Inspect work on day completed.

Verify completion to include final roof surfacing on all material installed with exception of area required for tie-in of future work. The tie-in area is glaze-coated with bitumen. Glazing is acceptable in lieu of final surfacing when inclement weather is imminent.

(f) WORK ITEM NO. 6: Do not allow application of BURS components when moisture in any form can be seen or felt on the substrate to which the components will be applied.

Action: Assure that components are not applied when steaming, sputtering or foaming of the hot bitumen occurs when placed on substrate.

Inspect application of bitumen to felts for similar evidence that indicates moisture in felts.

Inspect application of aggregate into flood coat for similar evidence that would indicate wet aggregate.

(g) WORK ITEM NO. 7: Except for expedient temporary work, do not proceed with roofing work during inclement weather.

Action: Make sure that work being performed is only temporary and protects the facility and previously completed roofing system.

Assure that all temporary work is removed prior to installation of permanent components when work is resumed.

(h) WORK ITEM NO. 8: Install temporary water cut-offs and tie-ins each work day. Remove temporary cut-offs and tie-ins such that all vertical faces of insulation are exposed.

Action: Observe tie-in to verify that insulation joints are staggered and ply structure continued.

Verify removal of temporary work and perform visual check of previously installed system for moisture.

(i) WORK ITEM NO. 9: Insulation board, cant strips and tapered edge strips which can be readily lifted or displaced by hand are not adequately secured.

Action: Assure that the perimeter insulation (first layer) is secured to steel deck with mechanical fasteners. Measure the distance from the inner row of fasteners to the perimeter. Count and locate fasteners with respect to insulation board.

Test bond of insulation boards, cant strips and tapered edge strips by trying to lift them after installation. Materials that are readily lifted or rocked without breaking the board or strip are not securely fastened.

(j) WORK ITEM NO. 10: Insulation board over underlayment: Stagger end joints by maximum dimension; bring boards into moderate, uniform contact at sides and ends while the asphalt is hot and fluid. Stagger all joints between layers by maximum dimensions in both directions.

Action: Assure that staggered pattern of insulation joints is initiated at start of placement and develop a pattern to establish the joints at one half the width and length of a full piece of insulation board.

Assure that contact at sides and ends of board is obtained when insulation boards are placed in hot and fluid asphalt.

Assure that insulation covers entire area of deck to within 1/4-inch of vertical surfaces and wood insulation stops.

Assure that long dimension of insulation boards is parallel to direction of roof slope.

(k) WORK ITEM NO. 11: Insulation board on steel deck: Apply hot asphalt, in ribbon application, running parallel to and on top of every flange of the deck. Position insulation with long dimension parallel to direction of roof slope and ends or sides of boards parallel to deck flanges so that joints between boards do not occur over deck flutes. Assure that proper face of board is down. Use mechanical fasteners for perimeter rows of insulation boards.

Second Layer (if specified or required): Secure in full and uniform moppings of hot, fluid asphalt; stagger end joints by maximum dimensions; bring boards into moderate, uniform contact at sides and ends while the asphalt is still hot and fluid. Stagger all joints between layers by maximum dimensions in both directions.

Action: Observe application of asphalt by machine, insuring that jets are flowing evenly and consistently. Application rate should be controlled to the rate of 12 to 15 pounds per square.

Assure that ends or edges of insulation are parallel to the flanges and that joints do not occur over flutes.

(l) WORK ITEM NO. 12: Over existing BURS (does not apply to new construction): Secure all insulation boards in full and uniform moppings of hot, fluid bitumen. Stagger end joints by maximum dimensions; bring boards into moderate, uniform contact at sides and ends while the bitumen is still hot and fluid.

Action: Assure that the bitumen used is always Type III or Type IV asphalt.

(m) WORK ITEM NO. 13: Mechanical application devices shall be mounted on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation or the roofing membrane.

Action: Check the necessity for using runways of wood planks or plywood to support mechanical equipment. Damaged insulation boards and roofing membrane shall be removed and replaced with undamaged materials.

(n) WORK ITEM NO. 14: Provide asbestos or organic felt envelopes at roof edges and sheet metal bitumen stops at deck penetrations to prevent bitumen drippage, if required by specifications and roof construction.

Action: Before the start of felt application, assure that 2 felt strips, each 18 inches wide, are set in steep asphalt or plastic cement as specified and are applied so that 9 inches are set on the nailer around perimeter of building and 9 inches are lapped over the edge of the building.

Assure that after felt application is complete, the 9-inch overlapped sections of felt are folded back over the BUR and mopped down to form an envelope around the perimeter of the roof membrane.

Assure that at all penetrations where required a metal bitumen stop is installed with its flange set in plastic cement on the deck. The felts are then applied over the flange with the sleeve of the dam preventing drippage of the bitumen into the facility. Sleeve and flange should be measured and compared to drawings and specification for conformance.

Assure that flanges of metal are primed prior to installation into system.

(o) WORK ITEM NO. 15: Apply membrane in proper bitumen for entire roof or particular portion thereof.

Action: Inspect bitumen when put into kettle to verify that specified material and type is used, depending on felt used, roof slope, and how felt is to be installed.

(p) WORK ITEM NO. 16: Control the distance between edges of succeeding plies.

Action: Determine the distance required between plies as follows: "(36 minus 2)" over "(number of plies)" equals distance.

$$\text{Distance} = \frac{36-2}{\text{No. of plies}}$$

Measure across 10 plies and compare that distance with 10 times the required distance between plies. Long measurement should be plus or minus 1/2-inch of computed distance. Make the measurement as frequently as required to assure compliance.

Assure that ply structure starts at low point on roof. Measure width of felts used as starters. Evaluate layout measurements to assure headlap is obtained. See Figures 1 and 2.

Assure that laying of membrane commences at the low points.

Assure that the felt edge is not positioned so that the flow of water would be against the exposed edge of the lap.

(q) WORK ITEM NO. 17: Apply felts shingle fashion and maintain proper lap distance to result in a two-inch headlap. Maintain a straight run of felts such that no wrinkles or fishmouths result and the felts are completely flat. Where only one ply is installed, such as for base sheet or roll roofing, refer to proper specification paragraph for lapping requirements.

Action: Assure that felts are rolled true to lines.

Assure that immediately upon deviating from the line, the roll of felt is cut and restarted with specified endlap. Do not allow roll to be forced back on line without cutting.

Assure that no fishmouths or wrinkles appear at the felt edges due to a run of felts other than in a straight line.

Measure lap exposure (the distance between two exposed adjacent edges) and compare this to the required distances. These distances should be equal (plus or minus 1/4-inch).

(r) WORK ITEM NO. 18: Once established, do not change the direction of felt application, unless made necessary due to changes in direction of slope.

Action: Assure that the ply lines are parallel for entire roof area and that the direction of felt application is not changed.

(s) WORK ITEM NO. 19: Broom each ply of felt into place, full width, while the bitumen is hot and fluid, such that felt is completely adhered to surface below and there are no voids or skips in the bitumen.

Action: Daily, check the first drawn bitumen from each kettle to assure that the minimum application temperature has been reached. Periodically, check the temperature of the bitumen at the point of application, to make sure that application temperature is within the manufacturer's published EVT range.

Each ply of the rolled felt should be firmly embedded in the hot bitumen with an 18" to 20" soft fiber broom, applied to the felt across the full width of the roll. Verify that brooming is adequate to embed the felt into the bitumen and check bitumen application to insure that bitumen is between all surface areas of the felts, and extends beyond the edges.

(t) WORK ITEM NO. 20: Two-ply flashing system (for use over nailable substrates): Use an asbestos felt inner ply with a reinforced asbestos flashing sheet as the outer ply. Install according to roofing manufacturer requirements and, in addition, to the specification requirements.

Action: Assure that proper materials are being applied and that materials are the products of the BURS manufacturer.

Prior to start of application, assure that roofing felts are extended over cant strip.

Assure that all vertical surfaces are clean and primed prior to receiving flashing, and that the primer is dry before the flashing is applied.

Assure that bituminous cement or hot asphalt is applied over the entire area to receive asbestos felt sheet. Layer of bituminous cement or hot asphalt is to be uniform in thickness and applied to thickness specified by BURS manufacturer. Asbestos felt application should extend approximately 6 inches above top of cant strip, to a point immediately below the reglet for counterflashing.

Assure that bituminous cement or hot asphalt is applied over the asbestos felt in full coating to thickness specified by manufacturer. Assure bond of reinforced asbestos flashing felt into coating of bituminous cement or hot asphalt along entire length of flashing.

Measure spacing of nails applied to top edges of flashing. Distance should be 4-inch centers.

Assure that 4-inch-wide seal has been applied to top edge and vertical seams of flashing. Sealing material should be woven glass fabric embedded into a coating of bituminous cement.

Assure that the complete exposed surface of reinforced flashing has been coated with specified coating applied to a smooth, even finish.

Check for flashing bond to all areas of contact and for overlap of all end joints.

Assure that end joints between asbestos 15-pound felts and reinforced asbestos felts do not coincide during application.

(u) WORK ITEM NO. 21: Three-ply flashing: Use an inner ply of woven glass fabric followed by one ply of asbestos felt and a mineral cap sheet. Embed each ply in bituminous cement.

Action: Assure that proper materials are being applied and that materials are approved for use.

Prior to application, assure that roofing felts are extended over the cant strip.

Assure that all vertical surfaces are clean and primed prior to receiving flashing.

Assure that bituminous cement has been applied over the entire area to receive glass fabric. Cement to be of uniform thickness approximately 1/8-inch thick.

Assure the full embedment of glass fabric into bituminous cement and subsequent coating of the area with an additional covering of bituminous cement. This procedure to be repeated throughout the application of the flashing.

Check for complete bond of all materials to each other and to the cant and vertical wall where applied.

Assure that end joints between plies do not coincide throughout application.

(v) WORK ITEM NO. 22: Sampling and repair of the completed roof should be done by the Contractor before application of final surfacing.

Action: Witness removal of test samples required by the project specification. Sample should be cut accurately using a template.

Direct removal of test samples in locations selected by the Contracting Officer.

Examine sample components for adhesion to each other and presence of moisture and record observations. Also record insulation thickness and type. Weigh sample.

Complete and include Attachment 4 in accordance with instructions thereon.

Direct and observe repair of sample area.

Since early detection of a defect will minimize the actions required to correct it, the following field test is necessary.

Direct the cut of an accurate 12- x 12-inch square of the membrane before application of the surfacing materials. Make the cut down through the insulation board cover. The cover should be included along with the membrane when the membrane is removed.

Weigh the sample on a postal-type platform scale and compare results with the appropriate portion of the chart below.

The following weights include the insulation board cover:

Membrane Type	Minimum Weight (one sq. ft.)	Maximum Weight (one sq. ft.)
4-ply CTP on Insulation*	1 lb 13 oz	2 lb 3 oz
4-ply asphalt on Structural Concrete or Insulation* (without base sheet)		
(organic or asbestos)	1 lb 12 oz	2 lb 1 oz
(glass fiber)	1 lb 8 oz	1 lb 15 oz
4-ply Asphalt on Gypsum or Insulating Concrete (with base sheet)		
(organic or asbestos)	1 lb 3 oz	1 lb 6 oz
(glass fiber)	15 oz	1 lb 4 oz

*Adjust minimum and maximum values by subtracting 0.45 pounds or 7 oz for no fiberglass insulation backing sheet with the sample.

For 1 ply of glass fiber roll roofing instead of 4th ply of felt, add 9 oz to weight of glass fiber roofs.

(w) WORK ITEM NO. 23: Install walkways as indicated for servicing mechanical equipment.

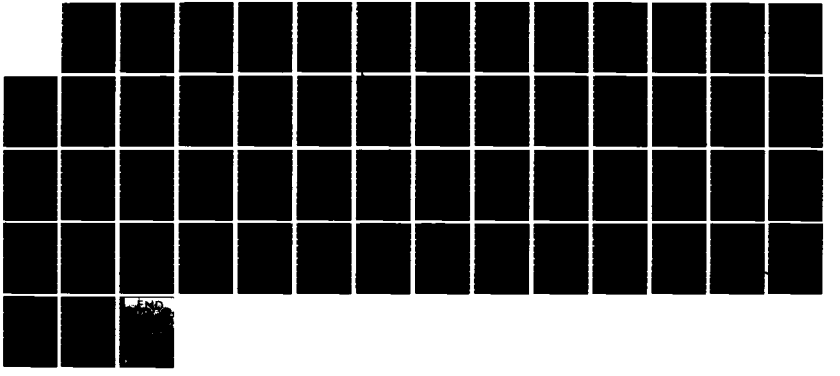
Action: Filler strips for support of wood walkways should be set in bituminous cement on top of roll roofing or before flood coat and aggregate are applied. Wood bases should be set in bituminous cement on the filler strips. Asphalt planks should be set in the flood coat before application of aggregate, or in bituminous cement if roll roofing is used as the surface.

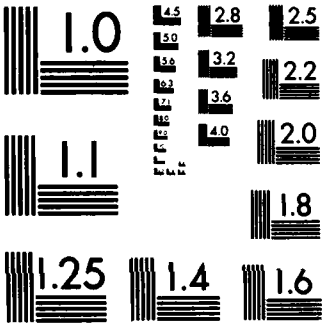
(x) WORK ITEM NO. 24: Apply final aggregate surfacing in a flood coat of hot bitumen.

Action: Bitumen may be applied by a mechanical spreader or by mopping. The heavy coating is necessary for embedment of the aggregate. Aggregate may be broadcast from shovels or laid from wheeled spreaders but must completely cover the hot bitumen. After the roof has completely cooled, all loose aggregate must be swept off and the roof inspected for poor or no embedment. All such areas must be re-treated with hot asphalt and aggregate, and loose aggregate once again swept off.

AD-A135 672 EVALUATION OF CONTRACTOR QUALITY CONTROL OF BUILT-UP ROOFING(U) CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL M J ROSENFIELD OCT 83 CERL-TR-M-334 2/2

UNCLASSIFIED F/G 14/4 NL





If the bitumen froths when the aggregate is applied, this indicates excessive moisture in the aggregate. Operations must stop until the aggregate has been dried to within specification limits or frothing no longer occurs when hot bitumen is contacted by the aggregate.

b. Attachments

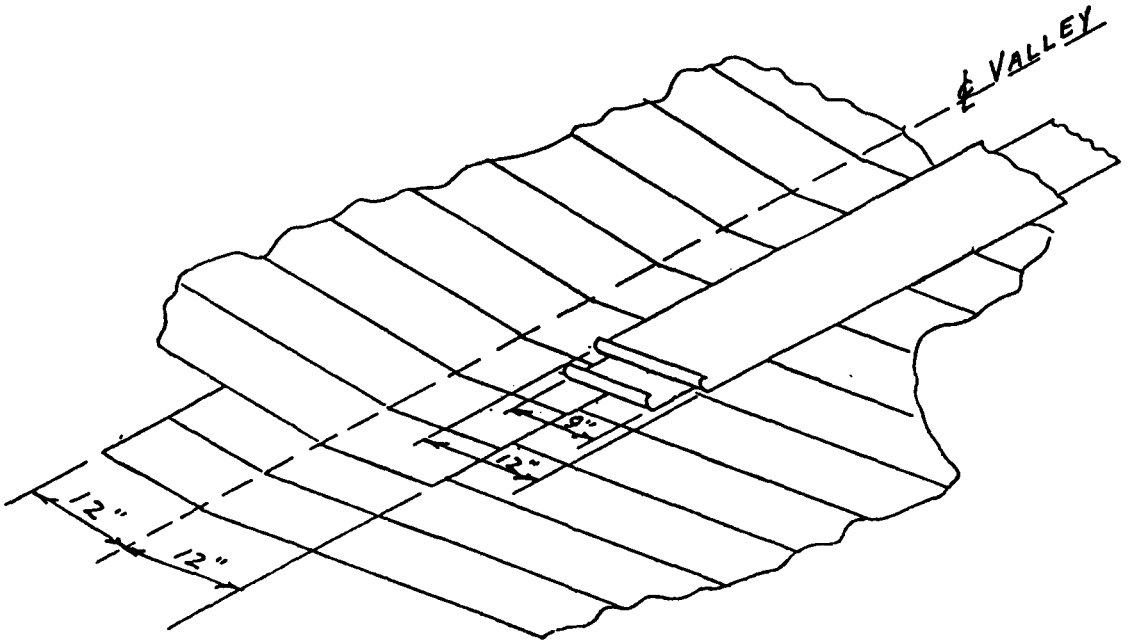


FIGURE 1

APPLICATION OF FELTS AT A VALLEY

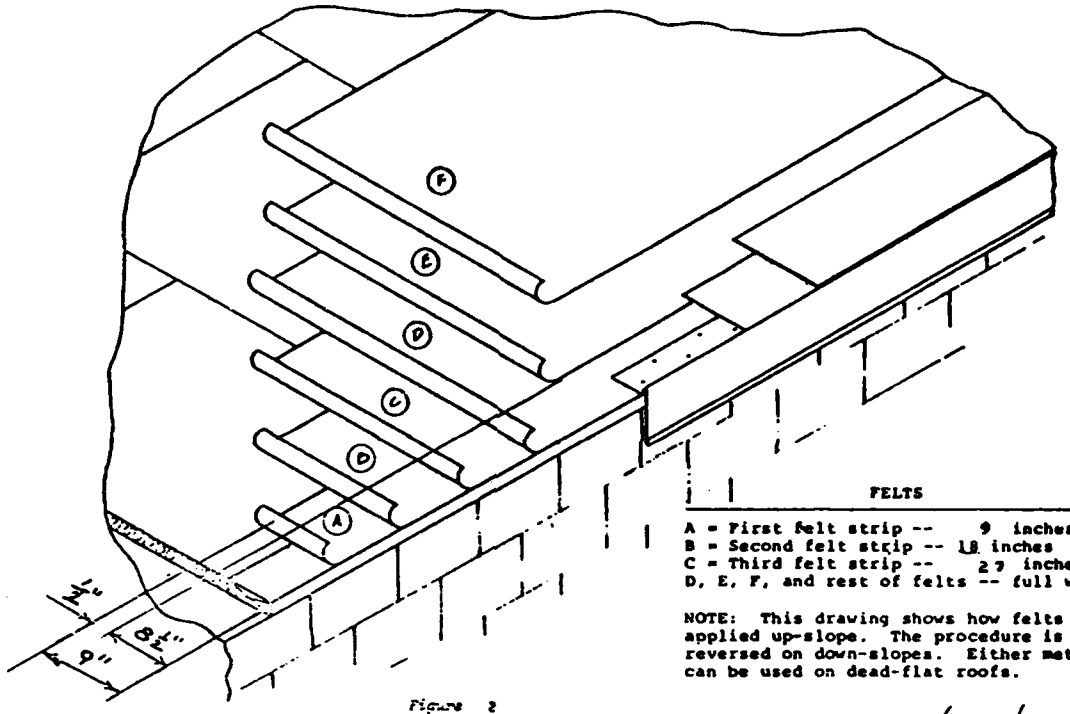


Figure 2

START OF 4-PLY ROOFING

FELTS

A = First felt strip -- 9 inches
B = Second felt strip -- 18 inches
C = Third felt strip -- 27 inches
D, E, F, and rest of felts -- full width

NOTE: This drawing shows how felts are applied up-slope. The procedure is reversed on down-slopes. Either method can be used on dead-flat roofs.

Edge envelope has been omitted from this drawing.

DATE

RECORD NO

QUALITY CONTROL RECORD

PROJECT NO. _____ BLDG. NO. _____

WEATHER (DESCRIBE) _____ AVERAGE TEMPERATURE _____

ROOFING CREW START _____ A.M. P.M. STOP _____ A.M. P.M. QUALITY CONTROLLER START _____ A.M. P.M. STOP _____ A.M. P.M.

TOTAL ROOF AREA (SQUARES) _____ PREVIOUSLY COMPLETED _____ COMPLETED TODAY _____ TEST SAMPLES REMOVED _____

PRODUCTS (SEE PROJECT SPECIFICATIONS - (CHECK APPROPRIATE BOX BELOW)				EXECUTION (SEE QUALITY CONTROL GUIDE (CHECK APPROPRIATE BOX BELOW)							
COMPONENTS (Type, Quantity, Size)	Complies	Varies	Not Applicable	WORK ITEM	Complies	Varies	Not Applicable	WORK ITEM	Complies	Varies	Not Applicable
UNDERLAYMENT				1				13			
INSULATION				2				14			
MEMBRANE				3				15			
COMPO. FLASHING				4				16			
SHEET METAL				5				17			
FASTENERS				6				18			
WOOD				7				19			
SEALANTS				8				20			
EXPANSION JOINTS				9				21			
ALL OTHER MATERIALS				10				22			
				11				23			
				12				24			

EXPLAIN VARIANCE (IF NONE WRITE "NONE")

UNRESOLVED VARIANCES ON RECORD NOS. _____

ACTION TAKEN TO RESOLVE VARIANCE

On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

QUALITY CONTROLLER _____ SIGNATURE

RECEIVED BY _____ SIGNATURE DATE _____

Attachment 1

Appointment of Quality Controller:

_____ is hereby appointed as Quality Controller on Project No. _____. He has the authority to regulate the quality of the work so that it conforms to the Contract and is authorized to order discontinuance of any operation causing non-conforming work. He is directed to report to an officer of this firm and is not subordinate to the job superintendent or project manager.

He is a registered journeyman and/or has a minimum of five years prior experience in the supervision and inspection of BURS construction similar to that required in this Contract. He understands all requirements of these Specifications.

Project No. _____

Name of Firm _____

Address _____

Telephone _____

Authorized Representative's Signature _____

Authorized Representative's Name
(Print or Type) _____

Date _____

This is to acknowledge receipt of this letter.

Quality Controller's Signature _____

Quality Controller's Name
(Print or Type) _____

Date _____

Attachment 2

As-Built Roof System Summary:

After completion of roofing, accurately fill in the information required on this sheet. If more than one system applies to the same building, complete one sheet for each system. Submit two copies of each sheet prior to final acceptance.

Bldg. No. _____ Proj. No. _____

Building area where this system is installed _____

_____

Deck type _____ Deck slope _____

Underlayment components (type and number) _____

Underlayment attachment _____

Insulation:

Type _____ Manufacturer _____

First layer:

Thickness: _____
Attachment: _____

Second layer (if used):

Thickness: _____
Attachment: _____

Membrane:

Manufacturer _____
Manufacturer System Designation _____

No. of plies: _____ Felt type (circle one); organic, asbestos, glass

Bitumen type: _____ Surfacing (circle one): aggregate, smooth, granules

Was this new system installed over an existing roof (Superimposing)?

_____

Roof completion date _____

Roofing Contractor (name, address, and phone) _____

_____

Attachment 3

BUR Sample Identification Tags:

Immediately place the sample into two polyethylene bags. Seal each bag separately, using duct tape, and include this attachment in the outer bag. Provide the following information, using indelible ink or typing.

Sample No. _____ Project No. _____

Air Base _____ Bldg. No. _____

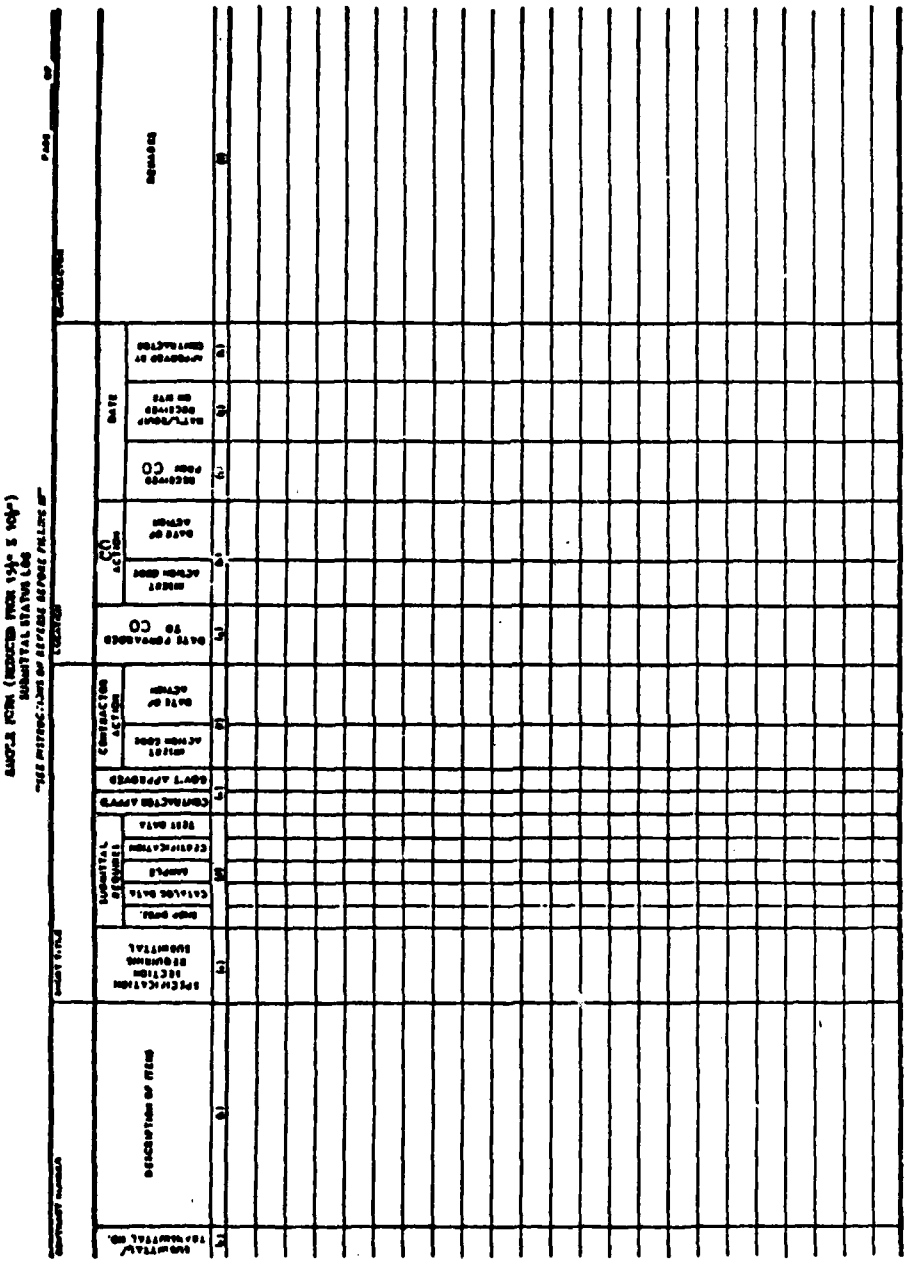
BURS Manufacturer _____

Membrane System Designation _____

Sampling Date _____

Sketch the roof shape below and dimension the sample location on the roof.

Attachment 4



Attachment 5

Attachment 5 (Reverse)

INSTRUCTIONS

1. This form may be used by the contractor for listing any material submittals that require action by either the contractor or the government.

2. Columns (a) through (e) should be completed by the contractor and must include all submittals that are required by the specifications. This partially completed form then becomes the submittal log portion of the CQC Plan.

3. As submittals are received and processed, the remaining columns are to be completed by the contractor.

4. In those instances where the contractor has approved the submittal under his contract responsibility, there may be a dual Action Code indicated under column (f); e.g., "A/E", indicating approved as submitted and forwarded to the CO for record purpose.

5. In column (f) for those items requiring CO action (Action Code "D"), the reason for forwarding to the CO should be entered in the column (g), the Remarks column; e.g., gov't approval required; extent requested because of variance, substitution, etc.

6. Where no government action is required, (no contractor review/approval items), there need be no entry in columns (d) and (e).

7. Column (j) is completed when material or equipment is delivered to the project. Column (k) is completed only after verification that the delivered item is that represented by the approved submittal.

ACTION CODE. To be used when completing columns (f) and (h)

A - Approved as submitted
B - Approved as noted
C - Disapproved
D - Forwarded to CO for action
E - Forwarded to CO for record purpose

APPENDIX F:
CONTRACT REQUIREMENTS FOR ROOFING AND CQC

Disk 192-C

ZERO ACCIDENTS

SECTION 7B
INSULATION FOR BUILT-UP ROOFING

INDEX

Attachment: Dwg. 40-01-01, Sheet 07241-1

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

1.1. FEDERAL SPECIFICATIONS (Fed. Spec.).

FF-N-105B & Int. Am-4	Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
HH-I-526C	Insulation Board, Thermal (Mineral Fiber)
HH-I-530A & Int. Am-4	Insulation Board, Thermal (Polyurethane and Polyisocyanurate)

1.2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.

D 312-78	Asphalt Used in Roofing

1.3. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE) PUBLICATION.

ASHRAE Handbook & Product Directory, Fundamentals (1977)

2. GENERAL. Insulation for built-up roofing shall be applied to the roof surfaces indicated. All work performed under this section shall be under the control of the roofing System Quality Controller as outlined in SECTION: BUILT-UP ROOFING.

2.1. STORAGE OF MATERIALS. Materials shall not be exposed to moisture in any form before, during, or after delivery to the site. Store insulation and felts in an enclosed building or in a trailer. Wet materials shall not be used and shall be removed from the worksite. Felt rolls shall be stacked on end. For 24 hours immediately before laying, roll goods shall be maintained at a temperature above 50° F. Isocyanurate and composite board insulation shall be stored away from areas where welding is being performed or where contact with open flames is possible.

2.2. PREPARATION REQUIREMENTS. The roof-deck surface shall be free from ice, frost, and surface moisture and shall be smooth, firm, free from dirt, projections, and foreign materials. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing.

Am #0001

2.3. APPLICATION REQUIREMENTS.

2.3.1. Surfaces shall be inspected and approved prior to application of insulation.

2.3.2. Application of materials shall not be performed under damp or wet conditions, excessive wind conditions, or when the ambient temperature is less than 40° F. Except when used as part of composite board insulation, urethane shall not be used on steel decks.

2.3.3. Kettles and tankers shall be equipped with automatic thermostatic controls and accurate charted temperature recorders, maintained in working order. Accuracy of the charted temperature recorder shall be verified daily with a certified, calibrated portable thermometer. Overheated or contaminated bitumen shall not be used, but shall be permanently removed from the site. Temperature of the bitumen at the time it is applied, as measured at the mop bucket and/or mechanical applicator, shall be in accordance with the insulation manufacturer's recommendations. Bitumen temperatures shall be maintained within the following limits.

2.3.3.1. Maximum at Kettles. Asphalt - 475°F., unless a lower temperature is recommended by the manufacturer.

2.3.3.2. Minimum at Point of Application. Asphalt - 350°F., unless a higher temperature is recommended by the manufacturer.

2.3.3.3. Maximum for Holding 1,000 Gallons or Less. Asphalt - 425°F., 4 hours maximum holding period.

2.3.3.4. Maximum for Holding 1,000 Gallons or More. Asphalt - 350°F., 96 hours maximum holding period, thermostatically controlled heating.

2.3.4. Mechanical fasteners are required for all insulation installed within the 4-foot wide band at the building exterior perimeter. Method of attachment shall be in accordance with insulation manufacturer's recommendations and the requirements specified hereinafter. Fasteners shall be installed at the rate of one fastener for each 2 sq. ft. of insulation. Filler pieces shall have at least two fasteners.

2.3.5. Insulation work shall be coordinated with roofing and sheet metalwork so that all material applied each day is waterproofed the same day with the complete roofing system and sheetmetal flashings.

2.3.6. Temporary work shall be installed when necessary to protect the roofing work in progress from inclement weather. Such temporary work shall be removed before proceeding with installation of permanent components and materials. Temporary work is the only work that will be permitted during inclement weather.

3. SUBMITTALS.

3.1. CATEGORY I. None.

3.2. CATEGORY II for approval.

3.2.1. Samples.

Asphalt (1 quart)

Samples shall be selected at random from each lot as directed and approved. Samples shall be placed in approved metal containers,

identified as to type of material, batch number, project contract number, intended use, and approximate quantity to be used in the project. The first samples may be tested by the Government. If the sample fails to meet the specification requirements, the material represented by the sample shall be replaced and the cost of retesting will be deducted from the payments due the Contractor at the rate of $75 per sample tested.

3.2.2. Descriptive Data.
Insulation
Adhesive
Fasteners
U-value computations to determine insulation thickness

4. MATERIALS shall conform to the following requirements:

4.1. ADHESIVE.

4.1.1. Adhesive for application of insulation to steel decks shall meet the requirements of the Underwriters' Laboratories, Inc., for metal roof deck construction or Factory Mutual Research Corp., for Class I steel deck construction.

4.2. BITUMEN.

4.2.1. Asphalt. ASTM D 312, Type III.

4.3. INSULATION shall be of the following materials:

4.3.1. Composite Board Insulation. Composite board insulation shall consist of urethane board factory bonded to a noncombustible material. The top surface of the urethane board shall be covered with a layer of asphalt saturated felt or glass-fiber mat securely bonded to the urethane during manufacture. The urethane component shall conform to Fed. Spec. HH-I-530, type I. Composite board insulation shall be fire approved for class I steel deck construction by Factory Mutual Research Corp., or for metal roof deck constructions fire labeled by Underwriters' Laboratories, Inc.

4.3.2. Mineral-fiber Insulation Board. Fed. Spec. HH-I-526.

4.3.3. Isocyanurate. Fed. Spec. HH-I-530, Type I, Grade 2, Class 2, Style D. Isocyanurate insulation shall be fire approved for Class 1 steel deck construction by Factory Mutual Research Corporation or for metal deck constructions fire labeled by Underwriters' Laboratories, Inc.

4.4. FASTENERS.

4.4.1. Fasteners.

4.4.1.1. Fasteners designed to secure insulation to steel decks shall conform to the requirements of Underwriters' Laboratories, Inc., or Factory Mutual Research Corporation.

4.4.1.2. Bolts and nuts shall be semifinished or finished, threaded for medium fit with either hexagonal-shaped or square-shaped nuts and boltheads.

4.4.1.3. Metal disks shall be flat and not less than 30 gage thickness. Disks used with fasteners for securing board insulation shall be minimum 2-1/8 inch diameter.

5. THICKNESS OF INSULATION. The drawings shall not be scaled to determine the required thickness of insulation. Actual installed thickness of insulation shall be such as to provide a coefficient of heat transmission or U-value, through the completed roof construction air-to-air, not in excess of 0.05 B.t.u. per hour, per square foot, per degree F. temperature difference, when determined for winter conditions in accordance with recognized methods in agreement with ASHRAE Handbook & Product Directory, Fundamentals. Roof construction air-to-air may include finish ceilings, provided unceilinged areas do not occur under the same roof area or space above the ceiling is not vented to the exterior or used as an air plenum. (Unceilinged mechanical rooms need not be considered when computing the required thickness of insulation.) Insulation thickness shall be uniform over common roof areas.

6. APPLICATION OF INSULATION.

6.1. INSTALLATION REQUIREMENTS.

6.1.1. Units of insulation shall be laid in courses with the long dimension parallel with the roof slope so that roofing plies are laid across the short dimension of the board. Boards shall be cut to fit neatly against adjoining surfaces. Insulation shall be laid in two or more layers. First layers shall be one of the materials specified hereinbefore. Final layer shall be mineral fiber board, 3/4-inch thick. End joints shall be staggered by the maximum possible. Joints in successive layers shall be staggered the maximum dimension with respect to joints in the preceeding layer. Boards shall be brought into moderate, uniform contact at sides and ends, with maximum joint width of 1/16-inch. Insulation which can be readily lifted after installation is not considered to be adequately secured. Undamaged units shall be reinstalled. Damaged units shall be replaced.

6.1.2. Bitumen shall not be applied further than one panel length ahead of roof insulation being installed. Except for the first layer on steel deck specified hereinafter, all successive layers shall be laid in solid moppings of hot bitumen applied at the rate of at least 20 pounds of asphalt per square. The edges of insulation boards adjoining vented nailers shall be kept free of bitumen. A 1/2-to-1-inch air space shall be provided between parapet walls and insulation for use with wood vents hereinafter specified. Composite board insulation shall be laid with the urethane component up.

6.1.3. Insulation laid directly on steel deck shall be installed using 12 to 15 pounds of asphalt per square. In lieu of asphalt, nonflammable adhesive may be applied in the quantity recommended by Underwriters' Laboratories, Inc., or Factory Mutual Research Corporation. Asphalt or adhesive shall be applied to steel decks by machine whenever possible. Asphalt or adhesive shall be applied in ribbons parallel to flutes and on every top flange. The continuous joints between insulation units, parallel with the roof slopes, shall not occur over the fluted openings in steel decks.

6.2. FASTENING REQUIREMENTS. When mechanical fasteners are used for insulation installed in two or more plies, only the first layer need be secured with fasteners. When using serrated nail-type fasteners for steel decks and through an asphalt covering, a hole will be prepunched in the covering.

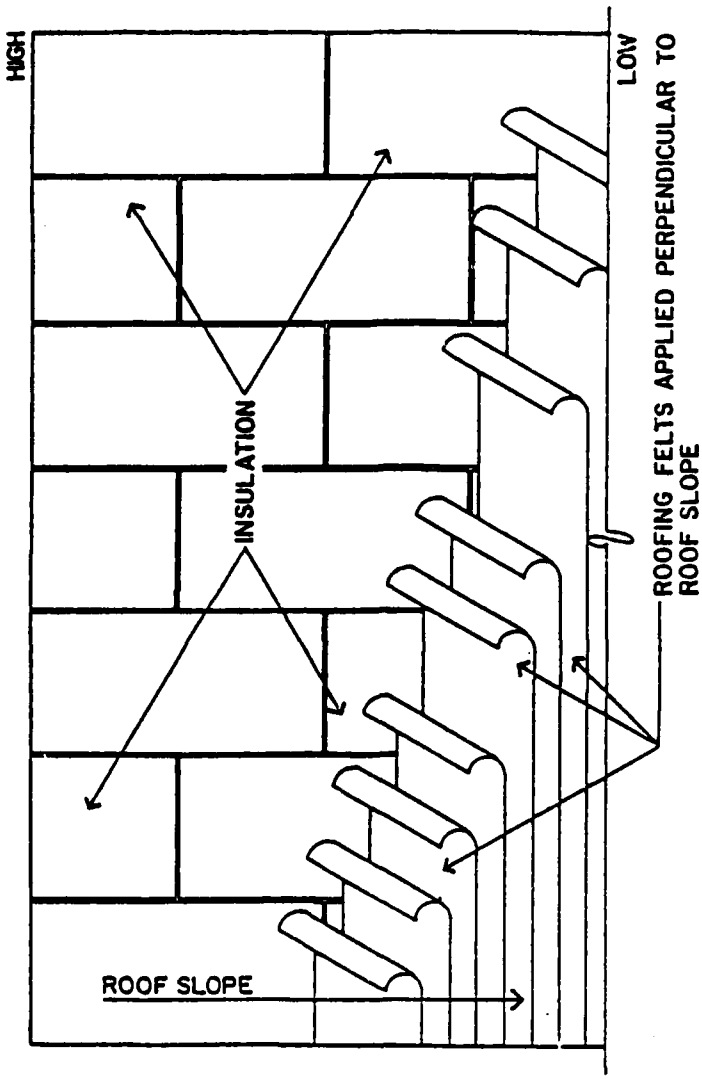
6.3. PROTECTION REQUIREMENTS. The insulation shall be kept dry at all times and shall be laid just before application of the roofing felts. No more insulation shall be laid than can be covered the same day with the complete roofing system. Install temporary water cut-offs and tie-ins at the terminating edges of each day's work. At the beginning of the next day's work, the temporary work shall be removed so that all vertical faces of insulation are exposed. Do not cut off the staggered insulation boards that are already installed. Provide unattached cut pieces of insulation at each layer to straighten the staggered insulation side of the day's work. The cut insulation pieces shall not be permanently incorporated into the roof system. Protect the exposed edge of each layer of insulation with a single-ply strip-in. Exposed surfaces of insulation shall be glaze-coated with bitumen.

7. WOOD NAILERS. Nailers installed on the surface of the roof deck shall be furnished and installed under this section. Nailers shall be treated with waterborne preservative as specified in SECTION: ROUGH CARPENTRY. Plywood, where required, shall be treated with waterborne preservative and laminated with exterior-type glue.

7.1. EDGE NAILERS shall be continuous wood members installed as indicated, where insulation is applied on the roof deck. Nailers shall be not less than the width indicated and of thickness to finish flush with the top surface of the insulation. The bottom half of the nailer shall be groove-cut, or have scab pieces of lumber secured to the bottom, to provide a net open area equivalent to 10 percent of the edge face for ventilation of the insulation.

7.2. NAILER SECUREMENT. Nailers shall be secured to steel decks as indicated. Bolt anchors shall have nuts and washers countersunk, and bolts shall be cut flush with top of nailer. Powder-actuated fasteners, sized and spaced for nailer anchorage equivalent to that specified and indicated, may be used when approved.

8. WOOD VENTS FOR PARAPET WALL. Wood vents shall be 1-inch nominal thickness, treated as specified for wood nailers, and installed continuously between top of insulation and sheetmetal reglet or top of curb. Wall side of vent shall be groove-cut to provide a net open area equivalent to 20 percent of the thickness edge for venting insulation. Wood vents shall be secured to parapet walls with masonry or concrete nails spaced not more than 18 inches on centers and staggered. Groove cuts shall be matched for continuity when wide vents are built of more than one width of wood.



INSULATION PATTERN
NO SCALE

OCTOBER 1977
DWG. 40-01-01
SHEET 07241-1
OFFICE OF THE DISTRICT ENGINEER
OMAHA, NEBRASKA

ZERO ACCIDENTS

SECTION 7C
BUILT-UP ROOFING

INDEX

Attachments: A1-1, 2, 3

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

1.1. FEDERAL SPECIFICATIONS (Fed. Spec.).

SS-C-153C	Cement, Bituminous, Plastic

1.2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.

C 208-72	Insulating Board (Cellulosic Fiber), Structural and Decorative
D 41-72	Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
D 226-77	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
D 250-77	Asphalt-Saturated Asbestos Felt Used in Roofing and Waterproofing
D 312-78	Asphalt Used in Roofing
D 1863-77	Mineral Aggregate Used on Built-up Roofs
D 2178-76	Asphalt-impregnated Glass Mat Used in Roofing and Waterproofing
D 2626-73	Asphalt-saturated and Coated Organic Felt Base Sheet Used in Roofing
D 3617-77	Sampling and Analysis of New Built-up Roof Membranes

2. GENERAL. Asphalt built-up roofing shall be applied to the roof surfaces indicated.

2.1. STORAGE OF MATERIALS. Materials shall not be exposed to any moisture before, during, or after delivery to the site. Felts and roll roofing shall be stored in an enclosed building or in a trailer, stacked on end, and maintained above 50° F. for 24 hours immediately before laying. Aggregate shall be maintained surface dry as defined by ASTM D 1863.

2.2. COORDINATION REQUIREMENTS. Roofing operations shall be coordinated with sheet metalwork so that flashings are installed to permit continuous roof surfacing operations the same day felts are installed. Roofing operations shall also be coordinated with roof insulation work so that all insulation applied each day is waterproofed the same day with the complete roofing system.

Am #0001

2.3. PREPARATION REQUIREMENTS. The entire roof-deck construction of any bay or section of the building shall be completed before roofing work is begun thereon. Roofing on structural concrete shall not be scheduled until frothing or bubbling does not occur when hot bitumen is applied to the deck and until the hot bitumen sticks tightly to the deck. Vents and other items penetrating the roof shall be secure in position and properly prepared for flashing.

2.4. APPLICATION REQUIREMENTS. Surfaces shall be inspected and approved immediately prior to application of roofing and flashings. The roofing or flashing shall be applied to a smooth and firm surface free from ice, frost, moisture, dirt, projections, and foreign materials. Application of roofing shall not be performed under damp or wet conditions, excessive wind conditions, or when the ambient temperature is less than 40° F.

2.4.1. Asphalt shall be used with asphalt-saturated felts. Kettles and tankers shall be equipped with automatic thermostatic controls and accurate charted temperature recorders, maintained in working order. Accuracy of the charted temperature recorder shall be verified daily with a certified, calibrated portable thermometer. Overheated or contaminated bitumen shall not be used, but shall be permanently removed from the site. Temperature of the bitumen at the time it is applied, as measured at the mop bucket and/or mechanical applicator, shall be in accordance with the roofing felt manufacturer's recommendations. Bitumen temperature shall be maintained within the following limits.

2.4.1.1. Maximum at Kettles. Asphalt - 475° F., unless a lower temperature is recommended by the manufacturer.

2.4.1.2. Minimum at Point of Application. Asphalt - 350° F., unless a higher temperature is recommended by the manufacturer.

2.4.1.3. Maximum for Holding 1,000 Gallons or Less. Asphalt - 425° F. 4 hours maximum holding period.

2.4.1.4. Maximum for Holding 1,000 Gallons or More. Asphalt - 350° F. 96 hours maximum holding period, thermostatically controlled heating.

2.4.2. Bituminous-plastic-type flashings installed in accordance with these specifications shall be used throughout unless otherwise specified or indicated. Metal flashings are specified in SECTION: SHEET METALWORK, GENERAL.

2.5. TEMPORARY WORK shall be installed when necessary to protect the roofing work in progress from inclement weather. Such temporary work shall be removed before proceeding with installation of permanent components and materials. Temporary work is the only work that will be permitted during inclement weather.

3. QUALITY ASSURANCE.

3.1. GENERAL. The acceptability of completed roofing work will be based on its conformance to the contract requirements. The Government is not obligated to accept non-conforming work, and such non-conforming work may be rejected. The rejected work shall be expeditiously replaced or corrected in a manner and by methods approved by the Contracting Officer.

3.2. QUALITY CONTROLLER. The Contractor shall hire or appoint a representative as Quality Controller to effect the quality assurance program for roofing application. The representative shall be a registered journeyman or an individual having a minimum of five years experience in the supervision and inspection of built-up roofing construction. Responsibilities of the Quality Controller are outlined in the Quality Control Guide (Attachment 1).

3.3. ROOFING CONFERENCE. Before the start of any roofing work, and at a time and place designated by the Contracting Officer, the Contractor or his designated representative shall attend a conference relative to the roofing construction. The Quality Controller and the roofing foreman or superintendent shall also attend the conference. The conference may include a visit to the work site.

3.3.1. The Contractor shall furnish the following at the Roofing Conference.

3.3.1.1. Appointment of Quality Controller (Attachment No. 2).

3.3.1.2. Four copies each of the manufacturer's current published product and installation literature pertinent to the roofing system.

3.4. DAILY INFORMATION. The following information shall be furnished each day as applicable.

3.4.1. Quality Control Record (Attachment No. 1).

3.4.2. Recorded bitumen temperature charts.

3.4.3. Supplier certification for bitumen delivered in hot bulk and for truckloads of aggregate.

3.5. FINAL INFORMATION. The following information shall be furnished following completion of the roofing installation and prior to final acceptance.

3.5.1. A plan view drawing of each roof showing location and date of each day's work.

3.5.2. As-Built Roof Summary (Attachment No. 3).

4. MATERIALS shall conform to the following requirements:

4.1. ASPHALT PRIMER. ASTM D 41.

4.2. BITUMEN.

4.2.1. Asphalt. ASTM D 312, Type II or Type III.

4.3. CANTS shall be made from treated wood or treated fiberboard and shall reduce the angle covered into two equal angles. Treated wood shall be water-borne preservative-treated material as specified in SECTION: ROUGH CARPENTRY. Fiberboard shall conform to ASTM C 208, treated for moisture resistance by integral treatment with wax or other sizes or with bituminous impregnation.

4.4. FELT shall be the bituminous-saturated type and shall conform to the following requirements:

4.4.1. Organic-Fiber Felt.

4.4.1.1. Asphalt-Saturated Roofing Felt. ASTM D 226, Type I.

4.4.2. Glass-Fiber Felt.

4.4.2.1. Asphalt-Impregnated Roofing Felt. ASTM D 2178, Type IV.

4.4.3. Asbestos-Fiber Felt.
4.4.3.1. Asphalt-Saturated Roofing Felt. ASTM D 250, Type I, perforated.

4.5. NAILS, FASTENERS AND ANCHORS shall be an approved type recommended by the roofing felt manufacturer.

4.6. BITUMINOUS CEMENT. Fed. Spec. SS-C-153, Type I with asphalt-saturated felts.

4.7. SURFACING MATERIALS. Crushed stone, gravel, or crushed slag conform to ASTM D 1863. Subject to approval, other materials may be used when blended to the grading requirements of ASTM D 1863.

5. SUBMITTALS.

5.1. CATEGORY I. None.

5.2. CATEGORY II for approval.

5.2.1. Samples of materials.
Bituminous cement (1 quart)
Asphalt (1 quart)

Samples shall be selected at random from each lot and, unless otherwise directed, shall be taken under observation by the Contracting Officer. Samples shall be placed in approved metal containers clearly identified as to type of material, batch number, project contract number, intended use, and approximate quantity to be used on the project. The samples will be tested by and at the discretion of the Government. If a sample fails to meet the specification requirements, the material represented by the sample shall be replaced and the cost of testing the replacement sample will be deducted from the payments due the Contractor at the rate of $75 per replacement sample tested.

5.2.2. Descriptive Data.
Fasteners
Base Flashing System

6. ROOFING SYSTEMS.

6.1. ASPHALT BUILT-UP 4-PLY ORGANIC ROOFING.

6.1.1. On Concrete or Insulation Surfaces. Four plies of 15-pound saturated felt shall be mopped in solid with hot asphalt. Felts shall be laid shingle-fashion at right angles to the direction of the roof slope and lapped in accordance with Table I. The flashings shall be installed and the flood coat and surfacing applied.

6.2. ASPHALT BUILT-UP 4-PLY GLASS-FIBER ROOFING.

6.2.1. On Concrete or Insulation Surfaces. Four plies of glass-fiber felts shall be mopped in solid with hot asphalt. Felts shall be laid shingle-fashion at right angles to the direction of the roof slope and lapped in accordance with Table I. The flashings shall be installed and the flood coat and surfacing applied.

6.3. ASPHALT BUILT-UP 4-PLY ASBESTOS ROOFING.

6.3.1. On Concrete or Insulation Surfaces. Four plies of asbestos felts shall be mopped in solid with hot asphalt. Felts shall be laid shingle-fashion at right angles to the direction of the roof slope and lapped in accordance with Table I. The flashings shall be installed and the flood coat and surfacing applied.

7. APPLICATION OF ROOFING.

7.1. GENERAL REQUIREMENTS. The entire roofing system, including aggregate surfacing, shall be finished in one operation up to the line of termination at end of day's work. Application of roofing shall immediately follow application of insulation as a continuous operation. Phased construction will not be permitted. Application shall begin at low points or drains, and proceed shingle-fashion up the slope so that the flow of water is not against the exposed edge of the flap. Use cut starter strips at eaves. To insure a waterproof membrane, care shall be taken to preclude bare spots between plies. To prevent slippage, care shall be taken to preclude use of an excessive amount of bitumen. At the terminating edges of each day's work, exposed surfaces of roofing plies shall be glaze-coated with bitumen.

7.2. DETAIL REQUIREMENTS.

7.2.1. Asphalt primer for concrete surfaces to receive asphalt products shall be applied at a rate of not less than 1 gallon per square. Bitumen shall uniformly cover all roof areas to be mopped to provide effective bond.

7.2.2. Mechanical application devices shall be mou. ıd on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation or the roofing membrane. Provide adequate plank or plywood protection where materials are transported over the partially or fully completed roof.

7.2.3. Bitumen stops, formed of edge envelopes shall be installed at eaves and rakes. Envelopes shall be formed of two 18-inch wide layers of roofing felt. Only organic or asbestos felts shall be used. Nine inches of the width shall be attached to the roof surface with 9 inches extending beyond the edge. The first layer shall be applied in a 4-inch wide layer of plastic roofing cement and nailed 1/2 inch from the roof edge at 6-inch spacing. The second layer shall be applied to the first in a 9-inch wide mopping of bitumen. The free edges shall be protected from damage throughout the roofing period.

7.2.4. Each layer of organic roofing felt shall be laid in not less than 15 pounds of asphalt per square, and a maximum of 25 pounds of asphalt per square. Each layer of glass fiber felt shall be laid in not less than 20 pounds of asphalt per square or more than 30 pounds of asphalt per square. Each layer of asbestos felt shall be laid in not less than 15 pounds of asphalt per square or more than 25 pounds of asphalt per square.

7.2.5. Layers of roofing shall be laid in a straight run free of wrinklee, creases, or fishmouths, at right angles to the slope of the deck and immediately behind the applicator. Immediately upon deviating from the specified lap dimension, the roll of felt shall be cut and restarted with a 6-inch end lap. Once established, do not change the direction of felt application, unless made necessary due to changes in direction of slope. The surface of the felts shall be broomed-in full width while the bitumen is hot and fluid, to obtain complete adhesion between plies and to eliminate air pockets. The method of mopping a half-sheet width and turning the sheet back to mop under the other half will not be used. Workmen shall not walk on mopped surfaces when the bitumen is sticky. Each layer of roofing felt shall be carried up abutting vertical surfaces at least 4 inches, or to the top of the cant strip. After the last ply of roofing felt is applied, the edge

envelope shall be formed by folding back and mopping each layer. The gravel stop, specified in SECTION: SHEET METALWORK, GENERAL, shall be installed on top of the envelope. Sheet metal in contact with bitumen shall be primed with asphalt primer and allowed to dry before installation. Gravel stop shall be embedded in bituminous cement and nailed on top of the envelope.

7.2.6. Each course of roofing felts shall be mopped in hot bitumen and shall be lapped as specified in Table I. Apply the felts single-fashion and maintain proper lap distance to result in a 2-inch headlap.

7.2.7. Whenever precipitation is imminent, the terminated edge of built-up roofing shall be sealed with two full width strips of felt set in plastic bituminous cement. Extend half-width of strips up and over the finished roofing and extend the other half-width out and onto the bare roof deck surface or onto the insulation. Water cutoffs shall be removed before continuing installation of roof system.

7.3. APPLICATION AT VALLEYS AND RIDGES.

7.3.1. Valley Parallel to Roofing Plies. At valleys and drains use full width sheets to maintain ply structure and headlap in two directions. The first ply shall be started on the reverse slope, 27-1/2 inches past the valley centerline, and extending 8-1/2 inches onto the slope to be roofed. Subsequent plies shall be applied shingle-fashion so that the fourth ply extends 2 inches onto the reverse slope. Roofing of the reverse slope shall start at the valley centerline with plies applied shingle-fashion.

7.3.2. Ridge Parallel to Roofing Plies. Full width sheets shall be used at ridges. Two plies of the first surface to be roofed shall be extended past the ridge and onto the reverse slope. Three plies of the second surface to be roofed shall be extended past the ridge.

7.3.3. Valley Diagonal to Roofing Plies. At intersecting roofing membranes the number of overlaping plies shall be kept to the minimum required to provide continuity in the membrane. Roofing application shall be in accordance with an approved plan that will prevent any excessive ply structure.

8. FLASHINGS shall be provided in the angles formed at walls and other vertical surfaces and where required to make the work watertight. Bituminous-plastic-type-flashings described below shall be used, except where metal flashings are indicated or specified in SECTION: SHEET METALWORK, GENERAL. Flashings shall be provided and installed immediately after the top ply of roofing is placed and shall be returned and sealed or capped and sealed to waterproof edges and ends. Flashings shall be stepped where vertical surfaces abut sloped-roof surfaces.

8.1. BASE FLASHINGS for organic-fiber and asbestos-fiber felt roofing systems shall consist of one ply of asbestos roof felt and one ply of a reinforced asbestos flashing sheet as the outer ply. Base flashings for glass fiber felt roofing systems shall be a three-ply system using a mineral cap sheet as the outer ply. Surfaces to receive flashing shall be primed and dry before application of the flashing materials. Flashing shall extend above the top of the cant to a point immediately below the counterflashing reglet. Over nailable substrates, the top edge of the flashing shall be nailed at 4-inch centers. Materials and installation shall be in strict accordance with the published recommendations of the roofing felt manufacturer.

8.1.1. Cants shall be installed in the angles formed at walls and other vertical surfaces as backing for base flashings. Cants shall be laid in a solid coat of bituminous cement just prior to laying the roofing plies. Cants that can be readily lifted or displaced by hand are not adequately secured. Cants shall have 5-1/2-inch face dimension and shall be continuous and installed in lengths as long as practicable.

8.2. STRIP FLASHINGS. Roof flanges of lead and sheet-metal flashings, such as gravel stops, base flashings, and plumbing flashings, furnished and installed under other sections of the specifications shall be stripped with two layers of roofing felt set in plastic cement. After installation of flanges or flashings over the top ply of roofing, the strip flashings consisting of two layers of roofing felt, 9 and 12 inches wide, shall be successively cemented to the top of the roof flange using bituminous plastic cement, to form a waterproof joint between roofing and flashings.

9. ROOF MEMBRANE SAMPLING and repair of the sample areas shall be done by the Contractor. Samples shall be taken in the presence of and as directed by the Contracting Officer when there is reason to believe that deficiencies exist in the roofing membrane. Samples may be required for visual inspection or weight testing in accordance with ASTM D 3617.

9.1. ROOF CUTOUT REPAIR. Damaged insulation shall be replaced or brought up to level with new material. The sample may be bedded in roofing cement and replaced in the roof membrane, or the void may be filled level with layers of felt set in roofing cement. Cap the cutout area with four plies of roofing felt. The first ply shall be set in roofing cement, and shall lap the cutout area by 2 inches on all sides. Succeeding plies shall be embedded in hot bitumen, and shall lap the preceding ply by 2 inches. Apply final roof surfacing over the repaired area.

10. SURFACING. After roofing felts have been laid and flashings installed, the roof surface, except cants, shall be flood-coated uniformly with 60 pounds of hot asphalt per square. While bitumen is still hot, 400 pounds per square of roofing gravel or 300 pounds per square of other approved aggregate shall be embedded therein. Aggregates shall be placed in the manner and quantity required to form a compact embedded overlay. Roof surface shall be swept and all loose aggregate removed. Flood coat and aggregate shall be applied the same day as the felts are laid. If there is a probability of rain falling on the felts before the flood coat and aggregate can be applied, a light glaze coat of bitumen, 10 to 15 pounds per square, shall be applied over the exposed felts. The glaze coat may be considered as part of the flood coat provided the surfacing operation is completed within 48 hours after application of the glaze coat. Where glaze coat is used, surface treatment shall be completed as soon as weather conditions permit.

Table I

LAPS FOR ROOFING FELTS AND ROLL ROOFING[1]
(for 36-inch width roll)

Layers Plies	Laps (Inches)	Exposure (2) (Inches)	Starting Widths (Inches)
4	27-1/2	8-1/2 (7-1/2)	9-1/2, 18, 26-1/2 and 35

[1] End laps of roofing felts shall be not less than 6 inches and shall be staggered a minimum of 12 inches.

[2] Number in parenthesis ( ) is the dimension from edge of the first full sheet to edge of roof, as required to provide 2-inch headlap with the first starter strip.

QUALITY CONTROL GUIDE
(FOR BUILT-UP ROOFING)

1. GENERAL. The sole responsibility of the Quality Controller is to assure that all roofing and related work is installed in strict conformance with the contract requirements. He is responsible for all components of the roofing system including insulation, sheet metal, and wood items specified in other sections of these specifications. The Quality Controller must continually observe the work in progress, verify conformance of the work, and report his findings daily on the Quality Control Record form. He must be familiar with the Contract drawings and specifications, tests and measurements he is required to make, and the Quality Control Record form and reporting procedures. He must inspect the roof deck prior to roofing application and attend the roofing conference.

1.1. EQUIPMENT. The following equipment is necessary for the tests and measurements required.

Charted temperature recorder for each kettle or tanker.
Calibrated portable thermometer.
Scale for weighing roof membrane samples.
Measuring tape.

1.2. TOLERANCES. The following tolerances, plus or minus, establish the range of acceptable variances from the stated requirements for felt spacings. Work outside of this range should be removed and action taken to prevent recurrence.

1/4 inch for single dimension of 2 inches or more.
1/2 inch overall for 2 to 10 consecutive increments of a standard dimension.
3/4 inch overall for 11 to 20 consecutive increments of a standard dimension.
1 inch overall for 21 or more consecutive increments of a standard dimension.

2. QUALITY CONTROL RECORD. The Quality Control Record form shall be completed as follows for each day on which roofing work is performed.

2.1. TOP SECTION. Insert all requested information in the spaces provided. Use the contract number for project number. Insert building name in space for building number.

2.2. PRODUCTS SECTION. Check the appropriate box for each product major category. All materials within the category must comply with the contract to result in a check in the "complies" box. Compliance requirements are established by the drawings, specifications, and by the approved contractor's submittals.

2.3. EXECUTION SECTION. The work item numbers correspond to the work items listed hereinafter. The work items refer to specification requirements considered to be of major concern. The actions outlined with each work item should be performed as applicable and an entry made in the appropriate box on the form. Specification requirements not listed must also be considered and their acceptability grouped and documented on the reverse side of the form.

Attachment A1 (3 pages)

2.4. VARIANCE SECTION. Any entry in the "varies" column requires an explanation. The explanation should be a description of the variance; reasons for the variance are not necessary. Indicate action taken to resolve variance to result in complying work. If a variance is not resolved on the same day it occurs, enter the number of that day's record in the space provided for all succeeding days until the variance is resolved.

2.5. CLOSING SECTION. Sign the Quality Control Record form at the end of the work day and submit to the Contracting Officer.

3. WORK ITEMS. The following item numbers correspond to the work item number in the execution section of the Quality Control Record form. The Quality Controller should perform all actions necessary to assure that work performed complies with the specified requirements.

WORK ITEM NO. 1: Materials at point of application - Verify type and condition of materials to be installed. Check for damage that may have occurred during storage or transportation.

WORK ITEM NO. 2: Equipment - Check type, quality, and condition of equipment to be used. Verify accuracy of thermometers and metering devices.

WORK ITEM NO. 3: Weather - Verify that weather conditions are appropriate for the type of work to be done.

WORK ITEM NO. 4: Roof deck- Inspect the deck and other surfaces to which the work will be installed. Verify that surfaces are dry, primed, and prepared to receive the work.

WORK ITEM NO. 5: Wood items - Verify that wood items are preservative treated and properly installed, and that provisions are made for venting where required.

WORK ITEM NO. 6: Bitumen - Verify that all bituminous materials are of the proper types. Check temperatures at the kettle and at point of application.

WORK ITEM NO. 7: Vapor barrier - Verify that vapor barrier is properly installed and satisfactory for reception of subsequent work.

WORK ITEM NO. 8: Insulation - Check insulation orientation, staggered lap, joint width, nailing, and bitumen quantities. Verify that insulation is satisfactory to receive the membrane.

WORK ITEM NO. 9: Edge envelope - Verify that edge envelope plies are properly placed and protected, and that plies are folded back over the roofing membrane.

WORK ITEM NO. 10: Membrane placement - Check direction of roofing felts, width of starter sheets, headlap, end laps, etc.

WORK ITEM NO. 11: Membrane construction - Check for proper installation practices including bitumen quantities, brooming, etc. Verify that felts are laid flat, and are extended to top of cants.

WORK ITEM NO. 12: Ridges and valleys - Verify that membrane construction at ridges and valleys retains continuity without excessive ply structure.

WORK ITEM NO. 13: Nailing - Verify that membrane is properly nailed where required.

WORK ITEM NO. 14: Penetrations - Verify that drains and other penetrations are properly flashed and made watertight.

WORK ITEM NO. 15: Base flashing - Verify proper installation of base flashings.

WORK ITEM NO. 16: Sheet metalwork - Check thickness and configuration of sheet metal items. Verify proper priming, fastening, and strip flashing.

WORK ITEM NO. 17: Protection - Check for rubber tired equipment and planking to prevent damage to the work.

WORK ITEM NO. 18: Walkways - Verify that permanent walkways are properly installed on top of the membrane.

WORK ITEM NO. 19: Gravel topping - Verify proper application of flood coat and gravel, and removal of excess gravel.

WORK ITEM NO. 20: Completion - Verify that roof area worked on is complete when work stops, including topping and sheet metalwork.

WORK ITEM NO. 21: Edge protection - Verify that insulation and felts exposed at end of day are properly protected, and that stripping and cut insulation boards are removed before work is resumed.

WORK ITEM NO. 22: Samples - Verify that samples are taken and properly inspected, and that sample areas are repaired.

WORK ITEM NO. 23: Weather protection - Verify that work in progress is adequately protected from inclement weather, and that protective measures are taken if work is stopped before completion.

PROJECT NUMBER	BLDG NO.	ROOFING CREW	QUALITY CONTROLLER
		START AM PM	START AM PM
WEATHER (Describe)	AVERAGE TEMPERATURE	STOP AM PM	STOP AM PM
TOTAL ROOF AREA (Squares)		COMPLETED TODAY	TEST SAMPLES REMOVED

PRODUCTS (See Project Specifications) (Check Appropriate Box Below)				EXECUTION (See Quality Control Guide) (Check Appropriate Box Below)							
COMPONENTS (Type, Quantity, Size)	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE
UNDERLAYMENT				1				13			
INSULATION				2				14			
MEMBRANE				3				15			
COMPO. FLASHING				4				16			
SHEET METAL				5				17			
FASTENERS				6				18			
WOOD				7				19			
SEALANTS				8				20			
EXPANSION JOINTS				9				21			
ALL OTHER MATERIALS				10				22			
				11				23			
				12				OTHERS			

EXPLAIN VARIANCE (If none write NONE)

UNRESOLVED VARIANCES ON RECORDS NOS.

ACTION TAKEN TO RESOLVE VARIANCE

On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

QUALITY CONTROLLER (Signature)

RECEIVED BY (Signature) DATE

Attachment 1

Appointment of Quality Controller:

_____ is hereby appointed as Quality Controller on Project No. _____. He has the authority to regulate the quality of the work so that it conforms to the Contract and is authorized to order discontinuance of any operation causing non-conforming work. He is directed to report to an officer of this firm and is not subordinate to the job superintendent or project manager.

He has a minimum of five years prior experience in the supervision and inspection of BURS construction similar to that required in this Contract. He understands all requirements of these Specifications.

Project No. _____

Name of Firm _____

Address _____

Telephone _____

Authorized Representative's Signature _____

Authorized Representative's Name
(Print or Type) _____

Date _____

This is to acknowledge receipt of this letter.

Quality Controller's Signature _____

Quality Controller's Name
(Print or Type) _____

Date _____

Attachment 2

As-Built Roof System Summary:

After completion of roofing, accurately fill in the information required on this sheet. If more than one system applies to the same building, complete one sheet for each system. Submit two copies of each sheet prior to final acceptance.

Bldg. No. _____ Proj. No. _____

Building area where this system is installed _____

_____

Deck type _____ Deck slope _____

Underlayment components (type and number) _____

Underlayment attachment _____
Insulation:

Type _____ Manufacturer _____

First layer:

Thickness: _____
Attachment: _____

Second layer (if used):

Thickness: _____
Attachment: _____

Membrane:

Bitumen Manufacturer _____
Felt Manufacturer _____

No. of plies:. _____ Felt type (circle one); organic asbestos, glass

Bitumen type: _____
Surfacing (circle one) aggregate, smooth, granules

Was this new system installed over an existing roof (Superimposing)?

_____

Roofing completion date _____

Roofing Contractor (name, address, and phone) _____

Attachment 3

FORT CARSON, COLORADO

THREE TACTICAL EQUIPMENT SHOPS

Invitation DACA45-81-B-0049
Contract DACA45-81-C-0155

Extract from Section 1A, SPECIAL PROVISIONS.

21. CONTRACTOR QUALITY CONTROL (CQC). In conformance with the requirements of General Provisions Clause: "CONTRACTOR INSPECTION SYSTEM," the Contractor shall provide and maintain an effective Quality Control Program.

21.1. GENERAL. Except for isolated tests or other items of work specified to be performed by the Government, the quality of all work shall be the responsibility of the Contractor. Sufficient inspections and tests of all items of work, including that of subcontractors, to ensure conformance to applicable specifications and drawings with respect to the quality of materials, workmanship, construction, finish, functional performance, and identification shall be performed on a continuing basis. The Contractor shall furnish qualified personnel, appropriate facilities, instruments and testing devices necessary for the performance of the quality control function. The controls shall be adequate to cover all construction operations, shall be keyed to the proposed construction sequence and shall be correlated by the Contractor's quality control personnel.

21.2. PRE-CONSTRUCTION PLANNING. Within (20) days after the contract is awarded, and prior to starting on-site construction, the Contractor shall meet with the Contracting Officer and discuss the quality control requirements. During this meeting the Contractor shall submit for approval his proposed written QC plan which shall include all features outlined below. The proposed plan will be reviewed and the meeting shall develop mutual understanding relative to details of the system, including the personnel, facilities, forms, etc., to be used for the inspections, tests and the administration of the system. No change in the approved plan shall be implemented without written concurrence by the Contracting Officer.

21.3. CONTRACTOR'S PROPOSED QC PLAN. The Contractor's proposed written quality control plan (for submittal at the pre-constructior meeting) shall include as a minimum:

21.3.1. The quality control organization.

21.3.2. Names, number and qualification of personnel to be used for this purpose.

21.3.3. Authority and responsibilities of all quality control personnel.

21.3.4. Schedule of Use of inspection personnel by types and phase of work.

21.3.5. Proposed test methods including names of technicians or qualified testing laboratory to be used.

21.3.6. Method of performing, documenting and enforcing quality control operations of both prime and subcontract work including inspection and testing.

21.3.7. A copy of a letter of direction to the Contractor's representative responsible for quality control, outlining his duties and responsibilities, and signed by a responsible officer of the firm.

21.4. CONTROL OF ON-SITE CONSTRUCTION. The Contractor's quality control program shall include three phases of inspection and tests. The Contracting Officer's representative shall be notified at least 24 hours in advance of each such test.

21.4.1. Preparatory Inspections shall be performed prior to beginning each feature of work on any on-site construction work. Preparatory inspections for the applicable feature of work shall include (i) review of submittal requirements and all other contract requirements with the foremen or supervisors directly responsible for the performance of the work; (ii) check to assure that provisions have been made to provide required field control testing; (iii) examine the work area to ascertain that all preliminary work has been completed; (iiii) verify all field dimensions and advise the Contracting Officer of any discrepancies; and (iiiii) perform a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand.

21.4.2. Initial Inspection shall be performed as soon as work begins on a representative portion of the particular feature of work and shall include examination of the quality of workmanship as well as a review of control testing for compliance with contract requirements.

21.4.3. Follow-up Inspections shall be performed continuously as any particular feature of work progresses, to assure compliance with contract requirements including control testing, until completion of that feature of the work.

21.5. CONTROL OF OFF-SITE OPERATIONS. Contractor furnished items which are being fabricated or assembled off-site shall be inspected for conformance to specification requirements by quality control personnel at the place of fabrication (factory) and/or assembly. A record of such inspections shall be submitted prior to release of such items for shipment to the job site.

21.6. QUALITY CONTROL STAFF. In addition to the Contractor's job-supervisory staff, a separate quality control group shall be provided. This group shall report to the Contractor's management at a level no lower than an executive of the company. As a minimum, the overall strength of the quality control group for this contract shall be as follows:

21.6.1. The Quality Control Supervisory Engineer shall be an approved, qualified engineer or technician whose sole responsibility is to insure compliance with the contract plans and specifications. This person shall demonstrate his ability to perform correctly the duties required of him to the satisfaction of the Contracting Officer and shall be physically at the

project site whenever work is in progress and will be in charge of the Contractor's Quality Control program for this project. All the Contractor's submittals for approval shall be reviewed and modified or corrected as needed by him or his authorized assistants and approved correct prior to forwarding of such submittals to the Contracting Officer.

21.6.2. A Mechanical Technician, who is experienced in the construction of industrial air-conditioning, steam and sewer systems, plumbing, heating, mechanical tests and other components of mechanical devices equipment and/or systems in the work, shall assist the QC Supervisory Engineer in the performance of his duties. The Mechanical Technician may have other duties but shall be on the project site at the times indicated in both the approved QC Plan and Progress Chart and as called for in Division 15 of the specifications.

21.6.3. An Electrical Technician, experienced in the construction of industrial electrical systems, overhead and underground high voltage systems, instrumentation and control systems, and the required electrical tests shall assist the QC Supervisory Engineer in the performance of his duties. The Electrical Technician may have other duties but shall be on the project site at the times indicated in both the approved QC Plan and Progress Charts and as called for in Division 16 of the specifications.

21.6.4. The QC Supervisory Engineer shall be given full cooperation by all technicians in the Contractor's staff to ensure the carrying out of the Contractor's Quality Control program.

"21.6.5. A Roofing Technician, who is experienced in the construction of built-up roofing systems and related work, shall assist the QC Supervisory Engineer in the performance of his duties. The Roofing Technician shall be at the project site at times indicated in both the approved QC Plan and Progress Chart and as called for in Division 7 of the specifications. Duties are outlined in the Quality Control Guide attached to SECTION: BUILT-UP ROOFING."

21.7. TESTING LABORATORY AND EQUIPMENT. The Contractor shall provide either an on-site laboratory with testing apparatus and qualified laboratory technicians, or (at his option) employ approved laboratory or laboratories to perform all sampling and testing as specified. All measuring and testing devices, laboratory equipment, instruments, transportation, and supplies necessary to accomplish the required testing and inspection shall be provided. All measuring and testing devices shall be calibrated at established intervals against certified standards. The testing laboratory organization shall be experienced in the type of testing work to be done. A representative of the testing laboratory shall be at the work site as necessary for sampling, inspecting and testing required to control the quality of the work. Upon request, certain measuring and testing devices shall be made available for use by the Government for verification tests.

21.8. REPORTING. All inspections and test results shall be recorded daily.

21.8.1. Daily Submittals. The attached sample "Quality Control Daily Report" form shall be reproduced and fully executed to show all inspections and tests and submitted to the Contracting Officer's representative on the first work day following the date covered by the report.

21.8.2. Results of Tests. Triplicate copies of complete results of tests shall be submitted not later than 3 calendar days after performing the test.

21.9. ENFORCEMENT. The Contractor shall stop work on any item or feature, pending satisfactory correction of any deficiency noted by his quality control staff or by the Contracting Officer's representative.

Construction shall not proceed upon any feature of work containing uncorrected work. Notations on quality control reports will not be acceptable as a substitution for other written reports by the Contractor if required under General Provisions Clauses: "Changes," "Differing Site Conditions" or "Termination for Default - Damages for Delay - Time Extensions."

21.10. PAYMENT. At the election of the Contracting Officer, no payment estimate will be processed under this contract until the entire Quality Control Plan has been approved or until overdue daily QC reports are properly executed and furnished.

APPENDIX G:
PROPOSED ARMY CQC REQUIREMENT—
FINAL DRAFT

CONTRACTOR QUALITY CONTROL

OF

BUILT-UP ROOFING

Clauses for Contractor Quality Control (CQC) of construction operations are written into the SPECIAL PROVISIONS section of Army construction contracts. It has been shown that special requirements are needed to provide effective CQC of built-up roofing operations. Requirements for CQC can be subdivided into two categories: generalized requirements for insertion into the SPECIAL PROVISIONS, and technical requirements for insertion into the TECHNICAL PROVISIONS, specifically SECTION 7, BUILT-UP ROOFING.

This document contains these two categories. The SPECIAL PROVISIONS section is, of necessity, general in nature, and applies to all construction operations. The TECHNICAL PROVISIONS section contains requirements that are specific to built-up roofing operations. This document is the result of the investigation described in TR M-334, "Evaluation of Contractor Quality Control of Built-Up Roofing."

Contractor Quality Control

SPECIAL PROVISIONS

SP__. CONTRACTOR QUALITY CONTROL. The Contractor shall provide and maintain an effective quality control program that complies with the requirements of the General Provisions clause: "CONTRACTOR INSPECTION SYSTEM."

SP__.1. General. Except for isolated tests or other items of work specified to be performed by the Government, the quality of all work shall be the responsibility of the Contractor. Sufficient inspections and tests of all items of work, including those of subcontractors, shall be performed on a continuing basis to ensure compliance with applicable specifications and drawings with respect to the quality of materials, workmanship, construction, finish, functional performance, and identification. The Contractor shall furnish qualified personnel, appropriate facilities, instruments, and testing devices needed to perform the quality control function. The controls shall be adequate to cover all construction operations, shall be keyed to the proposed construction sequence, and shall be correlated by the Contractor's quality control personnel.

SP__.2. Pre-Construction Planning. Within ___ days after the contract is awarded, and prior to starting on-site construction, the Contractor shall meet with the Contracting Officer and discuss the quality control requirements. During this meeting, the Contractor shall submit for approval his proposed written quality control plan which shall include all features outlined below. The proposed plan will be reviewed, and the meeting shall develop mutual understanding relative to details of the system, including the personnel, facilities, forms, etc., to be used for the inspections, tests, and

administration of the system. No change in the approved plan shall be implemented without written concurrence by the Contracting Officer.

SP__.3. Contractor's Proposed Quality Control Plan. The Contractor's proposed written quality control plan (for submittal at the pre-construction meeting) shall include the following as a minimum. The Contractor shall notify the Government in writing of any proposed change to his inspection system or plan.

SP__.3.1. The quality control organization.

SP__.3.2. Names, number, and qualifications of personnel to be used for this purpose.

SP__.3.3. Authority and responsibilities of all quality control personnel.

SP__.3.4. Schedule of use of inspection personnel by type and phase of work.

SP__.3.5. Proposed test methods, including names of technicians or qualified testing laboratory to be used.

SP__.3.6. Method of performing, documenting, and enforcing quality control operations of both prime and subcontract work, including inspection and testing.

SP__.3.7. A copy of a letter of direction to the Contractor's Quality Control Representative, outlining his duties and responsibilities and signed by a responsible officer of the Contractor's firm.

SP__.4. Control of On-Site Construction. The Contractor's quality control program shall include three phases of inspection and tests. The Contracting Officer shall be notified at least 24 hours in advance of each such test.

SP__.4.1. Preparatory inspections shall be performed prior to beginning each feature of work on any on-site construction. Preparatory inspections for the applicable feature of work shall include (a) a review of submittal requirements and all other contract requirements with the foremen or supervisors directly responsible for the performance of the work; (b) a check to assure that provisions have been made to provide required field control testing; (c) an examination of the work area to ascertain that all preliminary work has been completed; (d) a verification of all field dimensions and notification to the Contracting Officer of any discrepancies; and (e) a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data, and that all materials and equipment are on hand.

SP__.4.2. Initial inspection shall be performed as soon as work begins on a representative portion of the particular feature of work and shall include examination of the quality of workmanship as well as a review of control testing for compliance with contract requirements.

SP__.4.3. Follow-up inspections shall be performed continuously as any particular feature of work progresses to assure compliance with contract requirements, including control testing, until completion of that feature of work.

SP__.5. Control of Off-Site Operations. Contractor-furnished items which are fabricated or assembled off-site shall be inspected for compliance with specification requirements by quality control personnel at the place of fabrication (factory) and/or assembly. A record of such inspections shall be submitted prior to release of such items for shipment to the job site.

SP__.6. Quality Control Staff. In addition to the Contractor's job-supervisory staff, a separate quality control group shall be provided. This group shall report to the Contractor's management at a level no lower than an executive of the company. All members of this group shall be either employees of the Contractor or of an independent firm engaged by the Contractor specifically for quality control purposes. As a minimum, the composition of the quality control group shall be as follows:

SP__.6.1. The Quality Control Supervisory Engineer shall be an approved, qualified engineer or technician whose sole responsibility is to ensure compliance with the contract plans and specifications. This person shall demonstrate his ability to perform correctly the duties required of him to the satisfaction of the Contracting Officer and shall be physically at the project site whenever work is in progress. He will be in charge of the Contractor's Quality Control Program for this project. He shall review all the Contractor's submittals for approval and shall modify or correct them as needed, prior to forwarding such submittals to the Contracting Officer.

SP__.6.2. A Mechanical Technician experienced in the construction of industrial air-conditioning, steam, sewer, plumbing, and heating systems, and other components or mechanical devices, equipment, and systems in the work shall assist the Quality Control Supervisory Engineer in the performance of his duties. He may have other duties, but shall be on the project site at the

times indicated in both the approved Quality Control Plan and Progress Chart and as called for in Division 15 of the specifications.

SP__.6.3. An Electrical Technician experienced in the construction of industrial electrical systems, overhead and underground high-voltage systems, instrumentation and control systems, and the required electrical tests shall assist the Quality Control Supervisory Engineer in the performance of his duties. He may have other duties, but shall be on the project site at the times indicated in both the approved Quality Control Plan and Progress Chart and as called for in Division 16 of the specifications.

SP__.6.4. A Roofing Technician experienced in the construction of built-up roofing systems and related work shall assist the Quality Control Supervisory Engineer in the performance of his duties. He may have other duties but shall be on the project site at the times indicated in both the approved Quality Control Plan and Progress Chart and as called for in Division 7 of the specifications. His duties are outlined in the Quality Control Guide attached to SECTION: BUILT-UP ROOFING.

SP__.6.5. The Quality Control Supervisory Engineer shall be given full cooperation by all technicians of the Quality Control Staff to ensure the proper implementation of the Contractor's Quality Control Program.

SP__.7. Testing Laboratory and Equipment. The Contractor shall provide either an on-site laboratory with testing apparatus and qualified laboratory technicians, or at his option, employ an approved laboratory or laboratories to perform all sampling and testing as specified. All measuring and testing devices, laboratory equipment, instruments, transportation, and supplies needed to do the required testing and inspection shall be provided. All

measuring and testing devices shall be calibrated at established intervals against certified standards. The testing laboratory organization shall be experienced in the type of testing work to be performed. A representative of the testing laboratory shall be at the work site as necessary for the sampling, inspecting, and testing required to control the quality of the work. Upon request, certain measuring and testing devices shall be made available for use by the Government for verification tests.

SP__.8. Reporting. All inspections and tests shall be recorded daily.

SP__.8.1. Daily Submittals. The attached sample "Quality Control Daily Report" form shall be reproduced and fully executed to show all inspections and tests and shall be submitted to the Contracting Officer on the first work day following the date covered by the report.

SP__.8.2. Results of tests. Triplicate copies of complete results of tests shall be submitted not later than 3 calendar days after performing the test.

SP__.9. Enforcement. The Contractor shall stop work on any item or feature, pending satisfactory correction of any deficiency noted by his quality control staff or by the Contracting Officer. Construction shall not proceed on any feature of work containing uncorrected work. Notations on quality control reports will not be acceptable as a substitute for other written reports by the Contractor if required under General Provisions Clauses: "Changes," "Differing Site Conditions," or "Termination for Default - Damages for Delay - Time Extensions."

SP__.10. Payment. At the election of the Contracting Officer, no payment estimate will be processed under this contract until the entire Quality

Control Plan has been approved or until overdue daily quality control reports are properly executed and furnished.

QUALITY CONTROL GUIDE

FOR

BUILT-UP ROOFING

1. GENERAL. The acceptability of completed roofing work will be based on its conformance to the contract requirements. The Government is not obligated to accept non-conforming work, and such non-conforming work may be rejected. The rejected work shall be promptly replaced or corrected in a manner and by methods approved by the Contracting Officer.

2. QUALITY CONTROLLER. The Roofing Technician described in the SPECIAL PROVISIONS shall be a registered journeyman or an individual having a minimum of 5 years experience in the supervision and inspection of built-up roofing construction. His sole responsibilty is to assure that all roofing and related work is installed in strict compliance with the contract requirements. He is responsible for all components of the roofing system, including insulation, sheet metal, wood items, and built-up roofing membrane. He shall continually observe the work in progress, verify compliance with the contract, and report his findings daily in the Quality Control Record form. He shall be familiar with the contract drawings and specifications, tests, and measurements to be made, and the Quality Control Record form and reporting procedures. He shall inspect the roof deck prior to roofing application and shall attend the roofing conference.

3. ROOFING CONFERENCE. Before the start of any roofing work, and at a time and place designated by the Contracting Officer, the Contractor or his designated representative, the Quality Control Supervisory Engineer, the Roofing Technician, and the roofing foreman or superintendent shall attend a

conference relative to the roofing construction. The conference may include a visit to the work site.

3.1 The Contractor shall furnish the following at the Roofing Conference:

3.1.1 Appointment of Roofing Technician (Attachment 1).

3.1.2 Four copies each of all manufacturers' current product and installation literature pertinent to all components of the roofing system.

4. DAILY INFORMATION. The following shall be furnished each day as applicable:

4.1 Quality Control Record (Attachment 2).

4.2 Recorded bitumen temperature charts.

4.3 Supplier certification for bitumen delivered in hot bulk and for truckloads of aggregate.

5. FINAL INFORMATION. The following shall be furnished upon completion of the roofing installation and prior to final acceptance of the roof:

5.1 A plan view drawing of the roof showing location and date of each day's work.

5.2 As-built roof summary (Attachment 3).

6. EQUIPMENT. The following equipment is needed for the required tests and measurements.

6.1 Charted temperature recorder for each kettle or tanker. This recorder shall be constructed so that the case must be unlocked in order to adjust the setting mechanism. The key shall be in the custody of only the Roofing Technician.

6.2 Calibrated portable thermometer.

6.3 Scale for weighing roof membrane samples.

6.4 Measuring tape.

7. TOLERANCES. The following tolerances, plus or minus, establish the range of acceptable variances from the stated requirements for felt spacings. Work outside this range shall be removed and action taken to prevent recurrence.

7.1 One-quarter inch for single dimension of 2 inches or more.

7.2 One-half inch overall for 2 to 10 consecutive increments of a standard dimension.

7.3 Three-quarter inch overall for 11 to 20 consecutive increments of a standard dimension.

7.4 One inch overall for 21 or more consecutive increments of a standard dimension.

8. QUALITY CONTROL RECORD. The Quality Control Record form shall be completed as follows for each day on which roofing work is performed.

8.1 Top Section. Insert all requested information in the spaces provided.

8.2 Products Section. Check the appropriate box for each product major category. All materials within the category must comply with the contract to result in a check in the "complies" box. Compliance requirements are established by the drawings, specifications, and approved Contractor's submittals.

8.3 Execution Section. The work item numbers correspond to the work items listed below. The work items refer to specification requirements considered to be of major concern. The actions outlined for each work item shall be performed as applicable and an entry made in the appropriate box on the form. Specification requirements not listed must also be considered and their acceptability grouped and documented on the reverse side of the form.

8.4 Variance Section. Any entry in the "varies" column requires an explanation. The explanation shall be a description of the variance. Reasons for the variance are not necessary. Indicate action taken to resolve the variance to result in complying work. If a variance is not resolved on the same day it occurs, enter the number of that day's record in the space provided for all succeeding days until the variance is resolved.

8.5 Closing Section. Sign the Quality Control Record form at the end of the work day and submit it to the Contracting Officer.

9. WORK ITEMS. The following item numbers correspond to the work item numbers in the execution section of the Quality Control Record form. The Roofing Technician shall perform all actions necessary to assure that all work performed complies with the specified requirements.

Work Item No. 1: Materials at Point of Application. Verify type and condition of materials to be installed. Check for damage that may have occurred during storage or transportation.

Work Item No. 2: Equipment. Check type, quality, and condition of equipment to be used. Verify accuracy of thermometers and metering devices.

Work Item No. 3: Weather. Verify that weather conditions are appropriate for the type of work to be performed.

Work Item No. 4: Roof Deck. Inspect the deck and other surfaces to which the work will be installed. Verify that surfaces are dry, primed, and prepared to receive the work.

Work Item No. 5: Wood Items. Verify that wood items are preservative-treated as specified and properly installed and that provisions are made for venting where required.

Work Item No. 6: Bitumen. Verify that all bituminous materials are the proper types. Check temperatures at the kettle or tank and at point of application.

Work Item No. 7: Vapor Retarder. Verify that vapor retarder is properly installed and satisfactory for reception of subsequent work.

Work Item No. 8: Insulation. Check insulation orientation, staggered laps, joint width, nailing and bitumen quantities. Verify that insulation is satisfactory to receive the membrane.

Work Item No. 9: Edge Envelope. Verify that edge envelope plies are properly placed and protected, and that plies are folded back over the roofing membrane.

Work Item No. 10: Membrane Placement. Check direction of roofing felts, width of starter sheets, headlap, end laps, etc.

Work Item No. 11: Membrane Construction. Check for proper installation practices, including bitumen quantities, brooming, etc. Verify that felts are laid flat, and are extended to top of cants.

Work Item No. 12: Ridges and Valleys. Verify that membrane construction at ridges and valleys retains continuity without excessive ply structure.

Work Item No. 13: Nailing. Verify that membrane is properly nailed where required.

Work Item No. 14: Penetrations. Verify that drains and other penetrations are properly flashed and made watertight.

Work Item No. 15: Base Flashing. Verify proper installation of base flashings.

Work Item No. 16: Sheet Metal Work. Check thickness and configuration of sheet metal items. Verify proper priming, fastening, and strip flashing.

Work Item No. 17: Protection. Check for rubber-tired equipment and planking to prevent damage to the work.

Work Item No. 18: Walkways. Verify that permanent walkways are properly installed on top of the membrane.

Work Item No. 19: Gravel Topping. Verify proper application of flood coat and gravel, and removal of excess gravel.

Work Item No. 20: Completion. Verify that roof area worked on is complete when work stops, including topping and sheet metal work.

Work Item No. 21: Edge Protection. Verify that insulation and felts exposed at end of day are properly protected, and that stripping and cut insulation boards are removed before work is resumed.

Work Item No. 22: Samples. Verify that samples are taken and properly inspected, and that sample areas are repaired.

Work Item No. 23: Weather Protection. Verify that work in progress is adequately protected from inclement weather, and that protective measures are taken if work is stopped before completion.

(Sample of typical Contractor Quality Control Report)

CONTRACTOR'S NAME
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Date: _____ Report No. _____

Contract No.: _____

Description and Location of Work: _____

WEATHER: (Clear) (P. Cloudy) (Cloudy); Temperature: _____ Min. _____ Max;
Rainfall _____ inches.

Contractor/Subcontractors and Area of Responsibility with Labor Count for Each

a. _____

b. _____

c. _____

d. _____

Equipment Data: (Indicate items of construction equipment, other than hand tools, at the job site, and whether or not used.)

1. Work Performed Today: (Indicate location and description of work performed. Refer to work performed by prime and/or subcontractors by letter in Table above.)

2. Results of Surveillance: (Include satisfactory work completed, or deficiencies with action to be taken.)

   a. Preparatory Inspection:

   b. Initial Inspection:

   c. Follow-up Inspections:

3. Test Required by Plans and/or Specifications Performed and Results of Tests:

4. Verbal Instructions Received: (List any instructions given by Government personnel on construction deficiencies, retesting required, etc., with action to be taken.)

5. Remarks: (Cover any conflicts in plans, specifications, or instructions or any delay to the job attributable to weather conditions.)

5. Safety Violations (EM 385-1-1 and approved Safety Program) and Corrective Action Taken:

Contractor's Inspector

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

Contractor's Approved Authorized Representative

Appointment of Roofing Technician

_____ is hereby appointed as Roofing Technician on Contract No. _____. He has the authority to regulate the quality of the work so that it conforms to the Contract and is authorized to order discontinuance of any operation causing nonconforming work. He is directed to report to an officer of this firm and is not subordinate to the job superintendent or project manager.

He has a minimum of 5 years prior experience in the supervision and inspection of BURS construction similar to that required in this Contract. He understands all requirements of these Specifications.

Contract No. _____

Name of Firm _____

Address _____

Telephone _____

Authorized Representative's Signature _____

Authorized Representative's Name
(Print or Type) _____

Date _____

This is to acknowledge receipt of this letter.

Roofing Technician's Signature _____

Roofing Technician's Name
(Print or Type) _____

Date _____

Attachment 1

QUALITY CONTROL RECORD

Contract Number	BLDG	RECORD NO.	DATE
WEATHER *(Describe)*	AVERAGE TEMPERATURE	ROOFING CREW START AM PM / STOP AM PM	QUALITY CONTROLLER START AM PM / STOP AM PM
TOTAL ROOF AREA *(Squares)*		COMPLETED TODAY	TEST SAMPLES REMOVED

PRODUCTS *(See Project Specifications)* *(Check Appropriate Box Below)*				EXECUTION *(See Quality Control Guide)* *(Check Appropriate Box Below)*							
COMPONENTS *(Type, Quantity, Size)*	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE	WORK ITEM	COMPLIES	VARIES	NOT APPLICABLE
UNDERLAYMENT				1				13			
INSULATION				2				14			
MEMBRANE				3				15			
COMPO. FLASHING				4				16			
SHEET METAL				5				17			
FASTENERS				6				18			
WOOD				7				19			
SEALANTS				8				20			
EXPANSION JOINTS				9				21			
ALL OTHER MATERIALS				10				22			
				11				23			
				12				OTHERS			

EXPLAIN VARIANCE *(If none write NONE)*

UNRESOLVED VARIANCES ON RECORDS NOS.

ACTION TAKEN TO RESOLVE VARIANCE

On behalf of the contractor, I certify that this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Roofing Technician (Signature)

RECEIVED BY *(Signature)* | DATE

Attachment 2

As-Built Roof System Summary:

After completion of roofing, accurately fill in the information required on this sheet. If more than one system applies to the same building, complete one sheet for each system. Submit two copies of each sheet prior to final acceptance.

Bldg. No. _____ Contract No. _____

Building area where this system is installed _____

_____

Deck type _____ Deck slope _____

Underlayment components (type and number) _____

Underlayment attachment _____

Insulation:

Type _____ Manufacturer _____

First layer:

Thickness: _____
Attachment: _____

Second layer (if used):

Thickness: _____
Attachment: _____

Membrane:

Bitumen Manufacturer _____
Felt Manufacturer _____

No. of plies: _____ Felt type (circle one); organic, asbestos, glass

Bitumen type: _____
Surfacing (circle one) aggregate, smooth, granules

Was this new system installed over an existing roof (Superimposing)?

_____

Roofing completion date _____

Roofing Contractor (name, address, and phone) _____

Attachment 3

Chief of Engineers
ATTN: Tech Monitor
ATTN: DAEN-ASI-L (2)
ATTN: DAEN-CCP
ATTN: DAEN-CW
ATTN: DAEN-CWE
ATTN: DAEN-CWM-R
ATTN: DAEN-CWO
ATTN: DAEN-CWP
ATTN: DAEN-EC
ATTN: DAEN-ECC
ATTN: DAEN-ECE
ATTN: DAEN-ZCF
ATTN: DAEN-ECB
ATTN: DAEN-RD
ATTN: DAEN-RDC
ATTN: DAEN-RDM
ATTN: DAEN-RM
ATTN: DAEN-ZCZ
ATTN: DAEN-ZCE
ATTN: DAEN-ZCI
ATTN: DAEN-ZCM

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ATTN: DET III 79906

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US Army Engineer Divisions
ATTN: Library (14)

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ISAE 09081
V Corps
ATTN: DEH (11)
VII Corps
ATTN: DEH (15)
21st Support Command
ATTN: DEH (12)
USA Berlin
ATTN: DEH (15)
USASETAF
ATTN: DEH (6)
Allied Command Europe (ACE)
ATTN: DEH (3)

8th USA, Korea (14)

ROK/US Combined Forces Command 96301
ATTN: EUSA-HHC-CFC/Engr

USA Japan (USARJ)
ATTN: AJEN-FE 96343
ATTN: DEH-Honshu 96343
ATTN: DEH-Okinawa 96331

Rocky Mt. Area 80903

Area Engineer, AEDC-Area Office
Arnold Air Force Station, TN 37389

Western Area Office, CE
Vandenberg AFB, CA 93437

416th Engineer Command 60623
ATTN: Facilities Engineer

US Military Academy 10966
ATTN: Facilities Engineer
ATTN: Dept of Geography &
Computer Science
ATTN: DSCPER/MAEN-A

AMMRC, ATTN: DRXMR-WE 02172

USA ARRCOM 61299
ATTN: DRCIS-RI-I
ATTN: DRSAR-IS

DARCOM - Dir., Inst., & Svcs.
ATTN: DEH (23)

DLA ATTN: DLA-WI 22314

FORSCOM
FORSCOM Engineer, ATTN: AFEN-FE
ATTN: DEH (23)

HSC
ATTN: HSLO-F 78234
ATTN: Facilities Engineer
Fitzsimons AMC 80240
Walter Reed AMC 20012

INSCOM - Ch, Instl. Div.
ATTN: Facilities Engineer (3)

MDW
ATTN: DEH (3)

MTMC
ATTN: MTMC-SA 20315
ATTN: Facilities Engineer (3)

NARADCOM, ATTN: DRDNA-F 071160

TARCOM, Fac. Div. 48090

TRADOC
HQ, TRADOC, ATTN: ATEN-FE
ATTN: DEH (19)

TSARCOM, ATTN: STSAS-F 63120

USACC
ATTN: Facilities Engineer (2)

WESTCOM
ATTN: DEH
Fort Shafter 96858
ATTN: APEN-IM

SHAPE 09055
ATTN: Survivability Section, CCB-OPS
Infrastructure Branch, LANDA

HQ USEUCOM 09128
ATTN: ECJ 4/7-LOE

U.S. Army, Fort Belvoir 22060
ATTN: Canadian Liaison Officer
ATTN: Water Resources Support Center
ATTN: Engr Studies Center
ATTN: Engr Topographic Lab
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ATTN: Chief, ORHED-F
Wilmington 28401
ATTN: Chief, SAWCO-C
ATTN: Chief, SAWEN-D
Charleston 29402
ATTN: Chief, Engr Div
Savannah 31402
ATTN: Chief, SASAS-L
Jacksonville 32232
ATTN: Const Div
Mobile 36628
ATTN: Chief, SAMEN-D
ATTN: Chief, SAMEN-F
ATTN: Chief, SAMEN
Nashville 37202
ATTN: Chief, ORNED-F
Memphis 38103
ATTN: Chief, Const Div
ATTN: Chief, LMMED-D
Vicksburg 39180
ATTN: Chief, Engr Div
Louisville 40201
ATTN: Chief, Engr Div
Detroit 48231
ATTN: Chief, NCEED-T
St. Paul 55101
ATTN: Chief, ED-D
ATTN: Chief, ED-F
Chicago 60604
ATTN: Chief, NCCCO-C
ATTN: Chief, NCCED-F
Rock Island 61201
ATTN: Chief, Engr Div
ATTN: Chief, NCRED-F
St. Louis 63101
ATTN: Chief, ED-D
Kansas City 64106
ATTN: Chief, Engr Div
Omaha 68102
ATTN: Chief, Engr Div
New Orleans 70160
ATTN: Chief, LMNED-DG
Little Rock 42203
ATTN: Chief, Engr Div
Tulsa 74102
ATTN: Chief, Engr Div
Ft. Worth 76102
ATTN: Chief, SWFED-D
ATTN: Chief, SWFED-F
Galveston 77550
ATTN: Chief, SWGAS-L
ATTN: Chief, SWGCO-C
ATTN: Chief, SWGED-DC
Albuquerque 87103
ATTN: Chief, Engr Div
Los Angeles 90053
ATTN: Chief, SPLED-F
San Francisco 94105
ATTN: Chief, Engr Div
Sacramento 95814
ATTN: Chief, SPKED-D
ATTN: Chief, SPKCO-C
Far East 96301
ATTN: Chief, Engr Div

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ATTN: Chief, FM-1
ATTN: Chief, FM-2
Seattle 98124
ATTN: Chief, NPSCO
ATTN: Chief, NPSEN-FM
ATTN: Chief, EN-DB-ST
Walla Walla 99362
ATTN: Chief, Engr Div
Alaska 99501
ATTN: Chief, NPASA-R

US Army Engineer Division
New England 02154
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ATTN: Laboratory
ATTN: Chief, NEDCO
Middle East (Rear) 22601
ATTN: Chief, MEDED-T
North Atlantic 10007
ATTN: Chief, NADEN
South Atlantic 30303
ATTN: Laboratory
ATTN: Chief, SADEN-TC
ATTN: Chief, SADEN-TS
Hunstville 35807
ATTN: Chief, HNDED-CS
ATTN: Chief, HNDED-M
ATTN: Chief, HNDED-SR
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