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QA Inspections Via Condition Monitoring

4

Guidelines for Quality Assurance Inspection of Commercial Activities Contracts for Real Property Maintenance Activities

Guide #7: Building Services

by
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A Quality Assurance (QA) Program allows the Army to evaluate and document a contractor's work performance. It depends on a QA Surveillance Plan (QASP). The QASP, which is based on the contract Performance Work Statement, lists contractor activities and the surveillance approach, number of items to be inspected, and an Acceptable Quality Level (AQL) for each activity. This series of 12 guides will help the Contracting Officer's Representative/Quality Assurance Evaluator by defining and clarifying the inspection tasks required by the QASP, which will facilitate inspection uniformity and effectiveness.

This guide discusses QA monitoring of scheduled and unscheduled building services.

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FOREWORD

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GUIDELINES FOR QUALITY ASSURANCE INSPECTION OF COMMERCIAL ACTIVITIES CONTRACTS FOR REAL PROPERTY MAINTENANCE ACTIVITIES GUIDE #7: BUILDING SERVICES

1 INTRODUCTION

Background

A Quality Assurance (QA) program allows the Army to evaluate and document a contractor's performance. The Quality Assurance Evaluator (QAE) conducts skilled and carefully planned inspections aimed at verifying the satisfactory completion of contractor work. The inspections evaluate the quality, quantity, and timeliness of the services provided, not the contractor's methods used in performing the work. A good QA program promotes the best possible product within the terms of the standing contract.

A well organized QA program depends on a QA Surveillance Plan (QASP), which is prepared by the Government and contains the purpose and methods of the QA program. Although the QASP is not a part of the contract, it is based on the contract Performance Work Statement, which is part of the contract. The QASP lists contractor activities and the surveillance approach, approximate number of items to be surveyed, and an Acceptable Quality Level (AQL) for each activity.

The installation Director of Public Works (DPW), the Contracting Officer (KO), or the Contracting Officer's Representative (COR) often oversees the QASP. The COR/QAE needs an inspection guide to help define and clarify the inspection tasks required by the QASP, and to *facilitate inspection* uniformity and effectiveness. To meet this need, the U.S. Army Construction Engineering Research Laboratories (USACERL) developed this series of 12 inspection guides.

Objective

This guide series is intended to supplement any existing QASP and to provide QA guidance for evaluating Operations and Maintenance (O&M) work as performed by contractors on Army property. This building services guide contains recommended surveillance methods that can be amended by direction of the KO or QA management to fit the needs of a specific installation.

Guide Series Organization

This series includes the following guides by USACERL published in October 1993:

- #1: Water Systems (Special Report [SR] FF-94/01)
- #2: Wastewater Systems (SR FF-94/02)
- #3: Natural Gas Distribution Systems (SR FF-94/03)
- #4: Electrical Systems (SR FF-94/04)
- #5: Heating Systems (SR FF-94/05)
- #6: Ventilation, Air Conditioning, and Refrigeration Systems (SR FF-94/06)
- #7: **Building Services**
- #8: Grounds Maintenance (SR FF-94/08)
- #9: Surfaced Areas (SR FF-94/09)

- #10: Refuse and Recyclable Handling (SR FF-94/10)
- #11: Pest Control Services (SR FF-94/11)
- #12: Custodial Services (SR FF-94/12).

The QAE is expected to evaluate a contractor's performance by applying appropriate visual and instrumentation procedures along with necessary technical and interpretive skills. This guide covers QAE inspection of building services, and is divided into sections that take the inspector through a step-by-step process of recommended performance indicators, inspection tasks, and surveillance methods.

Building services are divided into two subsystems in this guide:

1. **Unscheduled Building Services**
2. **Scheduled Building Services.**

General QA information, including detailed explanations of the available surveillance methods, is given in Chapter 2.

Chapter 3 provides performance indicators, inspection tasks, and recommended surveillance approaches for each subsystem.

Appendix A contains sampling inspection tables. Appendix B contains QAE Worksheets for each subsystem, a building maintenance and repair questionnaire, and a service order questionnaire; they may be reproduced for field use.

2 GENERAL QA INSPECTION INFORMATION

Inspection Organization and Planning

According to custom and standard practice, the contractor submits copies of the previous month's O&M activities and regulatory agency reports to the COR and the QAE. The due dates of these reports control the start of inspection scheduling. If possible, the QAE's inspection should be conducted within 3 days after receiving the reports. Effective coordination will allow more efficient inspection of services. The COR/QAE should look for specific indicators of the contractor's performance and should evaluate that performance based on Detailed Inspection Tasks. The following chapter lists the Performance Indicators and Detailed Inspection Tasks for building services.

Quality Assurance Surveillance Methods

The QAE can use the following five surveillance methods to determine contractor performance:

1. Random Sampling
2. Planned Sampling
3. 100 Percent Inspection
4. Unscheduled Inspection
5. Customer Complaints.

Random Sampling

The methods are based on statistical criteria provided in Military Standard (MIL-STD)-105E, *Sampling Procedures and Tables for Inspection by Attributes* (10 May 1989) and are presented as recommendations. The methods used should be based on the unique needs of an individual system. Generally, all five methods are not used to evaluate an individual system.

Random sampling is recommended for situations where many work items are candidates for inspection. For instance, because it is impractical to inspect every roof on an installation with 500 buildings, only a select number of the buildings should be inspected. Likewise, in random sampling, only a portion of the total performed work is inspected. Acceptance of the work is based on the assumption that the inspected items are representative of the quality of the contractor's work. The random sampling technique spreads the selected samples evenly throughout the evaluation period. The following are steps to be used by the QAE in random sampling.

Tables A1 and A2 in Appendix A should be used to determine the number of samples to be inspected and the number of rejects allowed as a function of the number of inspected work items for AQLs of 4 and 10 percent, and the level of surveillance. The three levels of surveillance are: normal, increased (tightened), and reduced. Initially, this guide recommends normal surveillance for random sampling. However, under the direction of the KO, the level of surveillance can be changed depending on the contractor's performance.

As an example, assume that the contractor's total scheduled output (i.e., population size) for a particular work item is 125 units and that the normal surveillance level with an AQL of 4 percent has been selected. According to Table A1, 20 of the 125 units of work should be inspected, and the entire output of 125 units should be rejected if 3 or more of the 20 sample units are not acceptable.

The QA Worksheets in Appendix B provide room to record the population size, the number of samples, the maximum number of rejects, and the interval for each Performance Indicator.

The work planned by the contractor for each maintenance task should be listed by date to make it easier to predict the time when the work samples will be ready for inspection.

Planned Sampling

Evaluation by planned sampling inspects some, but not all, of the work activities and is appropriate when the number of work items is large. Some items are evaluated before scheduled completion because they are inaccessible after the work is completed. The COR/QAE subjectively selects key work items for inspection; the sample size is determined arbitrarily.

The COR/QAE will normally use planned sampling when the contractor's performance at selected locations or tasks is poor. With this type of evaluation, the contractor knows that work performed in these areas is more likely to be monitored. Planned sampling provides a systematic way of focusing on specific output and forming conclusions about the contractor's performance level.

100 Percent Inspection

Inspection at 100 percent requires total inspection of all items in a contract requirement. It is normally used to monitor infrequent work or critical contract work when the number of work items is small and in cases where nonperformance could seriously damage Army-furnished equipment or processes. It may also be used in areas where a contractor has had prior performance difficulties.

Unscheduled Inspection

Unscheduled inspections can be used for areas of poor past contractor performance, noncritical areas, areas of infrequent repairs, or as a follow-up check of previous inspections. If the QAE notices such an area, an unscheduled inspection can be conducted to evaluate contractor performance.

Customer Complaints

The customer complaint method is based on an informed and cooperative customer population, that is generally aware of local contract requirements. Customers are expected to monitor contractor services and, when performance is poor or nonexistent, to notify the COR/QAE. If investigation reveals that the complaint is valid, the COR/QAE documents the deficiency. Since this is a reactive QA inspection approach, this method of surveillance normally supplements planned inspection methods.

Increased Surveillance

For areas of poor past contractor performance, the QAE should consult with the KO to intensify the surveillance method. More than one option is usually available, and selection should be based on the initial method and the amount of work performed.

1. Random Sampling (Normal Surveillance) can be replaced by:

- Random Sampling (Increased Surveillance)
- Planned Sampling (for a large population size)

- 100 Percent Inspection (for a small population size)
 - Unscheduled Inspection (for any population size).
2. Planned Sampling can be replaced by:
 - Random Sampling (Normal Surveillance)
 - 100 Percent Inspection (for a small population size)
 - Unscheduled Inspection (for any population size).
 3. Unscheduled Inspections can be replaced by:
 - 100 Percent Inspection (for a small population size)
 - Random Sampling (Normal Surveillance)
 - Planned Sampling.

Decreased Surveillance

For work areas in which the contractor maintains a consistently satisfactory performance for 3 to 6 months, the QAE should consult with the KO to decrease the intensity of the surveillance. More than one option is usually available and selection should be based on the initial method and the amount of work performed.

1. Random Sampling (Normal Surveillance) can be replaced by:
 - Random Sampling (Reduced Surveillance)
 - Planned Sampling
 - Unscheduled Inspection (for any population size)
 - Customer Complaints.
2. Planned Sampling can be replaced by:
 - Unscheduled Inspection (for any population size)
 - Customer Complaints.
3. 100 Percent Inspection can be replaced by:
 - Random Sampling (Normal Surveillance)
 - Random Sampling (Reduced Surveillance)
 - Planned Sampling
 - Unscheduled Inspection (for any population size)
 - Customer Complaints.

3 BUILDING SERVICES QA INSPECTIONS

Unscheduled Building Services

Performance Indicators and Detailed Inspection Tasks

The following numeric items are performed by the contractor. The related detailed inspection tasks are used by the QAE to verify the contractor's performance.

1. Contracted Service Orders (SOs) and Individual Job Orders (IJOs) for building electrical work are done in a timely, effective, and professional manner.

Verify that contracted SOs and IJOs for building electrical work are done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any discrepancies between the QAE inspection and the contractor's report of work done.

Check to see that:

a. Generally:

- (1) Where possible, the replacement or repair products match the existing components in appearance and quality.
- (2) The replacement or repair performs its purpose.
- (3) The area of work is left as clean as before the workmen arrived.

b. Specifically:

- (1) Breaker panels. All areas served by the repaired breakers must receive adequate power. All wiring should be checked to ensure all voltages and amperages meet design specifications. Abnormally high operating temperatures should be detected.
- (2) Wall switches. The switch must be operative and control the fixtures or receptacles connected to it.
- (3) Receptacles. The receptacle should be compatible with the type of equipment that will use it and should supply adequate power. All wiring should be checked to ensure all voltages and amperages meet design specifications. QA instrumentation is recommended to check for electrical power quality (Johnson 1993).
- (4) Interior light fixtures. Interior light fixtures should produce light adequate for their intended use. The color and quality of exterior wiring (such as used in chain supports) must conform to the original wiring.
- (5) Main grounding systems. The grounding system must be in place.

2. SOs and IJOs for plumbing work are done in a timely, effective, and professional manner.

Verify that contracted SOs and IJOs for plumbing work were done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any discrepancies between the QAE inspection and the contractor's report of work done.

- a. For water systems, ensure as a minimum that:

- (1) Wastewater lines are free-flowing, and drains are not stopped.
- (2) Joints, faucets, and other outlets do not leak. QA instrumentation is recommended to check for leaks (Johnson 1993).
- (3) Bolts, pipe hangers, stainers, or drain covers are not damaged or missing.
- (4) Commodes are firmly fixed and do not rock when shaken.
- (5) Sump pumps operate properly, and sump pits are free from debris and sand. Check for vibration or shaft alignment problems. QA instrumentation is recommended to check for excessive vibration and shaft misalignment (Johnson 1993).

- b. For gas systems, ensure as a minimum that:

- (1) There are no gas leaks. QA instrumentation is recommended to check for gas leaks (Johnson 1993). Any indication of gas is unsatisfactory.
- (2) There are no leaks at fuel valves, regulators, or fuel burning equipment. QA instrumentation is recommended to check for leaks (Johnson 1993).
- (3) There are no leaks at fuel tanks. QA instrumentation is recommended to check for leaks (Johnson 1993).
- (4) Valves should be lubricated and vents free from debris.

NOTE: Any plumbing that leaks is likely to be unsatisfactory.

3. SOs and IJOs for building metal work are done in a timely, effective, and professional manner.

Verify that contracted SOs and IJOs for building metal work are done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any discrepancies between the QAE inspection and the contractor's report of work done.

Check to see that:

- a. The work is completed neatly (i.e., welds are neat and professional). QA instrumentation is recommended to check welds (Johnson 1993).

- b. No other surrounding surfaces or materials are damaged by the metal-working process (e.g., concrete or other material was not scorched by welding).
- c. Metal surfaces exposed to weathering or humid conditions have been protected from rusting by painting or sealing. QA instrumentation is recommended to check for corrosion/paint condition (Johnson 1993).
- d. The metals were not damaged or bent during installation (e.g., sheet metals have not been twisted or marred).
- e. Structural metals to be fireproofed have a uniform fireproofing coating that has not been broken or chipped to expose the metal. QA instrumentation is recommended to check coating condition (Johnson 1993).
- f. The repair is well anchored and is not firmly or easily moved when touched.
- g. The repaired equipment is operable.

4. SOs and IJOs for key and lock work were done in a timely, effective, and professional manner.

Verify that contracted SOs and IJOs for key and lock work were done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any discrepancies between the QAE inspection and the contractor's report of work done.

Check to see that:

- a. The equipment repaired is operable (e.g., the locking mechanism works with the key provided).
 - b. The appearance of the work is neat and professional.
 - c. The equipment effectively prohibits entry to persons not having the proper key.
 - d. The equipment operates according to its designed purpose.
5. SOs and IJOs for carpentry and masonry work are done in a timely, effective, and professional manner.

Verify that contracted SOs and IJOs for carpentry and masonry work are done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any discrepancies between the QAE inspection and the contractor's report of work done.

Check to see that:

- a. Carpentry (Army Technical Manual [ATM] 5-615, ATM 5-620, ATM 5-621):

- (1) There is no evidence of fungus, mildew, termites, water absorption, or other harmful effects caused by the environment. QA instrumentation is recommended to check for excessive moisture in wood (Johnson 1993).
- (2) All installed wood that touches concrete/masonry or ground is marked to indicate that it is preserved and treated by pressure (0.25 or 0.40 pound per cubic foot [pcf],* respectively) in accordance with the *American Wood Preservers Association Standards*, C2-93.
- (3) All wood used in exposed locations with no protection from the weather is marked as treated according to industry standards.
- (4) All cuts in treated wood are brush-coated with a preservative.
- (5) All carpentry work performed is consistent with the construction of the existing facility or structure.

b. Masonry (Army Field Manual [AFM] 5-742):

All masonry work completed should be consistent with the construction and appearance of existing facilities or structures. Check the structural integrity of the masonry. QA instrumentation is recommended to check for masonry and mortar condition (Johnson 1993).

6. SOs and IJOs for painting work are done in a timely, effective, and professional manner.

Verify that contracted SOs and IJOs for painting work are done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any discrepancies between the QAE inspection and the contractor's report of work done.

Have the contractor randomly select a 1-quart sample of each batch from the sealed containers. The contractor should provide the cans. Adequate mixing prior to sampling should ensure a uniform, representative sample. A batch is defined as a quantity of material processed by the manufacturer at one time and identified by a number on the label. Samples should be clearly identified by designated name, specification number, batch number, project contract number, intended use, and quantity involved. Ship the samples to the proper testing authority or use a paint kit to test for adequate paint quality. QA instrumentation is recommended to check for paint quality (Johnson 1993).

Visually check that:

- a. There is no dirt, rust, scale, splinters, loose particles, disintegrated paint, grease, soil, and other deleterious substances. Also check that there are no nail holes, alligations, or abrasions caused by removing picture hangers or contact paper.

*1 pcf = 16.018 kg/m³

- b. There are no ridges caused by the paint having not been sanded at the edges of places where it had peeled.
- c. There are no holes or imperfections on painted surfaces.
- d. There is no discoloration on natural wood finished.
- e. There is no paper masking on the walls, ceilings, and wood trim.
- f. There are no holes, cracks, loose plaster, or surface irregularities in the plaster.
- g. The painted surfaces are free from paint runs, drops, ridges, waves, laps, brush marks, variations in color, and other visible defects.
- h. The finishes are correct for the area in which they were used. This should be checked by running a clean hand over the surface. Surfaces painted with a flat paint should feel smooth but not slick; a surface painted with a semi-gloss paint should feel slick. The following paint types should be used in the applicable situations:
 - (1) Painted interior walls and ceilings other than kitchen, pantry, bath, utility, and laundry areas (Interior Flat).
 - (2) Interior walls and ceilings of kitchen, pantry, bath, utility, and laundry areas (interior semi-gloss).
 - (3) Painted (other than factory finish) wood or metal, trim, doors, windows, risers, and shelving (interior semi-gloss).
- i. Varnished surfaces should be slightly dulled in appearance, since the contractor is assumed to have rubbed them with steel wool or the equivalent. Varnish should be used in the following applications:
 - (1) Natural finished wood trim, doors, windows, stair risers, shelving, and cabinets not required to be stripped.
 - (2) Natural finished wood kitchen cabinets, doors, and trim specified to be stripped and refinished.
 - (3) Natural finished closed stairs and handrails.
- j. A properly waxed floor should be slightly dulled in appearance and smooth to the touch. Wax should be used on interior resilient tile floors and on wood floors in unoccupied units.

Ensure that:

- a. All contractor materials have been removed from the site.
- b. All doors and windows are operative.
- c. All paint has been removed from all glazing.

- d. All floors have been cleaned, waxed, and buffed.
 - e. All sinks, lavatories, refrigerators, cabinets, water closets, bathtubs, showers, and telephones are clean and free of residue.
 - f. All protruding nails have been removed.
 - g. No paint wastes have been disposed of through the sanitary sewer or storm sewer system.
 - h. All units are locked when unoccupied.
 - i. There is no paint waste on lawns or paved areas.
7. "As-built" drawings are updated with changes and corrections.

Verify that the contractor is maintaining current "as-built" drawings of the building facilities and equipment. Check to see that the drawings are updated annually with all changes and corrections. The draftperson's initials and the date should accompany each change.

Recommended Surveillance Approach

- For performance indicators #1 through #6, evaluate SOs monthly using random sampling (normal surveillance, 5 percent AQL), and evaluate IJOs monthly using the 100 percent inspection method. Obtain supplemental information using questionnaire feedback.
- Evaluate performance indicator #7 annually using the 100 percent inspection method.

Scheduled Building Services

Performance Indicators and Detailed Inspection Tasks

The following numeric items are performed by the contractor. The related detailed inspection tasks are used by the QAE to verify the contractor's performance.

1. The roofing Preventive Maintenance Inspection (PMI) report is complete, legible, and timely.

Verify that the contractor's roofing PMI report is complete, legible, and timely. Document any deficiencies between the QAE inspection and the contractor's report or work done.

2. The roofing Preventive Maintenance (PM) report is complete, timely, and shows no deficiencies.

Verify that the contractor's roofing PM report is complete, legible, and shows no deficiencies. QA instrumentation is recommended for roof inspections (Johnson 1993). Document any deficiencies between the QAE inspection and the contractor's report of work done. Check the following indicators:

- a. Built-up Bituminous Roofs.

- (1) Check for debris.

- (2) Surface condition. Check for proper drainage, gravel, general condition, physical damage, bare spots in gravel, alligatoring, cracking, and slippage.
- (3) Membrane condition. Check for blistering, splitting, ridging, fishmouthing, loose felt laps, punctures, securement to substrate, fasteners, and membrane slippage.
- (4) Base flashing. Check for punctures, deterioration, blistering, open laps, attachment, ridging, and wrinkling.
- (5) Counter flashing: Check for open laps, punctures, attachment, rusting, fasteners, and caulking.
- (6) Coping: Check for open fractures, punctures, attachment, rusting, drainage, fasteners, and caulking.
- (7) Wall: Check mortar joints, spalling, and movement cracks. QA instrumentation is recommended to check masonry and mortar condition (Johnson 1993).
- (8) Roof edging/fascia: Check for splitting, securement, rusting, felt deterioration, fasteners, and punctures.
- (9) Equipment base flashing: Check for open laps, punctures, and attachment.
- (10) Equipment housing: Check counter flashing, open seams, physical damage, caulking, and drainage.
- (11) Expansion joint covers: Check for open joints, punctures, splits, securement, rusting, and fasteners.
- (12) Pitch pans: Check for material shrinkage and attachment.
- (13) Check gutters and downspouts for proper slope, damage, rust, and corrosion. QA instrumentation is recommended to check for corrosion (Johnson 1993).

b. Slate and Tile Roofs.

- (1) Inspect for missing, broken, or loose tiles.
- (2) Check for flashing failures.
- (3) Check for deteriorated fasteners.
- (4) Check gutters and downspouts for proper slope, damage, rust, and corrosion. QA instrumentation is recommended to check for corrosion (Johnson 1993).

c. Metal Roofs.

- (1) Check for holes, looseness, punctures, and broken seams.
- (2) Check for rust and corrosion. QA instrumentation is recommended to check for corrosion (Johnson 1993).

- (3) Check for inadequate or improper fastening.
 - (4) Inspect condition of paint. QA instrumentation is recommended to check paint condition (Johnson 1993).
 - (5) Check gutters and downspouts for proper slope, damage, rust, and corrosion. QA instrumentation is recommended to check for corrosion (Johnson 1993).
 - d. Asphalt, Fiberglass, Shingles, Strip, and Roll Roofing.
 - (1) Check for loss of granules and coating asphalt.
 - (2) Check for bare areas with exposed or deteriorating felt.
 - (3) Check for brittle shingles or roll roofing.
 - (4) Check for adequate cementing of roll roofing.
 - (5) Check for curled, clawed, or missing tabs.
 - (6) Check gutters and downspouts for proper slope, damage, rust, and corrosion. QA instrumentation is recommended to check for corrosion (Johnson 1993).
3. Change of occupancy procedures are performed satisfactorily.

Verify that the contractor performed satisfactory change of occupancy procedures.

Schedule an inspection of all the following items, as required, that occur at the same building, during the same visit to the facility. It is important that the inspection occur immediately after receiving the completed work forms. This will ensure that the contractor's performance is appraised fairly and that the building is available for occupancy as soon as possible. Document the inspection results.

NOTE: A proven method of effectively inspecting the entire facility is to begin at the left wall and follow that wall through doors throughout the facility.

- a. Time Limits. Inspect all work orders to determine if they were completed within 72 hours of the start of work.
- b. Maintenance. Use completed work orders for maintenance and the PMI requirements to perform a PMI of the entire building. Document any deficiencies and notify the KO so that work orders may be issued for those deficiencies.
- c. Repairs. Using the completed work orders for repairs, schedule an inspection of all work completed. Document any deficiencies.
- d. Painting. Using the completed work orders for painting, schedule a field inspection of all work completed. QA instrumentation is recommended to check paint condition (Johnson 1993). Document any deficiencies.

e. **Insect Control.** Using the completed work orders for insect control, perform an inspection by placing a sticky trap where insects are likely to gather such as a kitchen or food storage area. Collect the sticky traps 24 hours later. More than five roaches or related pests means unsatisfactory performance of the contract requirements. QA instrumentation is recommended to check for pests (Johnson 1993). Document any deficiencies.

4. **Roofing SOs and IJOs are done in a timely, effective, and professional manner.**

Verify that contracted roofing SO and IJO work is done in a timely, effective, and professional manner. Check to see that the overall quality and appearance of the repair, including materials, is comparable to the facility's original construction quality and appearance. Document any deficiencies between the QAE inspection and the contractor's report of work done.

a. **To inspect shingle roofing:**

- (1) Visually check the repaired area to see that all shingles have been removed and replaced with new ones.
- (2) Walk over the entire repair area. If the area is firm, it is assumed that the decking is repaired properly. If it feels soft, the work should be recorded as unsatisfactory.
- (3) If the repair is at an eave, visually check to see that there are felt and shingle starter courses under the first course of shingles. If the felt course is not observed, lift the shingles carefully so as not to damage them, and look under the shingles for the felt. If either starter course is missing, the work should be recorded as unsatisfactory.
- (4) Visually inspect all replacement shingles to ensure that they match the existing shingles in color, texture, and alignment.
- (5) If there is concern about the quality of nailing, lift the shingles for checking. Each shingle should have at least four nails that are not aligned with the cutouts. The shingles must be lifted with extreme caution, since it is easy to damage them in very warm or cold weather.
- (6) Inspect valleys for roll roofing as per (1) and (4) above. To prevent damage, the valley should never be stepped on. If the valley is constructed of sheetmetal, no rust should be visible on it. All types of valleys should have at least 3-in. (76.2 mm) from the centerline to the shingles. Shingles should be cut true to the valley; those that overlap the valley material should be adhered to the material with bituminous cement (i.e., the corner of the shingles should not be able to be lifted).

b. **For built-up roofing inspection:**

- (1) Check that the base felts are in sound condition and not waterlogged, and that the insulation is sound and dry, with no leaks. If the roof's condition is questionable, the questionable area should be carefully walked over and should feel sound under foot.
- (2) Check to see if the repaired area matches the surrounding construction (i.e., gravel on a gravel roof and bare surfaces on a bare roof, etc.)
- (3) Ensure that there are no splits, blisters, buckles, or fishmouths in the roof membrane.

c. To inspect roof flashing:

- (1) Check that all repaired flashing is finished to match existing flashing. The flashing should be appropriately formed to the area.
- (2) Make sure that bituminous cement has been applied over the nail heads and the flashing edges.

5. Gutters, downspouts, and roof drains are free of debris.

Verify that gutters, downspouts, and roof drains are free of debris. This inspection should occur during the month after the contractor's scheduled cleaning. Document any deficiencies.

Recommended Surveillance Approach

- Evaluate performance indicators #1 and #2 monthly using the 100 percent inspection method and questionnaire feedback.
- Evaluate performance indicator #3 monthly using the 100 percent inspection method.
- For performance indicator #4, evaluate SOs monthly using random sampling (normal surveillance, 5 percent AQL) and questionnaire feedback, and evaluate IJOs monthly using the 100 percent inspection method.
- Evaluate performance indicator #5 semi-annually using random sampling (normal surveillance, 5 percent AQL).

ACRONYMS

AQL	Acceptable Quality Level
AFM	Army Field Manual
ATM	Army Training Manual
COR	Contracting Officer's Representative
DEH	Director of Engineering and Housing
IJO	individual job order
KO	Contracting Officer
MIL-STD	Military Standard
O&M	Operations and Maintenance
PM	preventive maintenance
PMI	preventive maintenance inspection
QA	quality assurance
QAE	Quality Assurance Evaluator
QASP	QA Surveillance Plan
SO	service order

REFERENCES

American Wood Preservers Association Standards, C2-93 (1993).

Army Field Manual 5-742, Concrete and Masonry (Headquarters, Department of the Army [HQDA], 14 March 1985).

Army Technical Manual [ATM] 5-615, Repairs and Utilities: Concrete and Masonry (HQDA, 27 November 1963).

ATM 5-620, Maintenance and Repair of Architectural and Structural Elements of Buildings and Structures (HQDA, 10 May 1990).

ATM 5-621, Repairs and Utilities: Buildings and Structures, Lathing and Plastering (HQDA, 18 August 1958).

Johnson, James, Special Report FF-93/DRAFT, Catalog of Industrial Instrumentation for Army Real Property Quality Assurance Applications (U.S. Army Construction Engineering Research Laboratory, 1993).

Military Standard 105E, Sampling Procedures and Tables for Inspection by Attributes (Department of Defense, 10 May 1989).

APPENDIX A: Inspection Sampling Tables

Table A1

Sample Sizes and Reject Levels (4% AQL)
(As developed from Tables I & II in MIL STD 105E)

Population Size	Normal Surveillance			Increased (Tightened) Surveillance			Reduced Surveillance		
	Class II Sample Size	Reject Level		Class III Sample Size	Reject Level		Class I Sample Size	Reject Level	
08 to 50	*	25%	1	*	40%	1	*	-	-
51 to 90	E	13	2	F	20	2	*	3%	1
91 to 150	F	20	3	G	32	3	*	3%	1
151 to 280	G	32	4	H	50	4	E	5	2
281 to 500	H	50	6	J	80	6	F	8	3
501 to 1200	J	80	8	K	125	9	G	13	4
1201 to 3200	K	125	11	L	200	13	H	20	5

The Reject Level is the number of failed inspections requiring rejection of the Lot (population).
An asterisk (*) indicates that the sample level is outside the range of a 4% AQL for the selected class.

Table A2

Sample Sizes and Reject Levels (10% AQL)
(As developed from Tables I & II in MIL STD 105E)

Population Size	Normal Surveillance			Increased (Tightened) Surveillance			Reduced Surveillance		
	Class II Sample Size	Reject Level		Class III Sample Size	Reject Level		Class I Sample Size	Reject Level	
06 to 15	*	33%	1	*	50%	1	*	-	-
16 to 25	C	5	2	D	8	2	*	8%	1
26 to 50	D	8	3	E	13	3	C	2	2
51 to 90	E	13	4	F	20	4	C	2	2
91 to 150	F	20	6	G	32	6	D	3	3
151 to 280	G	32	8	H	50	9	E	5	4
281 to 500	H	50	11	J	80	13	F	8	5
501 to 1200	J	80	15	K	125	19	G	13	6
1201 to 3200	K	125	22	L	200	19	H	20	8

The Reject Level is the number of failed inspections that require rejection of the Lot (population).
An asterisk (*) indicates that the sample level is outside the range of a 10% AQL for the selected class.

Table A3

Random Numbers

2	6	1	6	9	3	5	5	1	1	3	1	2	5	5	1	7	8	7	5	6	6	8	4	4	9	4	6	2	8	9	3	5
1	8	1	4	5	9	2	7	2	2	5	4	9	1	9	2	9	4	9	2	9	3	6	3	5	1	4	3	1	1	1	6	1
4	2	3	6	8	4	6	3	2	6	6	8	8	5	4	9	1	1	3	2	8	6	1	9	8	7	1	2	4	3	4	1	3
2	7	2	4	8	8	8	3	5	3	3	2	6	3	9	3	2	7	7	1	8	3	5	9	6	8	1	5	9	3	2	4	6
8	4	1	3	7	4	4	6	1	6	9	6	3	7	5	6	2	1	4	3	2	8	5	7	8	2	4	7	7	7	4	2	6
2	6	4	8	1	5	4	9	7	1	7	3	3	7	2	1	7	4	4	7	7	8	2	7	5	7	6	5	6	6	2	5	8
1	9	8	6	9	6	8	3	7	5	4	1	3	6	1	1	3	3	2	8	7	5	4	1	9	1	4	9	7	1	8	4	8
1	4	3	7	5	6	5	5	9	9	4	6	4	6	2	3	4	5	8	9	9	9	8	3	2	3	2	7	7	5	9	9	8
8	3	6	3	8	6	3	8	9	6	1	9	3	9	8	3	9	8	5	6	4	9	5	8	7	4	3	7	8	2	3	8	4
1	5	2	5	8	3	7	5	2	3	7	9	4	4	4	4	8	3	1	2	6	7	2	9	9	7	8	4	2	3	4	1	4
1	5	7	2	9	4	2	5	6	4	8	6	1	3	5	4	5	1	9	2	2	1	5	9	7	5	7	6	7	5	5	6	3
6	9	2	7	1	9	7	7	5	4	3	6	6	3	6	3	4	4	6	6	8	3	8	1	4	7	9	1	4	7	2	7	7
2	5	5	8	6	6	7	8	5	8	2	6	2	4	3	2	7	6	6	1	7	4	3	2	8	4	8	9	3	1	7	7	7
6	1	1	9	1	9	2	9	9	9	1	2	8	6	4	7	3	7	5	4	7	1	8	1	3	4	2	1	5	9	2	5	7
9	9	5	1	1	4	8	9	9	8	2	6	9	3	3	2	5	9	5	7	9	6	2	8	3	1	1	9	3	3	1	6	2
9	6	1	8	8	7	7	8	3	2	2	5	2	6	3	6	6	4	5	2	2	8	1	3	3	2	3	3	6	9	3	9	4
2	2	8	7	7	3	8	1	7	8	2	8	8	3	3	9	8	5	7	1	7	3	6	2	7	6	5	9	6	8	2	7	7
3	9	6	7	1	1	4	7	3	6	9	2	7	4	8	8	3	2	5	8	4	2	2	9	1	4	8	4	6	5	3	6	4
3	6	4	2	9	6	4	4	6	9	7	8	8	4	7	3	5	5	1	7	9	5	9	8	4	8	7	1	1	3	2	5	8
7	6	5	6	3	1	9	7	8	9	8	1	7	6	8	8	9	3	5	8	3	1	9	4	6	7	4	2	7	4	7	9	8
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2	2	6	5	1	1	3	3	7	6	1	7	4	4	4	9	5	2	5	9	1	7	2	5	4	9	9	4	9	9	8	8	2
4	6	6	8	6	4	6	1	5	4	6	3	9	6	8	4	5	6	2	4	2	4	1	8	3	8	4	3	5	9	5	9	6
4	5	7	4	1	8	8	2	3	5	6	3	5	3	2	1	8	2	9	2	5	6	5	1	9	9	4	8	4	4	4	4	5
9	9	9	1	1	9	5	8	9	9	8	9	8	3	4	7	9	1	2	5	7	5	3	6	5	4	2	3	1	8	8	3	5
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8	5	7	3	9	8	7	9	2	2	1	9	7	9	8	6	1	1	9	8	5	3	6	4	3	3	9	6	3	8	1	5	1
7	9	4	2	3	8	6	1	7	6	7	5	3	4	3	5	2	1	4	7	6	9	1	8	9	2	4	4	3	7	4	8	1
1	3	7	8	6	8	7	8	9	9	3	3	1	6	3	3	8	4	3	3	4	8	1	8	6	3	4	9	9	8	4	5	4
5	4	7	4	9	3	7	3	1	9	2	3	8	7	3	8	9	2	5	1	5	9	4	2	4	9	1	9	9	8	1	7	9
7	6	7	6	2	7	3	2	5	7	9	3	4	4	4	2	6	1	5	2	4	5	1	7	9	9	2	8	6	6	8	8	5
8	4	6	5	9	2	1	3	5	5	1	7	8	6	1	7	9	8	3	6	6	9	1	7	9	2	2	9	6	7	1	5	3
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6	2	2	4	5	8	2	9	4	9	5	6	2	6	3	6	2	6	6	2	1	3	9	6	8	4	6	1	4	2	5	7	4
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6	9	1	7	1	4	6	4	7	6	5	8	5	4	9	4	8	8	4	5	5	8	1	7	9	5	9	3	2	1	3	7	6
4	8	4	1	9	8	6	4	7	4	4	1	5	9	2	4	3	3	6	7	4	8	9	2	1	5	4	3	7	2	5	1	2
2	1	6	8	6	8	3	6	1	4	5	7	9	6	8	7	2	3	8	6	2	9	9	1	3	4	7	5	4	4	3	9	8
9	8	5	4	5	6	1	4	3	6	2	9	6	1	9	8	1	8	8	9	9	9	5	1	7	4	9	2	1	9	1	6	6
5	3	2	7	5	6	1	3	3	3	5	4	1	2	4	6	2	3	3	2	5	7	9	1	8	3	8	4	6	1	1	1	6
2	2	7	7	2	5	7	2	6	1	1	2	1	6	1	8	6	6	8	1	2	1	4	8	5	2	8	4	1	1	7	3	9
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7	2	3	2	1	7	2	8	6	4	6	9	7	3	9	3	3	4	4	7	1	4	4	8	8	6	7	4	1	9	9	5	1
8	4	3	4	9	2	7	2	6	3	7	9	8	3	1	9	9	5	8	7	1	2	9	9	6	6	8	8	8	7	8	4	8

APPENDIX B: QAE Inspection Worksheets

Unscheduled Building Services Worksheet

Page 1 of 7

Performance Indicator #1: Contracted SOs and UOs for building electrical work are done in a timely, effective, and professional manner.

- a. The work is done in a timely manner.
- b. The overall quality and appearance of the repair is comparable to that of the facility's original construction.

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

[illegible]**Remarks:**

*S = Satisfactory, U = Unsatisfactory, N = Not applicable. Circle one rating for each item.

Page 2 of 7

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

[illegible]**Remarks:**

Page 3 of 7

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

[illegible]**Remarks:**

Page 4 of 7

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

[illegible]**Remarks:**

Page 5 of 7

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

[illegible]**Remarks:**

Page 6 of 7

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

[illegible]**Remarks:**

Performance Indicator #7: "As-built" drawings are updated with changes and corrections.

a. The draftperson's initials accompany each change.

S U N

b. The date of change accompanies each correction.

S U N

Remarks:

Quality Assurance Evaluator

Date

Scheduled Building Services Worksheet

Page 1 of 5

Performance Indicator #1: The roofing PMI report is complete, legible, and timely.

a. All items are listed and initialed as inspected.

S U N

b. The report is timely.

S U N

Remarks:

Page 2 of 5

- a. The report is complete and timely.
- b. There are no deficiencies.

[illegible]

31

Page 3 of 5

- a. Work orders are completed in a timely manner.
- b. Maintenance and repairs are performed.
- c. Painting, if necessary, is done.
- d. An insect control check is made.

[illegible]

32

Performance Indicator #4: Roofing SOs and IJOs are done in a timely, effective, and professional manner.

- a. The work is done in a timely manner.
- b. The overall quality and appearance of the repair is comparable to that of the facility's original construction.

Using the population size_____, and referring to normal surveillance in Tables A1 and A2 gives_____number of samples and_____number of allowable rejects.

BUILDING

[illegible]**Remarks:**

Page 5 of 5

BUILDING

[illegible]**Remarks:**

Quality Assurance Evaluator

Date _____

Building Maintenance and Repair Questionnaire

Page 1 of 5

This survey should be completed with information from the person having the most contact with maintenance personnel. Please circle the letter of the answer selected or answer in the blanks, as appropriate.

1. How many maintenance service calls have you had during the past 3 months?

- None (skip to #22).....1
- 1 to 3.....2
- 4 to 6.....3
- 7 or more.....4

2. How satisfied are you with the service provided by the maintenance personnel?

- Very satisfied.....1
- Satisfied.....2
- Dissatisfied.....3
- Very dissatisfied.....4

3. Do you have difficulty reaching the work order clerk by telephone to request repair service?

- No.....1
- Yes, I usually must dial 2 to 5 times.....2
- Yes, I usually must dial 6 times or more.....3

4. How many times must you usually call to have a repair crew come to your quarters for normal (i.e., nonemergency) repair service?

- One.....1
- Two.....2
- Three.....3
- Four.....4
- Five or more.....5

5. How long does it usually take for repair personnel to show up after you telephone for normal repair service?

- 24 hours or less.....1
- 25-48 hours.....2
- 49-72 hours.....3
- 73-96 hours.....4
- 97 or more hours.....5

6. How many times must you usually call to have a repair crew come to your quarters for emergencies?

- One.....1
- Two.....2
- Three.....3
- Four.....4
- Five or more.....5
- Not applicable.....6
(Skip to #8)

7. How long does it usually take for repair personnel to arrive after you telephone for emergency repair service?

- Less than 2 hours.....1
- 2-4 hours.....2
- 5-8 hours.....3
- 9-24 hours.....4
- More than 24 hours.....5

8. When calling for repair service, do you normally find the person you talk to knowledgeable?

- Yes.....1
- No.....2

9. When calling for repair service, do you normally find the person you talk to courteous?

- Yes.....1
- No.....2

10. When calling for repair service, do you normally find the person you talk to helpful?

- Yes.....1
- No.....2

11. Do you have significant problems arranging a time for the repairmen to gain access to your quarters?

- No.....1
- Yes, nobody is home during the maintenance
personnel service hours.....2
- Yes, but only when maintenance personnel tried
to scheduled routine maintenance I did
not request.....3

12. Do maintenance personnel respond quickly enough to your requests?

Always.....1
Usually.....2
Usually not.....3
Never.....4

13. Did you see any identification from the repair personnel?

(Circle all that apply.)

Yes, ID card.....1
Yes, uniform.....2
Yes, patch on shirt.....3
Yes, insignia on truck...4
No.....5

14. Should repair personnel wear something distinctive to help you identify them?

Yes, ID card.....1
Yes, patch.....2
Yes, uniform.....3
Yes, other.....4
No, not necessary.....5

15. The last time you needed repairs, how many repair personnel arrived to do the work?

One..... 1
Two.....2
Three.....3
Four.....4
Five or more.....5

16. Do the repair personnel know what is to be repaired when they arrive?

Always.....1
Usually.....2
Usually not.....3
Never.....4

17. Are the repair personnel usually able to complete the work in one visit?

Yes (skip to #20).....1
No, lacks tools or materials.....2
No, usually leaves for lunch, break, or
quitting time.....3
No, leaves for unknown reasons.....4

18. Are you kept informed about the status of the repair job if it cannot be completed during the first visit?

Always.....1
Usually.....2
Usually not.....3
Never.....4

19. If the work is not completed during the first visit, how long does it normally take before the repair work is completed?

1 day.....1
2 days.....2
3 days.....3
4-5 days.....4
6 or more days.....5

20. Are the repair personnel courteous?

Always.....1
Usually.....2
Usually not.....3
Never.....4

21. Do the repair personnel leave a clean work site?

Always.....1
Usually.....2
Usually not.....3
Never.....4

22. How often do you make your own repairs using the "self help" program?

Never.....1
Once a month.....2
Once every 2 months.....3
Once every 3 months.....4
Once every 6 months.....5
Once each year.....6

Building Maintenance and Repair Questionnaire

Page 5 of 5

23. How many times have maintenance personnel inspected or visited your quarters during the months since last October to perform preventive maintenance (i.e., maintenance you did not specifically request to oil motors, check furnaces, check water heaters, etc.)?

None.....1
Once.....2
2 times.....3
3 times.....4
4 times.....5
5 or more.....6

24. Who provided the information for this questionnaire?

Sponsor.....1
Dependent.....2
Both.....3

25. Please make any comments on the maintenance/repair program in the space below:

Thank you for your cooperation.

Quality Assurance Evaluator

Date Questionnaire Completed

Service Order Questionnaire

Page 1 of 2

This survey should be completed with information from the person having the most contact with maintenance personnel. Please circle the letter of the answer selected or answer in the blanks, as appropriate.

1. Response (in days) to repair requested work:

- a) Excellent response (normal conditions - 7 days)
(emergency conditions - 1 day)
- b) Adequate response (within 2 weeks)
- c) Too long (Approximately how long? ____ days.)

2. Quality of work: (Are you satisfied that quality work was performed?)

Yes ____ No ____ Defect was not fixed ____.

Explain: _____

3. Cleanup of area after repair: (Is area left as clean as it was before work personnel arrived?)

Yes ____ No ____

Comments: _____

4. Efforts of work personnel: (Are you satisfied that the work was performed in a professional, effective manner?)

Comments: _____

5. Attitude of work personnel: (Are they helpful, friendly, courteous, cheerful?)

Comments: _____

6. Do you think this type of repair could be accomplished as "self help" if material and instructions were supplied?

Yes ____ No ____ Maybe ____

7. Remarks: _____

Thank you for your cooperation.

Quality Assurance Evaluator

Date Questionnaire Completed

USACERL DISTRIBUTION

Chief of Engineers
ATTN: CEHEC-IM-LH (2)
ATTN: CEHEC-IM-LP (2)
ATTN: CERD-L

CECPW 22060
ATTN: CECPW-FM-S
ATTN: CECPW-FM
ATTN: CECPW-FB
ATTN: CECPW-FU
ATTN: CECPW-F-DPN

US Army Engr District
ATTN: Library (40)

US Army Engr Division
ATTN: Library (13)

INSCOM
ATTN: IALOG-I 22060
ATTN: IAV-DEH 22186

HQ XVIII Airborne Corps 28307
ATTN: AFZA-DEH-EE

US Army Materiel Command (AMC)
Alexandria, VA 22333-0001
ATTN: AMCEN-F
Installations:
ATTN: DEH (19)
Rocky Mountain Arsenal 8002
ATTN: AMCPM-RM
Pine Bluff Arsenal 71602
ATTN: SMCPB-EH

FORSCOM
Forts Gillem & McPherson 30330
ATTN: FCEN
Installations:
ATTN: DEH (23)

National Guard Bureau 20310
ATTN: Installations Div

Fort Belvoir 22060
ATTN: CECC-R 22060

TRADOC
Fort Monroe 23651
ATTN: ATBO-G
Installations:
ATTN: DEH (20)

USARPAC 96858
ATTN: DEH
ATTN: APEN-A
HQ USEUCOM 09128
ATTN: ECJ4-LIE

AMMRC 02172
ATTN: DRXMR-AF
ATTN: DRXMR-WE

CEWES 39180
ATTN: Library

CECRL 03755
ATTN: Library

USA AMCOM
ATTN: Facilities Engr 21719
ATTN: AMSMC-IR 61299
ATTN: Facilities Engr (3) 85613

USAARMC 40121
ATTN: ATZIC-EHA

Military Traffic Mgmt Command
ATTN: MTEA-GB-EHP 07002
ATTN: MT-LOF 20315
ATTN: MTE-SU-FE 28461
ATTN: MTW-IE 94626

Military Dist of WASH
Fort McNair
ATTN: ANEN 20319

Norton AFB 92409
ATTN: Library

Engr Societies Library
ATTN: Acquisitions 10017

Defense Nuclear Agency
ATTN: NADS 20305

Defense Logistics Agency
ATTN: DLA-WI 22304

US Military Academy 10996
ATTN: MAEN-A
ATTN: Facilities Engineer
ATTN: Geography & Envr Engrg

Naval Facilities Engr Command
ATTN: Facilities Engr Command (8)
ATTN: Division Offices (11)
ATTN: Public Works Center (8)
ATTN: Naval Constr Battalion Ctr
93043
ATTN: Naval Civil Engr Service
Center (3) 93043

Tyndall AFB 32403
ATTN: HQAFCEA Program Ofc
ATTN: Engrg & Srvc Lab

US Gov't Printing Office 20401
ATTN: Rec Sec/Deposit Sec (2)

Defense Tech Info Center 22304
ATTN: DTIC-FAB (2)

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